



TEXAS CoCoRaHS OBSERVER

Winter 2018-19



"Because every drop counts, as do all Zeros."

Welcome to
the
Texas CoCoRaHS
Observer newsletter.

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

Do You Need a Speaker?

Contact:

texas@cocorahs.org

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Texas 2018-19 Winter Weather Summary

Recharge Time

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

As usual, saying that Texas received an average amount of precipitation this winter is rather deceiving. While the total amount was on track, the distribution was uneven.

Places like Abilene, Austin, and Tyler have (almost literally) been swamped. Here in College Station, we received about 40" of rainfall in the past six months, close to our normal annual amount. The majority of that was in the fall, but winter stayed wet too.

As a result, the ground was soaked and stayed soaked. The combination of evaporation (from the ground) and transpiration (from plants) is rather small in the wintertime. Many plants go dormant, and even those that stay green are not growing much. Plus, the atmosphere can contain much less water vapor in the wintertime because it's so much colder.

This winter was warmer than normal across the state. It really didn't seem that way, because of a few intense cold blasts, but the numbers don't lie. Temperatures averaged 0°F to 4°F above normal. While the warmer temperatures would have accelerated evaporation, it wasn't nearly enough to make up for the excess rain.

It's normal for the soil moisture profile to recharge over the winter, but I think we were overcharged.

Some areas went without much precipitation this winter. The High Plains and South Texas both featured widespread areas with less than 75% of normal precipitation for the winter. For many, it was a dry winter that followed a wet fall. This made for dry topsoil, while there was still plenty of moisture deeper down. So it was hard to characterize the moisture situation: was it too dry, too wet, or both?

Scientists are having similar problems figuring out what will happen to drought in a warmer climate. The number one factor is rain: if it rains less, there will be more drought. Temperature is also important: if it's hotter, there will be more evaporation and thus the impact of a lack of rainfall will be more severe. Carbon dioxide is important too: more carbon dioxide means plants use water more efficiently, so they can get by with less water without experiencing drought stress.

The net result of all of this for the ground, at least in places where rainfall doesn't change too much, looks like it will be a decrease in moisture in the top layer of soil, where it can evaporate directly, but maintenance or even an increase in moisture in the deep soil layer, where the roots of plants won't deplete it as rapidly. Is that good news or bad news? It depends on the particular location, and even the particular plant. Or on how you feel about mud.

Wichita Falls Regional Climate Summary

Near Normal Conditions for Wichita Falls Winter Season

By Charles Kuster
CIMMS/NSSL

A near normal winter was observed across much of the Wichita Falls region. One severe-weather event occurred on December 26, 2018 when damaging winds affected Archer and Wichita County. Snow was reported on at least 3 different days in the area with the most significant snowfall occurring on December 8, 2018 in Knox County. There were no very heavy rainfall events this winter, but a couple locations saw over 3.00" on December 26, 2018 (Fig. 1).

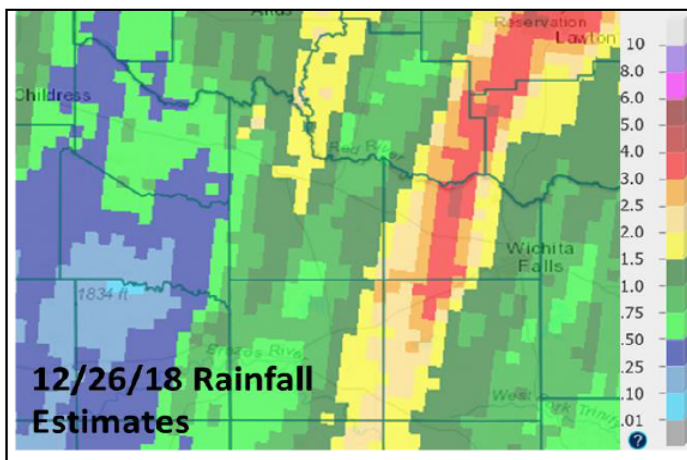


Figure 1: 24-hour rainfall estimates (in inches) for the time period ending at 7am on December 27, 2018.

In total, the area saw 73 dry days (all CoCoRaHS stations reported less than 0.05") and 17 wet days (at least one CoCoRaHS station reported 0.05" or more). For comparison, last winter there were 79 dry days and 11 wet days. Precipitation was slightly below average and temperatures were slightly above average this winter (Fig. 2). According to the drought monitor (<http://droughtmonitor.unl.edu/>), moderate drought did begin to expand across the Texas Panhandle, and by February 26, 2019 had expanded into far western Hardeman and Foard County (Fig. 3).

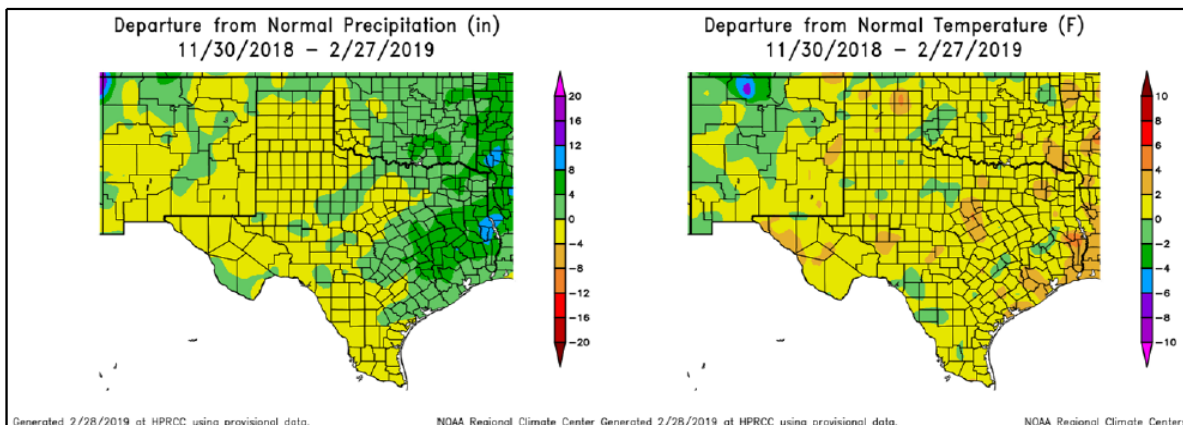
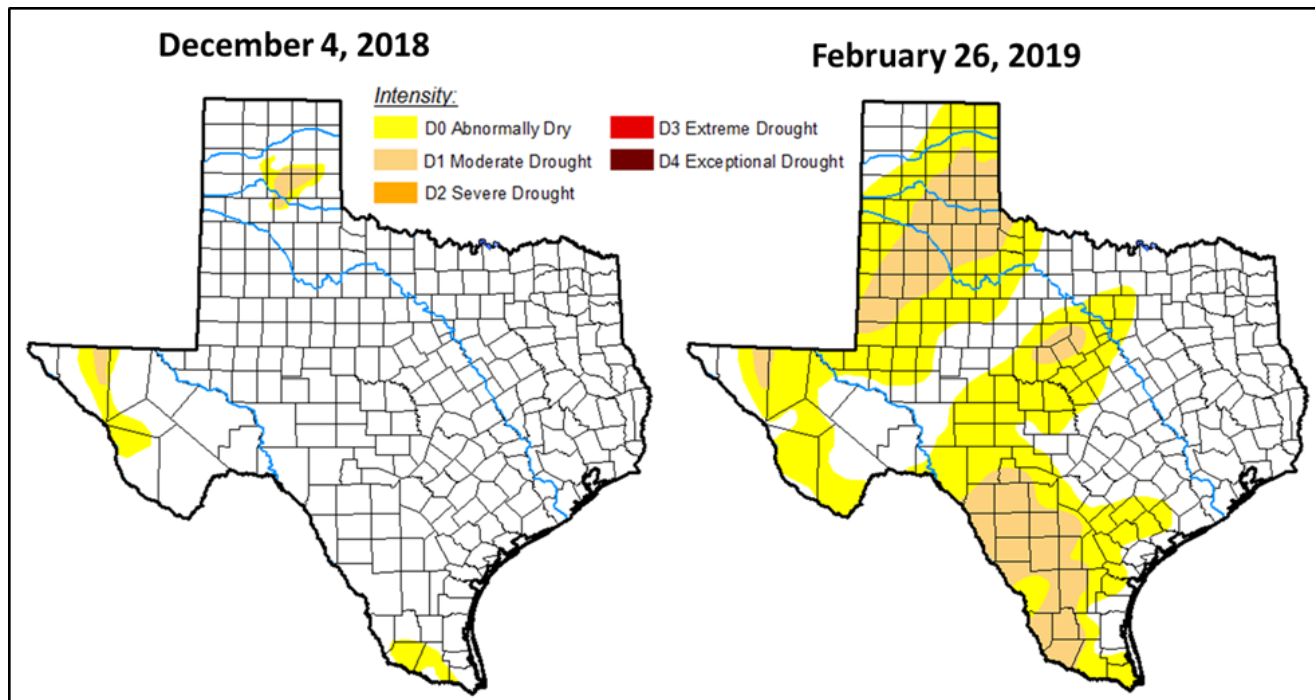


Figure 2: Departure from normal precipitation (left) and normal temperature (right) for December 2018 through February 2019. Warm colors indicate below normal precipitation and above normal temperatures, while cool colors indicate above normal precipitation and below normal temperatures.

“Wichita Falls Regional Climate Summary (continued)”



Local County Coordinator Recruiting Reminder

WANTED: CoCoRaHS Local County Coordinators

By Billy Forney

Harris County (Texas) Coordinator, and Texas CoCoRaHS Observer Newsletter Editor

Overview

CoCoRaHS is a unique, non-profit, community-based network of volunteers of all ages and backgrounds working together to measure and map precipitation (rain, hail, and snow). By using low-cost measurement tools, stressing training and education, and utilizing an interactive website, our aim is to provide the highest quality data for natural resource, education, and research applications.

Our network consists of over 20,000 individual volunteer observers across all fifty United States, all providing accurate, high-quality precipitation data for our numerous end-users on a timely basis. Our data is used by a wide variety of organizations and individuals, including the National Weather Service, other meteorologists, hydrologists, and many more. We have excellent quality control systems and processes in place to make sure our data is reliable and error-free. Our state and regional coordinators, as well as teams of quality control members, volunteer hours of their time to find potential errors in data across the state. But, in order to have the data to check, we need coordinators at the local level to help fill in the numerous gaps in data points.

That's why we are looking for local coordinators at the county level. Local county coordinators help support the CoCoRaHS network in many ways, primarily to spread the word about the network. Because of the high variability of rainfall over short distances, local county coordinators can help increase the density of precipitation data available throughout the country by encouraging volunteer weather observing. Becoming a citizen scientist in our network is both fun and rewarding, and becoming a local county coordinator is, too.

Want to be a county coordinator see page 20 →

Austin/San Antonio Regional Climate Summary

Relatively Quiet Winter across South Central Texas

By Brett Williams – NWS Austin/San Antonio

The 2018-2019 Winter Season across South Central Texas was fairly quiet. Weak El Niño was finally declared by the middle of February due to warmer than normal sea surface temperatures across the Equatorial Pacific Ocean. However, the typical impacts of El Niño for wintertime in the area were mostly not observed. Temperatures across the region were a bit warmer than normal, with the main reason for this being attributed to warmer than normal overnight low temperatures. Austin Camp Mabry and Austin Bergstrom came in at their 34th warmest and 32nd warmest winters on record, respectively. San Antonio posted its 52nd warmest winter on record while Del Rio recorded its 35th warmest winter on record. Austin Camp Mabry only recorded five freezing days, while Austin Bergstrom recorded 12 of them. San Antonio only recorded four freezing days, with Del Rio posting a total of six freezing days. These low numbers of freezing days and much warmer than normal overnight low temperatures can be largely attributed to very few true arctic cold fronts moving through the region and a high percentage of nighttime cloud cover.

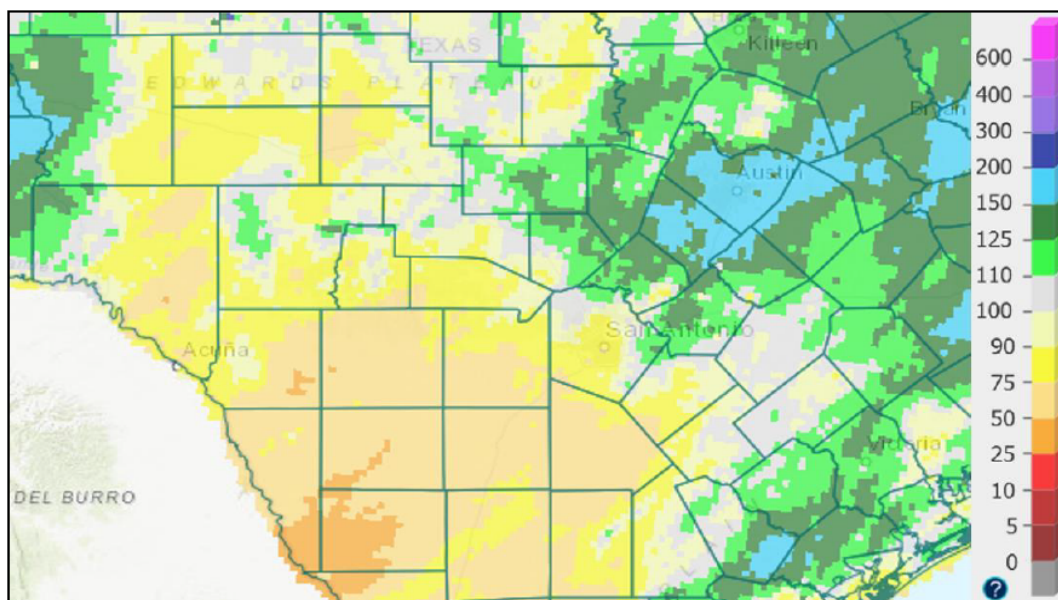


Figure 1: Percent of normal precipitation across South Central Texas for Winter 2018-2019

In regards to precipitation, the northeastern portions of the region were a bit wetter than normal (Figure 1). This includes the Austin metro area, in which Austin Camp Mabry recorded its 23rd wettest winter on record and Austin Bergstrom recorded its 13th wettest winter on record. San Antonio came in very close to normal for wintertime precipitation. The two biggest rainfall events of the winter season occurred on December 7th (Figure 2), in which a widespread two to four inches of rain fell along and east of US Highway 281 across South Central Texas, and on January 2nd, where the Austin metro area received one to three inches of rainfall.

The western and southwestern portions of the region were below normal for precipitation this winter, including the southern Edwards Plateau and the Rio Grande Plains. Del Rio came in at its 47th driest winter on record. After a very wet September and November last year had completely wiped out all drought conditions across the region, the past few months of dry weather across this area has allowed D0 and D1 drought conditions to return (Figure 3).

As mentioned earlier, there was a general lack of potent weather systems and arctic cold fronts impacting South Central Texas this winter. As such, there was essentially zero winter weather to speak of. There were reports of some brief sleet across the Hill Country and Central Texas on January 23rd. Sleet and graupel made another appearance on February 8th and 9th across much of the region, with the Austin metro area receiving a dusting of sleet/graupel on grassy surfaces.

“Austin/San Antonio Regional Climate Summary (continued)”

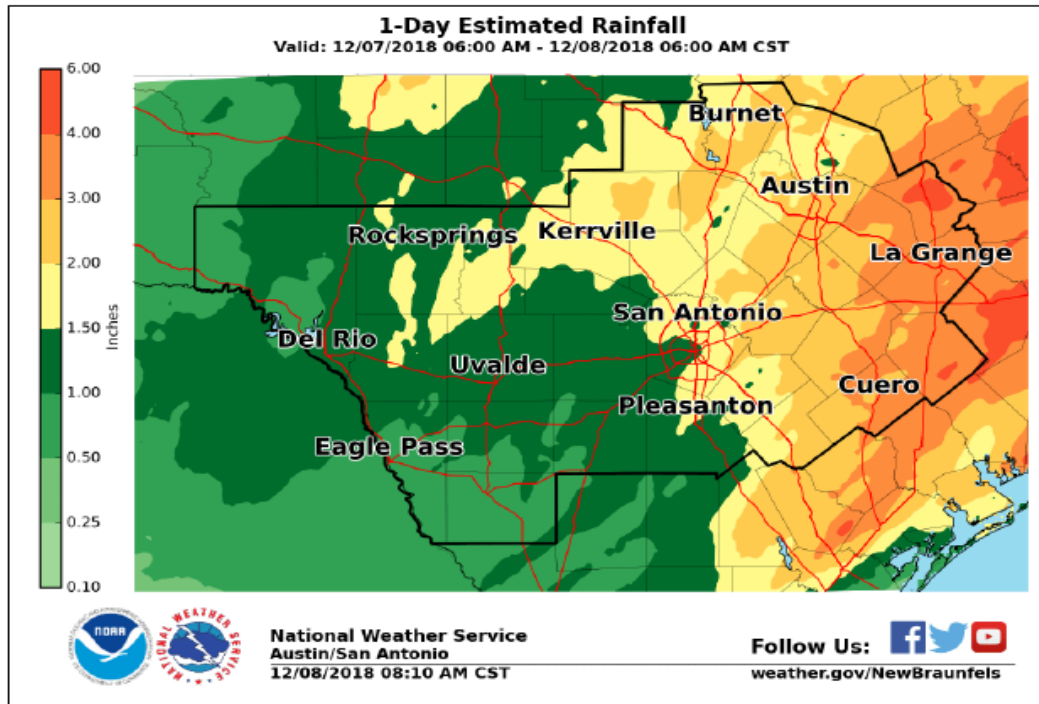


Figure 2: Rainfall across South Central Texas on December 7th, 2018

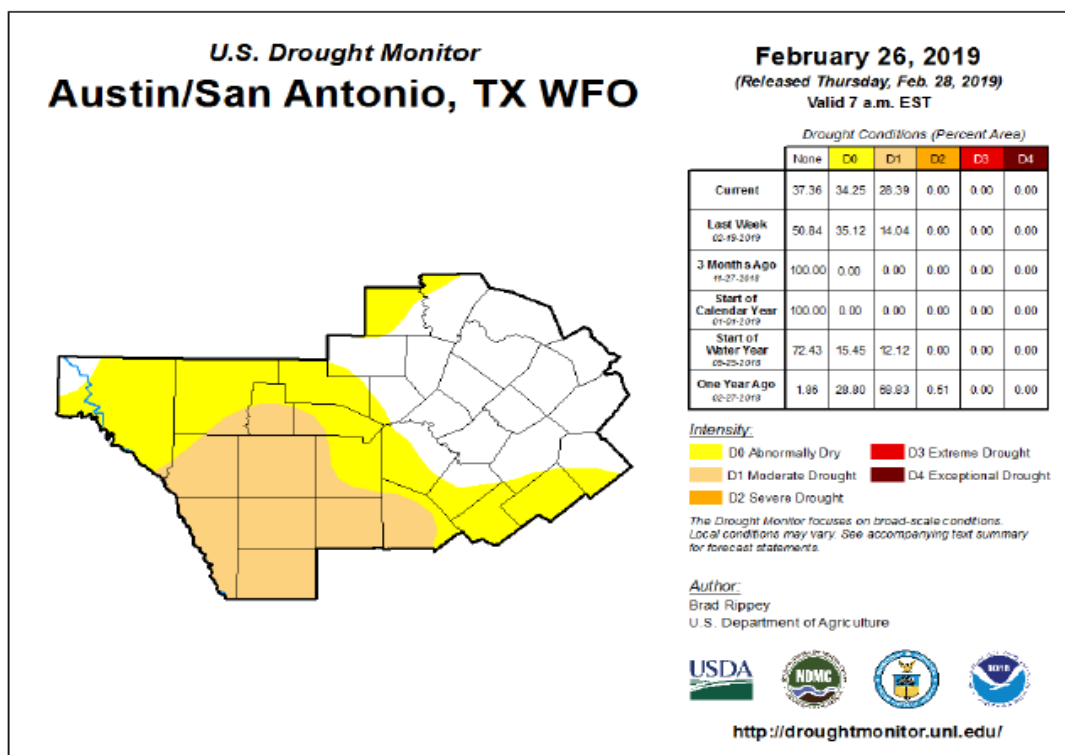


Figure 3: Drought conditions across South Central Texas as of February 26th, 2019

North Texas Regional Climate Summary

North Texas Winter 2018-19 CoCoRaHS Summary

By Greg Story

National Weather Service - WGRFC Fort Worth Texas

Greetings from North Texas! We were really on a rainfall roller coaster in north Texas in 2018. Just to review, January was dry, and then we had the wettest February on record. March was slightly below normal for rain. In April we had below normal rainfall in north Texas and ending up having the 7th driest April of record. In May most locations saw below normal rainfall especially over extreme northeast Texas. The below normal rainfall regime continued through June and July afterwards the weather started changing in August. Above normal rainfall occurred over north Texas except for the southeast portions. Then, the autumn season was historic. September and October of 2018 were the wettest September and October months of record. Not only that, but October was the fourth wettest month and the previous month (September) had seventh highest rainfall total ever for any month. In November, the weather pattern changed to a more normal (drier) autumn regime. Above normal rainfall was limited to portions of northeast Texas, while the remainder of north Texas was near to below normal.

December Summary:

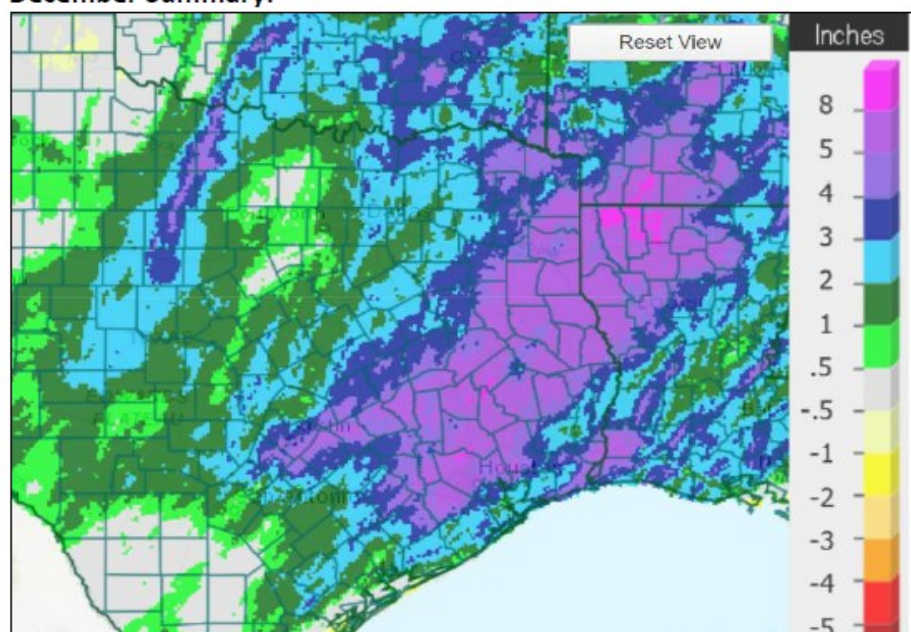


Fig.1 January 2019 departure from normal rainfall map. The green and beige colors indicate near normal precipitation, while the blue and purple colors indicate above normal. Note the areas southeast of the DFW metroplex had 3 to 5 inches of rain above normal.

December turned wet once again. Above normal precipitation occurred over much of the state, with only Deep South, far west Texas and the panhandle having below normal precipitation. At the DFW airport they got 4.55 inches in December. The normal amount for December is 2.55 inches so they were above normal by exactly 2 inches for the month. Adding up the totals for 2018, DFW received 55.97 inches. The normal amount is 36.14 inches so they were 19.83 inches above normal for the year. DFW ended with the 2nd wettest year on record. For reference, the top 5 wettest years are listed, along with the ENSO cycle added next to the year based on CPC's ENSO Oceanic Nino Index (if known).

Annual - Wettest

- 1 62.61" in 2015 El Niño
- 2 55.97" in 2018* La Niña/ENSO-Neutral
- 3 53.54" in 1991 El Niño
- 4 51.03" in 1932
- 5 50.62" in 1973 La Niña

“North Texas Regional Climate Summary (continued)”

There was a “parade” of storms across Texas in December. But three storms in particular brought the heaviest and most widespread rainfall during the month. Here are the highlights of the largest storms of the month.

December 1:

December started out with a strong low pressure system passing off to our north. A dryline advanced eastward and produced showers and thunderstorms over primarily northern and eastern Texas. Due to the speed of the storm system the rainfall amounts were mostly light.

December 7 – 9:

After a couple dry days, a major storm affected our region. Gulf of Mexico moisture, a stalled stationary front in Central Texas, a major upper-level low pressure system which moved from the Northern California coast across North Texas, and a teleconnection of moisture originating from the tropical equatorial Pacific Ocean all combined to produce heavy rain. The heaviest rainfall accumulations fell over southeast Texas where around 8.00” occurred near Huntsville. In the High Plains and Low Rolling Plains areas of the Texas Panhandle, it was cold enough for snow with accumulations of up to 10.00” in Lubbock.

December 13 – 15:

A short wave trough moved through south Texas. This was followed by a very strong low pressure system which transgressed central Texas. The most significant rainfall was again across southeast Texas.

December 19 – 20:

A weak storm system moved across Texas followed by a weak cold front. This resulted in mostly light rain across Texas.

December 26 – 28:

A deep low pressure system moved from southern New Mexico into the Midwest. With the storm moving in this path, it produced a dryline. The dryline raced eastward across Texas which created a line of thunderstorms. Some locations received upwards of 4.00” of rain, including the DFW metroplex with around 2.35”. The heaviest CoCoRaHS reports were out of Ellis County with Oak Leaf 0.6 NNE measuring 5.32” and Waxahachie 8.5 SW getting 4.77”.

End of December:

A strong cold front moved through the state which produced some rainfall. The amounts were less than 1.00”, with the DFW Metroplex picking up 0.55”.

January Summary:

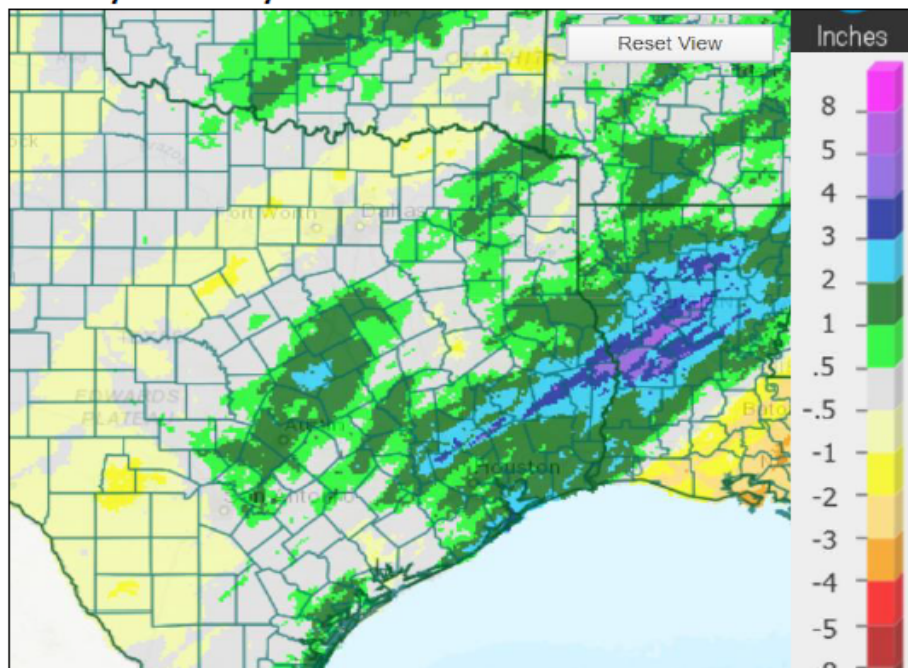


Fig.2 January 2019 departure from normal rainfall map. The yellow colors indicate below normal precipitation, while the green, blue and purple indicate above normal rain.

“North Texas Regional Climate Summary (continued)”

January 2019 saw above normal rainfall over central and east Texas, with near to below normal precipitation elsewhere. Much above normal rainfall occurred around Toledo Bend Lake, with below normal precipitation from north and west of the DFW metroplex down into the Texas Hill Country. At the DFW airport they got 1.58” in January, which is pretty close to the climatological normal. The normal amount for January is 2.13” so they were below normal by 0.55” for the month.

There was a shift in our weather pattern during January. We started off with storms coming off the Pacific Ocean and across the southwestern U.S., but by the end of the month the upper level air flow was coming more out of the northwest or west. This change limited the amount of moisture that came off the Gulf of Mexico. Thus, the storms which produced the heaviest rain in Texas were early in January. There were six storm systems this month, but the heaviest and most widespread rainfall occurred with the first one. Here are the highlights of the largest storms of the month.

January 2-4:

January started out with a strong closed low pressure system moving from southern Arizona to north Texas from the 2nd through the 4th. This storm produced widespread rainfall, with the heaviest being over east central and southeast Texas. In the DFW metroplex around 1.12” was observed, but down over the southern parts of north Texas in Falls County Rosebud 7.0 WNW received 4.41” while in Bell County Temple 8.5 SE got 4.31”.

January 11 – 12:

After about 6 days of dry weather, the next large storm system came in on the 11th and 12th and brought some light to moderate rain. The DFW Metroplex received around 0.42”.

January 19:

After a week of dry weather, an arctic cold front raced across the state. There were showers and thunderstorms with the passage of the front, mainly across east Texas.

January 23-24:

A weak storm system moved across Texas followed by another arctic cold front. The most significant rainfall was again across southeast Texas.

January 26 – 27:

A short wave trough moved across Deep South Texas in the southern branch of the jet stream. This produced some decent rain over south Texas, but little or no rain elsewhere across Texas.

January 29:

An arctic cold front moved across Texas. This front generated some light rain over east Texas. The amounts were 0.25” or less.

February Summary:

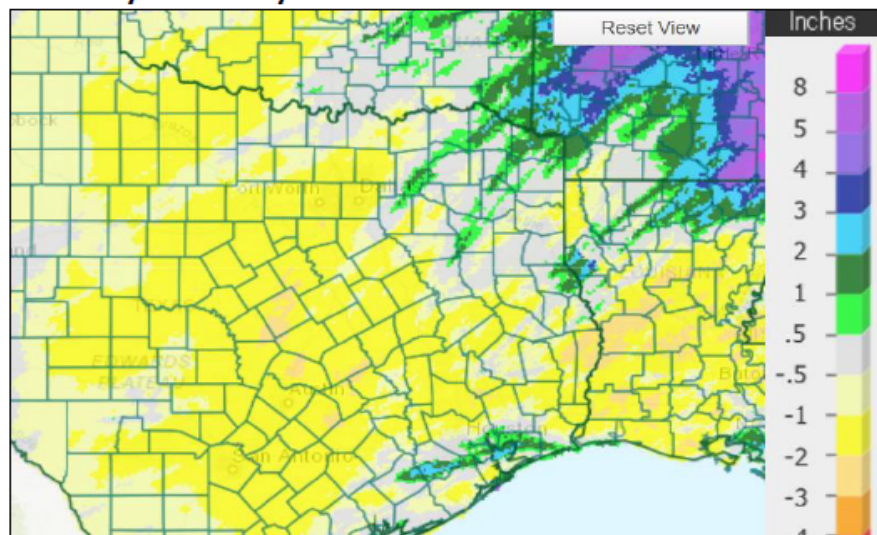


Fig.3 February 2019 departure from normal rainfall map. The brown and yellow colors indicate below normal precipitation, while the green, blue and purple colors indicate above normal rain.

“North Texas Regional Climate Summary (continued)”

February turned drier than normal over most of the state. Only a few areas along the Gulf coast, near Toledo Bend Lake, and over far west Texas saw above normal precipitation. But a vast majority of Texas had below normal values, especially from the DFW metroplex through Waco into central Texas. At the DFW airport they got 1.29” in February, which was quite a bit below normal. The normal amount for February is 2.66” so they were below normal by 1.37” for the month.

The weather pattern shift we saw during January continued through February. The upper level air flow was coming more out of the northwest or west. This limited the amount of moisture that came off the Gulf of Mexico. Thus, the majority of storms which affected Texas were not big rainfall producers. In fact, very few of the storms produced over one inch of rain on any given day. There were four large storm systems this month, with several smaller disturbances. Here are the highlights of the largest storms of the month.

February 7:

February started out with warmer weather conditions as a more zonal flow of air developed. A very minor upper air disturbance rippled across north Texas on the 2nd but it only generated light amounts of rain. The next storm system of consequence arrived on February 7 – 8 as a strong arctic cold front moved through. Only light rain fell over Texas, and since the main upper low passed to the north of Texas the heaviest rain remained northeast of the state. The DFW metroplex did receive around 0.40”.

February 11 – 13:

The next complex storm system came in on the 11th and 12th and brought some light to moderate rain. The main upper low passed north of Texas, but the final upper air disturbance brought widespread light rain. The DFW Metroplex received around 0.44”. Mexia 9.4 SSE in Limestone County measured 1.67” while in Lamar County Paris 4.2 NE got 1.58”.

February 19 – 21:

After several days of dry weather, a large upper low moved from Arizona and Utah eastward which passed to the north of Texas. There were showers and even a few thunderstorms with the passage of the storm, mainly across east Texas. This storm brought the heaviest rain amounts of the entire month. In north Texas an average amount in the DFW metroplex of 0.54” was observed while east of the Metroplex CoCoRaHS observers had more. Terrell 6.1 NNE received 2.09” while in Hopkins County Cumby 1.5 N had 2.00”.

February 26 – 27:

A strong cold front moved across most of Texas. While the drop in temperatures was the most significant weather news, there was some light precipitation along and behind the frontal boundary. The most significant rainfall was across southeast Texas.

Winter 2018-19 Precipitation Summary:

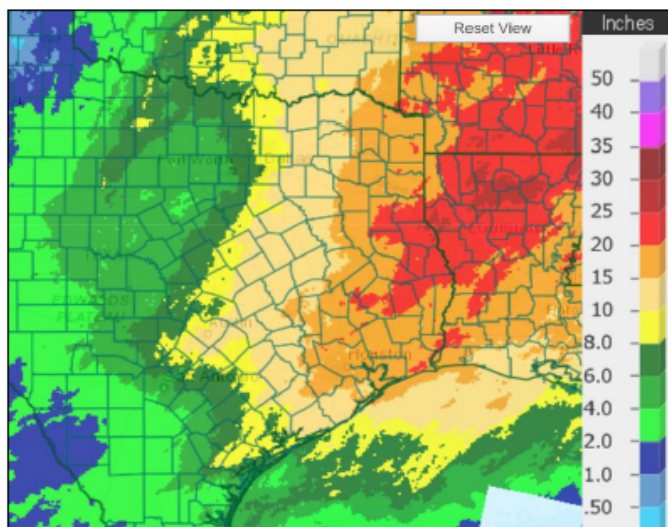


Fig. 4 Winter season precipitation 2018-19

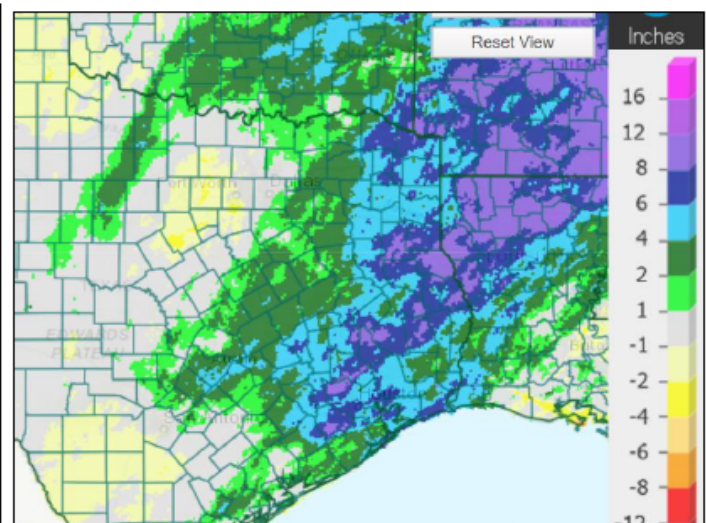


Fig.5 Winter season precipitation departure from Normal 2018-19

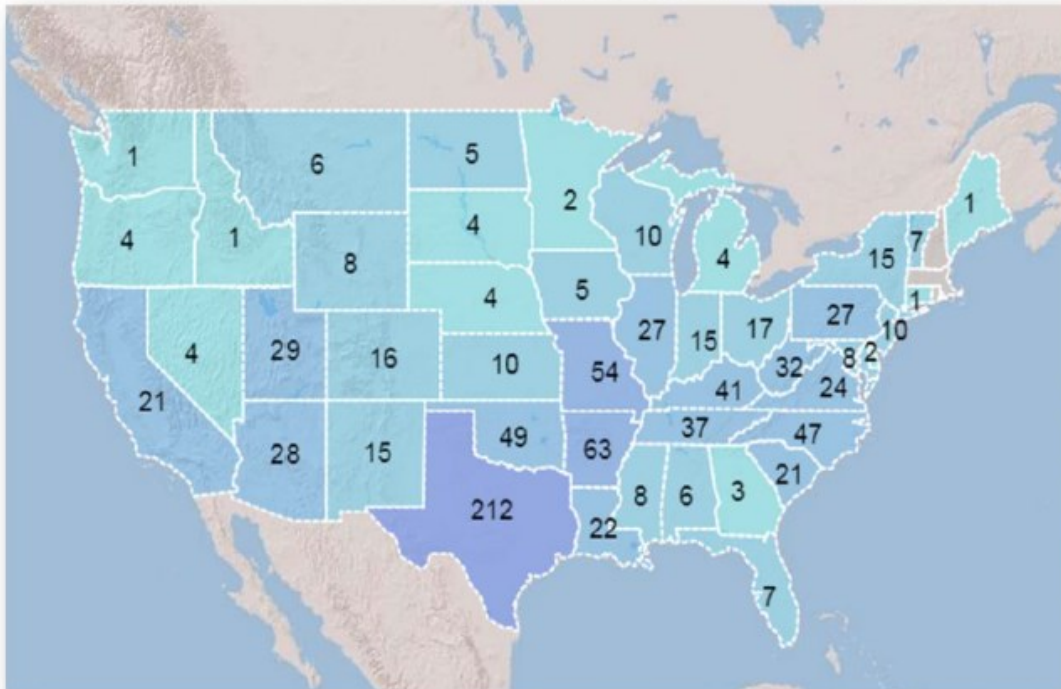
“North Texas Regional Climate Summary (continued)”

A good part of north Texas saw near normal precipitation in winter. It was heavier with above normal precipitation to the east of the DFW metroplex while drier than normal to the west. Adding up the totals for the winter season, DFW received 7.42". The normal amount is 7.34" so DFW was almost exactly normal, ending just 0.08" above normal for the season. There was only a trace of snow at DFW Airport for the winter which, if that holds, would tie a record for the lowest snowfall total which was also seen in two of the last three winters in 2016 and 2018. But we could still get snow in March. So far for 2019 the DFW airport has received 2.87". The normal amount is 4.79" so we are 1.92" below normal for the year so far.

I want to thank you for submitting your rainfall readings to CoCoRaHS during this winter season. They continue to be extremely valuable to us at the National Weather Service. It is critical that we see the magnitude of rainfall events in order to adjust the amounts of rainfall going into our hydrologic flood model. Please continue making your daily weather observations, even when the weather at your site had a low amount of rainfall (or no rainfall). A report of zero rainfall is just as important as a non-zero one!

Severe thunderstorm season is upon us. This often leads to flooding. The map below shows Texas far and away leads the nation in flood related deaths since 2010:

2010-2018 U.S. Flood Fatalities



Source: NOAA/National Weather Service



“North Texas Regional Climate Summary (continued)”

One way you can help the National Weather Service is by making significant weather reports in real time. When you make these reports, they immediately set off an alarm on our NWS workstations. Of most assistance to the West Gulf RFC is an hourly rainfall total, but snow reports can also be made and are useful the few times it snows. There is a separate link to significant hail reports. Please be safe when going out and making these observations! Here is the web site showing where to make these observations:

Once you enter your station, here is the form you fill out and submit:

That will help us out a lot. Thank YOU so much for your participation in CoCoRaHS. Have a great spring season!

Greg Story

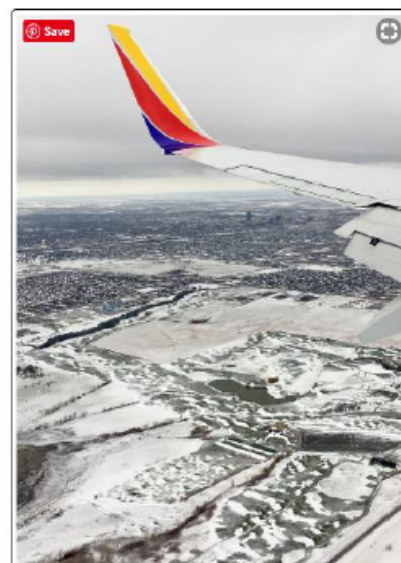
Amarillo Veterans Day Snow Storm

2018 Veterans Day Winter Storm Snow Record Thundersnow

By: Angie Margrave

National Weather Service - Amarillo

OVERVIEW



Flying over Amarillo – (Christy Fox)

Veterans Day 2018 will be remembered by some--not only as a day to remember all those great men and woman who served our country and gave the ultimate sacrifice--but also the day the Texas and Oklahoma Panhandles experienced a significant early season snowfall event. This was not just any snow event though...as some areas observed thundersnow!!! This is something that doesn't occur that often in this region.

Amarillo already surpassed the total snowfall amount for all of the 2017-18 winter season, when only a trace was measured. In fact, this snow event broke a 560 day streak of no measurable snow at the Amarillo International Airport, which is the official climate site for the city. This was the second longest streak of this kind. The longest streak was 669 days, ending January 30, 1951. So, we have already surpassed the total snowfall amount for all of the 2017-2018 winter season in Amarillo when we only received a trace of snowfall (for the entire season).

Snow began during the evening of November 11th as a strong trough approached from the northwest. This resulted in bands of snow that produced narrow corridors of heavy snowfall, which were only a county wide at times. One such band across the southern Texas Panhandle had embedded thunderstorms, which led to graupel (snow pellets) and periods of heavy snowfall that greatly limited visibility. The main band that produced the highest totals of 6-10 inches extended from Tucumcari, NM through Dumas, Morse and Darrouzette.

Due to accurate forecasts, the snowfall potential was messaged well in advance. Crews around the Texas and Oklahoma Panhandles were able to treat the roads well in advance, with a focus on the I-40 corridor that was forecast to be heavily impacted. Impacts that were observed included moderate to heavy snowfall, visibility below a mile, and occasional whiteout conditions (<1/4 mile visibility). Blizzard conditions were observed at times, but the official criteria for a blizzard were not met due to sustained winds being below 35 MPH. Regardless, travel conditions were not ideal with many schools reporting delays until 10 AM CST, and a few deciding to cancel classes outright due to safety concerns.

“Amarillo Veterans Day Snow Storm (continued)”

Snow/Ice

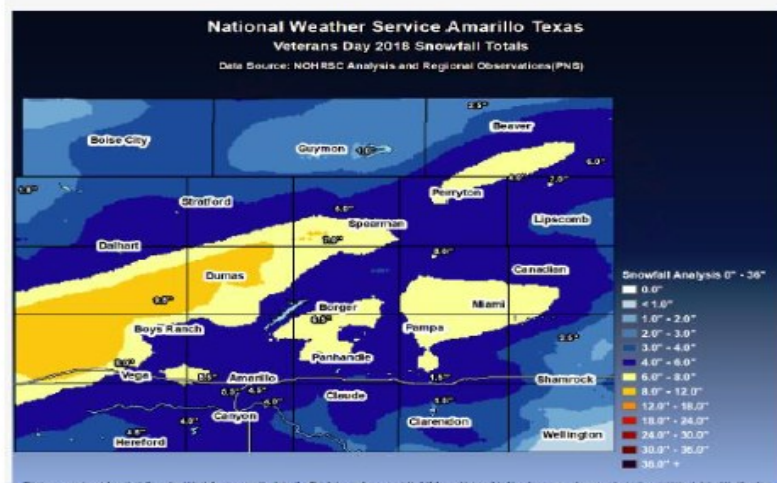
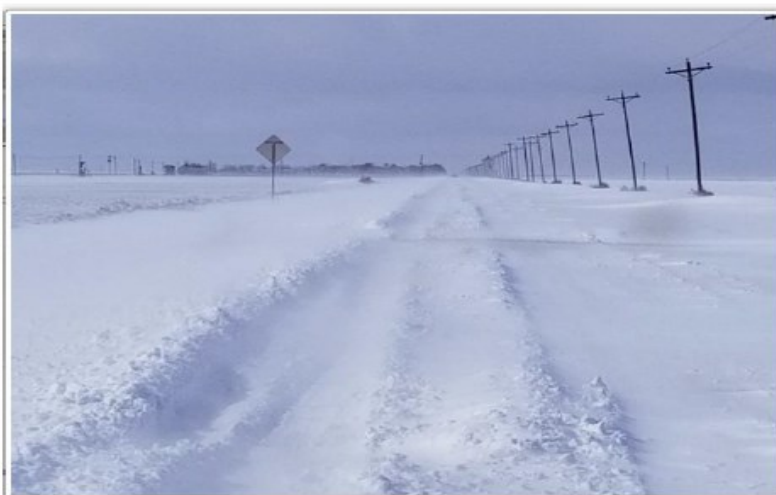
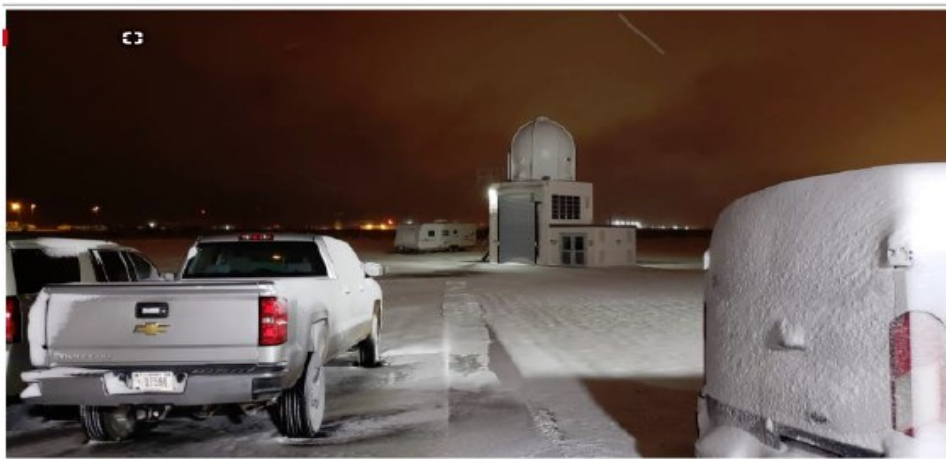


Figure 1: Veterans Day Snowfall Totals



Some of the heaviest snow totals
came from Channing to Dumas
to Spearman
(Credit: Brian Beck)

Figure 2 (above) and Figure 3 (below): Pictures of snowfall



Snow blanketed the grounds and vehicles at NWS Amarillo
(Credit: Aaron Ward)

Houston/Galveston Regional Climate Summary

Houston/Galveston Region Winter 2018-19 Summary

By: Ron Havran

CoCoRaHS Regional Coordinator SE Texas

December

Precipitation for the month of December was well above normal over much of the SE Texas region. Rainfall totals of reporting CoCoRaHS stations were very high in several northeastern counties including Polk, San Jacinto, Montgomery, and Liberty counties. (See chart 1 and figure 1) Parts of Chambers and Harris counties had several high monthly totals as well. The heaviest rainfall days of the month occurred on the 7th, 26th, and the 27th. The regional average rainfall of reporting CoCoRaHS stations was 8.12". Some CoCoRaHS stations had rainfall totals for the month as high as 11.00" to 14.00". Southwestern counties such as Wharton County had lower rainfall totals.

Temperatures for December across the region averaged near normal to slightly above normal. Several cold fronts brought much cooler temperatures across SE Texas with heavy rainfall that ended days of warm and dry conditions. The region had about 6 cold fronts pass through. Around 65% of the month had days that were either partly cloudy to clear. Temperatures at night stayed above freezing for just about the entire region during the month.

January

The new year started off cold and wet with heavy rainfall on the 2nd to 3rd. Warm and dry weather quickly returned for about a week after the cold and wet start. This pattern of cold to warm to cold continued for most of the month with about 8 cold fronts. Temperatures never did get that much below freezing the entire month. The average temperature for the region was about normal regionally with a few areas in the region being just slightly above normal.

Precipitation for the month averaged about normal to just slightly above normal for most areas except NE counties that were above normal about 2.00". (See figure 4) Polk had the highest CoCoRaHS station average rainfall. (See chart 1) The days with the highest rainfall for CoCoRaHS stations was on the 2nd – 3rd, 11th – 12th, 18th – 19th, and the 22nd – 23rd.

February

An El Nino Pattern in the Pacific in the month of February usually means SE Texas will have many overcast cloudy cool days with foggy conditions and mist where daytime highs struggle to warm up and nighttime lows usually don't get that cold. Well I just described the conditions SE Texas had this February. Sunny days to partly cloudy were few. Unlike some El Nino patterns SE Texas didn't get that much rainfall. Drizzle and light rain were very common but amounts were on the low side in most places. Most areas had below normal rainfall for the month in SE Texas, but there was one exception to this pattern. On the evening of the 26th a storm system produced a cluster of storms that developed in the SW parts of SE Texas and moved through Wharton, Fort Bend, northern Brazoria, southern Harris, and Galveston counties producing some storms totals up to about 4.00" of rain. The previous listed counties where this cluster of storms moved through received most of their rain for the month on the 26th into the morning of the 27th. Wharton County had a CoCoRaHS observer rainfall average in February of 6.89" of rain with most of the rain total in that county from this storm. (See chart 1)

CoCoRaHS observer rainfall reports are highly valued by data users in the weather and flood warning fields by supplying data that gives a clear picture of the path and intensity of a storm system such as this storm in rural and data sparse areas. (See CoCoRaHS map 1) The more observers CoCoRaHS can get to sign-up and report daily at 7am the better this picture becomes.

“Houston/Galveston Regional Summary (continued)”

Winter 2018-19 CoCoRaHS Houston/Galveston Region Rainfall
County Rainfall Average and County Station Rainfall Maximum Total in inches per month

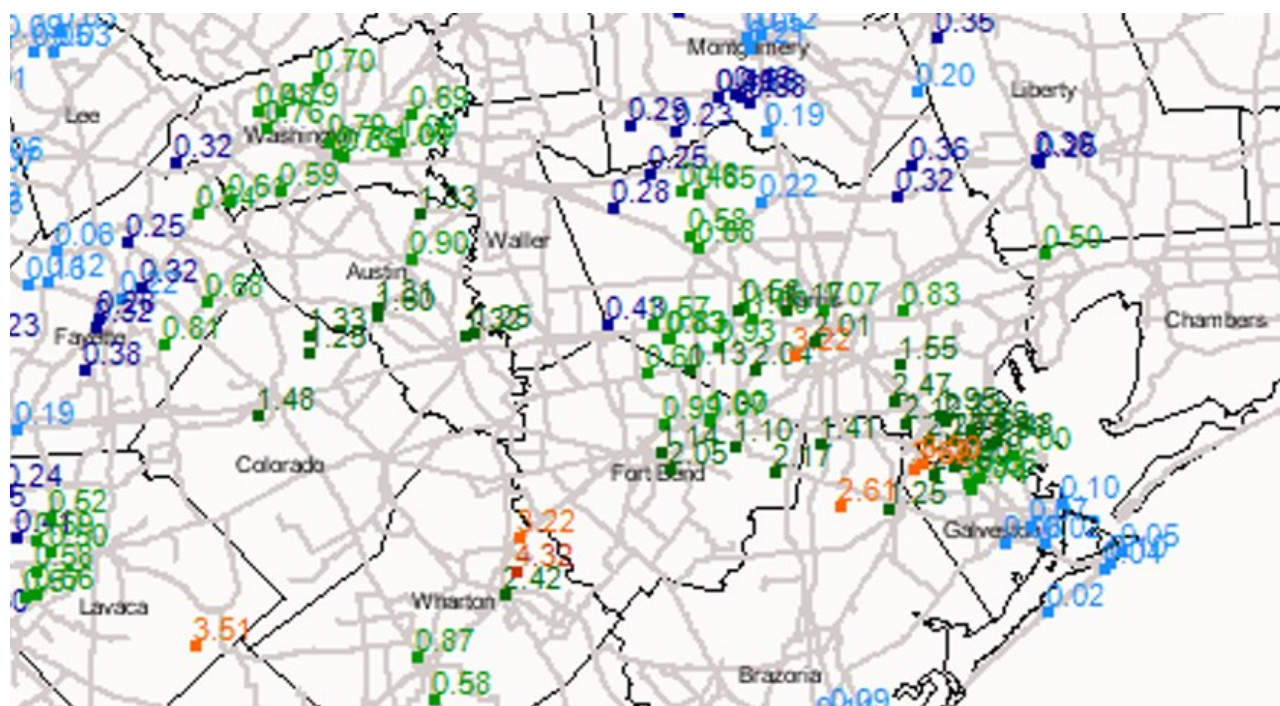
County	December		January		February		Winter Total
	AVG.	MAX.	AVG.	MAX.	AVG.	MAX.	3-Month Rain Total
Austin	7.49	8.33	4.53	5.32	2.14	2.48	14.16
Brazoria	6.03	6.45	4.39	5.24	2.73	4.11	13.15
Chambers	8.33	9.25	5.01	5.24	3.89	4.01	17.23
Colorado	7.53	7.93	3.45	4.04	2.45	2.69	13.43
Fort Bend	7.97	9.02	4.43	5.25	2.83	3.52	15.23
Galveston	6.48	7.88	5.83	7.41	3.03	3.86	15.34
Harris	8.51	10.49	4.74	6.63	2.82	4.75	16.07
Jackson	6.23	6.23	2.52	2.52	1.15	1.15	9.90
Liberty	9.65	9.68	5.56	5.73	2.79	3.54	18.00
Matagorda	7.03	7.03	3.31	3.31	2.48	2.48	12.82
Montgomery	9.73	12.26	6.03	7.26	1.58	2.01	17.34
Polk	11.88	14.95	6.42	7.09	3.35	3.65	21.65
San Jacinto	11.02	11.41	5.44	5.57	2.64	2.86	19.10
Wharton	5.82	6.75	3.07	3.72	4.49	6.89	13.38
Region Totals	8.12	14.95	4.62	7.41	2.74	6.89	15.49

Denotes wettest month for a category

Denotes driest month for a category

Note: All data taken from the cocorahs website by using the Total Precipitation Summary Report for each county by month.

Chart 1: Houston/Galveston Region rainfall averages by county and month for the Winter Season 2018-19



CoCoRaHS Map 1: Map of CoCoRaHS 24-hour rainfall from the morning of Feb. 26 to the morning of Feb. 27

“Houston/Galveston Regional Summary (continued)”

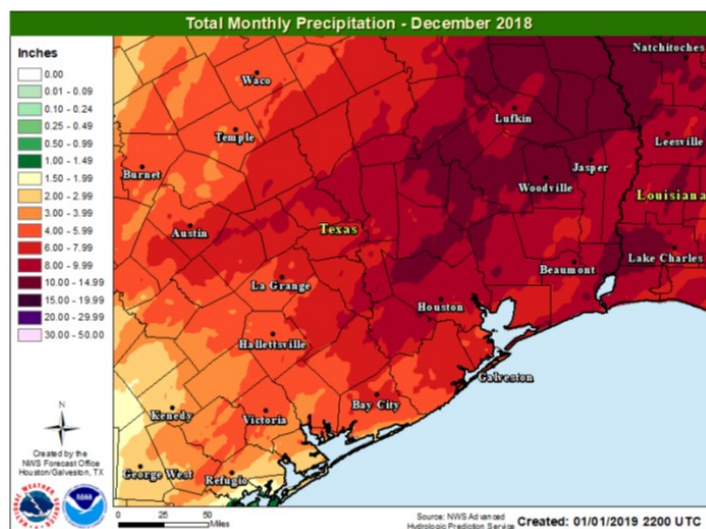


Figure 1: Total December Precipitation

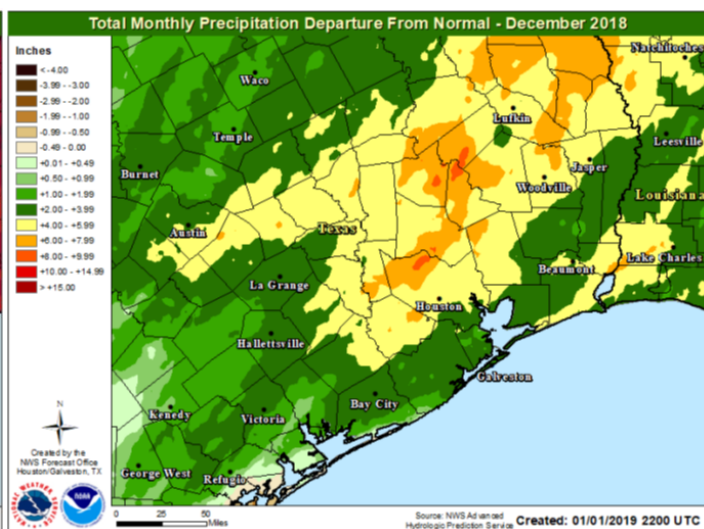


Figure 2: December Precipitation Departure from Normal

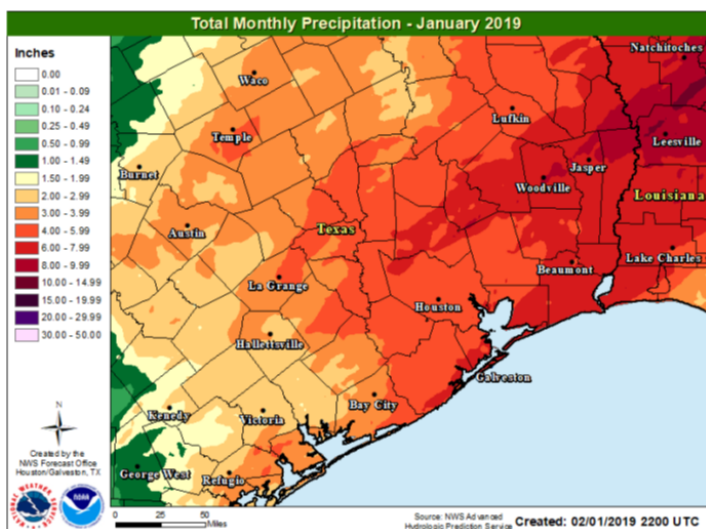


Figure 3: Total January Precipitation

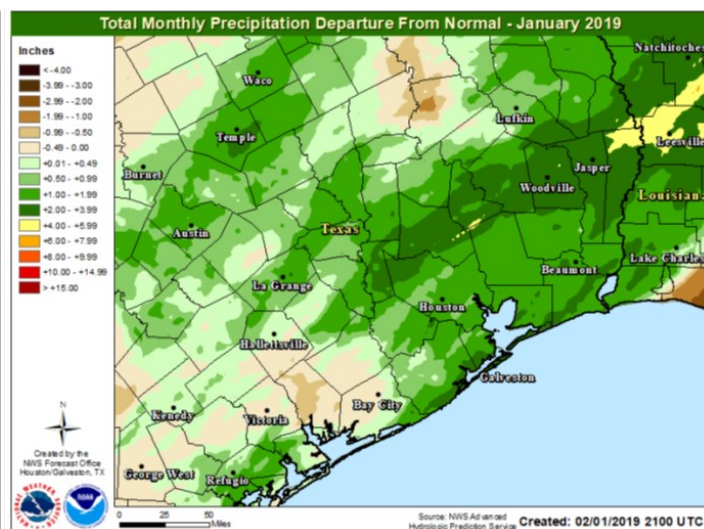


Figure 4: January Precipitation Departure from Normal

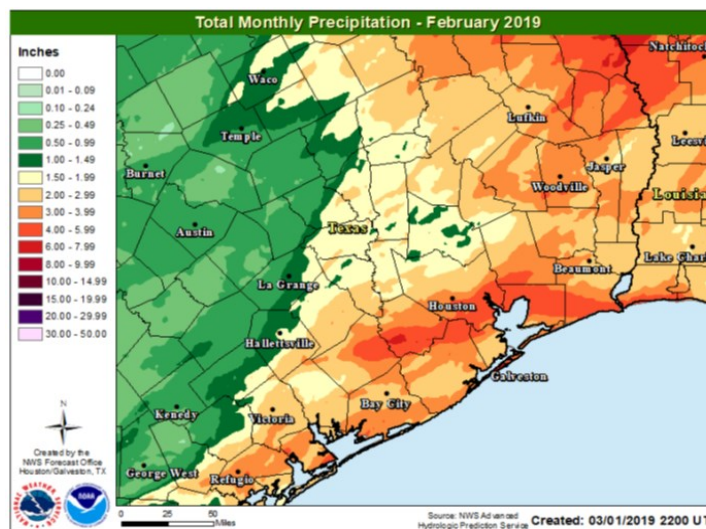


Figure 5: Total February Precipitation

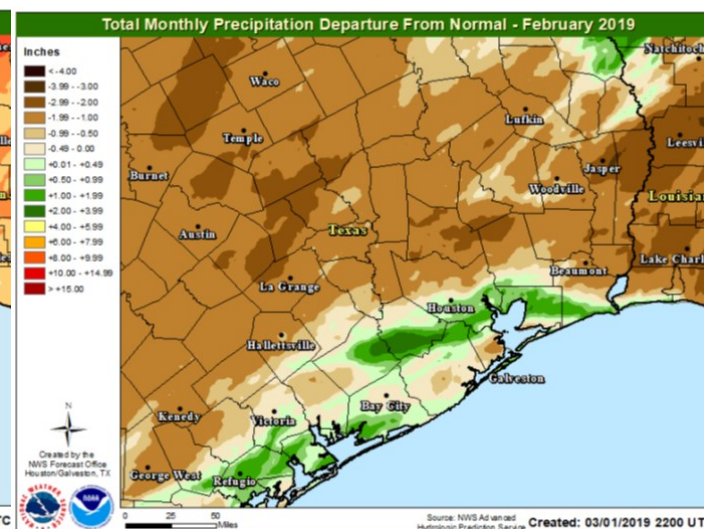


Figure 6: February Precipitation Departure from Normal

San Angelo Regional Climate Summary

San Angelo Winter 2018-19 Summary

By: Joel Dunn

San Angelo National Weather Service WFO

West Central Texas experienced a wet start to the winter months, with a record breaking snowfall event in December. After the New Year, the area returned to the dry pattern expected during the winter months.

December

December experienced above normal precipitation across West Central Texas. Abilene recorded 3.64 inches, making it the 6th wettest December on record, while San Angelo recorded 2.47 inches; the 8th wettest December on record. December also saw the first snowfall event of the season. On the 8th, the City of Abilene recorded 3 inches, breaking the previous record of a Trace on that date in 2016. Areas west of Abilene, in Nolan County, saw totals closer to 4 inches. Elsewhere, conditions were not conducive to frozen precipitation, resulting in either mixed precipitation or simply rain.



Another event of note occurred on the 13th and was responsible for 30% of the monthly rainfall, as well as a second snowfall event for the Big Country. Though the City of Abilene only saw a Trace of frozen precipitation, areas west of the city across Nolan County saw totals as high as 8 inches.

January

After a wet December, January's lack of rainfall was a return to the normal dry winter pattern. Though several systems moved through West Central Texas, rainfall remained light, resulting in precipitation deficits across the area.

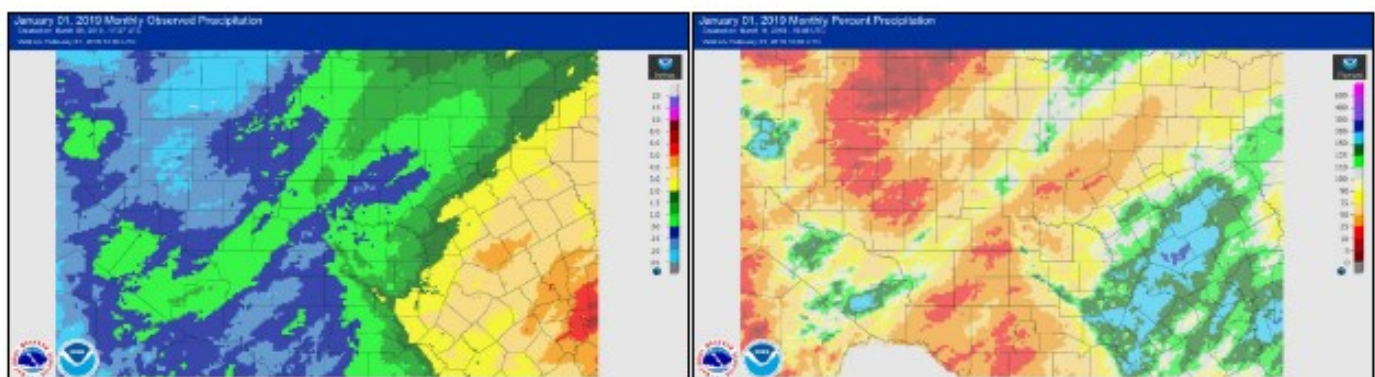


Figure 1 - January Rainfall

Figure 2 - January Percent of Normal

As can be seen from the images above, a few areas received in excess of 1 inches of rainfall for the month, but most of West Central Texas remained below normal for precipitation.

“San Angelo Regional Summary (continued)”

February

February experienced overall dry conditions similar to that of January. Though most areas saw nearly an inch of rainfall, some locations, such as Schleicher County, reported less than a tenth of an inch.

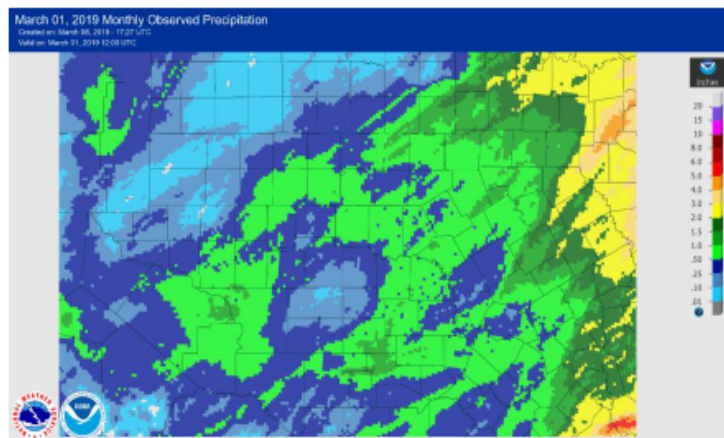


Figure 3 - February Rainfall

As seen in the image below, the departures from normal would indicate that February was indeed drier than normal.

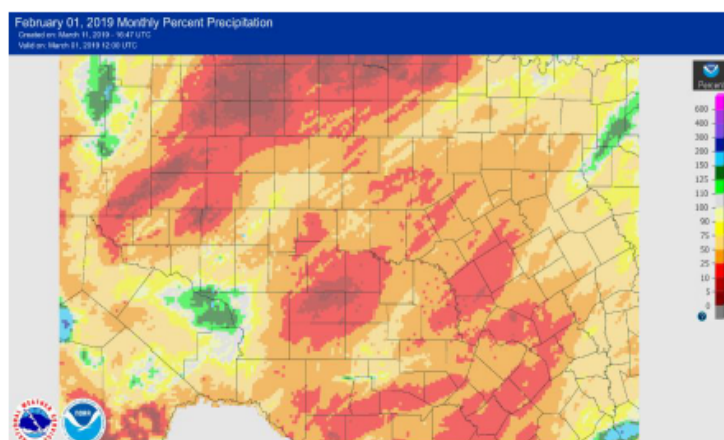


Figure 4 - February Percent of Normal

These dry conditions resulted in D0 (abnormally dry) conditions being reintroduced into the area. By the end of the month portions of Brown and Coleman County saw D1 (moderate drought) conditions.

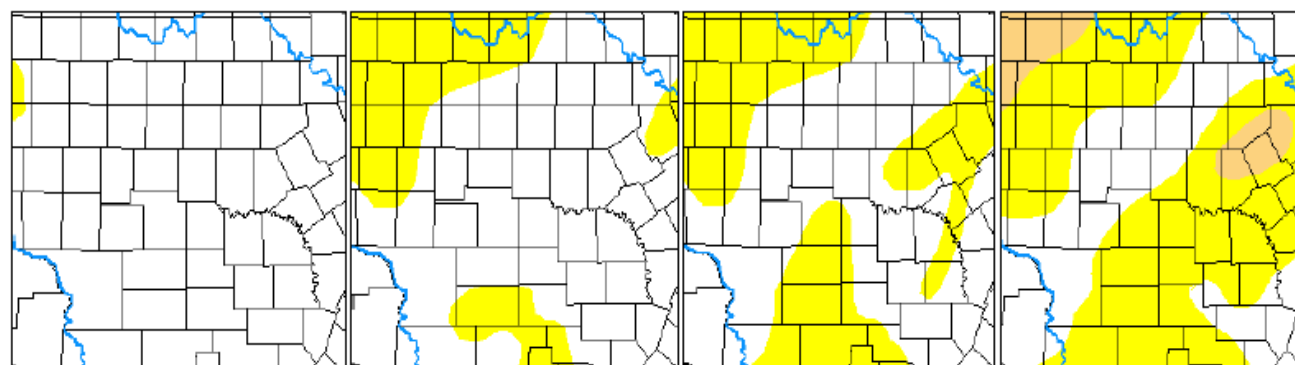


Fig. 5 – Drought areas on Feb.5

Fig. 6 – Drought areas on Feb.12

Fig.7 Drought areas on Feb 19

Fig.8 Drought areas on Feb. 26

Brazos Valley Regional Summary

Bryan-College Station/Brazos Valley Region Winter 2018-2019 Summary

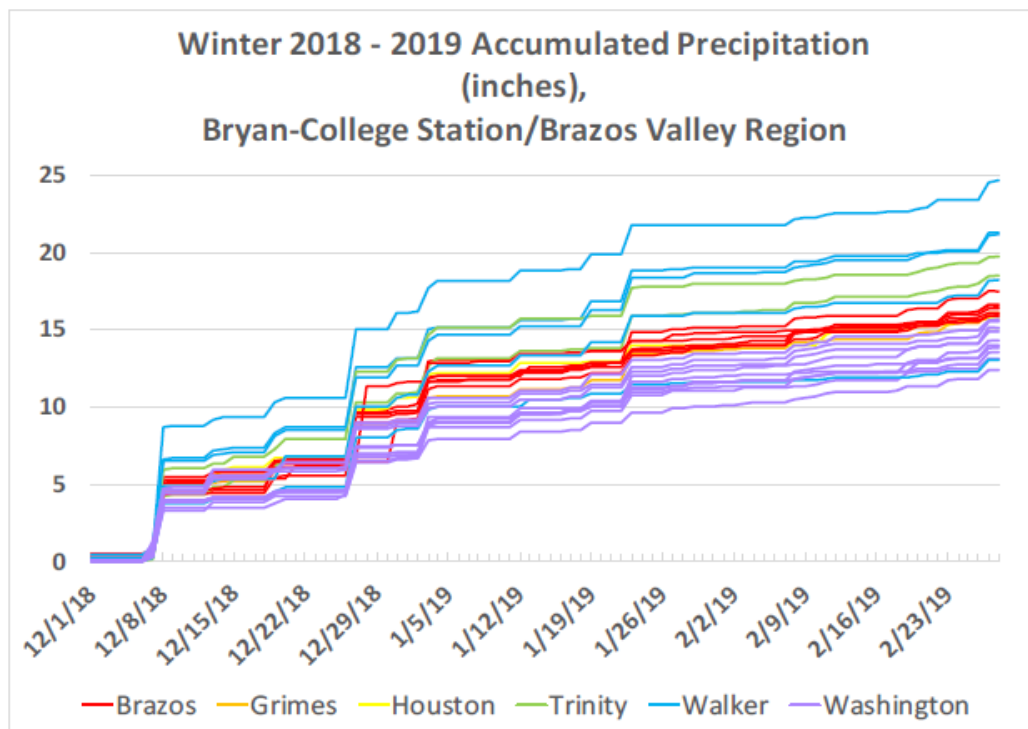
By: Jeramy Dedrick, Graduate Assistant for the Office of the State Climatologist
John Nielsen-Gammon, Texas A&M University, Texas State Climatologist, Regional
CoCoRaHS Coordinator

Summary:

It was a seasonably wetter-than-average winter for the Brazos Valley Region. Average totals for this season were on the range of 13 to 25 inches, with Walker and Trinity County observers measuring the highest totals (17 - 25 inches). Washington County, the region's southeasternmost county, observed the lowest total precipitation by the end of the season. Heavy accumulating precipitation events throughout December provided nearly half of the season's precipitation for the majority of observing stations.

Observer Statistics:

There were **46** active CoCoRaHS observers during the winter season, one down from the fall. For the past three seasons, **9** observers have reported for the full duration of the season. Not including these stations, **18** others reported for at least 85% of the period, providing a total of **27** active observers with reliable measurements across 6 (Brazos, Grimes, Houston, Madison, Trinity, Walker, Washington) of the region's 8 counties.



“Brazos Valley Regional Summary (continued)”

Accumulated Precipitation:

A significant rain event at the end of the first week in December brought multiple inches of rain to Central and Southeast Texas. The event was captured by all observing stations, measuring upwards of four to eight inches accumulation. Walker County stations overall observed the upper end of this range for the event. Steady precipitation accumulation persisted for the next weeks before another notable precipitation event followed the Christmas holiday, bringing accumulation amounts to half of the season's total for nearly all observers. January provided measurable rain occurrences throughout the month and into the fourth week, when accumulations were raised by two to three inches. February was a comparatively drier month in the season as no observer measured more than a 2.5 inch gain in precipitation accumulation from the start to the end of the month. Walker County observers maintained the highest accumulation throughout the season, finishing upwards of 20 inches in total. Washington County observers in the southeasternmost part of the Brazos region measured the driest totals for the season with some stations nearly 10 inches less than the observers in Walker County.

Season Statistics:

Wettest Day: 8", December 8 (Walker County)

Wettest seasonal total: 24.66" (Walker County)

Longest spell of days without measurable rain: 7; January 5 – January 11 (Grimes, Trinity, Walker, Washington Counties)

Longest spell of days with measurable rain: 12 (Brazos County)

Regional Season Average: 16.04" \pm 3.24"

“Local County Coordinator Recruiting Reminder (continued)”

Coordinator Responsibilities

Local County Coordinators help support CoCoRaHS in the following ways:

- Help recruit new volunteers through local press, contacts with local service organizations, social media, or through other creative means
- Help organize and attend local training sessions as needed
- Provide support for volunteers in their county
- Become familiar with the CoCoRaHS website

Other opportunities, if willing:

- Help volunteers with the installation of their equipment
- Help volunteers who do not have internet access by entering their data
- Quality control check the list of observers in your area and check for any stations no longer reporting

Get in touch

We provide a list of additional ideas that a local county coordinator can do beyond those mentioned above. Because of Texas's size, we are still recruiting volunteers to step into the role of local county coordinator. For a list of existing county coordinators in Texas, click this link and search for your county. You never know when your county might need you!

If you would like to be considered as a local county coordinator, please feel free to contact Bill Runyon, Texas state coordinator for CoCoRaHS, at texas@cocorahs.org

Remember: you are one of our most valuable resources, and we truly appreciate your time and efforts!

Midland/Odessa Regional Summary

2018-2019 Winter Climate Summaries for West Texas and Southeast New Mexico

By: James DeBerry, NWS Midland

West Texas and Southeast New Mexico ended 2018 wet, but have started off 2019 dry.

December

December was a relatively wet month for West Texas and Southeast New Mexico, characterized by steady events with small precipitation amounts that added up. As such, no significant hydrologic reports were received. This brought to an end a year that began dry, and ended with above-normal rainfall for much of the HSA.

Monthly radar rainfall estimates ranged from as little as a tenth of an inch on the Marfa Plateau to 3" in the upper Colorado River Valley. The highest observed rainfall was just over 2.75" in Reagan County. The average of rainfall reported across West Texas and Southeast New Mexico was just under an inch.

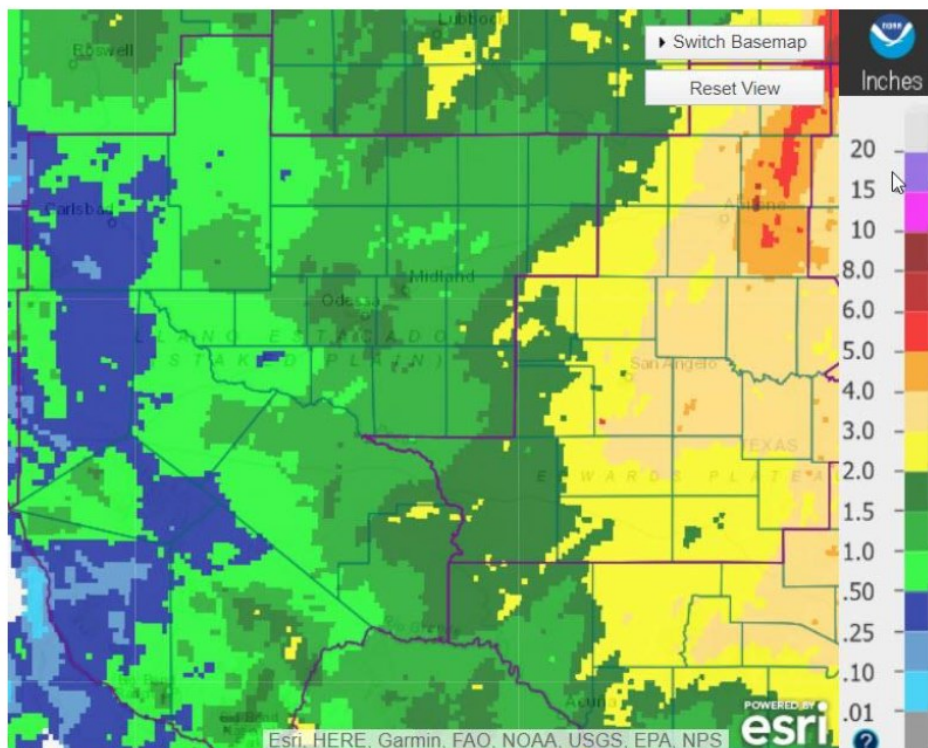


Figure 1: December Precipitation

January

January was relatively dry month, and no notable hydrologic events occurred.

Monthly radar rainfall estimates ranged from nothing in the Presidio Valley to up to 2" in the lower Trans Pecos. However, the highest observed rainfall was just over three quarters of an inch in Winkler County. The average of rainfall reported across West Texas and Southeast New Mexico was under a quarter of an inch.

“Midland/Odessa Regional Summary (continued)”

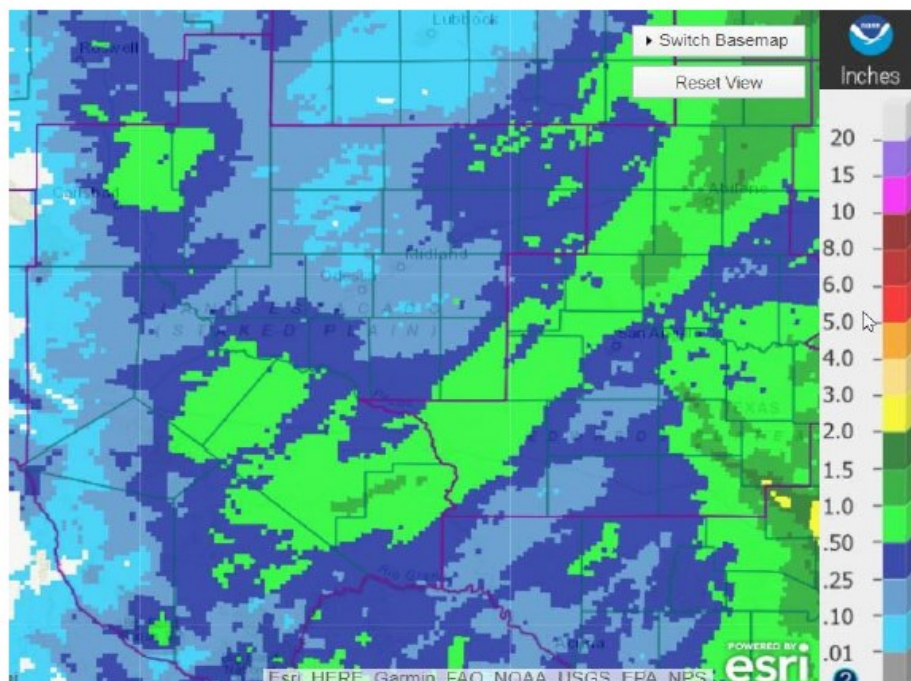


Figure 2: January Precipitation

February

The synoptic pattern during February favored keeping storm systems north or east of the HSA. As a result, very little precipitation fell and no significant hydrologic events occurred.

Monthly radar rainfall estimates ranged from nothing in western Culberson County to up to 2" in the Davis Mountains and lower Trans Pecos. However, the highest observed rainfall was just over half of an inch in Reagan County. The average of rainfall reported across West Texas and Southeast New Mexico was under a tenth of an inch.

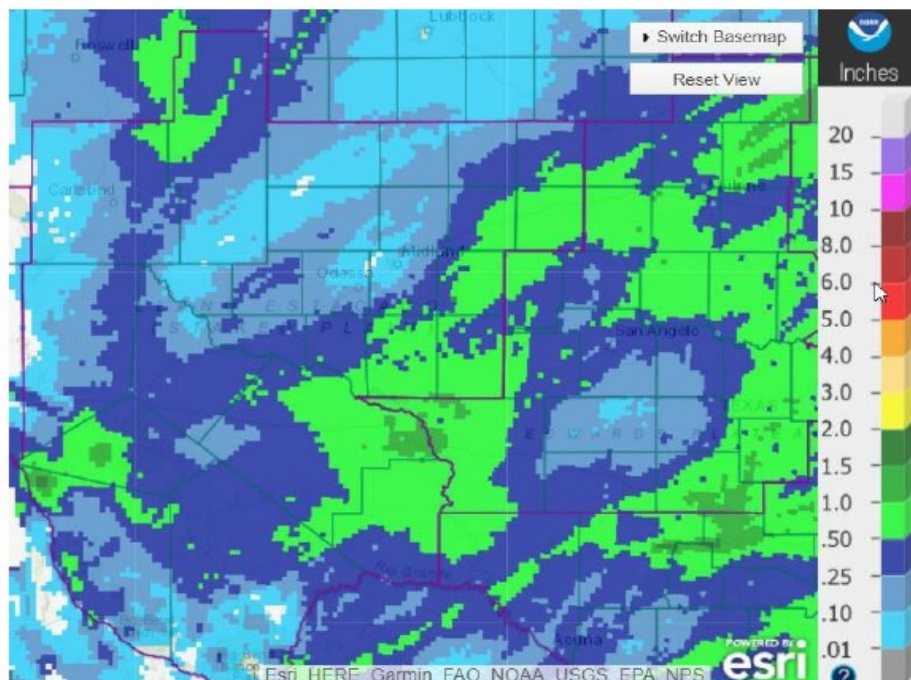


Figure 2: February Precipitation

East Texas Regional Winter Summary 2018-19

East Texas Regional Summary (Winter 2018-2019)

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

Weak El Nino conditions remained across the region during the winter months of 2018-2019. This resulted in above normal precipitation across East Texas. This was a continuation from the autumn months, where most of East Texas ended with above normal rainfall.

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2007	0.7	0.3	0.0	-0.2	-0.3	-0.4	-0.5	-0.8	-1.1	-1.4	-1.5	-1.6
2008	-1.6	-1.4	-1.2	-0.9	-0.8	-0.5	-0.4	-0.3	-0.3	-0.4	-0.6	-0.7
2009	-0.8	-0.7	-0.5	-0.2	0.1	0.4	0.5	0.5	0.7	1.0	1.3	1.6
2010	1.5	1.3	0.9	0.4	-0.1	-0.6	-1.0	-1.4	-1.6	-1.7	-1.7	-1.6
2011	-1.4	-1.1	-0.8	-0.6	-0.5	-0.4	-0.5	-0.7	-0.9	-1.1	-1.1	-1.0
2012	-0.8	-0.6	-0.5	-0.4	-0.2	0.1	0.3	0.3	0.3	0.2	0.0	-0.2
2013	-0.4	-0.3	-0.2	-0.2	-0.3	-0.3	-0.4	-0.4	-0.3	-0.2	-0.2	-0.3
2014	-0.4	-0.4	-0.2	0.1	0.3	0.2	0.1	0.0	0.2	0.4	0.6	0.7
2015	0.6	0.6	0.6	0.8	1.0	1.2	1.5	1.8	2.1	2.4	2.5	2.6
2016	2.5	2.2	1.7	1.0	0.5	0.0	-0.3	-0.6	-0.7	-0.7	-0.7	-0.6
2017	-0.3	-0.1	0.1	0.3	0.4	0.4	0.2	-0.1	-0.4	-0.7	-0.9	-1.0
2018	-0.9	-0.8	-0.6	-0.4	-0.1	0.1	0.1	0.2	0.4	0.7	0.9	0.8
2019	0.8											

Fig. 1 Oceanic Nino Index (ONI) from 2007 to 2019

Courtesy of The Climate Prediction Center

December was the wettest month of the winter season. National Weather Service climate locations at Lufkin's Angelina Airport and Longview's East Texas Regional Airport recorded top 10 all-time December rainfalls with 11.16" and 8.99" respectively. A couple of notable rainfall events occurred December 6-7th and December 26-27th.

On December 6th, southwest flow aloft set up over the region and an overrunning event developed. This event was enhanced by a surface low setting up in the Gulf, which brought additional deep layer moisture to the region. A daily rainfall record for December 7th of 4.83" occurred at Lufkin's Angelina County Airport. CoCoRaHS stations (Lufkin 3.0 SW) and (Hudson 0.9 E) recorded 6.02" and 6.00" respectively. Another heavy rain event occurred December 26-27th as a line of strong to severe storms move across the region. Several CoCoRaHS stations record over 3.00" of rainfall on the 27th including (Longview 3.4 NE) with 4.45" and (Nacogdoches Arbor Oak) with 4.42". Another daily record of 2.49" was set on December 27th at Lufkin's Angelina Airport.

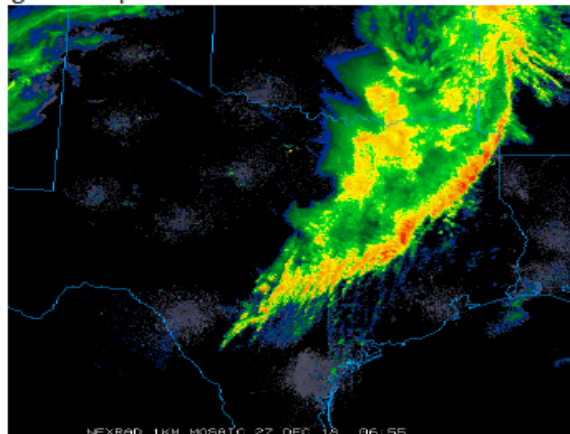


Fig. 2 Southern Plains Composite Radar – December 27, 2018 (12:55 PM)

Courtesy of UCAR.edu and College of DuPage

“East Texas Regional Winter Summary 2018-19 (continued)”

Rainfall totals for the months of January and February were closer to normal across East Texas, however, southwest flow aloft remained present over the region. This pattern yielded overrunning rain events on January 2nd and January 22nd. National Weather Service climate station at Tyler Pounds Fields Airport had daily records 1.33” on the 2nd and 1.74 inches on the 22nd.

Despite the above precipitation for the winter months, very little of it fell in the form of frozen precipitation. The only significant event occurred on February 8-9th, where light sleet and freezing rain occurred across portions of East Texas, south of Interstate 20. As much as a few tenths of an inch of sleet was seen across the portions of region, along with a trace of freezing rain. However, none of the CoCoRaHS sites reported more than a trace of any frozen precipitation.



Fig. 3 Sleet accumulations on highway near Jacksonville, TX – February 08, 2019
Courtesy of KETK-TV viewer Angelica Medrano

The forecast for the Spring months is very similar to the previous Fall and Winter months. A weak El Nino is forecast to remain in place. This usually means there will be an increase in moisture from the Pacific across the region as the southerly jet stream becomes more active. As a result, a greater chance for above normal precipitation for the region can be expected.

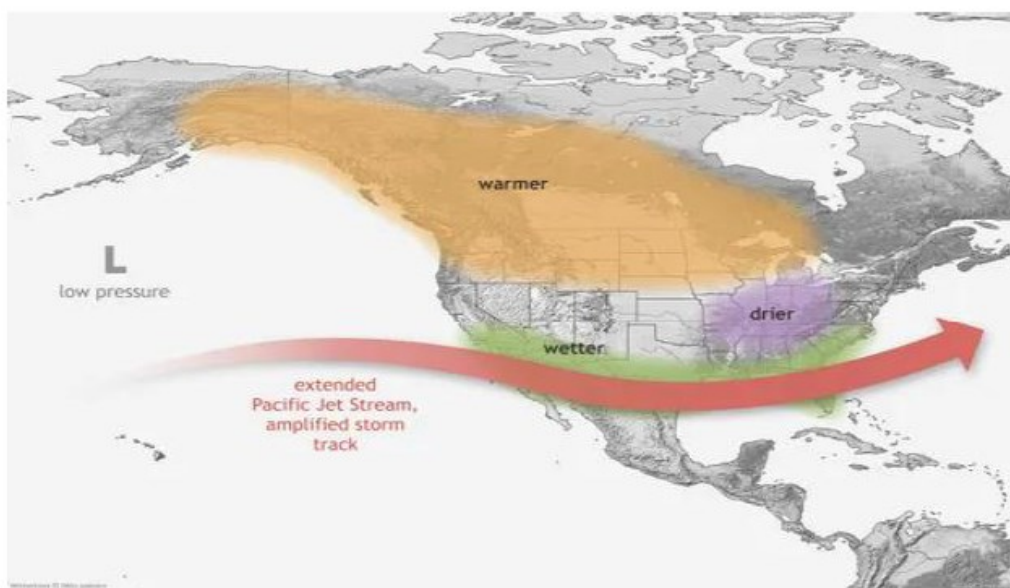


Fig. 4 El Niño Spring Impacts
Courtesy of Climate Prediction Center and USA Today

2019 Spring Weather Outlook

2019 Spring Weather Outlook for the State of Texas

By: Bob Rose – Lower Colorado River Authority, Ron Havran – SE Texas CoCoRaHS Regional Coordinator

Atmospheric Anomalies over North America

During early-to-mid-January, an anomalous trough-ridge pattern contributed to above-average temperatures in the western U.S. and to below-average temperatures in the eastern U.S.

Since mid-to-late January, an anomalous ridge strengthened over the Gulf of Alaska, and a downstream amplified trough was present over Canada and the northern U.S. These conditions contributed to well above-average temperatures in Alaska, and to below-average temperatures across much of Canada and the U.S.

Pacific Ocean SSTs and Tropical Pacific Patterns Affecting Texas

*El Nino has strengthened and is now forecast to continue through spring and summer.

*The El Nino will have some influence on spring weather, causing above normal rainfall across the state. Temperatures are forecast to be near normal, with more cold fronts expected into May.

*There will be an increased risk for flooding this spring due to the wet El Nino influence.

*Forecasts are showing some similarities between this spring and the spring of 2015.

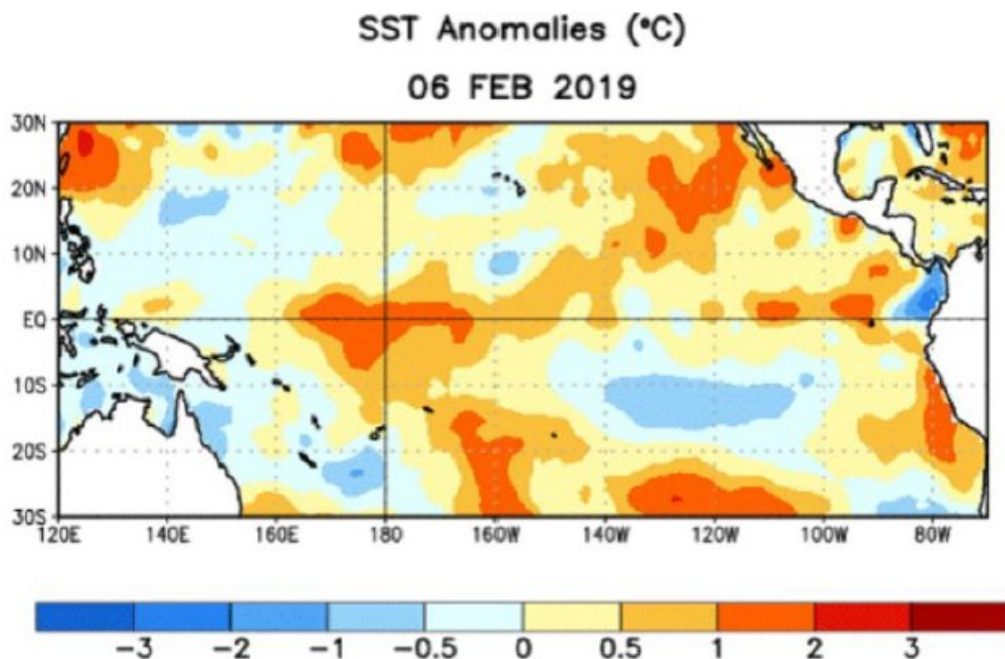


Figure 1. Average sea surface temperature (SST) anomalies (°C) for the week centered on 6 February 2019. Anomalies are computed with respect to the 1981-2010 base period weekly means.

“2019 Spring Weather Outlook (continued)”

U. S. Seasonal Outlooks

March- May 2019

The seasonal outlooks combine the effects of long-term trends, soil moisture, and, when appropriate, ENSO.

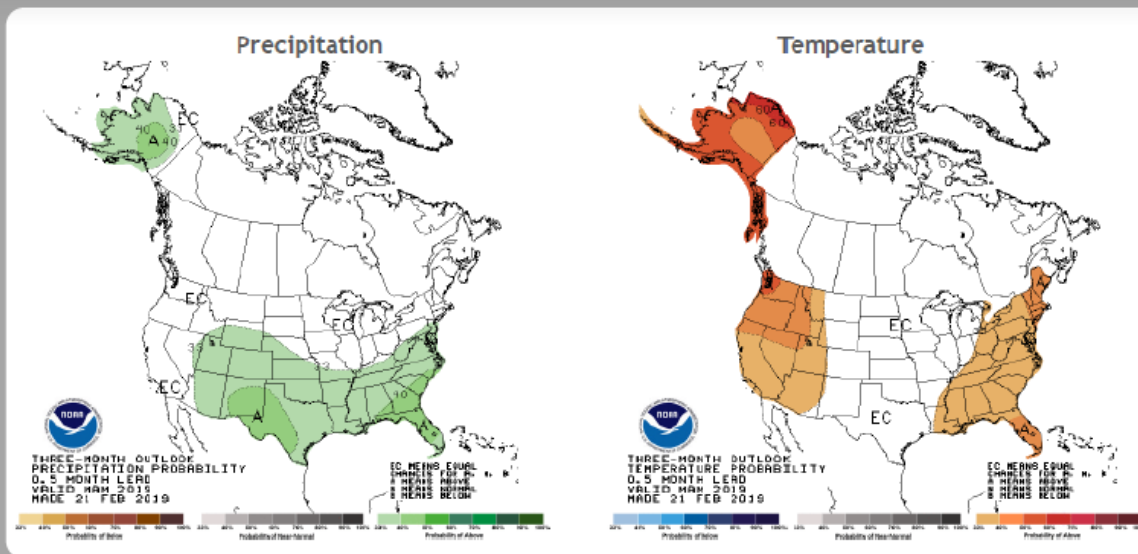


Figure 2: Spring Outlook for the months of March – May 2019.

Outlook Summary

The state of the tropical Pacific in early 2019 has some eerie similarities to that of early 2015. After several months of warmer-than-average sea surface temperatures, the atmosphere responded with weak El Niño conditions, similar to 2015. And, a down welling Kelvin wave is present, as it was in 2015.

So are we in for another 2015-style strong El Niño? Even with now and then having so much in common, it's far too soon to tell. Climate models are notoriously unreliable when making predictions in March and April, when ENSO is often in transition. Also, wind patterns and heat content in March are not very powerful predictors of fall El Niño patterns. While it's likely that the current weak El Niño conditions will continue through the summer, there are still plenty of innings left to play.

In summary, CPC forecasters believe El Niño conditions are likely to continue through the Northern Hemisphere spring 2019 (~80% chance) and summer (~60% chance). What does this mean for Texas weather? There will be an increased risk for flooding this spring from above normal rainfall and increased stormy conditions. More cold fronts and storm systems in May usually lead to an increased chance of severe weather and heavy rains across the state. Now is a good time to get those CoCoRaHS rain gauges cleaned and ready to measure all that rainfall this spring season.

Observer Tips and Training Section

Back to Basics - Observation Time

(Taken from Steve Hilberg's Message of the Day on the CoCoRaHS website)

When you signed up for CoCoRaHS you selected an observation time. This is the time that automatically appears in the Observation Time field on the Daily Report form, and for the many of us this is 7:00 a.m. The time is automatically entered into the field as a convenience since we assume that's when you will regularly take your observation. However, if for some reason you make your observation at an earlier or later time other than the "standard" time you chose, be sure to enter that actual observation time in the Observation Time field. This is especially important when we have rain occurring at the time of observation. A difference of 30 minutes could make a big difference between what you measure and what surrounding stations measured 30 minutes earlier. So if your observation time is more than 5 minutes either side of your chosen time, enter the actual observation time in the field. Also, the observation time is the time you make your measurement, NOT the time you enter it on the web. For example, if you make your measurement at 7:00 a.m. but don't enter it on the web until 3:00 p.m., your observation time remains as 7:00 a.m.

The rainfall you report each morning is the total that has accumulated since the previous day's observation. The total is reported on the day of the observation, not necessarily the day the rain fell. For example, let's say you had 1.23 inches rain on the afternoon of April 1st, and your next regular observation is the morning of April 2nd. Your observation for the morning of April 2nd would be 1.23 inches, representing all of the rain that fell since your last regular observation (the morning of April 1st). It would be helpful if you noted when the rain fell in your comments.

Most Common Type of Errors found by CoCoRaHS Quality Assurance and Quality Control

Most errors we find in CoCoRaHS data are *reporting* errors, not measurement errors. Here are some of the most common types of errors in no particular order:

*Typo/Decimal

Observer mistypes the amount into the precipitation field, or misplaces the decimal point. **Solution:** Always check your observation on the View Data section for Daily Precipitation Reports for your county and make sure you typed in the correct amount. Observers entering data by an I-phone make these kind of errors the most. Please be careful to type data in correctly.

*False Zero

Observer entered zero but evidence suggests value should be >0. **Solution:** Make sure you read your gauge every day to see if rainfall is in your gauge or condensation collected in it, and always empty any condensation out of the gauge. Always empty your gauge everyday so you know for certain if any rain falls over the next 24 hours that the amount is for only 24 hours.

* Incorrect date

Observer enters the incorrect date for the observation. These usually occur when the observations are entered one or more days after the observations were made, and often occur in pairs, i.e. ob1 is entered for date2, and ob2 is entered for date1. **Solution:** Please remember to make a Multi-Day Report if you didn't make a Daily Report the previous day. This is best way to avoid this type of error.

*Multi-day Accumulation Entered as a Daily Amount

Observers often forget that a different entry form (*Multi-Day Report Form*) is needed to enter accumulations occurring over a period of 2 or more days, and enter the amount using the Daily Report Form. **Solution:** Please remember to make a Multi-Day Report if you didn't make a Daily Report the previous day. You may think that this is getting old by us saying this again and again but until all observers remember to use the Multi-Day report we will keep mentioning this. This is the number one reporting error we see with the entered data being useless and contaminating the rainfall data base.

*A significant storm item such as heavy rainfall well after the 7am daily reporting time in the afternoon or evening being entered as a Daily Report in the afternoon or evening for the observation time of 7am that morning when the observer hadn't yet entered their normal Daily Report. **Solution:** Please use a *Significant Weather Report* for those type of storms or events. Please remember a *Significant Weather Report* is a real time report that goes directly to the National Weather Service for *storm warning purposes only* and is a separate report by itself. A Daily Report is for rainfall since the last mornings Daily Report and should be made at the normal 7am observation time each morning covering rainfall over the previous 24 hours. This a separate report by itself as well.

*An observer using an automated tipping bucket rain gauge which archives rainfall per a 24 hour day at midnight. This observer will enter these amounts by back dating in rainfall amounts in daily reports per day for long periods of time which do not match their 7am reporting time. **Solution:** CoCoRaHS DOES NOT ACCEPT RAINFALL DATA FROM TIPPING BUCKET AUTOMATIC GAGES. Please use your official 4-inch diameter CoCoRaHS rain gauge for all your measurements. You will find it is far more accurate than a tipping bucket rain gauge which must be calibrated and cleaned regularly to have any kind of reliable data. Automatic tipping bucket rain gauges have limitations during heavy rainfall and will always under report the amount that falls.

“Observer Tips and Training Section (continued)”

The four inch gauge -- how is it calibrated?

Rainfall is a DEPTH measurement and not a "volume" measurement. In other words, it's not "an inch per square inch" but it's an inch for any area in your immediate vicinity that the rain happens to land on. In the case of your new rain gauge, the "inch" of rain is falling into a cylinder that has an inside diameter of slightly less than 4" is then being funneled into a calibrated cylinder of a much smaller diameter (just greater than 1.2 inside diameter). The area of the opening of the inner cylinder is exactly 1/10th the area of the funnel and outer cylinder. This means, the inner tube will magnify the depth of rain by a factor of exactly 10. What this means is that 1.00" of rain will fill that inner cylinder to a depth of 10.0". It is then scaled accordingly.

Reading a CoCoRaHS Gauge at Night during a Storm

Reading your gauge at night during a thunderstorm with heavy rain falling and lightning can be challenging and quite dangerous. One observer has a clever way of reading the CoCoRaHS gauge from inside the safety of his home. This ingenious observer submitted pictures showing how he can read the gauge at night during a storm event. Using a laser pointer along with a reflecting mirror carefully mounted below the gauge and angled properly, the observer can acquire a fairly decent estimation of rainfall. This can be done by shining the laser through a window closest to the gauge aiming at the mirror. (See photo of red laser reflecting on the mirror) Overflow amounts collected in the outer cylinder may also be estimated by a general rule of thumb. 1 inch in the outer cylinder is roughly equal to 0.90 inches of rain. If the overflow in the outer cylinder were roughly 3 inches...combined with a full inner cylinder (1 inch) then the gauge would contain approximately 3.70 inches of rain (3 inches outer cylinder = $0.90 \times 3 = 2.70 + 1.00 = 3.70$). This is a fairly decent means to estimate heavy rainfall during a nocturnal event, without endangering an observer's life.

Editor's Note: Rainfall in excess of 2 inches collected over a 2 hour period of time at the onset of an event could possibly trigger Flash Flooding. If this were to occur a good rule of thumb is to immediately submit a real-time *“Significant Weather Report”*. This supplementary type of report alerts the local National Weather Service meteorologists of a potentially dangerous situation. A *Significant Weather Report* will activate an audible alarm in the local NWS office and draw the forecaster's attention to evaluate the area for a possible warning, if necessary. CoCoRaHS observers in or around an area that has been warned for Flash Flooding could continue to update meteorologists with hourly updates using the Significant Weather Report. This is a wonderful way for a good CoCoRaHS observer to become a Great weather observer and possibly help to save someone's life during a potentially dangerous weather situation. Once any type of Flood event has begun to occur...frequent updates are invaluable to Meteorologists and Hydrologists at the National Weather Service and the River Forecast Center.

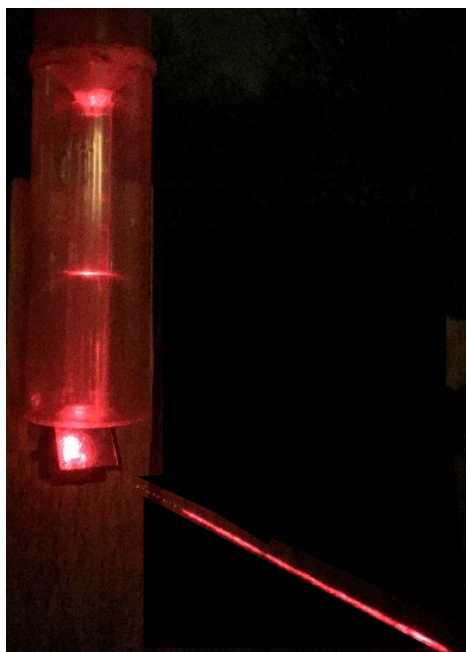


Figure 1: Laser shining on CoCoRaHS gauge highlighting the meniscus.



Figure 2: Parts used include mirror and laser light projector

How to deter birds from getting on top of your gauge?

An observer sent in this picture of their gauge being bird proof.



CoCoRaHS Webinars



Upcoming WxTalk Webinars:

Thursday, March 21, 2019 - 1:00PM EDT

Into the wind...Oh, the places mobile radars will go!

Karen Kosiba
Center for Severe Weather Research
Boulder, CO



[\(Biography\)](#)

The Doppler on Wheels (DOW) mobile radars have been used, often in tandem with other instrumentation, to study tornado formation and structure, the boundary layer of landfalling hurricanes, the internal structure of lake effect snow bands, the gust front structure of potentially severe-wind producing MCSs, and other mesoscale phenomena. Some key findings include the existence of rear-flank downdraft surges, which may impact tornadogenesis, the existence of strong winds in tornadoes very close to the surface, small scale structures that may impact energy distribution and wind speeds in the near surface hurricane boundary layer, and the existence of misovortices in intense lake-effect snow bands. As part of this webinar, Karen will share with you the adventures (and misadventures!) of learning about tornadoes, hurricanes, winter storms, and other high impact weather from over a decade of field work...and discuss what projects are on the horizon.

	<h3><i>Texas CoCoRaHS Observer</i></h3> <p>The official newsletter of Texas CoCoRaHS</p>
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