CRH SSD
DECEMBER 1986

CENTRAL REGION TECHNICAL ATTACHMENT 86-28

THE APPALACHIAN SNOWSTORM OF FEBRUARY 11-13, 1985

Glenn S. Austin and Robert N. Klein
National Weather Service Forecast Office
Louisville, Kentucky

1. Introduction

Intense cyclogenesis often occurs as the high speed center of a jet maximum in the upper atmosphere crosses the trough axis (Black, 1971). This phenomenon occurred during the period from February 11-13, 1985 and combined with other meteorological conditions to produce the most intense snowstorm of the 1984-85 winter season over the central Appalachians.

As much as a foot of snow fell over parts of western Kentucky during the early stages of the storm. The full force of the storm didn't occur until more than 24 hours later as more than 20 inches of snow fell over parts of eastern Kentucky. Many long-time residents claimed the snowfall to be the most in their lifetime. The amount remained below the 27 inch snowfall measured at Bowling Green on March 11, 1960 that remains the record for the state for the most snow from a single storm.

Nearly every person in the region was affected by the storm. Hundreds of Kentucky residents were isolated in their homes. Many others couldn't make it home due to impassable roads. Power outages left many without heat for extended periods of time. Schools and businesses were forced to close throughout the region. Total recovery from the storm took days.

This report will highlight the meteorological processes that caused the storm to develop. We will focus on conditions that occurred in Kentucky and on the effect the snowstorm had on people within the state.

2. Meteorological Development

At 12Z Monday, February 11, 1985 the ridge position at 300 mb was located near longitude 80°W. The main trough extended from central Canada south through the Plains to the Texas coast. Another ridge extended along the Rockies. A jet maximum was digging through the southwest quadrant of the upper level trough over Colorado and northern Texas (Figs. 1a-c).

Moderate height falls of 150 m or greater in a 12-hour period generally indicate cyclogenesis has or will occur shortly (Weber, 1979). Fig. 2 shows a 12-hour height fall of 210 m over Alabama at 00Z Tuesday, February 12. A low at 500 mb developed over Memphis as the upper level wind max moved along the polar jet stream and reached the trough axis. The track of the height fall center (HFC) bottomed out over Alabama. The movement of the HFC and associated 500 mb low then turned northeast following the orientation of the jet stream.

The LFM 500 mb analysis for 00Z Tuesday, February 12, indicated a large area of positive vorticity advection over the southeast United States (Fig. 3). The 850 mb low was crossing eastward through Kentucky Monday night preceded by strong warm advection. A large area of mixed precipitation extended from Georgia northward through the Tennessee and Ohio Valleys and into West Virginia. The release of latent heat combined with the warm advection to produce strong upward vertical motion centered along the Kentucky/West Virginia border. Bernier and D'Aleo (1983) suggest storm intensification is favored in the area where these ingredients are found. Note the deepening of the sea-level low between 00Z and 12Z February 12 (Figs. 4a, b).

Winter storm warnings were in effect for east and southeast Kentucky where the deepening low and orographic lifting were expected to enhance the rate of snowfall. At 12Z Tuesday, the surface low was centered over West Virginia with a central pressure of 991 mb. The cyclonic circulation of the storm fed Atlantic moisture into the system. The winds gradually shifted to the northwest and increased to 20 to 40 mph. Arctic air rushed southward from Canada into Kentucky (Figs. 5 and 6). Temperatures dropped well below freezing as darkness approached.

The magnitude of the 500 mb HFC increased once again. The storm at the surface reached its maximum strength and produced near-blizzard conditions over eastern Kentucky Tuesday night and early Wednesday. The storm system then began to occlude and by 12Z Wednesday, the entire storm had become vertically stacked over western Pennsylvania. The wind and snow finally diminished during the day as the storm weakened and moved away.

3. Storm Evolution

Rain changed to snow over west Kentucky early Monday morning, February 11. A mixture of precipitation developed over the rest of the state by midday. Snow was still falling west of a line from Owensboro to Hopkinsville. Sleet was falling along the line with rain reported further east.

Evansville, Indiana, as well as Henderson and Paducah, Kentucky were all reporting snow at noon with 3 to 4 inches on the ground (2 inches of new snow on top of snow from a previous storm).

At sunset Monday, rain and drizzle were still reported over most of central and east Kentucky, including Louisville, Lexington and Covington. Snow was beginning to taper off over the west.

The rain/snow line finally reached Louisville to Nashville late Monday evening. Heavy snow developed over parts of central and eastern Tennessee and was expected to move into south central and southeast Kentucky after midnight.

Snow began to accumulate in south central Kentucky during the pre-dawn hours Tuesday, February 12. Snow was also reported in the higher elevations of southeast Kentucky. Freezing rain and drizzle were occurring over the remaining areas of eastern Kentucky while snow and flurries were still being reported elsewhere in the state.

Four to twelve inches of snow were reported on the ground over west Kentucky Tuesday morning. A foot of snow was reported in Madisonville and 4 foot drifts were reported in some areas. Curiously, the storm missed Louisville, the state's largest city. Officially, only a trace of snow was reported on the ground Tuesday morning at Standiford Field in Louisville, although amounts in surrounding communities ranged from 1 to 2 inches.

The storm continued to intensify and by mid-morning the rain had changed to snow over all of east Kentucky. Winds gradually shifted to the northwest and increased to 20 to 40 mph.

Six to twelve inches of snow were on the ground in southeast Kentucky Tuesday evening. It continued to snow heavily with drifts reaching 5 feet in places. The combination of blowing snow and icy roads caused many traffic problems across the state. Four wheel drive vehicles were recommended on all secondary roads. Several power lines were downed as a result of the weight of the ice and snow. Power outages were numerous over east Kentucky Tuesday night.

The storm center was moving through Pennsylvania and away from Kentucky Wednesday morning; however, dangerous and life threatening conditions persisted over the eastern third of the state. Unofficial snow depths of more than 20 inches were reported in parts of southeast Kentucky. Blowing snow reduced visibilities to near zero for extended periods of time. Snow drifts of 6 feet or more blocked a number of roads. Wind chill temperatures were 10 to 20 below zero. Power outages continued and residents were urged to check on neighbors without heat as hypothermia became a real threat. Kentucky State Police continued to recommend that people not attempt to drive over Kentucky roads due to hazardous conditions.

4. Human Reaction

Several state and local agencies were called on to render assistance. These agencies included the American Red Cross, the Kentucky Department of Highways, and the Kentucky Army National Guard.

The American Red Cross did not consider this storm to be a major disaster. As a result, the opening of shelters and the dispensing of food and clothing were handled by individual chapters on a local basis.

The Kentucky Department of Highways was heavily involved in the cleanup of this storm. Their operations began almost immediately with the onset of the storm and continued into the weekend of February 16-17, despite the fact that the heaviest snow ended on Wednesday, February 13.

Their primary duty was snow removal. At one point during the height of the storm both major interstate highways serving east Kentucky, I-64 and I-75, were closed. In addition, many state and local roads were either closed or virtually impassable except for four wheel drive vehicles.

A total of 2,599 Kentucky Department of Highway employees were involved in the actual snow removal. The total cost was $2,271,426, of which more than one million dollars was in the cost of labor alone (109,473 man-hours). The remaining money was divided between materials and equipment, some of which had to be rented from private contractors.

The third agency to become deeply involved in the storm was the Kentucky Army National Guard. The Governor activated approximately 200 personnel to perform a variety of duties.

The Guardsmen were on duty from February 11 to February 17. Their primary duty was to provide support to dislocated persons. The Guard furnished and transported food, water, clothing, and medicine. They fed livestock, delivered medical supplies, and transported medical personnel and cleared roads. The equipment used included bulldozers, graders, dump trucks, and helicopters.

The cost of the operation of the Guardsmen was relatively small ($60,000) due to the fact that a weekend was involved in which military personnel were on official training status and federal dollars could be used. The final cost to the state and federal governments was $125,000.

Over 1,500 people were displaced from their homes during the height of the storm. In one community alone, Mt. Sterling, over 400 persons were forced to seek shelter. It was estimated that over 10,000 homes were without power. A state of emergency was declared in many counties in eastern Kentucky.

Unfortunately, two persons lost their lives in an automobile accident on slick roads in Floyd County. Additionally, one death was reported in Berea, Kentucky after a man suffered a heart attack while shoveling snow.

5. Conclusion

It was evident that the central Appalachian area was the prime area for storm intensification. Several factors pointed to this area including strong mid and upper level positive vorticity advection, warm advection in the lower layers and the availability of Atlantic moisture. These factors coincided with the triggering mechanism provided by a favorable 300 mb jet maximum and produced the heavy snowfall (see Fig. 7).

The heavy snow over western Kentucky was triggered by the upper level trough as it approached the weak surface inversion lying over the Tennessee and Lower Ohio River Valleys Monday, February 11. However, this was not the main surface feature. The main surface low finally developed over Tennessee after the 300 mb jet produced cyclogenesis in the midlevels on Tuesday. This surface storm ultimately intensified and produced blizzard-like conditions over eastern Kentucky and adjacent states.

The heavy snow fell along the track of the 500 mb low and to the left of the 500 mb height fall center track. The snowfall was enhanced over the Appalachian mountains. The snowfall amounts were underestimated by many forecasters.

Despite the fact that this was one of the worst winter storms on record in Kentucky, the loss of life was minimal. The public's ability to cope with a storm of this magnitude seemed to intensify as the storm itself intensified. Also, people became more cognizant of the potential hazards of the storm as the conditions persisted.

The heaviest snowfall fell away from the more densely populated parts of Kentucky. It is obvious that if a major metropolitan area, such as Louisville, had received this much snow, the total cleanup costs and personal hardships would have been much higher.

6. Acknowledgements

The authors would like to thank Major Elmo Head of the Kentucky Army National Guard, Mr. Charles Pittenger of the American Red Cross, and Mr. Mel Jenkins of the Kentucky Department of Highways for their contribution to this report.

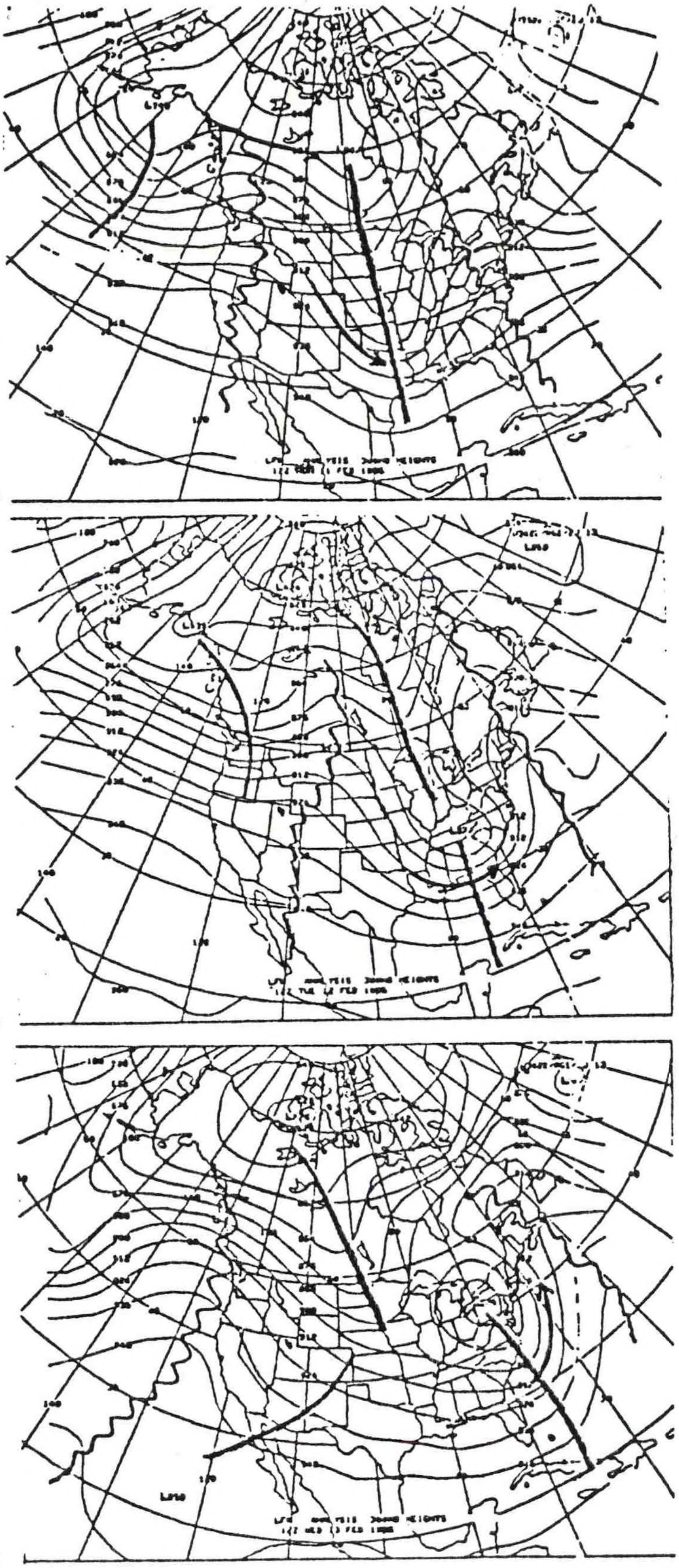
7. References

Bernier, A. and D'Aleo, J. S., 1983: Snow Study: The Storm of February 6-7, 1980. Nat. Wea. Dig., 5, 28-41.

Black, R. E., 1971: A Synoptic Climatology of Blizzards on the North Central Plains of the United States. NOAA Technical Memorandum NWS CR-79, 38 pp.

Ludlum, R. E., 1971: Weather Record Book. Weatherwise Inc., 79 pp.

Weber, E. M., 1979: Major Midwest Snowstorms. USAF 3WW Tech. Note 79-2, 95 pp.



a

b

c

Fig. 1. Height analysis at 300 mb valid (a) 12Z February 11, 1985, (b) 12Z February 12, 1985, and (c) 12Z February 13, 1985.

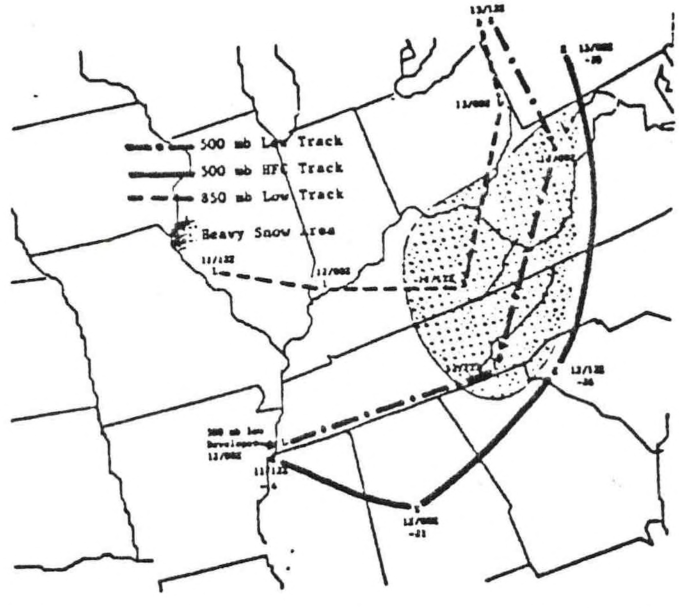


Fig. 2. Composite February 11-13, 1985.

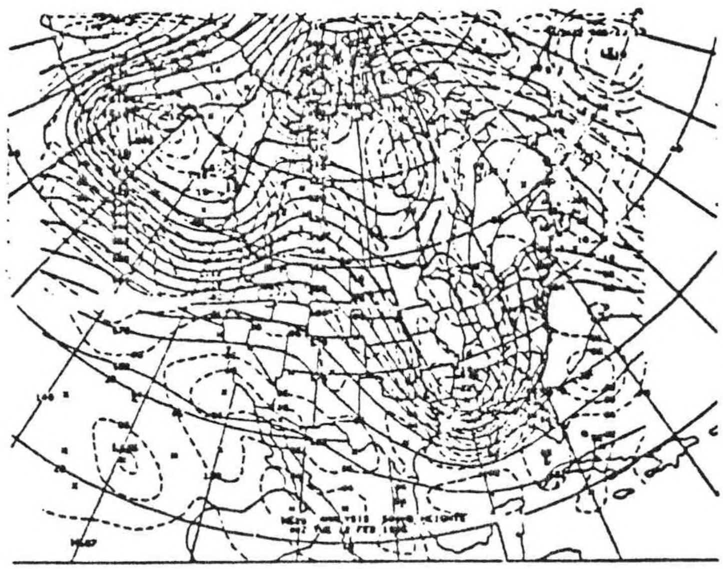
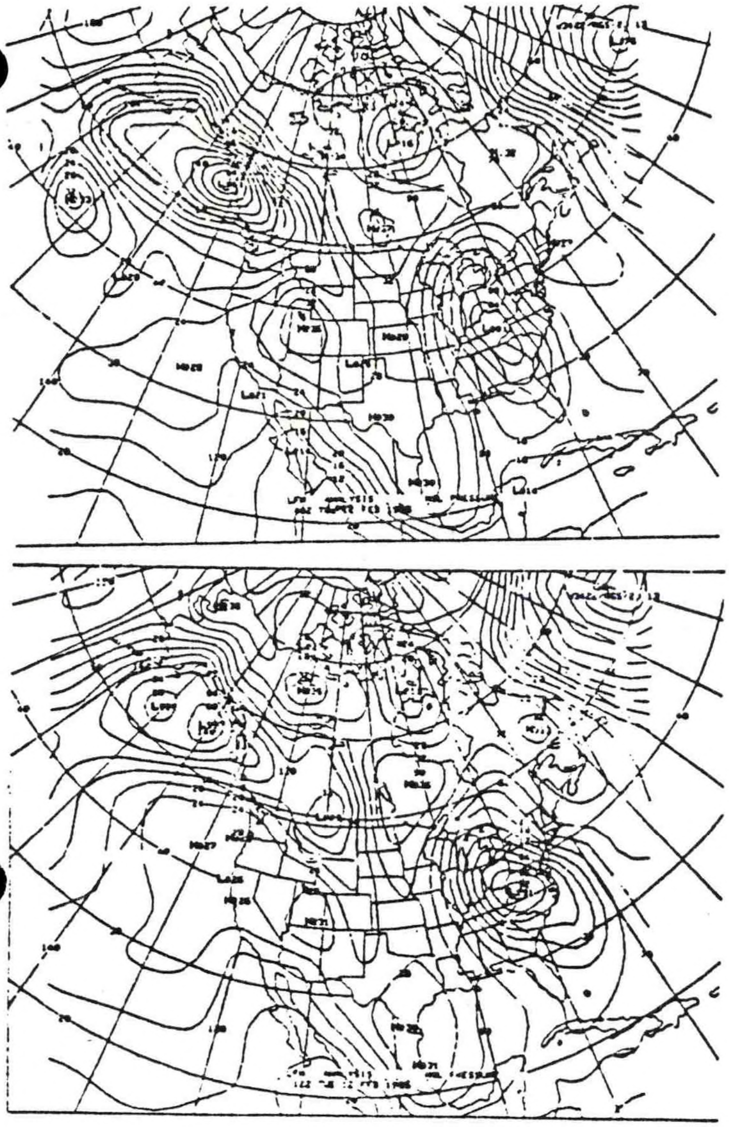


Fig. 3. Heights and vorticity at 500 mb valid 00Z February 12, 1985.



a

b

Fig. 4. Surface analysis valid (a) 00Z February 12, 1985, and (b) 12Z February 12, 1985.

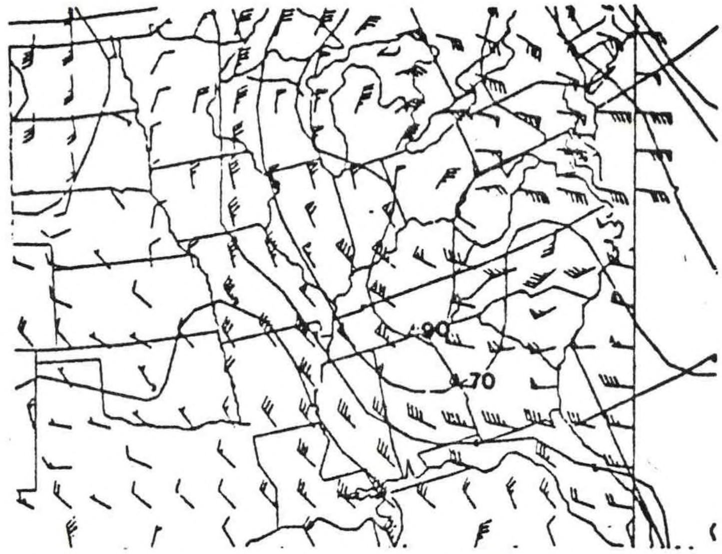


Fig. 5. Geostrophic wind/mean relative humidity valid 12Z February 12, 1985.

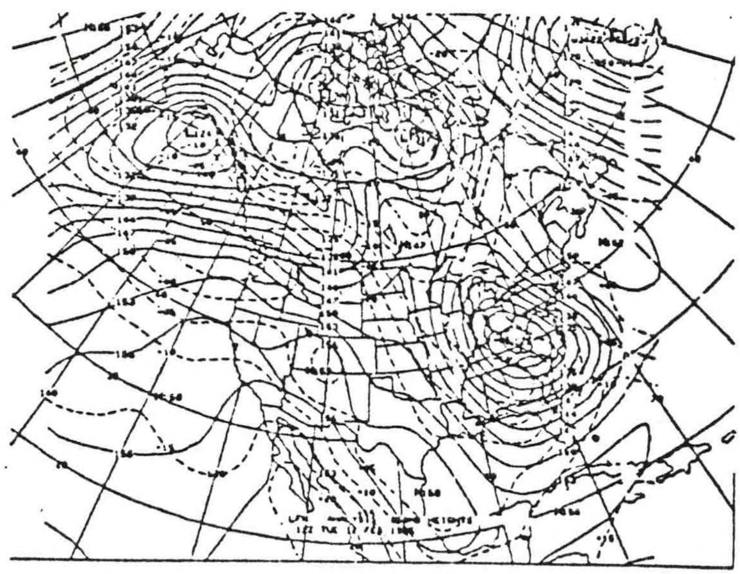


Fig. 6. Heights and temperature at 850 mb valid 12Z February 12, 1985.

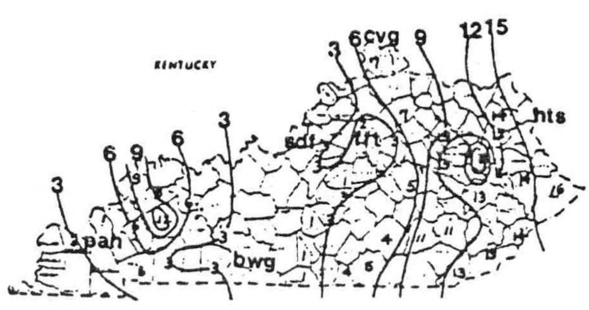


Fig. 7. Accumulated snowfall February 11-13, 1985.