



Historical Perspective and Impacts from Helene Rainfall

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May 6, 2025



Topics

- Impacts and personal experience
- Rainfall statistics and characteristics
- Historical perspective on rainfall

HELENE – Anatomy of a Killer

- 107 fatalities in NC alone
- \$60 Billion in damage in NC alone, for example:
- 74,000 homes damaged: of those ~9,000 severely damaged or destroyed
- Catastrophic damage to infrastructure, for example, Asheville water system severely damaged: 100,000 people had no running water for 19 days and no potable running water for 53 days
- In addition to being without water, I lost power for 15 days, cable/internet and cell service for 18 days
- More than 2,000 landslides-one of worst events in U.S. history according to U.S Geological Survey

Asheville River Arts District Flooding



View of Creek Next to my Subdivision



Flooding Creek Near my Home



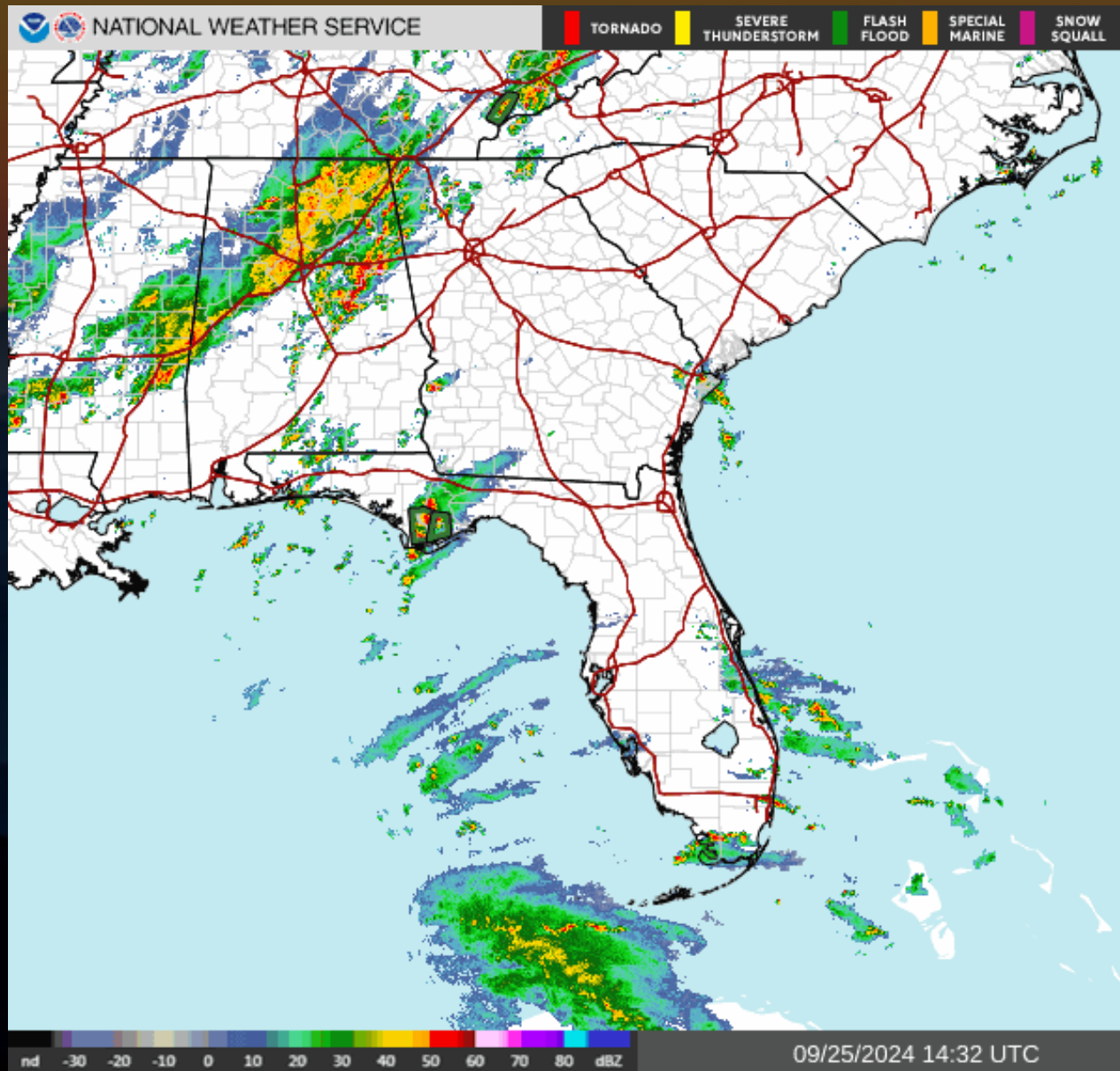
[Video link](#)

Selected Helene statistics

- 3-day rainfall totals: Busick (31 inches), Mt Mitchell (24 inches), Bear Wallow Mountain (20 inches), my house (15.6 inches, >1000 year return interval)
- High end tropical storm intensity when it reached NC
- Stalled front caused excessive rainfall before Helene's arrival
- All time record flood levels on French Broad River (previous record in 1916) and Swannanoa River (previous record in 1791)

100





NWS radar loop,
Sept. 25-27, 2024

Asheville, NC is
circled, underneath
Tornado at the top.

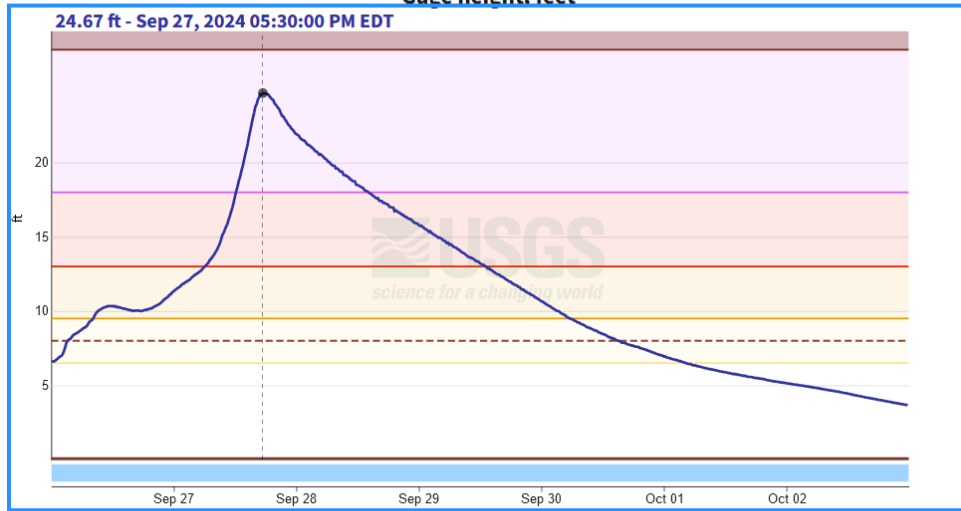
USGS Stream Gage Heights

09/26/2024–10/02/2024

French Broad River at Asheville, NC - 03451500

September 26, 2024 - October 2, 2024

Gage height, feet

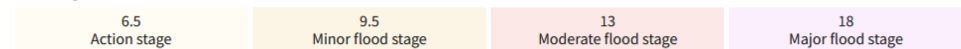


Gage height, feet
— Recorded

Data approval period
— Provisional

--- National Weather Service Floodstage: 8 ft

Flood stages in ft



Questions or Comments

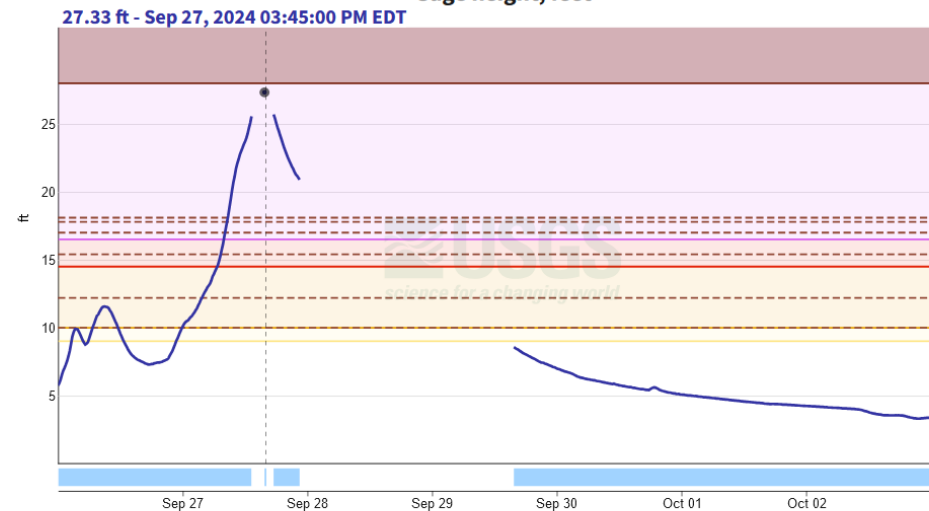
in NOAA's National Water Prediction System (NWPS)

IMPORTANT Data may be [provisional](#)

Swannanoa River at Biltmore, NC - 03451000

September 26, 2024 - October 2, 2024

Gage height, feet



IMPORTANT Data may be [provisional](#)

[Show legend](#) ▾

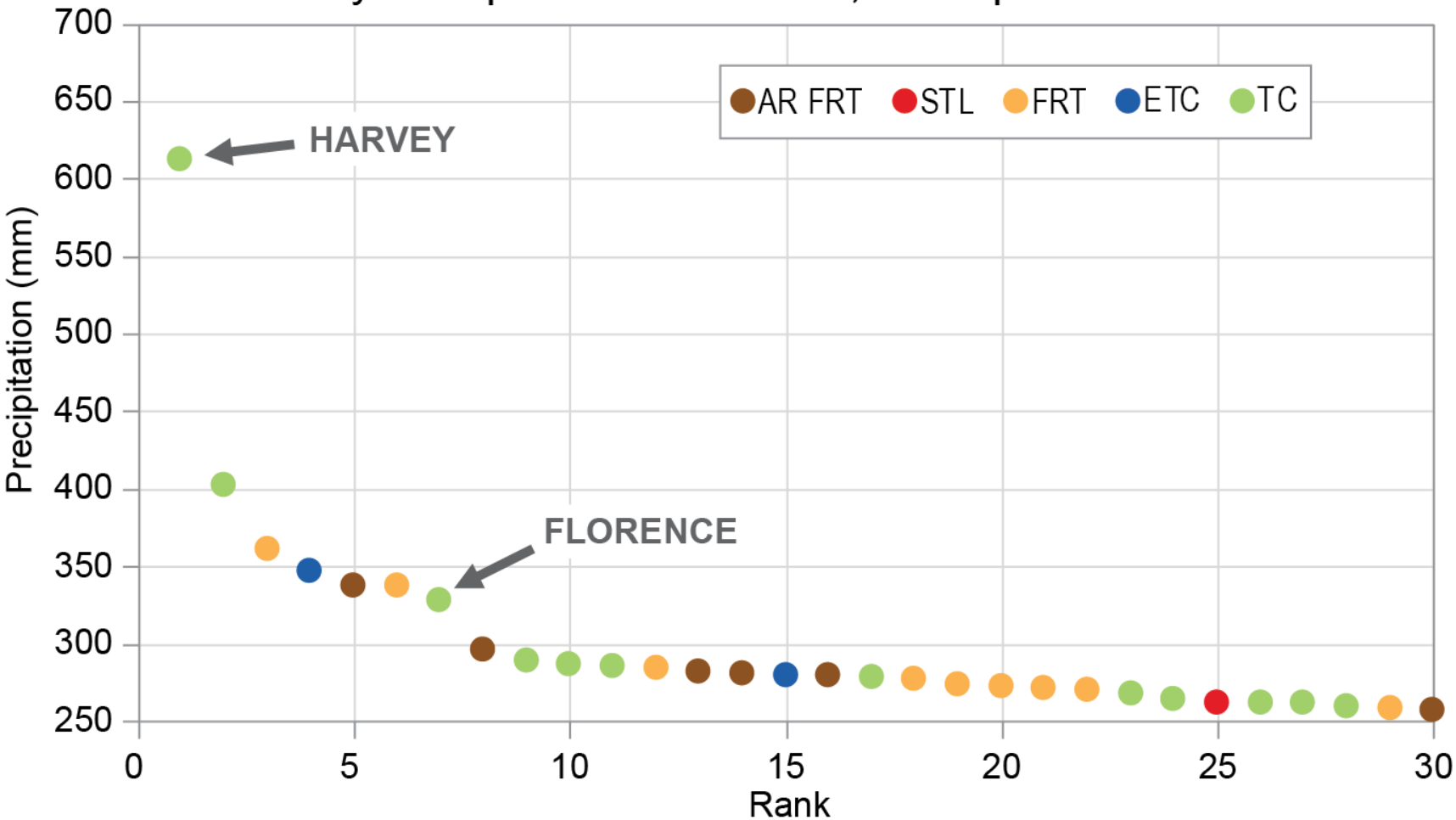
	Value	Status	Time
● Latest value	2.16 ft	Provisional	Nov 01, 2024 10:00:00 AM EDT
● Selected	27.33 ft	Provisional	Sep 27, 2024 03:45:00 PM EDT
● Compare			Not available with custom time spans
● Median			Add median data to graph

Questions or Comments



Hurricanes Harvey/Florence Analysis

4-day Precipitation Events: 50,000 Square Kilometers

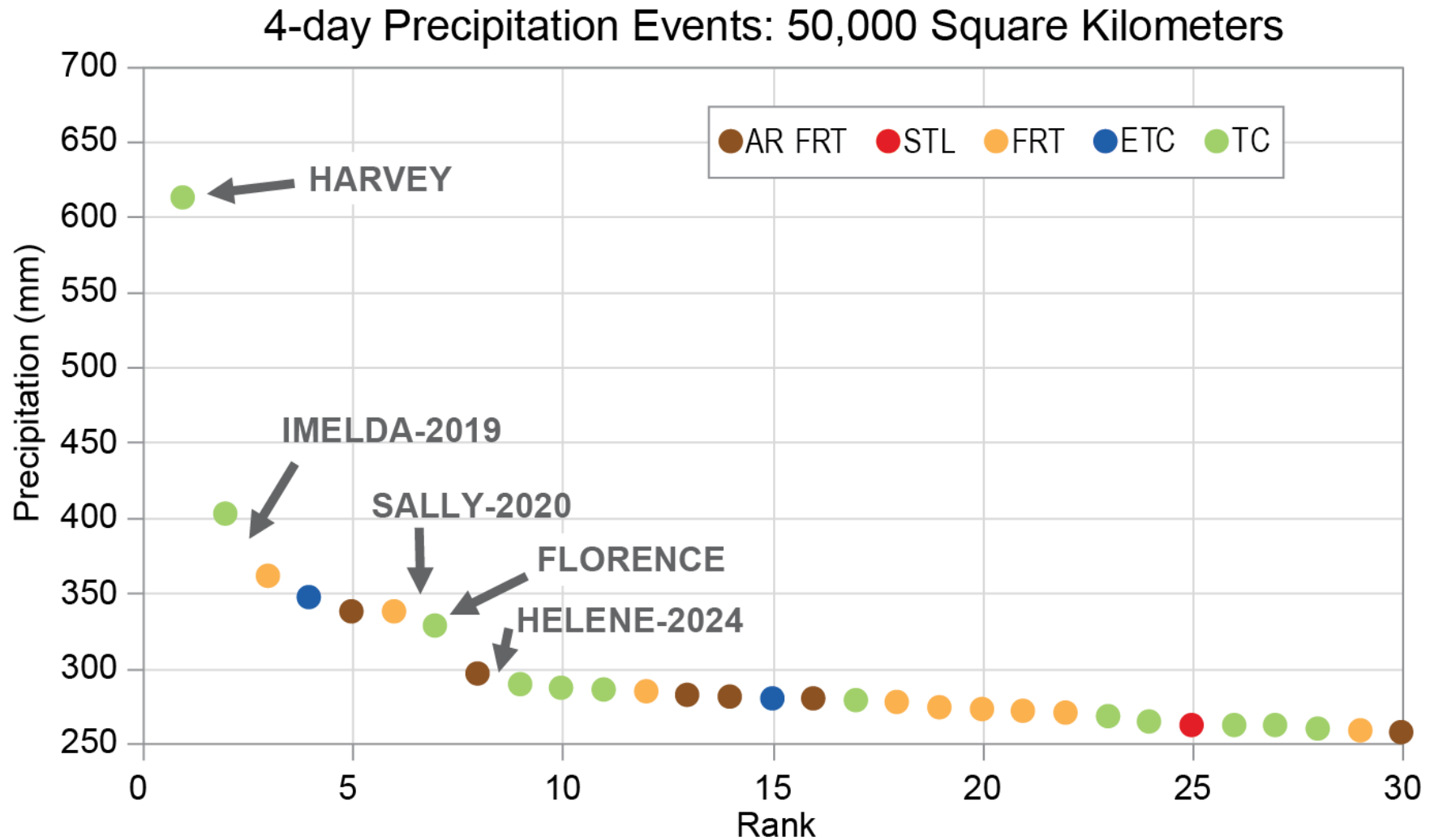


Kunkel, K.E. and S.M. Champion, 2019: An assessment of rainfall from Hurricanes Harvey and Florence relative to other extremely wet storms in the United States. *Geophys. Res. Lett.*, **46**, 13,500–13,506.
<https://doi.org/10.1029/2019GL085034>

Hurricanes Harvey/Florence Analysis

I updated the analysis to 1949–2024

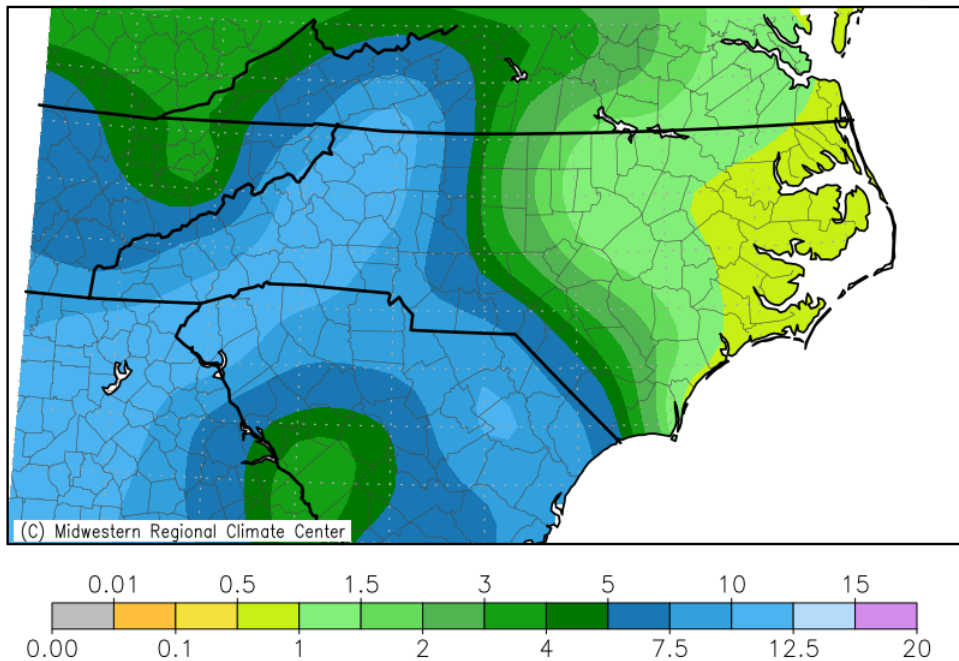
Update to 2024



Comparison of 1916 and 2024 Rainfall Events

1916

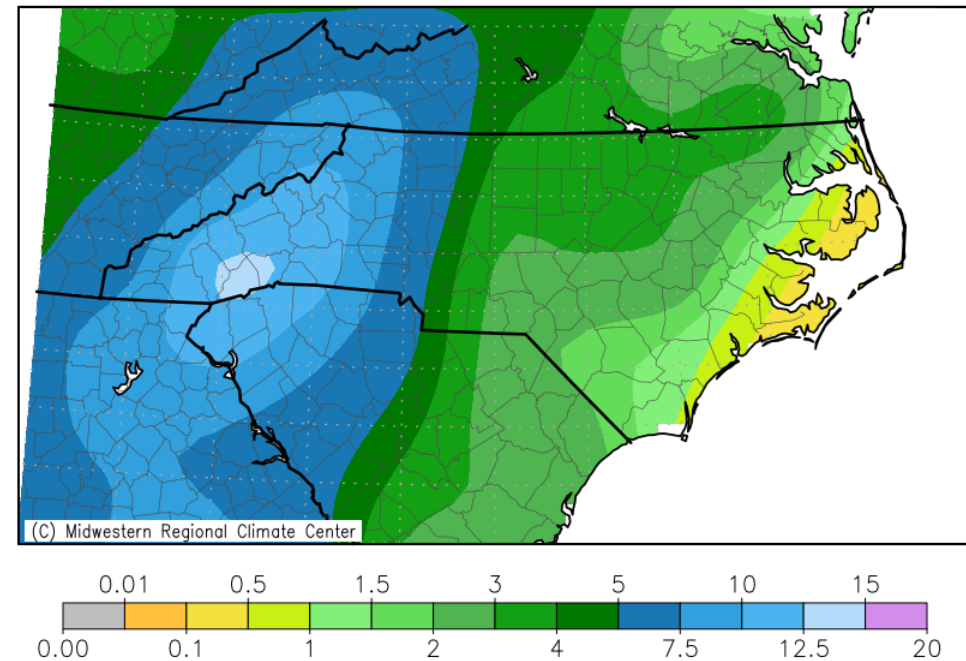
Accumulated Precipitation (in)
July 6, 1916 to July 19, 1916



Midwestern Regional Climate Center
cli-MATE: MRCC Application Tools Environment
Generated at: 4/28/2025 2:09:23 PM CDT

2024

Accumulated Precipitation (in)
September 24, 2024 to September 28, 2024



Midwestern Regional Climate Center
cli-MATE: MRCC Application Tools Environment
Generated at: 4/28/2025 2:11:00 PM CDT

Comparison of 1916 and 2024 Rainfall Events

Highest amounts in 1916:

Altapass: 31 inches

Rockhouse: 30 inches

Highlands: 26 inches

Brevard, Banner Elk: 22 inches

Hendersonville: 20 inches

The 1916 flood was also a compound event: back-to-back TCs

Comparable rainfall amounts to Helene, but the two TCs were separated by a week

Conclusions

- Meteorology: This was a compound event
 - Stalled front/upper level trough followed by Helene
 - These were independent but were fueled by the same very moist tropical air mass
- Rainfall amounts were historic
 - Area-averaged multi-day rainfall was (nationally) one of the largest in last 75 years and on a par with Florence (2018)
- Highest rainfall rates occurred at the end of the event
 - I hypothesize that this greatly amplified the peak river stages and associated impacts