

Recent Extreme Rainfall in Tennessee and the Northeast-Not Quite PMP But PMP-Like Problems

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September 13, 2021 • ASDSO Dam Safety National Conference

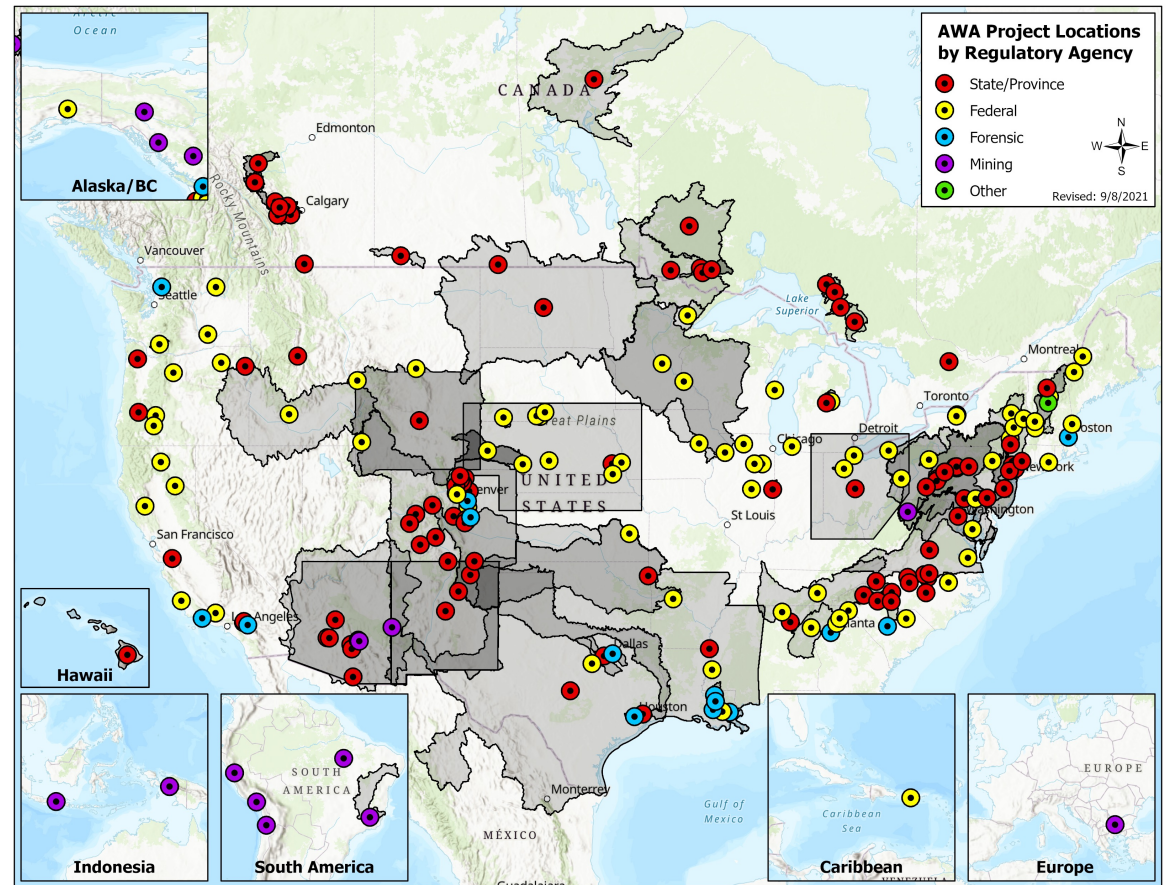


Background on the Storms

- Training thunderstorms Waverly, TN Aug 21
 - More than 18 inches in 12hrs
 - Devastating/deadly flooding
 - Poorly forecast
- Hurricane Ida remnant rainfall PA/NJ/NY
 - 6-10 inches in 24hrs
 - Very wet antecedent conditions
 - Devastating/deadly flooding
 - Very well forecast

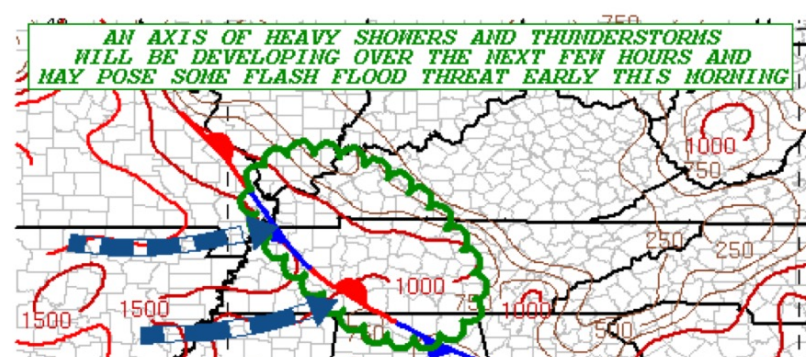
Waverly, TN Extreme Rainfall

- Previous/current PMP studies allowed for explicit comparisons
- Utilized these types of storms before

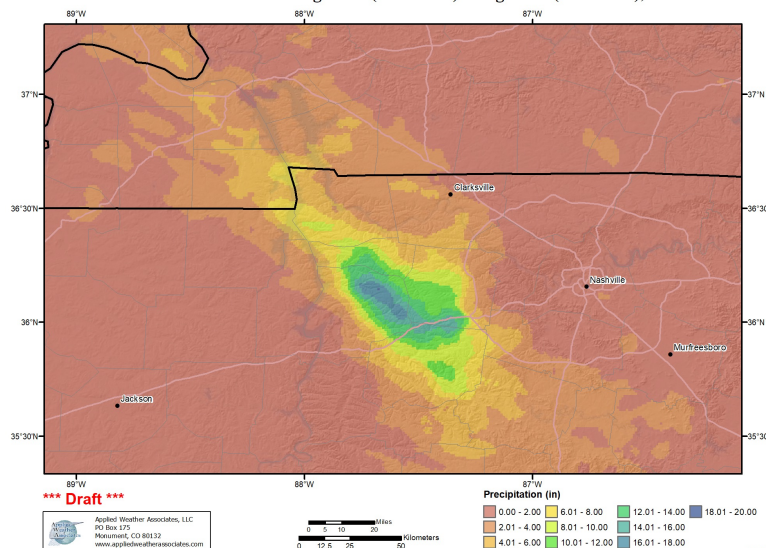


Waverly, TN Extreme Rainfall

- Line of thunderstorms along stalled front
 - Near record moisture
 - Extra instability in the area right along front and moisture boundary
 - LLJ from the W/SW
 - Steering winds aloft NW to SE
- Repeated development over the same area for several hours
- 12-18 inches widespread along the main axis
 - Heaviest in 6-12 hours
 - Short warning time and fast rising waters
 - Normal antecedent conditions



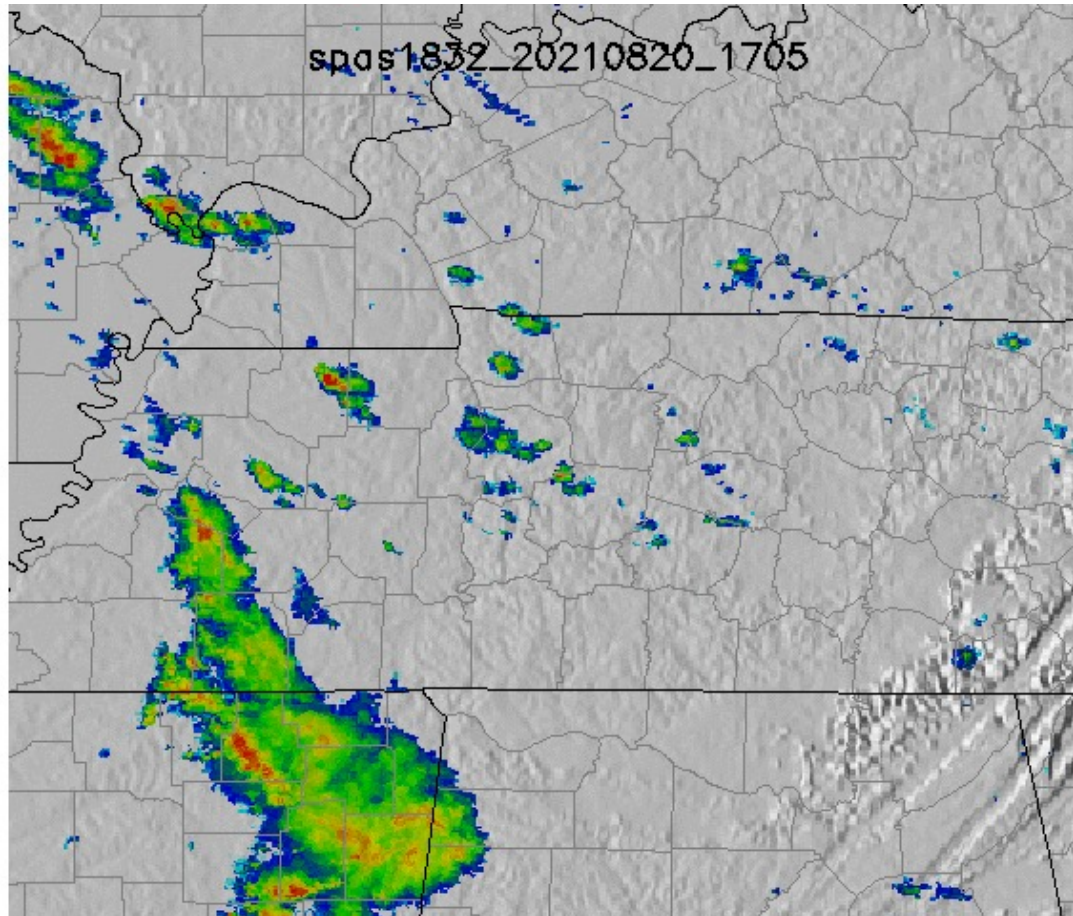
24-hour Maximum Precipitation
SPAS-NEXRAD 1832 - August 20 (1800 UTC) - August 22 (1100 UTC), 2021



Waverly, TN Extreme Rainfall

- At least 20 killed and millions in damages

Waverly, TN Extreme Rainfall-Radar Loop



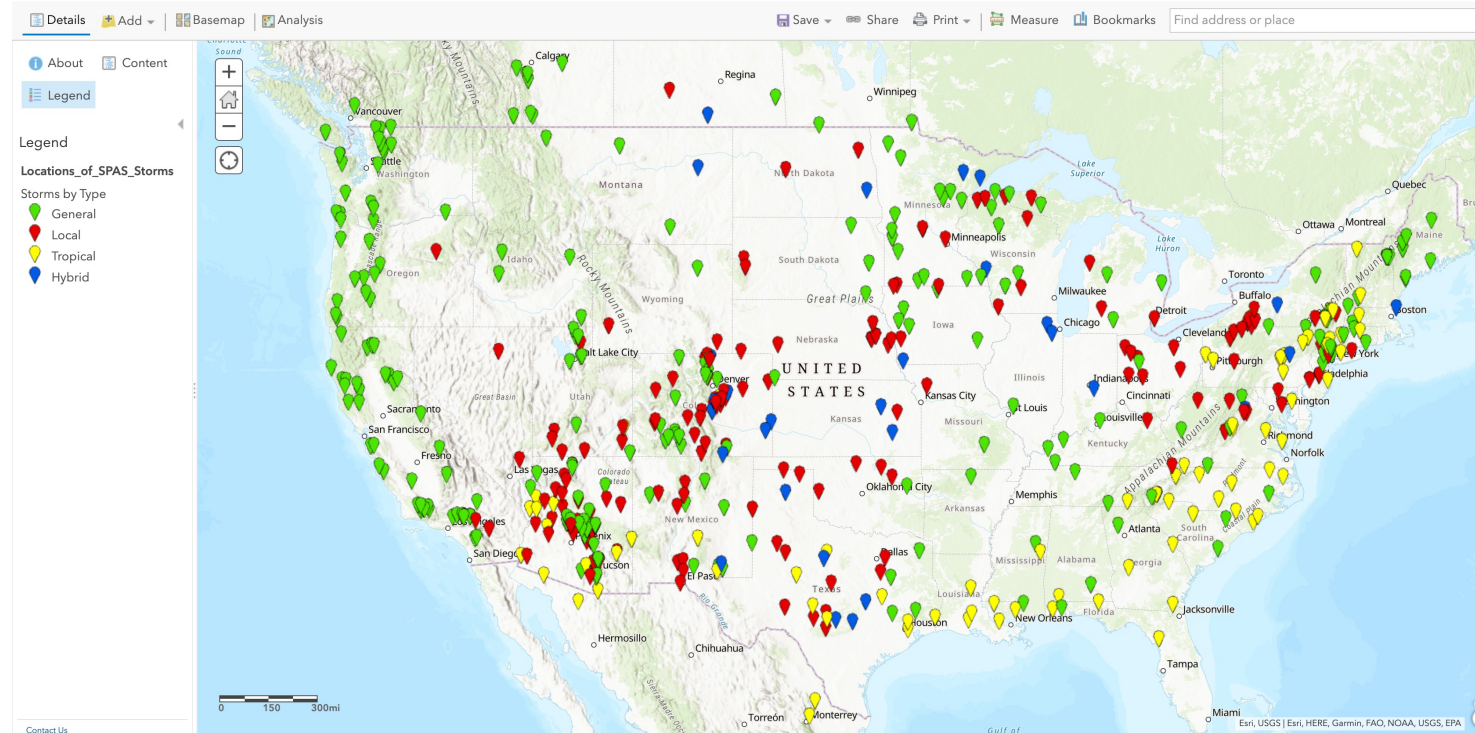
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Waverly, TN Extreme Rainfall

- SPAS used to analyzed more than 800 storms
- Analyzed these types of storms before in these areas

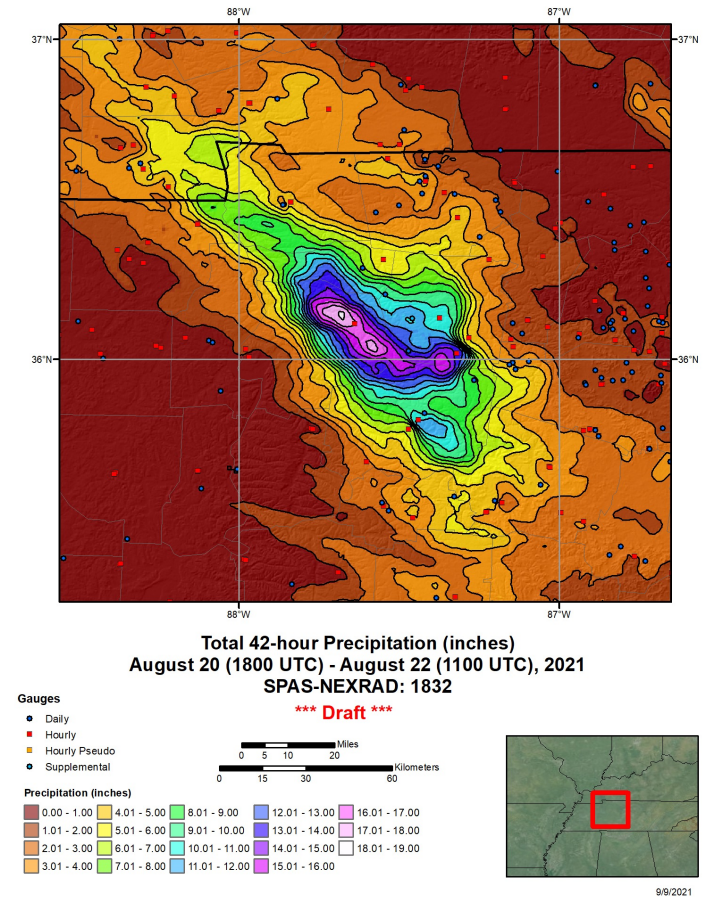
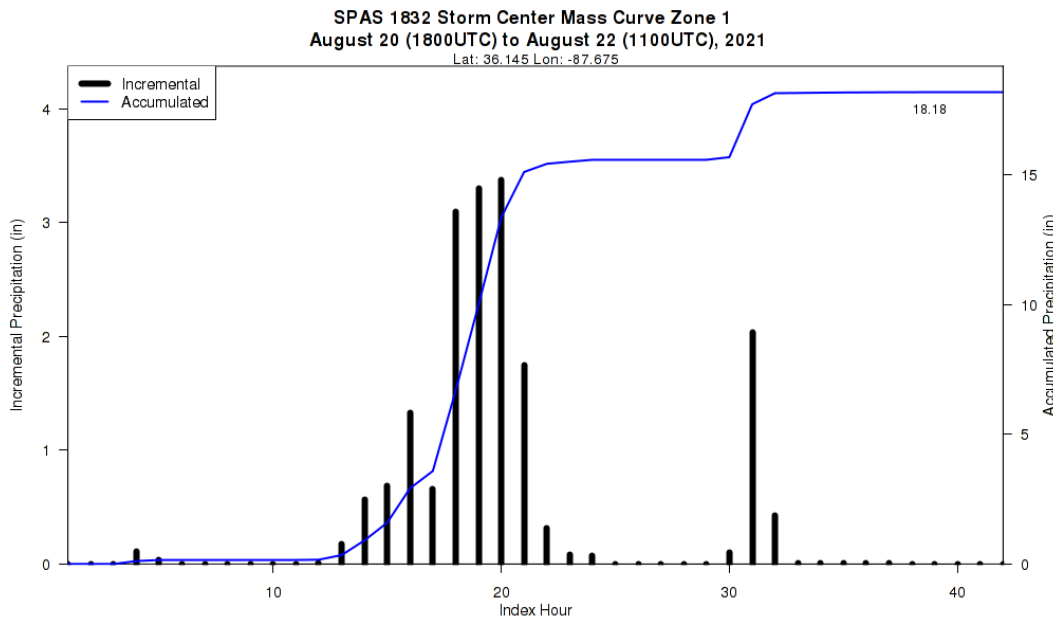
Home ▾ Locations of SPAS Storm Centers

New Map ▾



Waverly, TN Extreme Rainfall

- Preliminary SPAS analysis
 - More than 18" of rain
 - Excellent data in and around storm center
 - **Thank you TVA**

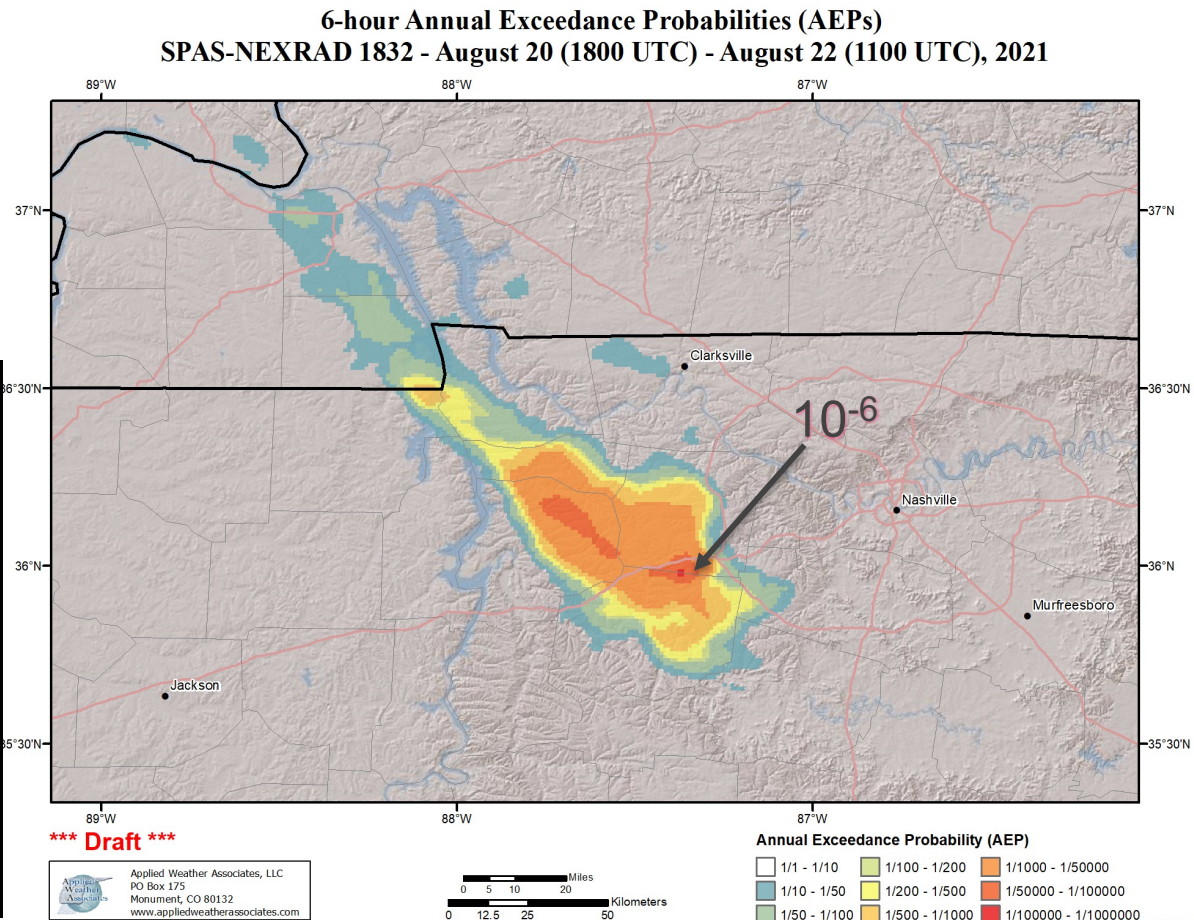


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Waverly, TN Extreme Rainfall

- This was a very rare event, but not PMP
 - 10^{-6} at 6hrs
 - PMP in the region 22-26" at 6 and 12hrs

SPAS 1832 DAD Curves Zone 1 August 20 (1800 UTC) to August 22 (11 UTC), 2021							
	1hr	3hr	6hr	12hr	18hr	24hr	42hr
0.4	5.2	10.2	13.5	15.4	17.4	18.0	18.2
1	5.2	10.1	13.4	15.3	17.2	17.9	18.0
10	5.1	9.7	13.2	15.0	16.9	17.5	17.7
25	4.9	9.5	12.9	14.7	16.5	17.2	17.3
50	4.6	9.2	12.5	14.3	16.1	16.8	16.9
100	4.2	8.8	12.0	13.7	15.4	16.0	16.2
150	3.9	8.4	11.6	13.3	14.9	15.5	15.7
200	3.7	8.0	11.3	12.9	14.5	15.1	15.3
300	3.4	7.4	10.7	12.3	13.7	14.3	14.5
400	3.0	6.9	10.1	11.7	13.1	13.7	13.9
500	2.8	6.4	9.6	11.1	12.6	13.1	13.3
1,000	2.0	5.0	7.7	9.2	10.5	11.0	11.2
2,000	1.5	3.7	5.6	6.8	7.9	8.4	8.6
3,500	1.1	2.7	4.2	5.2	6.1	6.5	6.7
5,000	0.8	2.1	3.4	4.3	5.1	5.5	5.7
7,500	0.6	1.5	2.6	3.5	4.2	4.5	4.7
10,000	0.4	1.2	2.1	2.8	3.6	3.9	4.1
15,000	0.3	0.8	1.5	2.1	2.6	2.9	3.2
20,000	0.3	0.6	1.2	1.6	2.1	2.4	2.6
35,000	0.1	0.4	0.8	1.1	1.4	1.6	1.8
50,000	0.1	0.3	0.5	0.8	1.1	1.3	1.4



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Waverly, TN Extreme Rainfall-Compared to PMP

- Waverly rainfall
18" in just over
12hrs
- 66% of PMP in
place
- IPMF factor
 $1.10 = \sim 20''$

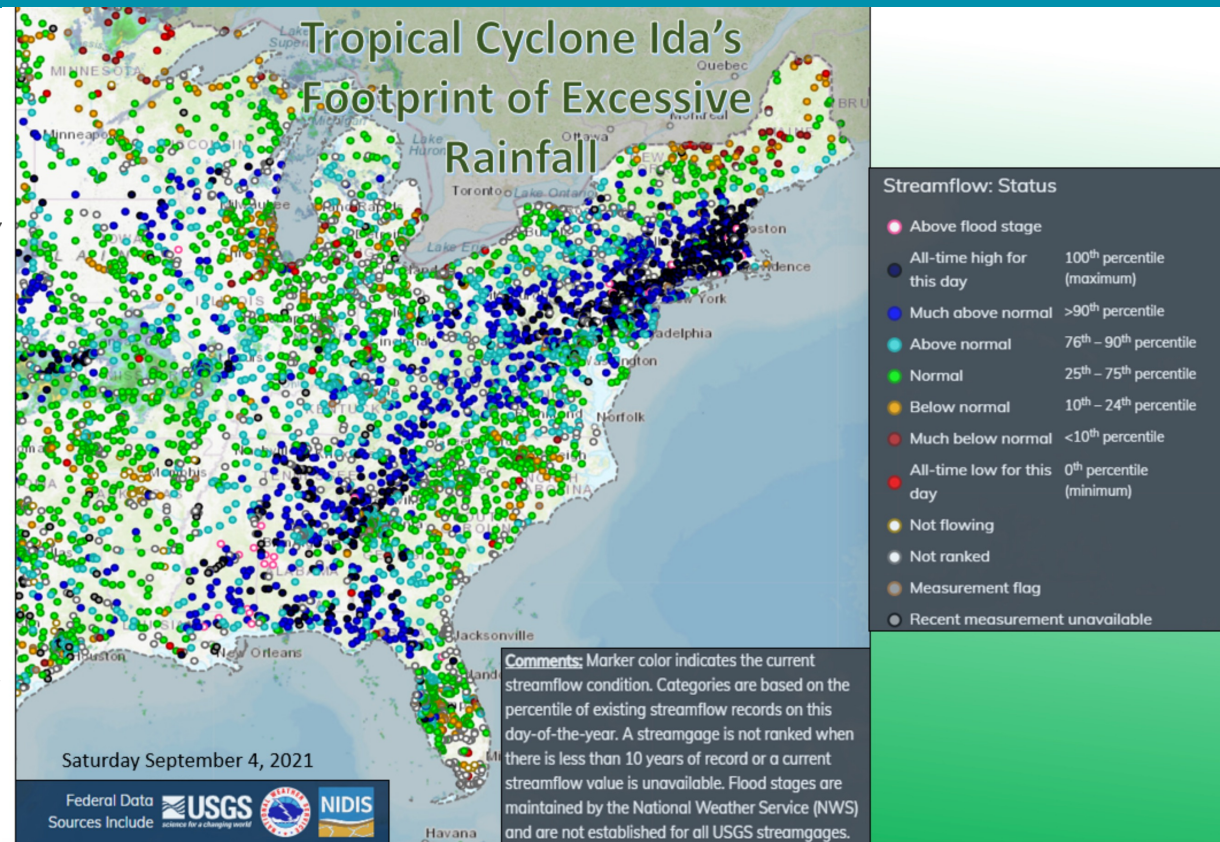
TVA Local Storm PMP					
	1hr	3hr	6hr	12hr	24hr
1	10.5	18.7	23.0	27.0	31.5
100	7.4	16.7	20.6	22.9	22.9
1,000	3.7	7.6	10.1	13.5	15.4

TVA General Storm PMP					
	1hr	6hr	12hr	18hr	24hr
1	7.1	20.7	24.0	24.8	25.8
100	4.9	17.2	20.1	21.5	22.7
1,000	3.2	11.8	16.5	17.5	17.8

SPAS 1832 DAD Curves Zone 1					
August 20 (1800 UTC) to August 22 (11 UTC), 2021					
	1hr	6hr	12hr	18hr	24hr
1	5.2	13.4	15.3	17.2	17.9
100	4.2	12.0	13.7	15.4	16.0
1,000	2.0	7.7	9.2	10.5	11.0

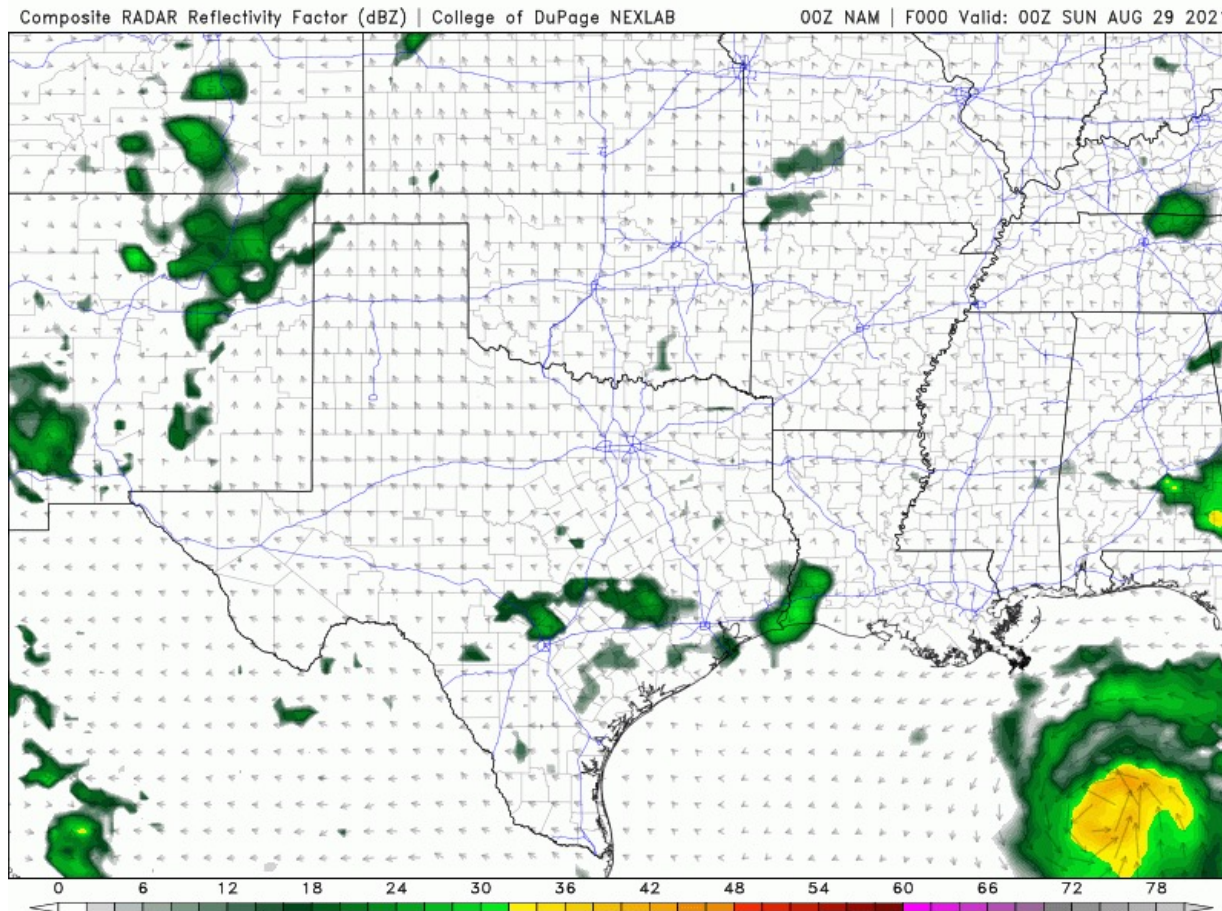
Ida Extreme Rainfall

- Strong Cat 4
 - Wind, surge rain LA/MS
 - Moved north/northeast
 - Instability increased PA-NJ-NY
- Heavy rain/severe weather along boundary
- 5-10 inches widespread
 - Very wet antecedent conditions
 - Urban environment runoff



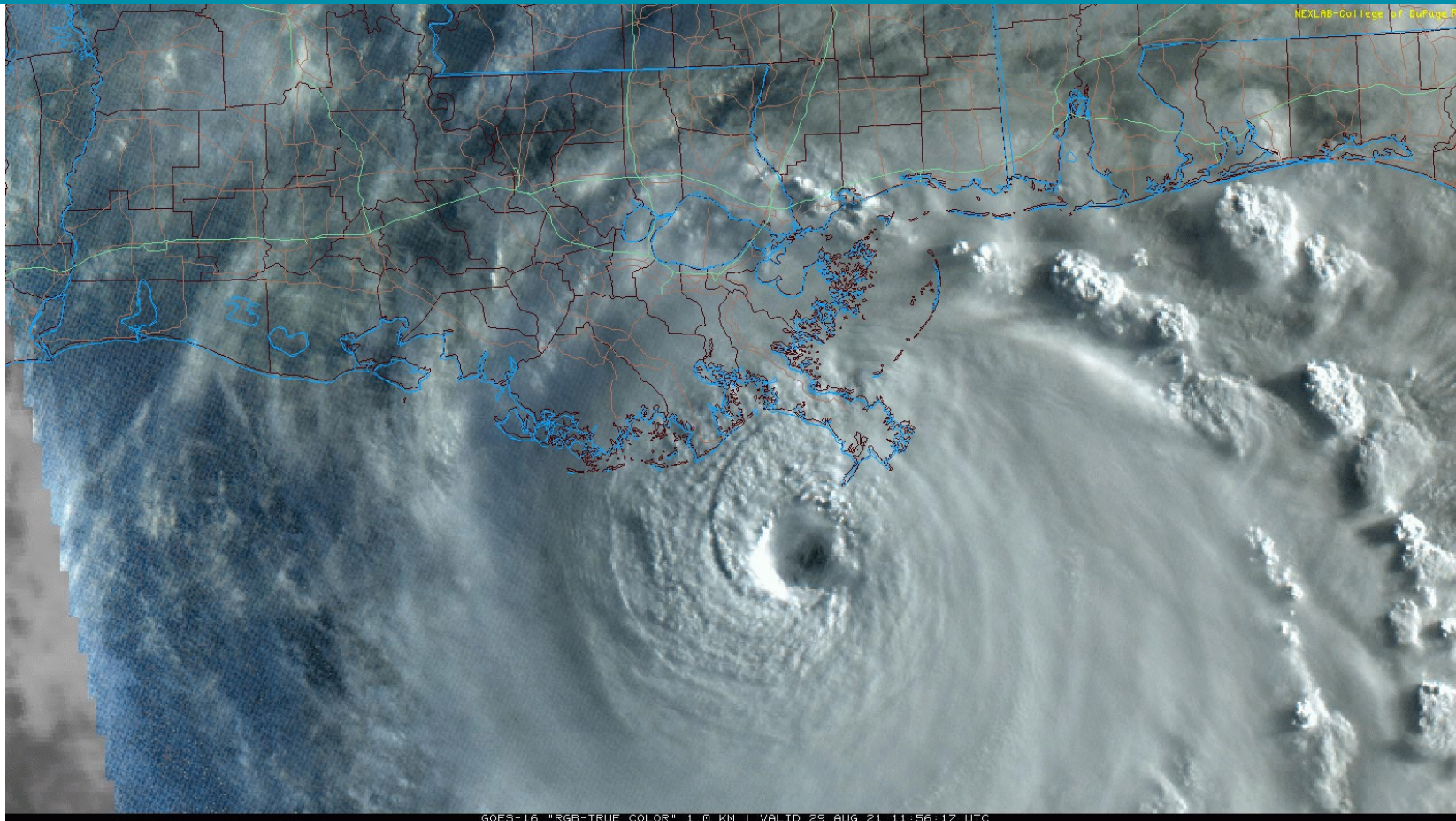
https://www.weather.gov/images/mob/events/Ida/TC_Ida_StreamFlowFootprint.png

Ida Rainfall-the Forecast



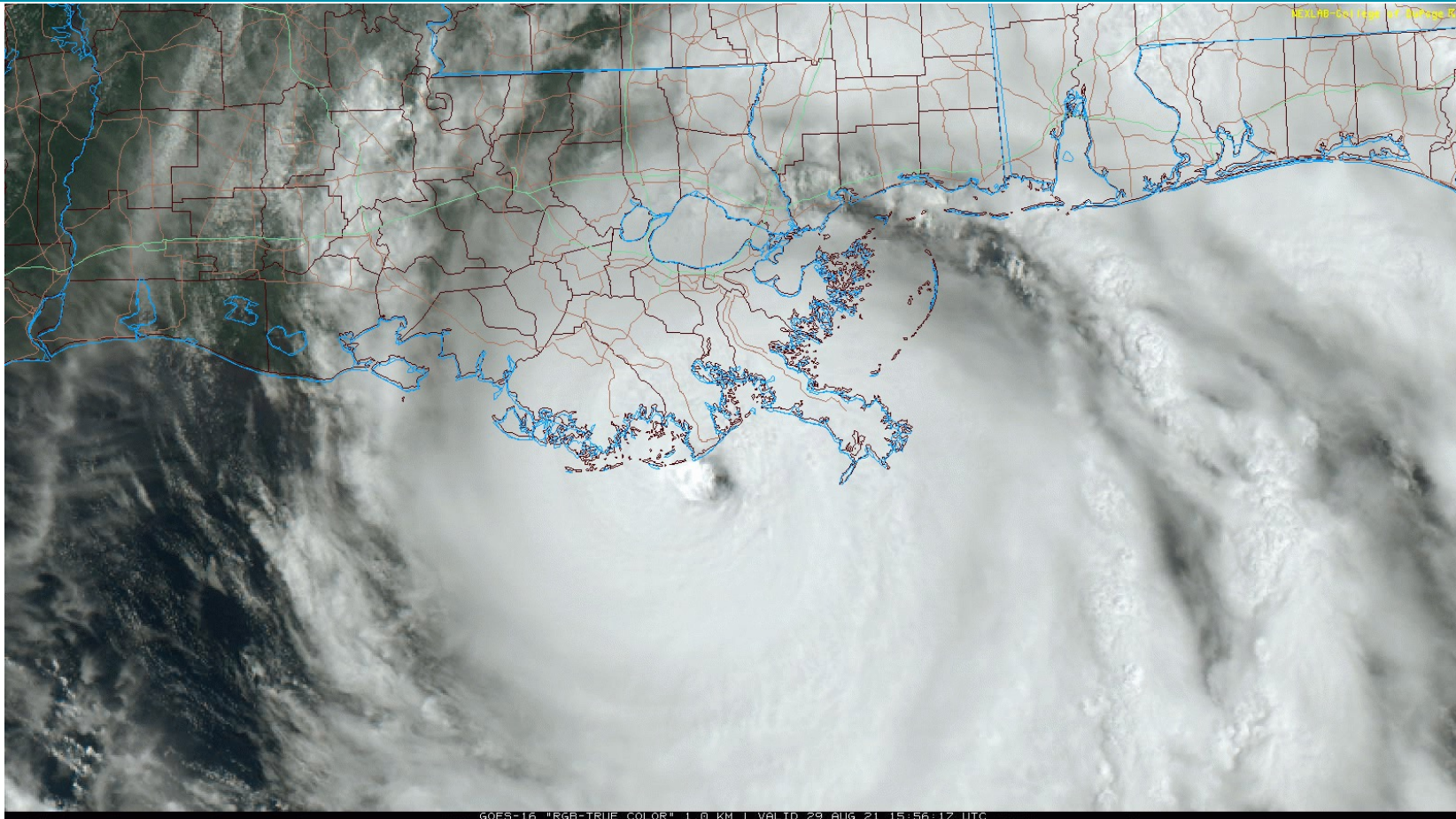
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Ida Rainfall

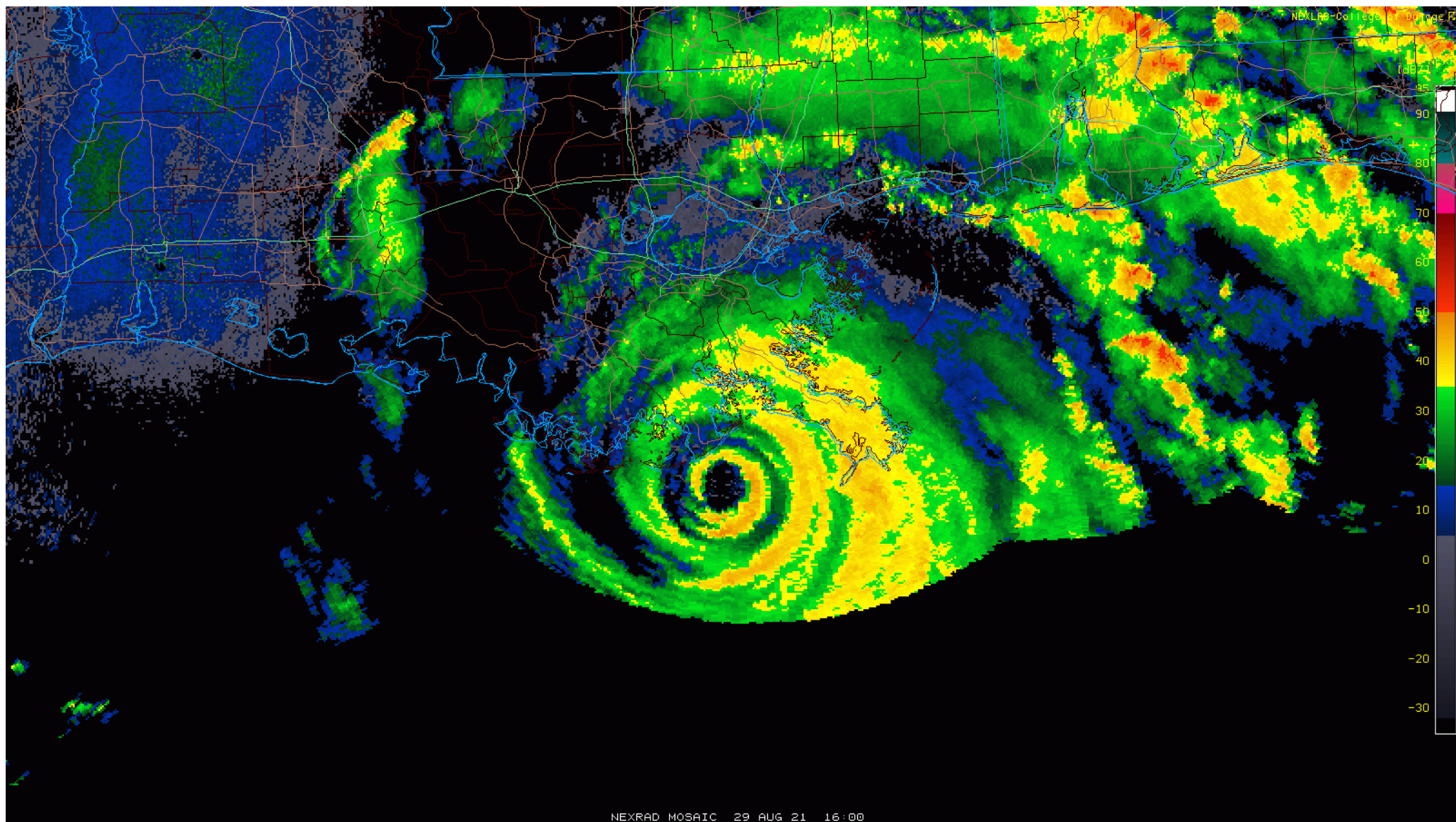


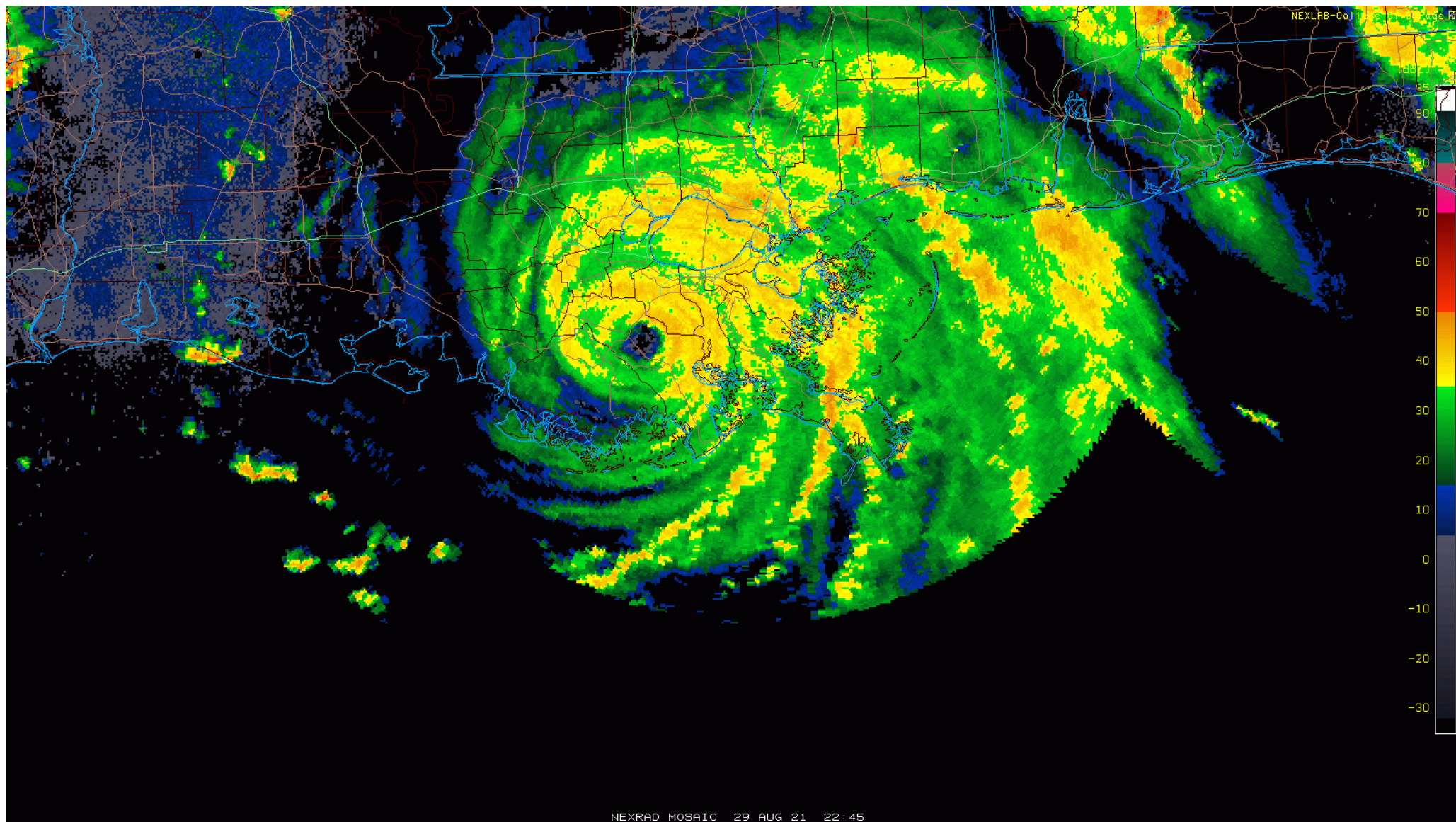
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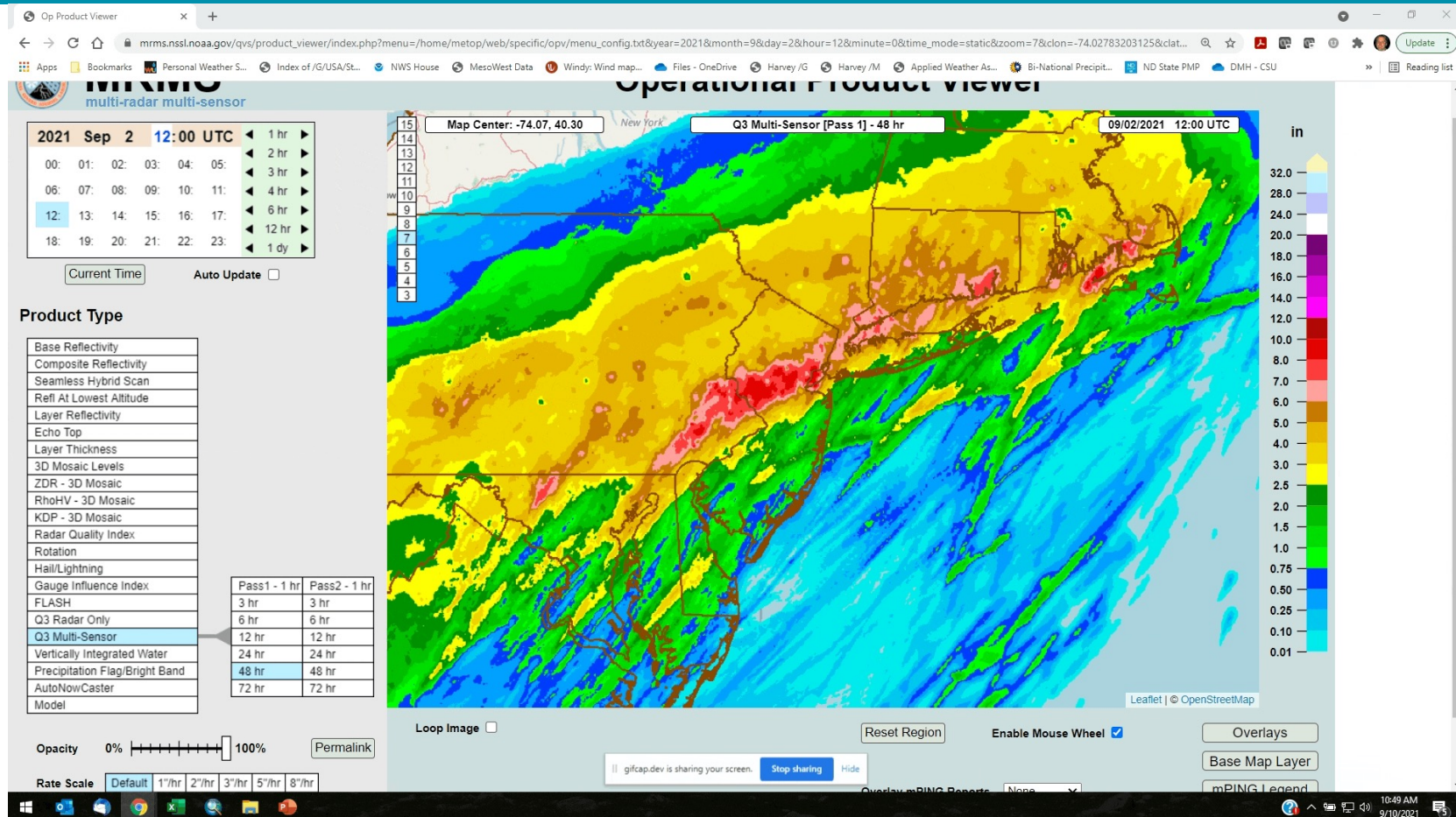


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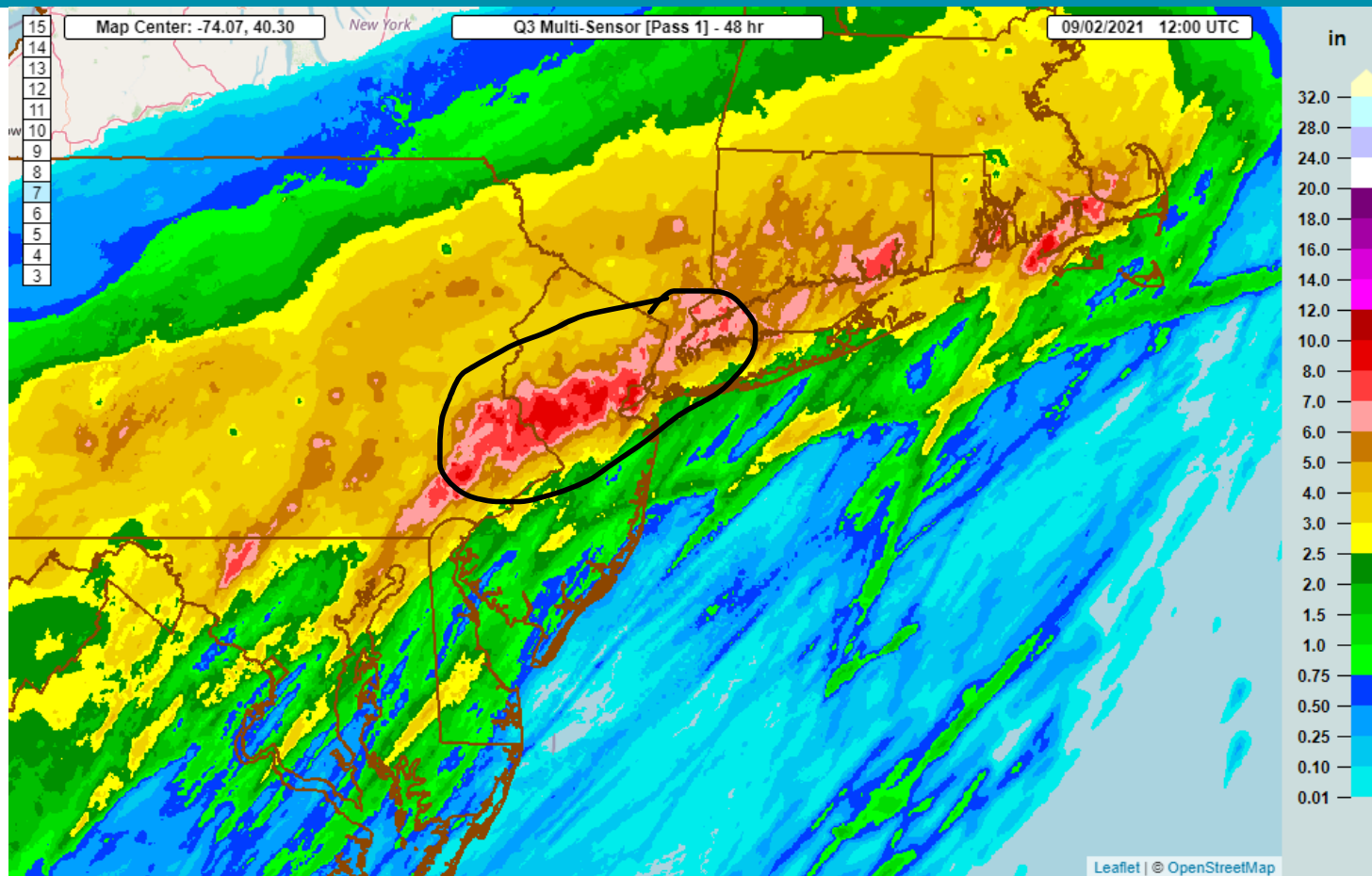


Ida Rainfall



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Ida Rainfall

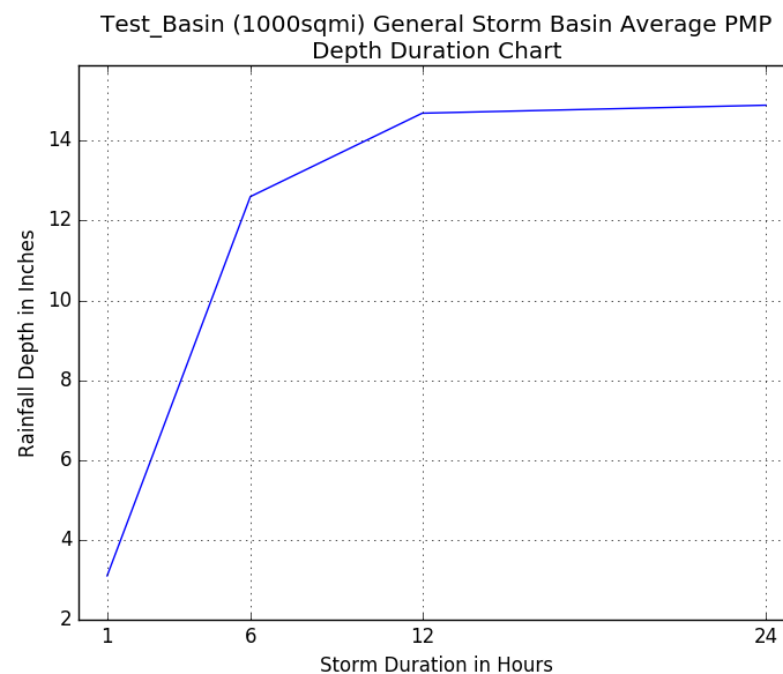
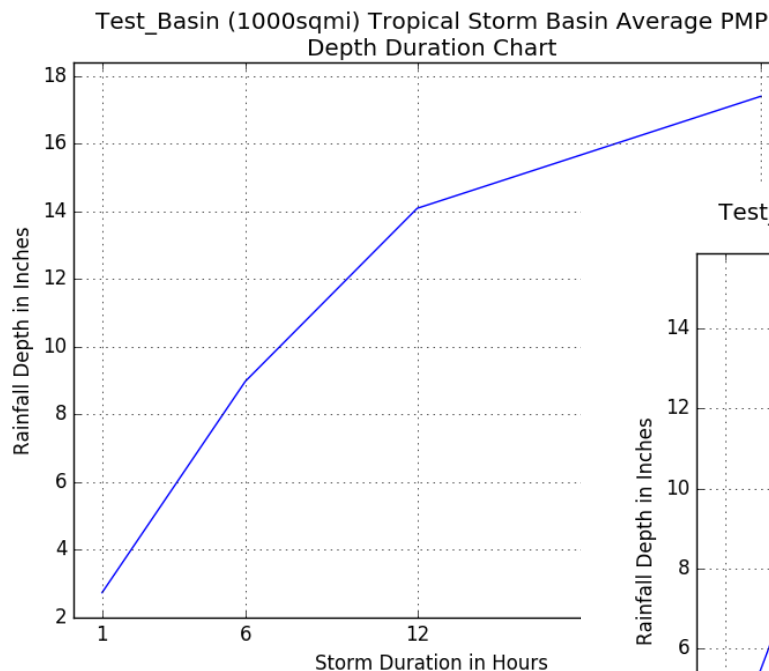


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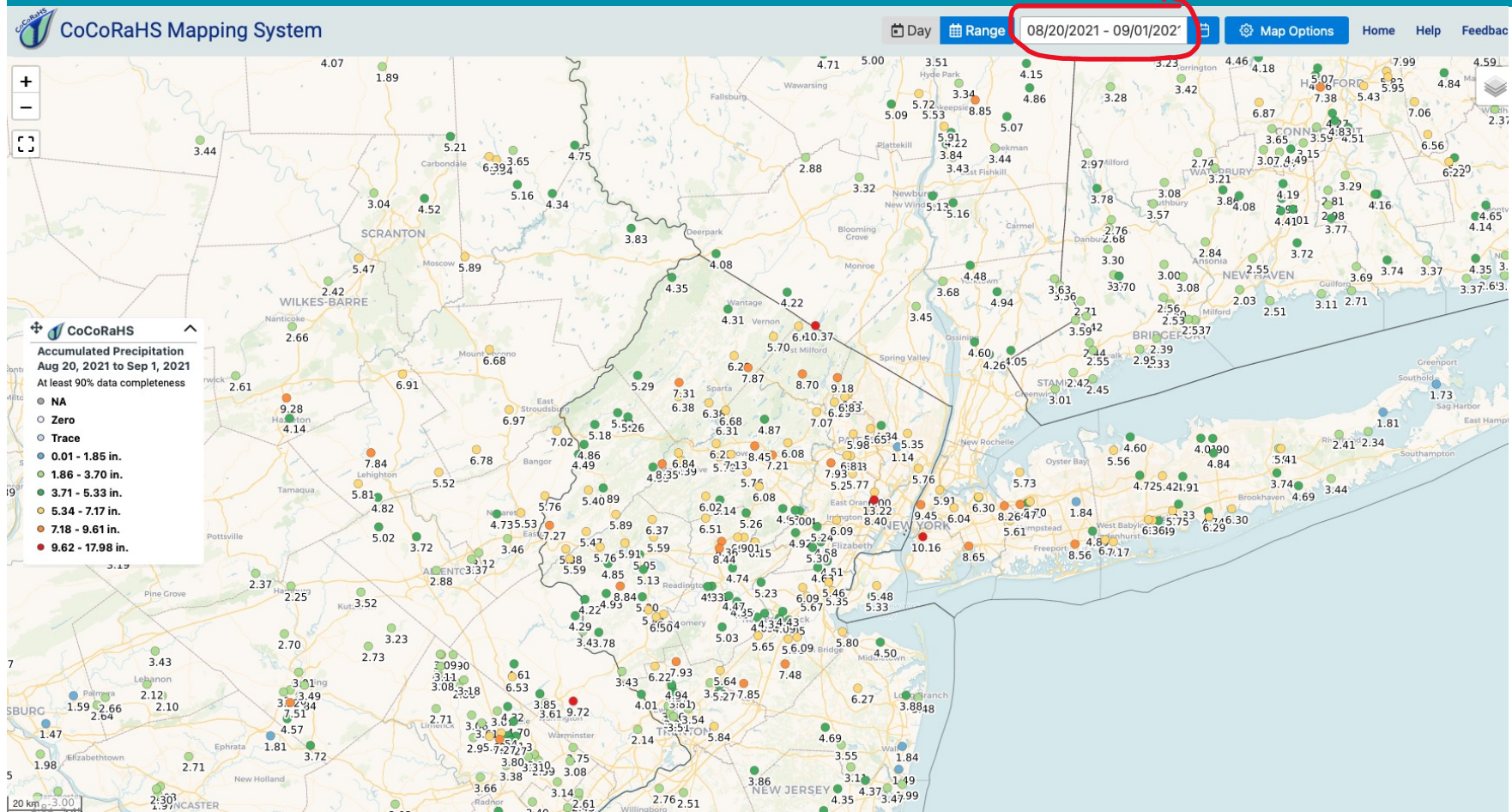
Ida PA-NJ-NY Extreme Rainfall-Compared to PMP

- 5-6" over 2000sqmi
- 7-8" over 500sqmi
- Only half of PMP
- Similar results in western PA test basin

**Thanks FERC
NYRO for
checking PA**

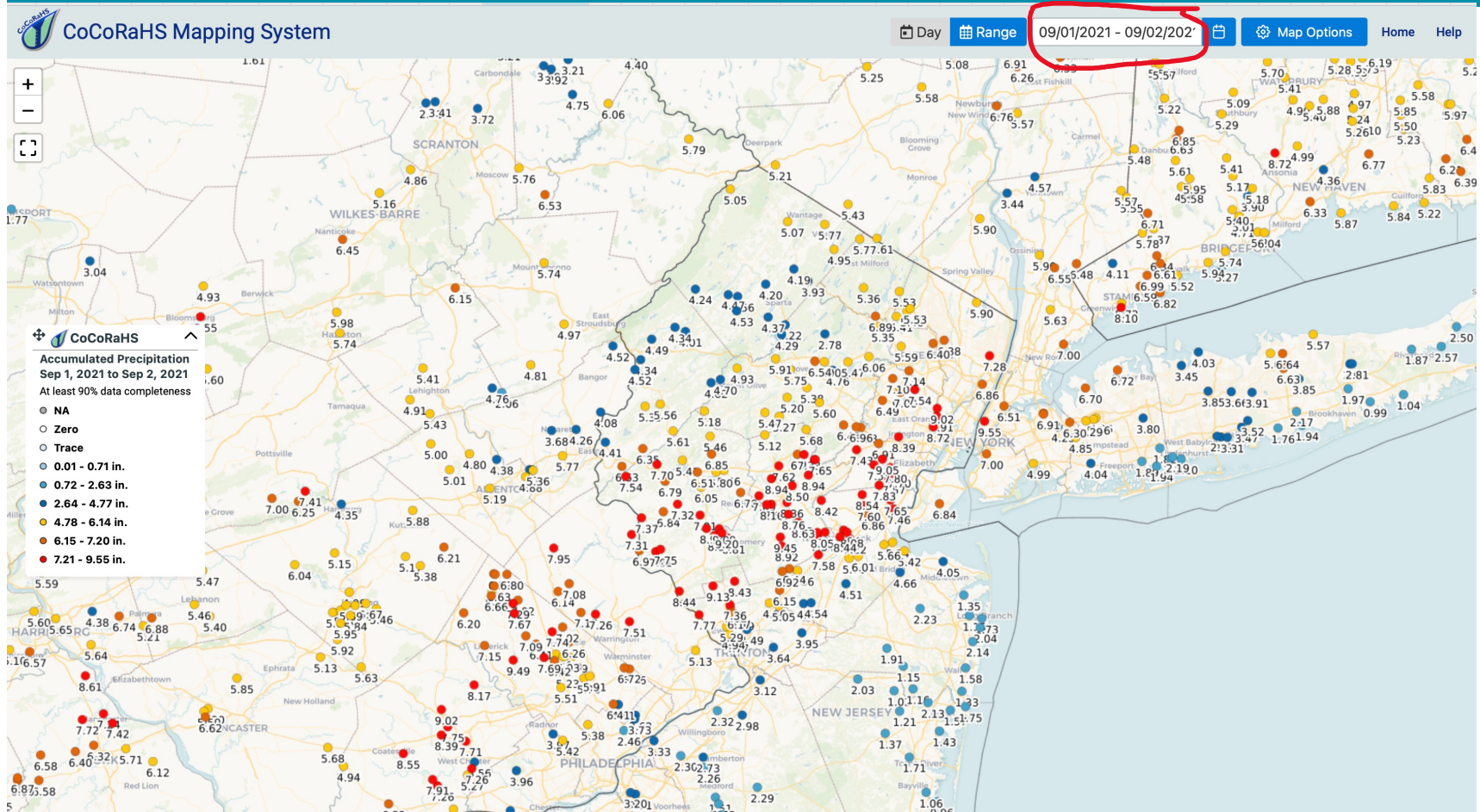


ID PA/NJ/NY Extreme Rainfall



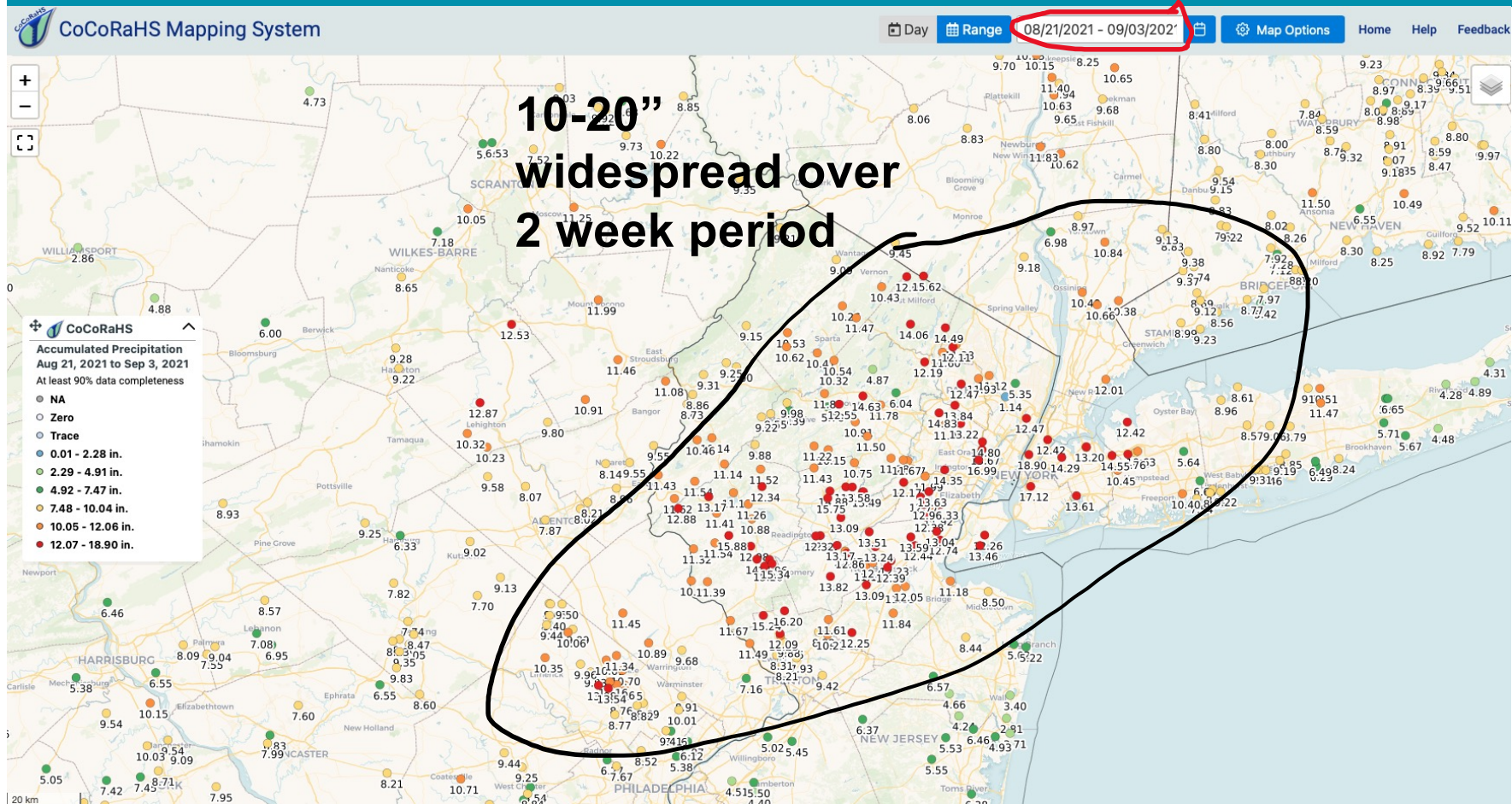
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ID PA/NJ/NY Extreme Rainfall



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Summary

- Each event produced extreme rainfall but not PMP
- Resulting in significant loss of life and damages
- Storms of these magnitudes have happened before and will happen again
- What does this say about our infrastructure readiness?

THANK YOU



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Waverly, TN Extreme Rainfall

- Did this exceed PMP?
- How did it compare to previous events?
- Preliminary storm analysis
- If not why so much devastation?
- Forecast performance
- Have these happened before? Yes and with greater amounts, so what's different?