



Pennsylvania
Emergency Management Agency

Future Rainfall Patterns & Change

October 21, 2025





Flash Flood Causes in PA

- High rainfall rates ($\geq 1.5''/\text{hr}$) in urban areas and regions of poor drainage
- Training thunderstorms
- Tropical remnants
- Stationary, upslope rainfall
- Riverine and ice jams
- Post-drought (hardened ground, runoff)

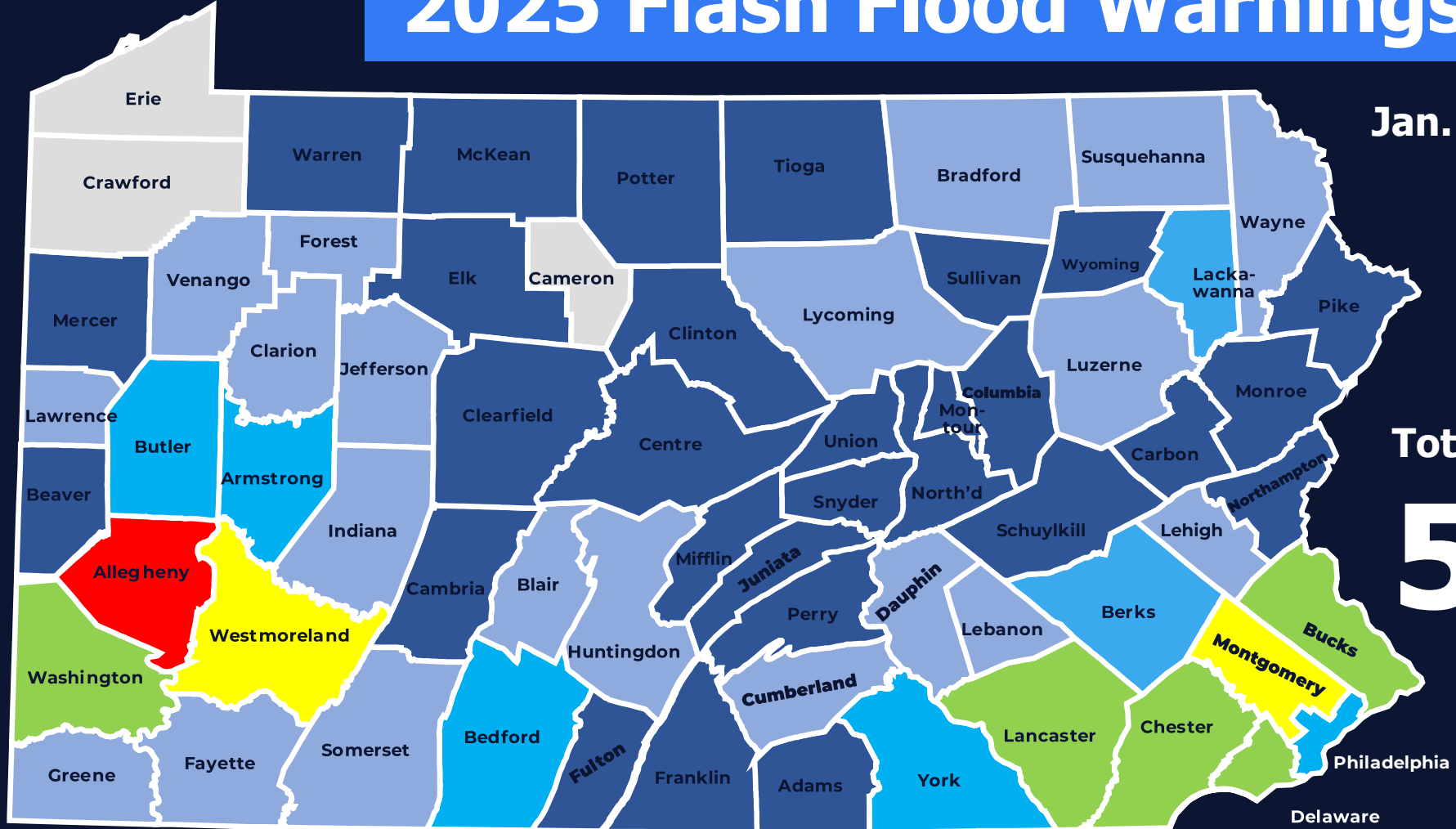


2025 Flash Flood Warnings



2025 Flash Flood Warnings

Jan. 1 – Oct. 20



Total:

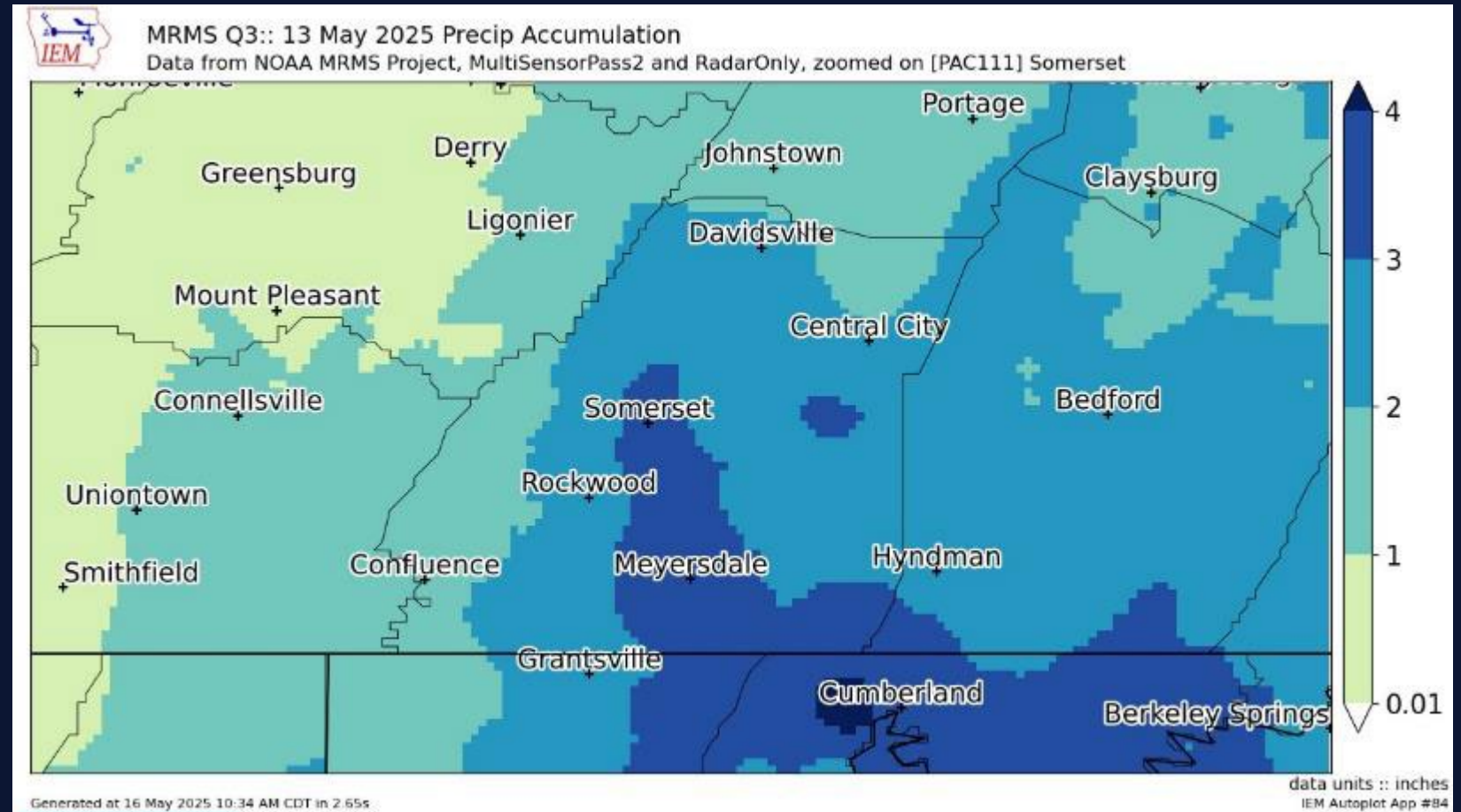
504

1 - 5 6 - 10 11 - 15 16 - 20 21 - 25 26 - 30 31 +



Meyersdale, Somerset Co.

- May 13, 2025



Meyersdale, Somerset Co.

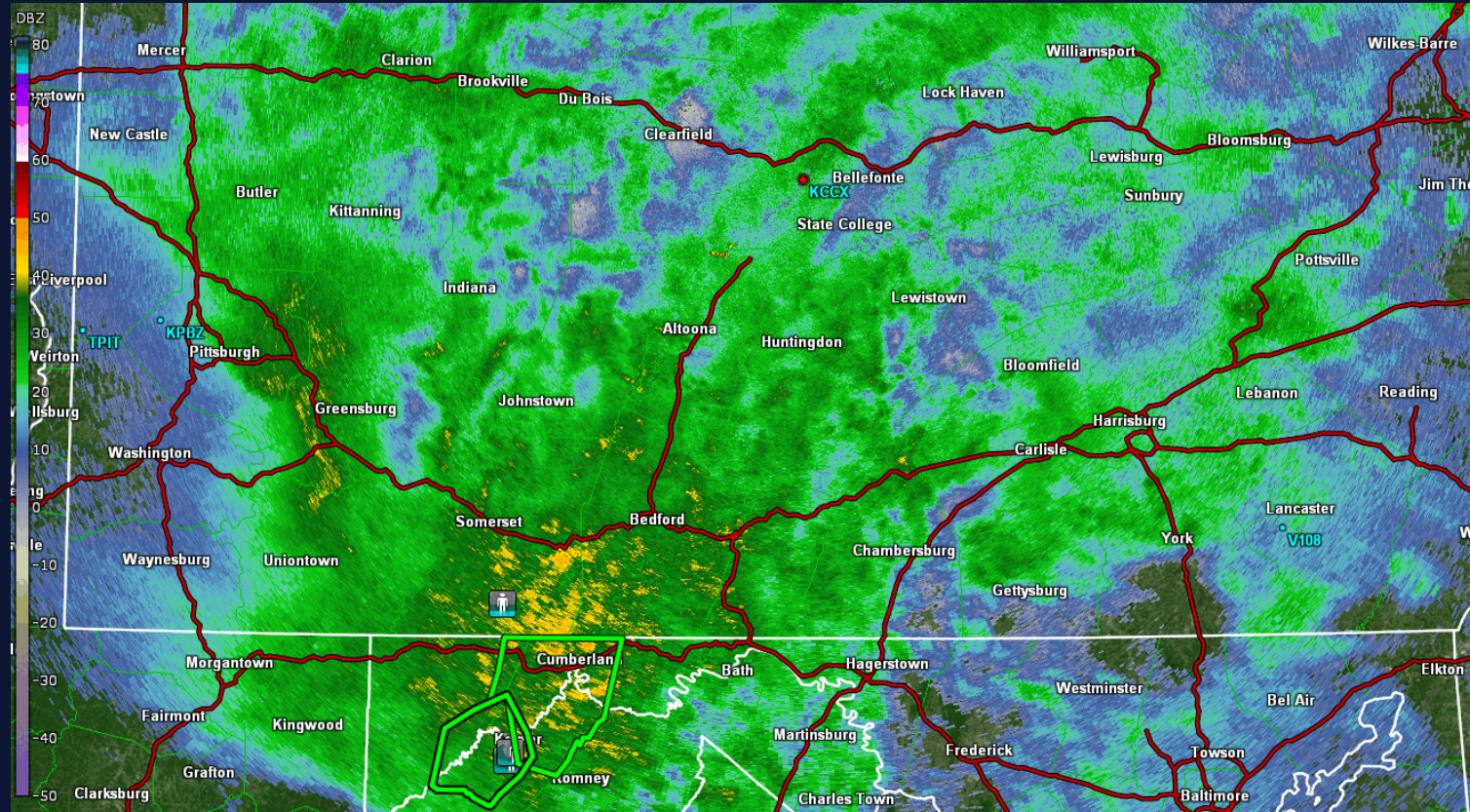
- May 13, 2025



Meyersdale, Somerset Co.

- May 13, 2025

NWS State College
radar loop

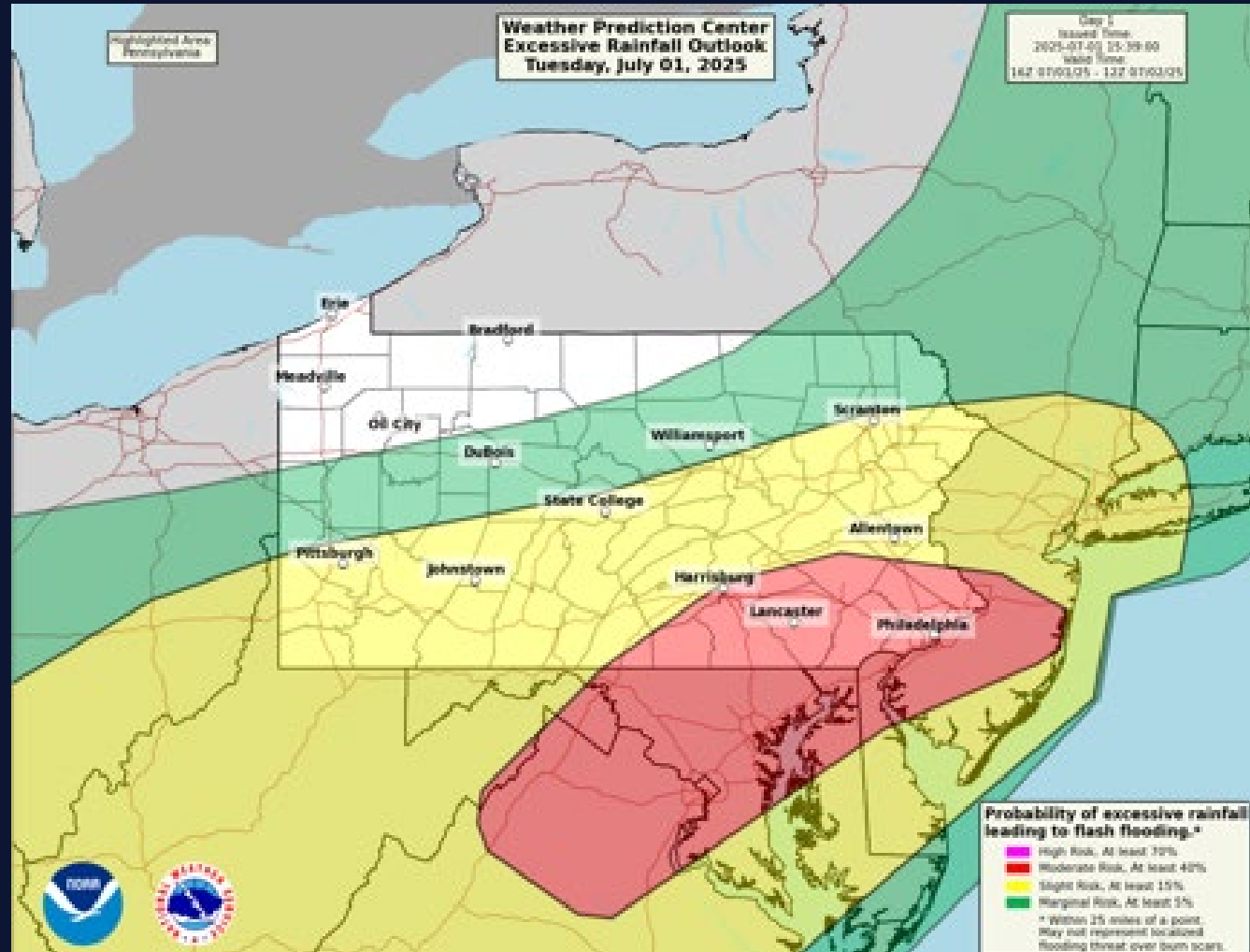


Mount Joy, Lancaster Co.

- June 30, 2025

WPC Excessive Rainfall Outlook (ERO) included a moderate risk area (level 3/4)

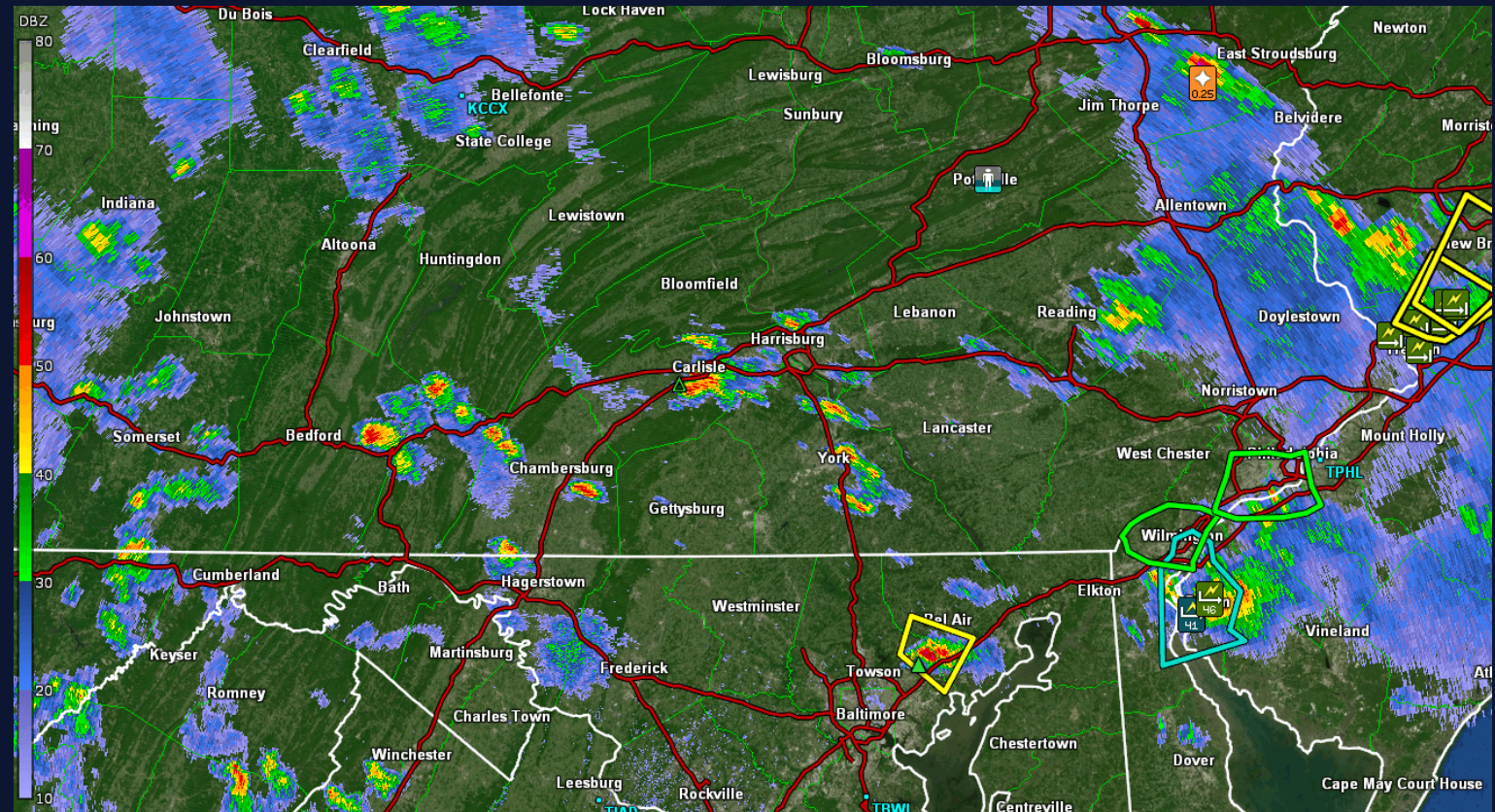
Occurs, on average, only 2-3 times per year



Mount Joy, Lancaster Co.

- June 30, 2025

NWS Sterling, VA
radar loop





Favorable Weather Patterns

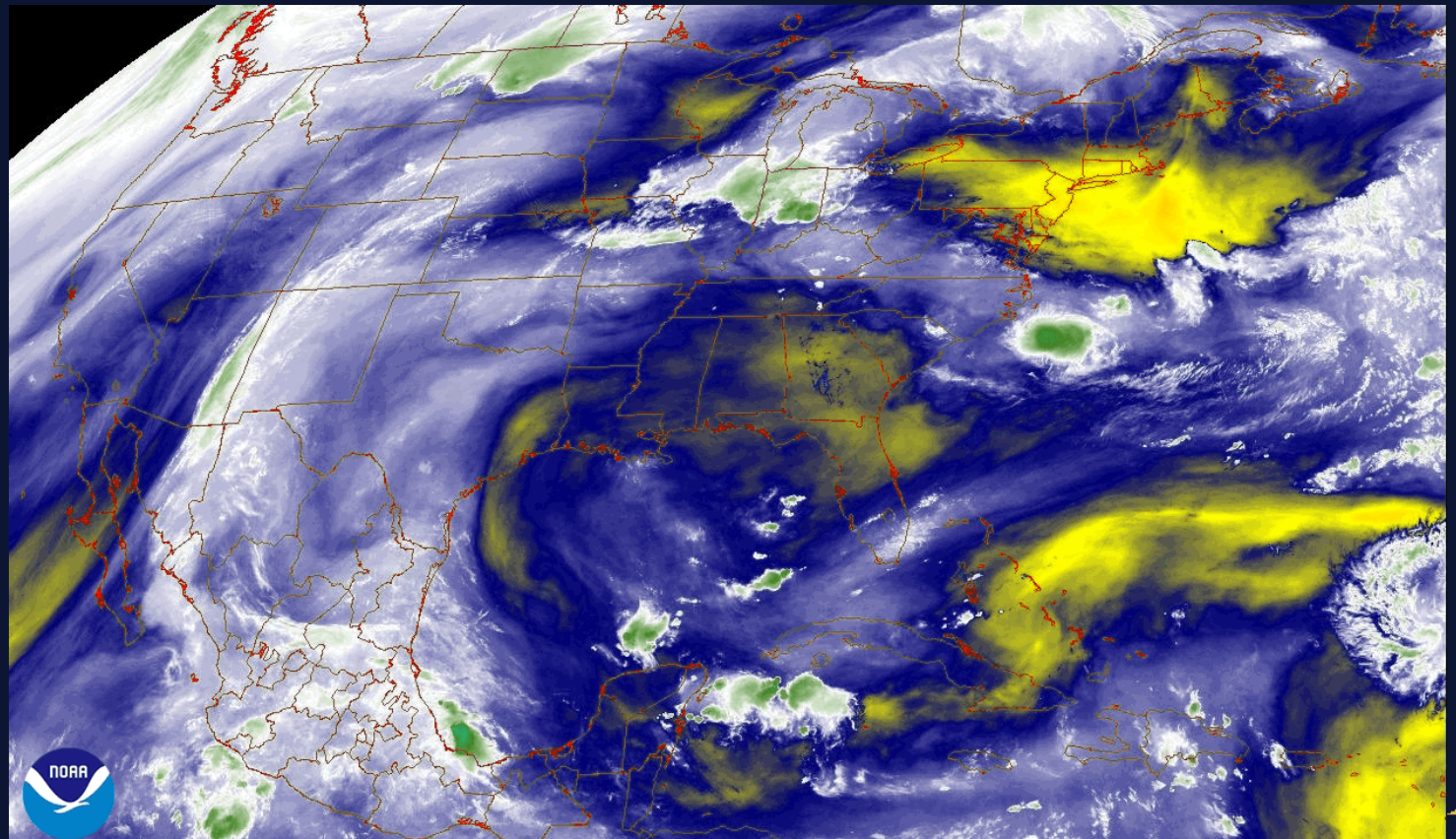
- Excessive humidity at surface
 - (Dewpoint $\geq$ 70 F / 21.1 C)
 - “Bermuda high pressure” directs flow from the Gulf / SW Atlantic
- Stationary front overhead / nearby
- Antecedent rainfall – areas already very wet





Forecasting Heavy Rainfall

- NESDIS mid-level water vapor

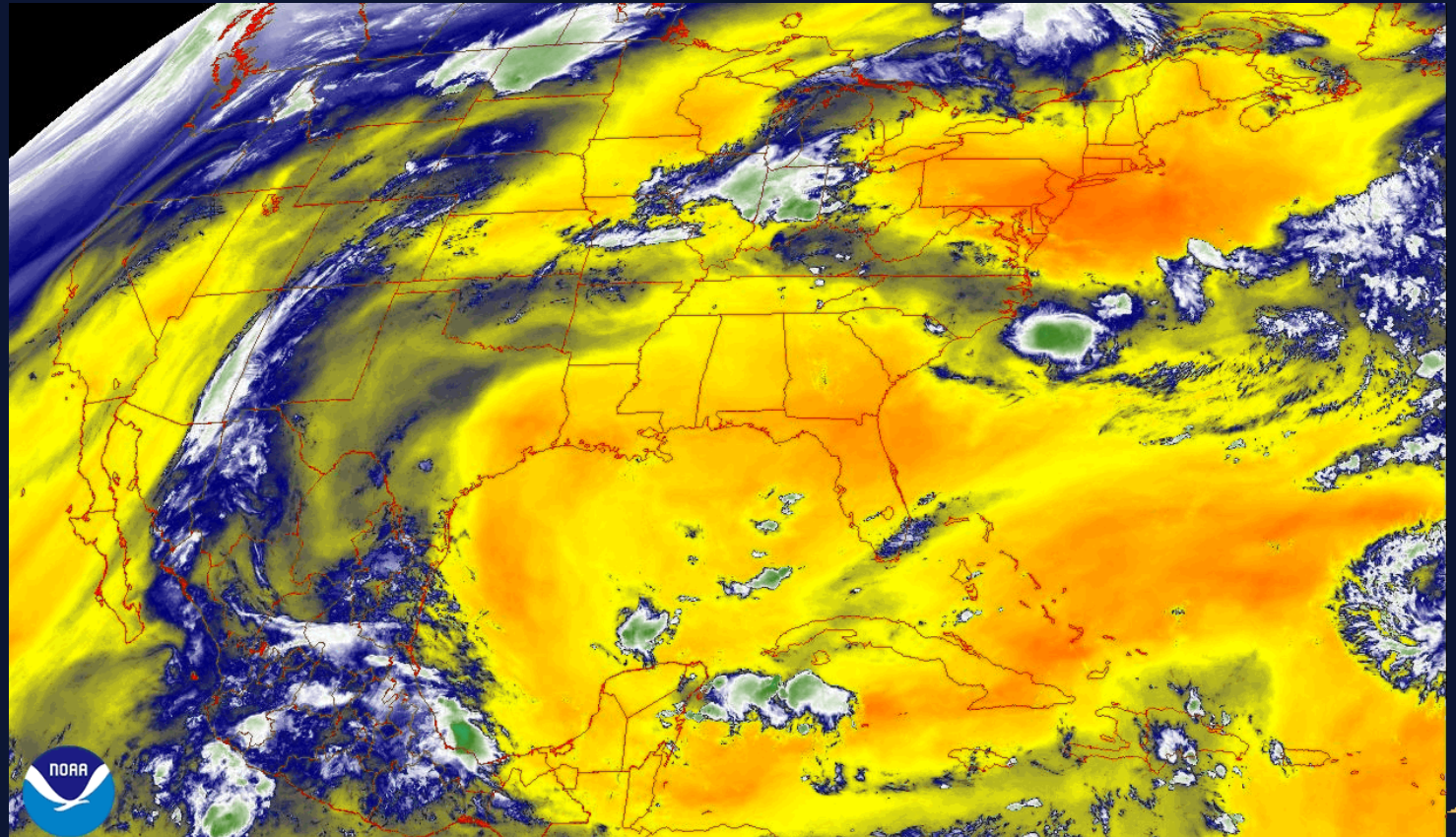


28 Jul 2025 14:06Z - NOAA/NESDIS/STAR - GOES-19 - Band 09



Forecasting Heavy Rainfall

- NESDIS low-level water vapor



28 Jul 2025 14:11Z - NOAA/NESDIS/STAR - GOES-19 - Band 10

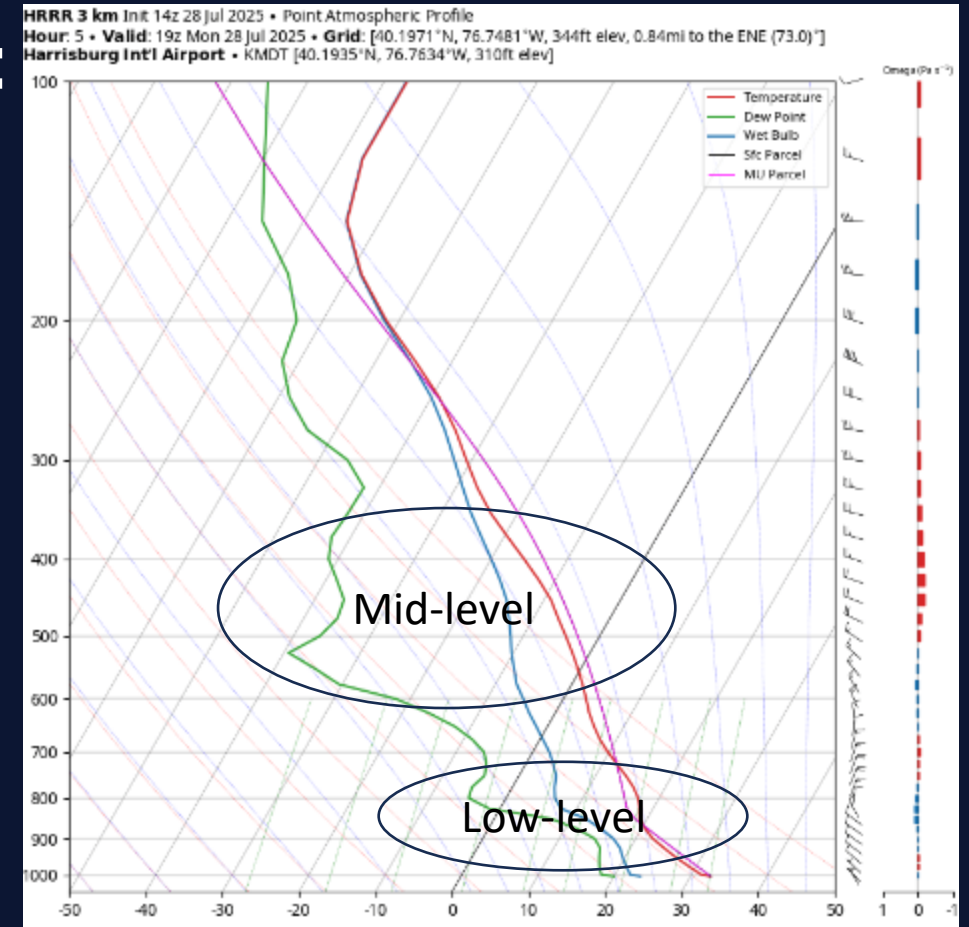


Forecasting Heavy Rainfall

- Soundings: Moisture

— Temperature

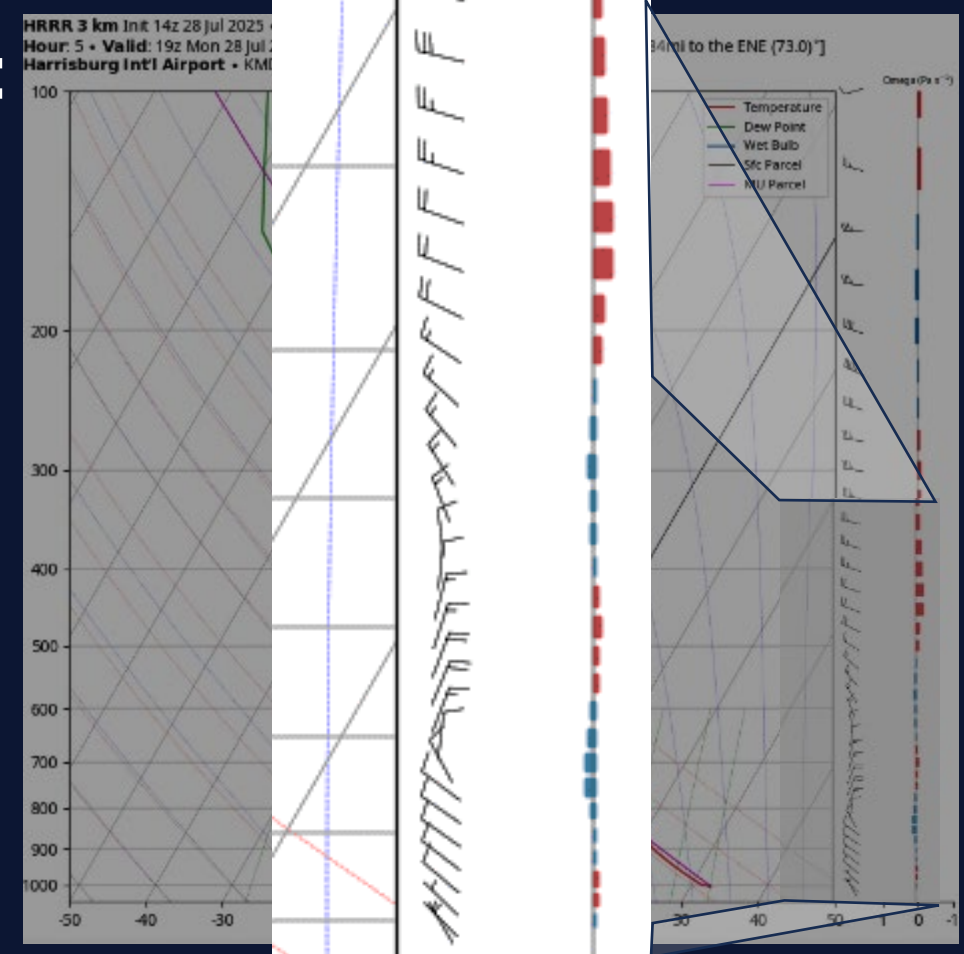
— Dewpoint





Forecasting Heavy Rainfall

- Soundings:
Wind
Profile



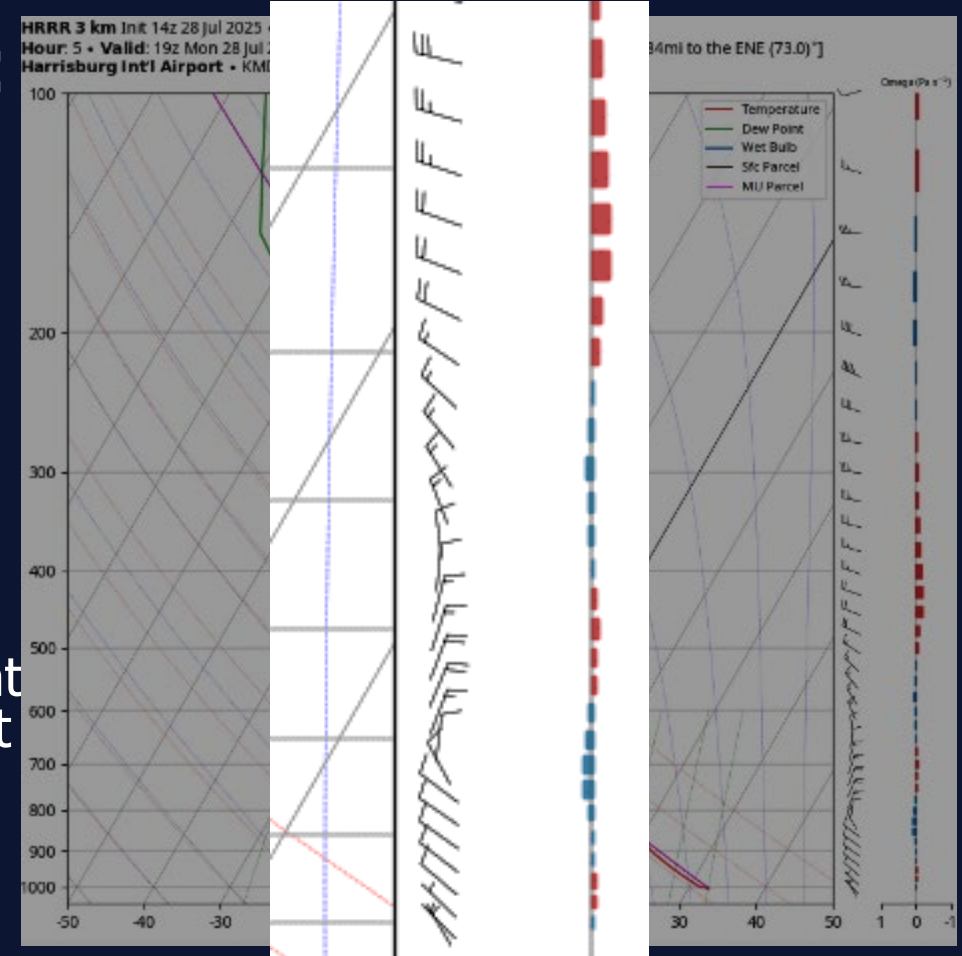


Forecasting Heavy Rainfall

- Soundings:
Wind
Profile

Light wind at
mid-levels =
slow-moving
precipitation

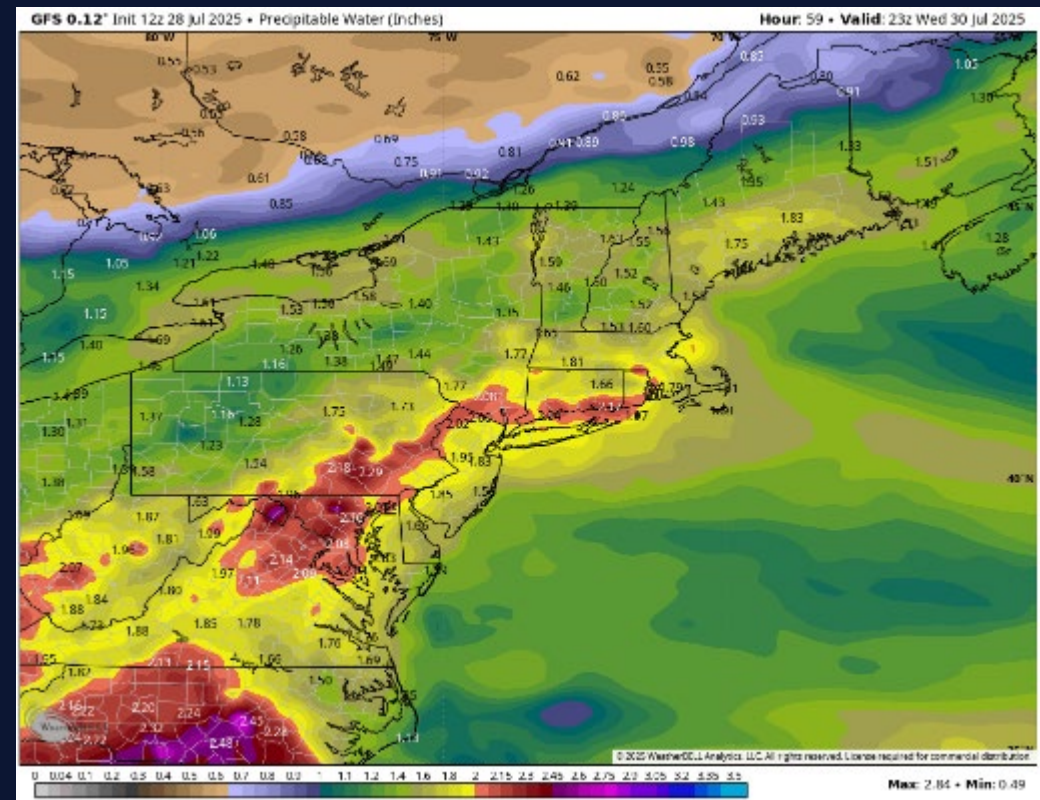
Linear wind
profile with height
= training, repeat
precipitation





Forecasting Heavy Rainfall

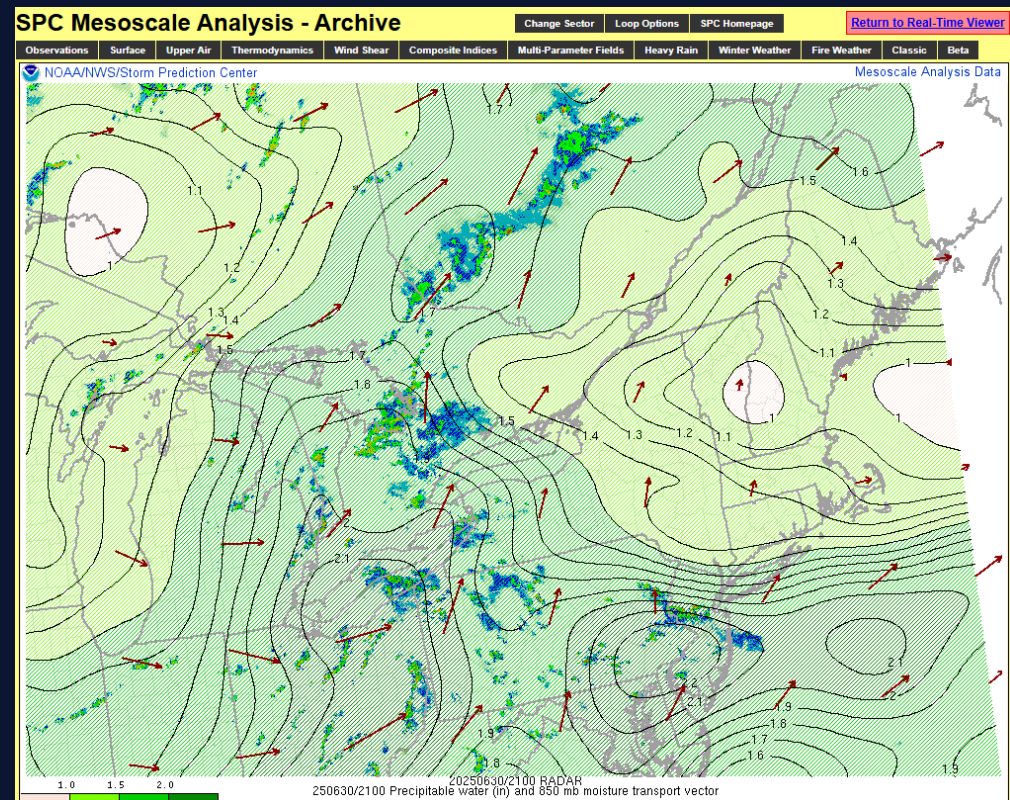
- Precipitable water (PW) 1.0" or >





Forecasting Heavy Rainfall

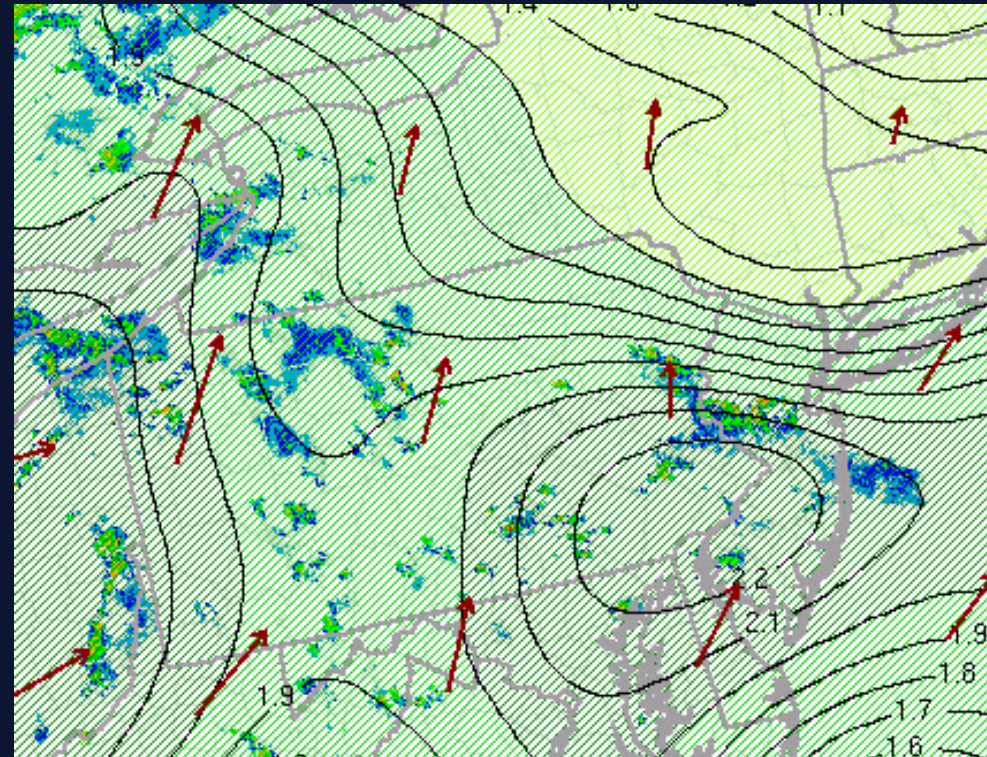
Diverging transport vectors





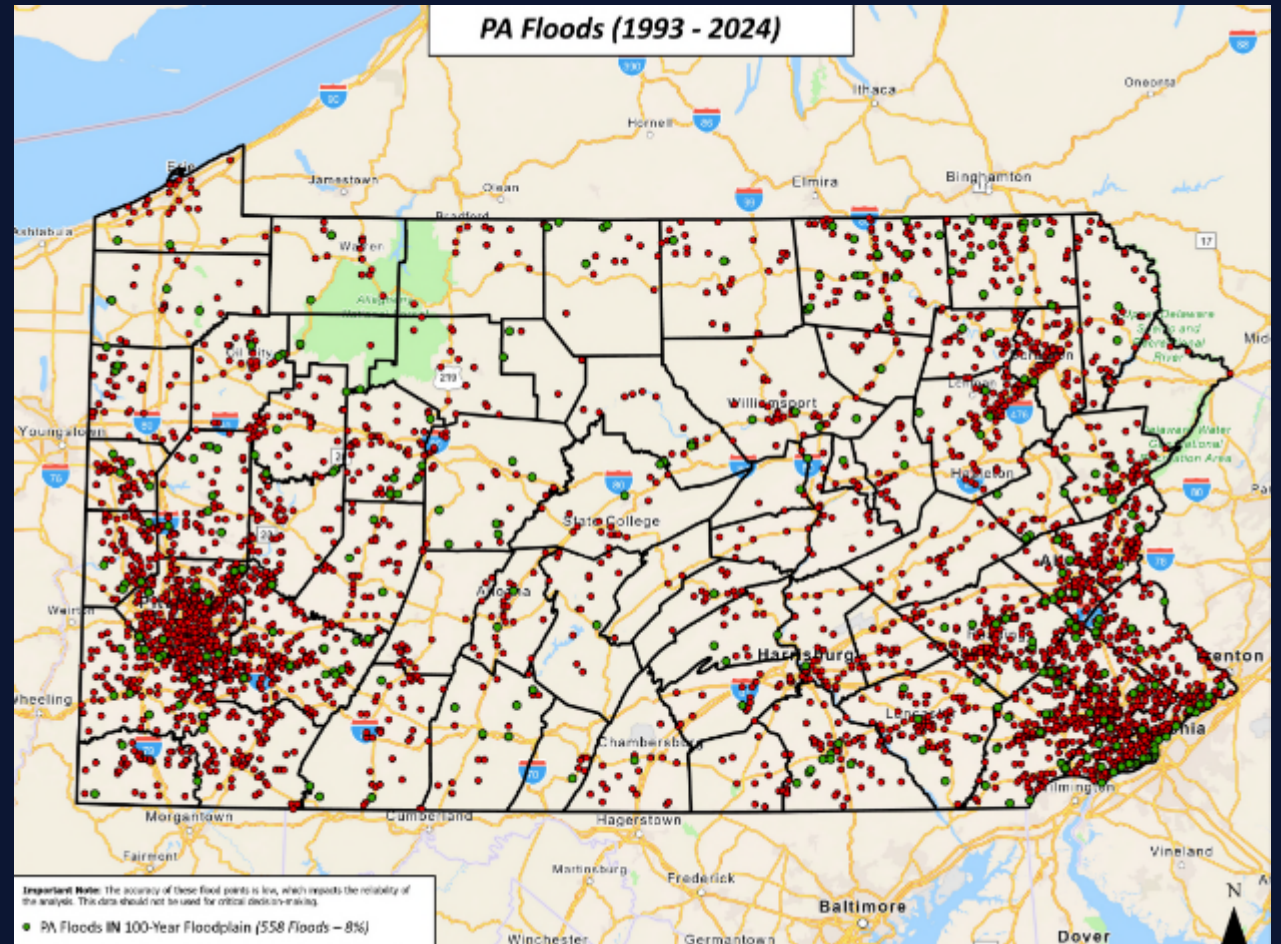
Lancaster County, June 30th

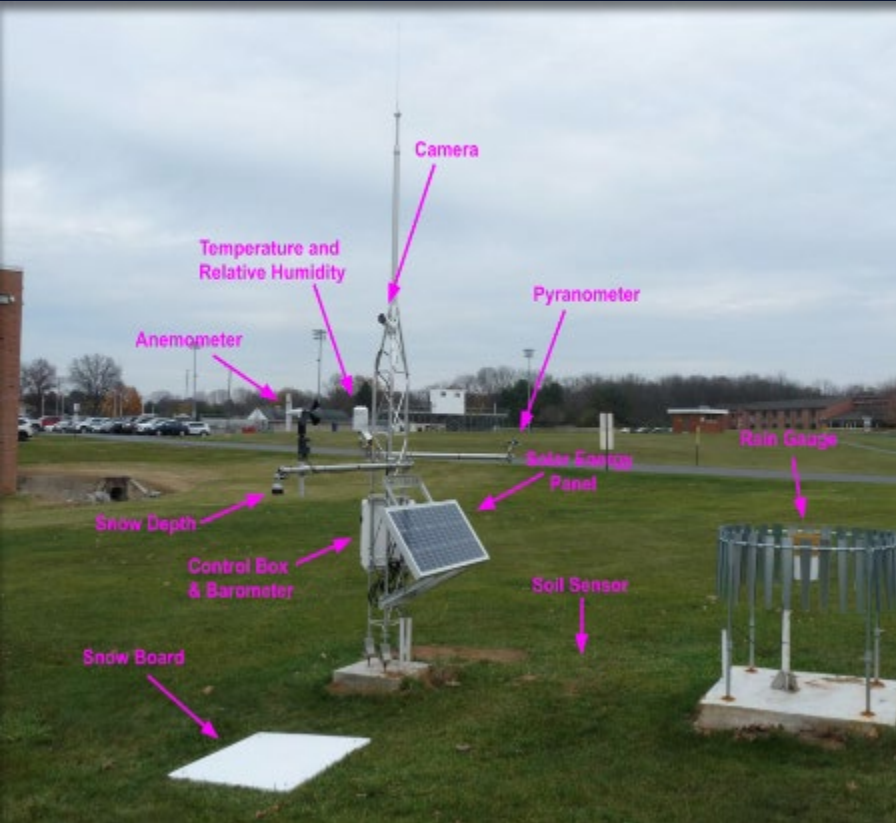
PW was in 99th percentile, or record levels (2.0" to 2.2")





Where It Can Rain, It Can Flood





iFLOWS 2.0

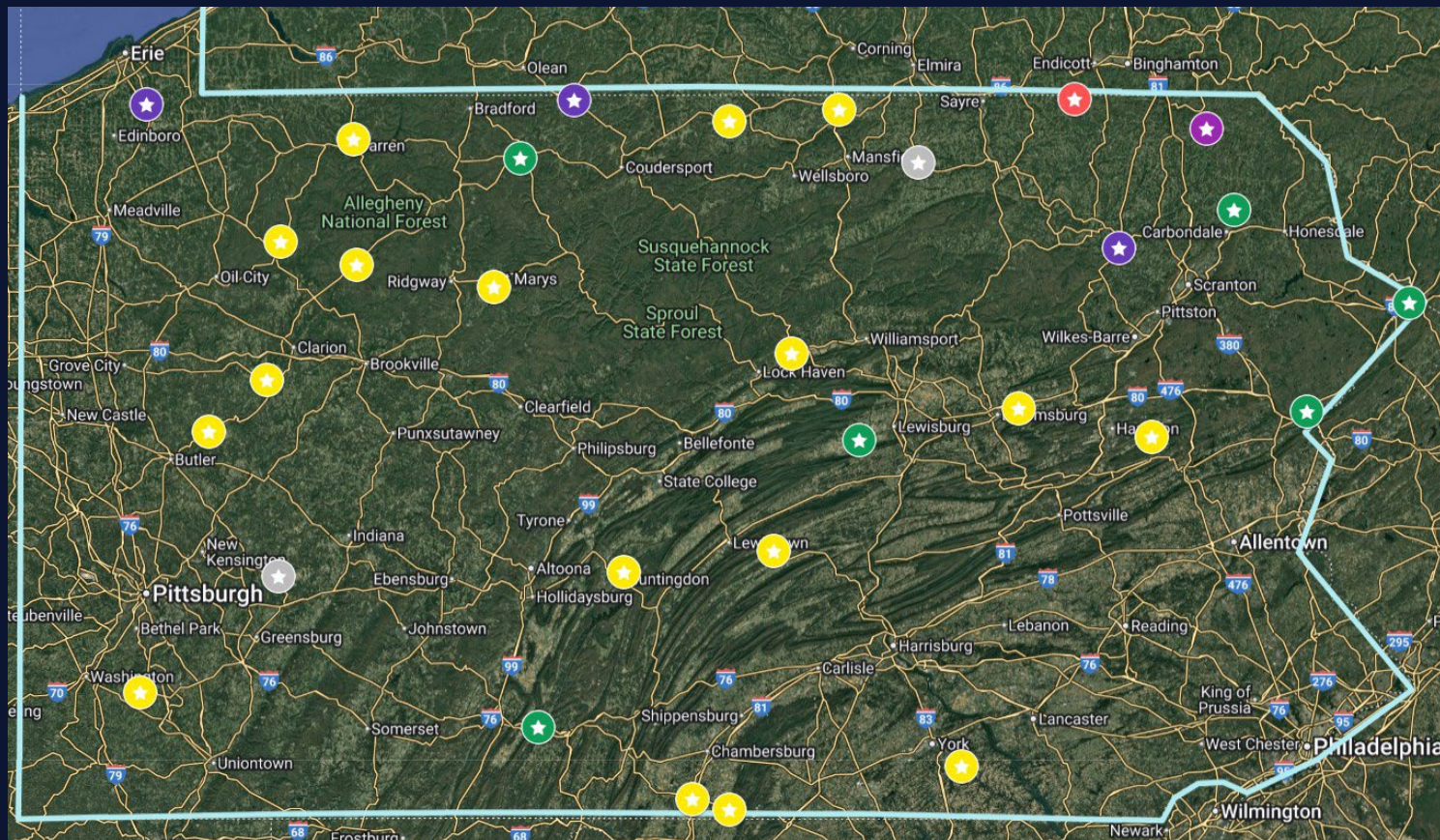
- **Integrated Flood Warning and Observing System**

- Provides real-time weather information and alerting tools to emergency managers, meteorologists, and the public at sites across PA
- 30 new weather stations planned for installation thru August 2026 – most on school properties
- Educational curriculum now added
- Funded thru HMGP grant in December 2022; Title 35 compliant

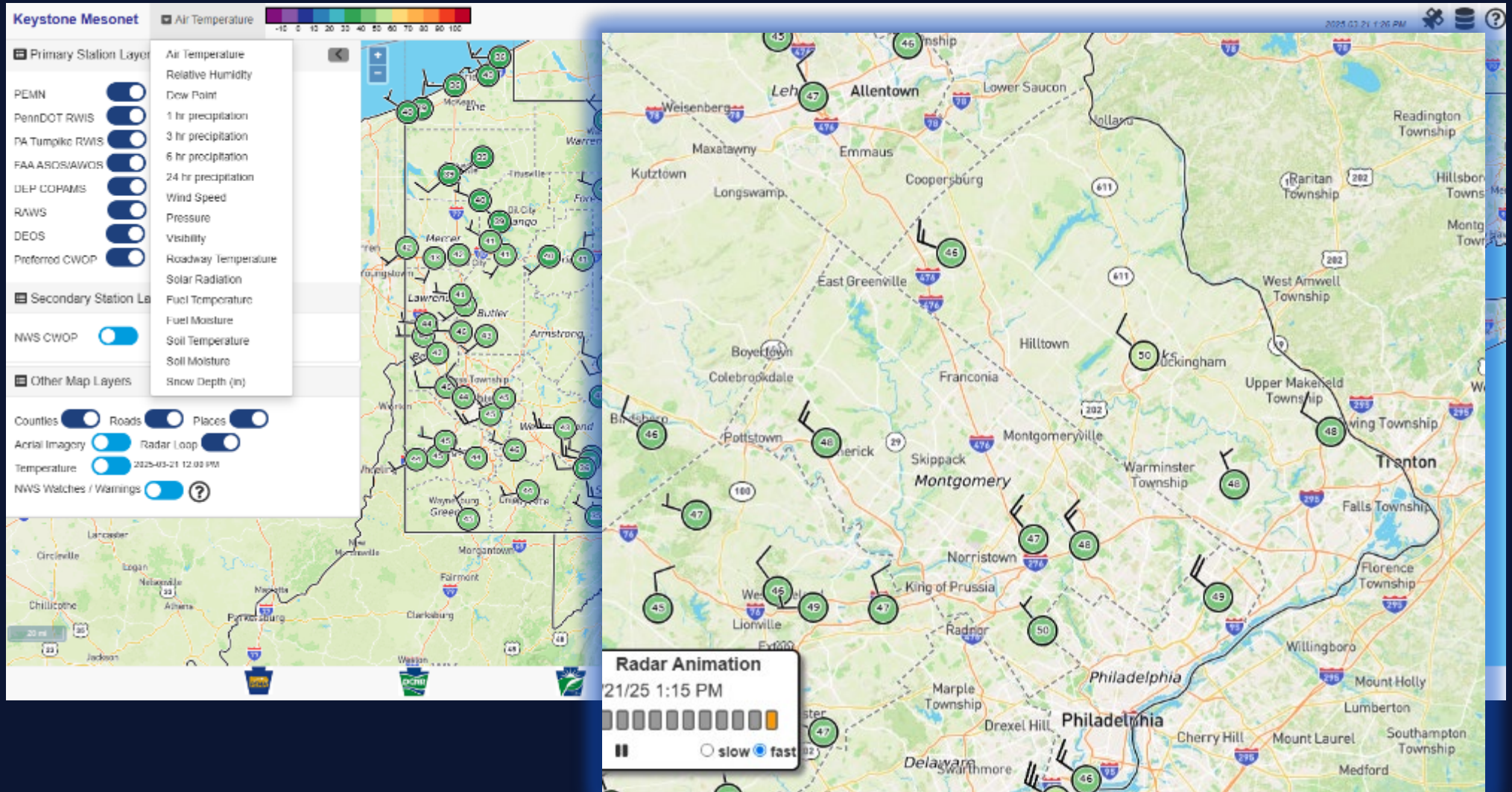


IFLOWS 2.0 Sites (30)

Yellow – Installed (17)
Green – Site Ready (6)
Purple – Lease Signed (4)
Orange – Lease Pending (1)
Blue – Site Proposed (0)
Gray – Site Denied (2)



Keystone-Mesonet.org





Pennsylvania
Emergency Management Agency

Contact Me

Scott Stuccio, State Meteorologist



ssuccio@pa.gov



717-651-7066



pema.pa.gov



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