TEXAS CoCoRaHS OBSERVER

Summer 2016

"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.

If you have questions, comments or suggestions, feel free to contact us via the emails listed on the back page.

Please mention CoCoRaHS to a friend to join the network and become part of an interesting and fun observation network..

Inside this issue:

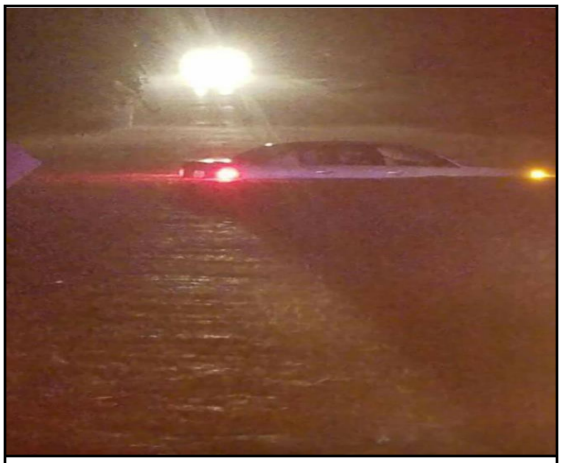
Flash Flooding swamps Zapata County

A slow moving thunderstorm system developed across the Rio Grande Plains and South Texas Brush Country just prior to midnight on August 20th, and proceeded to drop an estimated 5 to 8 inches of rain from Zapata through Escobas, mostly along and north of State Highway 16, during the pre-dawn hours of August 21st.

The torrents, falling over a 3 to 6 hour period, proved too much for poor drainage locations and rapidly swelling arroyos/streams, flooding a number of vehicles and requiring six known water rescues, including from vehicles shown at right and below in Zapata. Standing water levels reached 3 feet on some roads, and creeks that exceeded their banks left between 1 and 2 feet of fast flowing water nearby.

After near-record heat in July and a continuation of said heat/low rainfall into mid-August, the back-side of a westward moving upper level disturbance – the same one that created unprecedented flooding in south Louisiana – dropped 3 to 6 inches of rainfall over very thirsty ranches in parts of Starr, Jim Hogg, and Zapata County during the afternoon and evening of August 13th.

SEE PAGE 2————->



Car stranded in flood waters during the pre-dawn hours of Aug.21, 2016. Photo by: Zapata County Sheriff Department.

Heavy Rain, Hail and Tornadoes hit Kingsville area

An upper level disturbance moving across South Texas, combined with a very moist and unstable atmosphere produced strong to severe thunderstorms across South Texas on Tuesday, May 31. The strongest storms crossed Kleberg County and produced 3 tornadoes, very strong winds, large hail and torrential rainfall.

The first two tornadoes occurred nearly simultaneously as a supercell moving from the west merged with another cell from the south. One tornado occurred from roughly US-77 to Business US-77 just north of General Cavazos Blvd. This tornado

SEE PAGE 2————————>

Tornado damage at Casa Del Rey Apartments in Kingsville

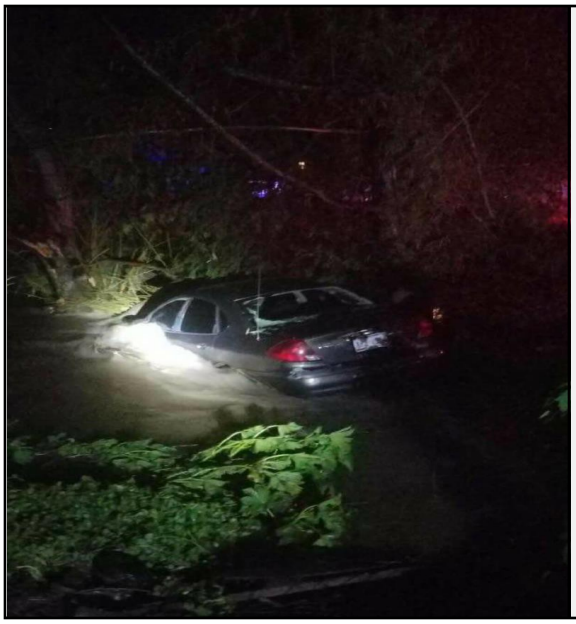
Zapata County Flash Flooding

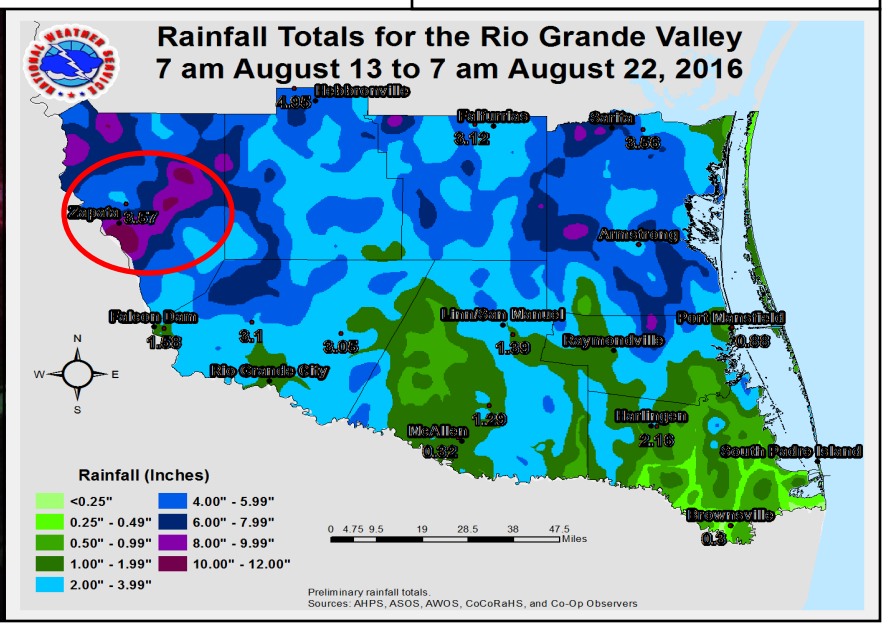
Similar events over populated locations or previously wet soils. typically produce some level of flooding, but for this case, ranchers asked about the impact shared the same sentiment: They were 'dancing' over the necessary water for livestock and vegetation alike. All rains soaked nicely into the soil, and helped the process of re-greening pastures and rangelands once again.

The arrival of a spring-like upper level disturbance *from the west* – highly unusual in south/central Texas in August – helped lift tropical moisture into several thunderstorm systems" typically seen in spring and sometimes later in autumn from the Big Bend region through South Central Texas on August 20th. The final systems formed over the Rio Grande Plains of Texas and along the Sierra Madre near Monterrey, Mexico, late on the 20th and early on the 21st. The Rio Grande Plains event brought repeating torrential rain-producing thunderstorms that focused on central/northern Zapata County and northwest Jim Hogg County, primarily along and north of State Highway 16.

Farther south, more helpful than harmful rains affected parts of Starr County, and a "welcome surprise" of generally 0.25 to 1" on (though up to 4 or more inches in rural pockets of Brooks, Willacy, and Kenedy County) fell across the rest of Deep South Texas and the Rio Grande Valley aided by the low pressure system formed by the aforementioned thunderstorm systems.

Left: Car submerged in floodwaters in Zapata on Aug 21st, 2016. Photo from: Zapata County Sheriff Department
Below: Rain totals from Aug 13th to Aug 22nd. Heaviest rains fell along Hwy 16 in Zapata County (circled in red)





KINGSVILLE From Page 1->damaged baseball fields near H M King High school and traveled westward to cause significant damage at the Casa Del Rey Apartments and homes along Otis Drive. A portion of a roof was blown off a home on Otis drive and numerous large trees and power poles were snapped. The second tornado occurred about a mile south, traveling west to east. This tornado first touched down near Dick Kleberg Park where bleachers were tossed 300 yards and the roof was blown off a metal building. This tornado tracked east and southeastward for 2.28 miles, snapping numerous trees and utility poles. A third tornado occurred 45 minutes later as these same cells continued to interact and move very slowly. While no damage was found from this tornado due to its inaccessible location, there are photos of this short-lived tornado southeast of Ricardo.

Left: Tornado in the town of Ricardo, just south of Kingsville Photo from: Harley Shwartz.
Below: Home damaged by tornado along Otis Drive in Kingsville

Rio Grande Valley Weather Summary

By Barry Goldsmith
NWS Brownsville

The rains came. And came again and again. By the time spring 2016 was over, nearly the entire Rio Grande Valley/ Deep South Texas ranchland region had received above average totals. The ranchlands of Jim Hogg, Brooks, and Kenedy County were eerily similar to 2015 in reaching "jackpot" status – though substantially lower than the exceptionally wet 2015, which ranked #1 and #2 across the Deep South Ranchlands and Rio Grande Valley, respectively (2016 ranked #27 wettest in both areas). Many areas receiving 12 to 20 inches of rainfall for the period, or two to four times the 20th century spring average (4.5 to 6 inches). One pocket that often missed the significant rainfall was in the Lower Valley between Harlingen and Raymondville, where totals of 3 to 6 inches were right around the three month average. Notable rain events (often occurring with damaging winds and some hail) occurred between March 8-10, April 18-19, May 14-20, and May 30-31.

May 2016 (below, rainfall and percentage) like May 2015, was the month that put the majority of the region over the top with widespread areas of 200 to 300 percent of average, and pockets of 400 to 600 percent above average (across the ranchlands).

The Stormy

Severe weather season – when damaging windstorms, hailstorms, and lightning storms are most common across the Rio Grande Valley – typically occurs from late March through mid-May. 2016's stormy season generally fit into the mold, with the first isolated minor hail events occurring as part of an unusual upper level disturbance that dove deep into Mexico between March 8th and 10th . Localized minor wind damage and quarter sized hail occurred in the mid Valley, between McAllen and Linn/San Manuel. April brought lightning storms that took out power to portions of the Lower Valley, along with pockets of gusty winds and quarter sized hail, on the 18th and 19th

Less than a week later, a supercell thunderstorm drove southward through Kenedy County behind an exiting upper level disturbance, and produced golfball sized hail from the King Ranch through northern Willacy County on April 24th .

The more notable events waited until May. Between May 14th and 20th, a combination of wind and hailstorms, as well as some flooding rains, occurred. More than three dozen homes in *colonias* east of Edinburg sustained roof, carport, and other damage when 60 to 65 mph winds surged through in a quick-hitting microburst during the afternoon of the 14th. On the 16th, hailstorms pounded rural Jim Hogg, Zapata, and Starr County. Fortunately, populated areas were spared, but hail up to 2" in diameter was observed in El Sauz and near Rio Grande City. The big one waited until the 31st, when an individual cell along a broken line of storms intensified and dropped a long-lived downburst with 85 to 95 mph estimated winds from south Mission to Hidalgo. The fun wasn't *quite* done with the start of June; bands of morning thunderstorms on June 4th dropped up to 2.5 inches of rain from San Benito to Harlingen, and 60 mph wind felled trees in Rancho Viejo.

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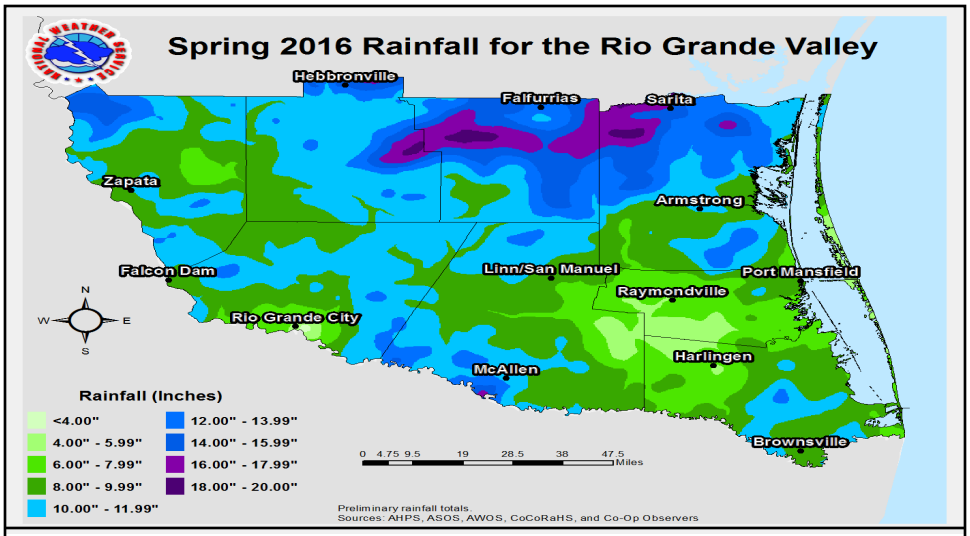
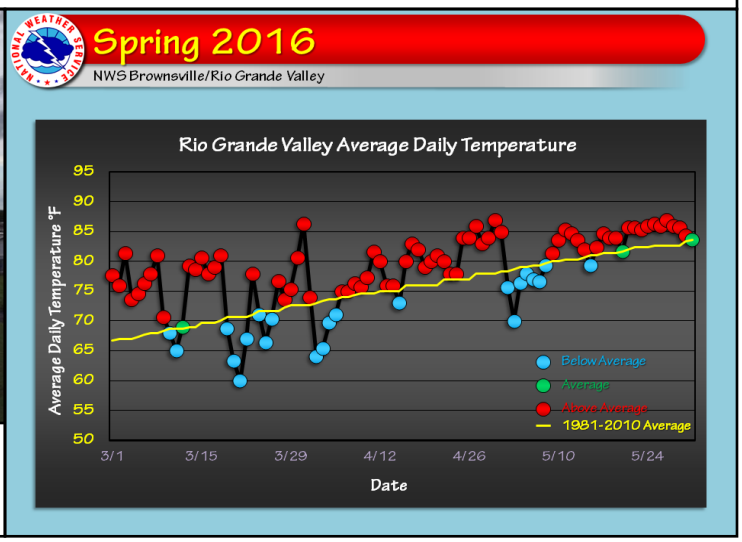


Rainfall totals (above) and average temperatures (below) for March-April-May across the valley.

Widespread wind damage to Chimney Park mobile home/RV community south of Mission, Texas, after May 31st downburst.



Rio Grande Valley Weather Summary

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The Warm and the Dirty

While the long-term spring forecast for March to May largely panned out for rainfall potential (a 35 percent probability of above average for the region), the forecast for below average temperature (37 percent probability of below average) fell short again by a long shot. Persistent southerly flow of tropical air and cloud cover kept nights warm on most days, and heat and humidity by day became an issue in April and May. The southerly flow brought abundant pollutants (known as Fine Particulate Matter, or varying levels of smoke, dust, and dirt) from industrial and agricultural burning in southern Mexico and Central America on a number of days between March and May, with several bouts of air quality that was "unhealthy for sensitive groups". Often, pollutants became trapped under a strong subsidence inversion and peaked by late morning. The worst day was March 31st, when air quality reached 155, or unhealthy for all groups. By the end of spring, temperature departure from average was 2 to 4°F – a far cry from below normal once again.

El Niño…Or Not?

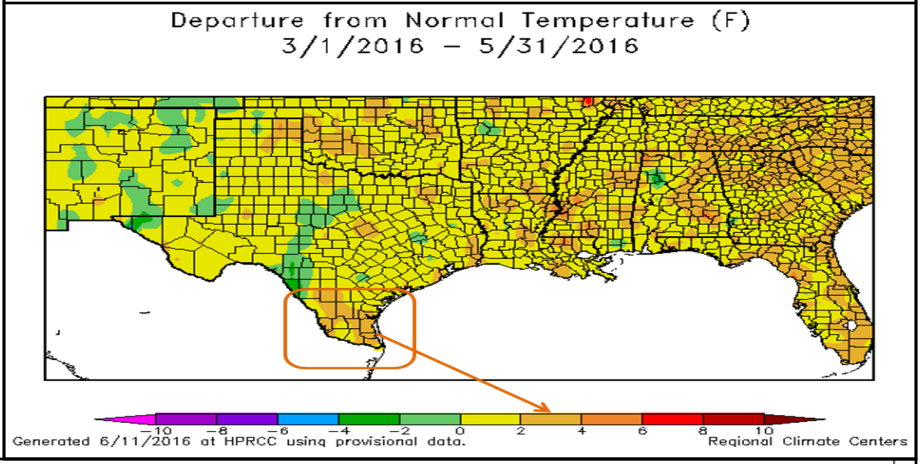
Despite the hype of El Niño, the warm phase of the oscillation had little to do with the spring 2016 outcomes. In fact, the general pattern was not too different across the southwest U.S. than in 2015, when El Niño was just getting started. Unlike 2015, when the rain was more pronounced across all of Texas, including the Valley, rain was a bit less so in 2016. The flow pattern was a smidge more amplified in 2015 than 2016, but the jet stream "dip" was similar.

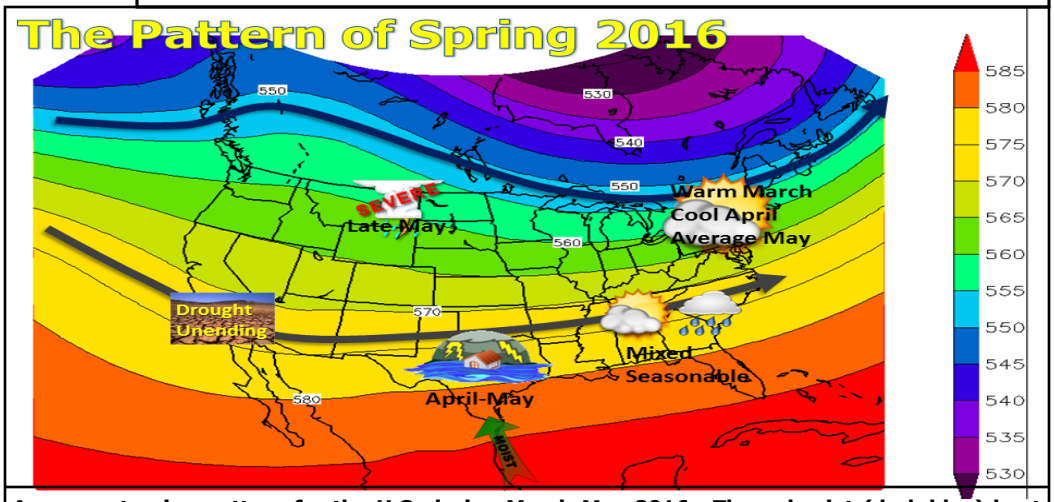
In 2016, nearly all of the systems that caused the hazardous weather in the Valley originated from the temperate (mid-latitudes) of the eastern Pacific, and "dipped" into the southwest U.S. where they moved slowly but were able to pull in sufficient atmospheric moisture ahead of them, on which the disturbances would "trigger" the combination of lightning, wind, hail, and flooding rainstorms. Put another way, a full-on El Niño impact that overwhelms all other factors brings above normal rainfall from southern California through parts of Texas into Florida.

In 2016, only the eastern half of that area saw the expected rains; severe to exceptional drought remained across southern California, much of Arizona, and western New Mexico.

Location	Rainfall (inches)	Departure
Sarita 7 E	10.44	+4.82
McAllen/Cooperative	9.17	+4.77
McAllen/Miller	8.33	+3.71
Falfurrias (Cooperative-west)	8.22	+2.52
Brownsville/SPI Int'l Airport	8.11	+2.70
Edinburg Cooperative	7.75	+2.61
La Joya	7.28	+3.62
Falcon Dam	6.67	+2.35
Port Mansfield	6.16	+0.98
Rio Grande City	5.94	+1.69
Harlingen/Cooperative	5.00	-1.74
Harlingen/VIA	4.98	-0.47
Santa Rosa	4.92	+0.23
South Padre Island	3.76	-1.80
Weslaco 2 E Cooperative	3.70	-1.36

Rainfall totals for March-April-May 2016 and departure from 1981-2010 average.





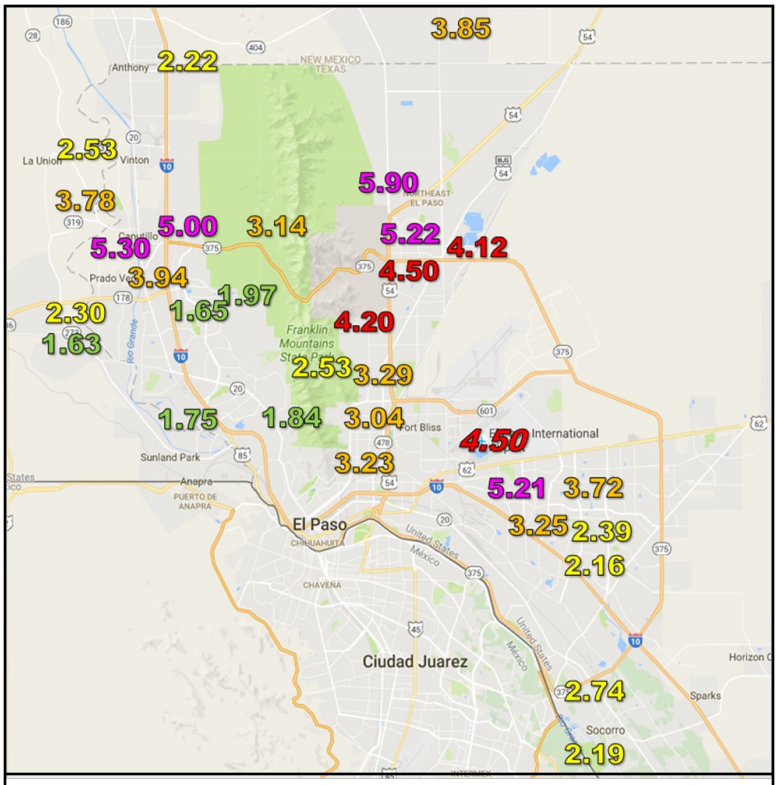
Average steering pattern for the U.S. during March-May 2016. The polar jet (dark blue) kept cool air out of the west, but allowed some to enter into the Northeast and Midwest in late April and May. The subtropical jet generally remained well south of the U.S. but was "tapped" by the flow (gray arrow) that dipped into the southwest U.S., peaking in Texas (green "moist" arrow).

El Paso region Weather Summary

By Mike Hardiman
National Weather Service- El Paso, TX

Far West Texas saw a slow start to the Monsoon Season, with spotty precipitation in July. The official climate station at the El Paso International Airport picked up only 0.24 inches for the month, just 15% of normal. No CoCoRaHS observers in El Paso County had more than an inch of rain in a single day in July. The highest 24-hour precipitation report in the city for July was 0.58 inches on July 25th, in Central El Paso just north of Memorial Park. Out in Hudspeth County, Salt Flat reported 1.50" on July 2nd. Most monthly totals across El Paso and Hudspeth County were under an inch as well.

Enhanced upper level moisture in August led to an improvement in rainfall across most of the area, but it remained spotty in El Paso, with areas east of the Franklin Mountains seeing the most rainfall. The Monsoon Season Totals from June 15th through August 29th ranged from just over an inch and half over much of the west side to over 5 inches in the northeast. The area around Canutillo was the exception on the west side. The map at right shows the varying amounts of rainfall around the city from June 15 to Aug 29. While the official station at the airport was running slightly above normal with 4.50 inches, CoCoRaHS observers were able to fill in the gaps and help tell the whole story. Those on the west side can take some comfort in the fact that how *little* rain you received can be just as important as how *much*.



El Paso area rainfall from June 15th to August 29th, 2016. Heaviest totals fell north of downtown along Loop 375 between I-10 and US 54.

Hudspeth County Rebounds

Much like their neighbors to the west, Hudspeth County saw rainfall far below normal through July. But the increase in moisture in August brought a much-needed rebound to most areas. Jerry and Kit Bramblett dutifully collect rainfall reports via phone from ranches in much of southern Hudspeth County. They report that grazing land west of the Diablo Mountains was looking bleak by early August, but additional rainfall caused a quick green-up by month's end. Heavy rainfall south of the Quitman and Eagle Mountains late in the month sent the Rio Grande over flood stage downstream in Candelaria.

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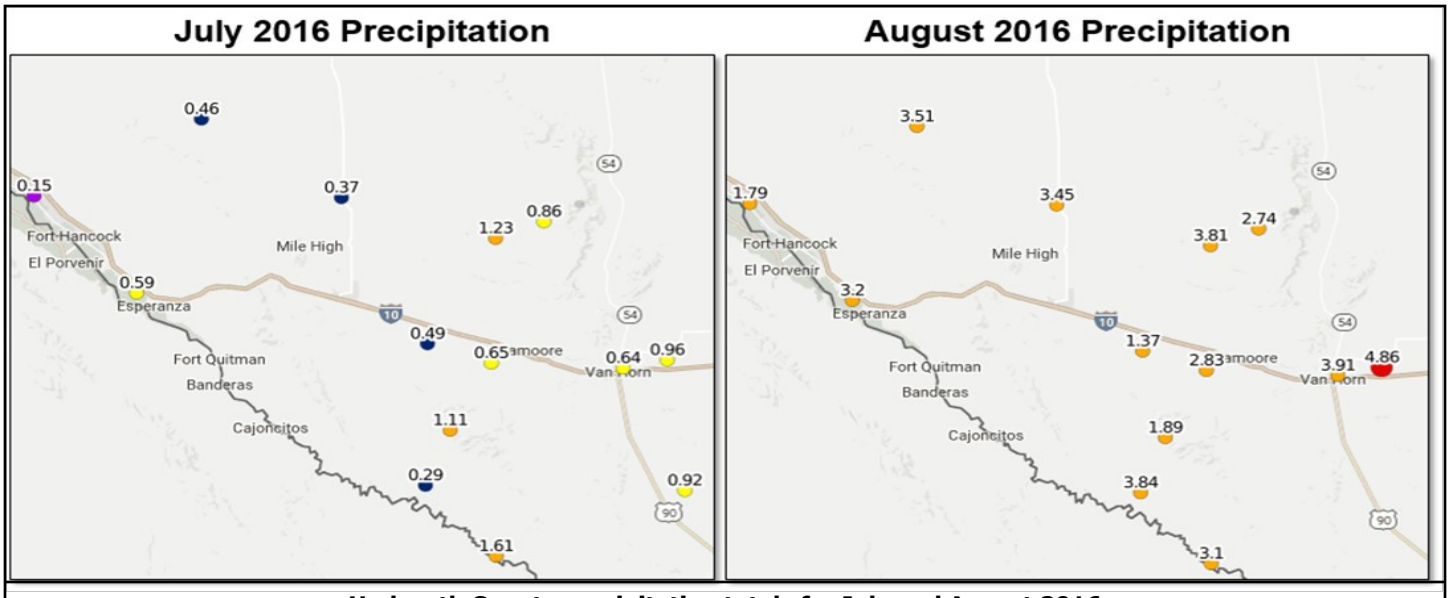


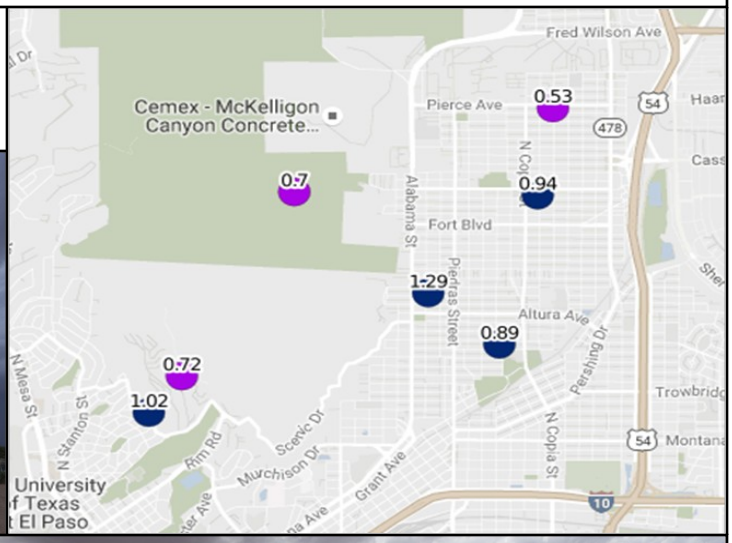
Hudspeth County precipitation totals for July and August 2016

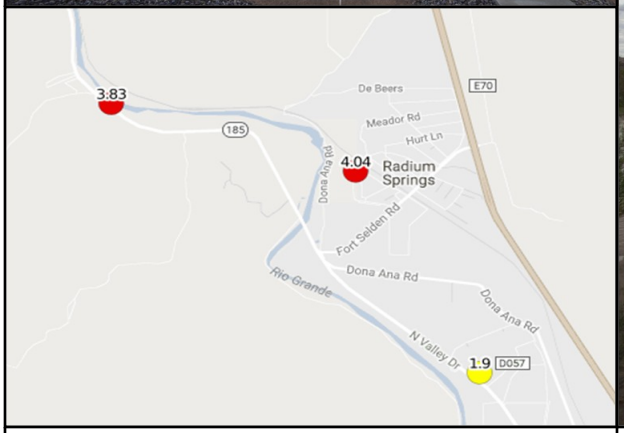
El Paso region Weather Summary

Flash Flooding August 27th

An upper level trough interacted with Monsoonal Moisture on August 27th, with the increased wind shear helping to create more organized thunderstorms on August 27th. A rare squall line affected the El Paso Area towards dusk on the 27th, developing over the Upper Valley before sweeping east across the city. The storm was fairly fast-moving, especially for this time of year, but intense rainfall focused itself on the SE side of the Franklin Mountains, causing flash flooding across the Manhattan Heights neighborhood. Once again CoCoRaHS observers proved their value as the official reporting station at the airport only picked up 0.33 inches, while CoCoRaHS observers in the heart of the flooding area reported 0.89 to 1.29 inches, most of which fell in about 15 minutes.

Above: High water on the Rio Grande floods the trail system north of Canutillo, TX on August 23rd.
Below right : CoCoRaHS Precip Reports for the 24hr Period ending the morning of August 28, 2016
Below left: Squall Line near the El Paso National Weather Service office





Heavy rainfall on the afternoon of August 21st near Radium Springs, NM sent a large volume of water into the Rio Grande.

High water on the Rio Grande floods a Park in Sunland Park, NM, just next door to El Paso, TX.

Rain and Flooding across South Plains region

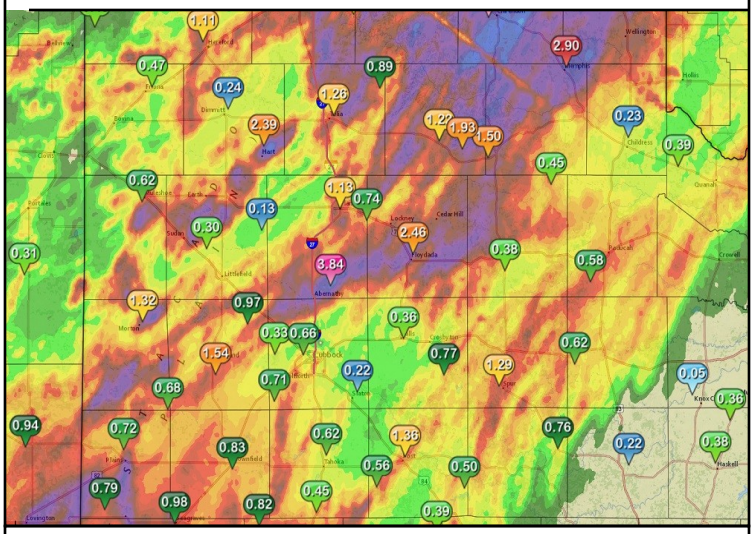
By National Weather Service-Lubbock TX

The combination of deep moisture moving in from the south, and a slow-moving storm system coming in from the west, brought a period of stormy weather to the region. Most of the area saw at least a quarter inch of rain through the period. In general, the storms moved pretty slowly, and the activity tended to track in a southwest to northeast pattern, bringing repeated rounds of rain to some locations. Narrow swaths across the area saw more generous rainfall, from about 2 to 5 inches in some locations. As can be seen in the map below, heavier rain was more widespread across much of Floyd, Briscoe and Hall Counties.

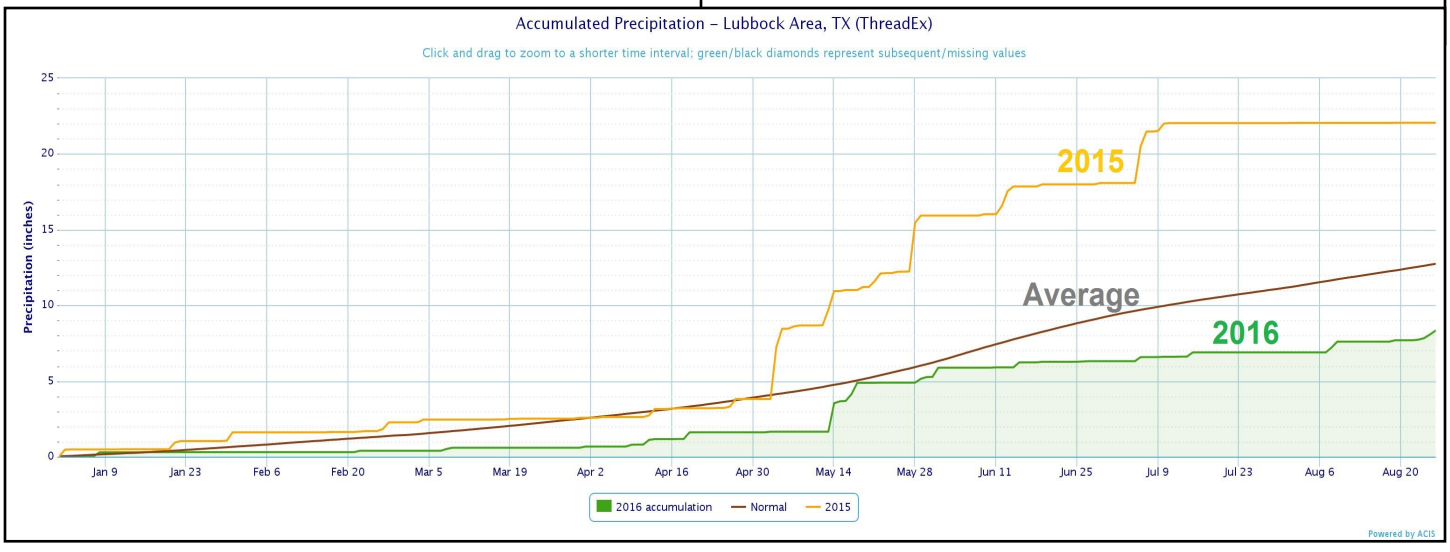
Some severe weather was reported as well. On Tuesday the 23rd, several wet microbursts produced severe wind gusts near Abernathy, Levelland and Paducah, causing some minor damage. The storm near Abernathy was part of a line of storms that movesd slowly across northwest Lubbock and southern Hale Counties. One of the storm cells dropped very heavy rain in Shallowater, which caused some street flooding as can be seen in the photograph below.

As of 8 pm CDT on August 26th, Lubbock has received 8.23 inches of precipitation, which is about 4.5 inches less than the amount that usually falls through this time of year. The graph below shows how except for a wet period in May, rain has been pretty scarce this year. Of course, this is measured at the Lubbock airport, and areas across the South Plains (including right around the city of Lubbock) have received significantly higher amounts.

Above: Flooded road in Shallowater, Texas on August 23, 2016 Photo Courtesy of Bruce Haynie via NWS Lubbock.

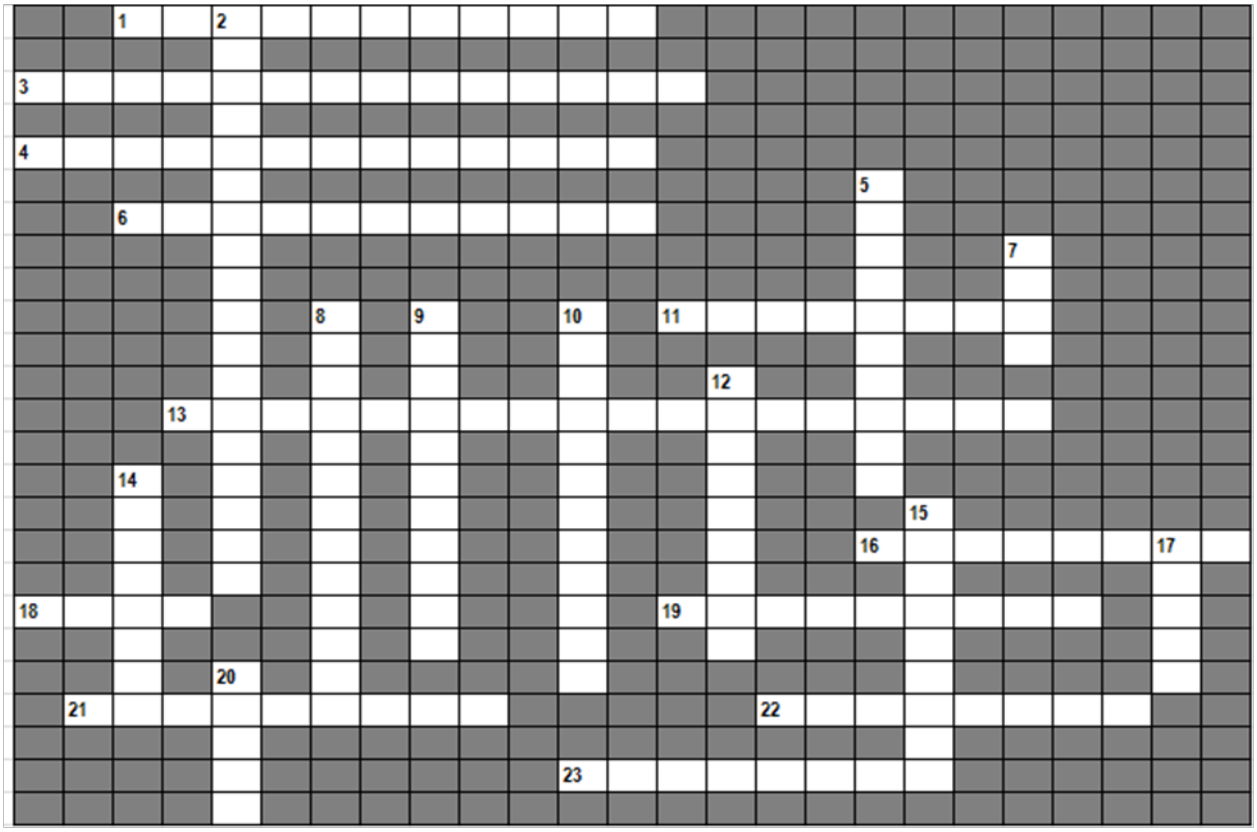


Above: Rainfall totals from Tuesday August 23rd through Friday, August 26th.



CoCoRaHS Crossword Puzzle

Test your knowledge of CoCoRaHS and related scientific fields which use CoCoRaHS data in their professions with the following simple crossword puzzle. Answer the clues given correctly for the word answer, and then see is you can fill in the puzzle with the correct answers. Have fun. Answers to puzzle will appear in the 2016 Fall edition.



Down

2. This report allows an observer to send information directly to the NWS when heavy rain or hail falls.

5. What increment are the lines on the inner tube of the 4 inch diameter gauge read at?

7. This occurs in parts of Texas at times in the winter months.

8. An observer must do this when installing their post and mounting their gauge to measure accurate readings.

9. The study of weather is called this.

10. The name of the cloud on the front of the newsletter is called what?

12. This will make the inner tube overflow in a short period of time.

14. If you go more than 24 hours without a daily report you should enter what report for an observation.

15. A supercell thunderstorm can produce many of these during its track.

17. Which state was the fifth state to join CoCoRaHS?

20. An amount of rainfall less than 0.01" is called what?

Across

1 This is taken daily at 7am by CoCoRaHS observers.

3. Daily reports of zero rain are very important for this to be mapped across the U.S.

4. Any water in a liquid or solid form that falls from the sky is called?

6. The study of climate is called this.

11. In what state did CoCoRaHS begin?

13. A type of warning issued for large hail falling or winds greater than 58 mph.

16. These are very important to users looking at reports of CoCoRaHS data.

18. Thunderstorms can have this object fall from them which can cause serious damage.

19. Thunderstorms produce this across the sky or to the ground?

21. The study of water in the atmosphere, earth's surface, and in the soils and rocks is called this?

22. What happens in low lying areas when high rainfall rates occur?

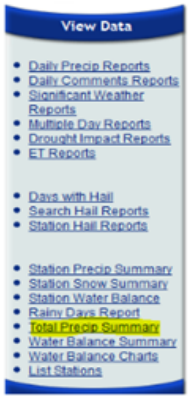
23. An observer always reads the inner tube of the gauge at the bottom of this

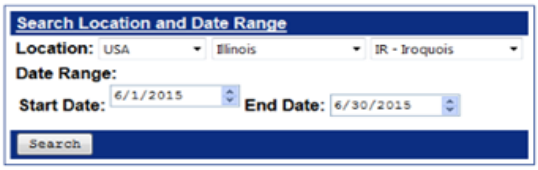
Training Section: Looking at Monthly Precip Totals

Here is how to look at all monthly totals for stations in a county (or the entire state) to be able to compare measurements.

The option Total Precip Summary will do this for you. Click on 'View Data' from the menu at the top of this page. You will find 'Total Precip Summary' in the third group of options in the menu, or click here. Once the selection page appears, enter the date range, and select a county from the list if you don't want the entire state. If you select the entire state for a month it will take a few seconds for the data to be compiled and displayed. Once the data displays, you can sort precip amounts in ascending or descending order by clicking on the column header. You can also sort any of the other columns as well. Try sorting by "# of reports", highest to lowest. This groups all of the stations with complete data at the top of the list.

The Total Precip Summary is a great way to see how precipitation varies across your county or the state. Give it a try!





4 Stations with 99 Reports over 30 Days

Station Numbers	Station Name	Daily Precip Sum in.	Multi-Day Precip in.	Total Precip in.	Daily Snow Sum in.	# of Reports	Latitude	Longitude	Multi-Day Overlap Warning
IL-IR-2	Ashkum 5.6 E	17.29		17.29	0.0	30	40.8783798	87.84622	
IL-IR-9	Sheldon 2.5 NE	8.17	7.28	15.45	0.0	21	40.793143	87.5285	* Includes multi-day report starting on 5/25/2015
IL-IR-10	Buckley 0.2 SSE	6.62		6.62	0.0	18	40.5949135869741	88.0355186015368	
IL-IR-14	Watseka 6.9 WNW	11.82		11.82	0.0	30	40.800179	87.859526	

Click on station number to see the Station Precip Summary for this period and station.

Total precip accounted for in daily reports.

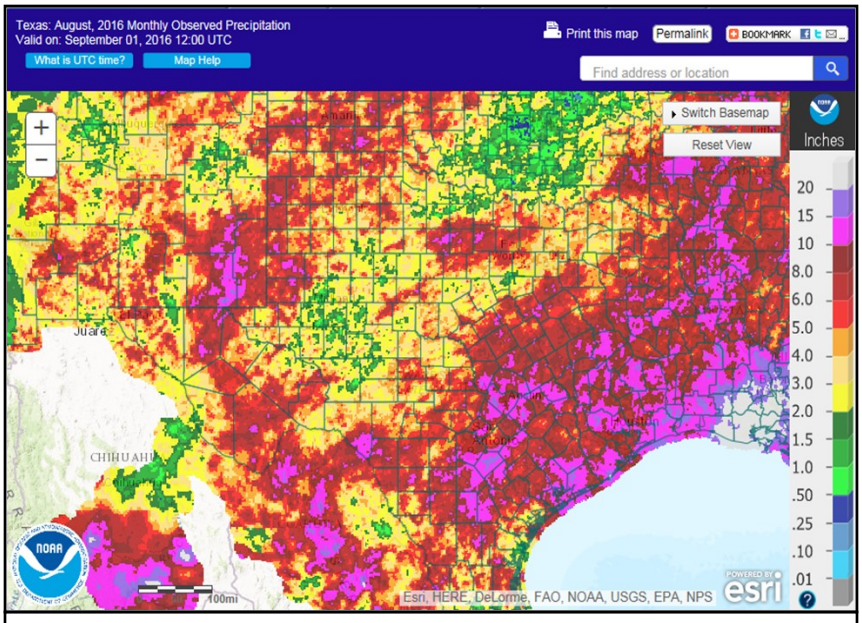
Total precip accounted for in multi-day precip reports.

There are a couple of other items to note. The multi-day overlap warning identifies instances where the beginning or end of a period of a multi-day accumulation is outside of the period, so the total precip may not be representative of what occurred during the period selected. Also, if the number of observations is greater than the number of days in the period selected (for example 32 days instead of 30 days in June), then there are, in this case, two days that have a multi-day and daily report for the same day. The most common cause for this is the observer entered the incorrect start date for the accumulation period.

August: One of the wettest ever for Texas

Texas observed one of its wettest August on record this summer after having a very dry July. Several areas in the state observed heavy rainfall and flooding from robust storms. Several stories in this edition were about heavy rain and flash flooding in August. The air mass across Texas was very moist in August from a consistent supply of very moist air from the Gulf of Mexico at the lower levels of the atmosphere. Add in lift from weak upper level disturbances and the perfect set-up for very heavy rainfall was in place in many parts of the state. These storms produced high rainfall rates and moved very slowly.

Texas received an average of 5.69 inches of rain statewide. This is the same amount as the previous record high average in 1914. The heaviest rainfall areas were mainly in east, central, southeast, and southern portions of the state. See map below. It is interesting to look at the average rainfall for August since the year 2000 and see all the very dry August average rainfalls from 2009 to 2015. This year the pattern in August was completely different than the state had over that 7 year period.



Radar estimated rain totals for August. Many areas of the state, especially the Gulf Coast region, received 10 to 15 inches of rain.

Training Tips: Observation Tips

Look for Completeness of Observations

You can easily check your observation at the end of the month (or during the month). On the View Data menu, select Station Precip Summary. If you report snowfall during the winter use the Station Snowfall Summary (it also includes precip). Type in your station number, select the date range (default is the month to date), and click "Get Summary". You will get a list of your observation for each day, and a sum at the bottom.

If you see a "*" in place of an observation - that indicates the amount for that day is part of a multi-day report (the next reported amount). If you see a "--" for your observation - that indicates the observation for that day is missing. Many observers only have one or two missing observations during a month, usually through oversight. You can enter those observations after the fact - late observations are always welcome - by selecting My Data on the top-line menu. The Daily Report screen will be displayed. Enter the data and the amount, then click "Submit".

06/22/2015	0.00
06/23/2015	**
06/24/2015	**
06/25/2015	2.70 *
06/26/2015	0.01

Multi-day total

06/16/2015	2.61
06/17/2015	--
06/18/2015	--
06/19/2015	0.16
06/20/2015	--
06/21/2015	0.13

Missing observations

There is one thing to be aware of when using this report. There is a small bug in the report. If you have a multi-day amount that spans the beginning or end of the month, the days included in that multi-amount will show as missing if you are looking at only the current month. If you expand your date range into the previous/next month, then the multi-day amount will be displayed and observations will be listed as **, indicating it is part of a multi-day total. Below is an example where the observer had a multi-day total that began on 6/30/2015 and ended on 7/8/2015:

Date	Precip in.
07/01/2015	--
07/02/2015	--
07/03/2015	--
07/04/2015	--
07/05/2015	--
07/06/2015	--
07/07/2015	--
07/08/2015	--
07/09/2015	1.04
07/10/2015	0.02

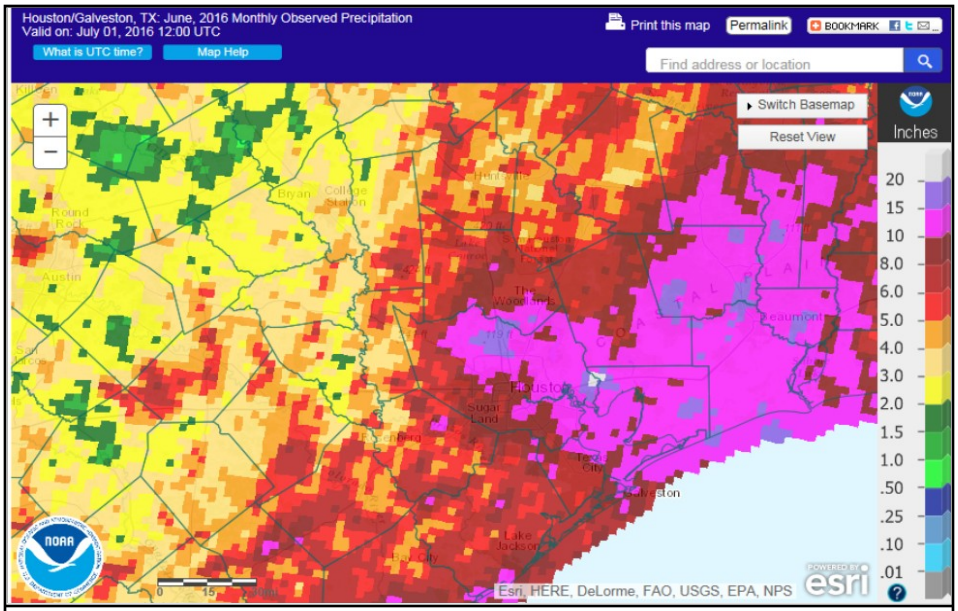
This Station Precipitation Summary lists observations for 7/1 to 7/10. The multi-day amount and the days included in that total are marked as missing.

06/27/2015	1.10
06/28/2015	0.00
06/29/2015	0.18
06/30/2015	**
07/01/2015	**
07/02/2015	**
07/03/2015	**
07/04/2015	**
07/05/2015	**
07/06/2015	**
07/07/2015	**
07/08/2015	1.72 *
07/09/2015	1.04
07/10/2015	0.02

We have now expanded the date range to include observations from 6/27 to 7/10. The multi-day amount is displayed for 7/8 and the days included in that total are marked correctly.

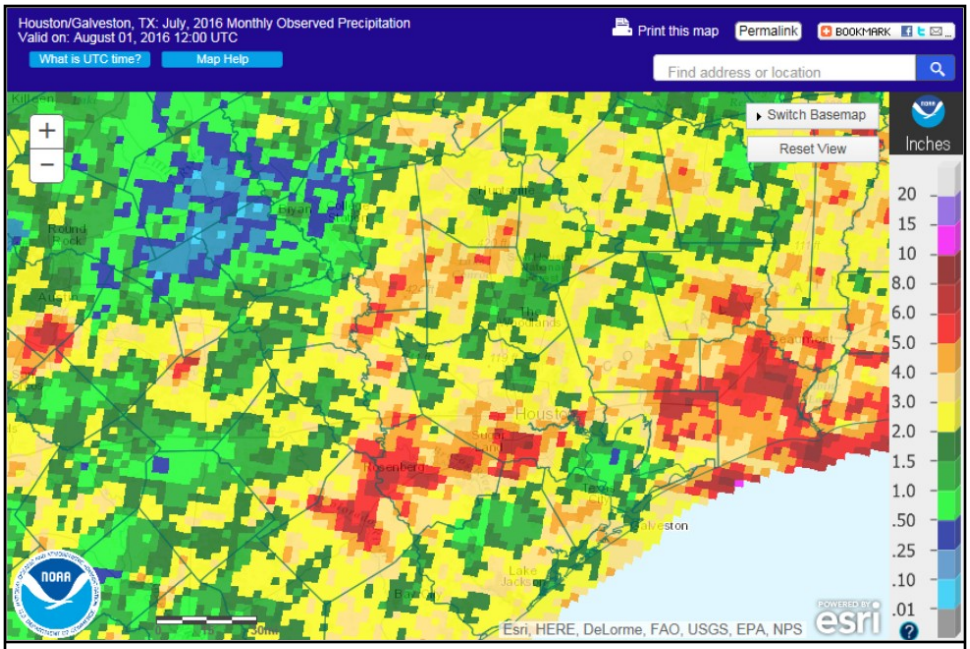
Houston-Galveston Regional Summary

June: The month of June started off with a continued stormy pattern across the region for the first half of the month. Most counties in the central and eastern areas of the region had from 11 to 17 days with thunderstorms and about 3 to 5 days with heavy rainfall. Galveston and Harris counties CoCoRaHS observers recorded an average county rainfall for each county well over 8 inches. The regional average rainfall for June was 5.23 inches per county. Drier conditions and warmer temperatures gradually began in the latter half of the month. The central and southeastern counties averaged well above normal rainfall and slightly less than normal temperatures while the northern and western counties had below average rainfall and near normal temperatures. Southwestern counties averaged near normal temperatures to slightly above normal. Rainfall in these counties was variable and isolated in nature with some areas receiving much above normal while other areas received less than normal rainfall. The sea breeze brought heavy rains in some locations in the coastal counties, a typical pattern in the summer along coastal counties. Rainfall map for June is shown above.



Radar estimated rainfall for the moth of June across Southeast Texas. Much of Harris County received between 10 to 15 inches, with a pocket of 15 to 20 inches in north-central Harris.

July: Much drier and hotter conditions prevailed across the region in July. The big story on temperatures was the 30 record high minimum temperature records set across the Houston area. Intercontinental airport had 9 of 11 nights with low temperatures of 80 degrees or higher from the 3rd through the 13th, 7 were for record high minimum temperature. Temperatures across the entire region were above normal with very high nighttime temperatures. Daytime highs were hot with high dewpoints combining for rather high heat indexes. Fort Bend County averaged over 4.91 inches of rain for the month of July from CoCoRaHS observer reports while nearly all other counties averaged below 2.75 inches of rain from CoCoRaHS observer rainfall reports. The low amounts of rainfall and very sunny days with high temperatures brought dry conditions across several counties in the region. Coastal areas were much below normal on rainfall. The only areas that didn't have below normal rainfall for July were Fort Bend County, northeastern Wharton County, southern parts of Harris and northeastern Galveston County. These counties had a few areas which were slightly above normal in rainfall mainly from afternoon sea breeze front storms.



Radar estimated rainfall for southeast Texas for the month of July. The heaviest rains fell across portions of Chambers, Jefferson, Fort Bend and Wharton Counties.

Houston-Galveston Regional Summary

Summer 2016 CoCoRaHS Houston/Galveston Region Rainfall

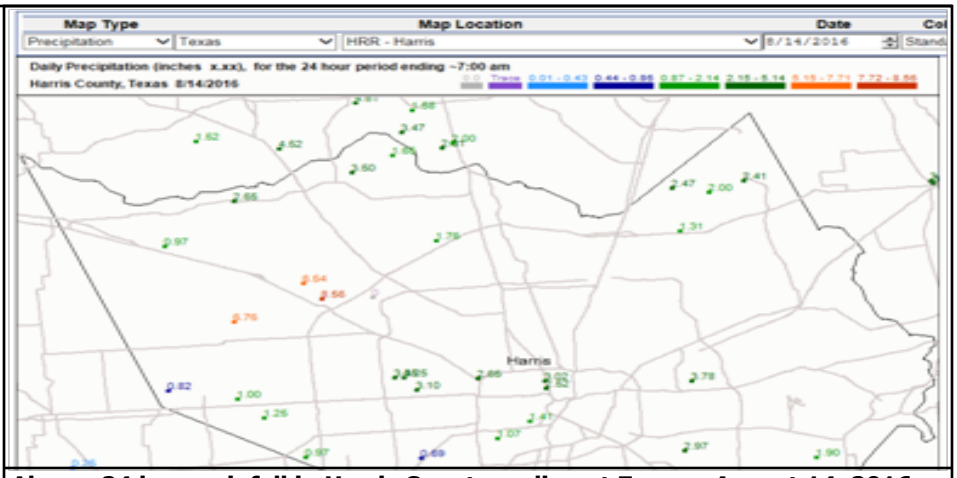
County Rainfall Average and County Station Rainfall Maximum Total in inches per month

County	June			July			August		Summer Total
	AVG.	MAX.		AVG.	MAX.		AVG.	MAX.	3-Month Rain Total
Austin	2.91	5.99		2.27	4.96		5.08	7.97	10.26
Brazoria	5.27	7.68		2.52	4.68		10.82	13.89	18.61
Chambers	N/A	13.27		N/A	1.99		N/A	9.17	N/A
Colorado	2.52	3.73		2.50	5.44		5.73	7.04	10.75
Fort Bend	4.69	6.78		4.91	7.23		6.55	8.65	16.15
Galveston	8.81	12.44		2.20	4.12		9.07	11.04	20.08
Harris	8.22	15.04		2.99	6.04		9.21	15.36	20.42
Jackson	N/A	8.94		N/A	3.51		N/A	11.53	N/A
Liberty	5.82	9.25		1.93	2.44		7.34	9.15	15.09
Matagorda	N/A	4.87		N/A	2.29		N/A	12.31	N/A
Montgomery	6.89	10.28		2.36	6.21		8.43	12.36	17.68
Polk	4.32	5.23		2.71	4.03		9.89	13.87	16.92
San Jacinto	3.37	3.58		N/A	0.73		N/A	4.32	N/A
Waller	N/A	2.95		N/A	2.30		N/A	5.43	N/A
Wharton	4.71	6.37		3.35	4.78		6.47	11.75	14.53
Region Totals	5.23	15.04		2.77	7.23		7.86	15.36	15.86

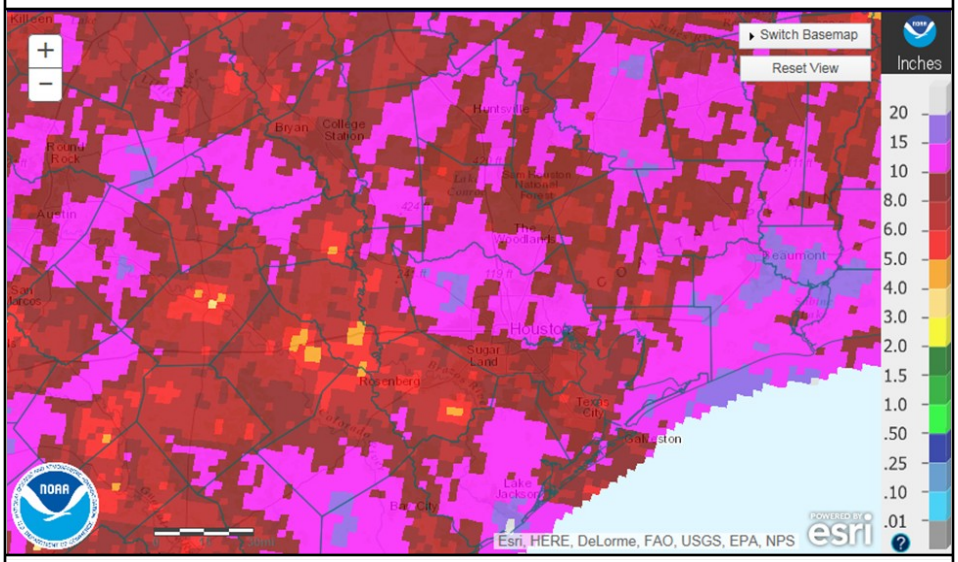
August Climate Summary

The month of August started hot and dry across the region for the first 11-12 days. Houston recorded highs at 100 or above from the 7th to the 11th. Several counties had very dry conditions with burn bans being issued across the region. From the 13th until the end of the month, abundant rainfall and cooler temperatures were prevalent across the region. Hobby airport in Harris County had measureable rainfall on 16 of the final 18 days of the month. All counties recorded above normal too much above normal rainfall for the month. The only exception was parts of southern Austin and eastern Colorado County which had rainfall totals slightly below average. The CoCoRaHS observer rainfall average for the month was 7.86 inches. On the night of the 13th -14th a rather intense area of thunderstorms settled in for the night over parts of northwestern Harris County. Amounts ranged from 4 inches to as much as 10 inches in a small area where the thunderstorm cells were stationary. The CoCoRaHS totals map for the morning on the 14th shows three stations which were under these heavy stationary cells.

Temperatures for the month averaged near normal across most of the region after the hot start to the month followed by cooler rainy conditions from the 13th to the end of the month.



Above: 24 hour rainfall in Harris County ending at 7am on August 14, 2016



Radar estimated rainfall for August 2016. Many areas received between 10 to 15 inches of rain.

NWS Corpus Christi Summer Rainfall totals

County	June		July		August		Summer Total
	Avg	Max	Avg	Max	Avg	Max	3-month rain total
Aransas	3.41	3.77	1.10	2.01	5.00	8.98	9.51
Bee	2.51	5.01	1.49*	1.49*	6.76	8.88	10.76
Calhoun	3.96	4.84	2.11	2.79	8.32	10.02	14.39
Duval	1.54	1.97	1.26	2.50	8.15	13.20	10.95
Goliad	2.89	5.11	2.06	4.38	6.37	8.31	11.32
Jim Wells	1.06	2.06	2.62	4.22	7.98	9.19	11.66
Kleberg	3.51	4.48	0.20	0.38	6.27	7.08	9.98
LaSalle	1.48	2.52	1.78	2.09	7.19	8.73	10.45
Live Oak	1.02	2.93	1.63	2.80	8.69	12.71	11.34
McMullen	1.19	1.14	2.31	2.56	8.70	9.93	12.20
Nueces	1.97	3.84	0.40	3.12	3.21	6.23	5.58
Refugio	2.27	4.78	1.81	1.91	4.51	5.78	8.59
San Patricio	3.00	4.92	0.41	0.64	2.99	4.15	6.40
Victoria	3.25	5.93	0.69	1.96	6.83	14.68	10.77
Webb	2.40	4.98	1.49	4.73	4.35	7.86	8.24

NWS Brownsville/Rio Grande Valley Summer Rainfall Totals

Month	June		July		August		Summer Total
County	Avg	Max	Avg	Max	Avg	Max	3-month rain total
Brooks	1.53	2.01	0.30	0.52	5.37	7.12	7.20
Cameron	3.74	7.67	0.42	1.29	1.04	2.66	5.20
Hidalgo	1.79	3.95	0.21	0.29	1.58	2.34	3.58
Jim Hogg	no data		no data		no data		no data
Kenedy	no data		no data		no data		no data
Starr	1.10	1.50	0.69	1.29	2.51	3.25	4.30
Willacy	2.56	2.56	no data		no data		no data
Zapata	no data		no data		no data		no data

* = only one station reported in that county

CoCoRaHS Webinar Schedule

Thursday, September 29, 2016 - 12PM CDT

Climate of the South-Central United States: Hot Spot for Extreme Events

Barry Keim, Luigi Romolo, and Alan Black
Southern Regional Climate Center
Baton Rouge, LA

This presentation will address the climate of the south-central United States, with particular emphasis on extreme events. The region gets way more than its fair share of extremes, including tornadoes, heavy rainfall, hurricanes and storm surge. Oklahoma has long been known as ground-zero for tornadoes, and our coastal zone has experienced some the most catastrophic hurricanes and surge events in the history of the western hemisphere. These extremes include the Galveston Hurricane of 1900, which is the still the deadliest natural disaster in U.S. history, and Hurricane Katrina, which is the most costly disaster in U.S. history. We will also focus on winter extremes as well, including ice storms and snowfall.

Thursday, October 20, 2016 - 12PM CDT

The COMET Program: Freely available online lessons in weather and the natural sciences

Matt Kelsch
Boulder, CO
Greg Byrd
Boulder, CO

Located in Boulder, the award-winning COMET Program has produced over 800 hours of online lessons in meteorology, hydrology, climate science, oceanography, and astronomy that are freely available to over 450,000 registered users in 190+ countries worldwide. These lessons range from very complex college-level training to more basic lessons geared for the public. We will highlight some of the more basic, highly visual lessons on various topics in the natural sciences. You will also see how CoCoRaHS reports are a vital part of ongoing research and how that relates to our training activity.

Central Texas Summer Weather Summary

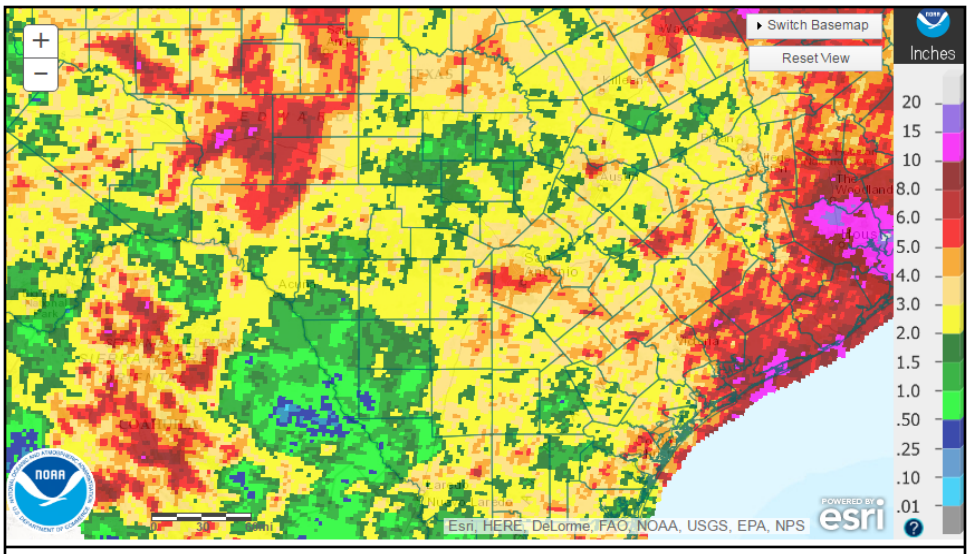
By Mark Lenz
NWS Austin/San Antonio

The summer across South Central Texas began on a wet note following a very wet spring across the region. By the second week in June the subtropical high pressure began to expand west across the southern portions of the United States. This weather pattern is very typical in the summer months and generally tends to keep the region warm with less rainfall. When the high shifts east or west then tropical moisture or even tropical cyclones can impact the area and often produce much needed rainfall. The Rio Grande plains did see an upper level low pressure area that lingered in the area for several days and this produced some localized heavy rainfall. Overall June ended up with slightly above average temperatures and below average rainfall. Del Rio actually saw above average rainfall and San Antonio experienced slightly below average temperatures.

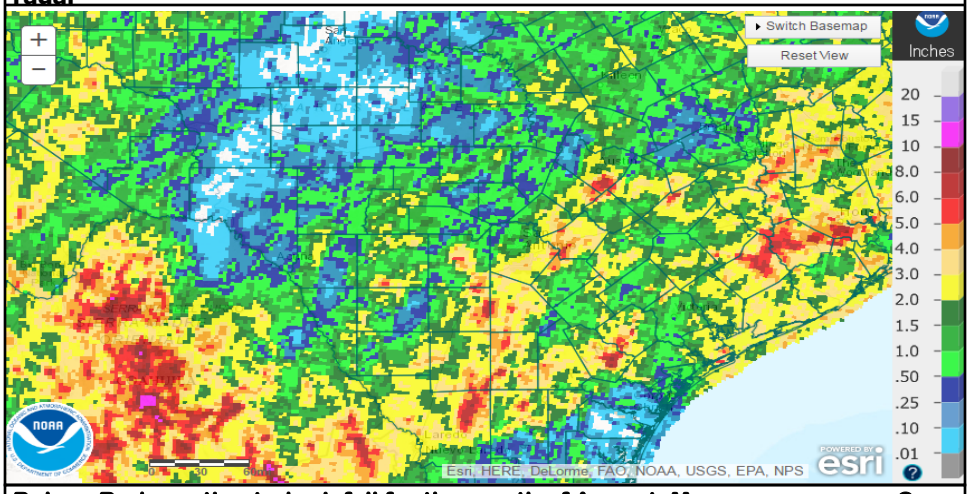
July began in a typical fashion with warm and fairly dry conditions across most of South Central Texas. Late in the month the upper level high pressure area moved north and allowed a disturbance to move westward across the area starting on July 25th. This helped to produce scattered showers and thunderstorms for three days. Locations along the Rio Grande missed out on the majority of the rainfall and saw little or no rain. Temperatures ended up above average and precipitation was below average. Austin Bergstrom International had the 4th wettest July on record while Del Rio had the 10th driest July. Del Rio ended the month being the 4th warmest on record, San Antonio was the 7th warmest and Austin Bergstrom was the 12th warmest.

August began slightly drier after the brief wet spell at the end of July. By the middle of August a fairly deep trough developed across the western United States and this combined with a surface boundary and upper level disturbances produced scattered showers

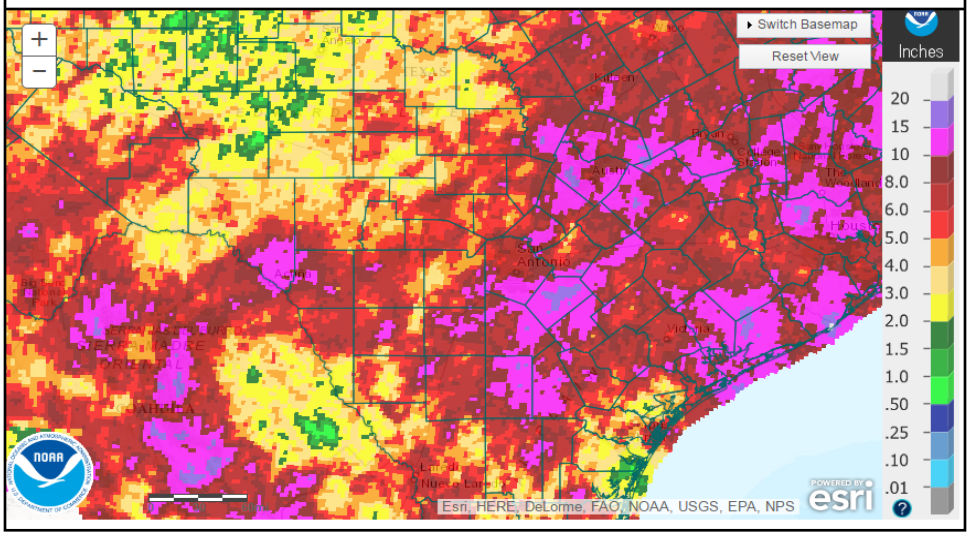
CONTINUED PAGE 15————->



Above: Precipitation totals for Central Texas for June 2016 as estimated by radar
Below: Precipitation totals for Central Texas for July 2016 as estimated by radar



Below: Radar estimated rainfall for the month of August. Many areas across Central and Southeast Texas received 10 to 15 inches of rain. With a few pockets of 15 to 20 inches in western Travis County, SE Williamson and coastal counties.



Central Texas Weather Summary

FROM PAGE 14—->and thunderstorms. These storms were slow moving and many dropped locally heavy rainfall of 4 to 6 inches. By the 20th another strong upper level trough, upper level energy and a surface boundary combined to produce widespread rainfall across the region. This rainfall event produced rainfall of 10 to 12 inches in several locations that lead to localized flash flooding. The heavy rainfall on saturated soils also produce runoff that sent rivers, creeks and streams into moderate and major flood levels in most river basins from the Rio Grande to the Colorado. This heavy rainfall was very unusual for August given that the causes were non-tropical. Overall temperatures were below average and rainfall was well above average. Several records were noted for August. Austin Bergstrom has the 2nd wettest, Austin Mabry had the 6th wettest, and Del Rio had the 3rd wettest. Overall, summer across the region had near or slightly above average temperatures and above average precipitation.

Above: San Antonio River at State Highway 72 near Rungle, Texas

Graphic showing how summer's rainfall ranks among the top 10 wettest.

Wettest Augusts on Record

National Weather Service Austin / San Antonio

San Antonio

Rank	Amount	Year
1	11.14	1974
2	9.42	1971
3	9.09	1892
4	8.55	1894
5	7.83	2001
20	4.83*	2016*

*Period of Record Aug 1885 – Aug 25, 2016

Austin Mabry

Rank	Amount	Year
1	9.48	2001
2	8.90	1974
3	8.81	1996
4	8.50	1994
5	7.75	1914
6	6.66*	2016*

*Period of Record Aug 1892 – Aug 25, 2016

Del Rio

Rank	Amount	Year
1	20.93	1998
2	11.32	2008
3	8.82*	2016*
4	6.10	1971
5	5.89	1932
6	5.74	1972

*Period of Record Aug 1906 – Aug 25, 2016

Austin Bergstrom

Rank	Amount	Year
1	8.91	1966
2	7.94	1969
3	7.79	1974
4	7.75*	2016*
5	7.32	1971
6	6.17	1991

*Period of Record Aug 1943 – Aug 25, 2016

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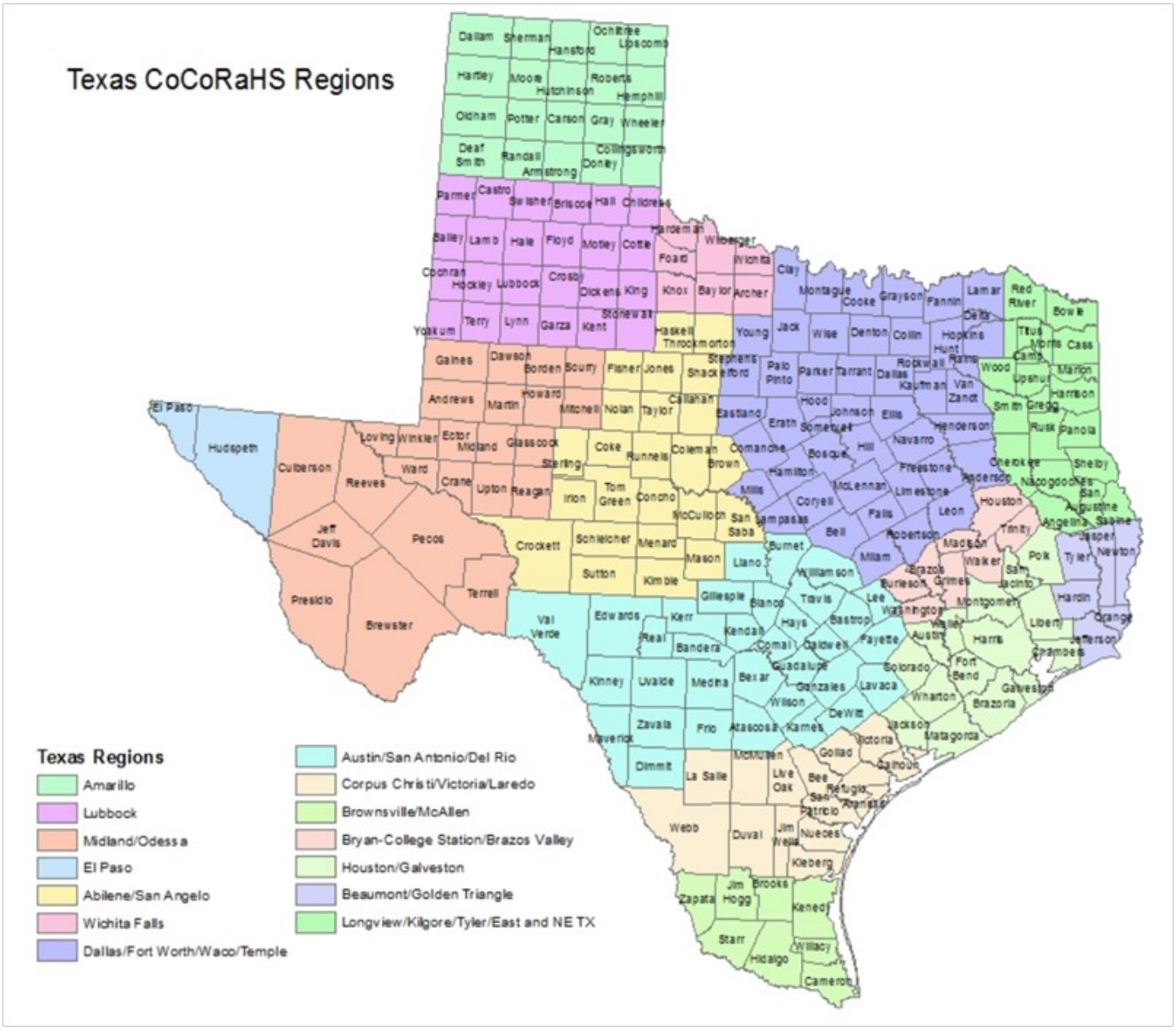
Texas CoCoRaHS Regions



Texas CoCoRaHS Observer

The official newsletter of Texas CoCoRaHS

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Texas CoCoRaHS
CoCoRaHS of South Texas

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