Using The WES to Examine The High Wind Event of February 11, 2002

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I. Introduction

A forecasting tool developed at the Glasgow Weather Forecast Office (WFO GGW) for synoptic-scale high wind events is demonstrated for the February 11, 2002, high wind event. Strong synoptic-scale wind events have challenged WFO GGW forecasters, and examining this event via the Weather Event Simulator (WES) will improve their predictive skill for high wind events. Tragic occurrences since the mid-1990s in northeast Montana were a result of strong winds, for example, the Halloween fires of 1999 and several boating accidents on Fort Peck Lake.

II. Background

Over the course of several years the forecast team in Glasgow has worked on a technique to forecast high winds. Most of the high wind events in eastern Montana are due to mixing down of higher winds above the boundary layer. In general, the technique uses wind speeds at 850 mb (about 50 to 75 mb above ground level in northeast Montana) and lapse rates near the surface, to determine if the mixing is possible.

Years of post-analysis revealed that 850 mb winds will often mix-down when the 1000-850 mb lapse rates are 7 C/km or greater. However, strong cold advection and downward vertical motion (especially greater than 3 ubars/s at 700 mb) are helpful, and in some cases necessary, to mix the winds down to the surface. High winds usually occur after a cold frontal passage and ahead of the largest pressure rises (3 hr pressure rises greater than 8 mb/hr). With 850 mb wind speeds of 30 kt and lapse rates between 1000 and 850 mb greater than 7 C/km, the peak surface winds are typically around 25 mph. For high winds (sustained winds for an hour or longer of 40 mph and/or gusts to 58 mph) the 850 mb wind speed is generally 50 kt or more. Using the lapse rate and 850 mb winds has been referred to locally as the "Jamba technique."

A four panel display of the key components of the Jamba technique for forecasting winds across northeast Montana is displayed in Fig. 1. The upper left panel shows mean-sea-level surface pressure and the 1000-500 mb thickness, the upper right panel shows 850 mb winds and temperatures, the lower left panel shows 700 mb winds and temperatures, and the lower right panel shows forecasted 1000-850 mb lapse rates.

III. Overview of February 11, 2002 Case

On February 11, 2002, a synoptic-scale high wind event occurred across northeast Montana. Strong winds with this system began at daybreak, with sustained speeds in excess of 40 mph and gusts over 60 mph during much of the day. There were several reports of gusts over 70 mph.

A High Wind Warning was issued by the National Weather Service in Glasgow in advance of the event, with a lead time of approximately 15 hr. The strongest winds occurred during the morning (around 1500 UTC) of February 11 with the highest speeds measured at 75 mph (Whitewater, Montana). All counties in northeast Montana reported high winds (sustained winds for an hour of 40 mph or gusts to 58 mph). Ground cover at the time consisted of a thin, crusty layer of snow and ice (average depth of 1 to 2 inches across northeast Montana), and inhibited the dispersion of fine particles (i.e., blowing dust, blowing snow). Visibilities across Northeast Montana during the event, as a result, never were reported below 10 miles at any of the observation stations.

IV. Analysis

On February 10, the upper level weather pattern had a distinct ridge over western North America with a strong zonal flow across the northeastern Pacific Ocean. The flow pushed a strong disturbance into the top of the ridge, on February 10, and into the north central states, on February 11.

The surface analysis at 0000 UTC, February 11, showed a low over Alaska, with a secondary low developing over northern Alberta. By the morning (1200 UTC), the secondary surface low center had moved into southwest Manitoba with a trailing cold front extending southwest through southern Saskatchewan and into north-central Montana. This secondary low developed with pressures dropping from 1005 mb at 0000 UTC, February 11, to 991 mb at 1200 UTC.

The cold front moved across northeast Montana during the morning hours, where surface winds increased immediately after its passage. Observations across the area showed that the highest winds occurred within a couple of hours after the frontal passage. The greatest pressure rise behind the front was 8 mb in 3 hr. This area of pressure rises progressed over the county warning area (CWA) during the day, February 11, but the strongest winds at Glasgow were observed ahead of the pressure rise area at 1400 UTC (Fig. 2). The strongest winds ahead of the greatest pressure rises occurred across many stations in eastern Montana and western North Dakota. Infrared satellite imagery (Fig. 3) showed that a broken deck of cumulus clouds near 5000 feet AGL (that contained virga and light rain and snow) was moving into the area after the peak wind. It is possible that cooling (due to evaporation and/or sublimation) below cloud level may have contributed to increasing lapse rates, helping to mix higher level winds to the surface.

The Eta model handled this event well. Eta 850 mb winds were close to observed values, as were the 1000 to 850 mb lapse rates, the track and strength of the surface low pressure center and associated cold front, and the strength and location of greatest pressure tendencies.

Using the Jamba technique, Fig. 1 shows an 850 mb jet maximum of 60 kt over North Dakota with speeds of 50 kt over northeast Montana. The atmospheric layer below 850 mb was mixed, with the lapse rate from 1000 to 850 mb greater than 7 C/km across the

CWA.

The 1200 UTC upper air sounding from Glasgow on February 11 showed a 50 kt wind or stronger above a surface-based inversion (Fig. 4). Figure 5 shows the atmosphere was mixed (nearly dry adiabatic) at 0000 UTC, February 12. Comparing the two observations, this event had good cold air advection at 850 mb, as the temperature dropped 11 C in 12-hr (about +5 C at 1200 UTC to -6 C at 0000 UTC).

V. Conclusion

Two key elements were noted to create a high wind event across northeast Montana on February 11, 2002. These key elements included 1000-850 mb lapse rates greater than 7 C/km, the 850 mb wind greater than 50 kt. The Jamba technique has proven to be a good predictor of synoptic-scale wind events in northeast Montana.

Acknowledgments

The author would like to thank Julie L. Adolphson, Meteorologist-in-Charge at WFO GGW, and Thomas L. Salem Jr., Science and Operations Officer, at WFO GGW, for their work on finalizing this document.

Figure captions:

Figure 1. Four panel display from the 1200 UTC Eta model run valid at 1800 UTC, February 11, for determining the possibility of high surface winds from mixing. The upper left panel is the 1000-500 mb thickness (red lines every 3 dam and shaded) and the Eta's mean sea-level pressure (tan lines every 2 mb). The upper right has the 850 mb wind speed (blue lines every 10 kt and shaded), temperature (orange lines every 2 C), and wind (green barbs). Lower left panel has the 700 mb wind speed (green lines ever 10 kt and shaded), temperature (yellow dashed lines every 2 C), and wind (green barbs). The lower right panel has the 1000-850 mb lapse rate (yellow lines every 0.5 C/km and shaded).

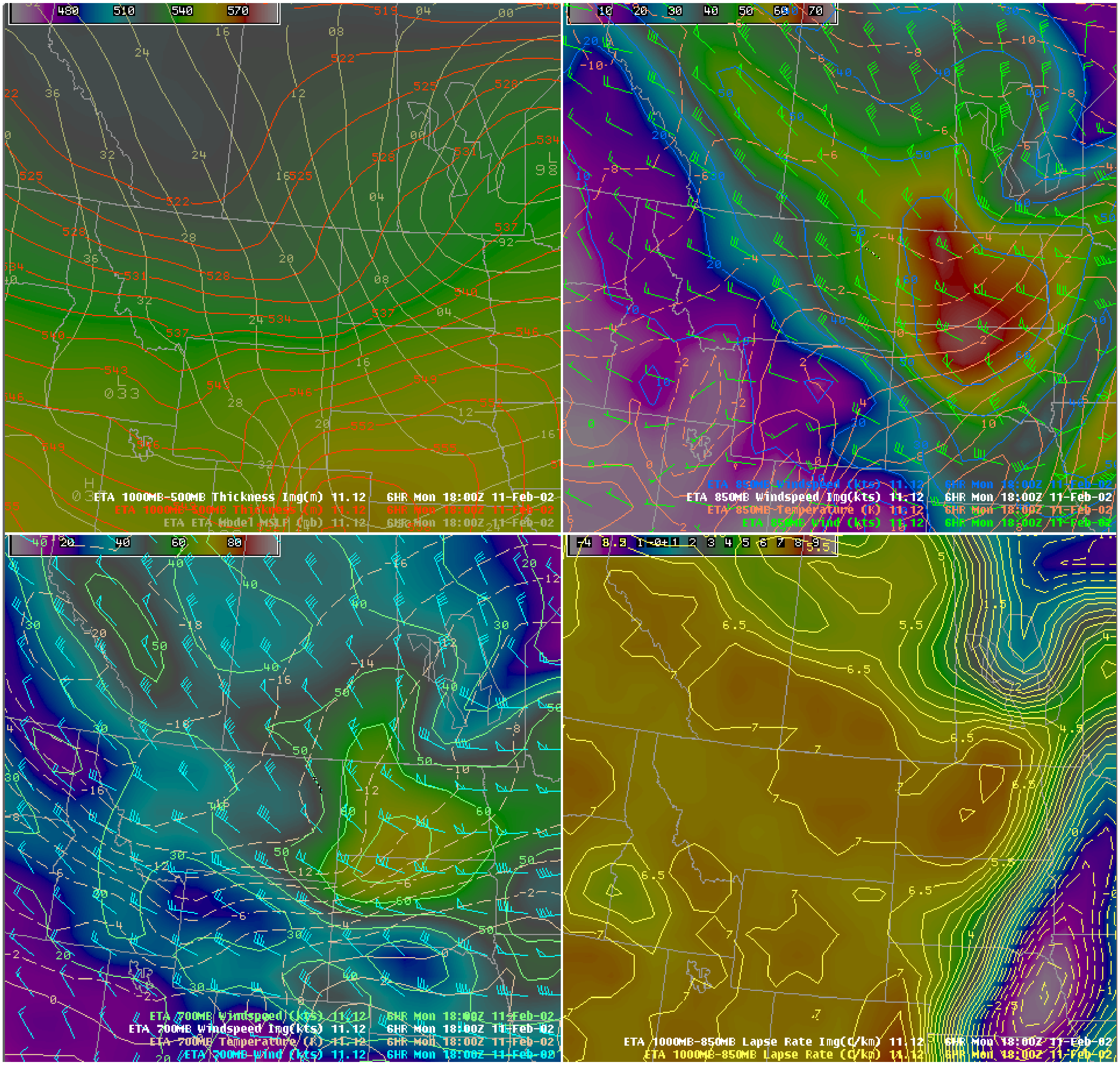
Figure 2. Surface map from 1400 UTC February 11 with the 3 hr pressure changes contoured (green lines every 2 mb/ 3 hr and shaded).

Figure 3. Infrared satellite image and surface map from 1400 UTC February 11 The surface map includes the mean sea-level pressure (green contours every 2 mb) and surface observation plots (white). The satellite image enhancement is in the upper left of the image, with higher clouds (lower cloud top temperatures) to the right of the scale.

Figure 4. Glasgow sounding from 1200 UTC February 11. The vertical temperature profile and dew point profile are displayed on the Skew-T.

Figure 5. Same as Fig. 4 except for 0000 UTC February 12.

Figure 1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ETA 850MB Windspeed (kts) 11.12 6HR Mon 18:00Z 11-Feb-02
ETA 850MB Windspeed Img(kts) 11.12 6HR Mon 18:00Z 11-Feb-02
ETA 850MB Temperature (K) 11.12 6HR Mon 18:00Z 11-Feb-02
ETA 850MB Wind (kts) 11.12 6HR Mon 18:00Z 11-Feb-02
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ETA 700MB Windspeed Img(kts) 11.12 6HR Mon 18:00Z 11-Feb-02
ETA 700MB Temperature (K) 11.12 6HR Mon 18:00Z 11-Feb-02
ETA 700MB Wind (kts) 11.12 6HR Mon 18:00Z 11-Feb-02
ETA 1000MB-850MB Lapse Rate Img(C/km) 11.12 6HR Mon 18:00Z 11-Feb-02
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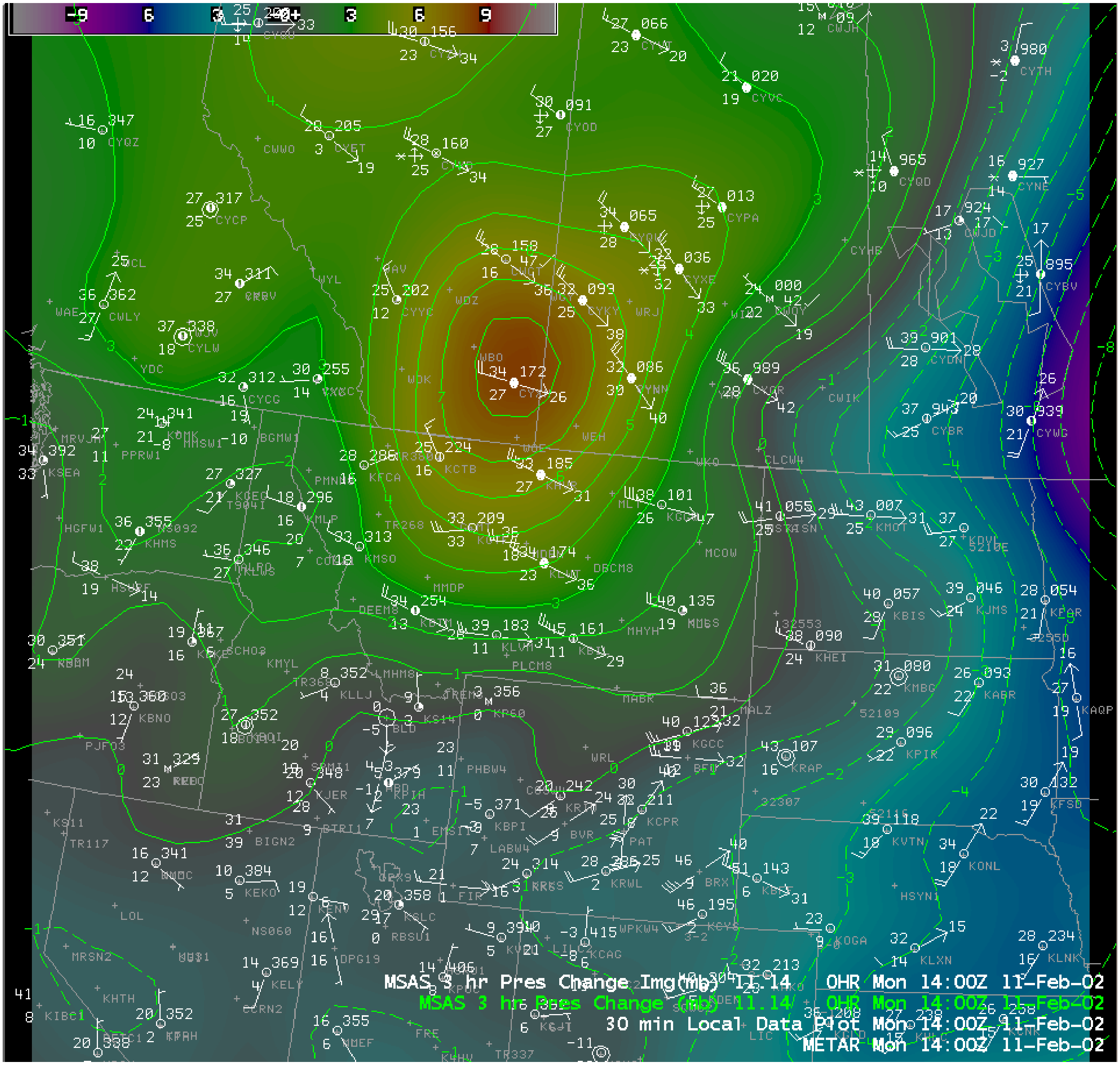
Figure 2



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MSAS 3 hr Pres Change (mb) 11.14 OHR Mon 14:00Z 11-Feb-02
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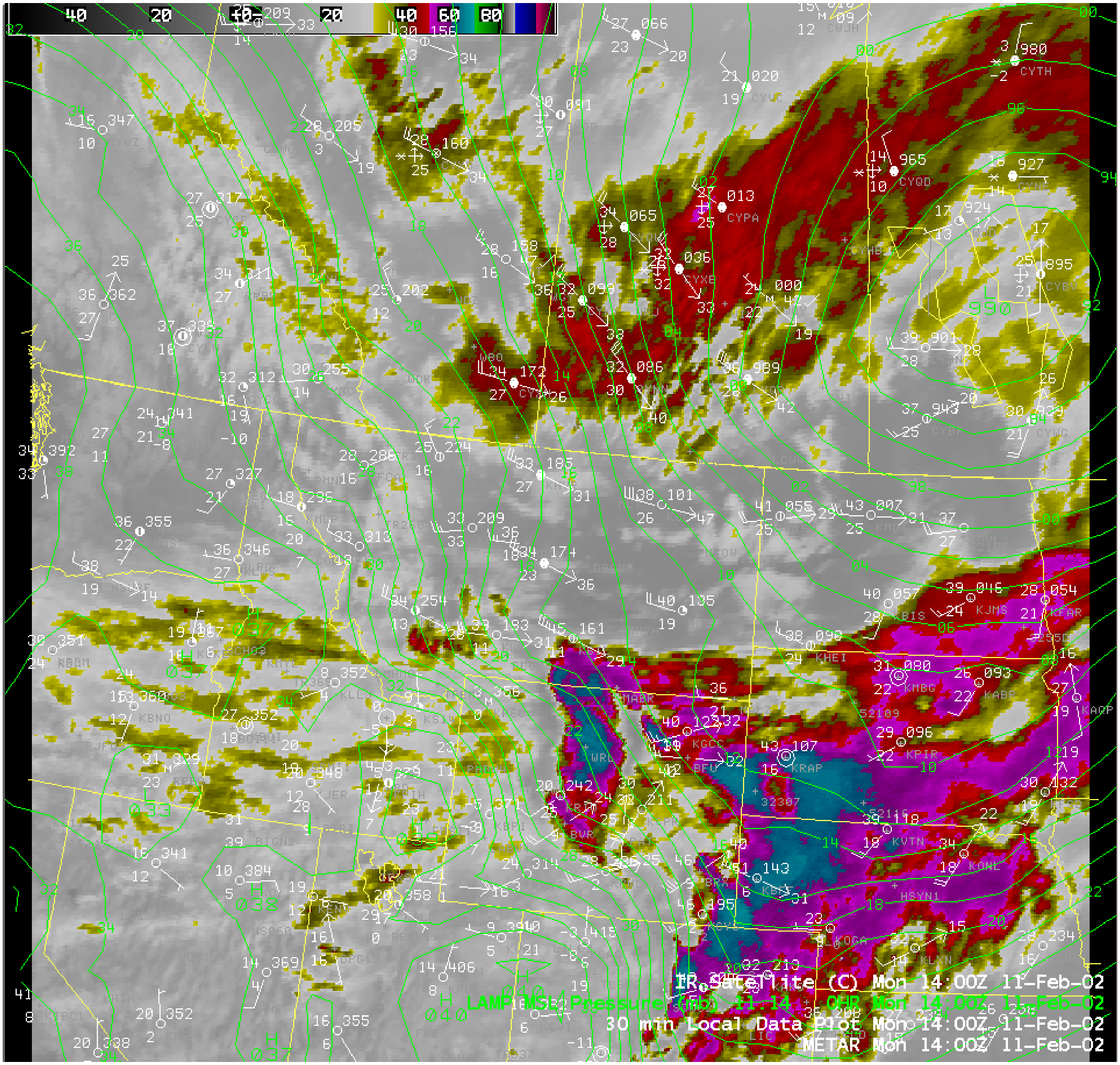
METAR Mon 14:00Z 11-Feb-02

Figure 3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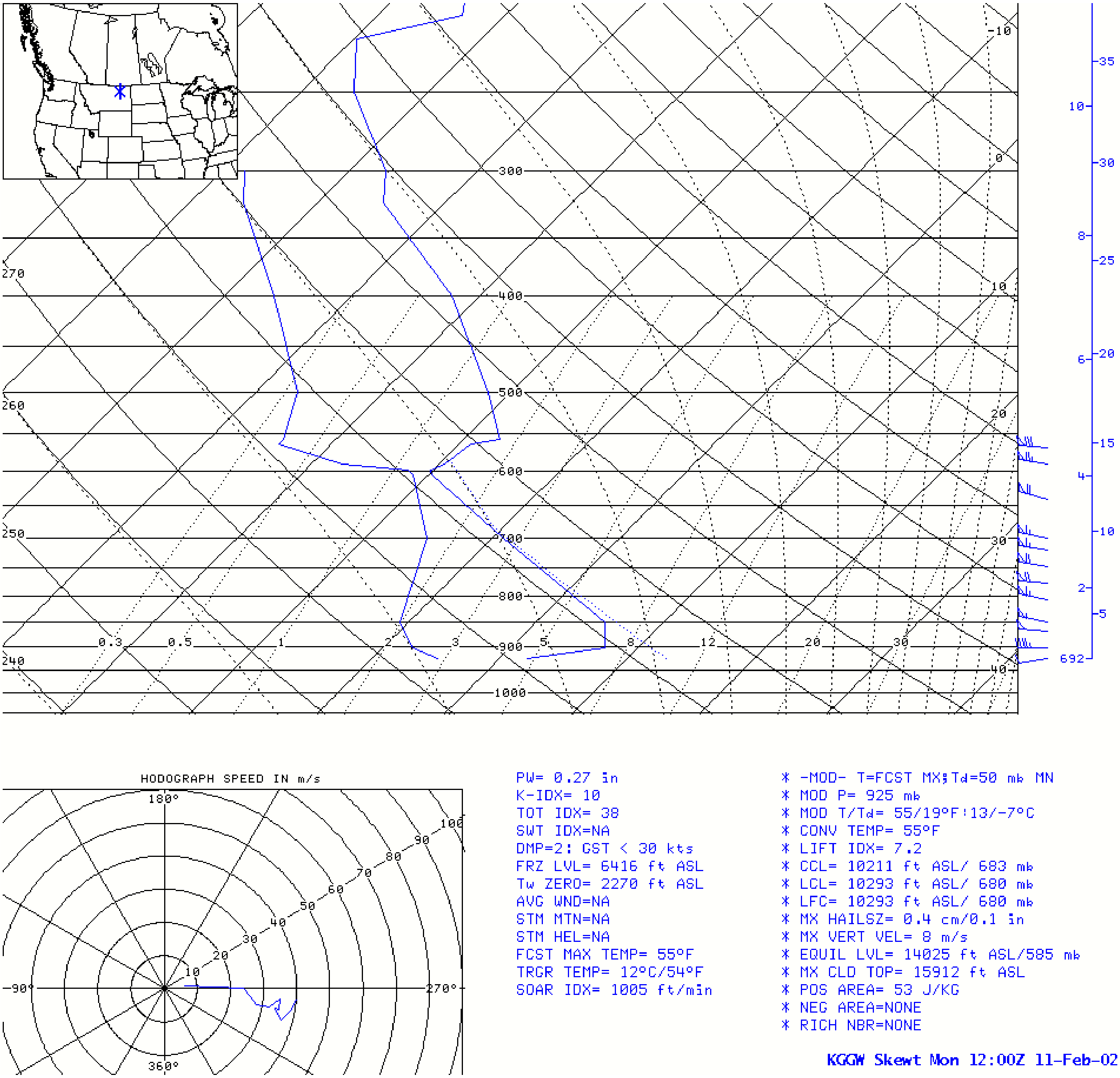
METAR Mon 14:00Z 11-Feb-02

Figure 4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Tw ZERO= 2270 ft ASL
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STM HEL=NA
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TRGR TEMP= 12°C/54°F
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* MOD P= 925 mb
* MOD T/Td= 55/19°F:13/-7°C
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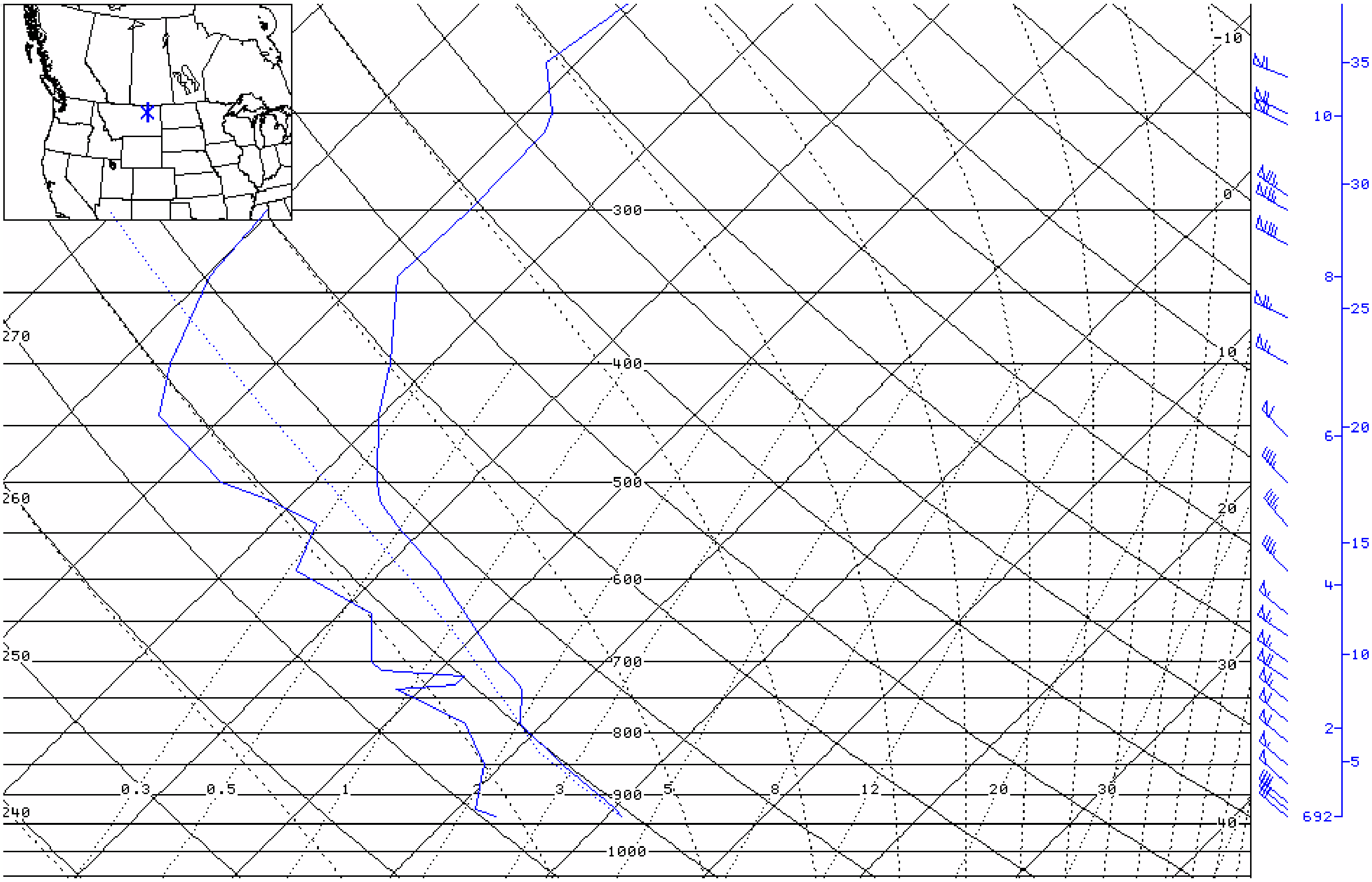
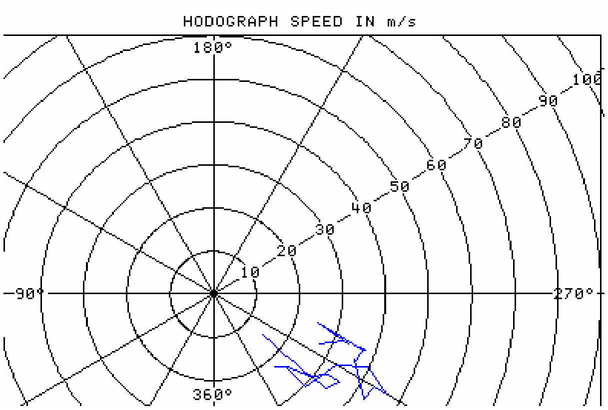
Figure 5





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EQL LVL=NA
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RICH NBR=NA

KGGW Skewt Tue 00:00Z 12-Feb-02