ANALYSIS OF A HEAVY SNOW EVENT OVER EAST CENTRAL NEVADA ON NOVEMBER 1, 2003 USING THE WEATHER EVENT SIMULATOR (WES)

Steven L. Apfel and Brandon Peloquin
WFO Elko, Nevada

Introduction

On the morning of Saturday, November 1, 2003 heavy snow fell over east central Nevada in White Pine County. Snowfall amounts of 4 to 6 inches were reported in a 50 mile wide band from Ely and Ruth to Lund, Nevada. While this type of snow event is not unusual for east Central Nevada, it presented a challenge to established forecast techniques. The Weather Event Simulator (WES) was used in a case study analysis mode to help the forecast staff identify supplemental meteorological parameters for diagnosing heavy snowfall potential.

Synoptic Overview

Light snow was observed over White Pine County beginning around 1100 UTC, 01 November 2003 as a cold upper level trough and strong vorticity maximum dropped into Nevada. IR satellite imagery indicated little cloud top enhancement and the KLRX WSR-88D did not indicate precipitation due to the low topped stratiform clouds. Snow accumulation was very light from 1100 UTC to 1500 UTC with areas of moderate snow reported from 1500 UTC to 1700 UTC.

By 1700 UTC, the 500 mb trough across central Nevada became positively tilted with a 100 kt speed max exiting White Pine County (indicated by the 1800 UTC Meso Eta analysis) (Fig. 1). Heavy snow with thunder was reported on the Ely Airport ASOS observation beginning at 1649 UTC through 1826 UTC. During the period from 1700 to 1830 UTC, moderate to heavy snow was reported in Ruth, Ely and Lund, Nevada.

Frontogenesis

The heavy snow with embedded convection had strong upper level support based on the 300 mb jet analysis of a 100 kt RRQ speed max and thermally direct circulation. In addition to the jet, a strong 500 mb vorticity maximum was shearing across east central Nevada to help enhance large scale upward vertical motion. The surface to 700 mb lifted index indicated values of -3 to -4 C to aid convective instability.

In an effort to gain a vertical perspective across the Ely area, a 1800 UTC Meso Eta cross section analysis graphic was constructed from northwest to southeast across the main convergence boundary with vertical circulation, relative humidity and the 2-D frontogenesis fields (Fig. 2). The relative humidity analysis indicated deep moisture to 700 mb with 80% relative humidity up to 500 mb. The vertical circulation field was very impressive as the streamlines showed a well defined wind convergence axis directly over the Ely area to 700 mb. In addition to the 700 mb wind convergence, the vertical circulation indicated some wind divergence in the streamlines from 400 mb to 300 mb.

The most pronounced feature, however, was the very strong 2-D frontogenesis field in the mid levels from 500 mb to 400 mb. This feature indicated a favorable thermal advection field with the northwest flow cold advection and southwest flow warm air advection variations. The 2-D frontogenesis field basically indicates the changes in the potential temperature gradient following the real wind. This feature helped enhance large scale ascent as the jet max exited and the vorticity maximum sheared across the area.

Fn Vector Divergence

To support the strong 2-D frontogenesis occurring at mid levels, a Meso Eta plan view analysis graphic of 450 mb Fn vector divergence was overlaid with a difference image of 700 mb to 300 mb of wind divergence at 1800 UTC (Fig. 3). The wind divergence difference image supported a convergence/divergence couplet over the heavy snow area, and the impressive Fn vector divergence directly supported the 2-D frontogenesis. The Fn vector divergence field was displaced slightly south and east of the main frontogenesis area in the warm sector. Since Fn vectors are the normal (perpendicular) component of frontogenesis to the potential temperature gradient, the large negative values indicated strong convergence, and enhanced vertical motion.

Discussion and Conclusion

The presence of strong mid level frontogenesis and convergence of Fn vectors not only indicated a favorable area of enhanced vertical motion, but it also indicated a favorable area for heavy banded precipitation along the tight potential temperature gradient and sloping of the mid level front. This was supported by the fact that the heavy snow band was only 50 miles wide with embedded convective elements. The snow ended at
1930 UTC across most locations in White Pine County with Ely and Lund, Nevada reporting 4 inches. Ruth, at 7000 ft msl reported the heaviest snow with 6 inches.

This WES case study review showed the forecast staff that meteorological parameters beyond broad scale quasi-geostrophic motion and jet dynamics are essential to focusing proper attention to a heavy snow event. Using parameters such as 2-D frontogenesis and Fn vector divergence can supplement the forecast process and focus attention on details needed to make the best possible decision in a critical weather situation.

Figure 1

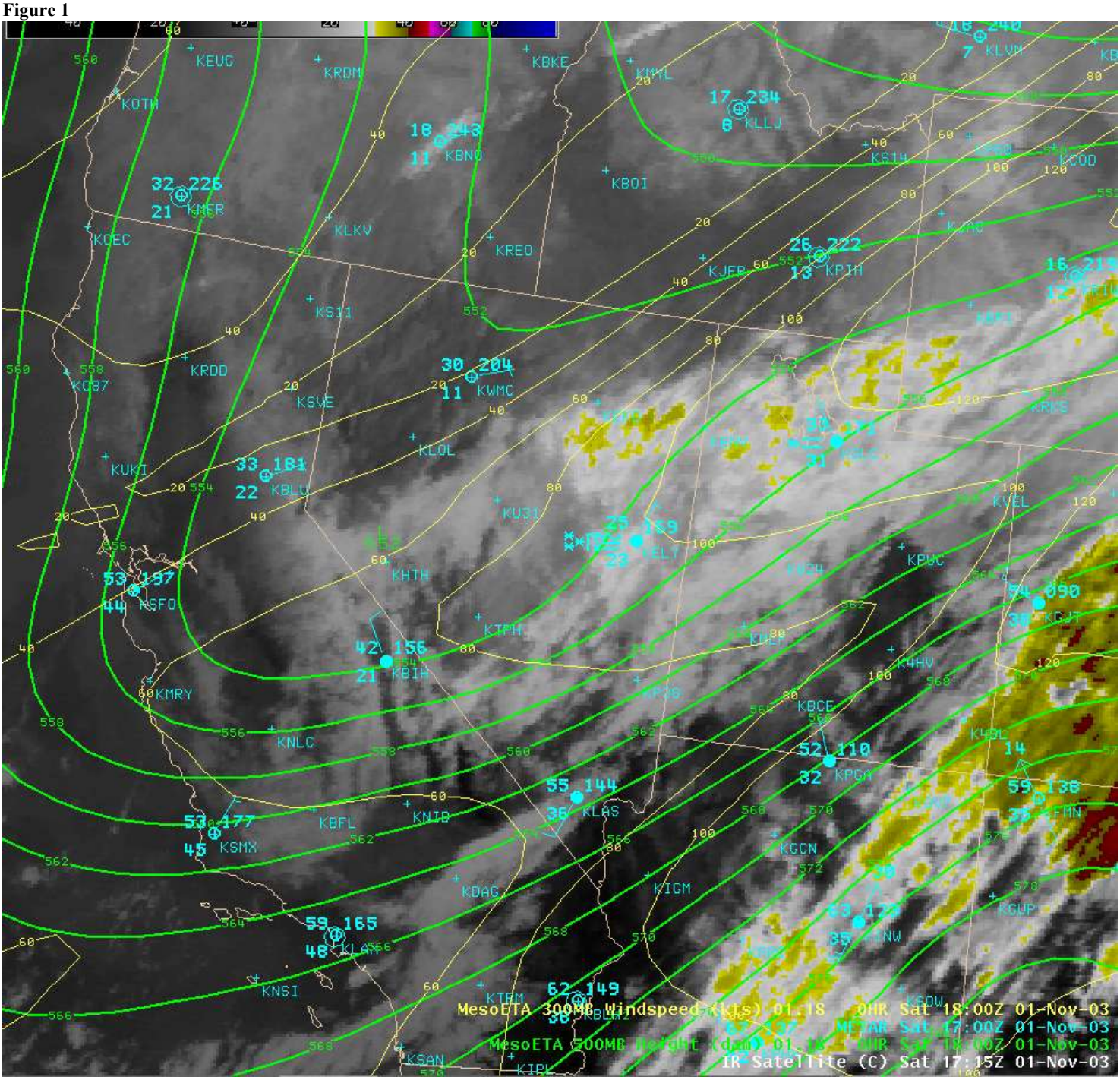


Figure 2

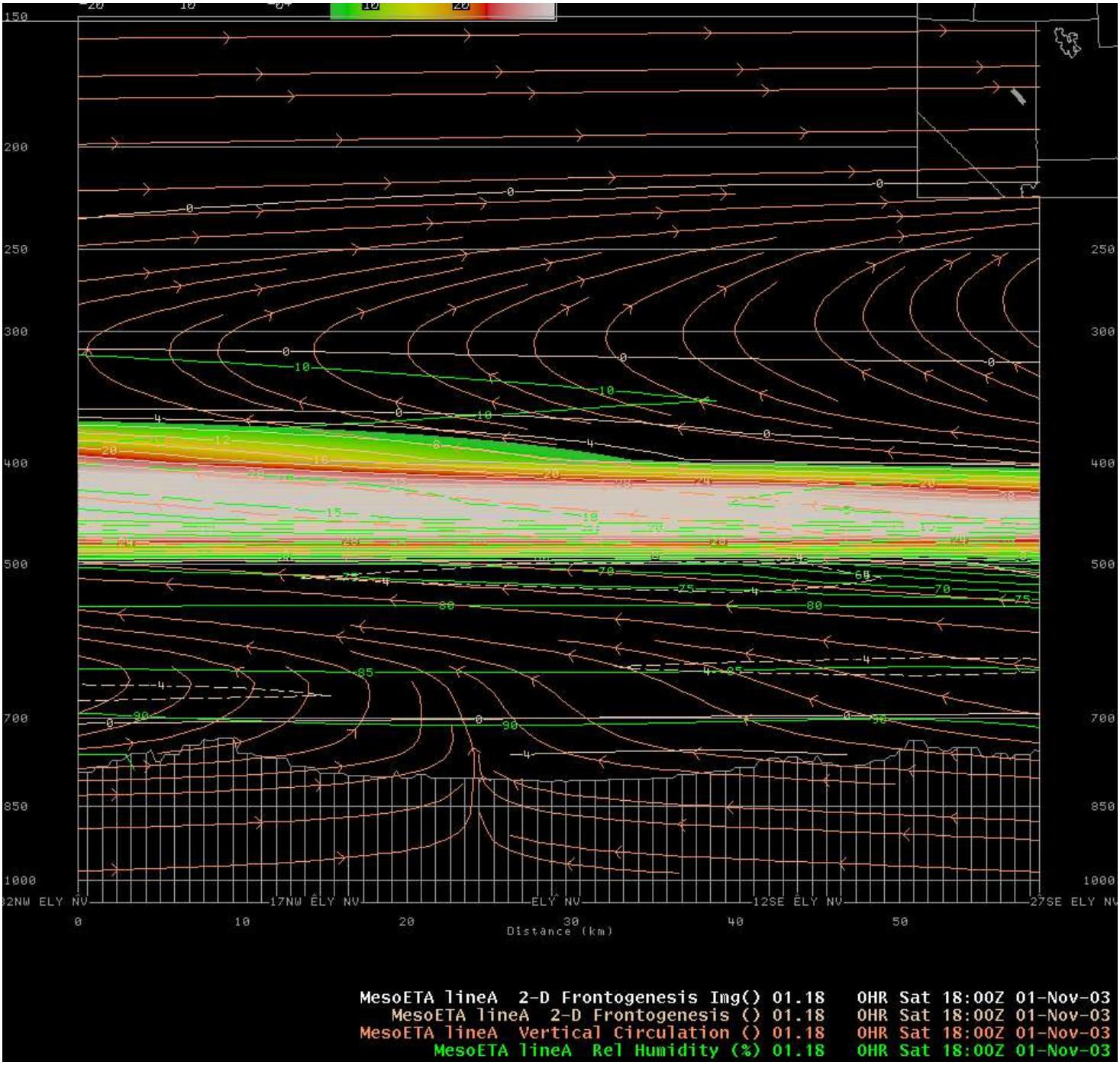
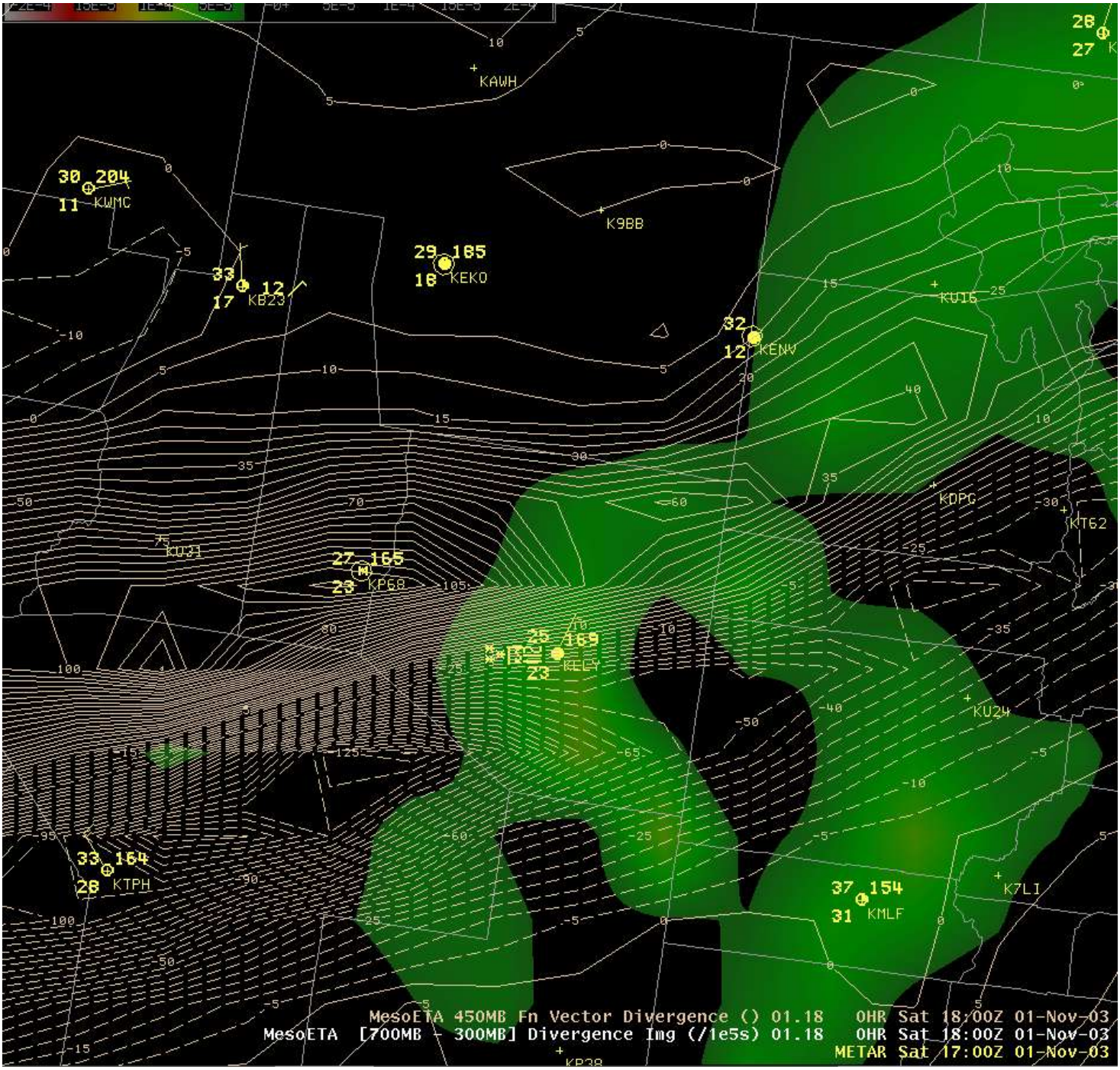

150
200
250
300
400
500
700
850
1000
32NW ELY NV
17NW ELY NV
ELY NV
12SE ELY NV
27SE ELY NV
0
10
20
30
40
50
Distance (km)
MesoETA lineA 2-D Frontogenesis Img() 01.18 OHR Sat 18:00Z 01-Nov-03
MesoETA lineA 2-D Frontogenesis () 01.18 OHR Sat 18:00Z 01-Nov-03
MesoETA lineA Vertical Circulation () 01.18 OHR Sat 18:00Z 01-Nov-03
MesoETA lineA Rel Humidity (%) 01.18 OHR Sat 18:00Z 01-Nov-03

Figure 3


MesoETA 450MB Fn Vector Divergence () 01.18 OHR Sat 18:00Z 01-Nov-03
MesoETA [700MB - 300MB] Divergence Img (/1e5s) 01.18 OHR Sat 18:00Z 01-Nov-03
METAR Sat 17:00Z 01-Nov-03
KAWH
K9BB
KWMC
KEKO
KBZ3
KENV
KU16
KDPG
KT62
KU31
KP68
KELY
KU24
KTPH
KMLF
K7L1
KP38