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APPLYING THE WSR-88D RADAR TO AVIATION INTERESTS

David Hadley - CWSU Salt Lake City, UT

Introduction

During the late afternoon and early evening hours of 16 March 1994, a strong cold front moved across southern Idaho. From Boise to Twin Falls, the frontal passage was characterized by a sudden drop in temperature, an abrupt wind shift, wind speeds of 35 to 50 kts, and restricted visibilities due to blowing dust. The frontal boundary and its forward rate of movement were clearly depicted on the Boise Weather Surveillance Radar 88-Doppler (WSR-88D) velocity display as it moved across southern Idaho. Identifiable features of this cold front enabled the duty forecaster, at Center Weather Service Unit (CWSU) Salt Lake City, to provide valuable and timely weather information, which affected the safe flow of air traffic, to FAA flight controllers, traffic management specialists, and tower personnel. This paper provides a quick look at the frontal passage depicted on the WSR-88D and focuses on the use of WSR-88D information for the aviation community.

Synopsis

The 0000 UTC 17 March 1994 850 and 700 mb analyses (Figs. 1 and 2) depict a cold front positioned in southwestern Idaho. The cold air advection at 850 mb (approximately 2°C hr^{-1}) behind the leading edge of the cold front was moderately strong, while surface reports of cold advection at Boise (between 0100 and 0200 UTC) were stronger with values over 3°C hr^{-1} (not shown). Surface wind gusts at Boise (46 kts) were also nearly twice that of the sustained winds indicated on the 850 mb analysis.

In the 0038 UTC velocity display (Fig. 3a), blue inbound velocities of 36 to 50 kts were indicated at about 1000 feet above ground level (AGL) six miles to the west-northwest of the Boise WSR-88D to nearly 2000 feet AGL farther to west-northwest. Forty minutes later at 0117 UTC (Fig. 3b), dark red outbound velocities of 36 to 50 kts were present at about 1000-2000 feet AGL 5-15 miles to the southeast of the radar site. Thus, radar velocity estimates and observed gusts correlated well. Although these radar images do not indicate that the 36-50 kt winds lowered to the surface, they did provide some guidance for potential surface gusts. Additionally, the forward movement of the surface front may be calculated at nearly 40 kts, which provided timing for the arrival of the cold front at Twin Falls, Burley, and Pocatello.

Frontal boundaries in the Intermountain Region are often difficult to pinpoint. This may be attributed to various degrees of frontal slope through the lower atmosphere, large differences in terrain height, and sparse surface observations. Further, mesoscale and synoptic-scale interaction often locally modify frontal speeds. Initial uncertainty in frontal location and "broad-brush" model guidance can still leave a forecaster with a poor estimate for frontal passage at any given location. In the case described above, however, the good spatial resolution of the WSR-88D velocity data clearly defined the frontal position, rate of movement, and provided an excellent estimate of surface wind speeds or gusts.

Despite the inability to see the cold front approach and pass the Twin Falls area due to velocity range-folding, time extrapolation of the previous frontal positions into the Twin Falls area worked quite nicely. The frontal passage at Twin Falls was forecast to occur at 0319 UTC and verified within 2 to 3 minutes. Additionally, the forecaster was able to provide the sector controller and tower personnel with over 1 hour and 30 minutes of lead time of the impending cold frontal passage with accompanying low-level wind shear, severe turbulence, and sharply reduced visibility.

Conclusions

In general, weather support to the aviation community might be characterized as a continually updated "nowcast" for any given airspace. Of course, monitoring the movement of surface frontal boundaries is only a small, yet important, part of the CWSU forecaster's job. With the onset of Doppler weather radars in the Intermountain Region, frontal detection, rate of movement, and more reliable surface wind estimates are now possible. And as more Doppler radars are installed, continuity on frontal location and speed will be possible from location to location. Surface observations, in some instances, can now be used to "tweak" radar-derived velocity estimates. Most importantly, the meteorologist can focus on forecasting readily identifiable weather parameters that impact aviation interests and move away from the sometimes disputable "meteorological labelling" of wind shifts as troughs, fronts, or outflow boundaries, etc.

For this particular case study, accurate nowcasting of surface wind shifts, wind speeds, and associated weather gave aircraft controllers and tower personnel plenty of time to properly configure runways at Boise, Twin Falls, and eventually Burley, Pocatello, and Salt Lake City. Verbal updates to flight service personnel as the front approached their particular location gave them the opportunity to forward important, previously unobtainable, weather information to VFR traffic. At a major hub, such as Salt Lake City, traffic management personnel had the opportunity to consider implementing flow restrictions and altering arrival and departure procedures.

Clearly, this case study illustrates that information obtained by the meteorologist from Doppler velocity displays can significantly enhance flight safety in and around many airport facilities. Knowledge of impending severe weather situations now gives air traffic controllers and traffic management personnel (especially at major hubs) the opportunity to more effectively and efficiently manage the flow of air traffic and avoid potential weather-related aircraft mishaps.

Acknowledgments

Thanks to Western Region Scientific Services Division for generating the analyses figures.

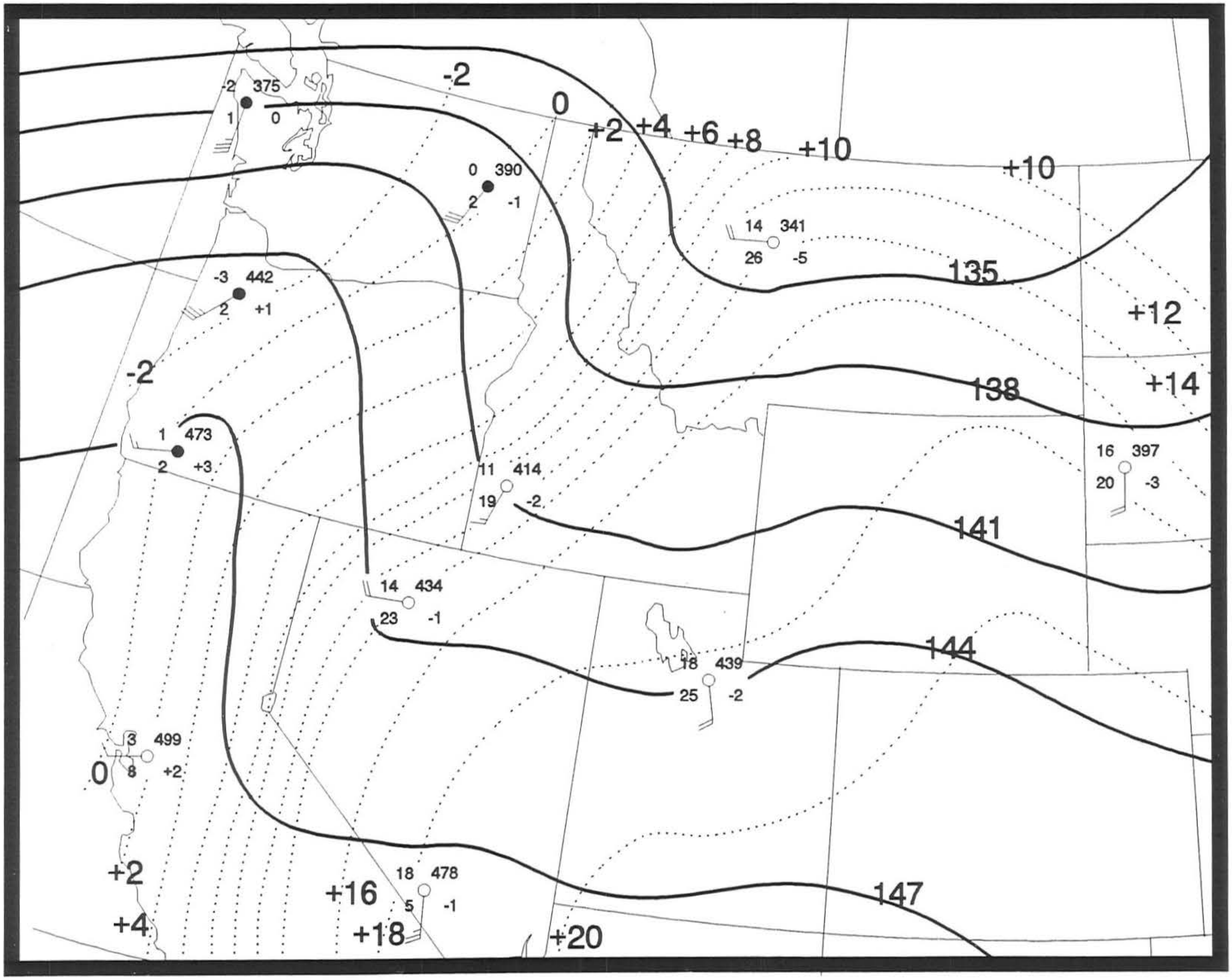


Fig. 1 0000 UTC 17 March 1994 850 mb analysis with height contours (solid), every 3 dam, and temperature contours (dashed), every 2°C.

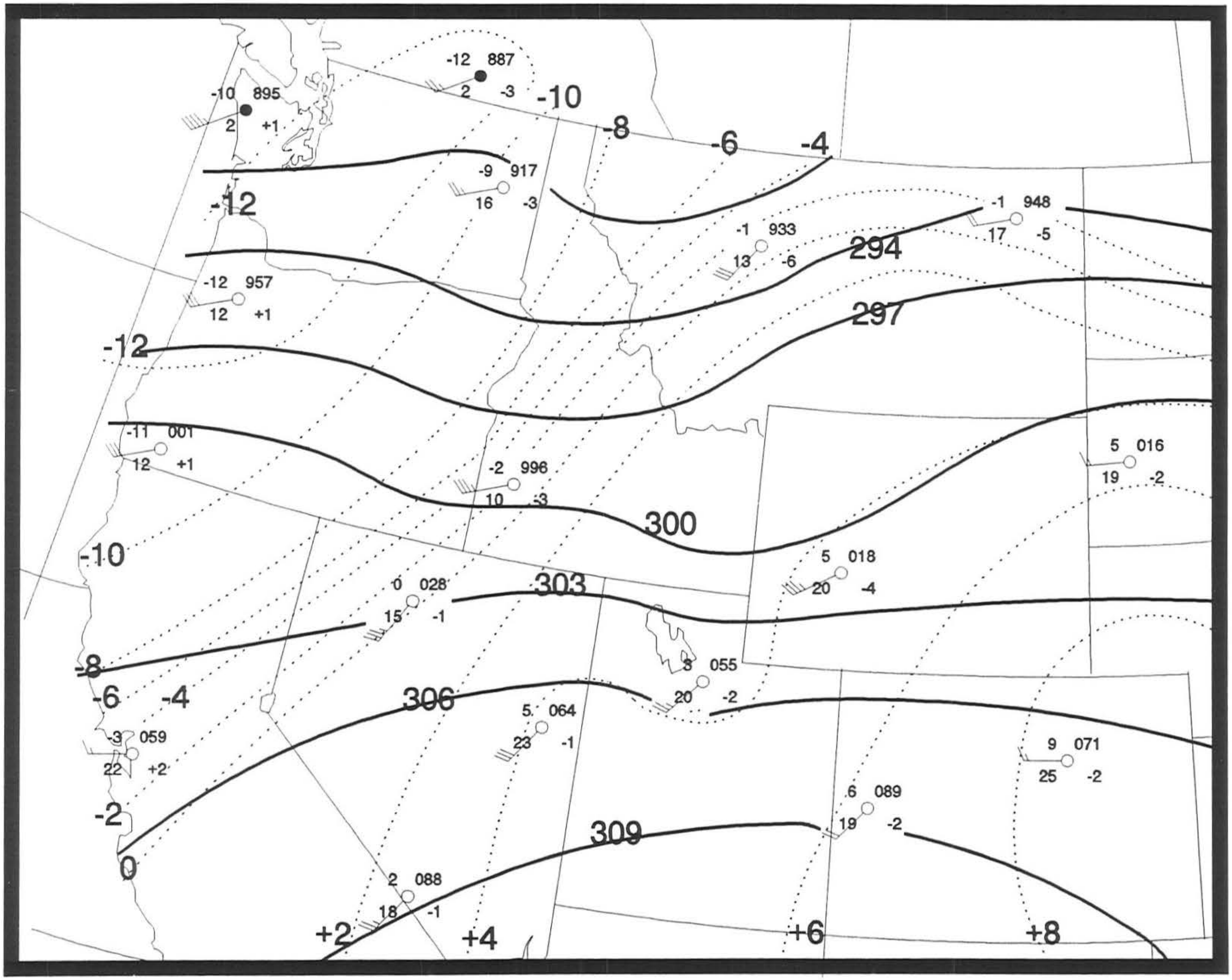
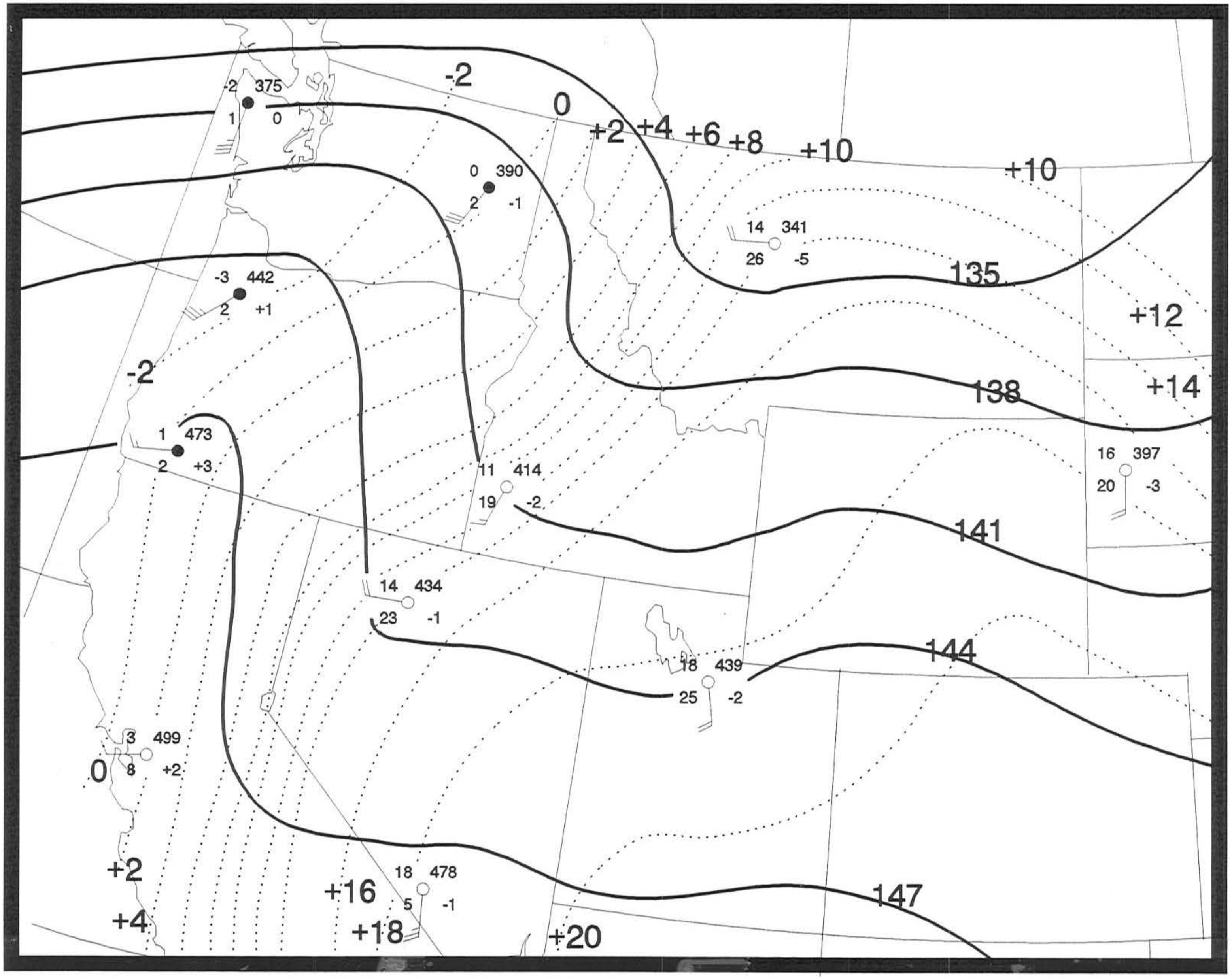


Fig. 2 0000 UTC 17 March 1994 700 mb analysis with height contours (solid), every 3 dam, and temperature contours (dashed), every 2°C.



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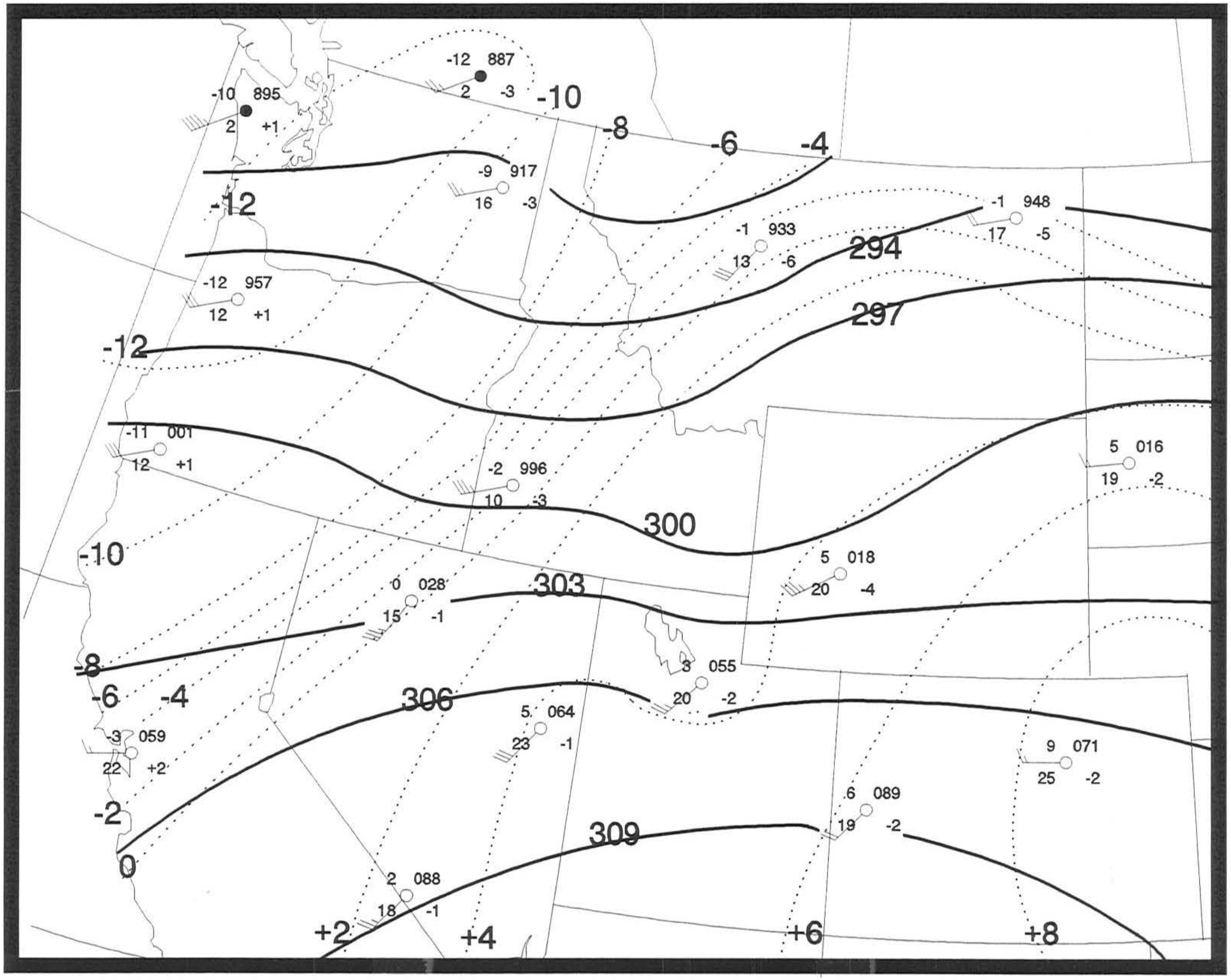

Fig. 2 0000 UTC 17 March 1994 700 mb analysis with height contours (solid), every 3 dam, and temperature contours (dashed), every 2° C.

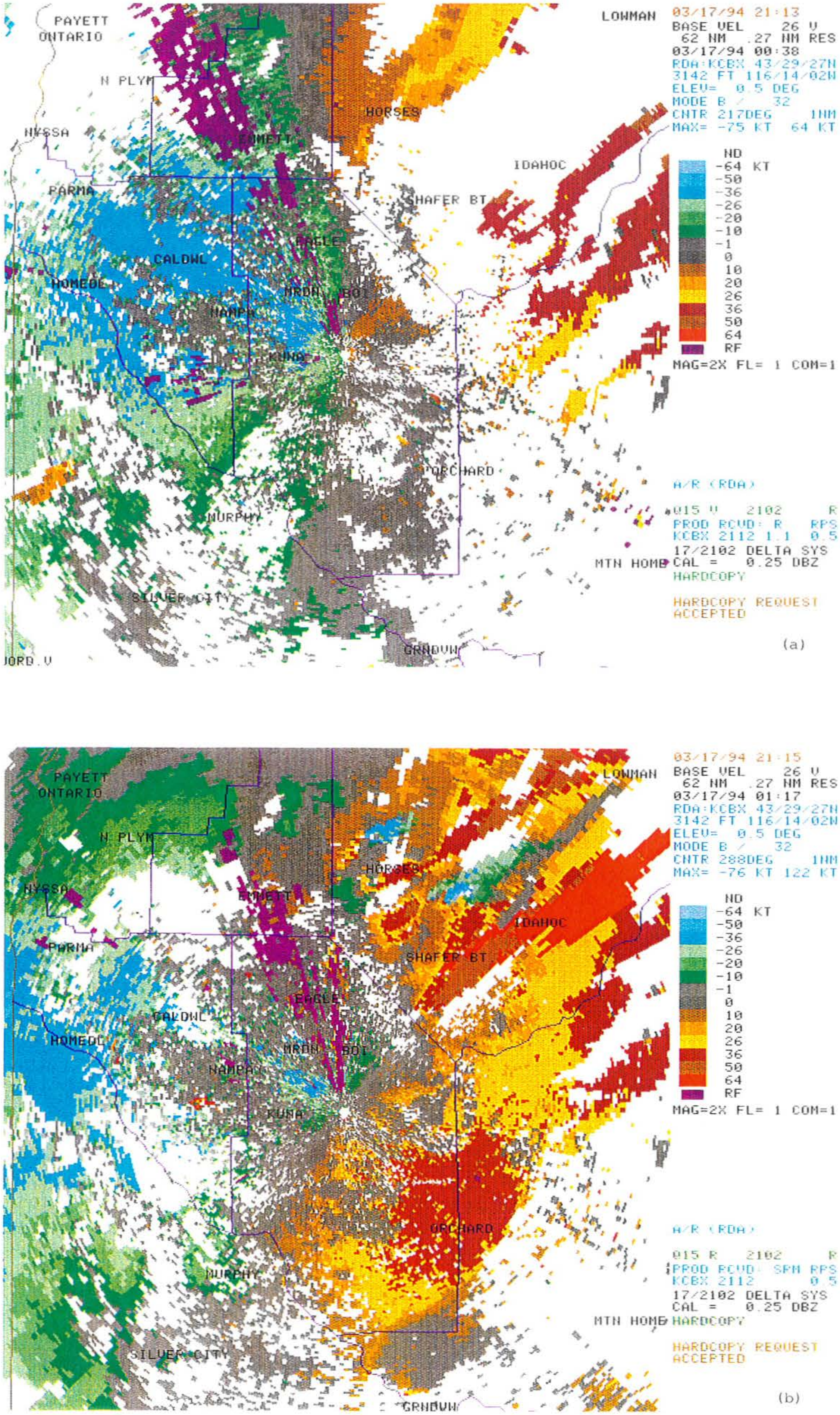

Fig. 3 Velocity images from the Boise WSR-88D on 17 March 1994 at a) 0038 UTC and b) 0117 UTC.