Hurricane Ida Case Study

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Christina Speciale

Antecedent Conditions

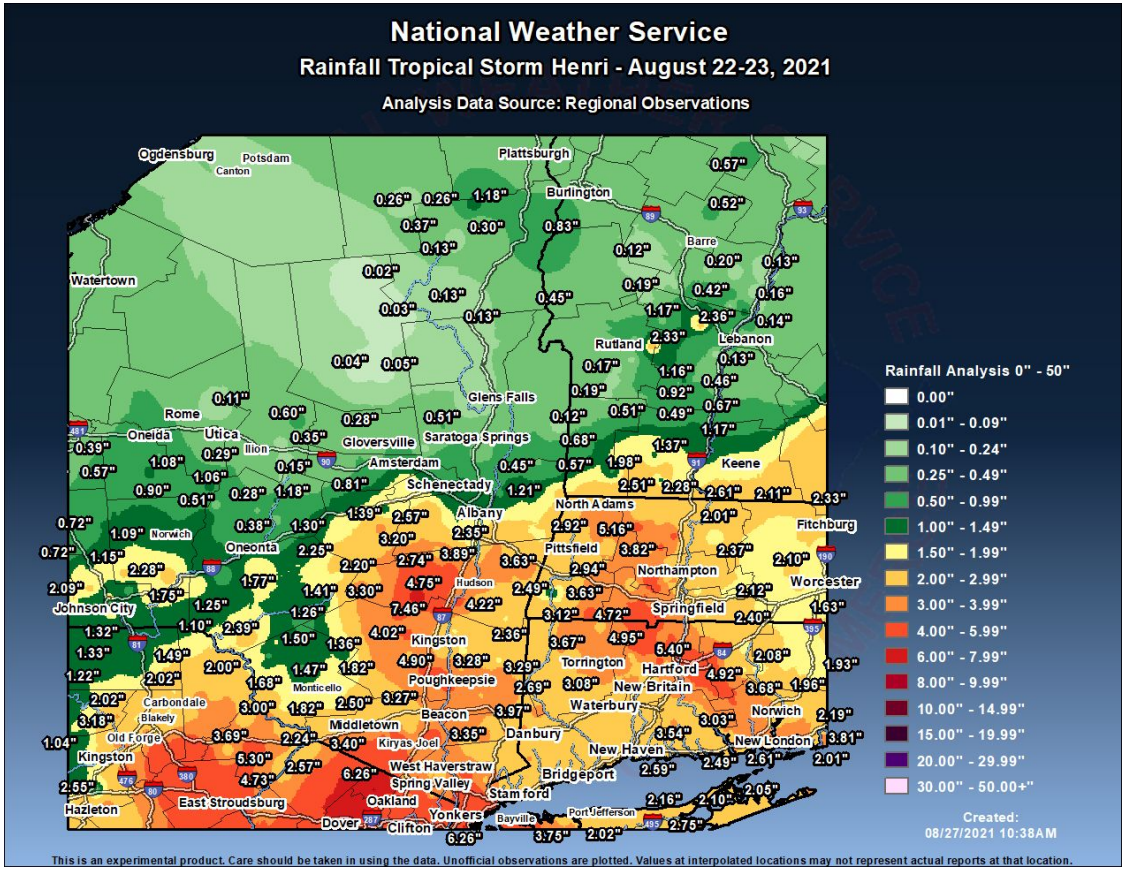
Hurricane Henri - August 22-23, 2021

PRE (Predecessor Rainfall Event)

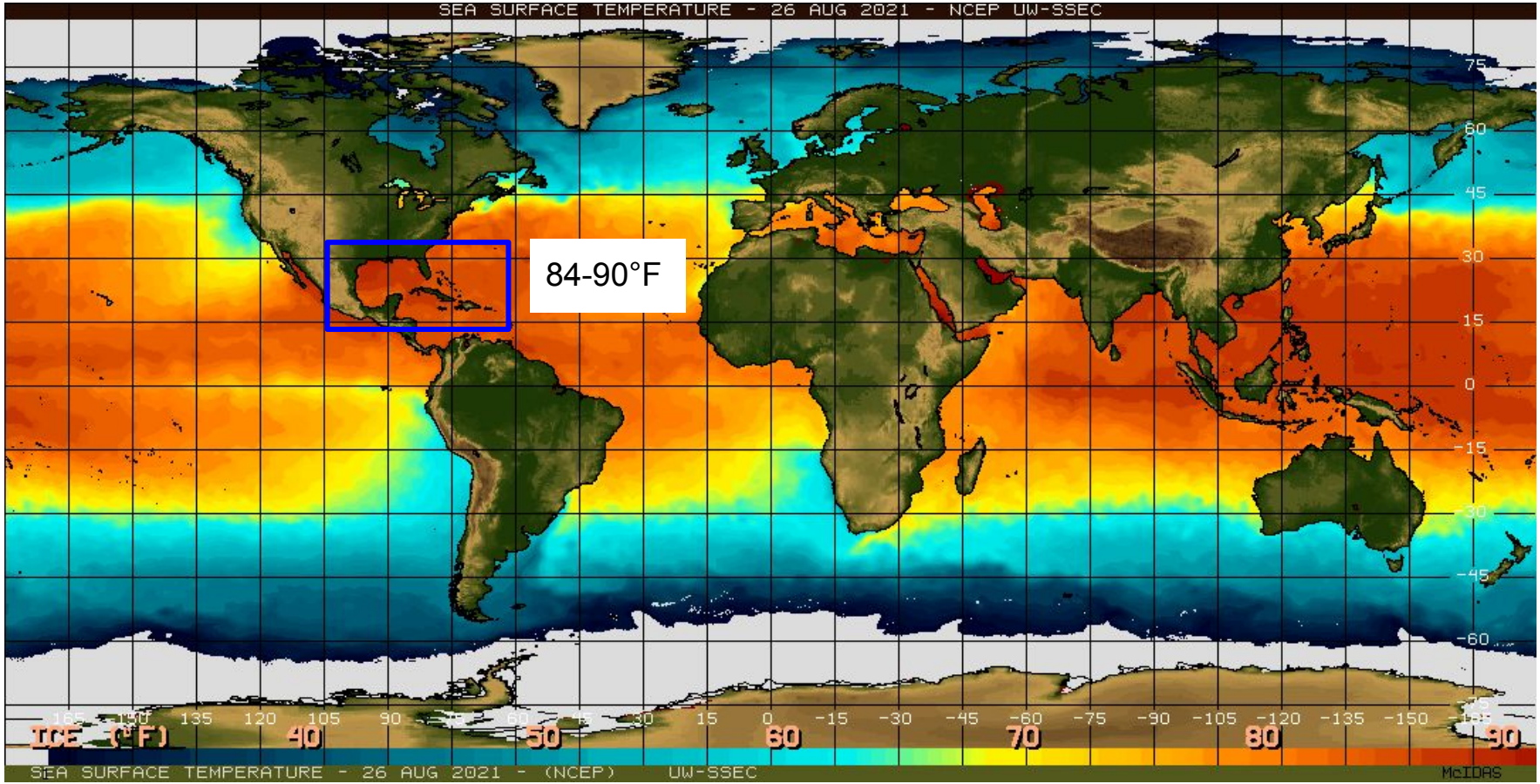
Record-breaking rainfall: 1.94” in one hour observed at Central Park ASOS

4.47” 24-hour rainfall reported at Central Park ASOS

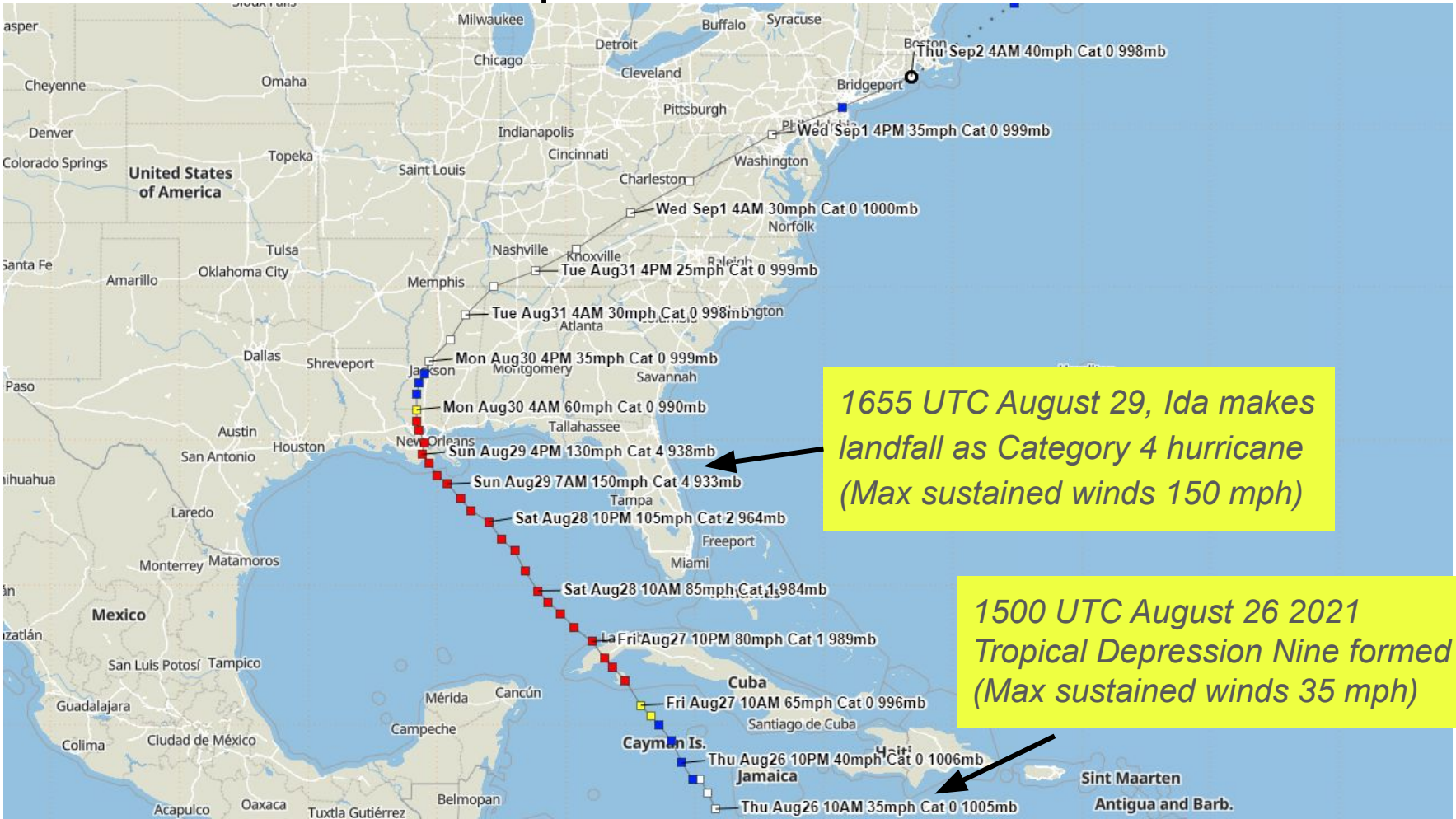
One of the wettest days in Central Park since Long Island flooding event August 14, 2014



Formation and Rapid Intensification of Hurricane Ida

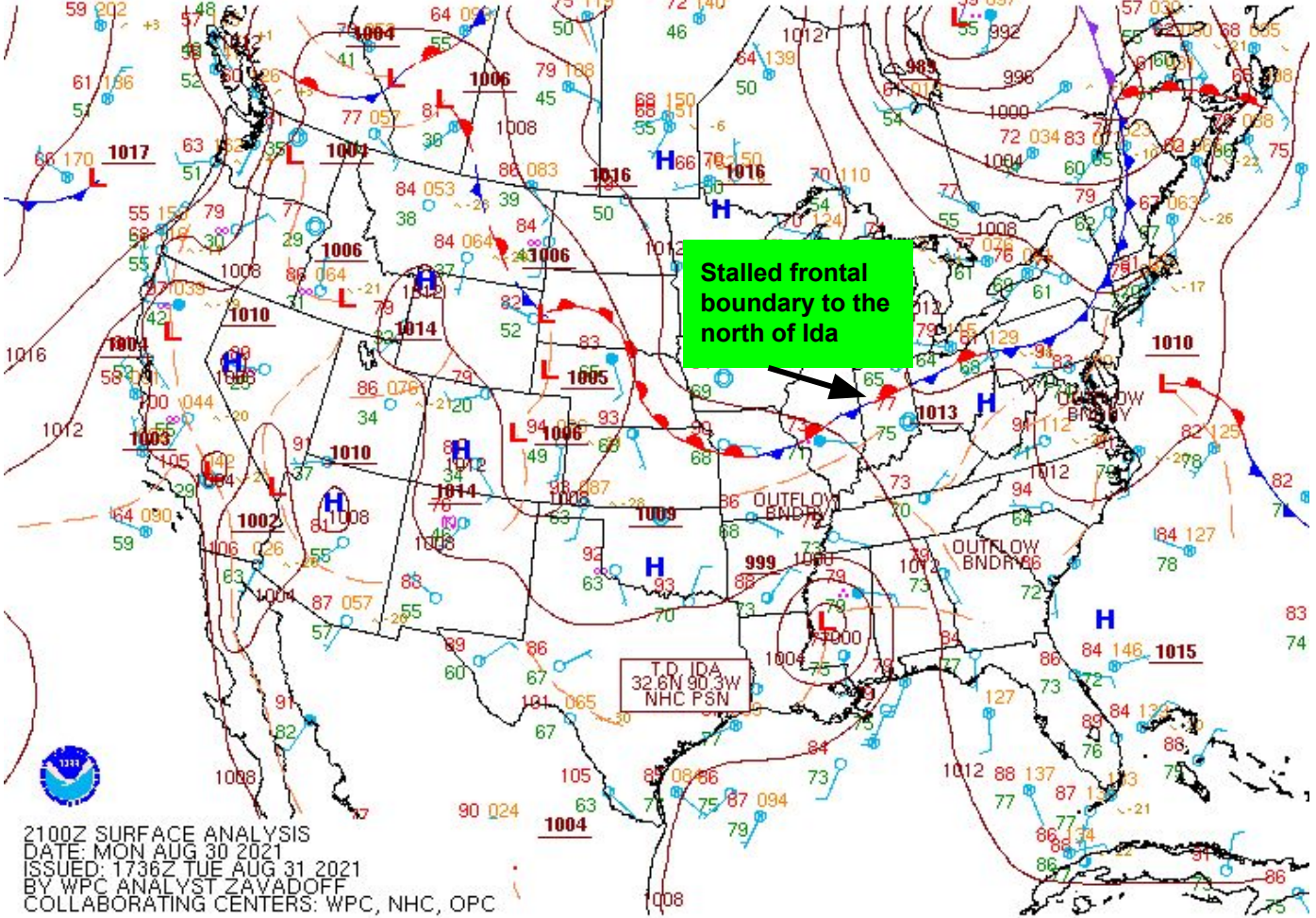


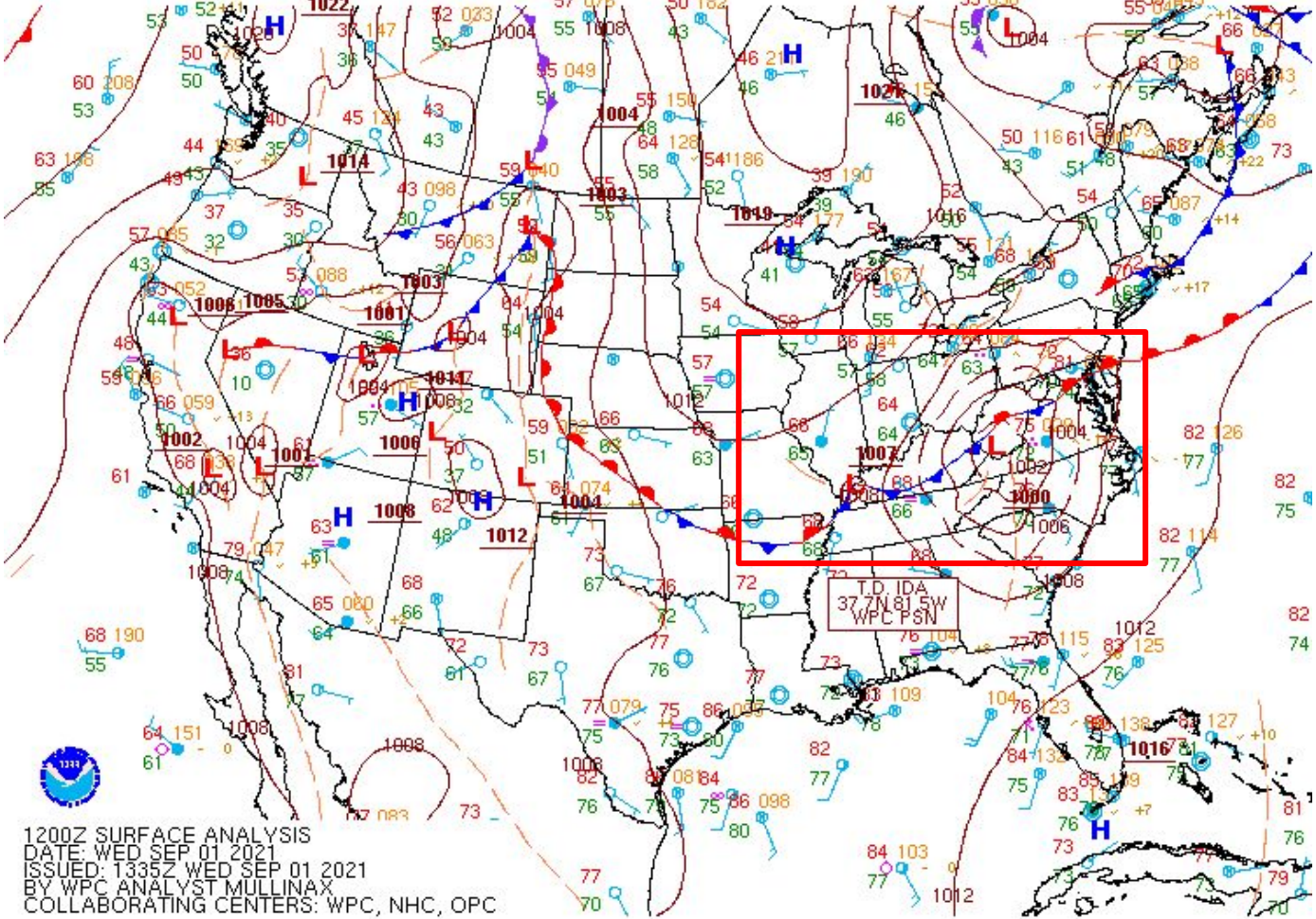
Formation and Rapid Intensification of Hurricane Ida

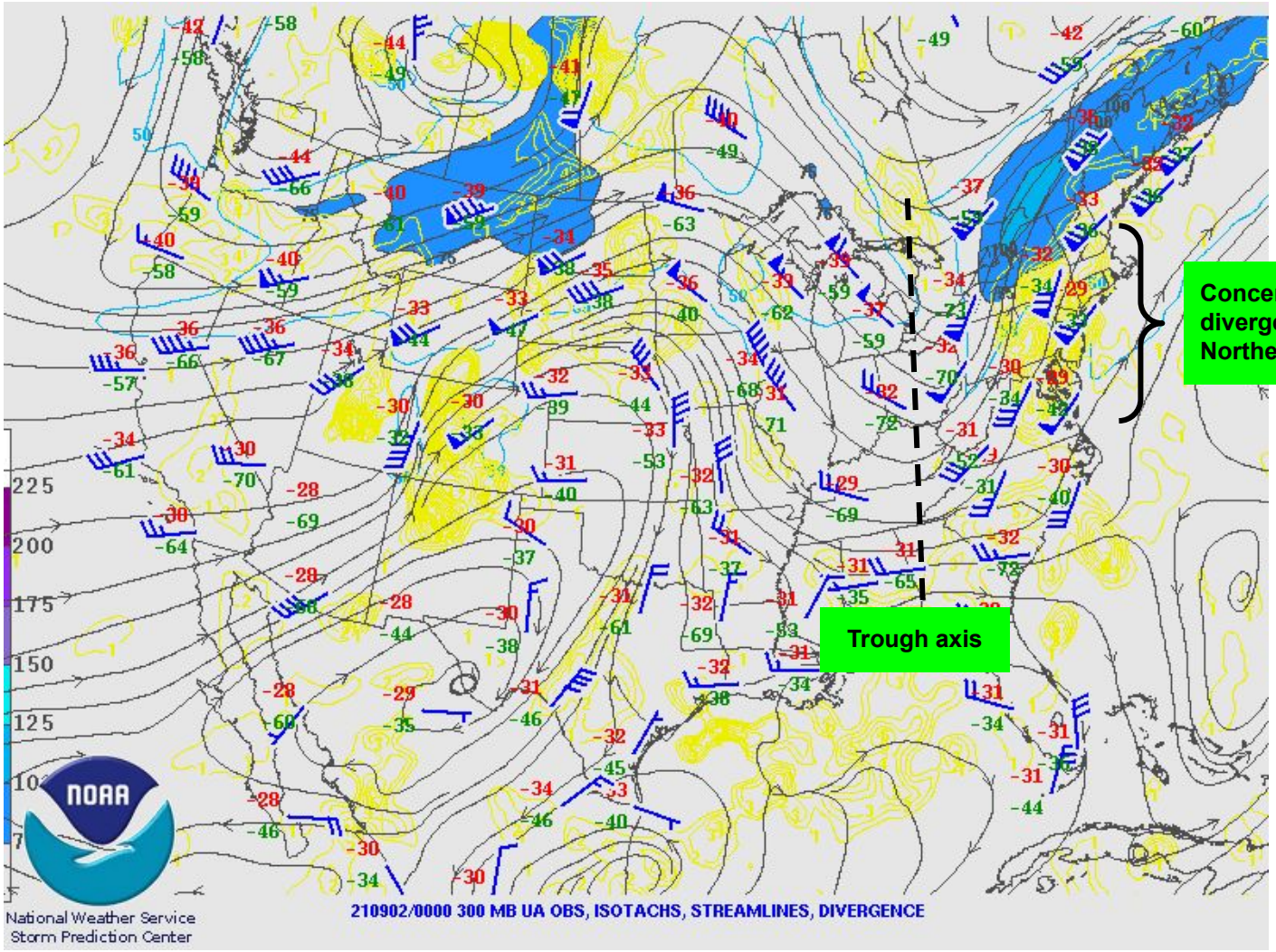


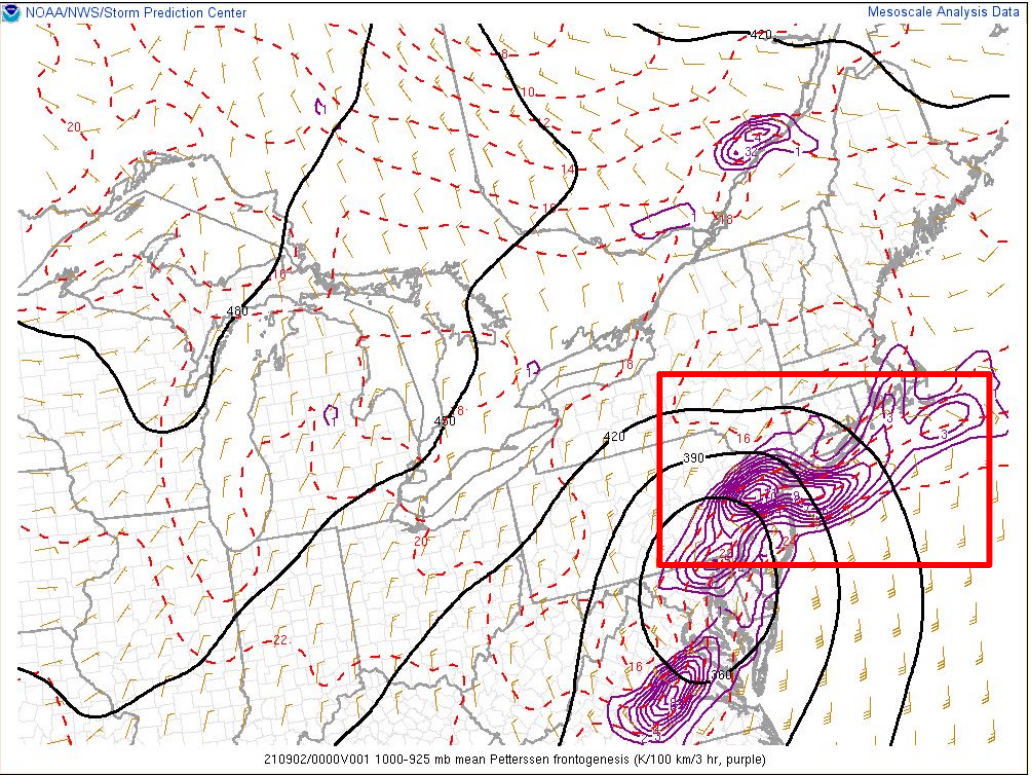
1655 UTC August 29, Ida makes landfall as Category 4 hurricane (Max sustained winds 150 mph)

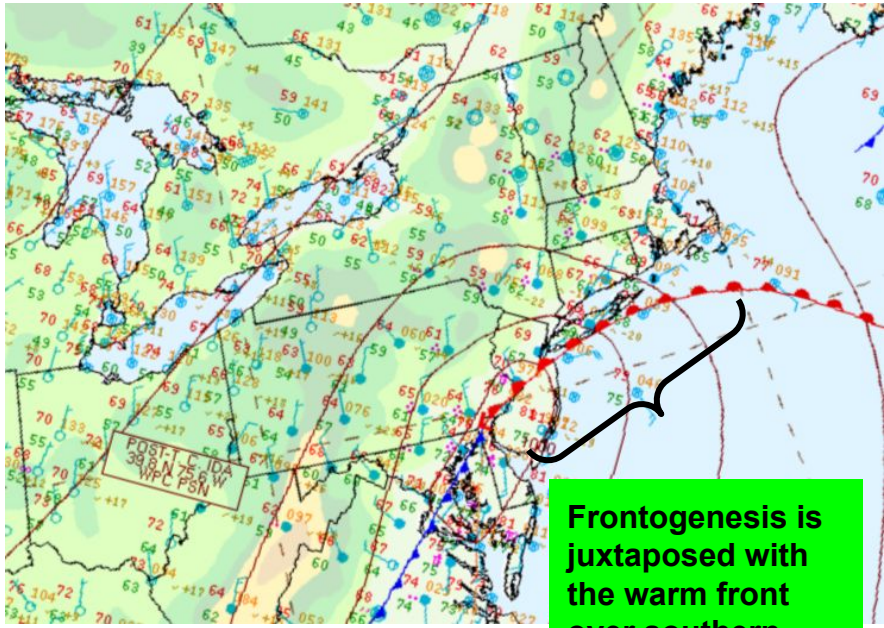
1500 UTC August 26 2021 Tropical Depression Nine formed (Max sustained winds 35 mph)


Stalled frontal boundary to the north of Ida
T.D. IDA
32.6N 90.3W
NHC PSN
OUTFLOW BNDRY
OUTFLOW BNDRY
2100Z SURFACE ANALYSIS
DATE: MON AUG 30 2021
ISSUED: 1736Z TUE AUG 31 2021
BY WPC ANALYST ZAVADOFF
COLLABORATING CENTERS: WPC, NHC, OPC


T.D. IDA
37.7N 81.5W
WPC PSN
1200Z SURFACE ANALYSIS
DATE: WED SEP 01 2021
ISSUED: 1335Z WED SEP 01 2021
BY WPC ANALYST MULLINAX
COLLABORATING CENTERS: WPC, NHC, OPC

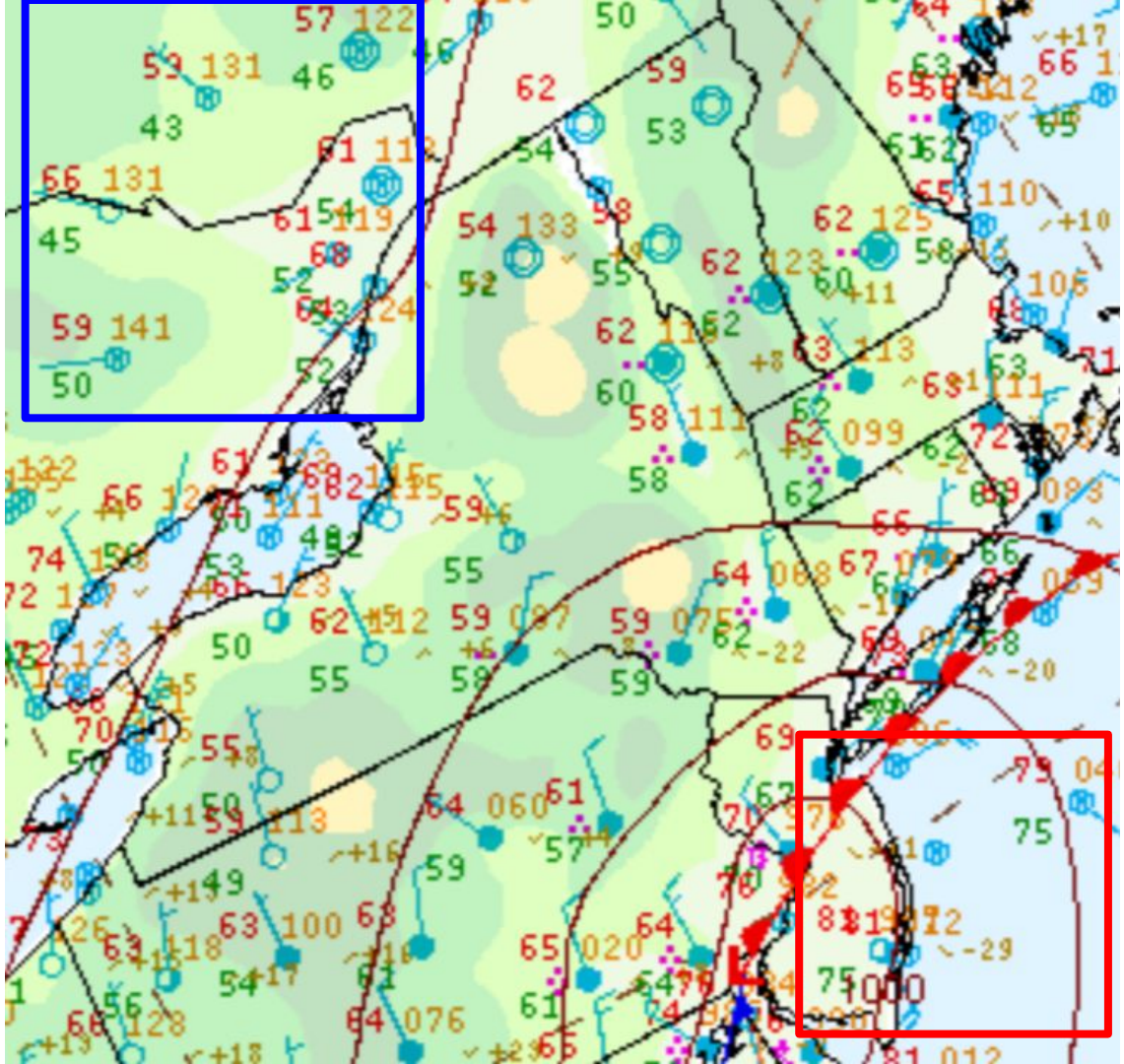

Concentrated divergence over Northeast
Trough axis
National Weather Service
Storm Prediction Center
210902/0000 300 MB UA OBS, ISOTACHS, STREAMLINES, DIVERGENCE





Frontogenesis is juxtaposed with the warm front over southern New York & New Jersey

Air mass well north of the warm front in 50s and low 60s, dewpoints in 40s or low 50s



Air mass behind the warm front in high 70s-low 80s, dew points in high 70s

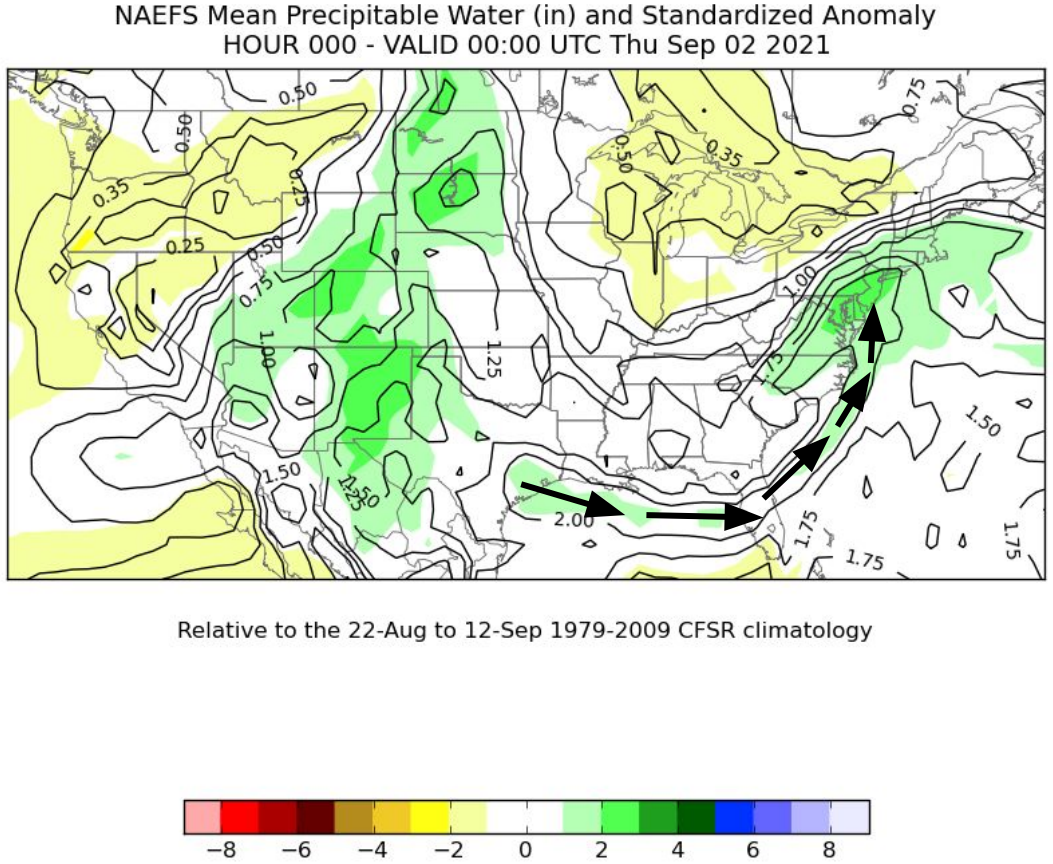
0000 UTC
02 September

CONUS PWAT Anomalies

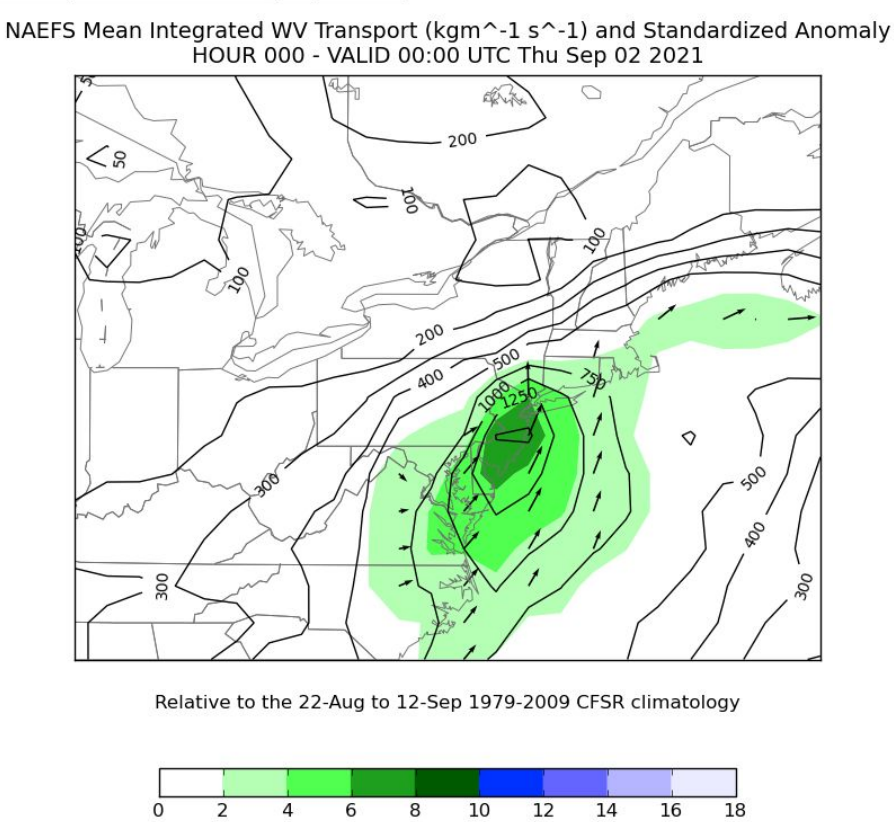
Ida brought an influx of warm, moist tropical air (1-3 standard deviations above normal) to the Northeast U.S. as it propagated north from the Gulf of Mexico.

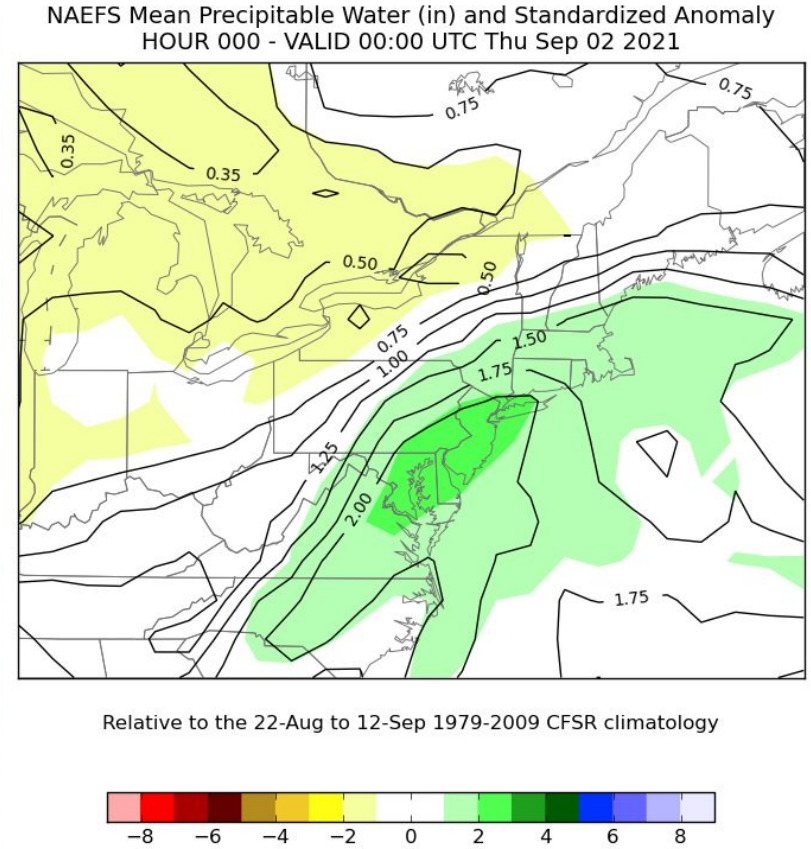
Strong southwesterly winds downstream of the amplifying trough enhanced the moisture transport from the Gulf and western Atlantic.

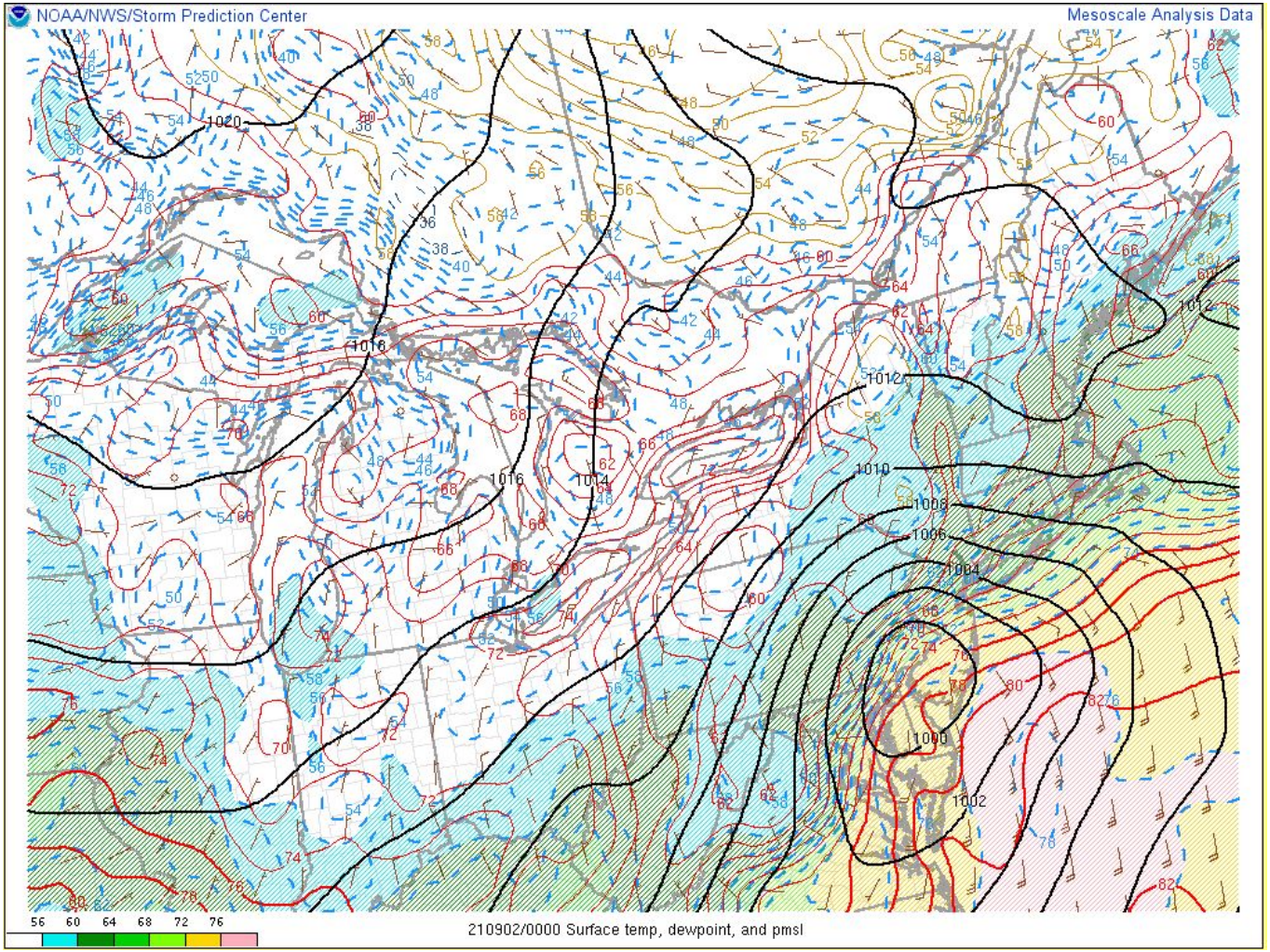
The combination of high precipitable water values and forcing for ascent due to the surface frontal boundary and strong jet streak resulted in intense rainfall.

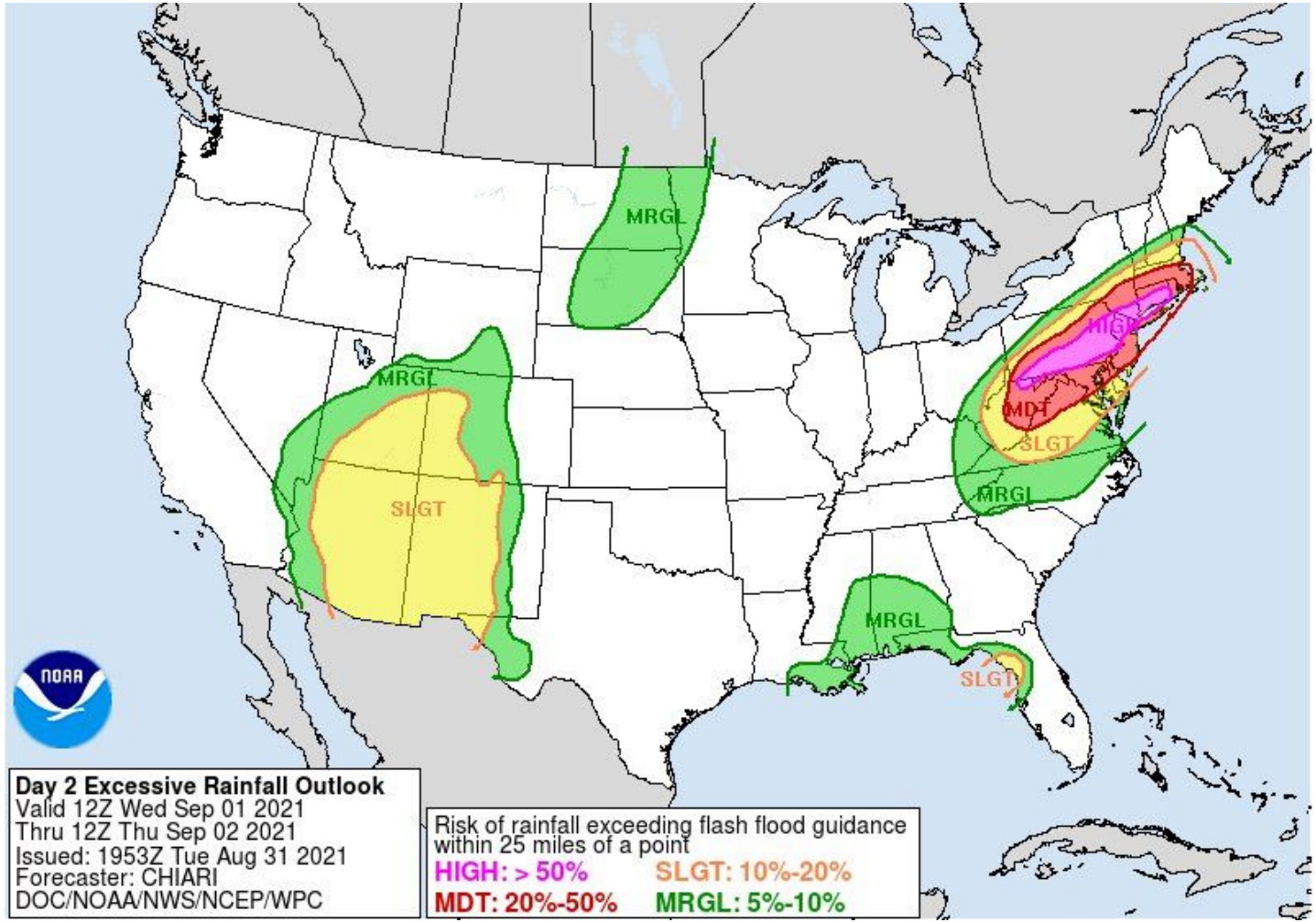


Moisture Transport & PWAT Anomalies for Northeast U.S.



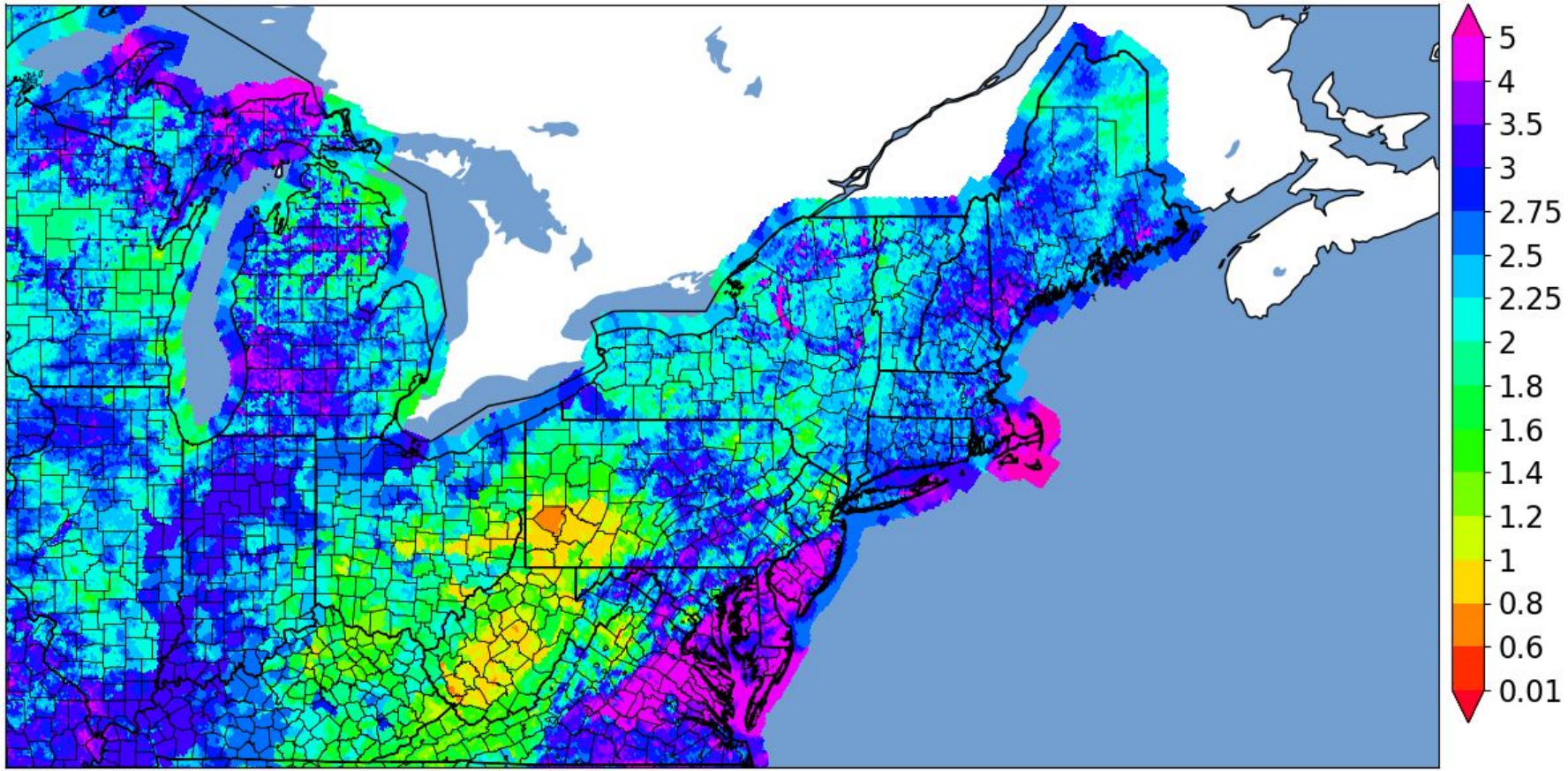



NOAA/NWS/Storm Prediction Center
Mesoscale Analysis Data
56 60 64 68 72 76
210902/0000 Surface temp, dewpoint, and pmsl


MRGL
MRGL
SLGT
HIGH
MDT
SLGT
MRGL
MRGL
SLGT
Day 2 Excessive Rainfall Outlook
Valid 12Z Wed Sep 01 2021
Thru 12Z Thu Sep 02 2021
Issued: 1953Z Tue Aug 31 2021
Forecaster: CHIARI
DOC/NOAA/NWS/NCEP/WPC
Risk of rainfall exceeding flash flood guidance within 25 miles of a point
HIGH: > 50%
SLGT: 10%-20%
MDT: 20%-50%
MRGL: 5%-10%

NWS RFC 3 Hour Flash Flood Guidance on 1 Sep 2021 12 UTC

Estimated amount of Three Hour Rainfall needed for non-urban Flash Flooding to commence



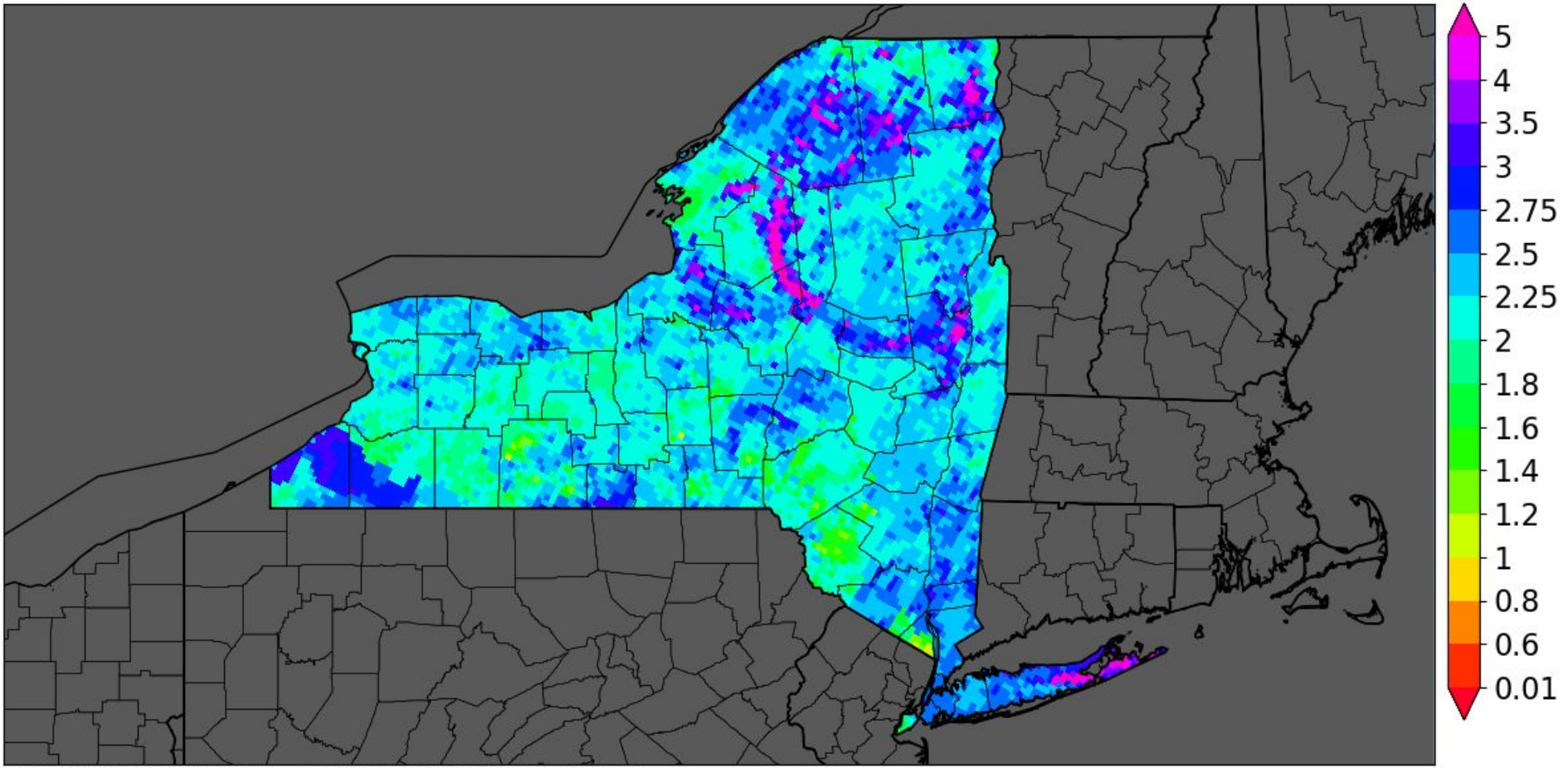
Iowa Environmental Mesonet :: generated 14 January 2022 11:04 PM

Generated at 14 Jan 2022 11:04 PM CST in 8.03s

IEM Autoplot App #178

NWS RFC 3 Hour Flash Flood Guidance on 1 Sep 2021 12 UTC

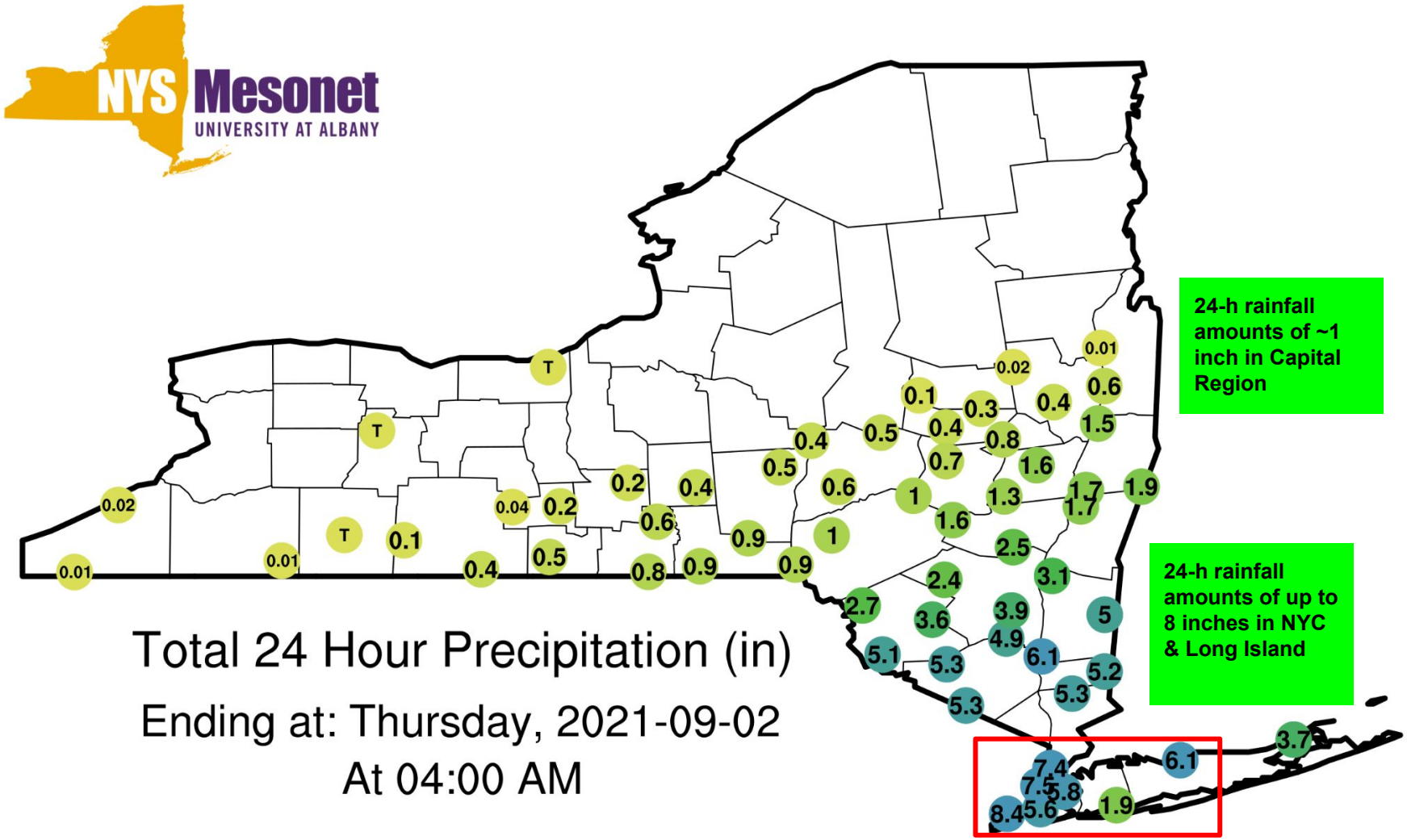
Estimated amount of Three Hour Rainfall needed for non-urban Flash Flooding to commence



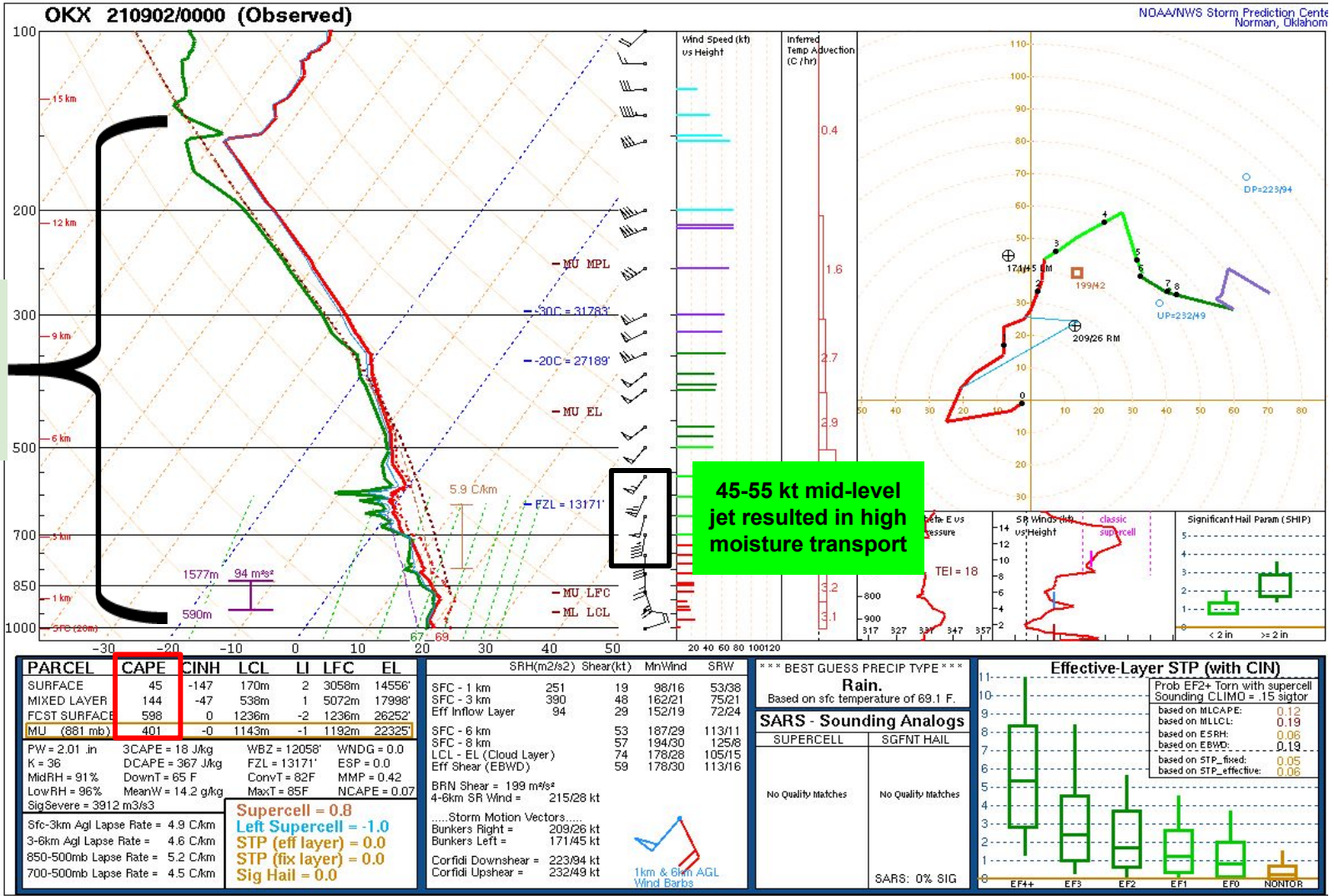
Iowa Environmental Mesonet :: generated 14 January 2022 11:00 PM

Generated at 14 Jan 2022 11:00 PM CST in 13.34s

IEM Autoplot App #178


NYS Mesonet
UNIVERSITY AT ALBANY
24-h rainfall amounts of ~1 inch in Capital Region
24-h rainfall amounts of up to 8 inches in NYC & Long Island
Total 24 Hour Precipitation (in)
Ending at: Thursday, 2021-09-02
At 04:00 AM
T
0.01
0.02
0.04
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.3
1.5
1.6
1.7
1.9
2.4
2.5
2.7
3.1
3.6
3.75
3.9
4.9
5
5.1
5.2
5.3
5.8
6.1
7.4
7.5
8.4

Deep moisture through the column



PARCEL	CAPE	CINH	LCL	LI	LFC	EL
SURFACE	45	-147	170m	2	3058m	14556'
MIXED LAYER	144	-47	538m	1	5072m	17998'
FCST SURFACE	598	0	1236m	-2	1236m	26252'
MU (881 mb)	401	-0	1143m	-1	1192m	22325'

PW = 2.01 in	3CAPE = 18 J/kg	WBZ = 12058'	WNDG = 0.0
K = 36	DCAPE = 367 J/kg	FZL = 13171'	ESP = 0.0
MidRH = 91%	DownT = 65 F	ConvT = 82F	MMP = 0.42
LowRH = 96%	MeanW = 14.2 g/kg	MaxT = 85F	NCAPE = 0.07
SigSevere = 3912 m3/s3			

Sfc-3km Agl Lapse Rate =	4.9 C/km
3-6km Agl Lapse Rate =	4.6 C/km
850-500mb Lapse Rate =	5.2 C/km
700-500mb Lapse Rate =	4.5 C/km

Supercell = 0.8
Left Supercell = -1.0
STP (eff layer) = 0.0
STP (fix layer) = 0.0
Sig Hail = 0.0

	SRH(m2/s2)	Shear(kt)	MnWind	SRW
SFC - 1 km	251	19	98/16	53/38
SFC - 3 km	390	48	162/21	75/21
Eff Inflow Layer	94	29	152/19	72/24
SFC - 6 km		53	187/29	113/11
SFC - 8 km		57	194/30	125/8
LCL - EL (Cloud Layer)		74	178/28	105/15
Eff Shear (EBWD)		59	178/30	113/16

BRN Shear = 199 m²/s²
4-6km SR Wind = 215/28 kt

.....Storm Motion Vectors.....
Bunkers Right = 209/26 kt
Bunkers Left = 171/45 kt

Corfidi Downshear = 223/94 kt
Corfidi Upshear = 232/49 kt

1km & 6km AGL Wind Barbs

*** BEST GUESS PRECIP TYPE ***
Rain.
Based on sfc temperature of 69.1 F.

SARS - Sounding Analogs

SUPERCELL	SGFNT HAIL
No Quality Matches	No Quality Matches

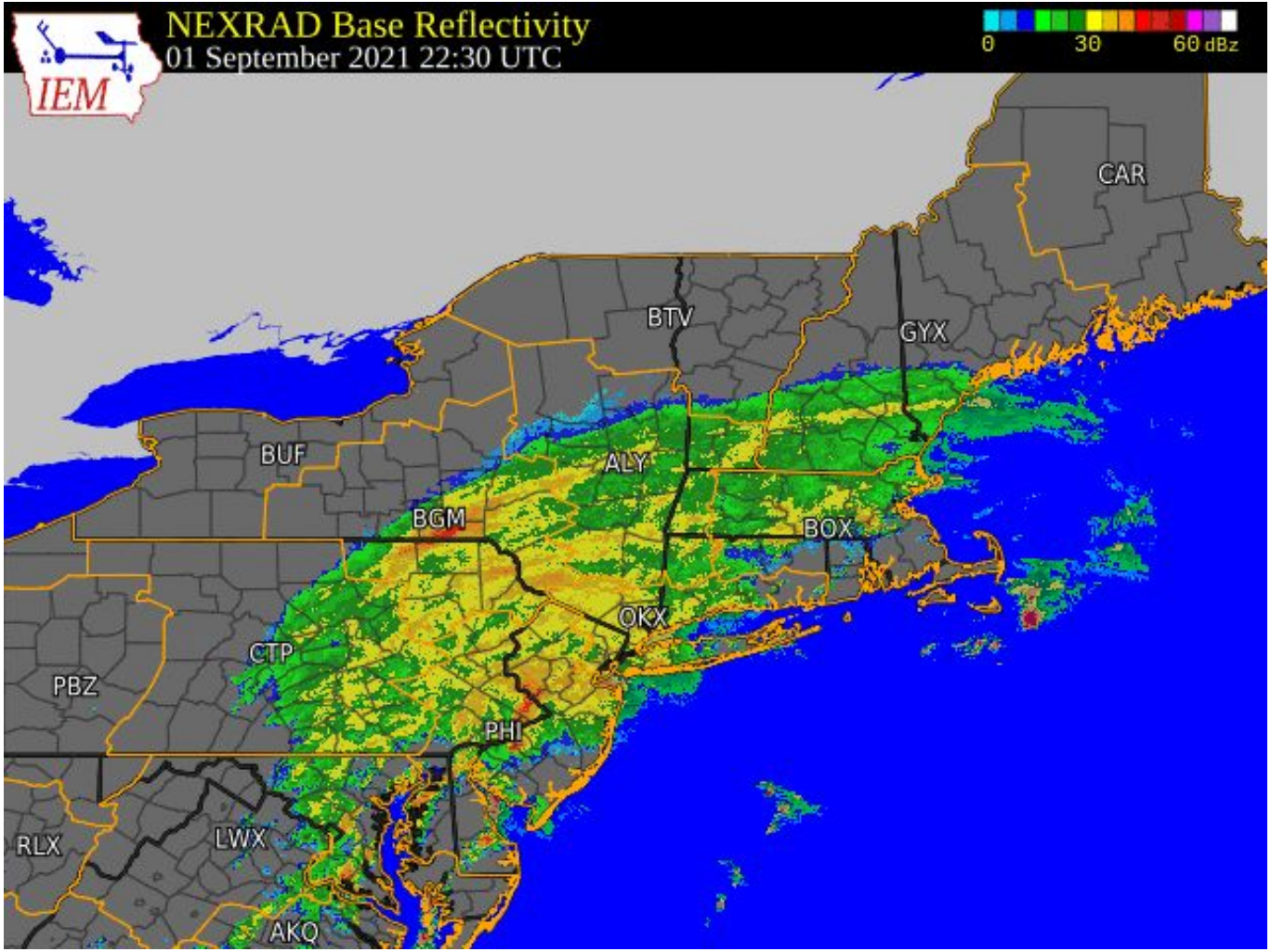
SARS: 0% SIG

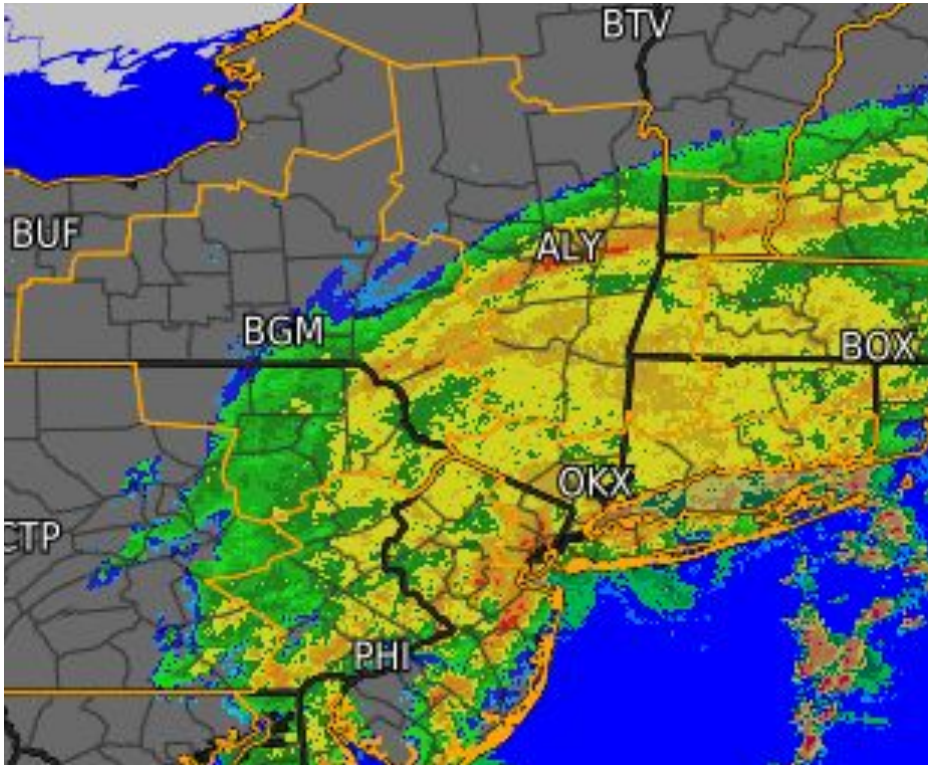
Effective-Layer STP (with CIN)

Prob EF2+ Torn with supercell
Sounding CLIMO = .15 sigtor

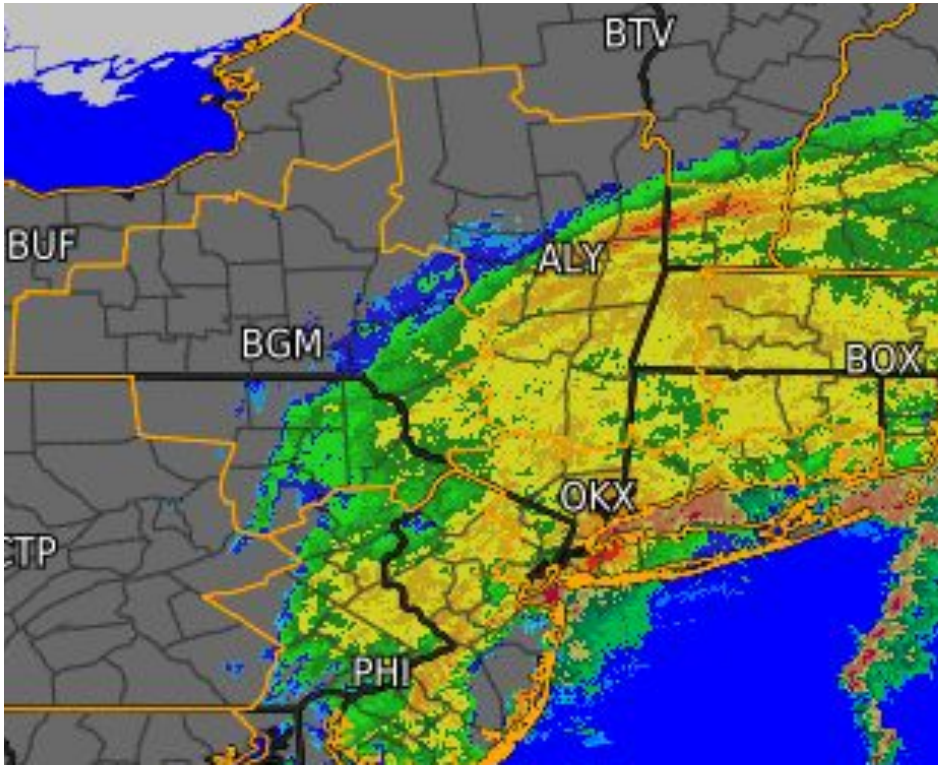
based on MLCAPE:	0.12
based on MLLCL:	0.19
based on ESRH:	0.06
based on EBWD:	0.19
based on STP_fixed:	0.05
based on STP_effective:	0.06

EF4+ EF3 EF2 EF1 EF0 NONTOR


NEXRAD Base Reflectivity
01 September 2021 22:30 UTC
IEM
0
30
60 dBz
CAR
BTV
GYX
BUF
ALY
BGM
BOX
OKX
CTP
PBZ
PHI
RLX
LWX
AKQ

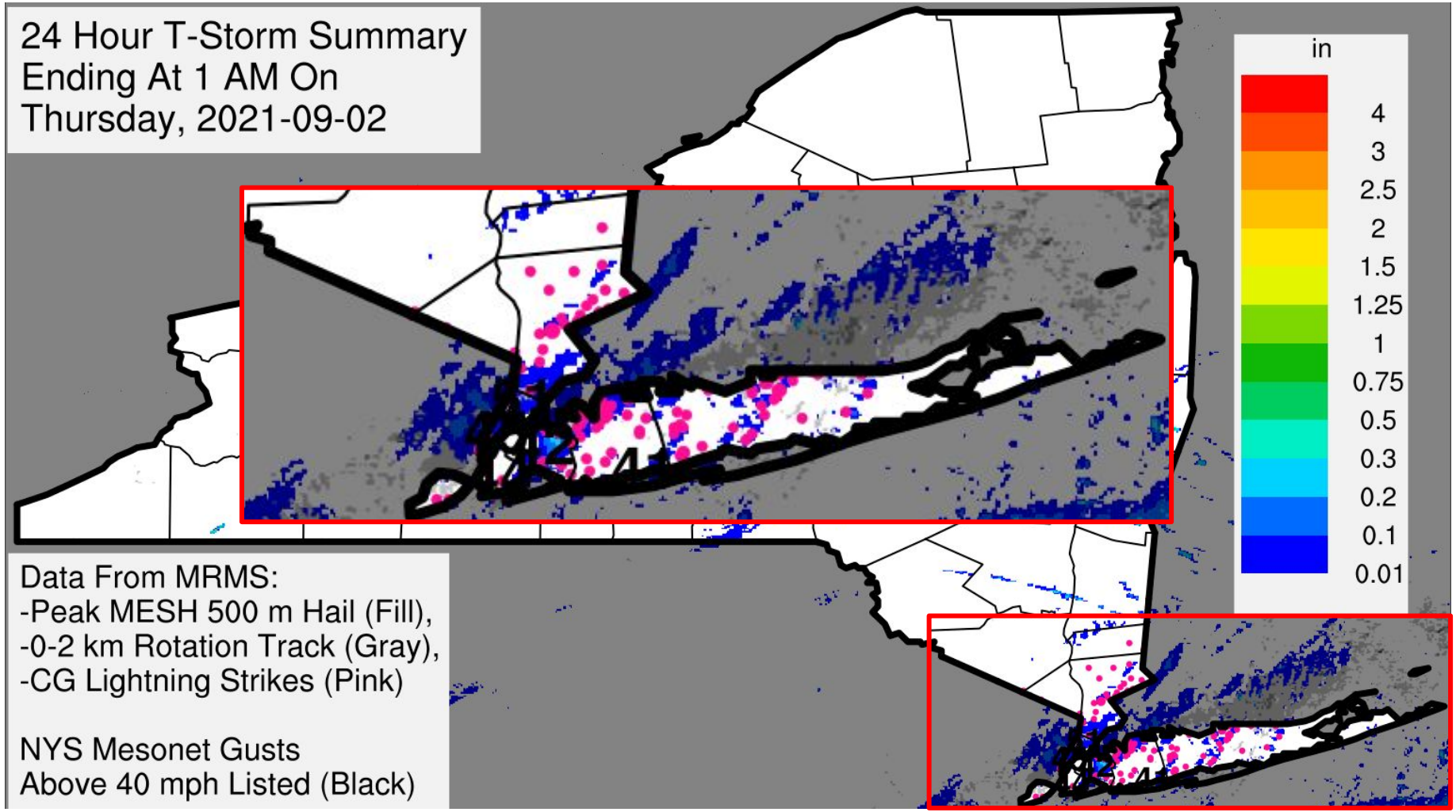


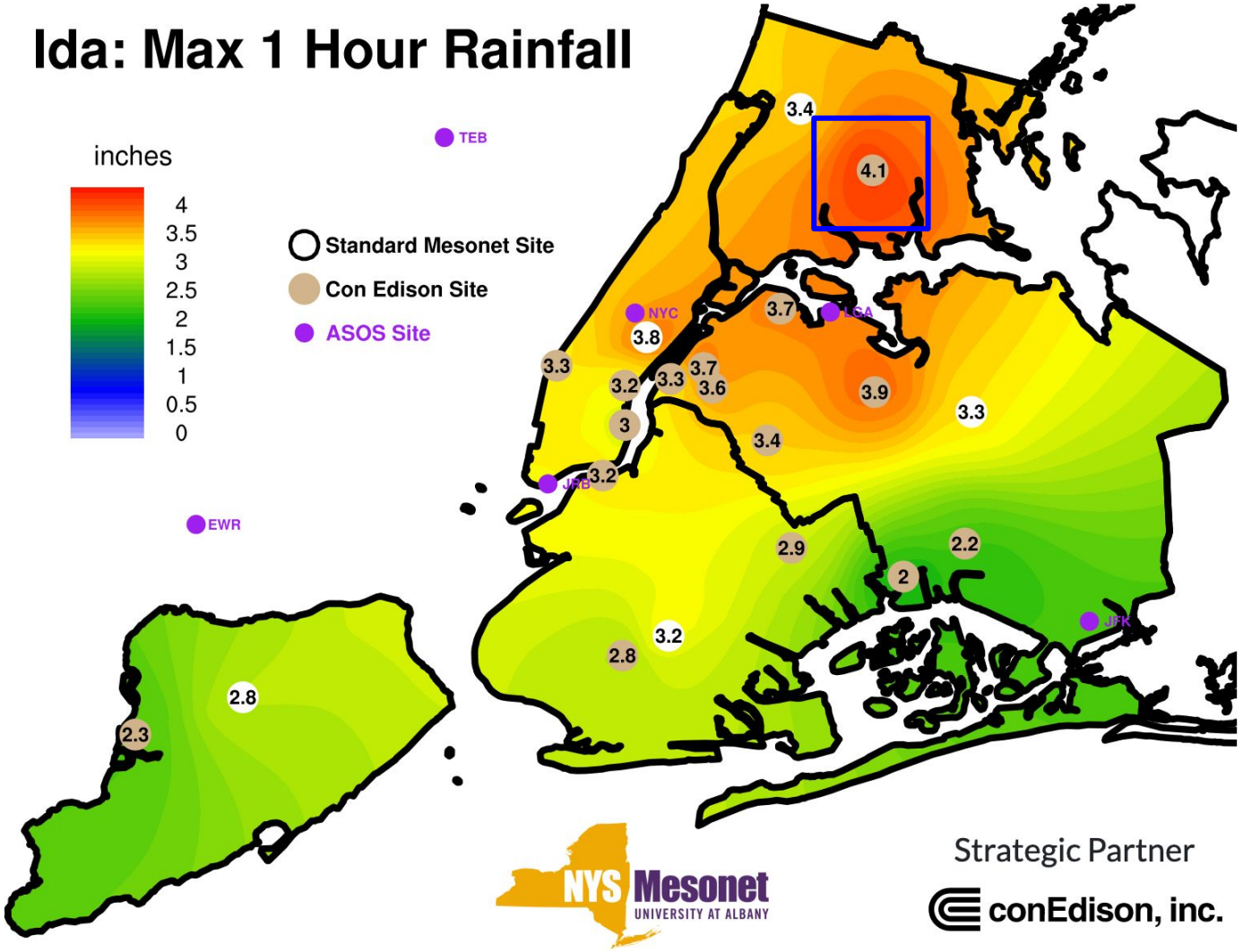
NEXRAD Base Reflectivity
02 Sept 2021 00:45 UTC



NEXRAD Base Reflectivity
02 Sept 2021 02:10 UTC

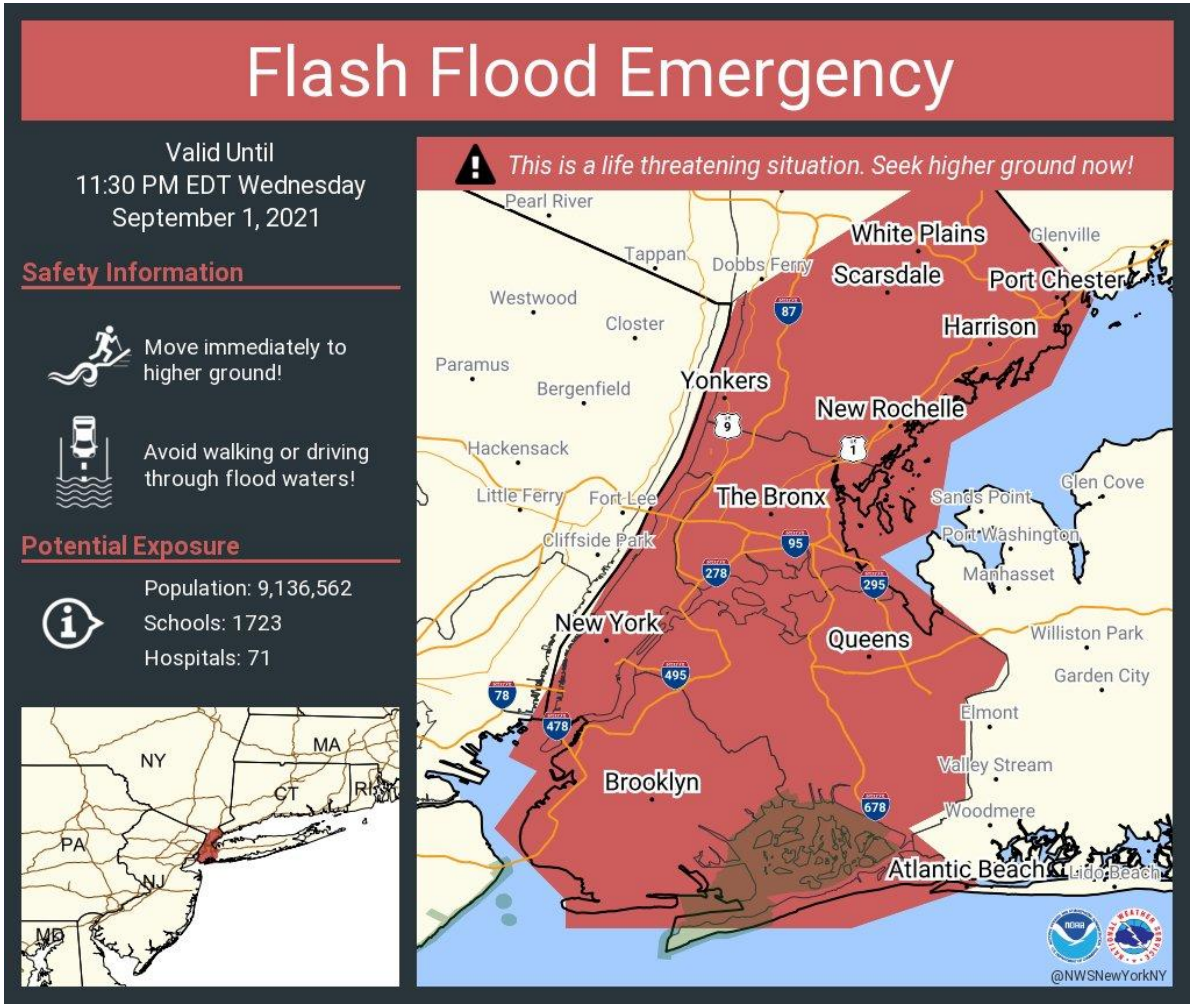
23 UTC 01 September - 0230 UTC 02 September 2021 ENX Loop of Very Heavy Rain Training Over Mid-Hudson Valley & Western New England. Notice Sharp Gradient over Capital District


24 Hour T-Storm Summary
Ending At 1 AM On
Thursday, 2021-09-02
in
4
3
2.5
2
1.5
1.25
1
0.75
0.5
0.3
0.2
0.1
0.01
Data From MRMS:
-Peak MESH 500 m Hail (Fill),
-0-2 km Rotation Track (Gray),
-CG Lightning Strikes (Pink)
NYS Mesonet Gusts
Above 40 mph Listed (Black)


Ida: Max 1 Hour Rainfall
inches
4
3.5
3
2.5
2
1.5
1
0.5
0
Standard Mesonet Site
Con Edison Site
ASOS Site
TEB
NYC
LGA
JRB
EWR
JFK
3.4
4.1
3.7
3.8
3.3
3.2
3.3
3.7
3.6
3.9
3.3
3
3.4
3.2
2.9
2.2
2
3.2
2.8
2.8
2.3
NYS Mesonet
UNIVERSITY AT ALBANY
Strategic Partner
conEdison, inc.

Impacts in NYC

First and second ever Flash Flood Emergency issued by the National Weather Service Office in Upton, NY for NYC



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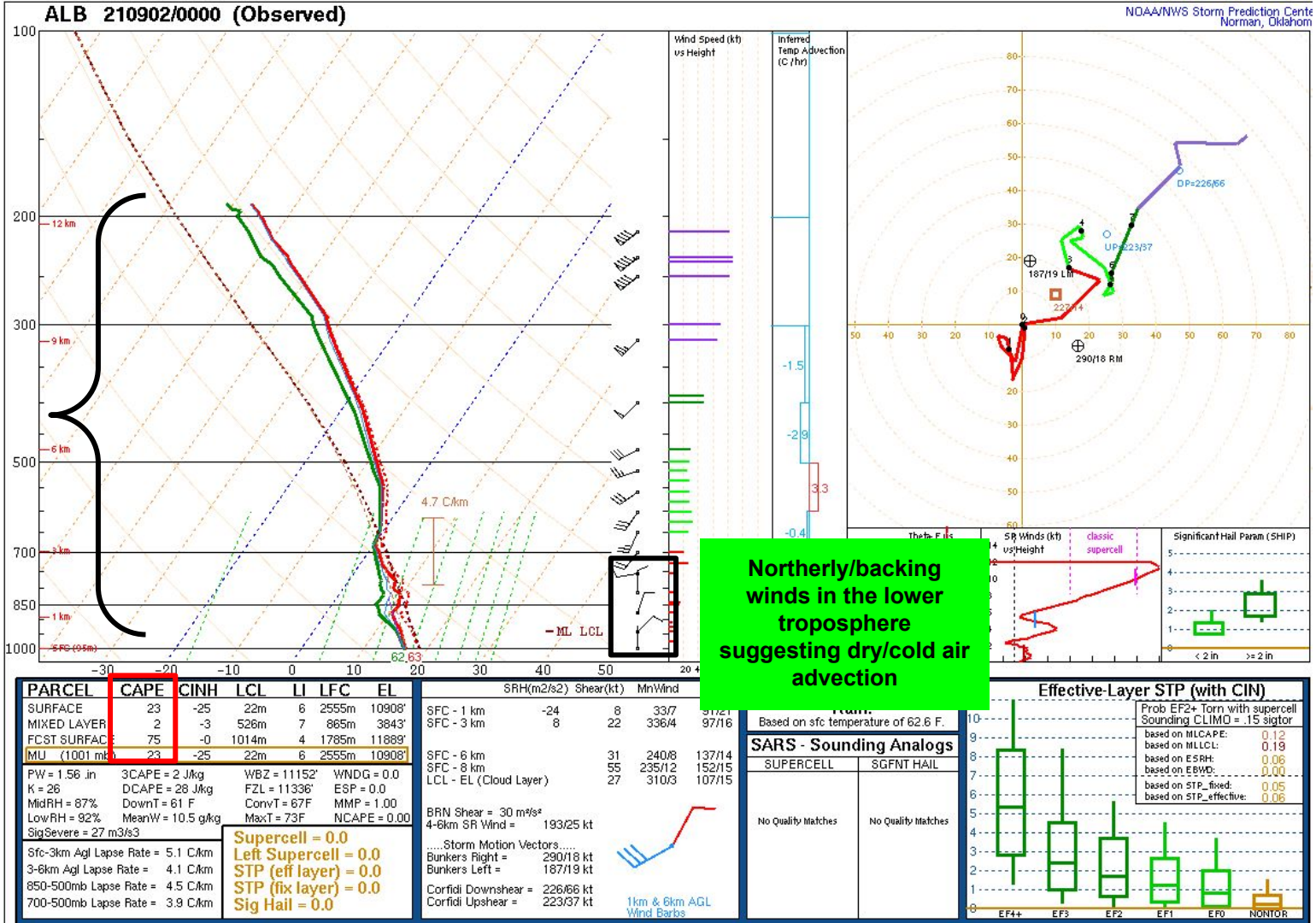
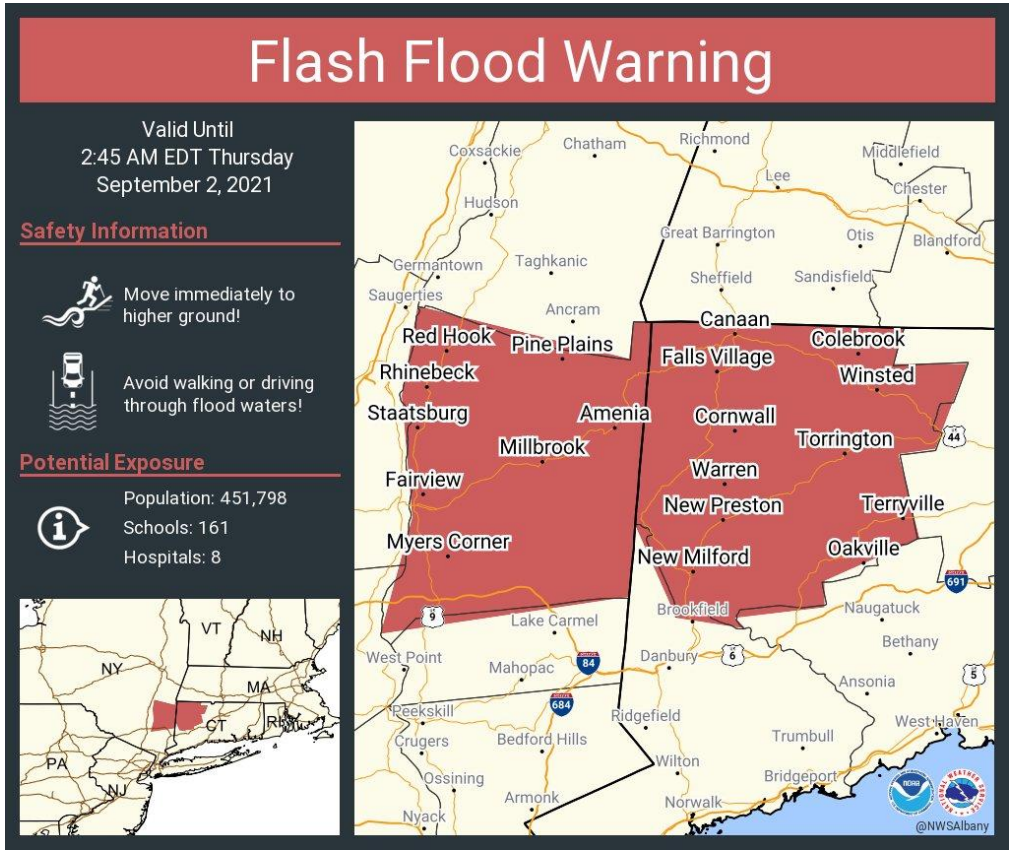


Impacts in Upstate New York & Connecticut

Though rainfall was not as intense as in NYC, rainfall totals still reached 4 to 6 inches in Ulster and Dutchess Counties in NY as well as Litchfield County CT which prompted Flash Flood Warnings. Regretfully, there was one fatality to flooding in Litchfield County.



Impacts in Upstate New York & Connecticut

Esopus, Ulster County

Rainfall total approx. 4 inches in 24 hours

Conclusions

- The heavy rainfall from TS Henri only ten days earlier resulted in wet antecedent conditions and therefore meant NJ and southern NY was more vulnerable to flash flooding
- The combination of an exceptionally moisture rich environment from Ida's extratropical transition and high moisture transport in the presence of strong forcing for ascent from a jet streak aloft and frontogenesis along a warm front resulted in heavy rainfall that persisted for multiple hours in southern NY.
- Record-breaking rainfall in the NYC metropolitan area resulted in the first ever Flash Flood Emergency issued by the local NWS office and widespread flooding over southern NY
- However, the strong precipitation gradient limited the effects of the heaviest rainfall from impacting most of the Capital region