Overview of the December 26, 2004 NWS MHX Winter Weather Event

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1. INTRODUCTION

On Sunday, December 26, 2004 portions of eastern North Carolina received a second round of December winter weather. While the previous event (December 20, 2004) was all snow, this event contained a mix of snow, sleet and freezing rain. Areas along and east of Highway 17 received all rain. Portions of Duplin, Lenoir, Greene, Pitt, Martin and Washington counties received 2-5" of snow, and up to a ¼" of ice accumulated in western Beaufort, Craven, Jones, Onslow and Duplin counties **(Figure 1)**.

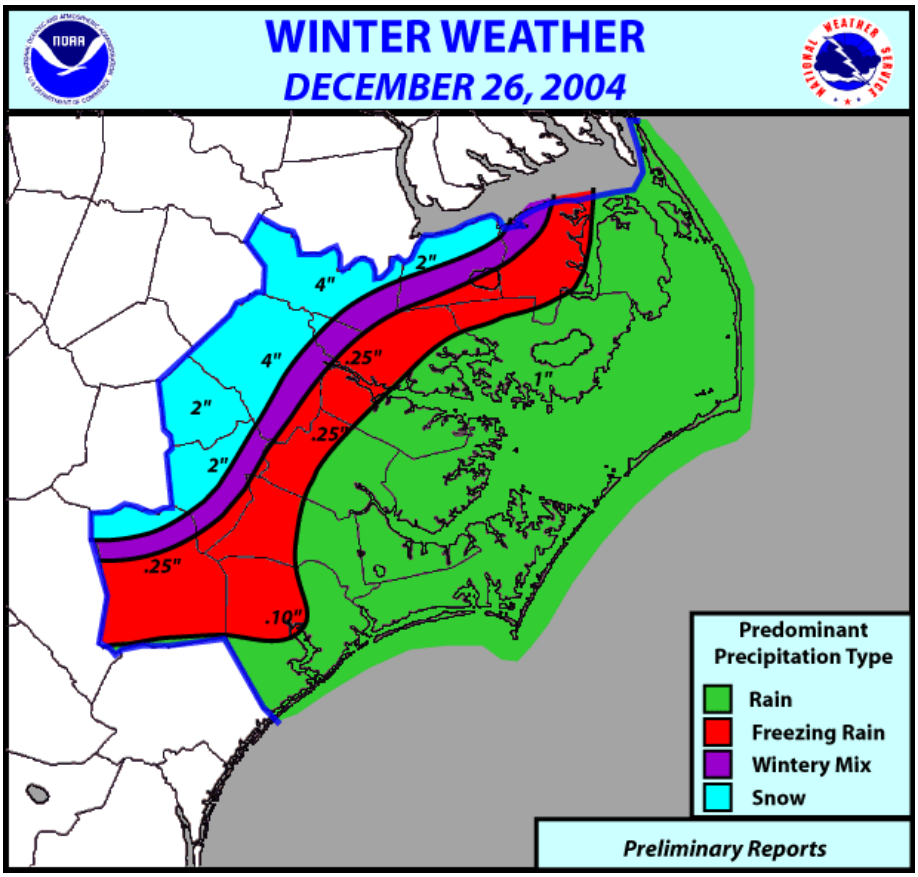

Figure 1. Preliminary Snow/Ice Accumulation Totals in NWS MHX's County Warning Area.

2. SYNOPTIC OVERVIEW

The upper-air pattern over the eastern U.S. at 00 UTC December 26, 2004 was characterized by a southern stream trough over the Gulf of Mexico and zonal flow over the northeast states south of an upper low in Canada **(Figure 2)**. At the surface, a 1004 mb low was located in the Gulf of Mexico downstream of the upper trough and in the Mid-Atlantic a classic case of cold air damming (CAD) was present. **Figure 2** shows the classic "U" shaped isobar pattern over the Mid-Atlantic and a 1030+ mb parent high over New England and southern Canada. This wedge of cold air over the Mid-Atlantic would set the stage for significant snow/ice accumulations in SC, NC and VA. By 06 UTC December 26, the southern stream trough was now over the Florida panhandle and the surface low was approaching the west-central coast of Florida **(Figure 3)**. Between 00 and 06 UTC precipitation had already begun to fall along the immediate coast in NC. By 12 UTC December 26, the southern stream trough was located over north

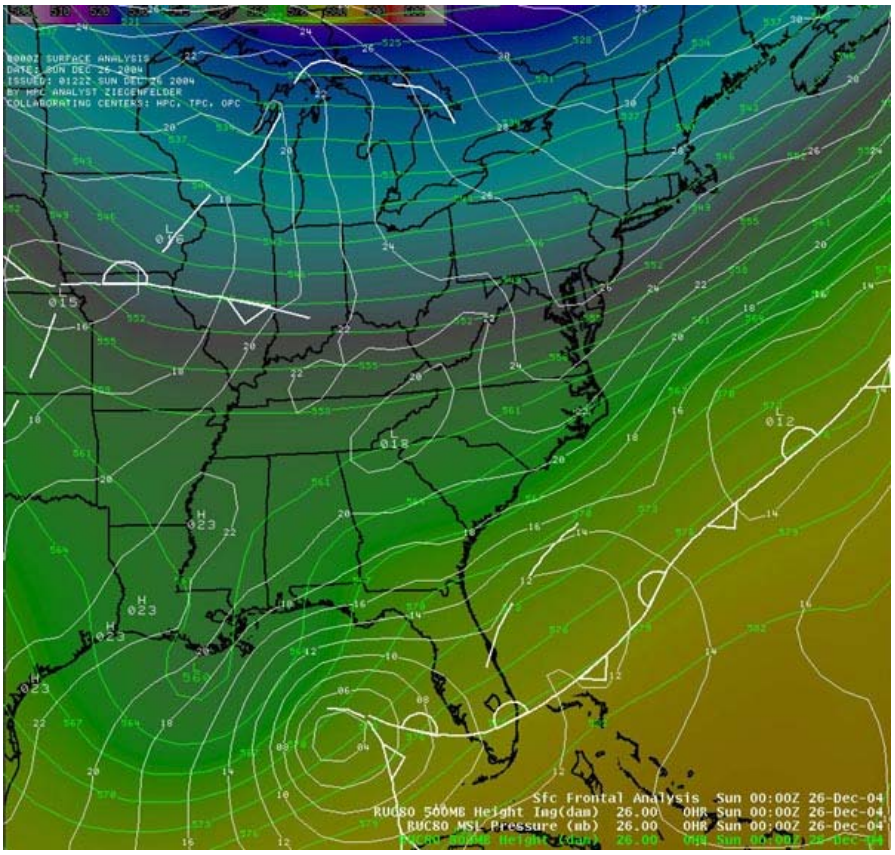

Figure 2. 00Z 12/26/04 RUC Analysis of 500 mb Heights and MSLP, and HPC Surface Fronts.

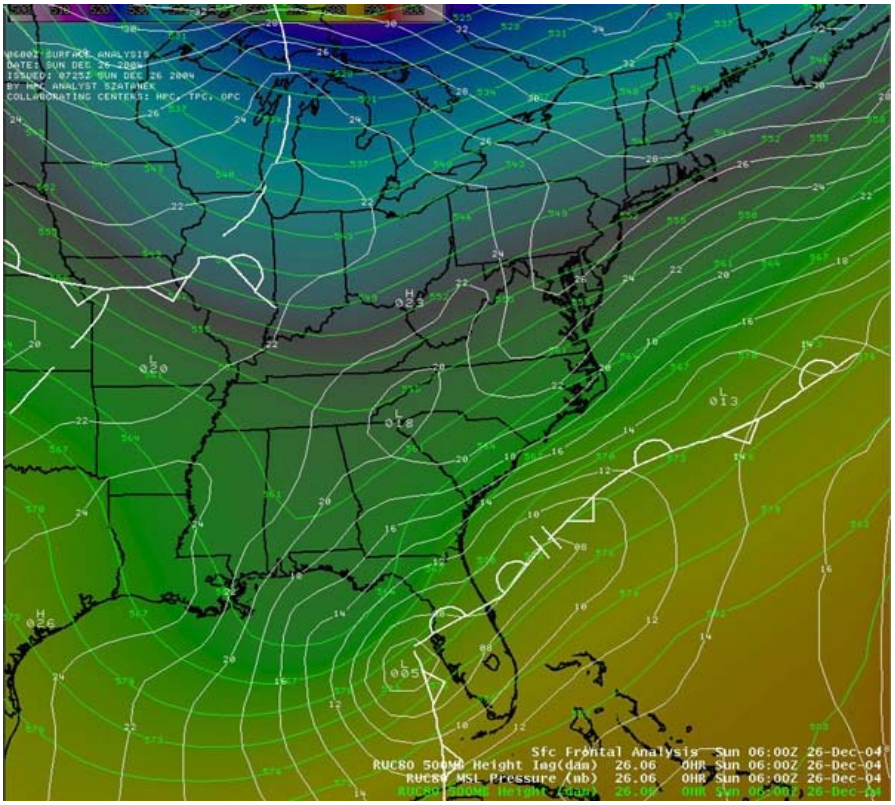

Figure 3. 06Z 12/26/04 RUC Analysis of 500 mb Heights and MSLP, and HPC Surface Fronts.

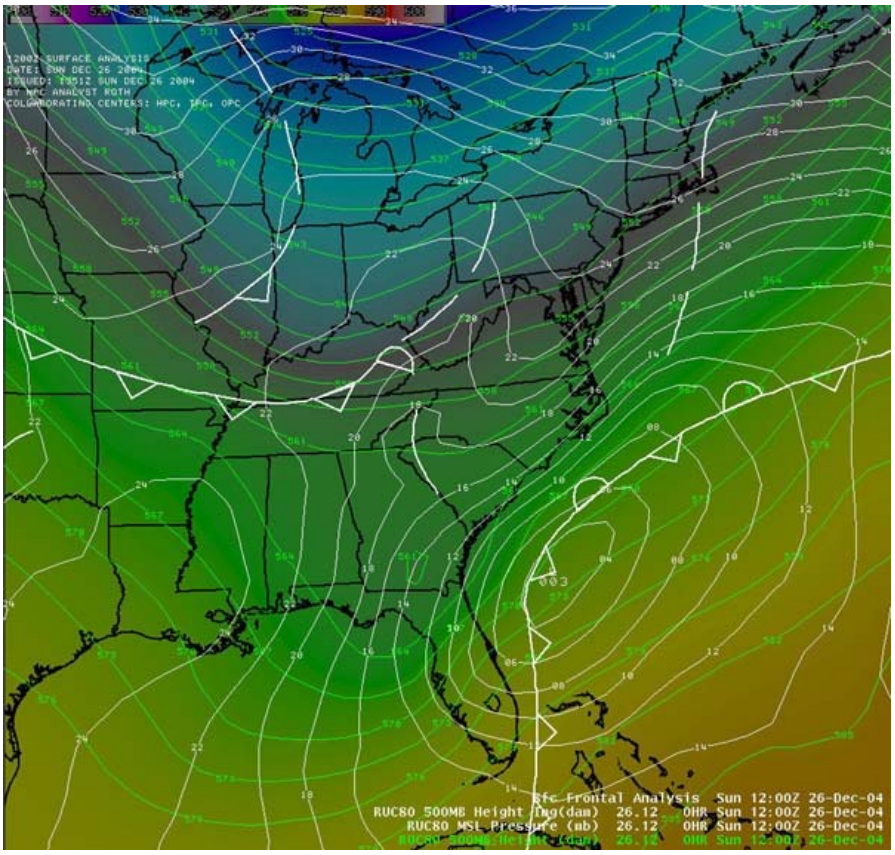

Figure 4. 12Z 12/26/04 RUC Analysis of 500 mb Heights and MSLP, and HPC Surface Fronts.

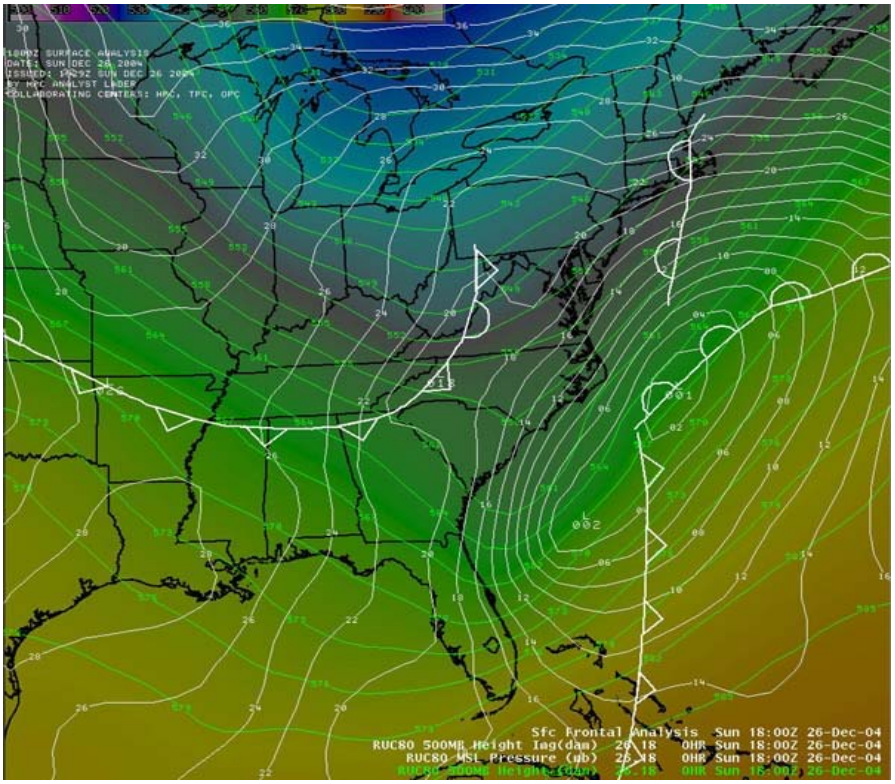

Figure 5. 18Z 12/26/04 RUC Analysis of 500 mb Heights and MSLP, and HPC Surface Fronts.

Florida and southern GA **(Figure 4)**. Also, by this time, some northern stream energy was apparent as a shortwave rotated around an upper low in Canada into the IN/OH/KY/TN area **(Figure 4)**. The surface low in the Gulf of Mexico at 06 UTC had crossed the Florida peninsula and was now located about 100 miles southeast of Charleston, SC at 12 UTC **(Figure 4)**. By 18 UTC December 26, the southern stream trough was located over the Carolinas, the northern stream trough was located over PA/WV/VA, and the surface low was elongated, stretching from about 100 miles southeast of Charleston, SC to approximately 150 miles west of Cape Hatteras, NC **(Figure 5)**. Between 18 UTC December 26 and 00 UTC December 27 the northern and southern stream troughs lifted northeast out into the Atlantic, as did the surface low. Precipitation over eastern NC ended during this time.

3. MESOSCALE OVERVIEW

Precipitation began over extreme eastern NC as rain around 02 UTC on Sunday, December 26, 2004 **(Figure 6)**. Temperatures over eastern NC at this time ranged from the low to mid 30s inland to the mid 40s to 50 along the Outer Banks **(Figure 6)**. As the night progressed, precipitation continued to spread over eastern NC from

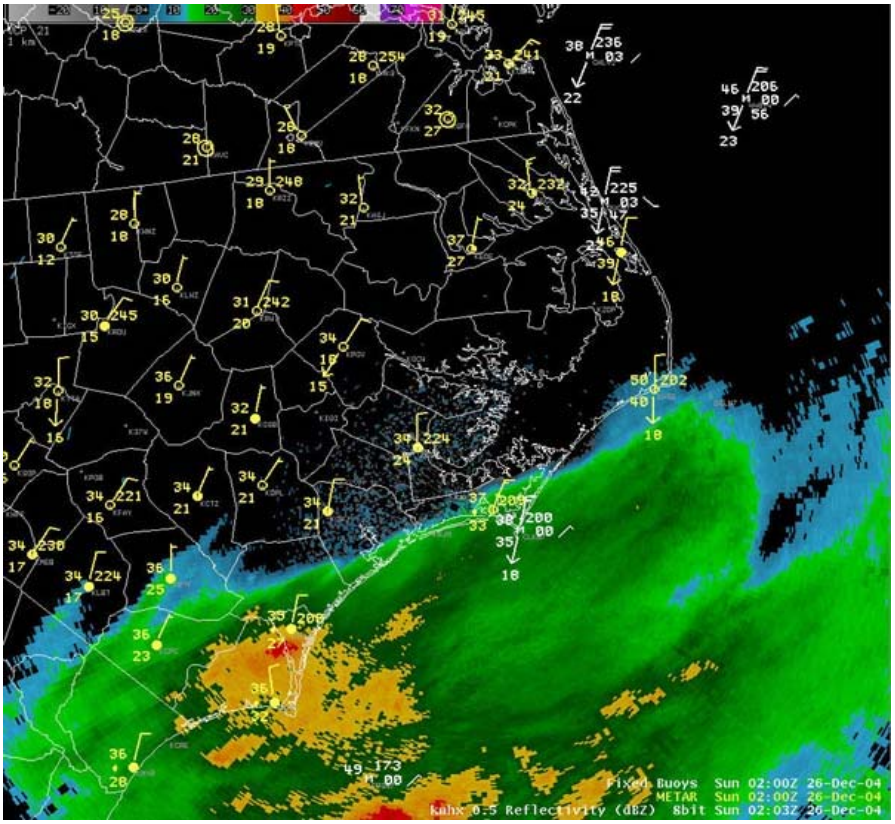

Figure 6. 02Z 12/26/2004 0.5 Degree Reflectivity and Surface Observations over eastern NC.

south to north. By 06 UTC on December 26, precipitation had overspread the whole NWS MHX county warning area (CWA) **(Figure 7)**. Most of the precipitation at this time was rain, although there was at least one observation showing freezing rain (New Bern, NC). Temperatures inland were primarily in the low 30s, while temperatures along the Outer Banks still remained in the 40s **(Figure 7)**. By 09 UTC, precipitation covered all of eastern NC and began to move north into VA **(Figure 8)**. Although temperatures in most locations were still in the low 30s, snow was now falling in several locations, including Greenville, NC **(Figure 8)**. The area of very high reflectivities over eastern NC shown in **Figure 8** are an artifact of the radar sampling melting snow in the above freezing layer a few thousand feet above the ground. Subsequently, the precipitation over this area is not as intense as the radar image depicts.

It is of interest to note that although at 09 UTC it was 34 degrees in Greenville and 41 degrees in Edenton, both stations reported snow! There are several possible reasons why snow fell in these above freezing locations. The process most likely responsible is the 'wetbulb' effect. When precipitation falls through air that is sub-saturated, the precipitation evaporates (liquid precipitation) or sublimates (frozen precipitation) an amount that depends on how dry the surrounding environment is. When precipitation evaporates or sublimates, energy (in the form of heat) is 'stolen' from the surrounding environment to complete the phase change, with the net result of cooling the surrounding environment. So, if snow is falling through air that is sufficiently dry (i.e. if the wetbulb temperature is 32 degrees or less), then the snow can make it to the ground even if the surface temperature is above freezing because the sublimation keeps the air surrounding the falling snow at the wetbulb temperature. The nature of this process dictates that the surface temperature doesn't remain above freezing for long if the air is sufficiently dry or if there is a

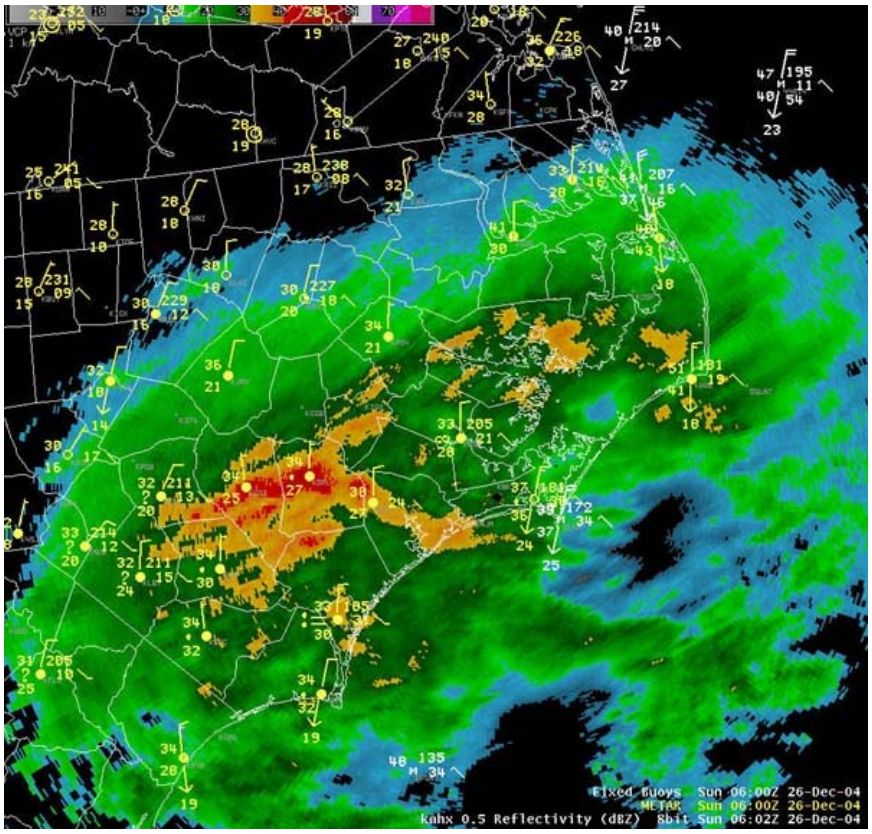

Figure 7. 06Z 12/26/2004 0.5 Degree Reflectivity and Surface Observations over eastern NC.

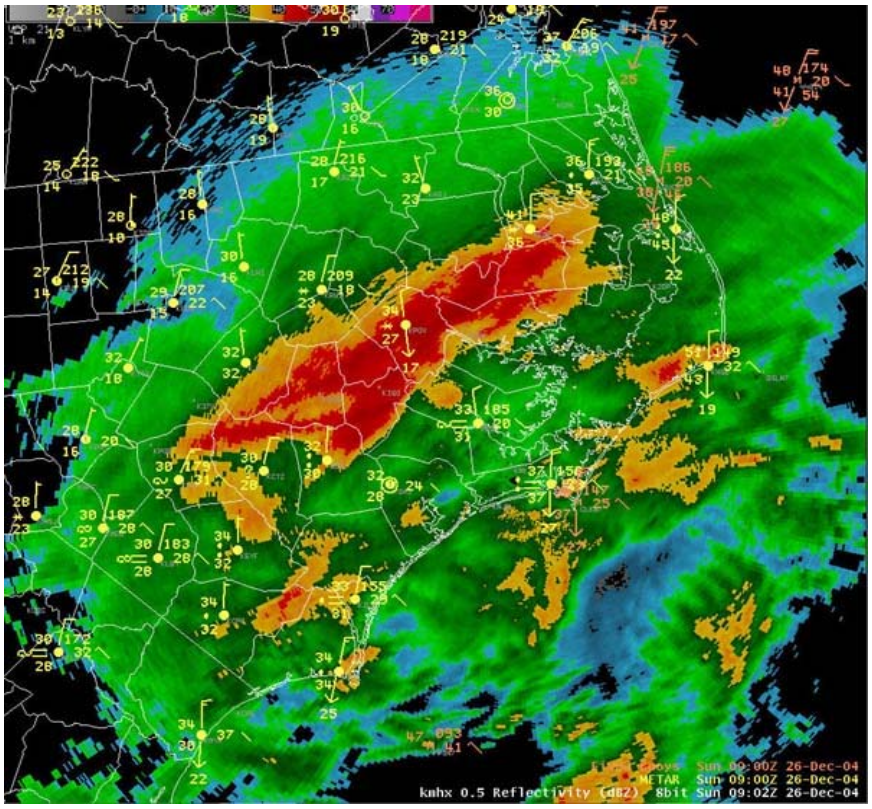

Figure 8. 09Z 12/26/2004 0.5 Degree Reflectivity and Surface Observations over eastern NC.

continuous supply of dry, low-level air. With the CAD wedge firmly in place over eastern NC and VA during the morning of December 26, northerly winds over the area continually advected drier air from southern VA (dewpoints in southern VA were in the upper teens) into eastern NC. After precipitation began, between 09 and 10 UTC on December 26, the temperature at Greenville, NC dropped from 34 degrees to 30 degrees, evidence that this 'wetbulb' cooling process could have been taking place.

Precipitation continued to fall over eastern NC through the morning and afternoon hours of the 26th. The rain/snow line depicted in **Figure 1** remained in the same location throughout the duration of the event. By 18 UTC December 26, precipitation started to end from west to east **(Figure 9)** as the surface low off the coast moved northeast well out into the Atlantic. By 23 UTC December 26, precipitation associated with this event ended.

Model upper-air soundings from 12 UTC December 26 for Greenville, New Bern and Kenansville (along with a map of these locations superimposed on Figure 1) are shown in **Figures 10**, **11**, **12** and **13**. The sounding for Greenville, NC (**Figure 11**) suggests precipitation falling as snow with temperatures at or below freezing throughout the depth of the atmosphere. The sounding for New Bern, NC (**Figure 12**) suggests precipitation falling as all rain, with temperatures above freezing from the surface to 775 mb. The sounding for Kenansville, NC (**Figure 13**) suggests freezing rain, with temperatures at or below freezing at the surface, then above freezing from 975 mb to 775 mb. The precipitation types inferred from these model soundings match up very well with the precipitation types observed at the sounding locations.

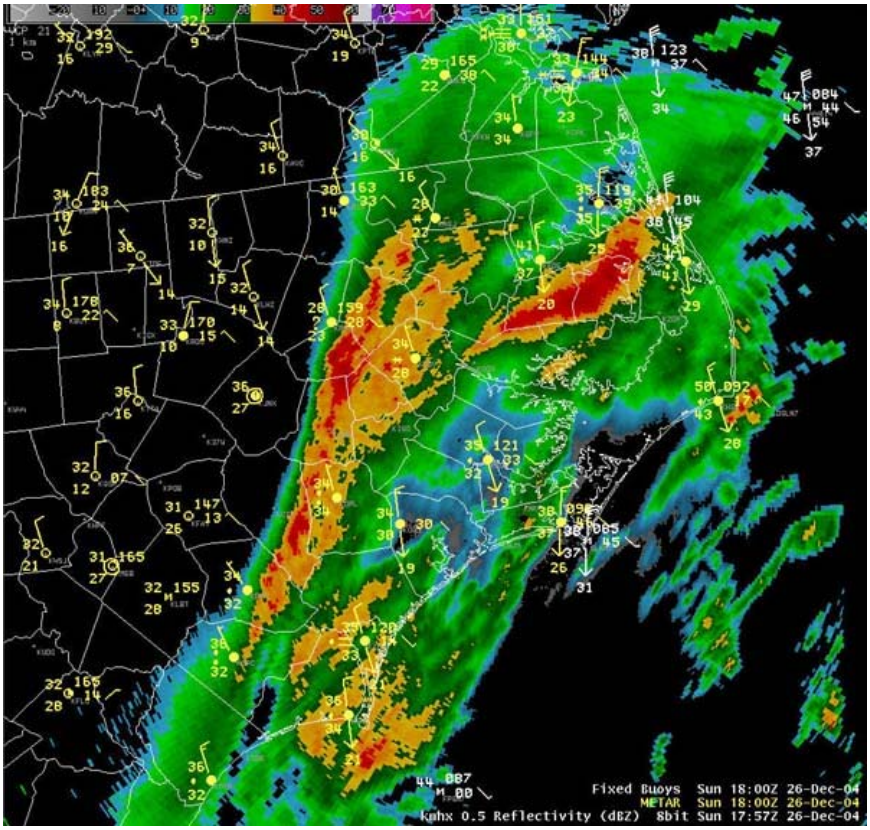

Figure 9. 18Z 12/26/2004 0.5 Degree Reflectivity and Surface Observations over eastern NC.

4. SUMMARY

This winter weather event occurred in a familiar scenario for central/eastern NC. Precipitation associated with a coastal low overran a wedge of cold surface air in place because of a classic cold air damming setup, resulting in a mixed bag of precipitation across central/eastern NC. The continuous advection of cold, dry surface air from VA via northerly flow within the cold dome resulted in subsequent cooling via the 'wetbulb' effect as precipitation fell through this reinforced cold dome. This cooling effect was able to offset the warm advection aloft and keep temperatures cold enough for all snow in northern Washington, Martin, Pitt, Greene and Lenoir counties. The cold, dry air airmass from southern VA could not penetrate any further south or east of Pitt or Greene counties because it was modified and saturated after reaching these locations.

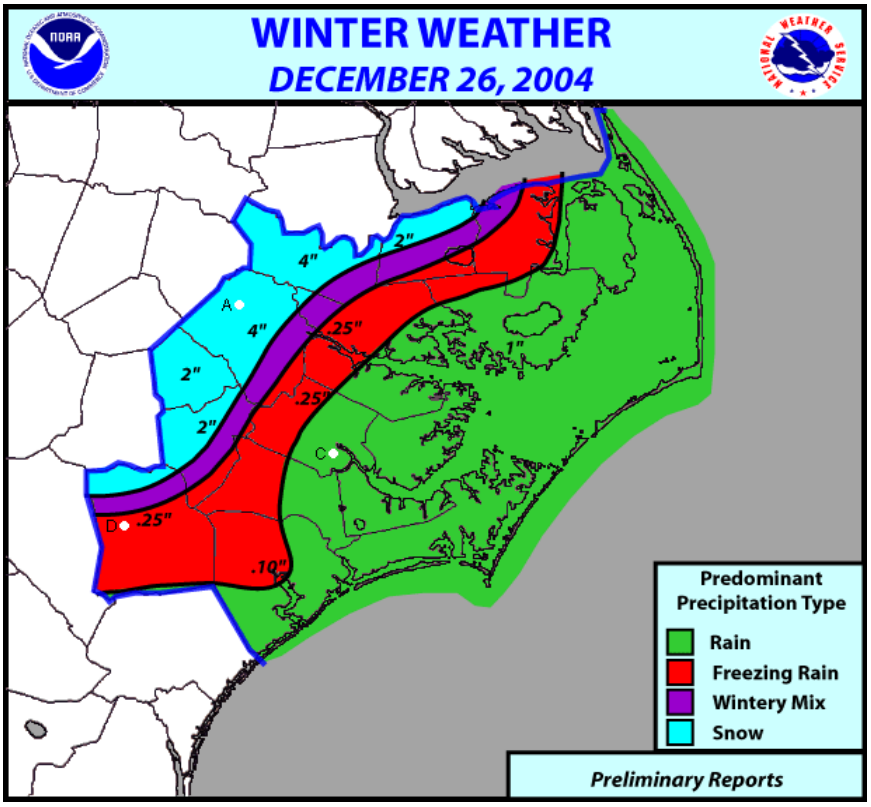

Figure 10. Preliminary Snow/Ice Accumulation Totals in NWS MHX's County Warning area with Eta model sounding locations superimposed as white dots along with a letter (A, C or D) that matches up with the corresponding sounding.

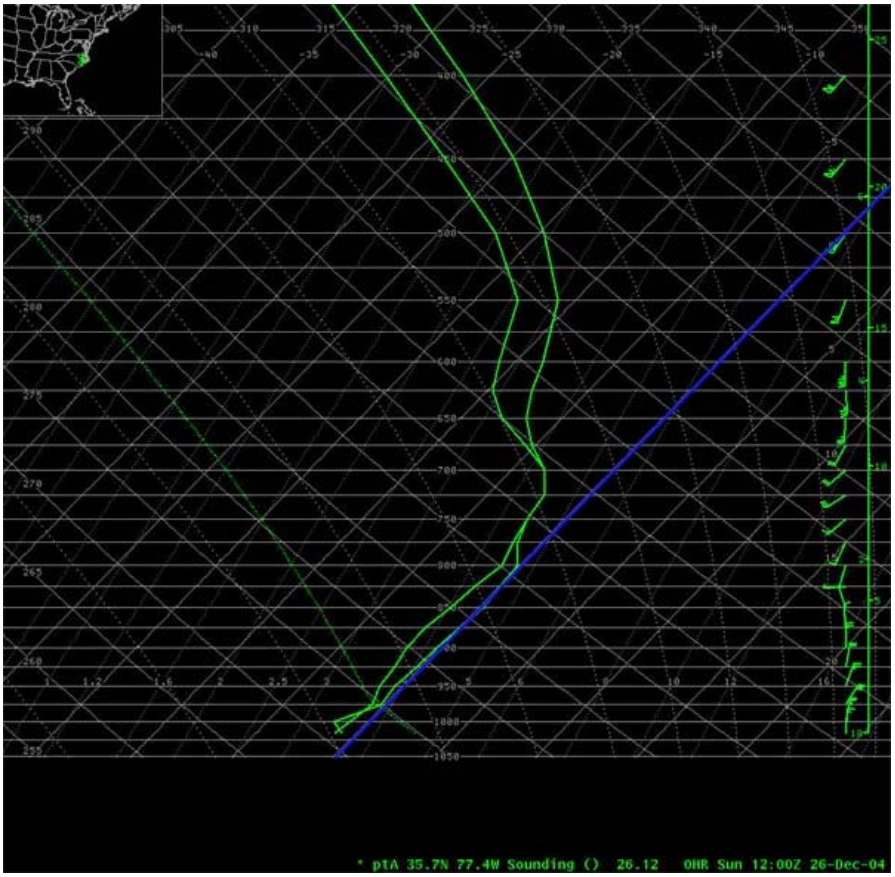

Figure 11. 12 UTC December 26 Eta Model Sounding for Greenville, NC (Point A) (Blue Line is 0 C).

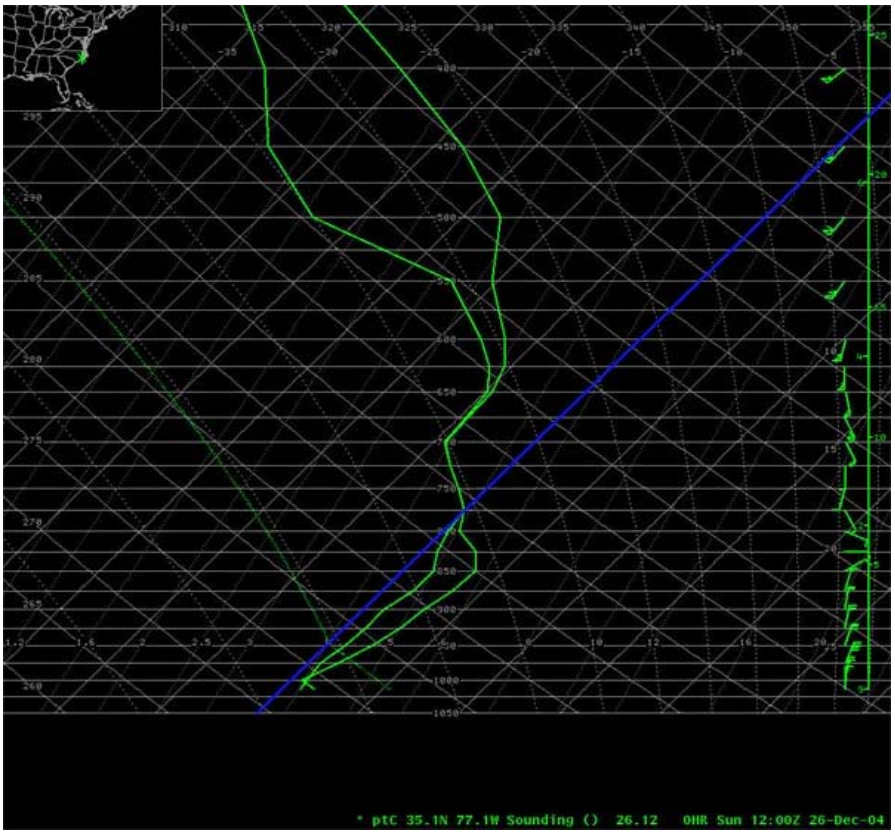

Figure 12. 12 UTC December 26 Eta Model Sounding for New Bern, NC (Point C) (Blue Line is 0 C).

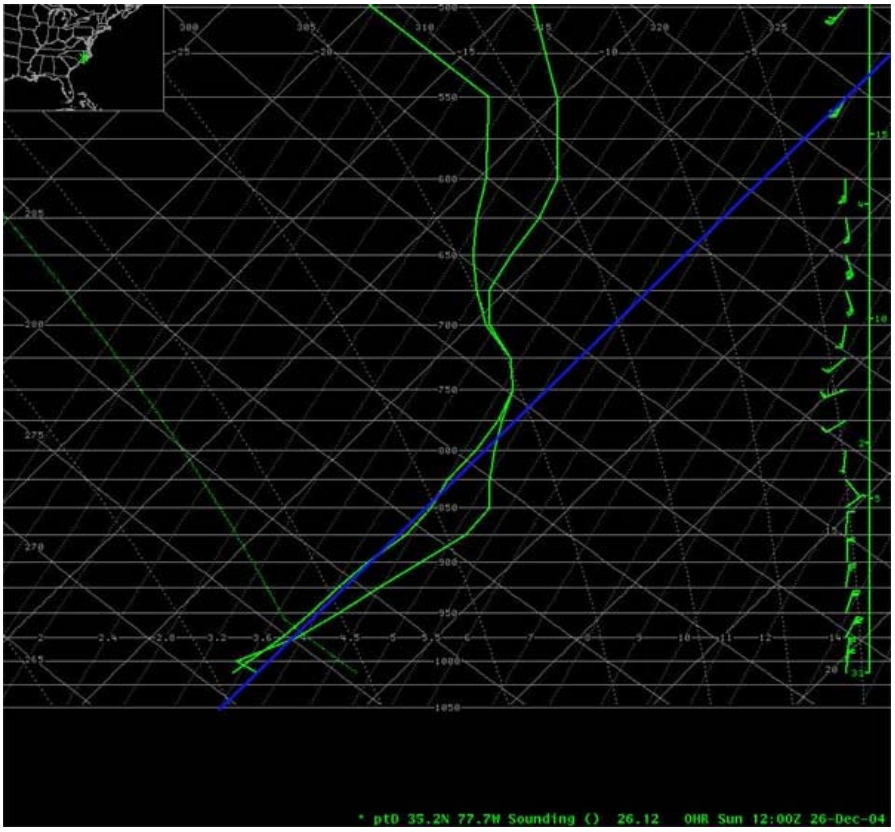

Figure 13. 12 UTC December 26 Eta Model Sounding for Kenansville, NC (Point D) (Blue Line is 0 C).

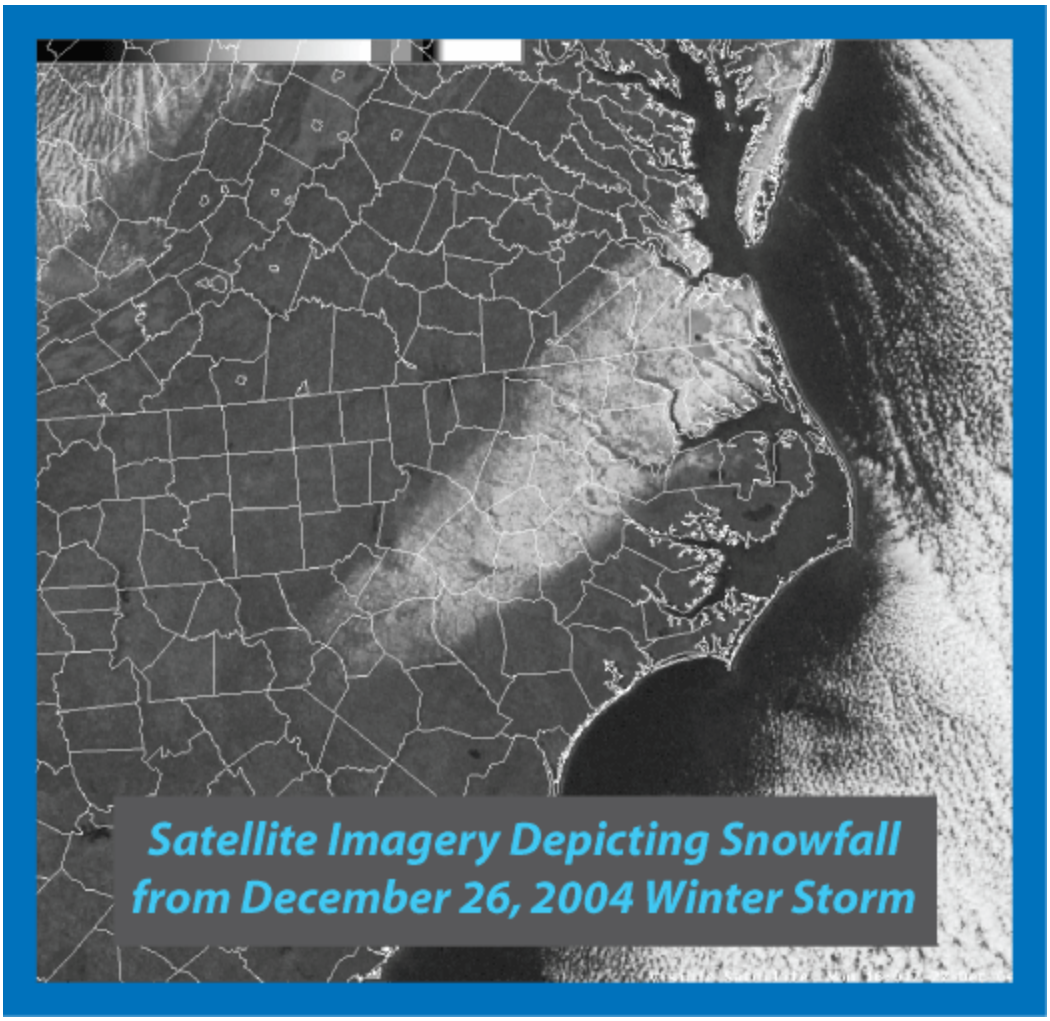

Figure 14. 1601 UTC December 27, 2004 Visible Satellite Image Showing Snowfall over Eastern NC.