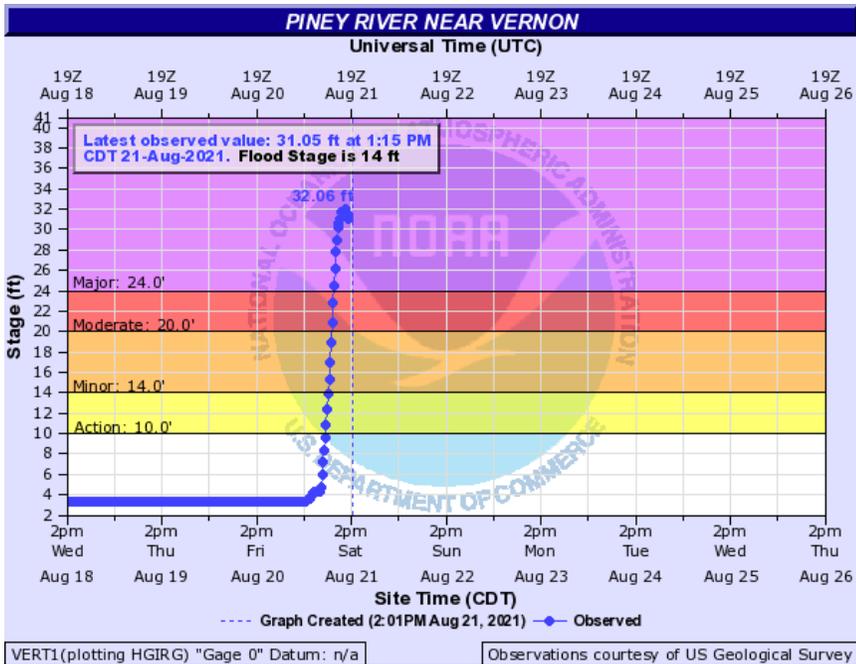
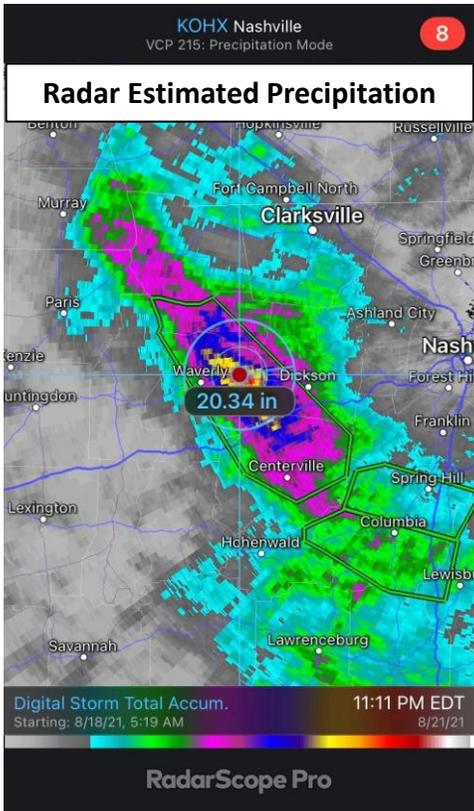


Middle Tennessee Flooding: 21 August 2021

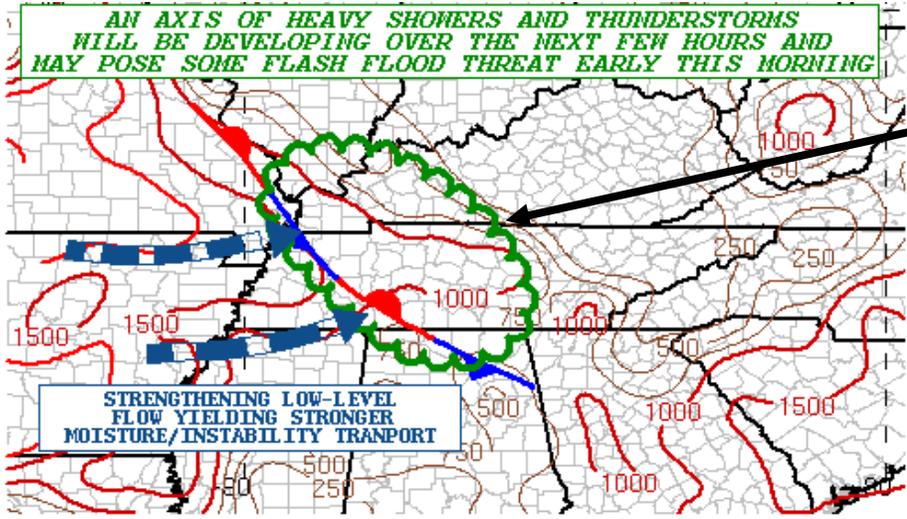
Extreme precipitation accumulations over Middle Tennessee resulted in catastrophic flooding

- A quasi-stationary pattern combined with anomalous atmospheric moisture created an environment favorable for high-intensity and long duration precipitation over parts of central Tennessee
- Efficient warm-rain processes as well as favorable storm cell trajectory produced as much as 17 inches of precipitation on top of already moist soils produced by the remnants of tropical storm Fred a few days prior
- The Piney River near Vernon, TN rose to 32 feet on the 21st, 18 feet over flood stage and nearly 12 feet higher than the previous record at this gauge
- While this particular event is not characterized as an atmospheric river, it is one example of the many meteorological features that can lead to flood producing precipitation in Tennessee



Source: Washington Post, <https://www.washingtonpost.com/weather/2021/08/23/tennessee-historic-flooding-explainer/>

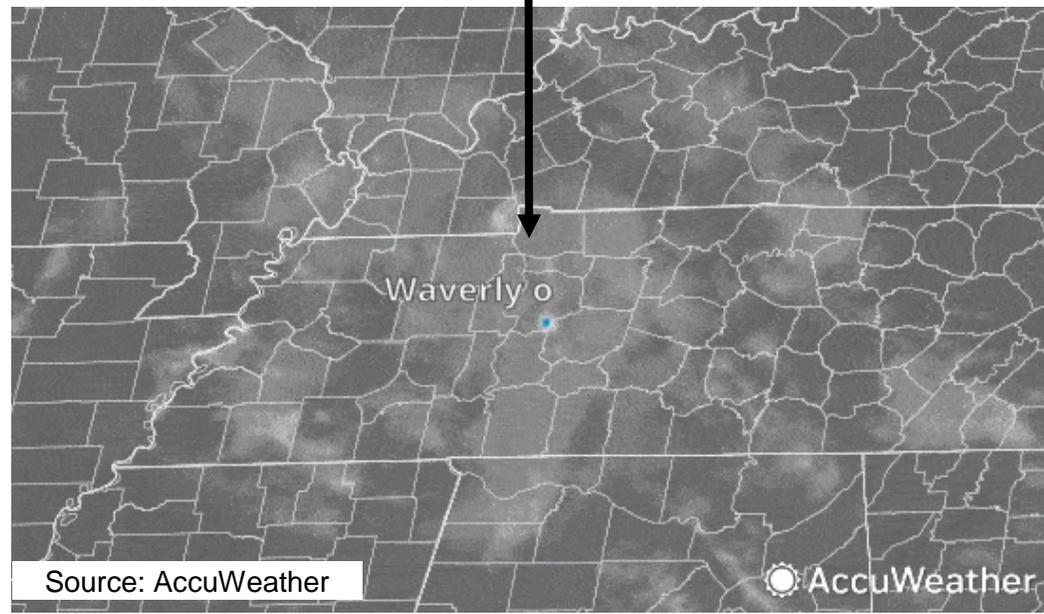
Middle Tennessee Flooding: 21 August 2021



A stationary front in western/central TN, combined westerly surface flow allowed for extremely moist air parcels to rise over central TN, initiating thunderstorm and heavy precipitation

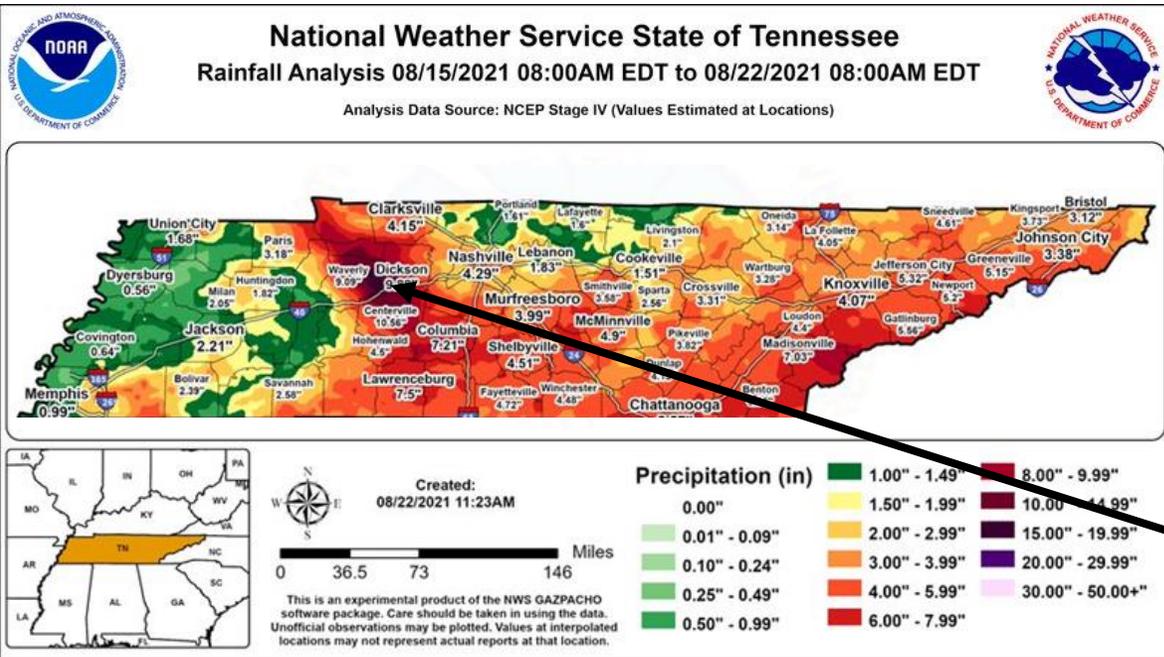
Once the convection was initiated the upper-level flow propagated the storms from the northwest to the southeast along the frontal boundary, resulting in the "training" of storms over the same location for several hours

RAP32 ML CAPE (lowest 90MB) j/kg 210821/0500f000
WPC MPD #0847



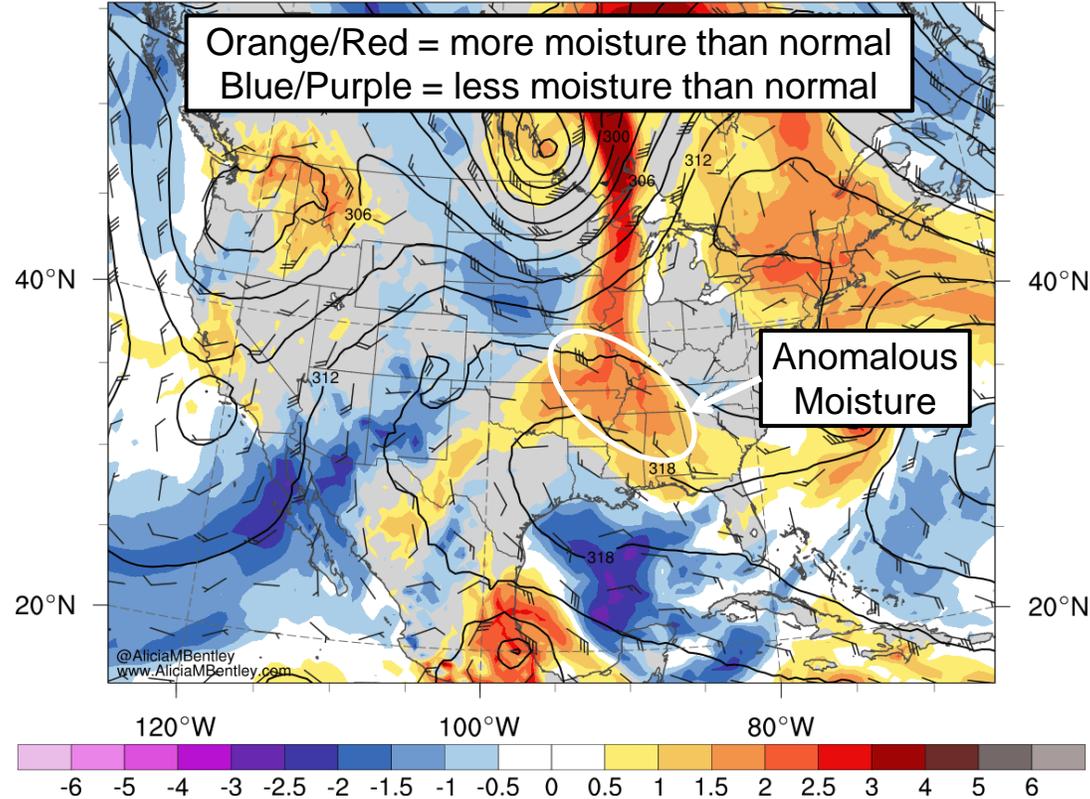
Source: AccuWeather

The long duration and high-intensity precipitation combined with the precipitation produced by remnant tropical cyclone Fred a few days earlier resulted in total 7-day accumulations >15 inches over north-central Tennessee

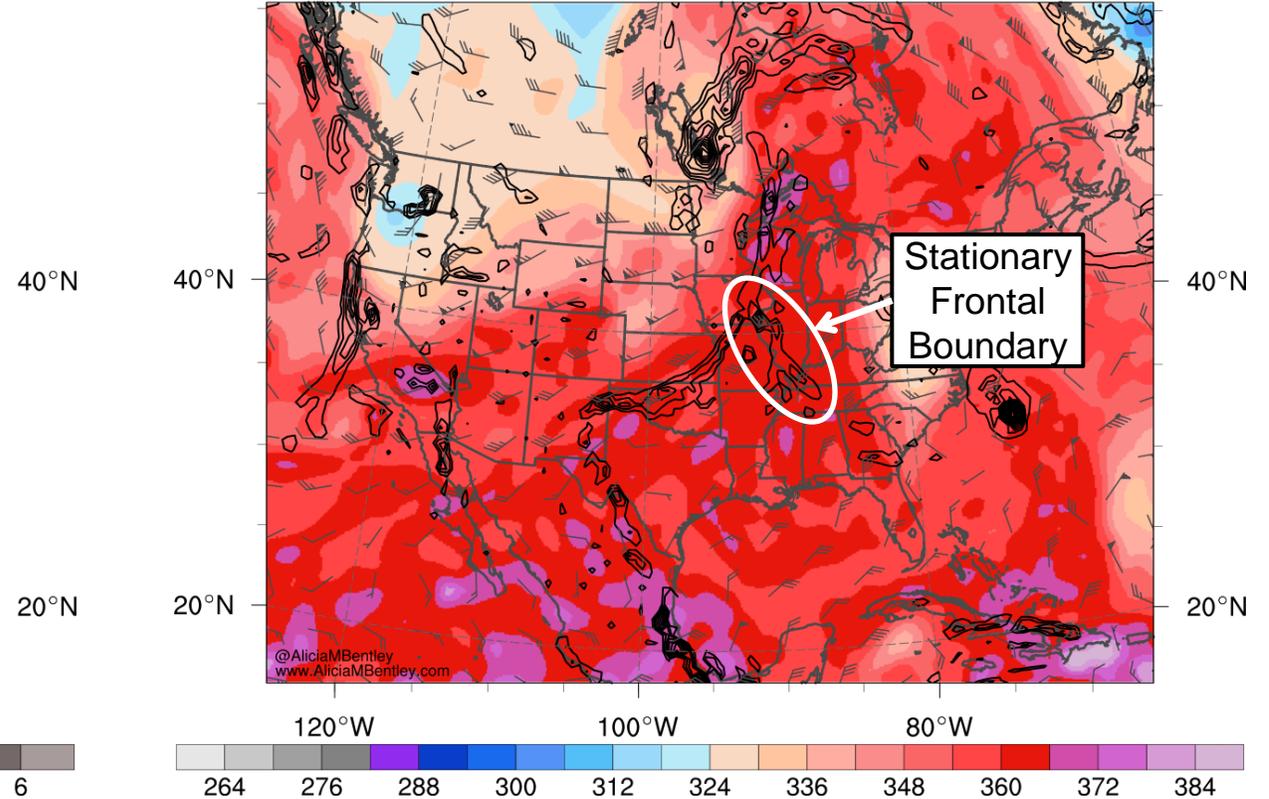


Middle Tennessee Flooding: 21 August 2021

700-hPa geo. height (black, dam), wind (barbs, kt), standardized precip. water anomaly (shaded, sigma)
Initialized: 1200 UTC 21 Aug 2021 | Forecast hour: 0 | Valid: 1200 UTC 21 Aug 2021



DT potential temperature (shaded, K) & wind (barbs, kt), 925-850-hPa cycl. rel. vort. (black, $0.5 \times 10^{-4} \text{ s}^{-1}$)
Initialized: 1200 UTC 21 Aug 2021 | Forecast hour: 0 | Valid: 1200 UTC 21 Aug 2021

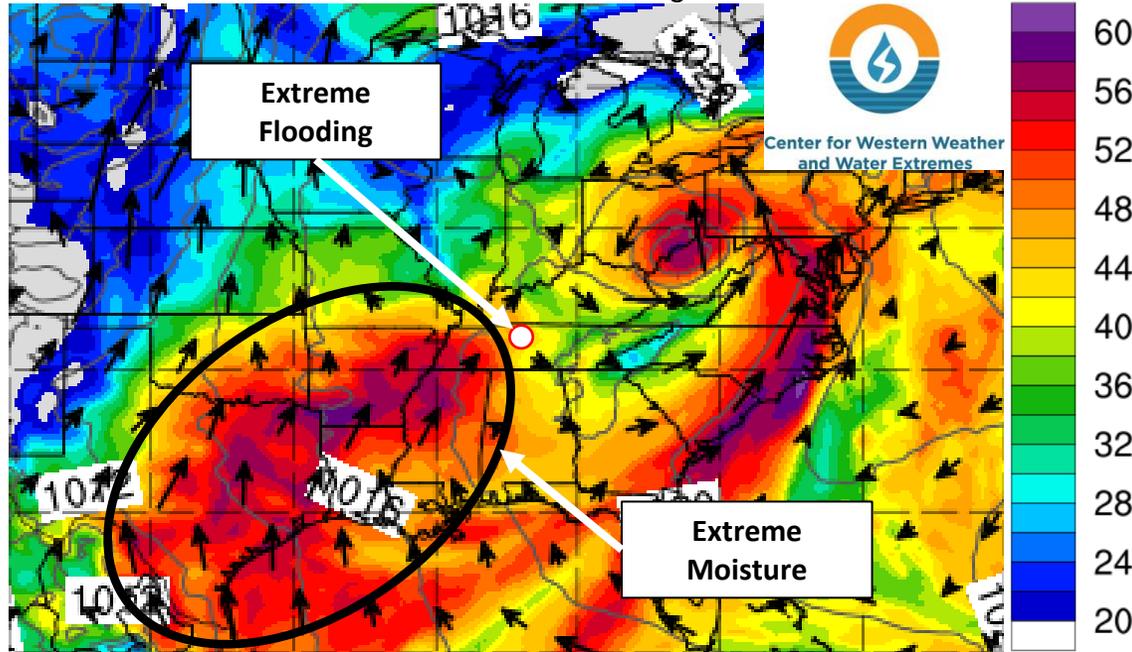


Source: Alicia Bentley, <http://www.atmos.albany.edu/student/abentley/index.html>

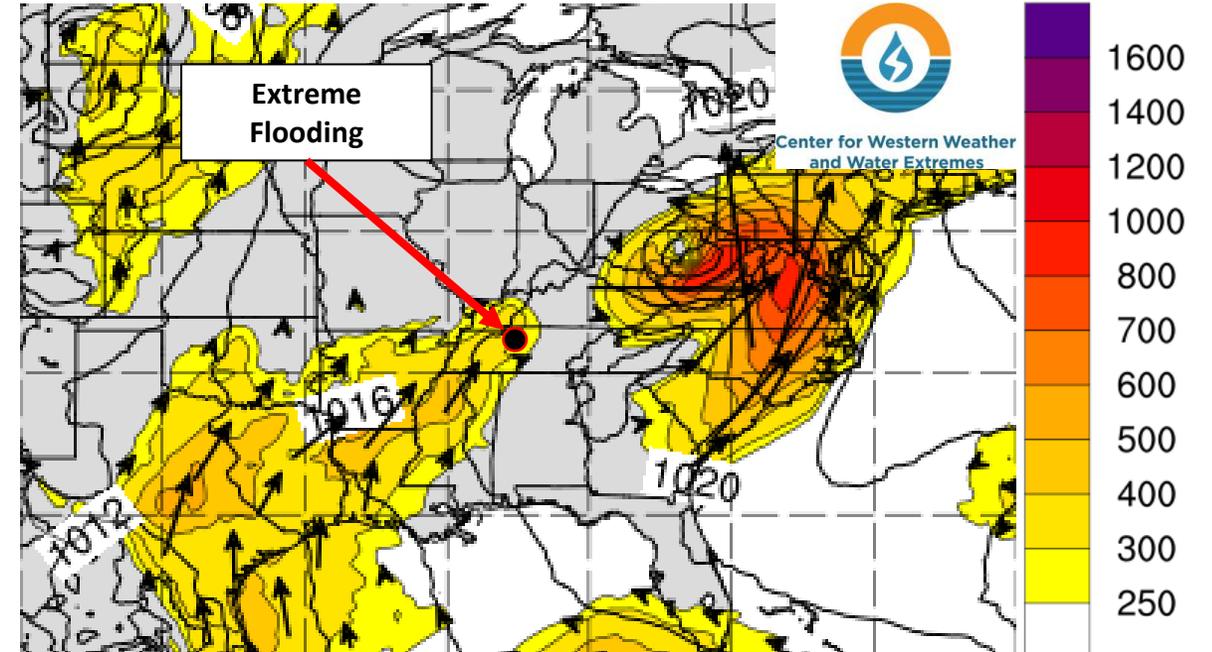
- At the time of the flooding, portions of western Tennessee were experiencing precipitable water anomalies of +2–2.5 standard deviations above normal
- The Stationary front that was oriented northwest to southeast over the Ohio River Valley provided the lift necessary to produce the extremely efficient and slow-moving thunderstorms over western to central Tennessee

Middle Tennessee Flooding: 21 August 2021

GFS IWV (mm) Analysis
Valid: 1200 UTC 21 August 2021



GFS IVT ($\text{kg m}^{-1} \text{s}^{-1}$) Analysis
Valid: 1200 UTC 21 August 2021

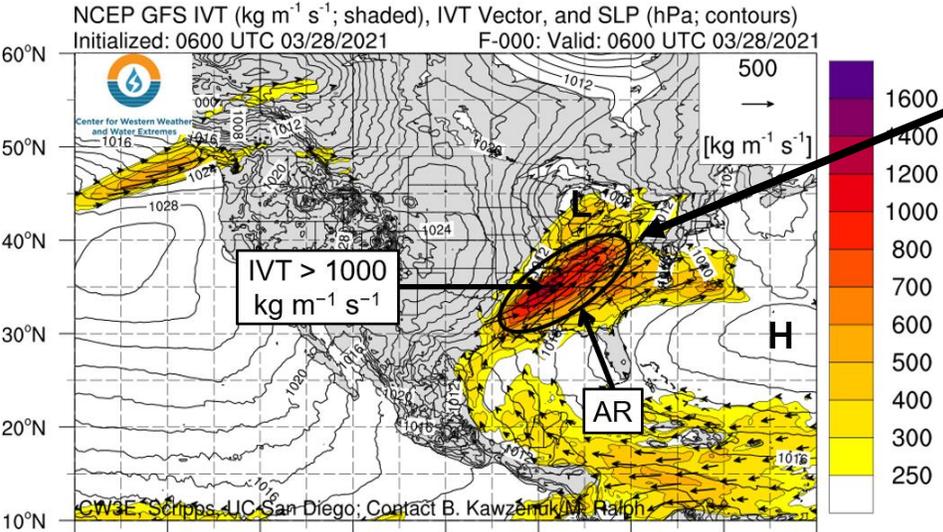


Source: CW3E, <https://cw3e.ucsd.edu/iwv-and-ivt-forecasts/>

- While there was considerable moisture (>50 mm) and southwesterly moisture transport ($300\text{--}400$ $\text{kg m}^{-1} \text{s}^{-1}$) overrunning the stationary front, this particular event was not an atmospheric river
- This event was an example of one of the many meteorological scenarios that can lead to extreme precipitation and flooding over Tennessee

Middle Tennessee Flooding: 21 August 2021

GFS IVT & IWV Analyses: Valid 06Z 28 Mar 2021



- While the event that produced the extreme rainfall and flooding on 21 August 2021 was not an atmospheric river, ARs are yet another important phenomena that can lead to flood producing precipitation over Tennessee
- An atmospheric river over the Eastern U.S. in late March 2021 resulted in heavy precipitation and flooding near Nashville, Tennessee
- This particular AR in late March produced a large swath of precipitation accumulations >6 inches over Central Tennessee

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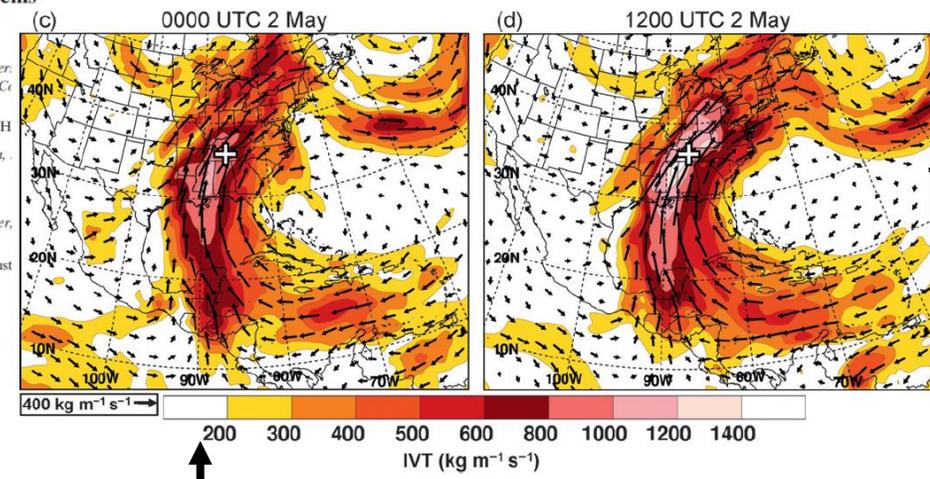
Physical Processes Associated with Heavy Flooding Rainfall in Nashville, Tennessee, and Vicinity during 1–2 May 2010: The Role of an Atmospheric River and Mesoscale Convective Systems*

BENJAMIN J. MOORE
 Cooperative Institute for Research in Environmental Sciences, Univer.
 and NOAA/Earth System Research Laboratory, Boulder, Co

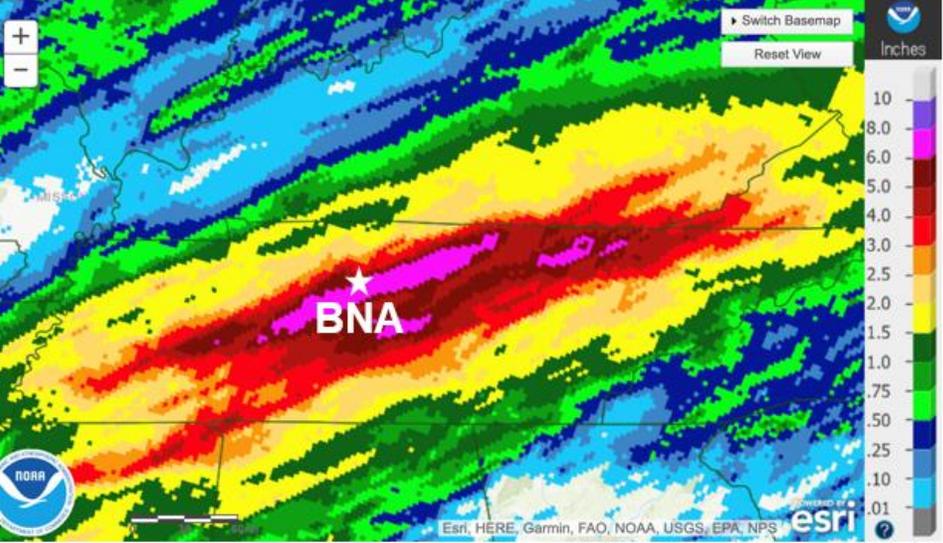
PAUL J. NEIMAN AND F. MARTIN RALPH
 NOAA/Earth System Research Laboratory/Physical Sciences Division,
 I. M. Systems Group, Inc., and NOAA/Hydrometeorological Prediction Center,

FAYE E. BARTHOLD

(Manuscript received 27 May 2011, in final form 24 August



NCEP Stage IV 24-h QPE: Valid 1200 UTC 27–28 Mar



- Additionally, the physical processes of an AR that produced heavy flooding rainfall in Nashville in early May of 2010 were studied in a paper published by Moore et al. 2011