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A REVIEW OF RADAR INTERPRETATION NEAR THE FREEZING-MELTING LEVEL

Charles M. Baker[1]
National Weather Service Meteorological Observatory
Limon, Colorado

1. Introduction

During the fall and spring months the weather in eastern Colorado often produces a mixed bag of precipitation. The radar observer must deal with thunderstorms, widespread rain and rain showers, and snow all at the same time. Unlike the random convection of summer, these thunderstorms are generally associated with vigorous cold fronts which are followed by upslope and overrunning conditions which produce widespread rain and snow. The thunderstorms and snow are generally straightforward as far as their display on the radar, but the transition zone between solid and liquid precipitation can cause serious interpretation problems for the radar observer. This is because erroneous DVIP levels can be caused by melting precipitation near the ground. It is the radar observer's job to understand the meteorological processes taking place and to determine if DVIP levels on the PPI are erroneous.

2. Basic Meteorological Processes

Upslope and overrunning conditions are slow lifting processes producing vertical velocities that are orders of magnitude less than vertical velocities in the updrafts of thunderstorms. The predominate precipitation type will fall from stratiform clouds although some embedded thunderstorms and/or showers may exist. When surface temperatures drop below 50°F, the freezing level (melting level) may only be 5,000 ft above ground level (AGL) and as surface temperatures near 32°F the problems produced by the freezing level (melting level) will increase.

In cold air stratiform precipitation, the formation of precipitation particles is predominantly in the form of ice crystals as described by the Bergeron-Findeison theory. In the zone between 0°C and -25°C ice crystals and supercooled liquid water droplets coexist. Supersaturation with respect to ice exists while the air is undersaturated with respect to liquid water. The supercooled water droplets lose mass due to evaporation while the ice crystals grow rapidly due to sublimation. As the crystals gain mass, they begin to fall and collide with both other crystals and with supercooled water droplets with slower fall speeds. As the conglomerate falls through the freezing level, the release

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1 Charles Baker will soon be affiliated with WSO Lander, Wyoming.

of heat by fusion, which warms the air around the crystal, works in concert with the warmer environmental air so that the three phase process can no longer function and a liquid coat forms around the crystal. The large diameter and liquid coating increases the reflectivity rapidly as they fall below the freezing level. Then, as the ice crystals melt, the conglomeration breaks up into smaller liquid droplets due to friction and collisions with other particles. The reflectivity decreases rapidly as the particles break up. This may occur too close to the surface to be detected.

With the freezing level (melting level) within a few thousand feet of the surface and the formation of large conglomerations of snowflakes and graupel, DVIP 4, 5, and 6 levels will often appear on the PPI. Since FMH-7, Part A, Table 5-2 states that VIP 4, 5, and 6 level stratiform rain does not occur, the observer is faced with a dilemma. If the observer takes the PPI presentation at face value and VIP 6 levels are present, then criteria for special observations are met and RWXX or TRWXX would be reported when, in fact, R+ is the most that may be occurring.

3. Operational Response

To comprehend what is being observed on the radar display, the height of the freezing level should be determined from the upper air data (it is on the 00Z and the 12Z surface observations; i.e., RADAT 54130, 54 is the relative humidity and 130 is freezing level at 13,000 ft). Draw a line on the RHI at the height of the freezing level above MSL. Scan vertically with the RHI through the area of high reflectivity and, if the high DVIP levels stop abruptly near the freezing level and has a fairly uniform top, the high DVIP levels should be ignored. In the zone above the freezing level the VIP levels should drop abruptly. Furthermore, these areas are typically not cellular in nature (as are convective cells). In addition, remember that the freezing level may drop due to loss of heat by melting, cold air advection, or radiational cooling.

The melting level should be reported in the observation as determined on the RHI. Use surface reports to determine precipitation type (R, R-S, etc.). Remember that with stratiform precipitation, the intensity reported is the one of predominate coverage. If the high level reflectivity area dominates the coverage, report the intensity of liquid precipitation as unknown (refer to FMH-7A, page 5-9, paragraph 5.2.9.3). The MDR blocks covered by the erroneous VIP levels should be reported as 9 -unknown (refer to FMH-7A, page 6-2, paragraph 6.4). The observer may wish to report a separate area containing the area of the erroneous VIP levels.