

# Dangerous Fire Weather Conditions and Severe Weather Case Study using WES

Thomas L. Salem Jr.  
NOAA's National Weather Service  
Glasgow, Montana

## Introduction

Wildfires and severe weather are never a good combination; however, on 2 July 2003 northeast Montana had severe thunderstorms and a couple of wildfires (not in the same locations). Upper level short waves moved through the area early in the morning and in the evening, and a surface cold front moved across the northeast Montana on 2 July. A couple of wildfires started in the western counties on the morning of 2 July, most likely from overnight lightning strikes. The wildfires continued for a couple days, fueled by the low relative humidities in the area. Despite the dry surface conditions, severe thunderstorms developed in the evening, producing hail and severe thunderstorm winds.

## Synoptic Overview

Northeast Montana had showers and thunderstorms during the early morning hours of 2 July 2003, by 1200 UTC, most thunderstorms had ended. The surface map ([Fig. 1](#)) from 1200 UTC shows a low centered over northwestern South Dakota with a stationary front stretching to the northeast and another low centered over southern Canada with a developing surface front in eastern Montana. On 2 July, the temperatures warmed throughout the day, and the dew points stayed around 50 F, which resulted in low relative humidities, allowing the fires to grow.

By the evening of 2 July the frontal system was still in northeast Montana, and thunderstorms started to develop as a short wave trough moved through the area (not shown). The thunderstorms remained east of the front and were mainly in the southeast corner of Glasgow's county warning area.

## Discussion

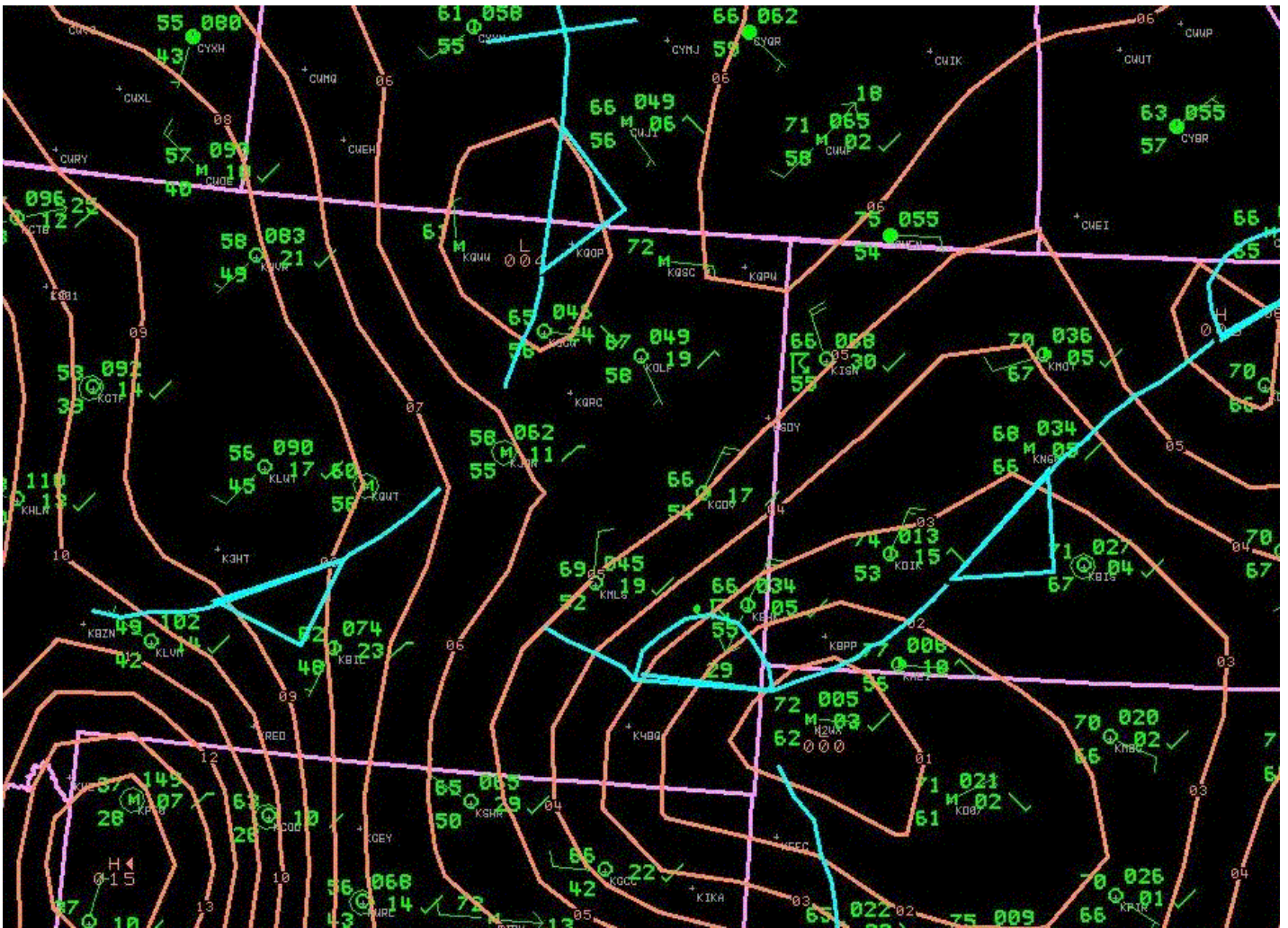
The forecasters on duty 2 July had to be concerned with both an active fire weather situation and severe weather. Surface conditions showed dry conditions across northeast Montana, even in the morning ([Fig. 1](#)) when relative humidities were about 35 to 40 percent. Behind the developing cold front the winds were expected to shift and increase slightly causing more risk for the development of the fires.

Later in the day, 0000 UTC 3 July, surface conditions ([Fig. 2](#)) did show the shift in the winds to the northwest and the wind speeds did increase. East of the cold front the surface relative humidities were around 20 percent as the temperatures increased; however, the thunderstorms did develop. The models from 0000 UTC 2 July had little precipitation expected for northeast Montana (not shown), the precipitation was light and was forecasted too far south.

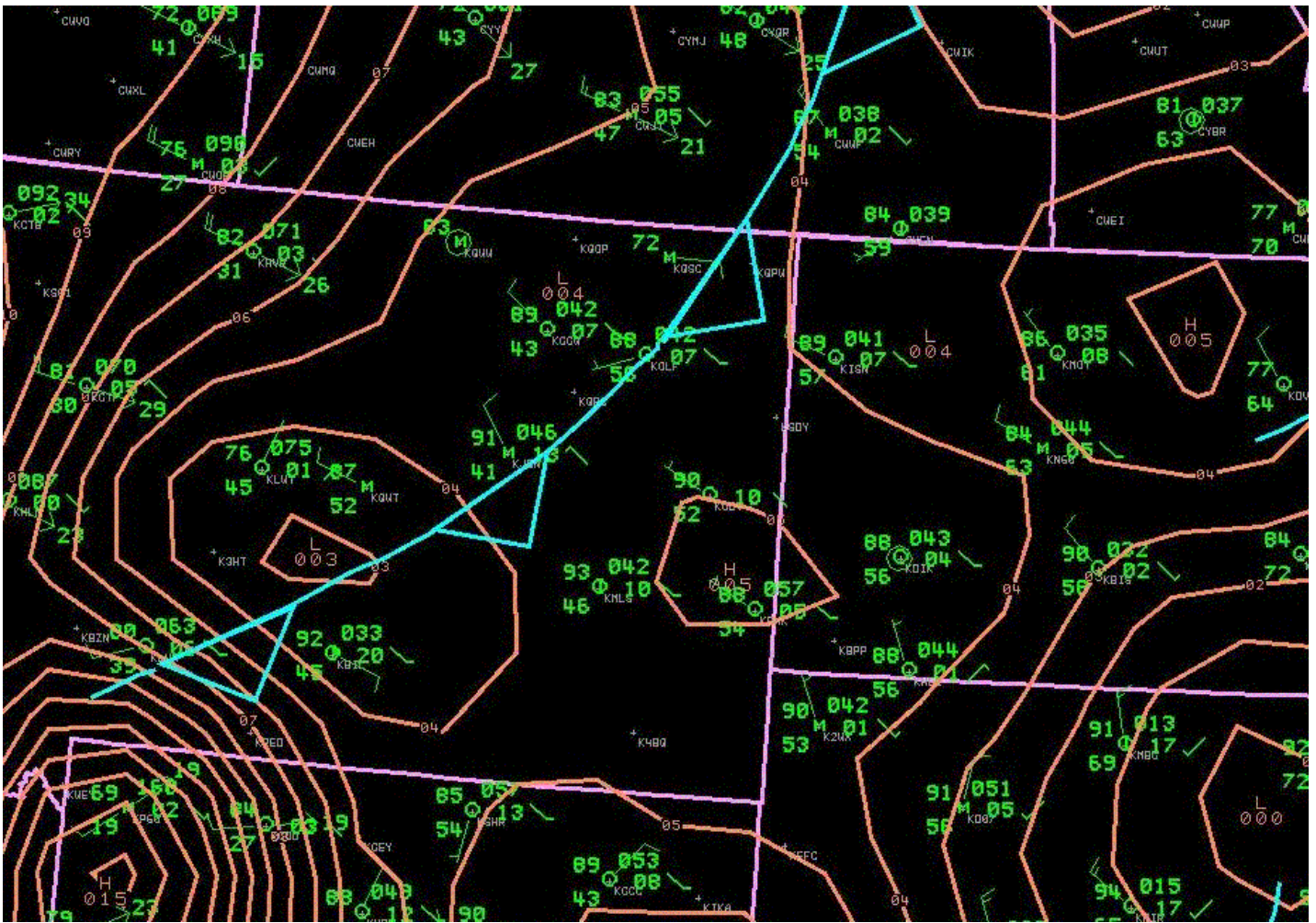
One hint that the models did provide for precipitation and thunderstorms in the southeast part of Glasgow's county warning area was the model soundings. Figure 3 shows the 24 hour and 30 hour forecast Eta model soundings for Glasgow, from 0000 UTC 2 July. The soundings showed an increase in the moisture in the middle atmosphere (600 mb and above). The 30 hour forecast ([Fig. 3b](#)) was more stable than the 24 hour forecast ([Fig. 3a](#)), which may be partially due to the convective parameterization of the Eta model, however, the model still showed an unstable sounding that was quite moist.

Comparing the 0000 UTC 2 July observed sounding ([Fig. 4](#)) to the forecast soundings from Figs. 3a and 3b, the convective indices are similar and the forecast soundings were relatively more moist. Since thunderstorms were in the vicinity of Glasgow around 0000 UTC 2 July, the forecaster can deduce that the atmosphere near the forecast sounding was also capable of developing thunderstorms again the following night. The model soundings from the southeast corner of the county warning area showed similar characteristics as the observed sounding ([Fig. 4](#)) and some had stronger convective indices. An example of these sounding is the 24 hour forecast sounding ([Fig. 5](#)) which has a CAPE value of 331 J/kg ([Fig. 5](#)) compared the observed CAPE ([Fig. 4](#)) of 48 J/kg from the previous evening. Thus, thunderstorms that would develop to the southeast of Glasgow on the evening of 2 July could be stronger than the previous night. This combined with a passing short wave trough keyed the forecasters to a strong potential for thunderstorms with the indices suggesting the possibility of severe thunderstorms.

**Figure 1.** Surface map analysis from 1200 UTC 2 July 2003. The contours of mean sea-level pressure (in mb) are in brown and the contour interval in 1 mb; the surface observations are in green; and the blue lines are the analyzed surface features from NCEP.



**Figure 2.** Same as Fig. 1, except it is from 0000 UTC 3 July 2003.



**Figure 3a.** Skew-T Log P diagram with the Eta model 24 hour forecast sounding from the 0000 UTC 2 July 2003, valid at 0000 UTC 3 July. The sounding is for around the Glasgow, Montana, area.

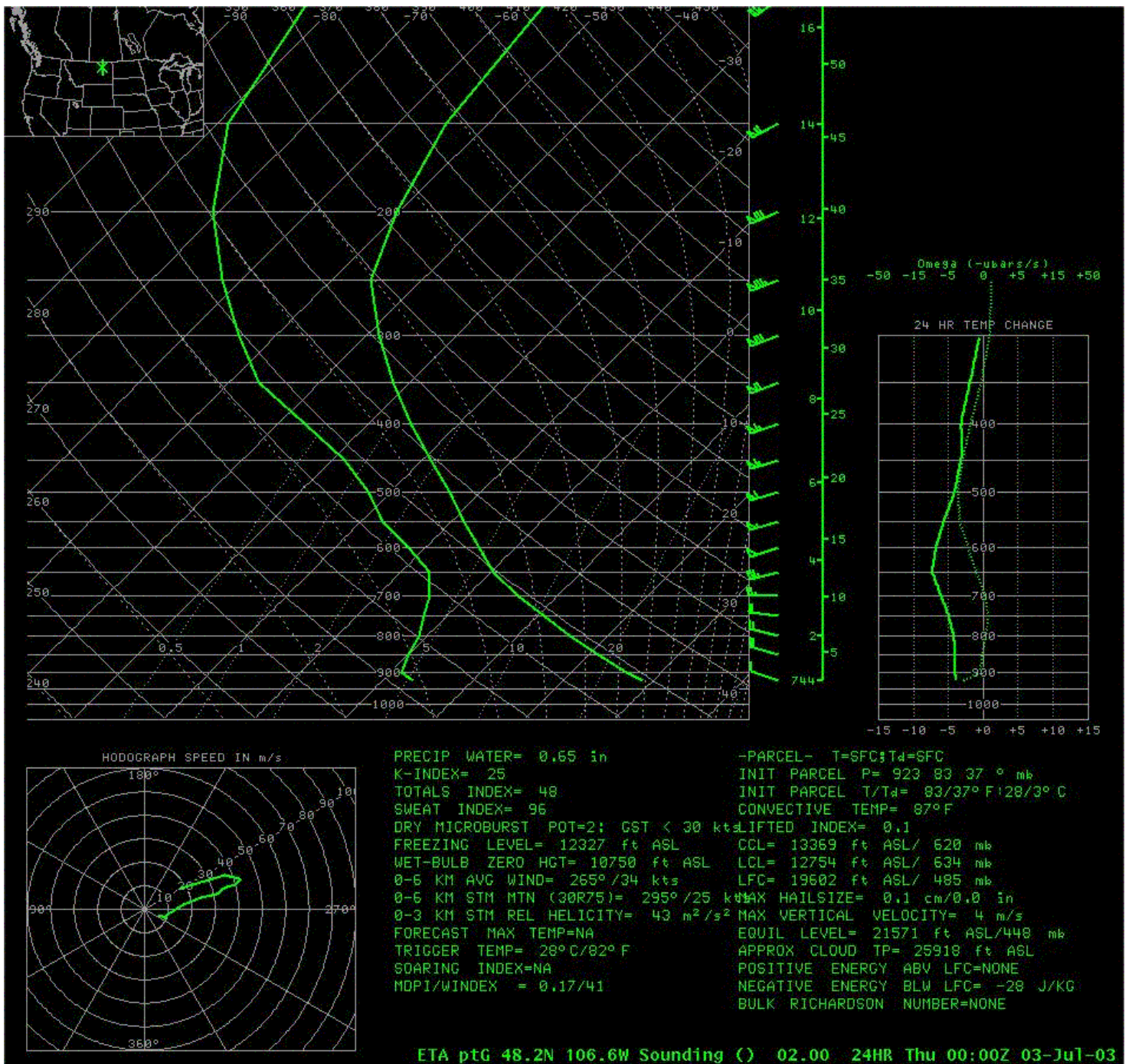


Figure 3b. Same as Figure 3a except it is the 30 hour forecast valid at 0600 UTC 3 July 2003.

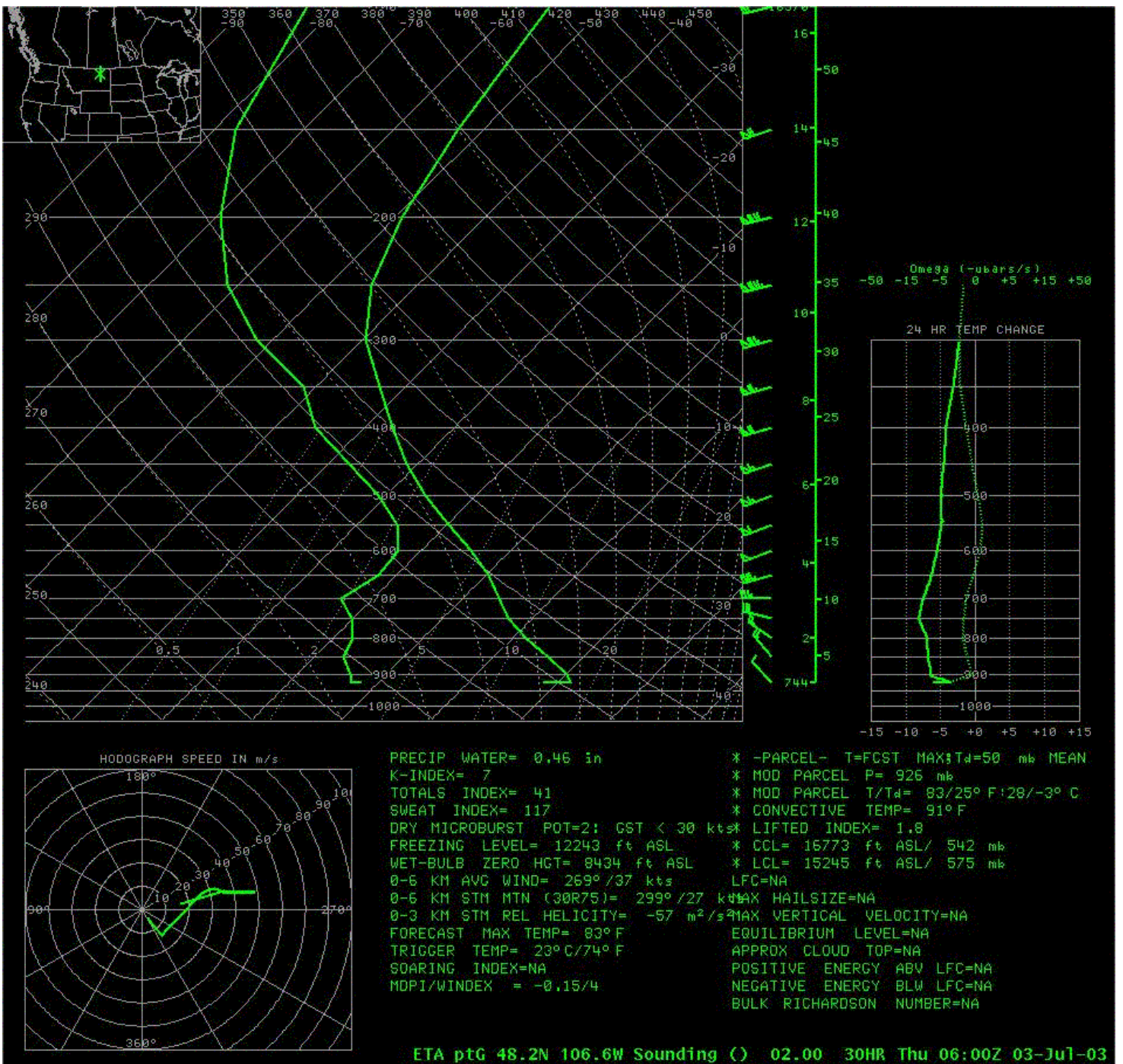
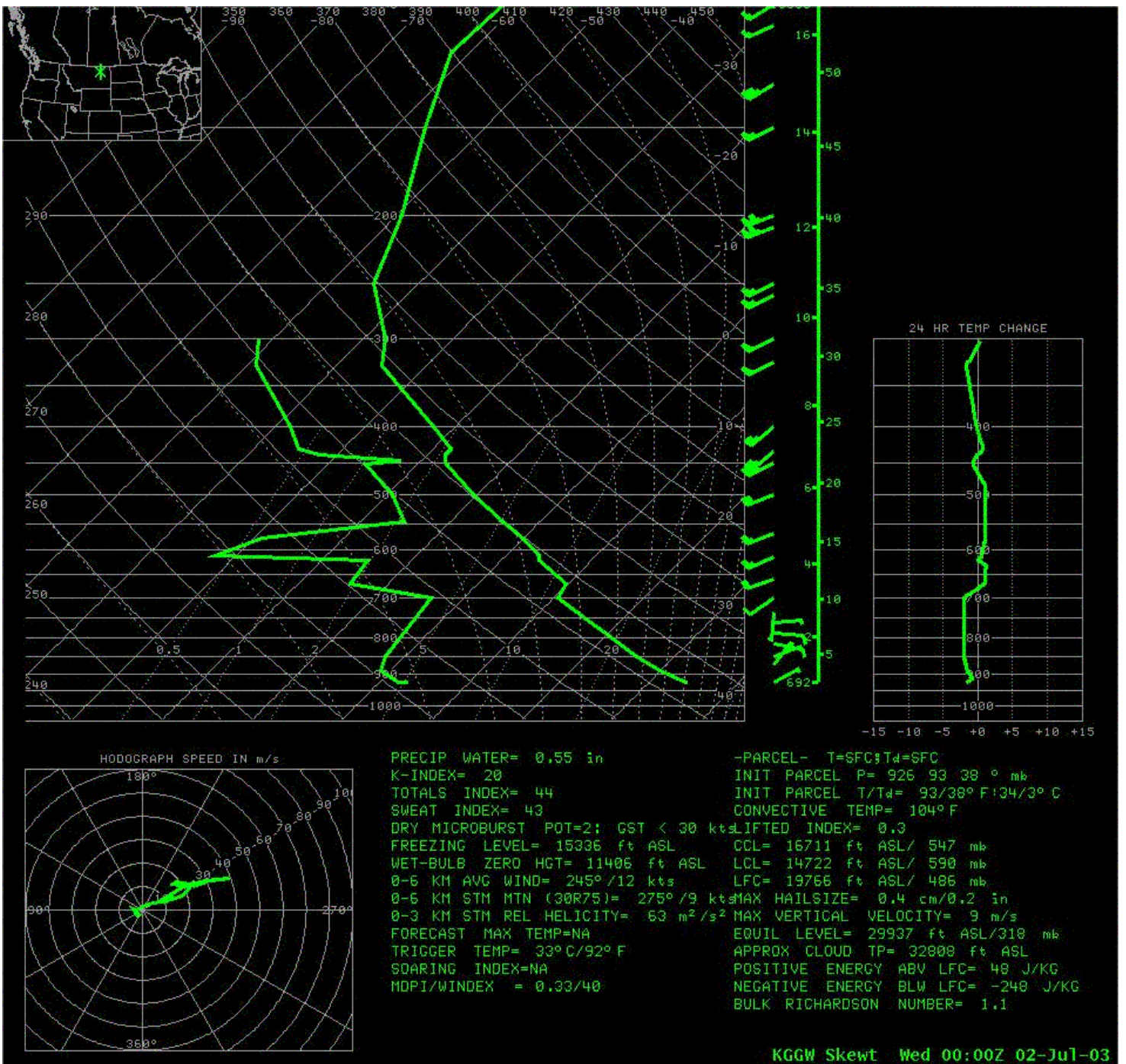
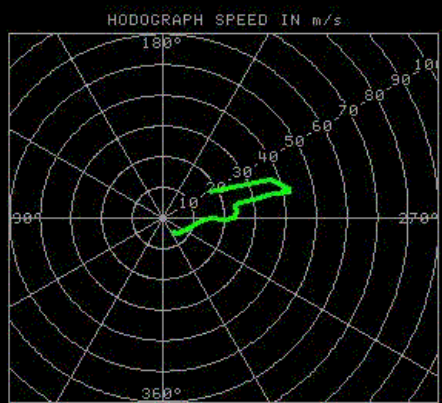
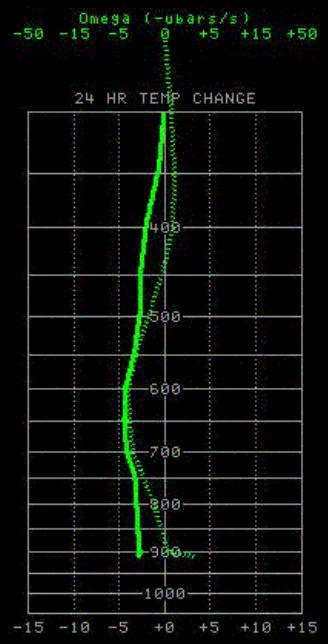
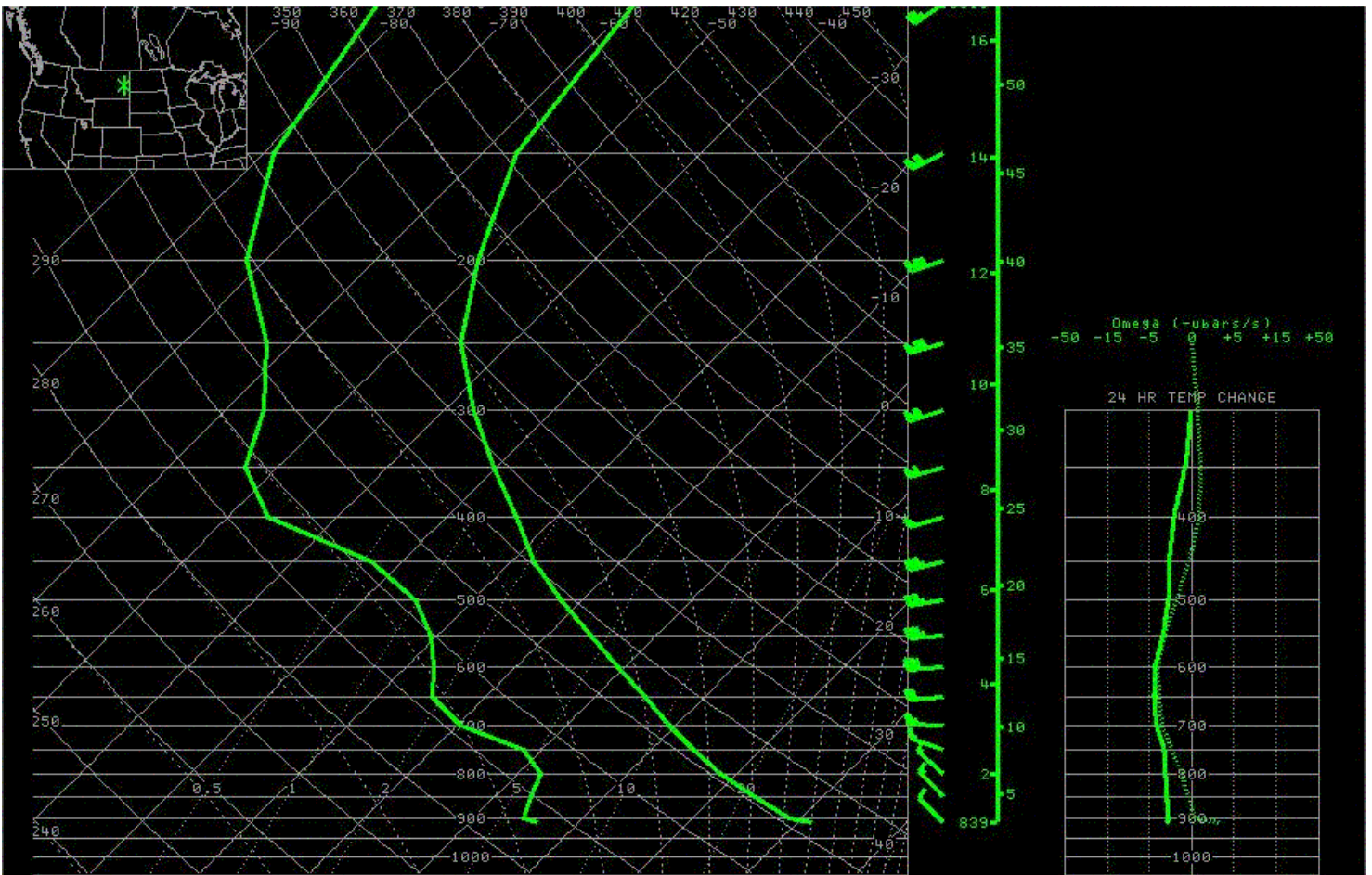


Figure 4. Observed Glasgow Skew-T Log P diagram from 0000 UTC 2 July 2003.



**Figure 5.** Skew-T Log P diagram with the Eta model 24 hour forecast sounding from the 0000 UTC 2 July 2003, valid at 0000 UTC 3 July. The sounding is from around the Glendive, Montana area.



PRECIP WATER= 0.59 in  
 K-INDEX= 20  
 TOTALS INDEX= 51  
 SWEAT INDEX= 153  
 DRY MICROBURST POT=2; CST < 30 kts  
 FREEZING LEVEL= 14123 ft ASL  
 WET-BULB ZERO HGT= 10735 ft ASL  
 0-6 KM AVG WIND= 275°/27 kts  
 0-6 KM STM MTN (30R75)= 305°/20 kts  
 0-3 KM STM REL HELICITY= 37 m<sup>2</sup>/s<sup>2</sup>  
 FORECAST MAX TEMP=NA  
 TRIGGER TEMP= 29° C/85° F  
 SOARING INDEX=NA  
 MDPI/WINDEX = 0.41/48

-PARCEL- T=SFC;Td=SFC  
 INIT PARCEL P= 912 88 43 ° mb  
 INIT PARCEL T/Td= 88/43° F/31/6° C  
 CONVECTIVE TEMP= 93°F  
 LIFTED INDEX= -2.3  
 CCL= 13861 ft ASL/ 610 mb  
 LCL= 12918 ft ASL/ 632 mb  
 LFC= 15337 ft ASL/ 577 mb  
 MAX HAILSIZE= 2.4 cm/1.0 in  
 MAX VERTICAL VELOCITY= 22 m/s  
 EQUIL LEVEL= 30265 ft ASL/312 mb  
 APPROX CLOUD TP= 30221 ft ASL  
 POSITIVE ENERGY ABV LFC= 331 J/KG  
 NEGATIVE ENERGY BLW LFC= -52 J/KG  
 BULK RICHARDSON NUMBER= 6.0

ETA pTA 47.1N 105.2W Sounding ( ) 02.00 24HR Thu 00:00Z 03-Jul-03