

## Mississippi Valley to Northeast Winter Storm – 20-22 February, 2015

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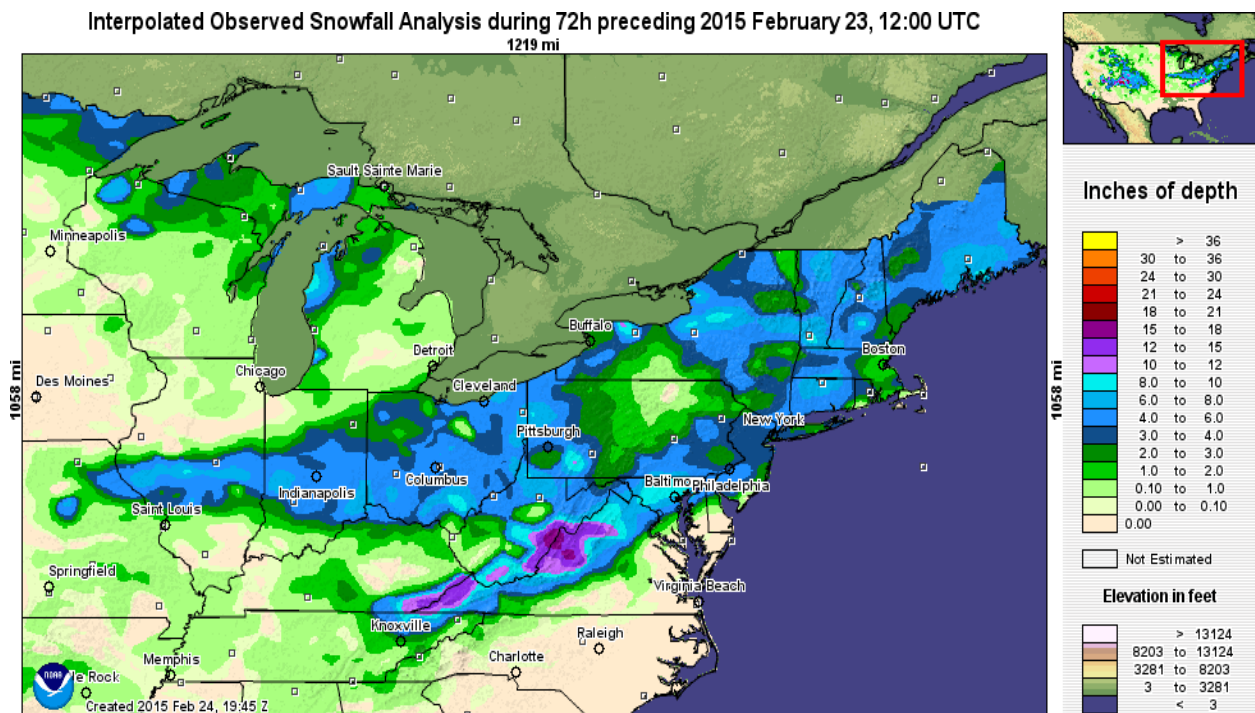
**Meteorological Overview:** A major winter storm affected a significant portion of the United States stretching from the middle Mississippi valley/Ozarks region to the Mid-Atlantic and New England. Even sections of the Deep South saw wintry precipitation as an anomalous dome of surface high pressure transported modified Arctic air into the region. This multi-day event impacted 24 states over the course of the 3-day period blanketing the region with heavy snow and/or ice (Figures 1 & 2).

For much of February, the NCEP 500 hPa reanalysis indicated deep cyclonic flow was a persistent feature from the Rockies eastward, which kept the region cold and in a very active synoptic weather pattern. While the primary vortex of arctic air remained in the vicinity of Hudson Bay, several impulses traversed the longwave trough with each being a conduit for precipitation. At the onset of the event, temperatures were well below normal as a strong surface anticyclone settled over the area. Morning temperatures on 19-20 February plunged into the negative teens Fahrenheit across much of the Ohio/Tennessee valleys accompanied by an abundance of dry air. The air mass would gradually moisten as broad 40 to 50 knot 850 hPa south-southwesterly flow overspread the dome of cold air across the Ozarks and points eastward. This warm air advection process would aid in enhanced vertical motions north of a west-east oriented frontal boundary with isentropic lift spreading a light wintry mix to sections of the lower Ohio and Tennessee valleys by the evening of 20 February.

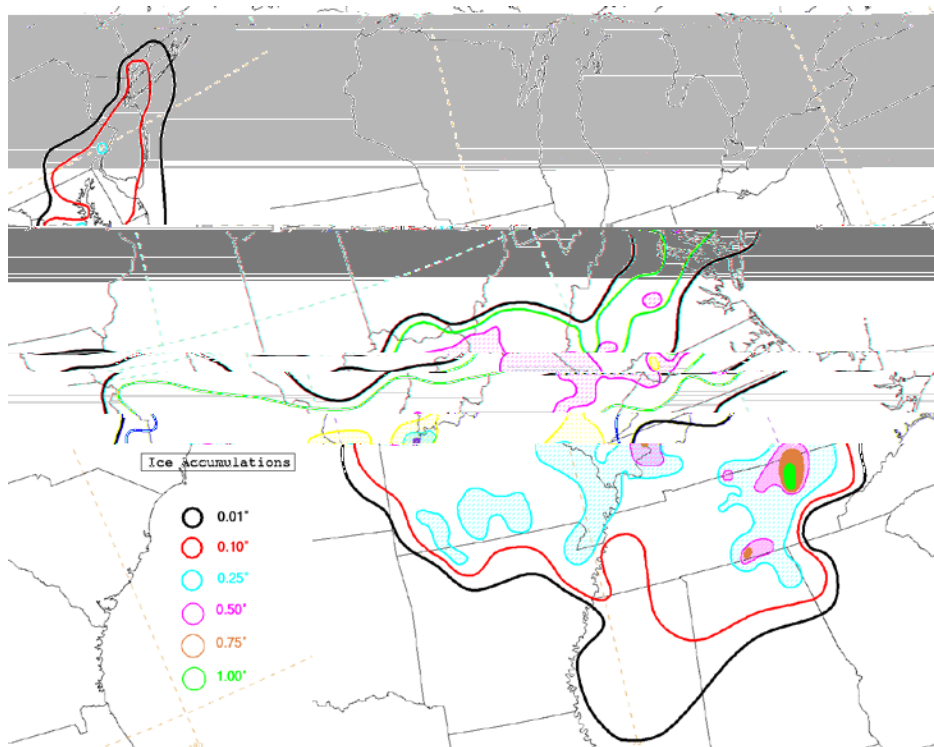
Later that night and into the following morning, radar imagery showed precipitation echoes blossoming over southern/central Illinois and locations to the south as a favorable coupled upper jet structure unfolded. The strong upper-level diffluence signature combined with ample low-level warm advection led to quite an uptick in the precipitation intensity. The 12Z sounding from KBNA (not shown) on the morning of 21 February sampled this low-level wind profile quite well with 85 knots of southwesterly flow observed at 850 hPa. This strong warm advection regime created a substantial ‘warm nose’ nearing 10°C extending between 900-650 hPa. Given the lowest 100 hPa of the troposphere was just below freezing, a heavy mixture of sleet and freezing rain fell with an inch of ice accumulating across northeastern Tennessee by the conclusion of the storm. Farther downstream across the lower Ohio valley, central Appalachians, and Mid-Atlantic, another area of heavy precipitation developed in advance of a 500-hPa speed maximum/shortwave crossing southern Indiana (Figure 3) during the early afternoon hours. Thermal profiles over these regions remained below freezing for much of the afternoon and evening of 21 February, which maintained snow as the dominant precipitation type. Mesoscale banding was evident in the radar imagery with 1 to 2 inch hourly snowfall rates per surface observations. Based on the available data, the snow-to-liquid ratio (SLR) was in the 10:1 to 12:1 range which is typical for many winter storms across the Mid-Atlantic (based on research from Marty Baxter at the University of Central Michigan). By 03Z on 22 February, the upstream ‘warm nose’ worked its way into the lower troposphere of Virginia which shifted the event into more of a freezing rain/sleet mix. This spread roughly 0.10 to 0.25” of ice from central Virginia northward along and east of the I-95 corridor to New York City (Figure 2). The winter storm gradually wound down by the morning of 22 February as the best forcing for ascent moved offshore and drier air moved in from the west.

**Impacts:** This major winter storm created significant disruptions to transportation, particularly across the southern tier of the country where heavy ice accumulations fell. Icy road conditions across northern Alabama led to multiple accidents including one involving an 18-wheeler on Interstate 65 which left other motorists stranded for over 12 hours. To the north, over 0.50” of ice accumulated in Crossville, TN which brought down a local radio station signal tower. Societal

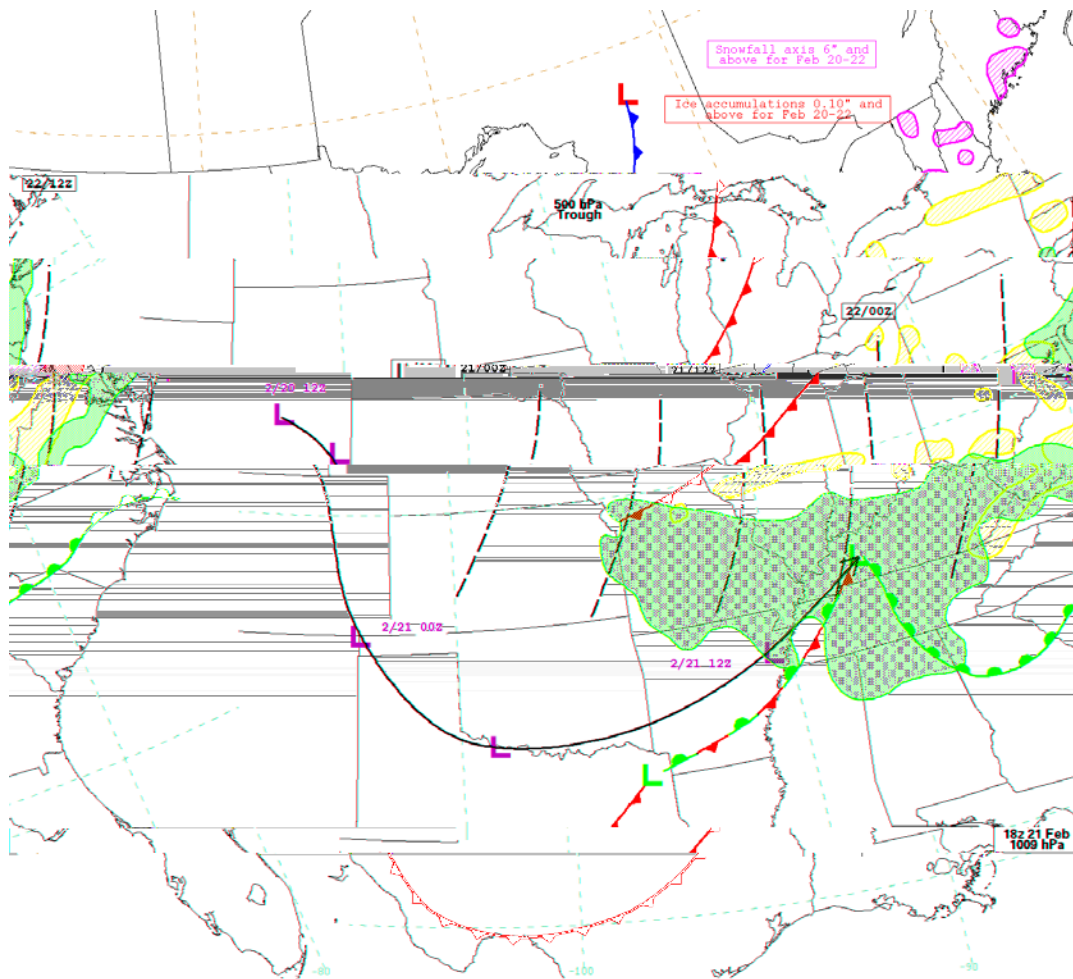
impacts continued north and east with the storm as downed trees and power lines, along with a multitude of automobile accidents caused significant issues for residents and travelers.



**Figure 1:** Total snowfall (inches) during the 20-22 February winter storm (image from National Operational Hydrologic Remote Sensing Center)



**Figure 2:** Total ice accumulations (inches) during the 20-22 February winter storm (image created from plots of local storm reports and public information statements)



**Figure 3:** 500 hPa trough tracks (black), surface low track (light blue), frontal analysis at 18 UTC on 21 February, snowfall axis 6" & above (pink), and freezing rain 0.10" & above (red)