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CENTRAL REGION TECHNICAL ATTACHMENT 90-41

A CASE OF FREEZING DRIZZLE ACROSS SOUTHEAST WYOMING

Scott A. Mentzer and James L. Hatten
National Weather Service Forecast Office
Cheyenne, Wyoming

1. Introduction

Freezing precipitation is a relatively rare event across southeast Wyoming and the front range of Colorado. When freezing precipitation does occur in these areas, the duration of the episode is usually short, generally two hours or less. On April 17, 1990, a freezing drizzle event occurred from central Colorado to southeast Wyoming and lasted more than nine hours. Freezing drizzle accumulated on roads, including Interstate 25, hampering travel through the morning hours. This paper documents that event.

2. Freezing Drizzle Climatology Across Southeast Wyoming

From 1970 to 1990 freezing drizzle occurred at the Cheyenne airport only 71 times, or three to four times a year. Freezing rain occurred even less frequently, less than ten times during the same 20 year period. The cause for the rarity of freezing precipitation is most likely the elevation of the site, which is over 6000 feet. The high elevation makes it difficult to form a warm layer (greater than 0°C) above the surface, a necessary step in freezing precipitation events. During the winter months when temperatures drop below freezing, most precipitation falls as snow.

Freezing drizzle across southeast Wyoming occurs most frequently in the months of March and November (Fig. 1). Usually temperatures are too cold at all levels for freezing drizzle to occur from December through February. Surface temperatures begin to warm in April, which accounts for the decrease in occurrences during that month.

It is even more rare for freezing drizzle events to last more than five hours. Of the 71 cases that occurred at Cheyenne from 1970 to 1990, only 12 lasted more than five hours, or about one every other year. The longest freezing drizzle event occurred on November 11 and November 12, 1978, and lasted a little more than 14 hours.

One of the largest contributors to (any kind of) precipitation formation over southeast Wyoming is the direction of the wind. The wind direction is critical as upslope components aid in upward vertical velocity while downslope

FREEZING DRIZZLE
AT CYS BY MONTH
(1970-1989)

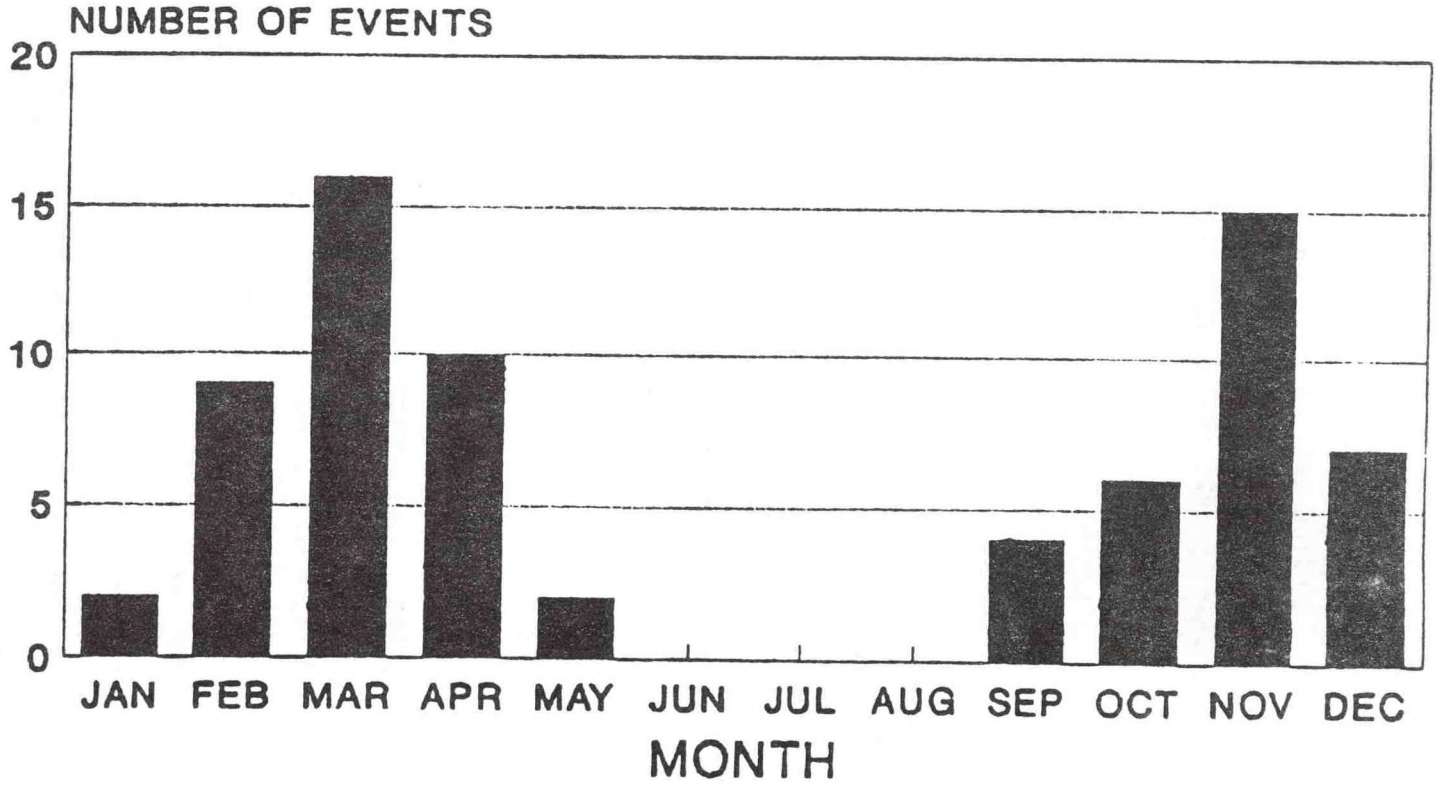

FIGURE 1

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components cause sinking air motions. Upslope wind components for southeast Wyoming vary from north through east to south. Most freezing drizzle events occurred when the predominant low level winds were from the south or southeast (Fig. 2). Significant events (those lasting more than five hours) also followed this pattern.

The event that occurred on April 17, 1990, lasted for nine hours and 27 minutes. This made it the third longest freezing drizzle event across southeast Wyoming in the last 20 years. Surface winds were primarily from the south.

3. Synoptic Pattern

Freezing drizzle occurred at the Cheyenne airport from 0836 GMT until 1827 GMT on April 17, 1990. Figures 3 and 4 show the predominant weather features across the western United States for that time period.

At 500 mb an area of low pressure was over southern Nevada and southern California with a weak high pressure ridge over Idaho and northwest Wyoming. An area of difluence extended from northwest Colorado through southern Wyoming.

At 700 mb the main low pressure system was over central Nevada which forced a ridge to develop from southwest Kansas to central Montana. A weak short wave trough was entering south central Wyoming. Moisture at this level (shaded in the figure) extended from southwest Kansas into central Wyoming. The 850 mb level and the surface level both showed a well developed high over the Central Plains states with a low in southeast Oregon/southwest Idaho.

The position of the high and low in the lower layers produced a strong south pressure gradient across Colorado and eastern Wyoming. Consequently, the surface winds were from the south or southeast which, as indicated in Part 2, tends to play a role in freezing precipitation development across southeast Wyoming.

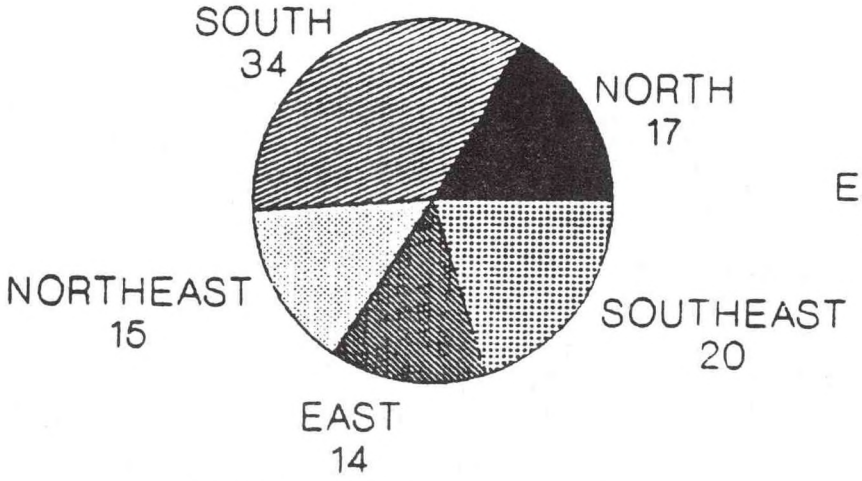
Adequate low level moisture was also indicated from the 700 mb charts. The short wave moving into Wyoming, albeit weak, and the area of upper level difluence aided in upward vertical motion, which may have prolonged the event.

Surface temperatures rose into the upper 30's by the afternoon which ended the event. Although surface winds remained from the south, the weak short wave had moved past the area by 18Z. This tended to decrease the upward vertical motion, also aiding in ending the event.

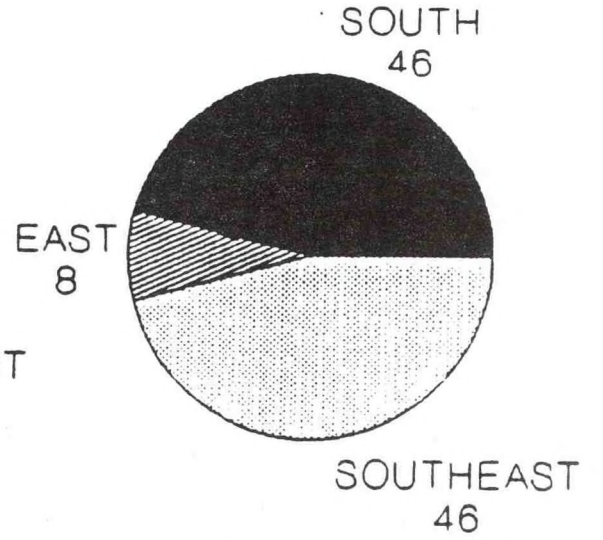
4. RAOB Analysis

Figure 5 shows the 1200 GMT upper air sounding traces for Denver (DEN) and Lander (LND) on April 17, 1990. The temperature profiles show a classic freezing precipitation trace: a shallow area of cold air near the surface with warmer air aloft. No temperature was above freezing in either trace, but this is not surprising in freezing drizzle events (Bocchieri, 1980). As expected, the air mass was saturated in the lower levels.

WIND DIRECTIONS (%) AT CYS
OF FREEZING DRIZZLE EVENTS



TOTAL EVENTS
(1970-1989)



SIGNIFICANT EVENTS
(1970-1989)

FIGURE 2

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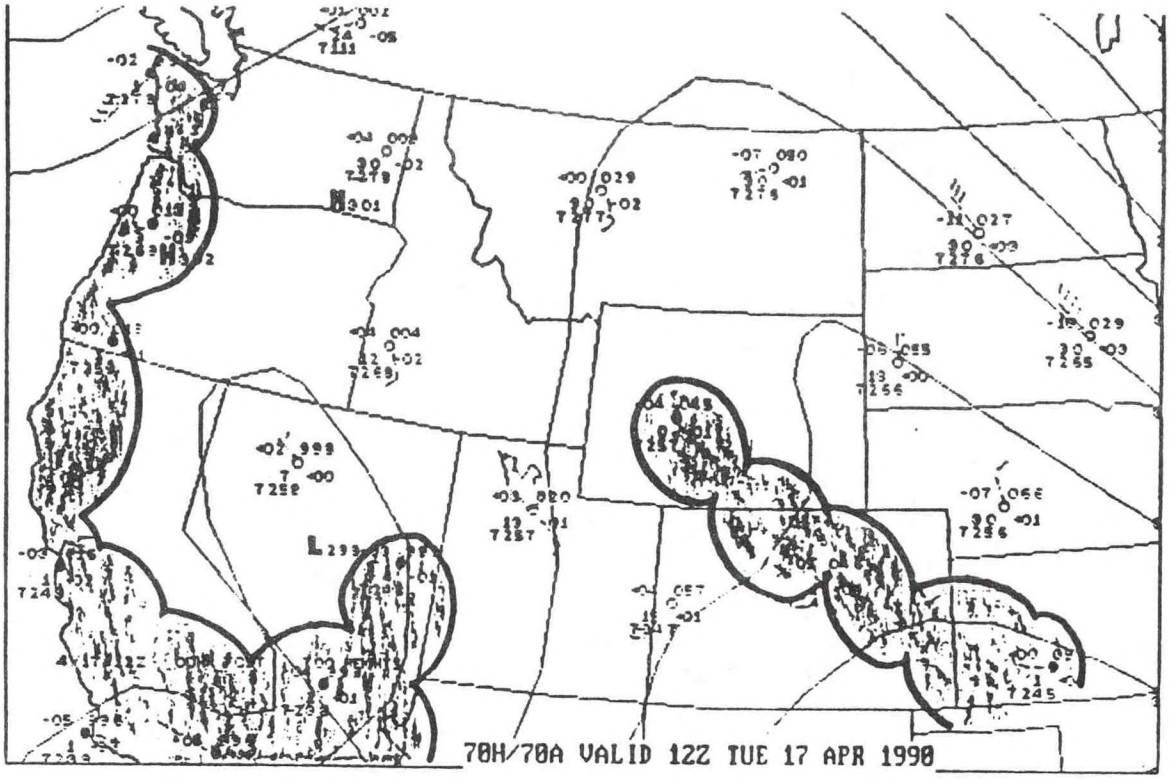

70H/70A VALID 12Z TUE 17 APR 1990

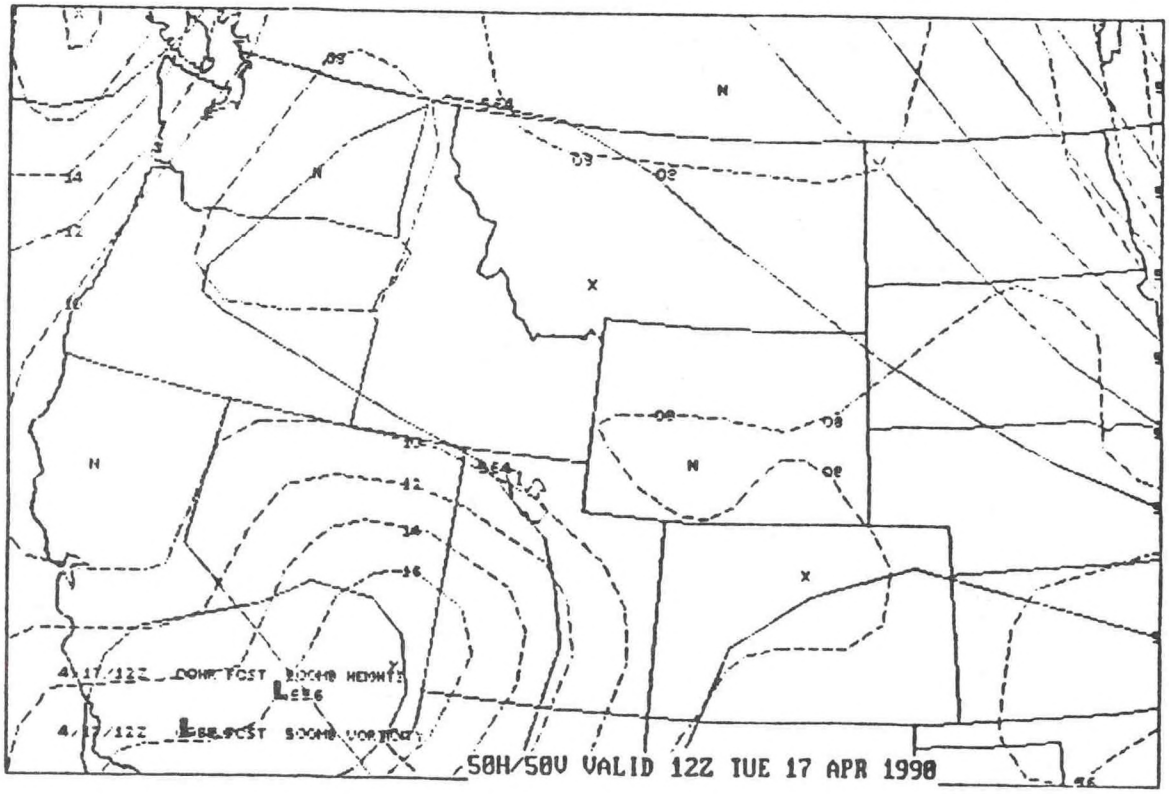
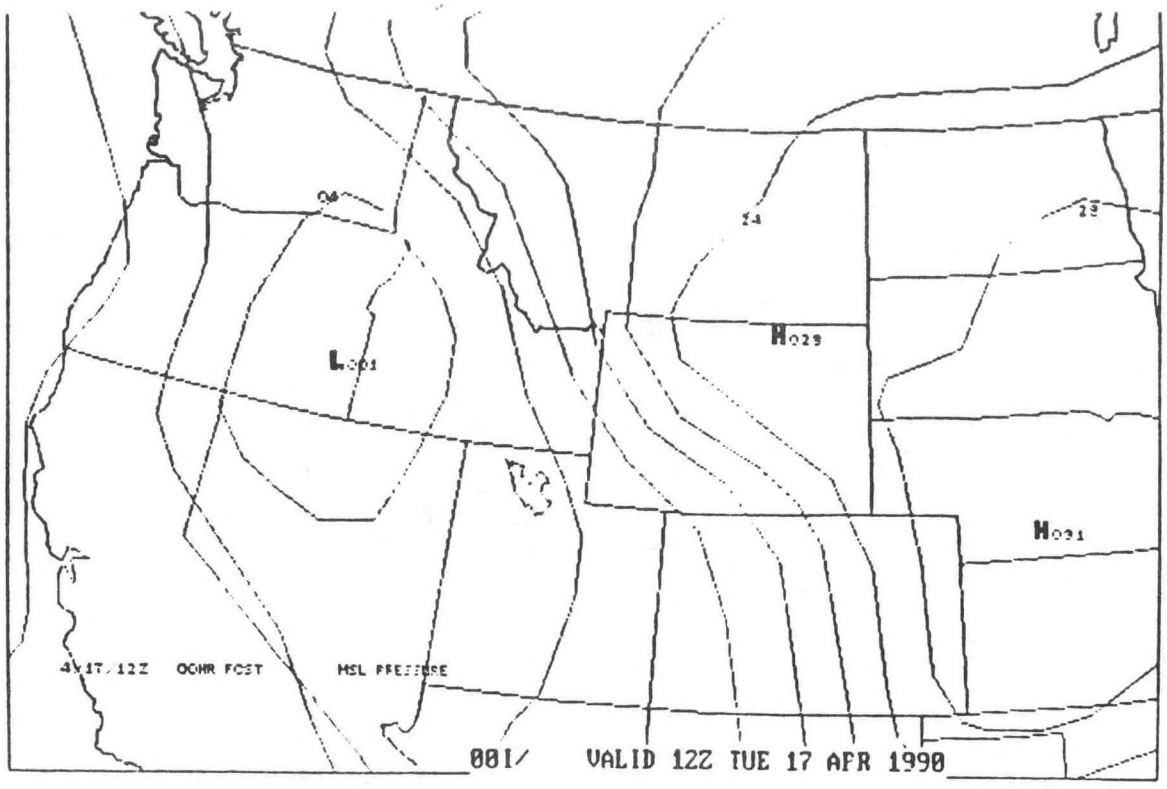

50H/50V VALID 12Z TUE 17 APR 1990

FIGURE 3


L
H
H
4/17/12Z 00HR FCST MSL PRESSURE
00Z VALID 12Z TUE 17 APR 1990

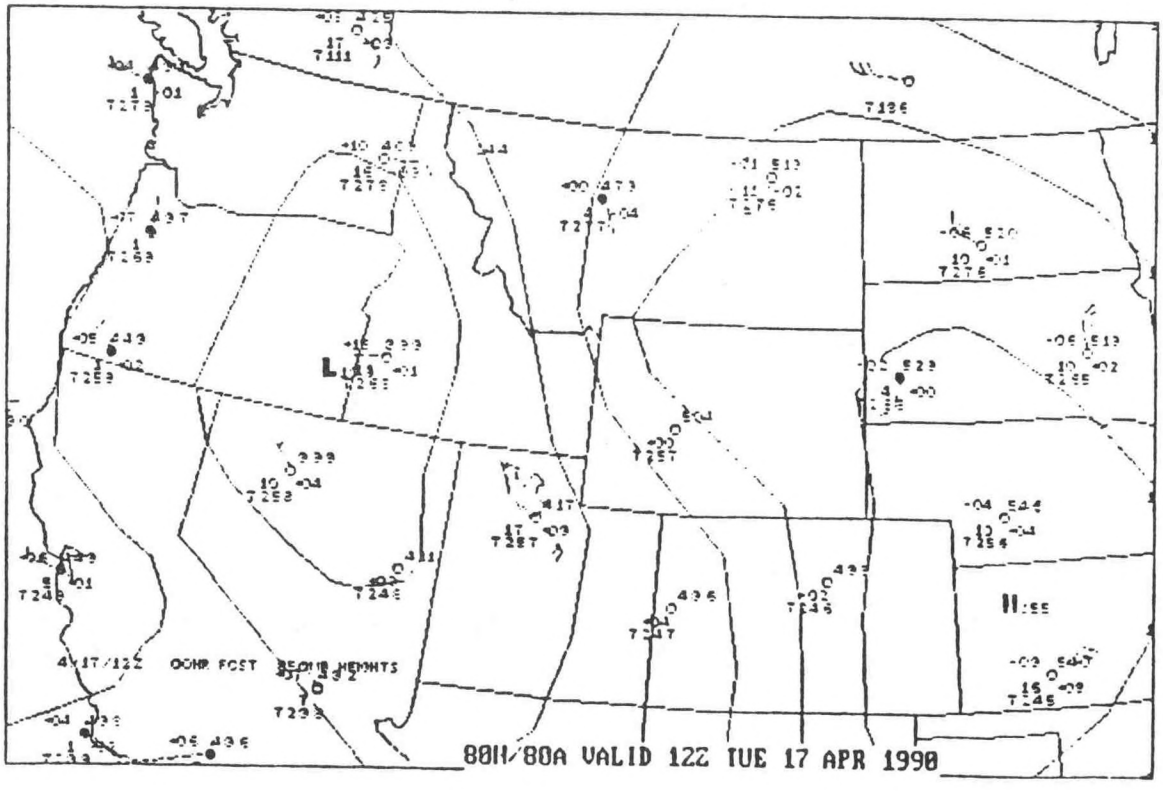
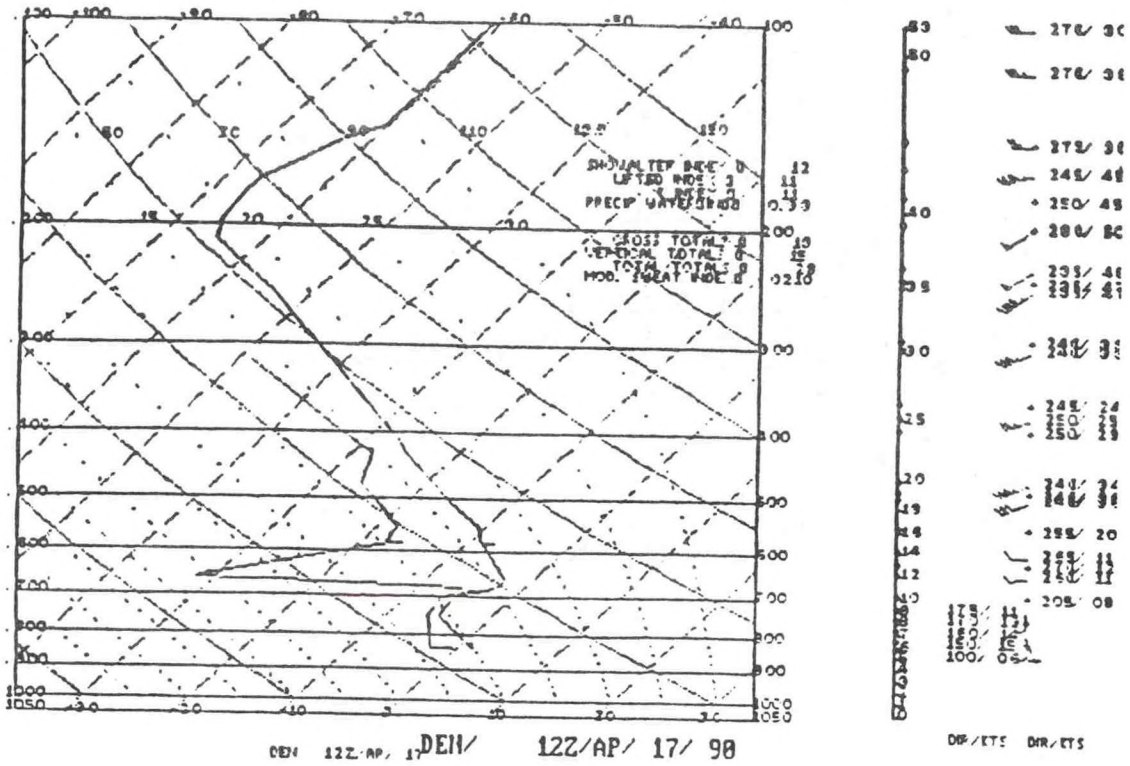

L
H
4/17/12Z 00HR FCST 850MB HEIGHTS
80H/80A VALID 12Z TUE 17 APR 1990

FIGURE 4



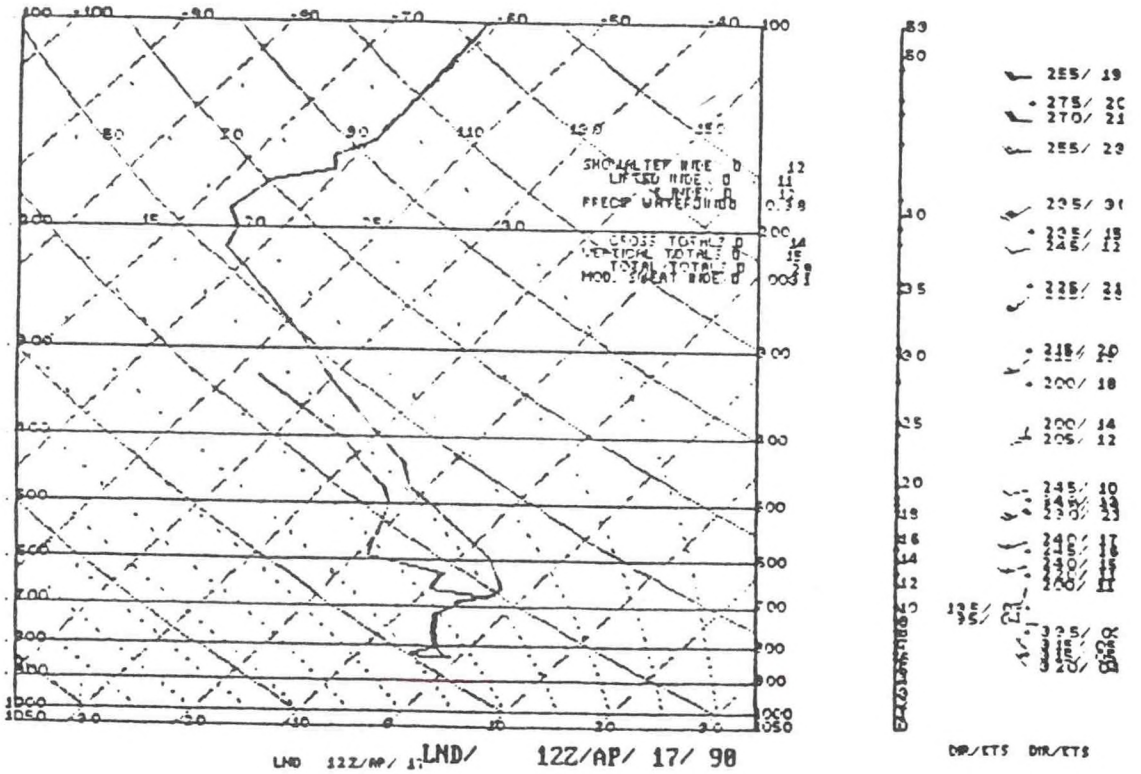


FIGURE 5

5. Conclusion

Although freezing drizzle is not common along the east slopes of the Rocky Mountains, forecasters should be aware that it does occur a few times in late fall and winter. In southeast Wyoming, freezing drizzle tends to occur in November and March, with the event accompanied by moist south or southeast (upslope) low level winds. This wind flow pattern is favored synoptically when a strong surface high establishes itself over the Great Plains states while low pressure is west of the Rocky Mountains.

6. Reference

Bocchieri, J. R., 1980: The Objective Use of Upper Air Soundings to Specify Precipitation Type. Mon. Wea. Rev., 108, 596-603.