



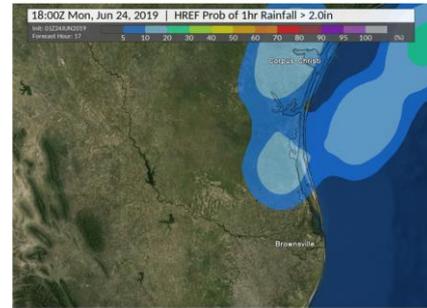
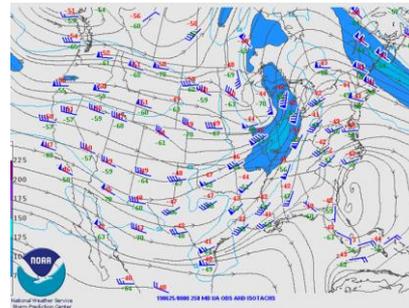
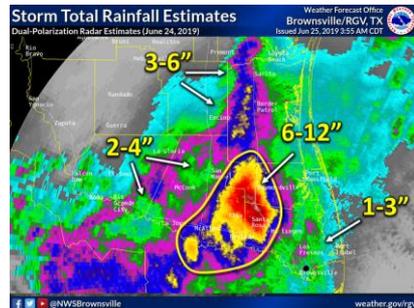
The Future Is Here: Incorporating Mesoscale Forecasts Into Predictions for a Flood Disaster in the Rio Grande Valley of Texas



**NATIONAL
WEATHER
SERVICE**

JANUARY 15, 2020

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Alex Lamers, NOAA/NWS Weather Prediction Center, College Park, MD



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HREF 00Z/24 Jun Run

Naming Conventions

South Texas Border Region

Weather Forecast Office
Brownsville/RGV, TX
Issued Dec 20, 2018 1:28 PM CST

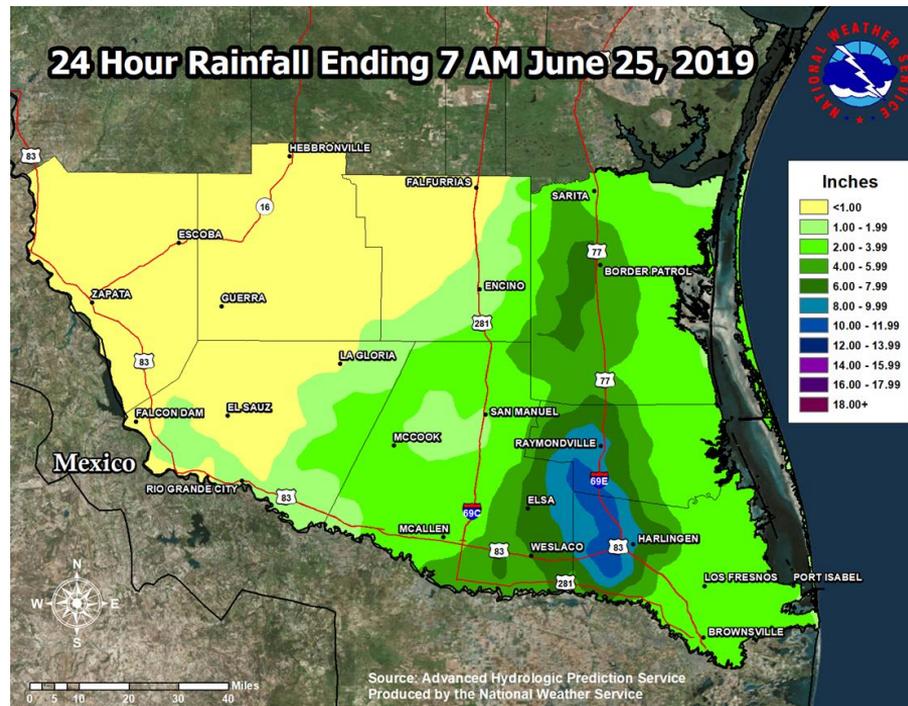


@NWSBrownsville

weather.gov/rgv

Event Overview: Great June Flood, the Sequel

- 8 to 15 in (20.32 to 38.1 cm) fell in six hours (right). This ranged from a 1/100 to a 1/1000 per year event.
- Nearly 1200 homes considered “destroyed”; 1500+ impacted
- Initial individual assistance damage estimated at \$27.6 million; event damage likely \$50 to 100 million
- More than 100 persons evacuated to safe ground
- New daily records set at most Rio Grande Valley locations



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Event, In Photos (Taken 25 June, 2019)



Northwest Harlingen, Texas



Raymondville, Texas



Elsa, Texas



Raymondville, Texas



Harlingen, Texas



Monte Alto, Texas

Credits: Texas Division of Emergency Management, National Weather Service

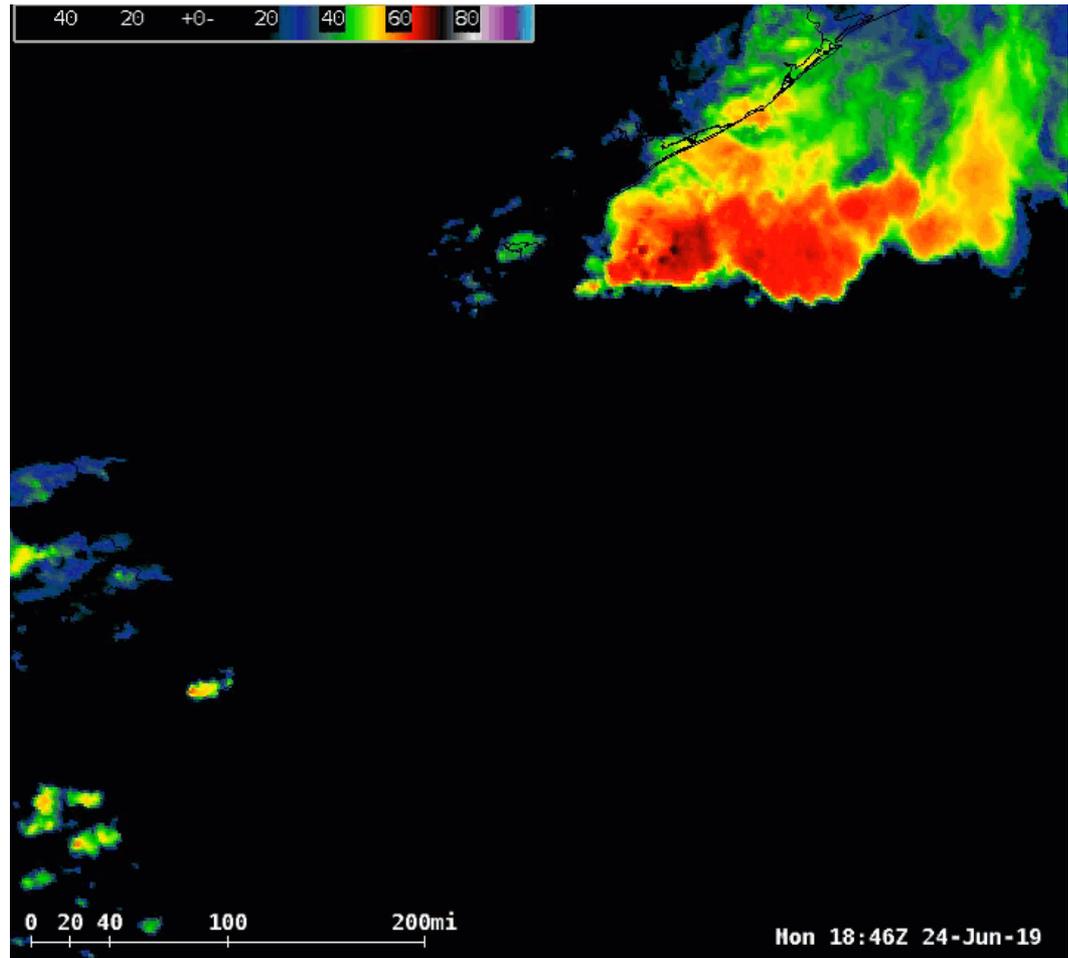


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Satellite

1846 UTC 24
June – 0431 UTC
25 June

(1346 through
2331 CDT 24
June)



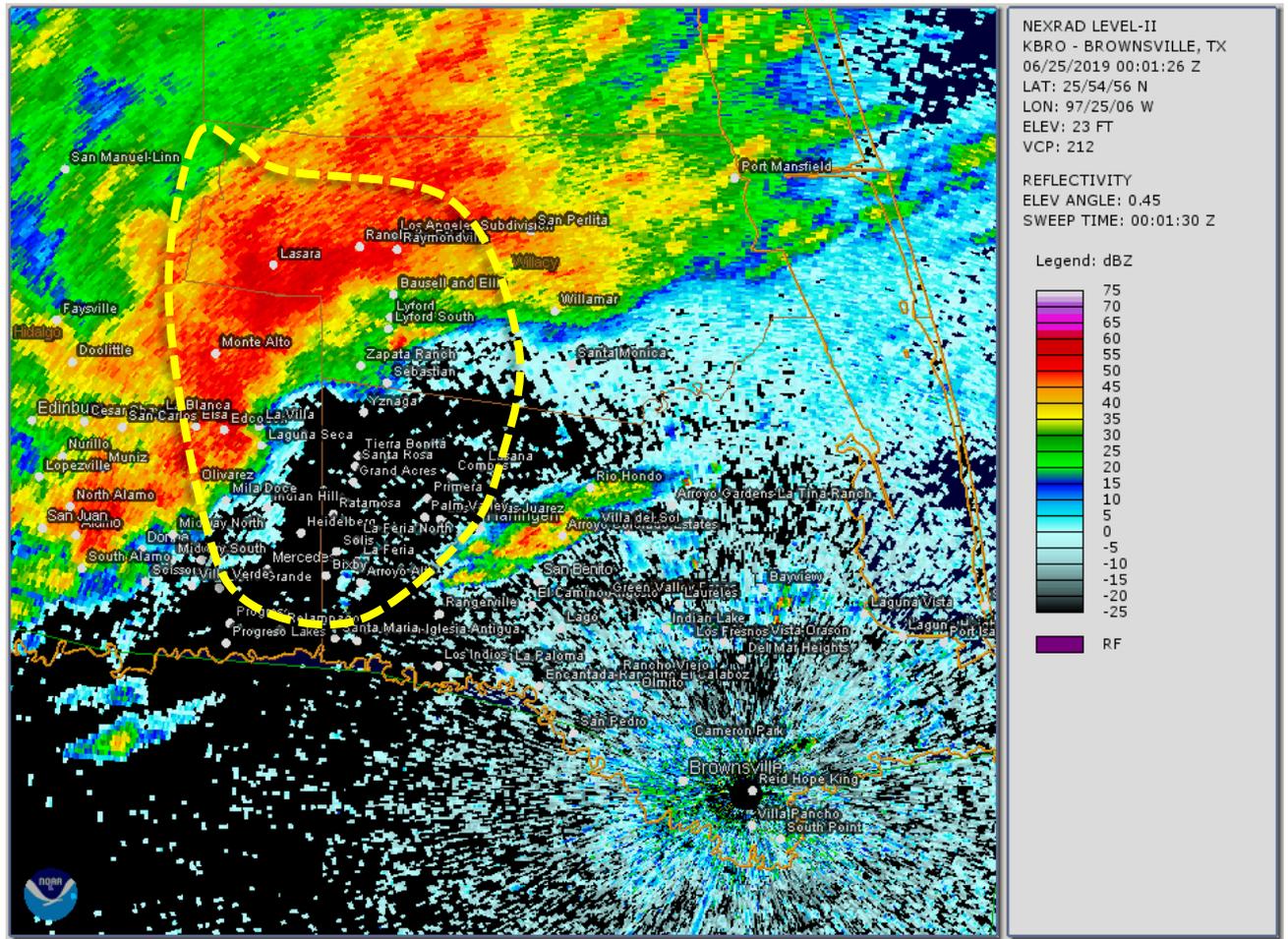
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Radar

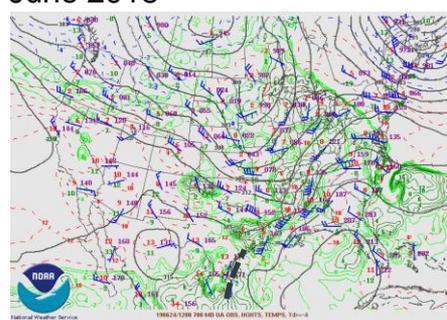
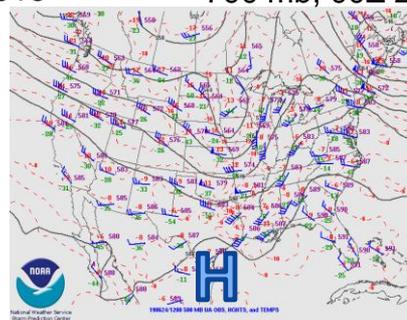
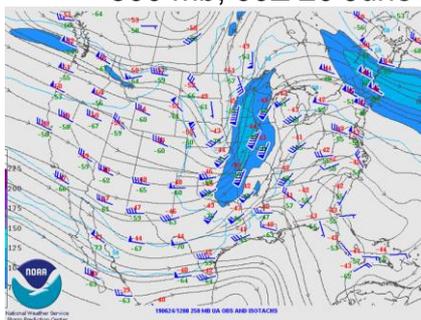
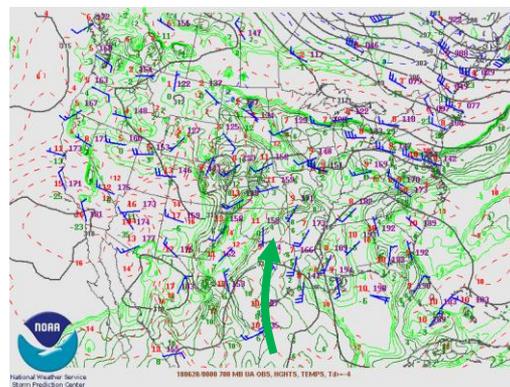
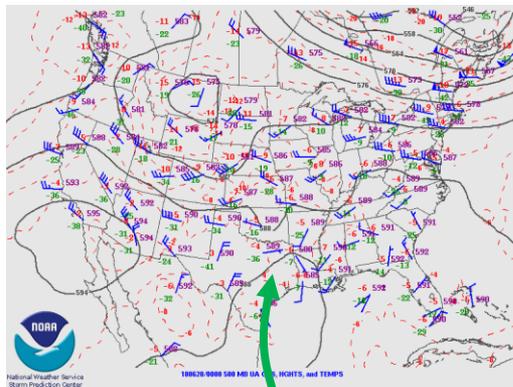
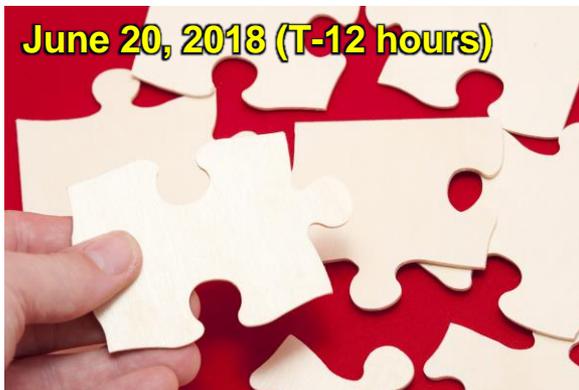
1905 UTC 24
June – 2356 UTC
24 June

(1405 through
1856 CDT 24
June)



Synoptic Contrast Between 2018 and 2019

2018 Flood Report: https://weather.gov/rgv/2018event_greatjunefflood



“Traditional” Model Output Statistics (MOS) Guidance Was of Little/No Help...

Harlingen – 12Z 23 Jun	Valid 00Z/25 Jun	Valid 06Z/25 Jun	Valid 12Z/25 Jun
PoP - GFS	11%	5%	5%
PoP - NAM	23%	7%	4%
PoP – Nat’l Blend	14%	24%	21%

Harlingen – 12Z 23 Jun	Valid 00Z/25 Jun	Valid 06Z/25 Jun	Valid 12Z/25 Jun
QPF – GFS	0	0	0
QPF – NAM	0	0	0
QPF – Nat’l Blend	0	0	0



“Traditional” MOS Guidance Was of Little/No Help...

Harlingen – 00Z 24 Jun	Valid 00Z/25 Jun	Valid 06Z/25 Jun	Valid 12Z/25 Jun
PoP - GFS	7%	8%	11%
PoP - NAM	15%	6%	2%
PoP – Nat’l Blend	27%	27%	21%

Harlingen – 00Z 24 Jun	Valid 00Z/25 Jun	Valid 06Z/25 Jun	Valid 12Z/25 Jun
QPF – GFS	0	0	0
QPF – NAM	0	0	0
QPF – Nat’l Blend	0.03	0.07	0.04



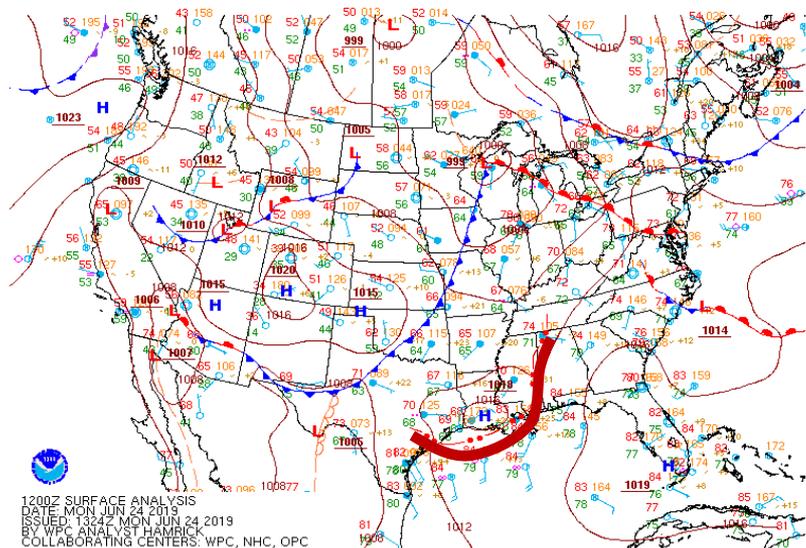
“Traditional” MOS Guidance Was of Little Help...

Harlingen – 12Z 24 Jun	Valid 00Z/25 Jun	Valid 06Z/25 Jun	Valid 12Z/25 Jun
PoP - GFS	14%	21%	22%
PoP - NAM	55%	20%	5%
PoP – Nat’l Blend	25%	33%	27%

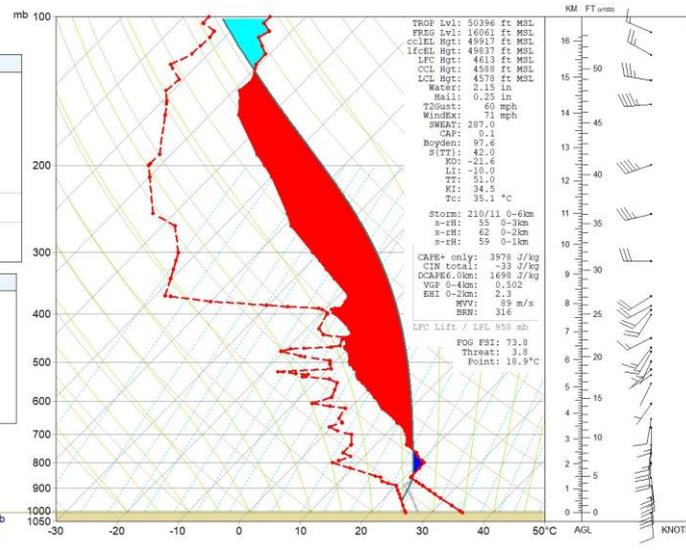
Harlingen – 12Z 24 Jun	Valid 00Z/25 Jun	Valid 06Z/25 Jun	Valid 12Z/25 Jun
QPF – GFS	0	0	0
QPF – NAM	0.25-0.49”	0	0
QPF – Nat’l Blend	0.17”	0.24”	0.05”



...But There Were Signs of Trouble



1200 UTC/24 Jun WPC Surface Analysis; note outflow boundary along N. Gulf Coast

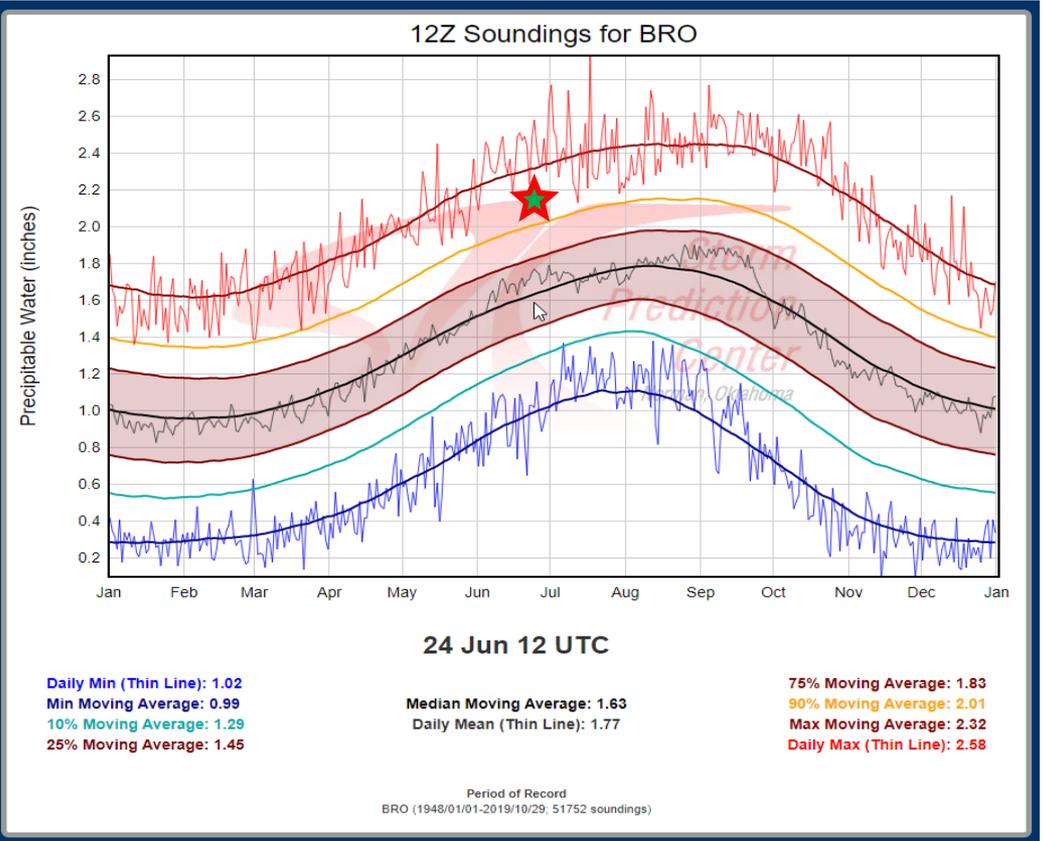
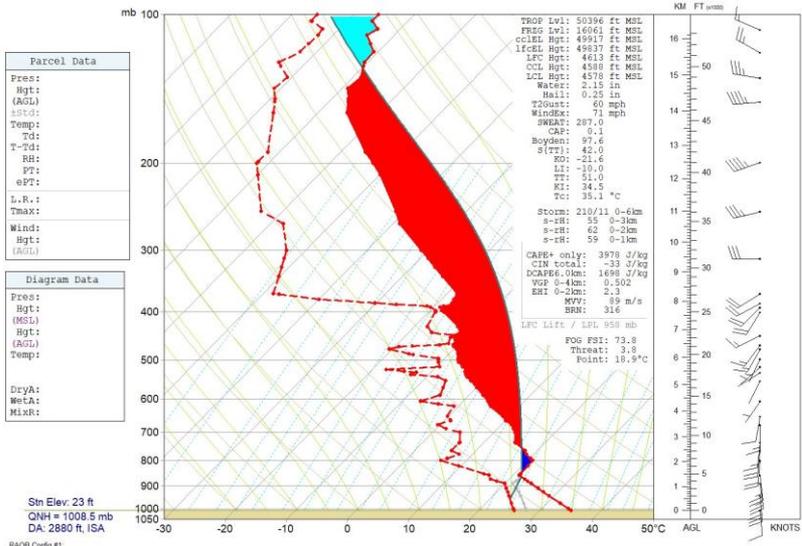


Modified 1200 UTC/24 Jun Brownsville sounding

- **Actual high 97°F.**
- **MLCAPE ~4,000 J/kg**
- **Precipitable Water = 2.15"**
- **Warm-cloud depth ~ 11.5 kft.**



Signs of Trouble: Sounding Comparison

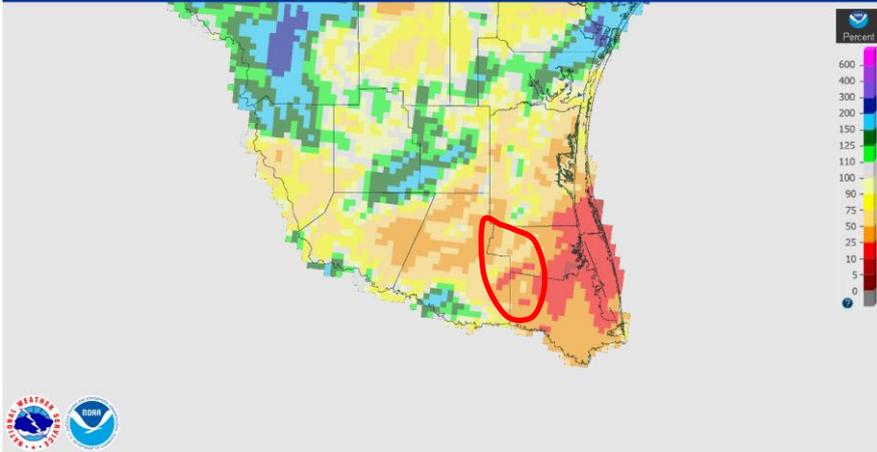


- Note the Precipitable Water (2.15", ★) is between the 90% and max moving average
- This adds another "piece" to the puzzle for potential flooding rainfall

Not Enough (Traditional) Confidence to Mention Flash Flooding on 23 June or early on 24 June

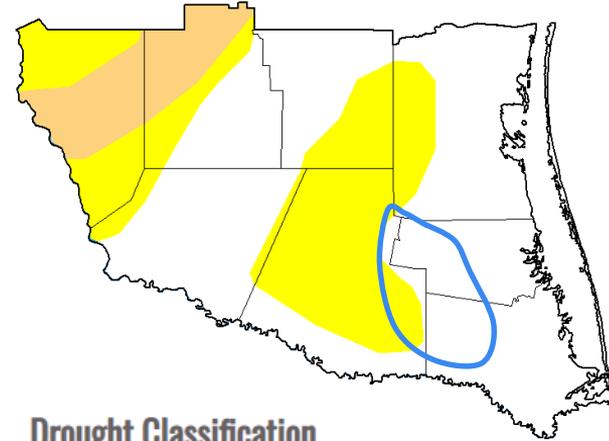
May 01, 2019 Monthly Percent Precipitation

Created on: November 21, 2019 - 15:06 UTC
Valid on: June 01, 2019 12:00 UTC



Percent of average rainfall for May was 10-50%;
2.26 in (5.74 cm) did fall in Harlingen from 1
through 12 June, a tad above average for that
period

US Drought Monitor, Deep S. Texas
Region, 18 June 2019



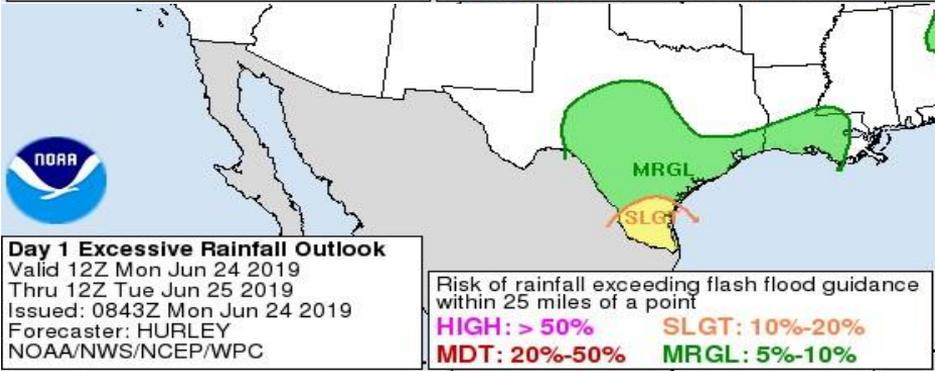
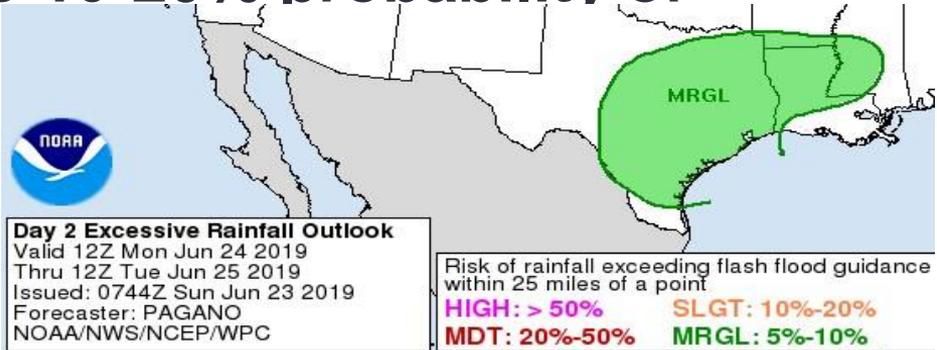
Drought Classification

- None
- D0 (Abnormally Dry)
- D1 (Moderate Drought)
- D2 (Severe Drought)

How did WPC get from “zero” to 10-20% probability of excessive rainfall??

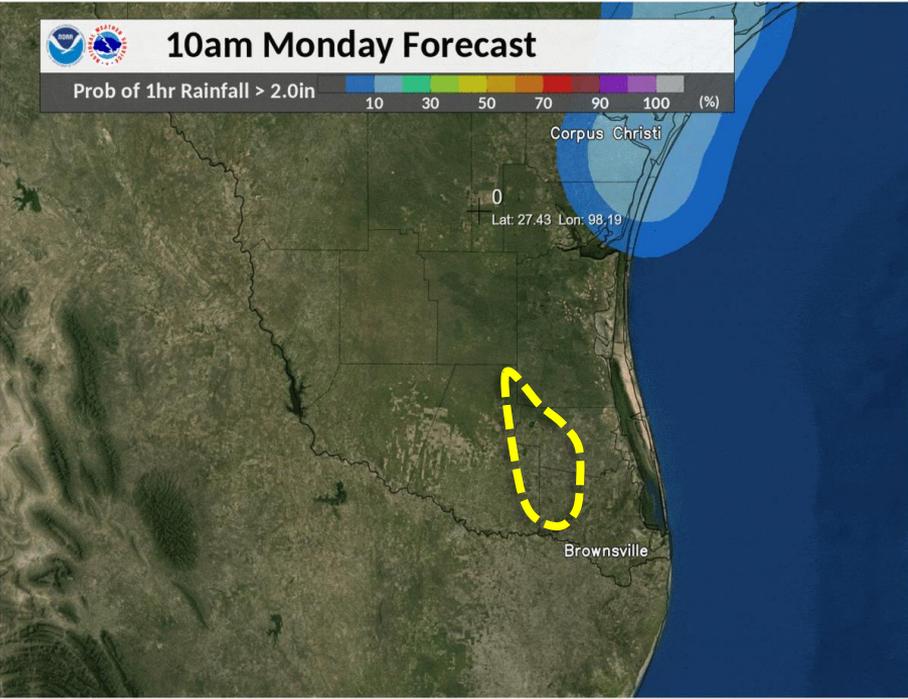
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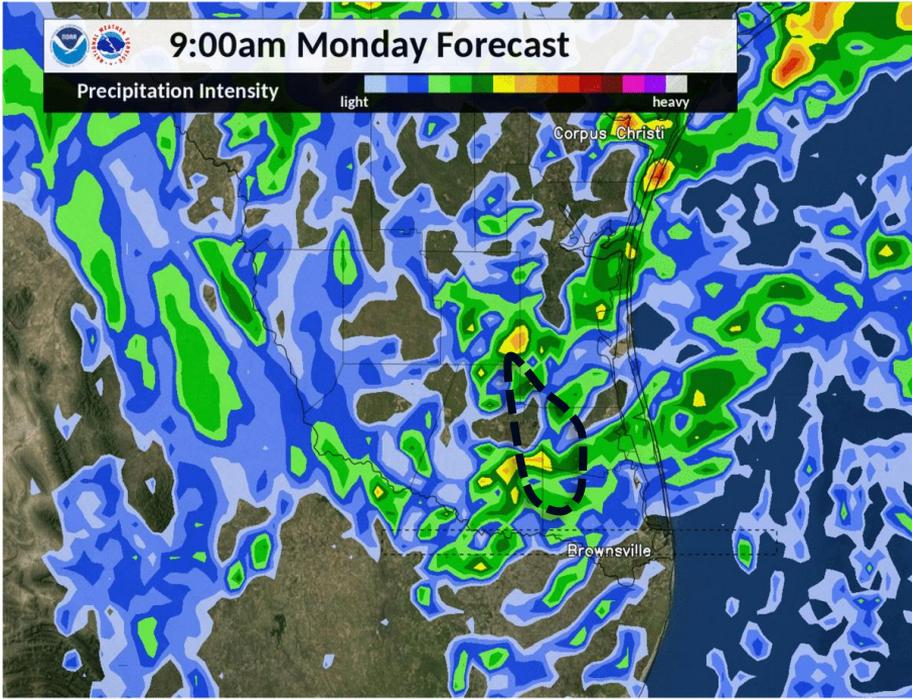


The 00Z HREF shows highest 3 hourly probabilities of exceeding 3" over South TX between 2100-0300Z -- with 6hr probs of >3" over 50%, and 12hr probs of >5" between 30-40%. WPC included a Slight Risk over this region as a result.

Confidence in Convection-Allowing Models (CAMs)

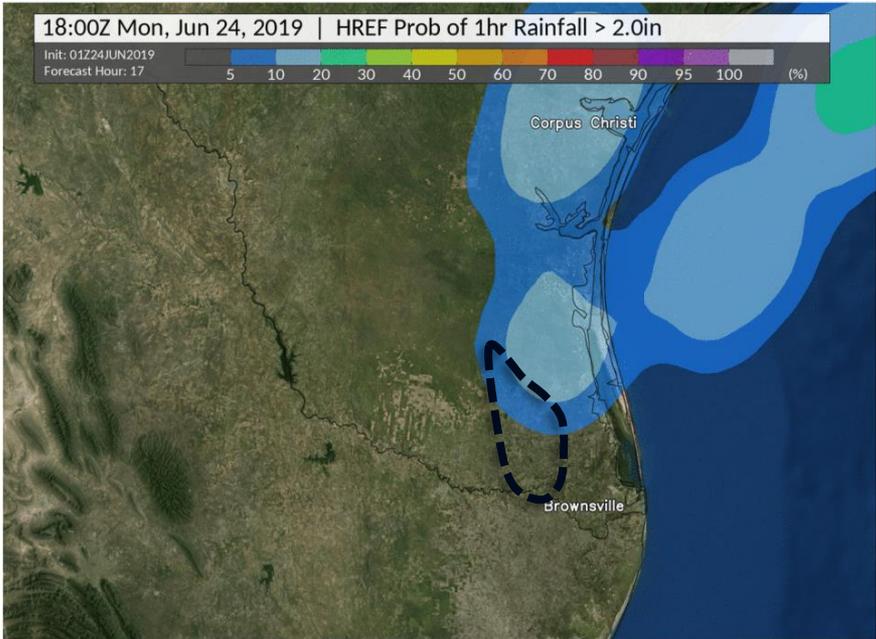


HREF 1200 UTC/23 June run; probability of 1 hr rainfall > 2 in (5.08 cm)

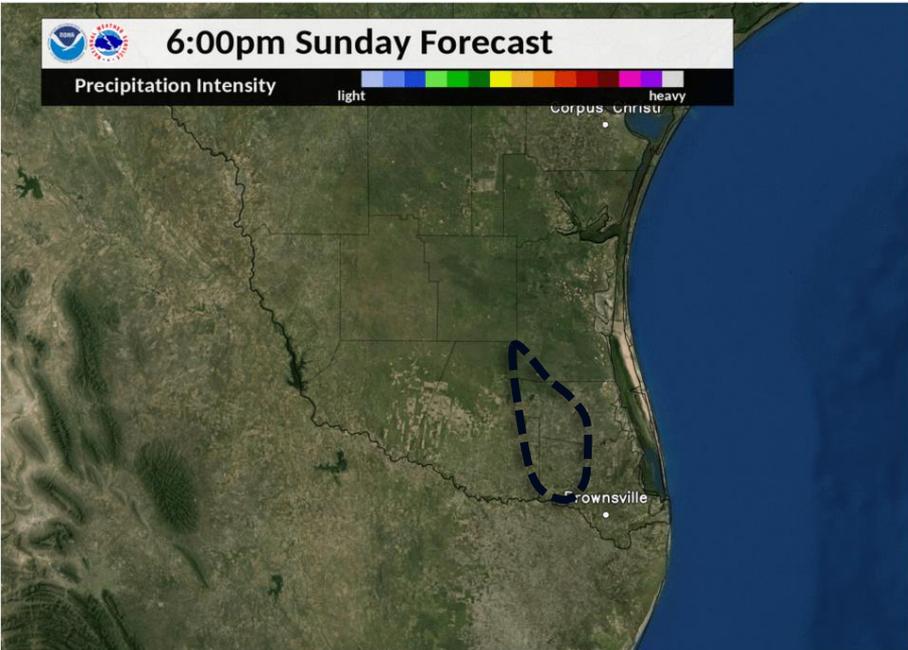


ARW/NMMB 12000 UTC/23 June run, Composite Reflectivity

Confidence in CAMs



HREF 0000 UTC/24 June run; probability of 1 hr rainfall of > 2 in (5.08 cm)



ARW/NMMB 0000 UTC/24 June run, Composite Reflectivity

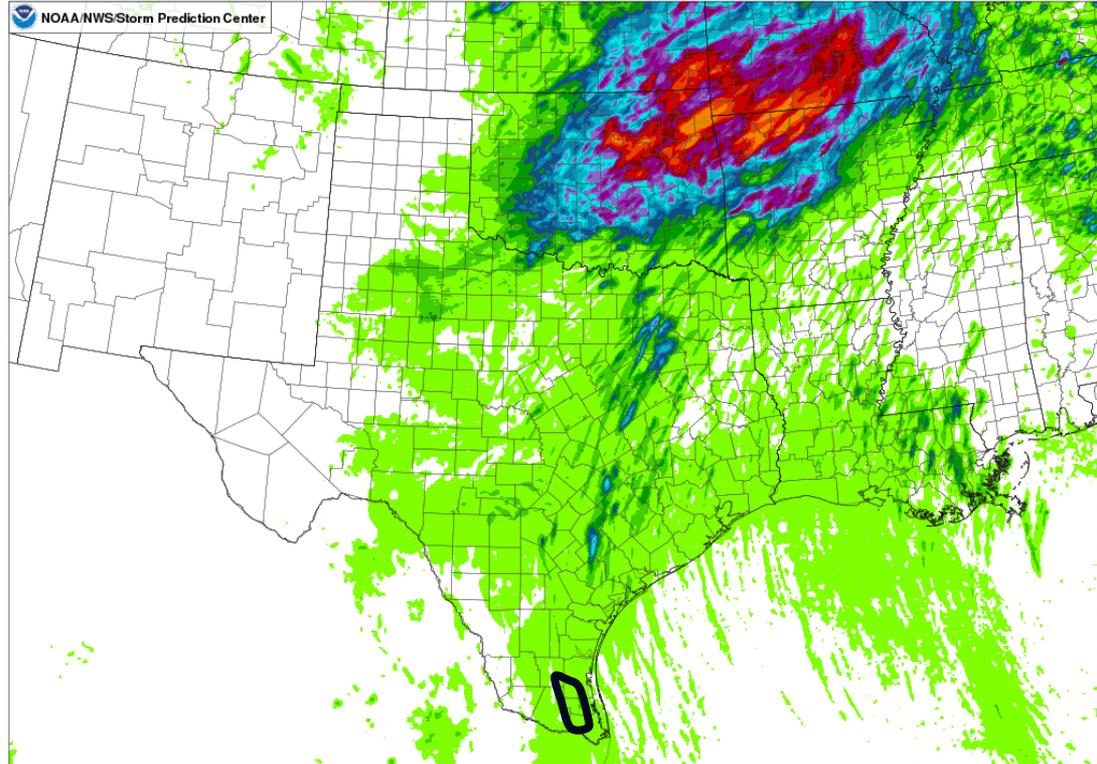
Confidence in CAMs

HREF

Run: Sun 2019-06-23 12:00 UTC

6-hr QPF (in), ensemble max

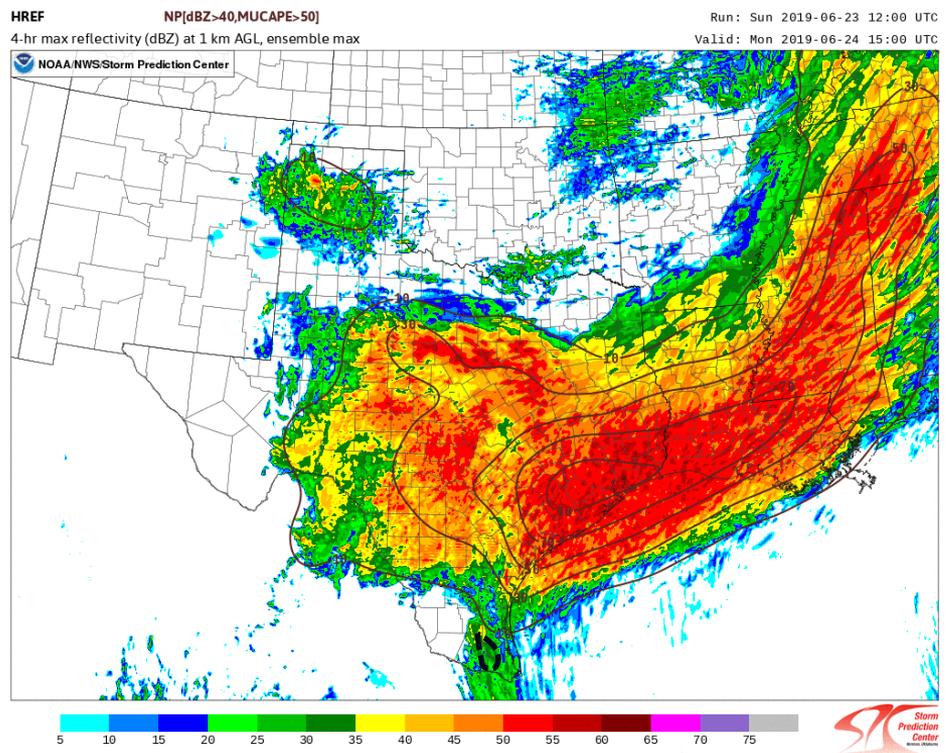
Valid: Sun 2019-06-23 18:00 UTC



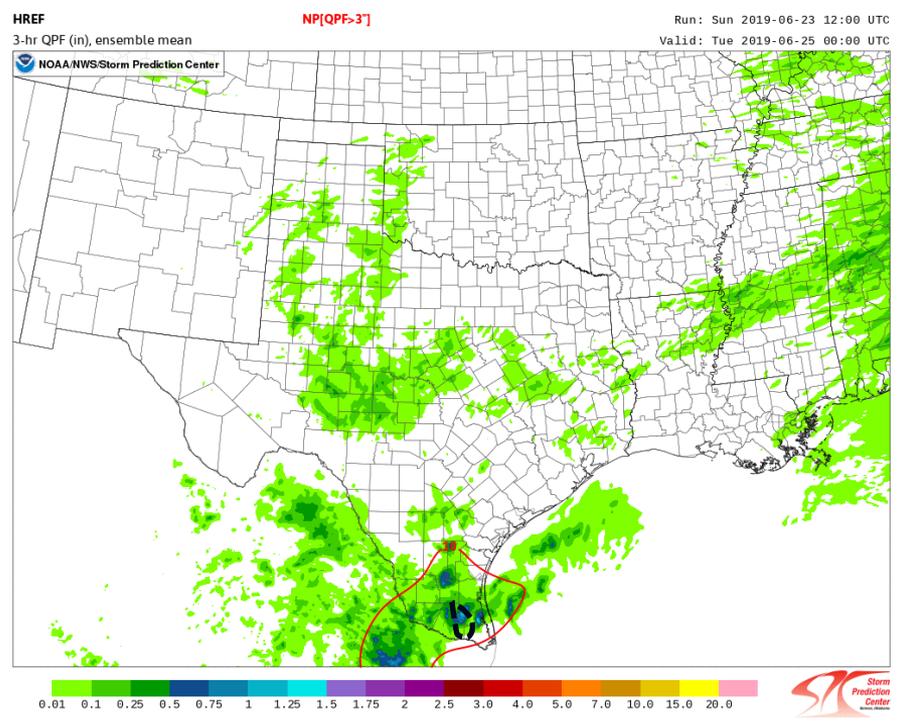
- HREF model, 1200 UTC 23 June 2019 run
- Six-hour QPF (loop) valid at 1800 23 June; 0000, 0600, 1200, and 1800 UTC 24 June; and 0000, 0600, and 1200 UTC 25 June



Confidence in CAMs

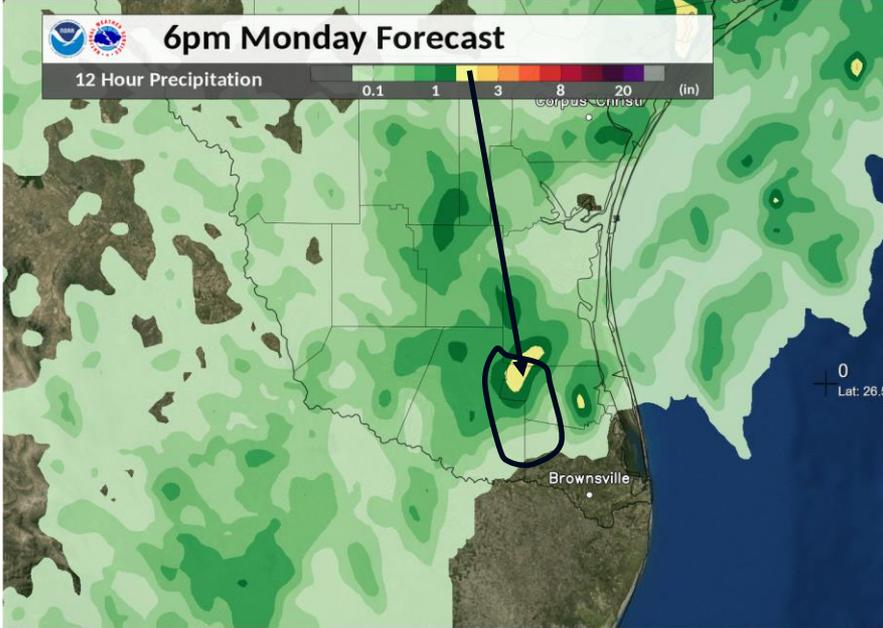


HREF 1200 UTC/23 June run, composite reflectivity max and probability of dbZ \geq 40 dBZ, most unstable CAPE > 50

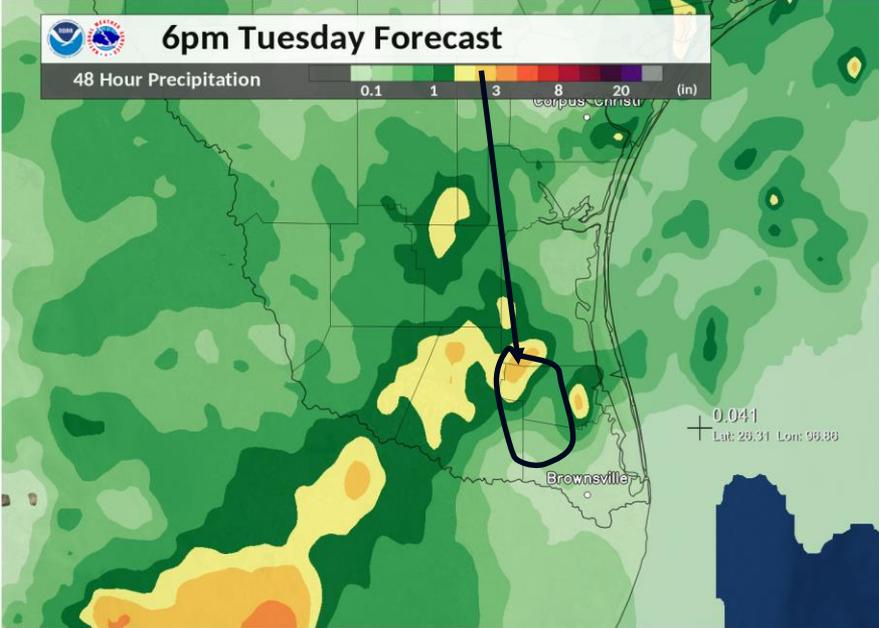


HREF 1200 UTC/23 June run, 3-hr QPF ensemble mean valid 25 June at 0000, 0300, and 0600 UTC. Note 10-30% probability of 3 hr QPF >3 in (7.62 cm, red contours)

Combining CAMs with human expertise

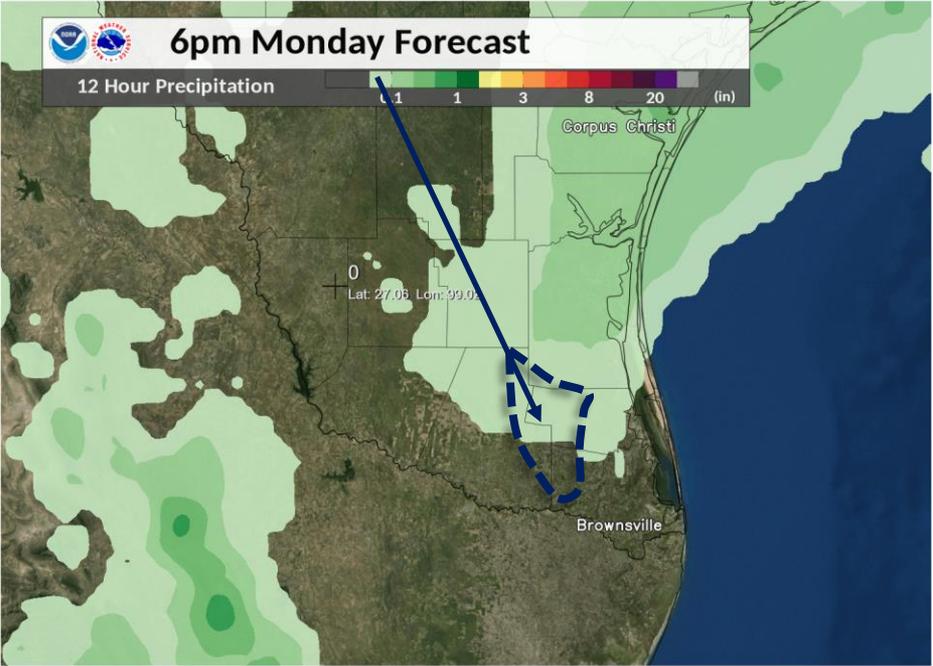


WPC Deterministic QPF (12 hour) for 1200 UTC 24 June through 0000 UTC 25 June 2019 (issued 2033 UTC 23 June, based partially on 1200 UTC 23 June CAMs)

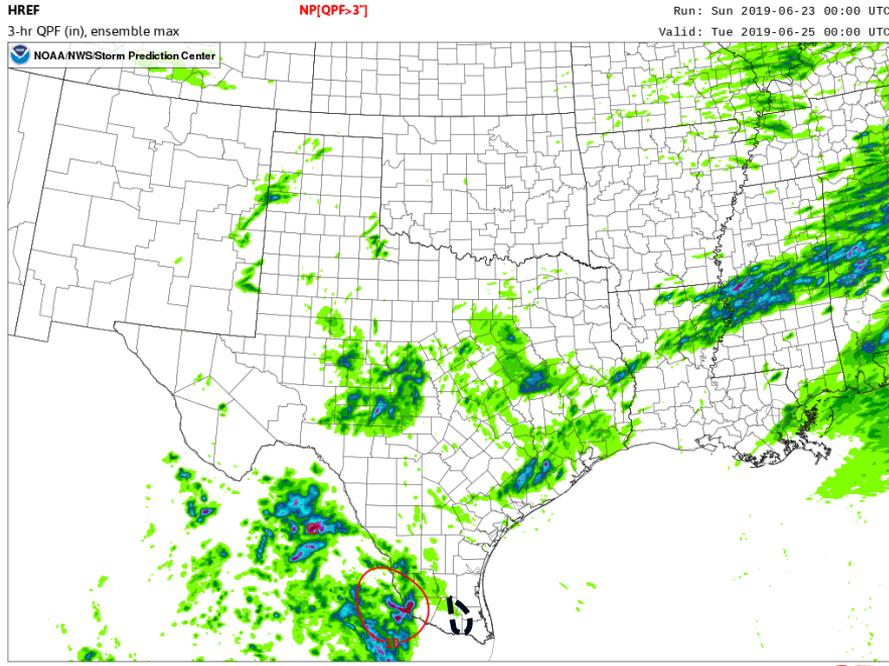


WPC Deterministic QPF (48 hour) for 0000 UTC 24 June through 0000 UTC 26 June 2019 (issued 2033 UTC 23 June, based partially on 1200 UTC 23 June CAMs)

Consider how 'puzzle pieces' did not add up, 12 h earlier



WPC Deterministic QPF (12 hour) for 1200 UTC 24 June through 0000 UTC 25 June 2019 (issued 0611 UTC 23 June, based partially on 0000 UTC 23 June CAMs)



HREF 0000 UTC/23 June run, 3-hr QPF ensemble mean valid 25 June at 0000 UTC. Note zero to trace amounts forecast in flood zone.



National Weather Service Brownsville/Rio Grande Valley



Good Monday everyone,

At the tail end of the one-week long oppressive heat (based on "feels like" temperatures), a potential for strong storms late this afternoon into this evening.

Bottom Lines Up Front

Event: Thunderstorm clusters capable of producing **flooding of poor drainage locations** due to **high rainfall rate** (up to 3 inches per hour)

Timing: 4 PM through 10 PM

Confidence: **LOW**. This is a *reasonable worse-case scenario forecast*. There are equal chances that it may not rain at all than it will downpour.

Location: Everywhere is in the reasonable worse case scenario.

Skinny

An active - though weakening - outflow boundary moving through the Gulf east of Kingsville (125 PM) is expected to move through the King Ranch area of Kenedy/Brooks County through 3 PM or so. As it reaches the more populated Rio Grande Valley, it is expected help "lift" a very unstable air mass into scattered to potentially numerous thunderstorms. Some of the storms will be stronger than others, producing not only torrential rain and lightning but an outside chance for hail and strong and potentially damaging winds to poorly built structures. The storms may "cluster" and move slowly...exactly if, when, and where that happens is very difficult to determine, even just several hours before the action begins.

Our very short range models show a wide variety of "solutions", from rainfall in excess of 4 inches to virtually nothing at all. Due to the uncertainty and low confidence, treat the following as a *reasonable worse-case scenario* - one to **prepare for to be safe ("better safe than sorry")**. Whichever way things pan out, the late afternoon/evening activity will shift south into northeast Mexico, and should be over with the exception of light rain, at or before midnight.

Leftover boundaries from any evening activity combined with a slow moving upper level disturbance on Tuesday could allow thunderstorms to develop quickly by late morning through the afternoon. Once again, exactly where those storms form and how much rain falls is impossible to determine this (Monday) afternoon. **Graphics of rainfall below are best used for reasonable worse case planning.** Do *not* use as a "this will happen" event.



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Impact-Based Decision Support (partner “blogmail”)

What to Watch For

Rainfall/Flooding

- Stronger cells will be capable of producing up to 3 inches in an hour, and 4+ inches overall.
- Such rains - falling over poor drainage locations despite having no rain in a week - would create **water depth of 2 to 3 feet** for a brief period.
 - This would cause primarily driving issues during the late afternoon/evening commute, including **potentially closed roads in prone areas**
- For better draining locations, ponding to perhaps a foot of water depth is possible with such rains.

Lightning

- Frequent to possibly excessive (i.e. 300+ cloud to ground strikes in 15 minutes) is possible in the strongest cells.
- This would be capable of **causing local power outages** and possible structural damage should stronger strikes hit unprotected buildings.

Wind/Hail

- This morning's atmospheric profile is conducive to individual cells that do not "share" their energy to produce **wind gusts in excess of 50 mph** and some **hail** that could reach **quarter size**.
- Clustered cells would be less capable of these elements (with rainfall and potential flooding the main concerns for them)



The Future Is Here!

- Man-Machine Mix incorporated human expertise with CAMs to forecast **substantial rainfall** where “traditional” models showed **virtually none**.
- The initial higher rainfall forecasts issued by WPC one day in advance were not considered for partner/public message at the time due to traditional thinking (i.e. “dry to flood” with tight mesoscale processes).
- This event changed that mindset! With Weather Forecast Office and WPC collaboration on deterministic and probabilistic outcomes, a **“zero to flood” message could be communicated** as a reasonable worse-case.
- Decision makers can have **human and physical resources ready** with the additional message lead time; populations can plan accordingly.



Questions? Thank You



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Author Contact Information:

Barry S. Goldsmith

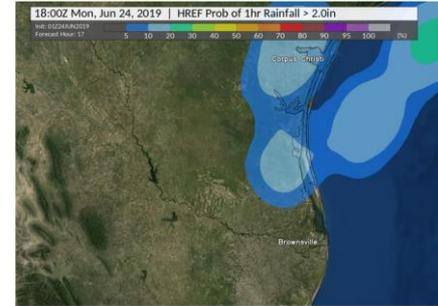
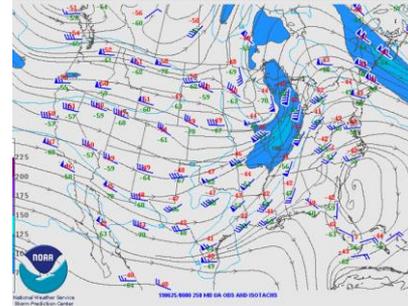
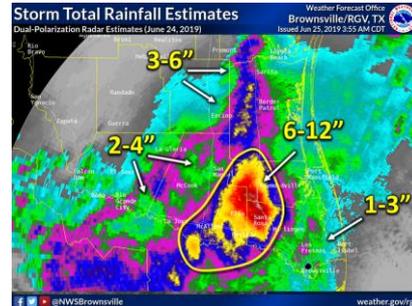
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