A Widespread High Wind Event in Central Montana - Using the Weather Event Simulator

10-11 February, 2002
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Introduction

High winds with gusts 58 mph or greater are often observed overnight near the Rocky Mountain Front in central Montana, but much less frequently over the plains. In this nighttime case, nearly all front range and plain zones within the Great Falls CWA experienced high winds. Because high wind events take hours to evolve, this Weather Event Simulator case was presented as if the forecaster was working the day shift on February 10th. High wind warnings began verifying late that evening. The first reported gust of at least 58 mph occurring at 10:30 pm on the 10th and the last report at around 7:00 am on the 11th. Model data from the 12Z run on the 10th was the primary tool used in this case. In addition to model data available in AWIPS, BUFKIT data from the Eta was provided during the simulation.

Discussion

A cold front moved through central Montana during the early morning hours on February 11th. Strongest winds generally occurred right after frontal passage, but winds remained gusty through the day. All but one of the high wind reports occurred between 2 am and 8 am MST on the 11th. All but four zones in the CWA reached high wind criteria (Fig. 1). Where gusts did not reach 58 mph, sustained criteria of 40 mph or more for at least an hour was met.

Both the Eta and GFS models were consistent in depicting the synoptic pattern associated with this event. A positively tilted upper ridge was over the western U.S. on the morning of the 10th (Fig. 2). An approaching cold front broke down the ridge on the night of the 10th. Cold fronts moving eastward through western and central Montana are difficult to analyze both in model output and in observed data due to the disruptive effect that the Rocky Mountains have on the surface temperature and wind pattern. However, analyzing data from between 700 and 800 mb usually reveals an approximate frontal location. This makes it easier to determine when the effects of a cold front will be felt.

The key ingredients that caused the high winds were also well forecast by the Eta and GFS models. The main components of this event were a strong core of winds aloft behind the cold front and large pressure rises collocated with this. The Eta indicated pressure rises of over 6 mb in 3 hr behind the front (Fig. 3). This was a crucial factor in helping strong winds aloft mix to the surface. In many cases the Eta has rare time continuity in pressure tendency patterns, but in this case it depicted a steady movement of pressure rises from southwest Alberta at 09Z to northeast Montana at 15Z.

It is rare for a nocturnal Pacific frontal passage to produce such strong winds because some instability near the surface is usually necessary to produce efficient mixing. However, downward motion associated with the isallobaric gradient was enough to force strong winds aloft to the surface. Low level omega is often handled poorly by the models due to noise created by the terrain of central Montana, and must be inferred using other methods.

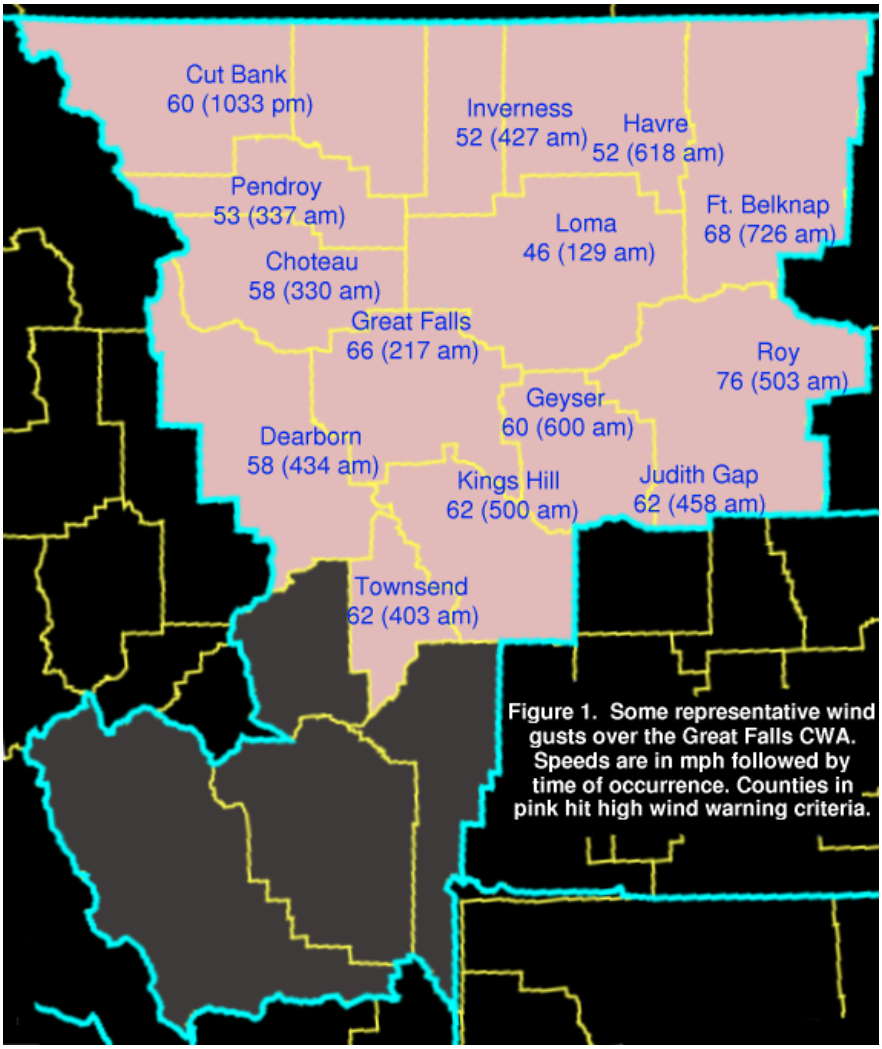
The models also did well forecasting the location and timing of strongest winds aloft, indicating an increase in wind speed as the system moved east. Forecasted peak winds between 700 and 800 mb in the Eta occurred at 12Z February 11 and were in excess of 70 kts over central Montana (Fig. 4). As shown in Figure 1, the highest gusts from this event were in the eastern zones of CWA, supporting the model forecast.

The only location that picked up high winds before the cold frontal passage was Cut Bank at 10:30 pm. Elsewhere, high wind reports did not occur until after frontal passage. This is typical for high wind events in central Montana. In the absence of cold air advection, high winds are rarely reported vary far away from the Rocky Mountains.

Summary

While widespread nocturnal high wind events are somewhat unusual for central Montana, this event was predictable when looking at the model forecast. The necessary ingredients for high winds over the plains of central Montana - rapid pressure rises and strong winds aloft - were forecast accurately by the Eta model. This gave forecasters the opportunity to post warnings with lead times much greater than regional and national GPRA goals. In addition, similarities between the Eta and GFS models with synoptic features should give forecasters adequate confidence that high winds would occur.

Figure 1


Cut Bank
60 (1033 pm)
Inverness
52 (427 am)
Havre
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Pendroy
53 (337 am)
Loma
46 (129 am)
Ft. Belknap
68 (726 am)
Choteau
58 (330 am)
Great Falls
66 (217 am)
Roy
76 (503 am)
Geyser
60 (600 am)
Dearborn
58 (434 am)
Kings Hill
62 (500 am)
Judith Gap
62 (458 am)
Townsend
62 (403 am)
Figure 1. Some representative wind gusts over the Great Falls CWA. Speeds are in mph followed by time of occurrence. Counties in pink hit high wind warning criteria.

Figure 2

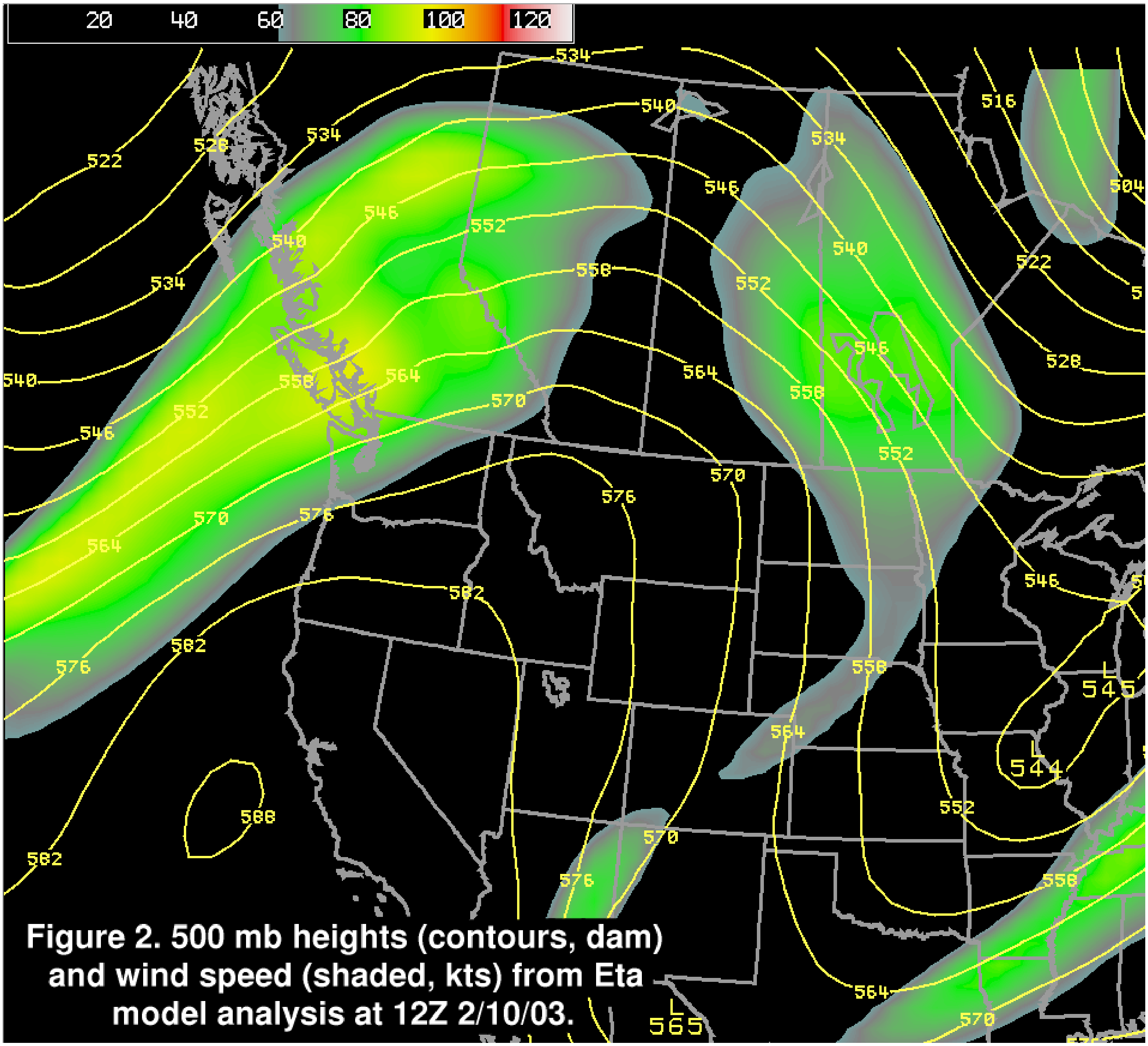

Figure 2. 500 mb heights (contours, dam) and wind speed (shaded, kts) from Eta model analysis at 12Z 2/10/03.

Figure 3

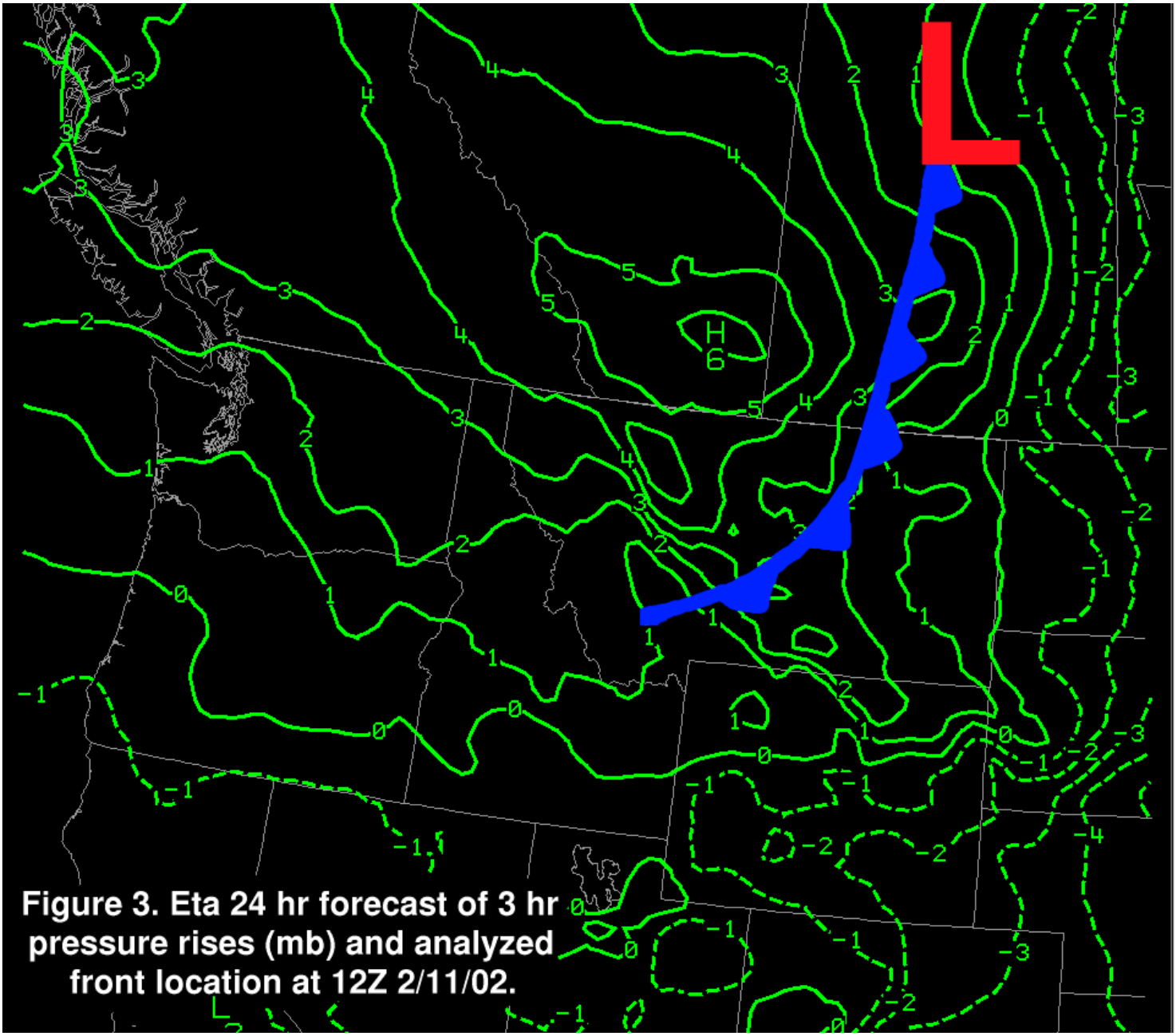
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Figure 3. Eta 24 hr forecast of 3 hr pressure rises (mb) and analyzed front location at 12Z 2/11/02.

Figure 4

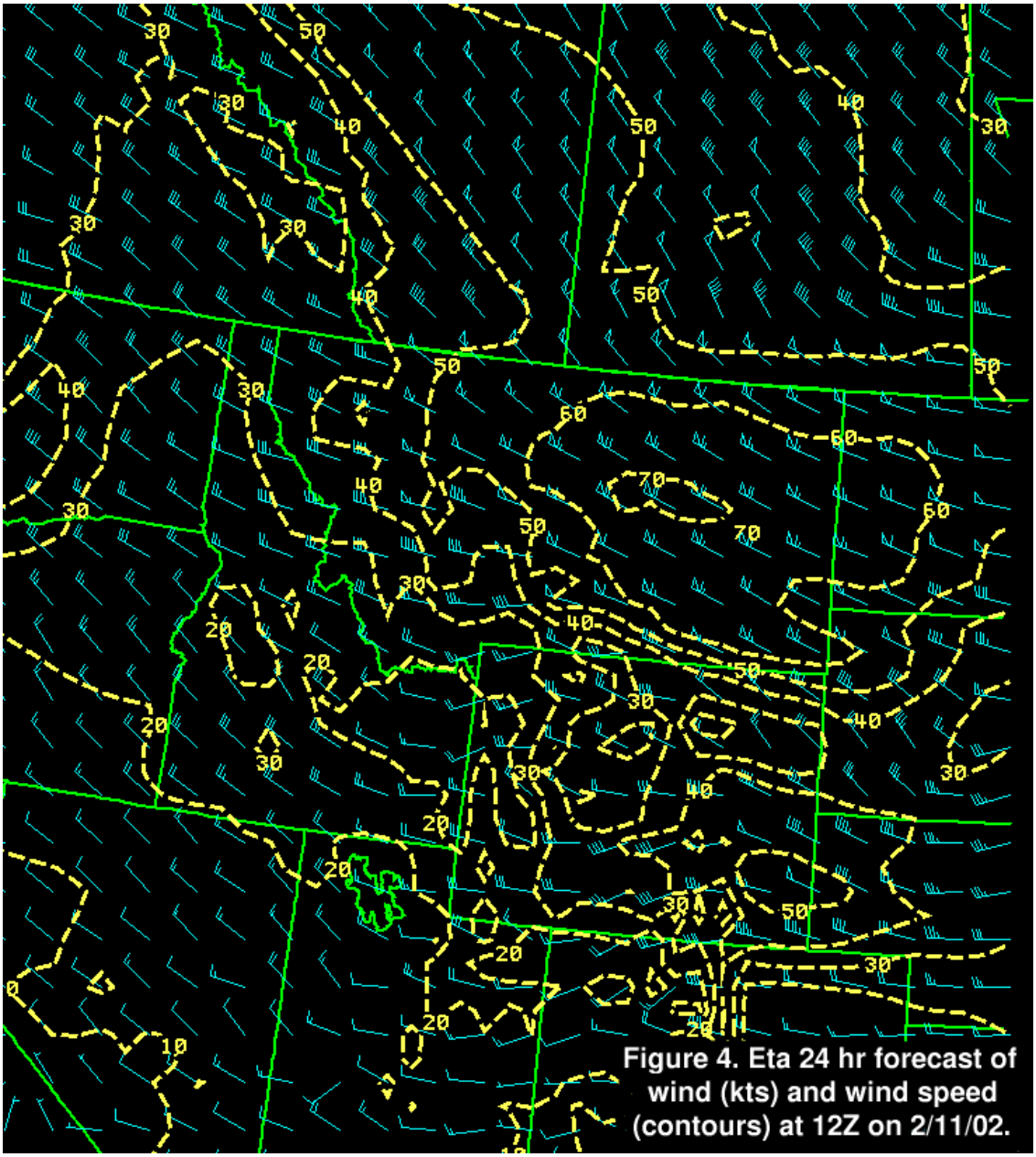
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Figure 4. Eta 24 hr forecast of wind (kts) and wind speed (contours) at 12Z on 2/11/02.