A Threshold Convective Event May 23 2003
A WES Case Study

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(Compiled by Jim Fischer, SOO)

Background

This convective case has several interesting features not the least of which was, it did not produce severe weather. It did produce near severe wind gusts at the Reno-Tahoe airport as the convection was dissipating late in the day. Also, the day was fairly typical of thunderstorm patterns over the Reno CWA. Finally, because it was a day when severe weather did not occur it can serve as an example of a threshold day, where if it was slightly more unstable or there were a few more dynamics or a bit more precipitable water, severe weather might well have occurred. It should not be viewed as a lower threshold event however, below which severe weather will not occur.

Introduction

The thunderstorms were well forecast by both the models and the forecasters the morning of the May 23rd, 2003. There was convection the previous day. The atmosphere in the morning was unstable over the northern part of the CWA and there was a moderate amount of precipitable water. Convection developed over several areas around Reno. The first convection was northeast of Reno and over the Sierra, and north of Lake Tahoe near Truckee. The first cells identified by SCAN were at 2000Z 23May03. The last lightning detected in the CWA was at 05Z 24May03. A wind gust of 43 mph from the SE was reported at 0328Z 24May03 at the Reno NV airport, and a spotter estimated 50-60 mph wind approximately 10 miles south of the airport. Maximum reflectivity values during event were 55-60dBz and VIL's were 25-30.

Synoptic Features

A 500 mb low was located along the southern California coast with a ridge over the desert southwest extending northwest into the Great Basin (fig 1.). This upper air pattern was also associated with a diffluent wind flow aloft. At the surface, a thermal trough extended over most of the Great Basin (fig. 2).

Preconditions of the Atmosphere

The 12Z 23 May 2003 sounding (fig. 3) at Reno, had a Lifted Index of -3.4, precipitable water of .53 in., CAPE of 662 J/Kg, and the K index was 21. Above the inversion the temperatures were nearly dry adiabatic up to 500 mb. There was also some cooling from the previous 24 hours, around the 500 mb level. This cooling was likely do to the previous days convection. A vertical wind shear was present at 500 mb. It was not a classic inverted V sounding. The sounding 12 hours later at 00Z (fig. 4) was. Aviation model initial analyzed LI's over the CWA, from the 12Z GFS analysis (fig. 5) indicated a 0 LI contour with a northwest-southeast axis over Lake Tahoe and the northern Sierra. An 850 mb theta-e contour of 324 degs K (fig. 6) was also over Lake Tahoe with the same orientation, and there was a theta-e gradient over the area where thunderstorms would produce the gusty winds. The 12 hour forecast at 00Z (fig 7.) the theta-e ridge built to 340 degs K and the theta-e gradient became stronger.

Evolution of Convection

Convection started prior to 2000Z 23May03 with the first cell detected by SCAN at 2000Z. The strongest convection was along the theta-e ridge west of Reno in the early afternoon. By 0015Z 24May03, a collapsing cell on the north end of Lake Tahoe produce heavy rain at Truckee, reported by a HAM radio operator and created a "Sierra" outflow boundary (fig. 8). (These boundaries are more complex than a traditional thunderstorm outflow. They are a combination of outflow and a thermal wind that develops between a meso high in the rain cooled air of a collapsing thunderstorm over the higher terrain of the Sierra and the thermal trough over the Nevada interior. They are commonly referred to as "the westerlies" by local forecasters and can last for hours after convection has ended.) At 0045Z (fig. 9) the south end of the outflow intersected with a developing convective cell which will produce the strong wind gust at the Reno airport. At that time, it was approximately 37 miles southeast of Reno. Another significant contribution to the development of this cell was a terrain ridge line to the southeast of Reno. It is suspected that the initial trigger for the cell may have been the outflow boundary, but the convection was enhanced as it traveled northwest over the ridge line. There were also moderate west winds (discussed above) at Reno from earlier convection, feeding into the cell. At 0217Z the cell indicated it's maximum reflectivity (fig. 10) and began collapsing. The cell continued to move northwest and the 0322Z radar image (fig. 11) was just prior to the 43 mph wind gust at the Reno airport. There was also a spotter report at 0350Z which estimated wind gusts of 50-60 mph about 10 miles south of the Reno airport.

Conclusion

Typically, convection in the Reno CWA is not severe but how do we distinguish the days that are or might be from the days that aren't? The typical methodology has been to study convection that produced severe weather and determine what values are associated with it. In this approach we look at convection that did not produce severe weather but was very close to severe. While no conclusion should be reached about the absolute values of the conditions prior to convection that day, this analysis and further study may be able to provide a threshold of values which trigger a heightened awareness in the forecaster prior to convective outbreaks.

Figure 1

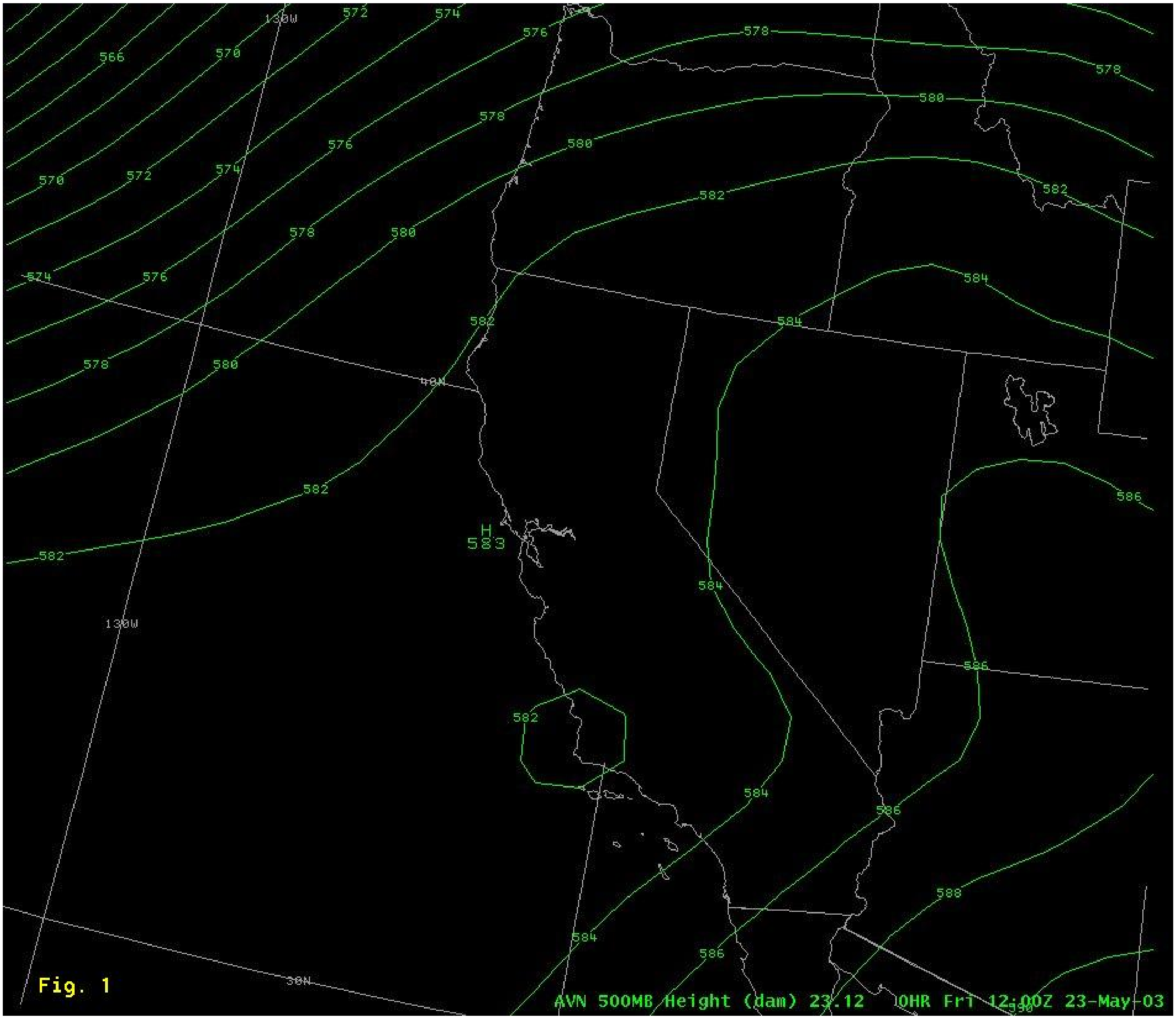


Fig. 1
AVN 500MB Height (dam) 23.12 0HR Fri 12:00Z 23-May-03
H
583
130W
40N
30N
566
570
572
574
576
578
580
582
584
586
588

Figure 2

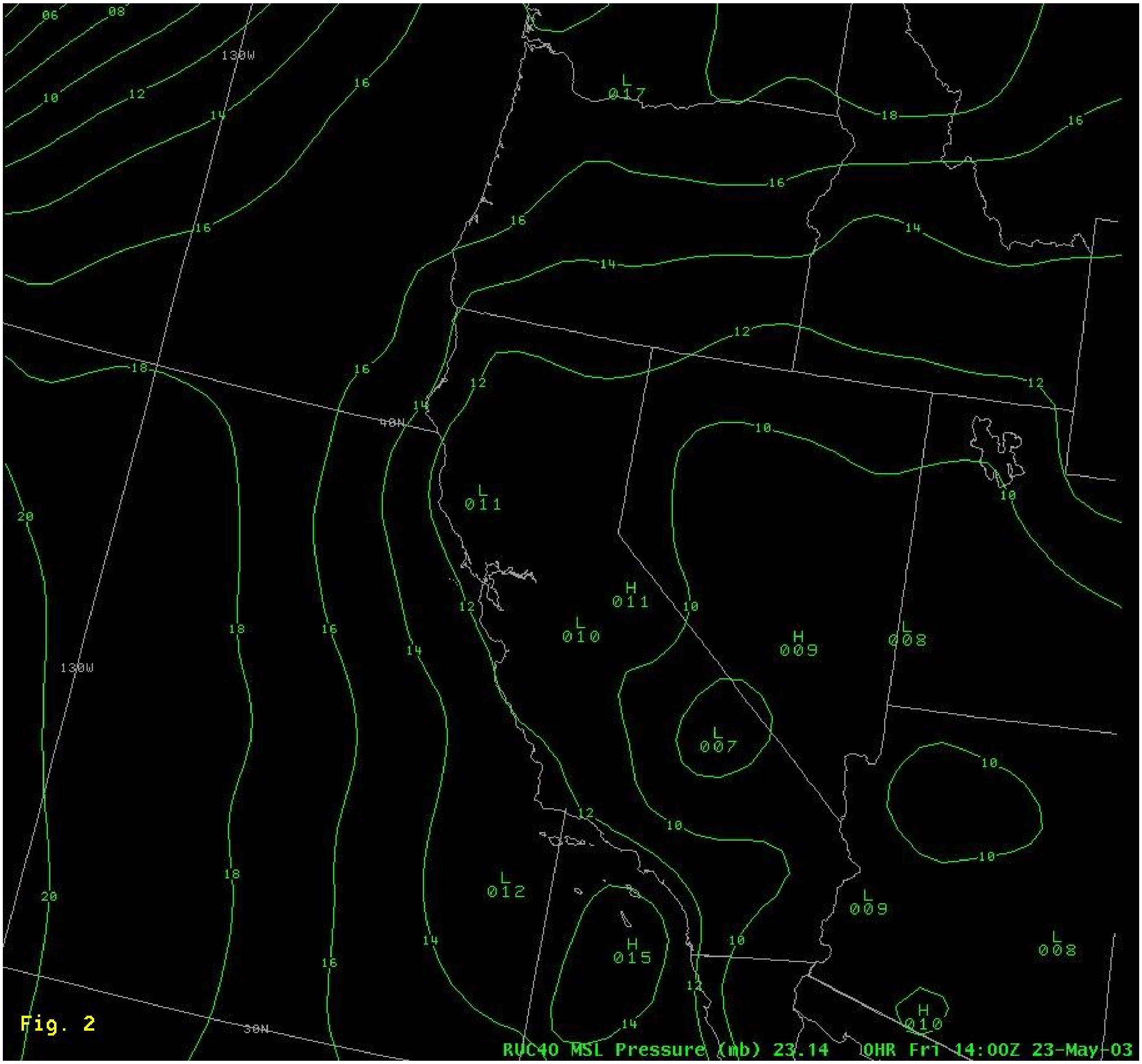


Figure 3

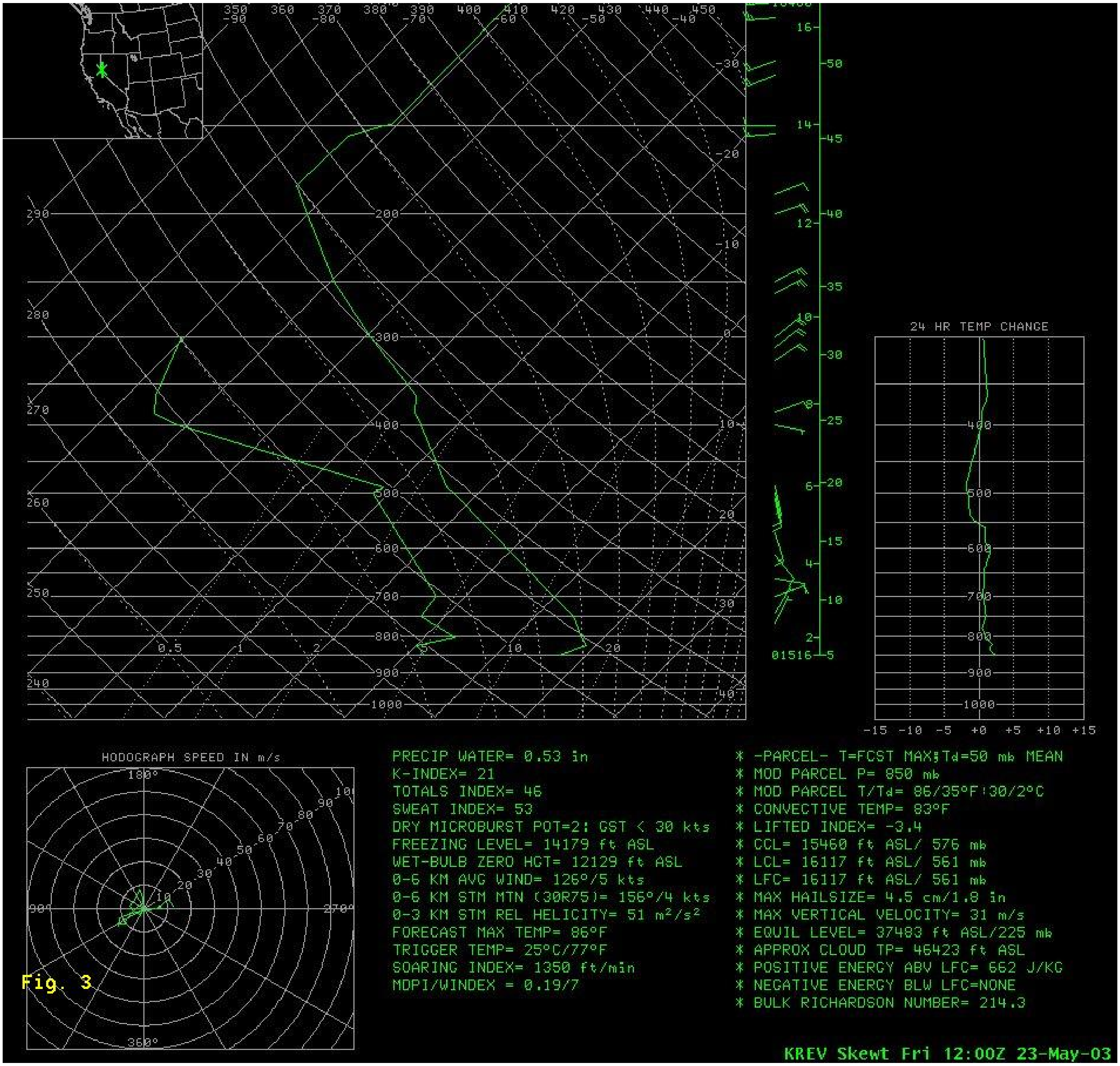
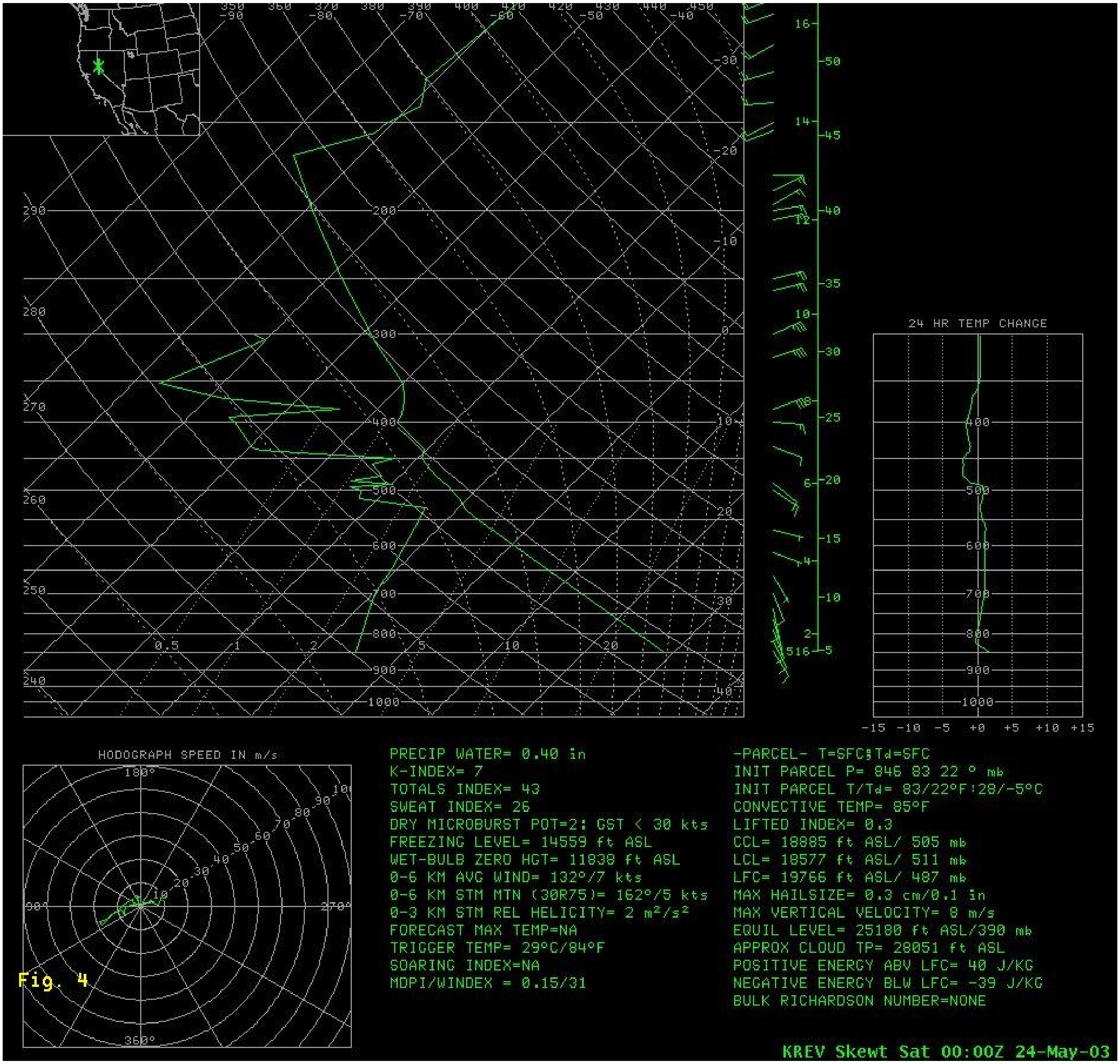

24 HR TEMP CHANGE
HODOGRAPH SPEED IN m/s
Fig. 3
PRECIP WATER= 0.53 in
K-INDEX= 21
TOTALS INDEX= 46
SWEAT INDEX= 53
DRY MICROBURST POT=2: GST < 30 kts
FREEZING LEVEL= 14179 ft ASL
WET-BULB ZERO HGT= 12129 ft ASL
0-6 KM AVG WIND= 126°/5 kts
0-6 KM STM MTN (30R75)= 156°/4 kts
0-3 KM STM REL HELICITY= 51 m²/s²
FORECAST MAX TEMP= 86°F
TRIGGER TEMP= 25°C/77°F
SOARING INDEX= 1350 ft/min
MDPI/WINDEX = 0.19/7
* -PARCEL- T=FCST MAX;Td=50 mb MEAN
* MOD PARCEL P= 850 mb
* MOD PARCEL T/Td= 86/35°F|30/2°C
* CONVECTIVE TEMP= 83°F
* LIFTED INDEX= -3.4
* CCL= 15460 ft ASL/ 576 mb
* LCL= 16117 ft ASL/ 561 mb
* LFC= 16117 ft ASL/ 561 mb
* MAX HAILSIZE= 4.5 cm/1.8 in
* MAX VERTICAL VELOCITY= 31 m/s
* EQUIL LEVEL= 37483 ft ASL/225 mb
* APPROX CLOUD TP= 46423 ft ASL
* POSITIVE ENERGY ABV LFC= 662 J/KG
* NEGATIVE ENERGY BLW LFC=NONE
* BULK RICHARDSON NUMBER= 214.3
KREV Skewt Fri 12:00Z 23-May-03

Figure 4



24 HR TEMP CHANGE
HODOGRAPH SPEED IN m/s
Fig. 4
PRECIP WATER= 0.40 in
K-INDEX= 7
TOTALS INDEX= 43
SWEAT INDEX= 26
DRY MICROBURST POT=2: GST < 30 kts
FREEZING LEVEL= 14559 ft ASL
WET-BULB ZERO HGT= 11838 ft ASL
0-6 KM AVG WIND= 132°/7 kts
0-6 KM STM MTN (30R75)= 162°/5 kts
0-3 KM STM REL HELICITY= 2 m²/s²
FORECAST MAX TEMP=NA
TRIGGER TEMP= 29°C/84°F
SOARING INDEX=NA
MDPI/WINDEX = 0.15/31
-PARCEL- T=SFC;Td=SFC
INIT PARCEL P= 846 83 22 ° mb
INIT PARCEL T/Td= 83/22°F:28/-5°C
CONVECTIVE TEMP= 85°F
LIFTED INDEX= 0.3
CCL= 18885 ft ASL/ 505 mb
LCL= 18577 ft ASL/ 511 mb
LFC= 19766 ft ASL/ 487 mb
MAX HAILSIZE= 0.3 cm/0.1 in
MAX VERTICAL VELOCITY= 8 m/s
EQUIL LEVEL= 25180 ft ASL/390 mb
APPROX CLOUD TP= 28051 ft ASL
POSITIVE ENERGY ABV LFC= 40 J/KG
NEGATIVE ENERGY BLW LFC= -39 J/KG
BULK RICHARDSON NUMBER=NONE
KREV Skewt Sat 00:00Z 24-May-03

Figure 5

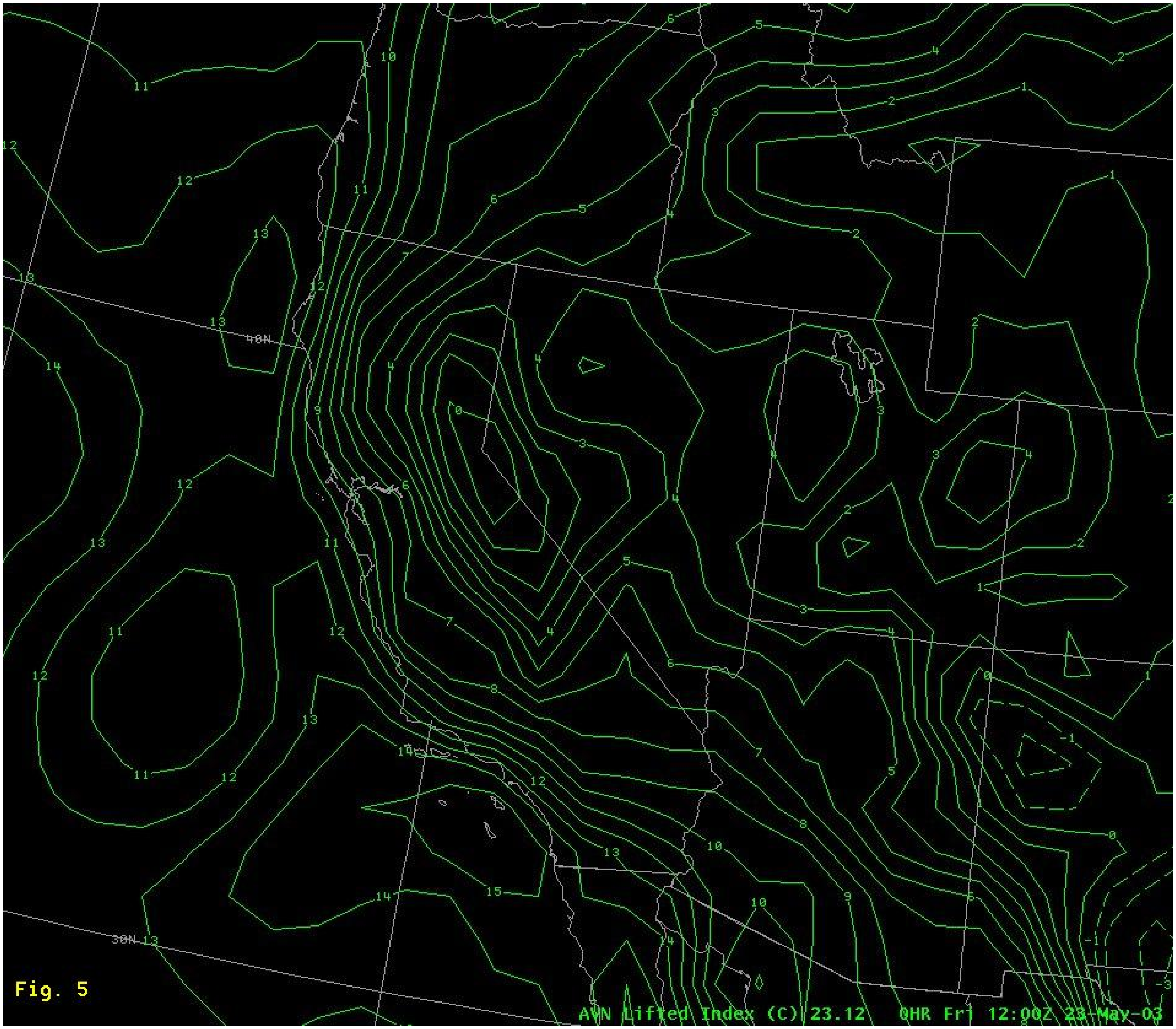


Figure 6

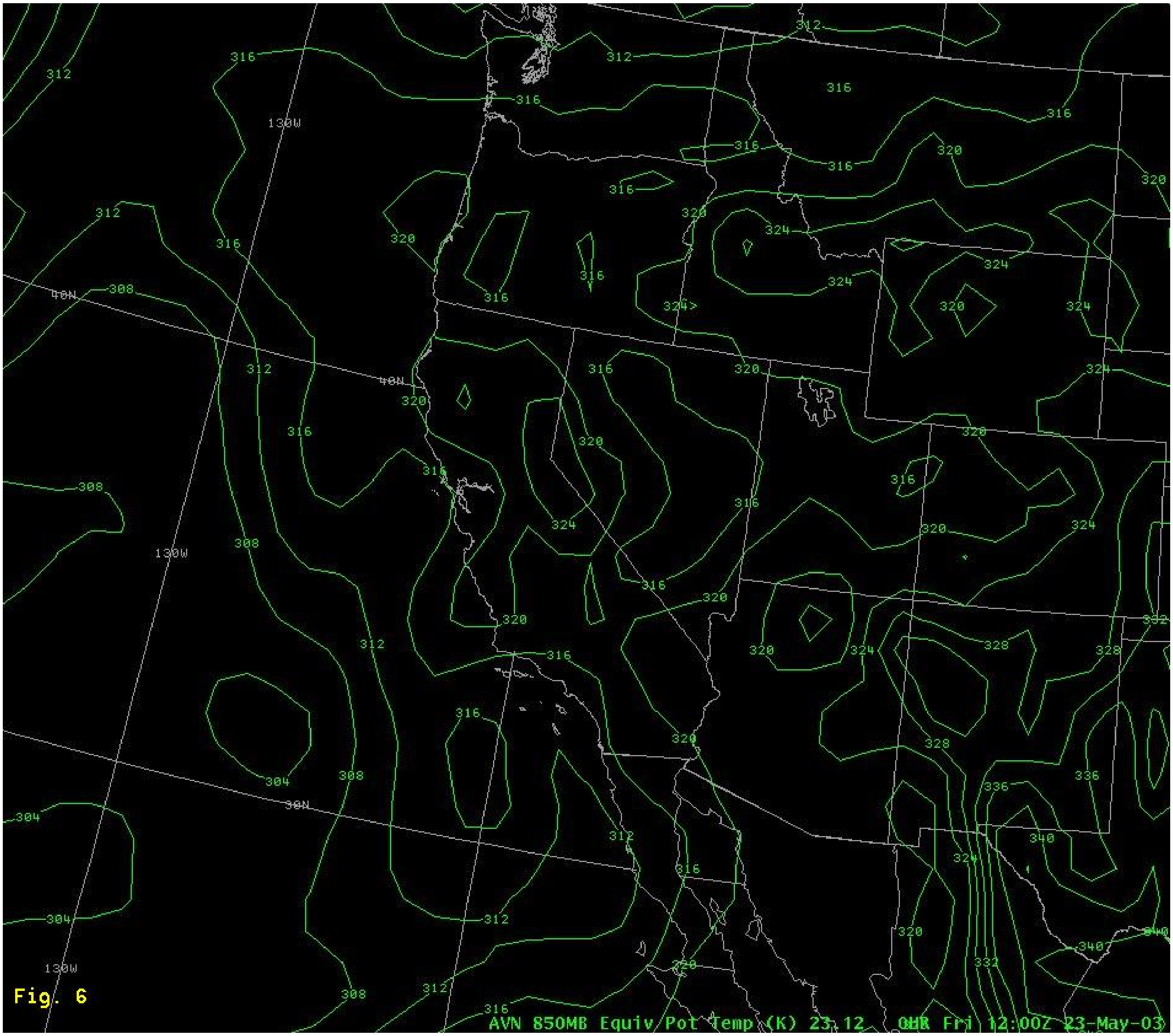


Figure 7

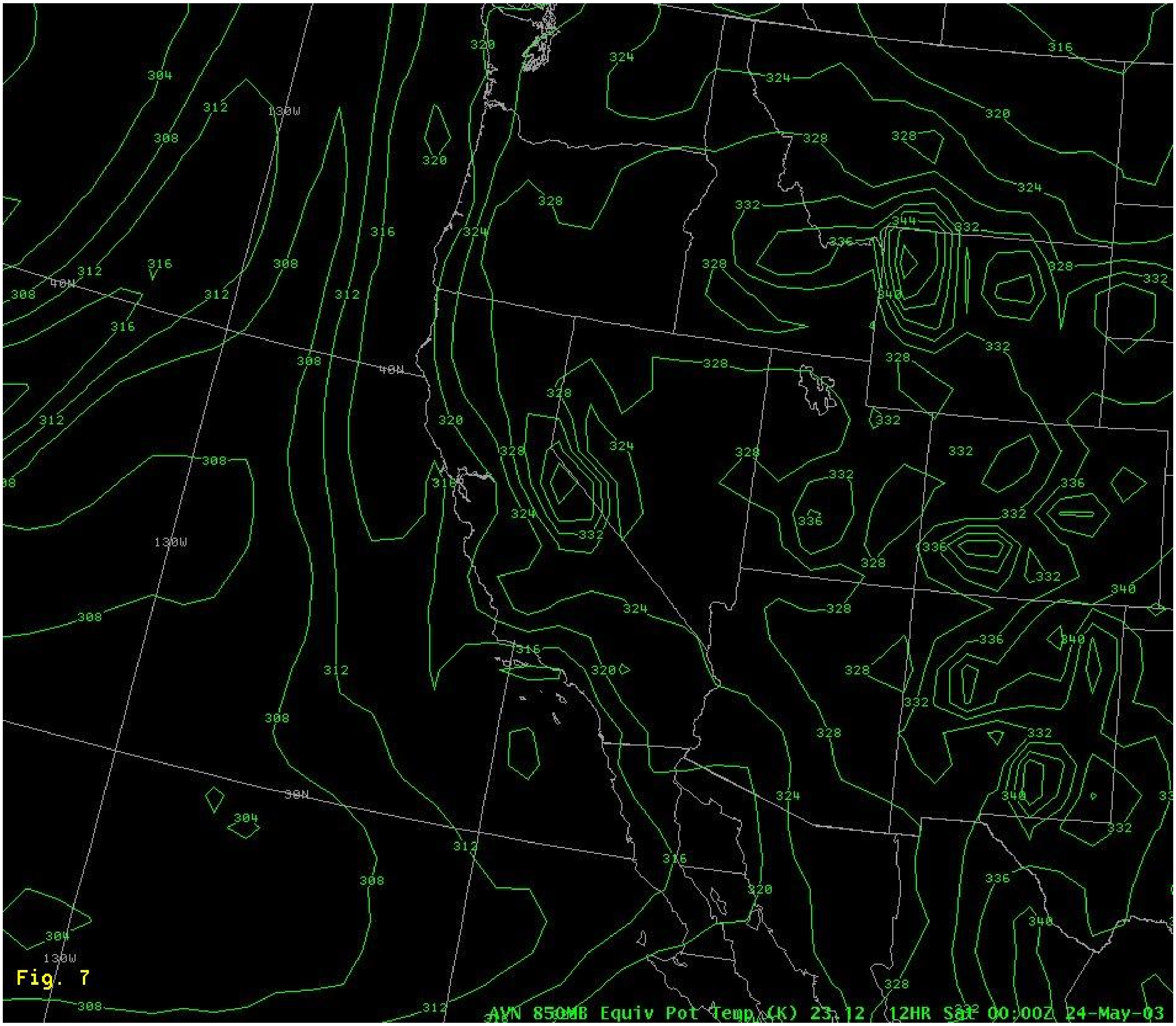


Figure 8

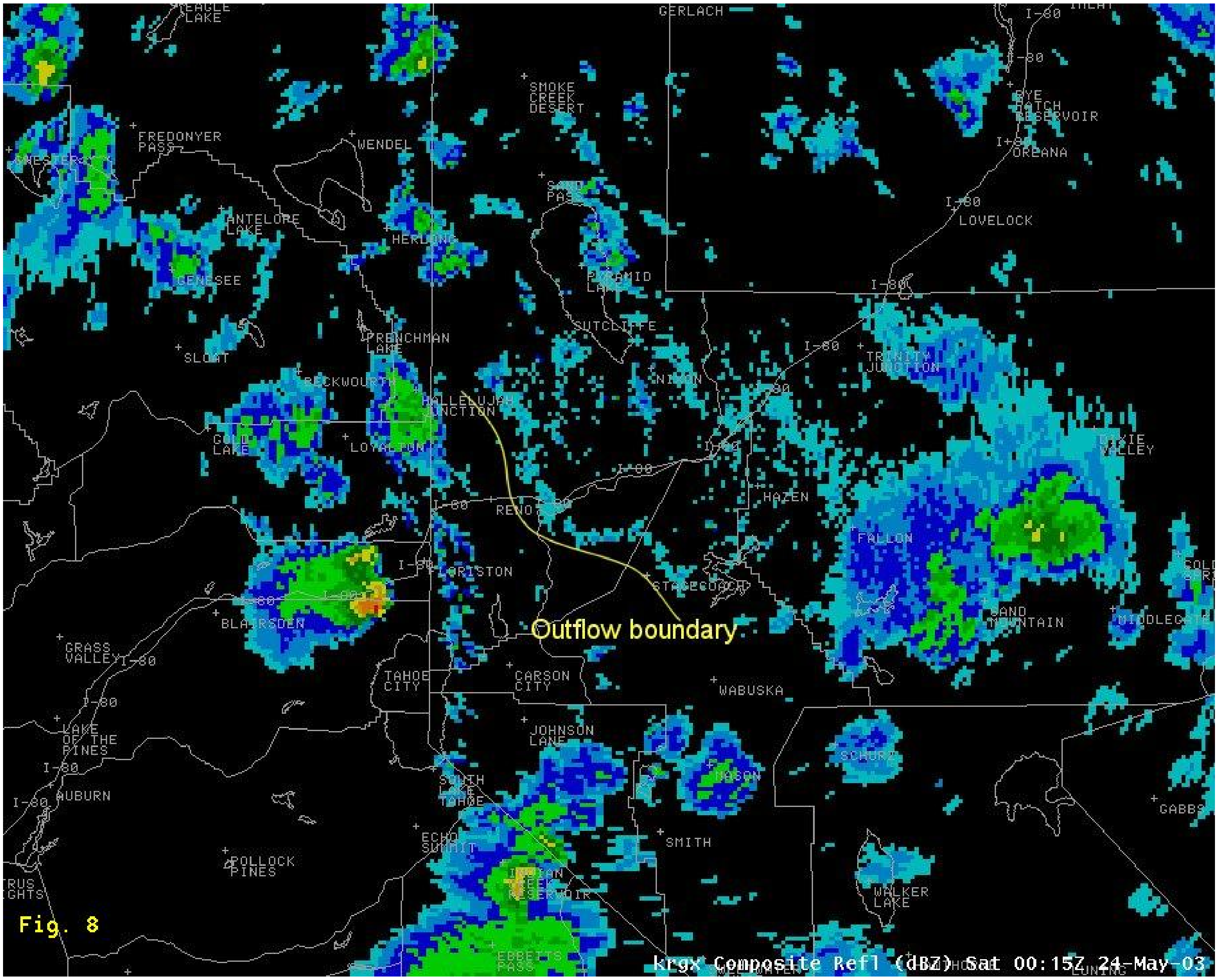


Fig. 8
Outflow boundary
krgx Composite Refl (dBZ) Sat 00:15Z 24-May-03
GERLACH
SMOKE CREEK DESERT
FREDONYER PASS
WENDEL
ANTELOPE LAKE
HERLONG
GENESEE
PYRAMID LAKE
SUTCLIFFE
FRENCHMAN LAKE
SLOAT
BECKWOURTH
HALLELUJAH JUNCTION
NIXON
TRINITY JUNCTION
LOVELOCK
OREANA
RYE PATCH RESERVOIR
LOYALTON
RENO
HAZEN
FALLON
DIXIE VALLEY
FLORISTON
STAGECOACH
BLAIRSDEN
GRASS VALLEY
SAND MOUNTAIN
TAHOE CITY
CARSON CITY
WABUSKA
JOHNSON LANE
LAKE OF THE PINES
AUBURN
SCHURZ
MASON
SOUTH LAKE TAHOE
ECHO SUMMIT
SMITH
POLLOCK PINES
WALKER LAKE
GABBS
EBBETTS PASS
I-80

Figure 9

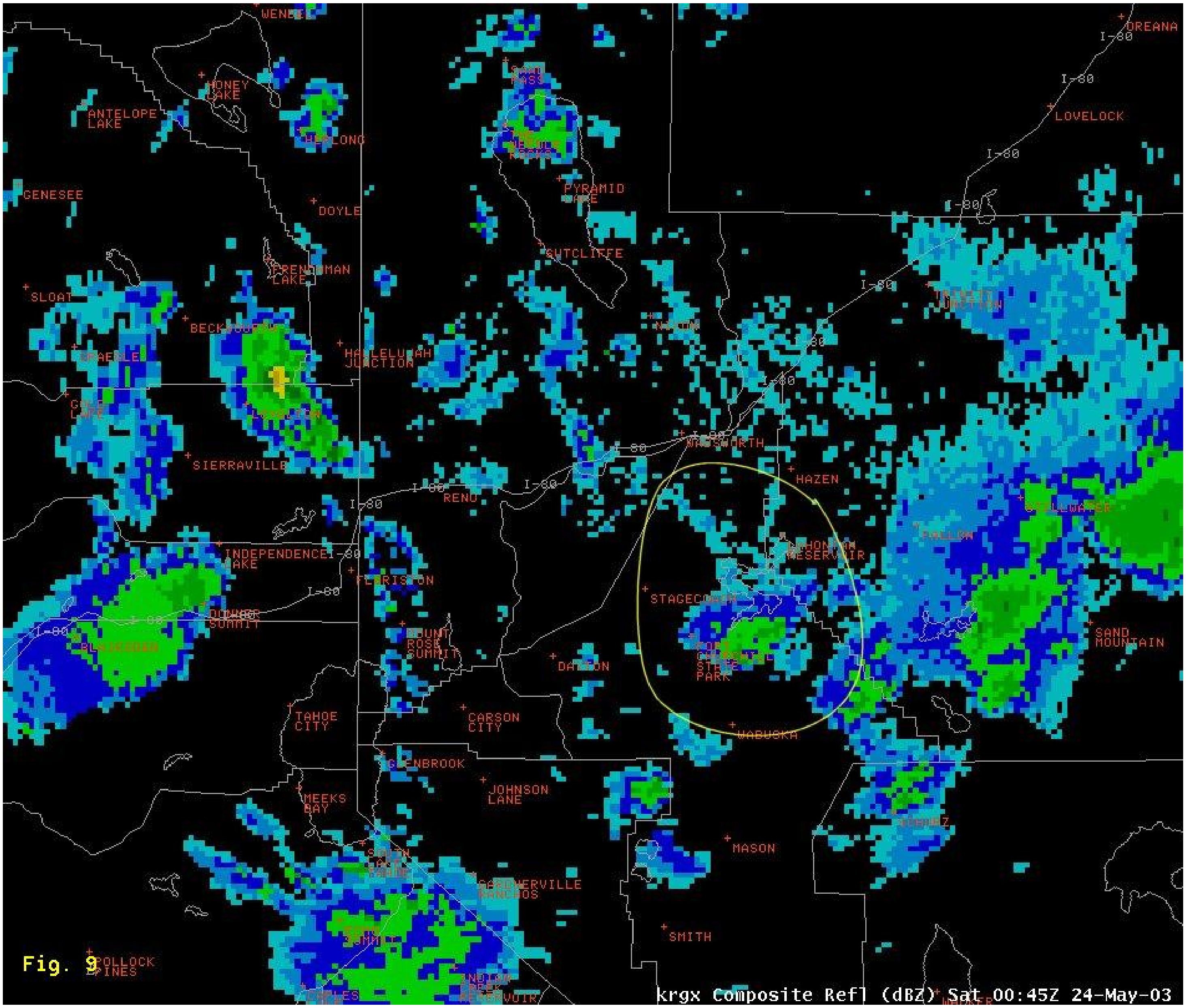


Fig. 9
krgx Composite Refl (dBZ) Sat 00:45Z 24-May-03
RENO
CARSON CITY
STAGECOACH
HAZEN
FALLON
LOVELOCK
PYRAMID LAKE
SUTCLIFFE
DOYLE
GENESEE
SLOAT
SIERRAVILLE
TAHOE CITY
GLENBROOK
JOHNSON LANE
MEEKS BAY
GARDNERVILLE RANCHOS
DAYTON
WABUSKA
MASON
SMITH
SAND MOUNTAIN
OREANA
FLORISTON
MOUNT ROSE SUMMIT
INDEPENDENCE LAKE
DONNER SUMMIT
ANTELOPE LAKE
HONEY LAKE
HALLELUJAH JUNCTION
I-80

Figure 10

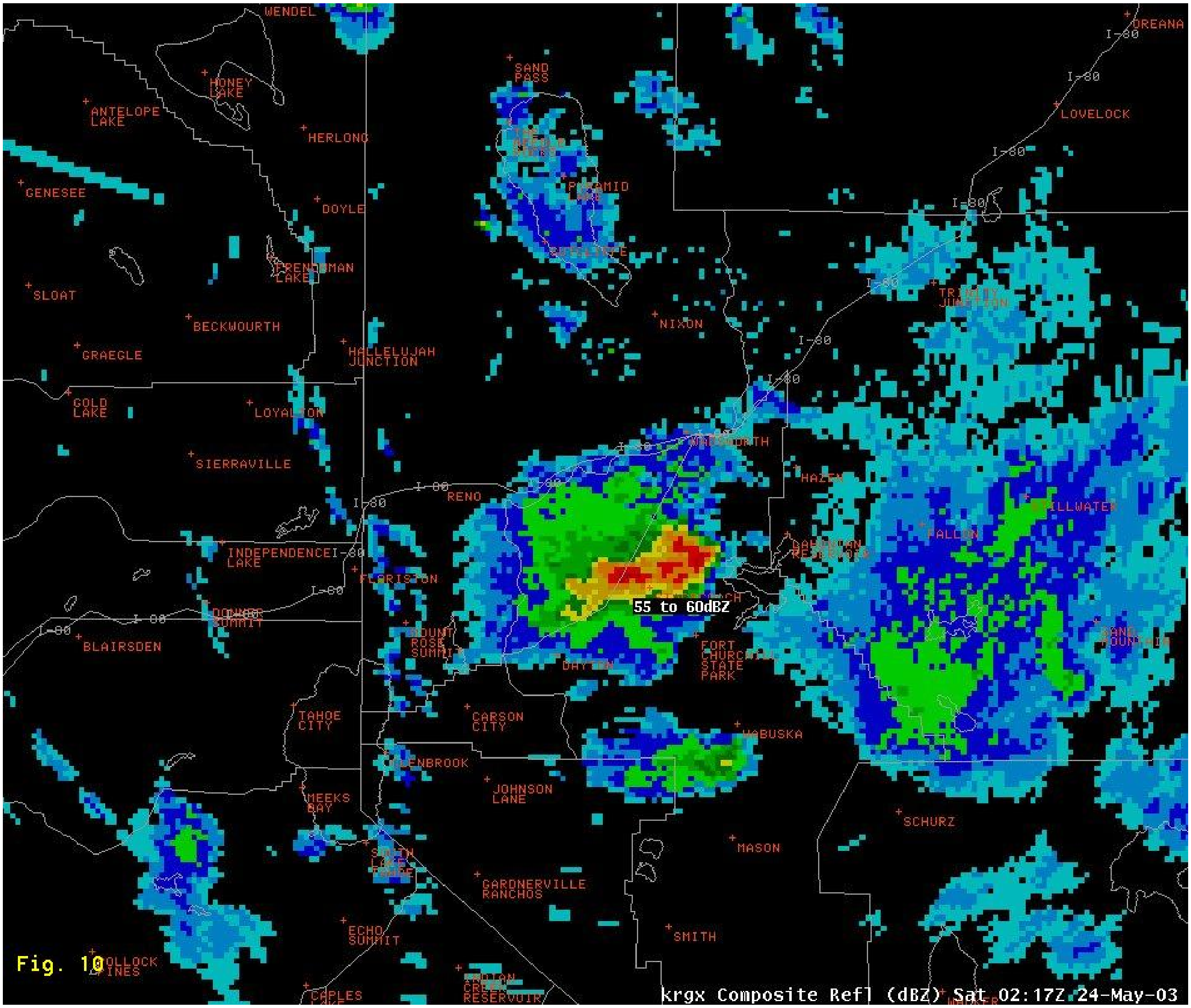
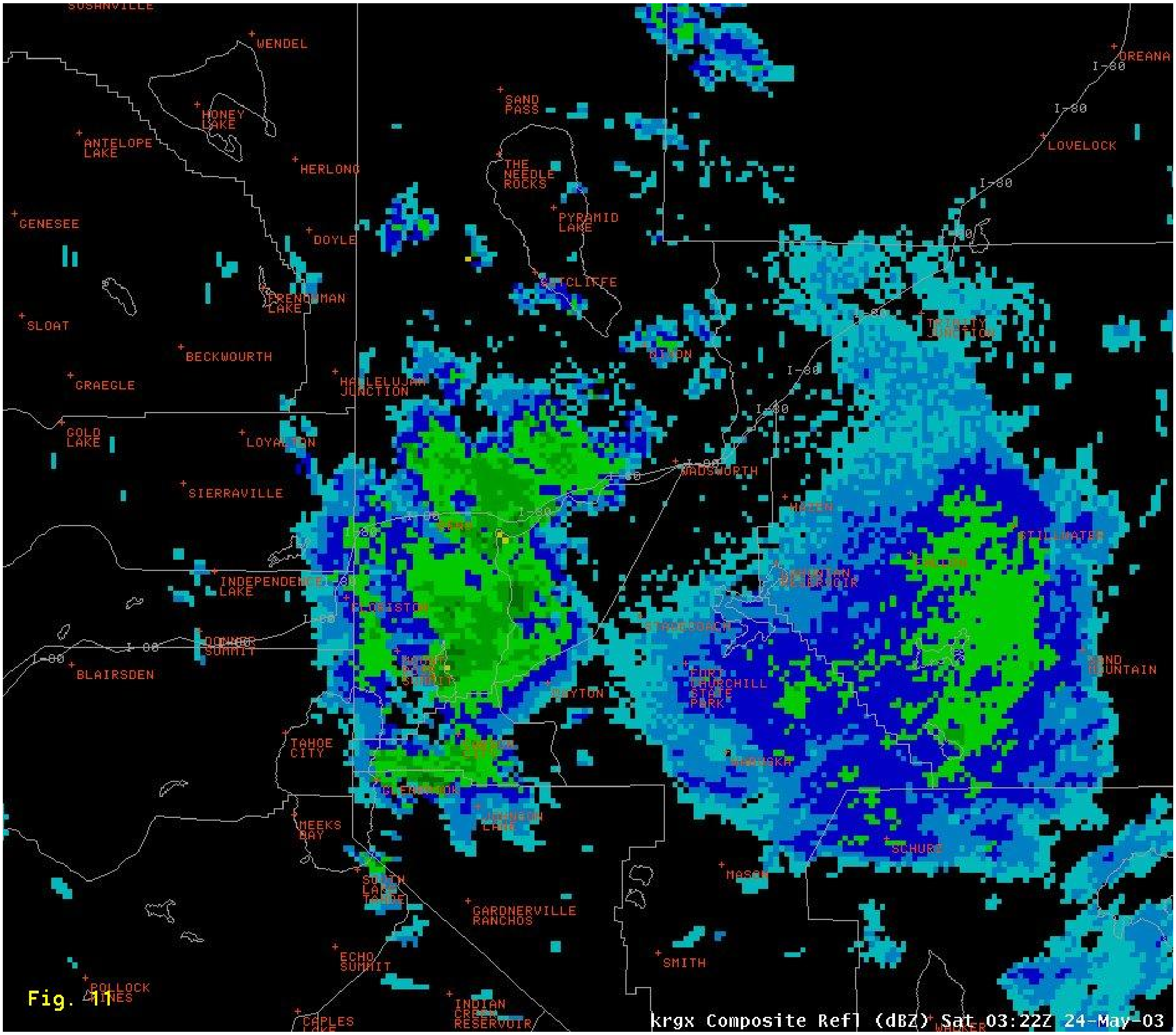

55 to 60dBZ
krgx Composite Refl (dBZ) Sat 02:17Z 24-May-03
Fig. 10
WENDEL
OREANA
SAND PASS
HONEY LAKE
ANTELOPE LAKE
HERLONG
LOVELOCK
GENESEE
DOYLE
SLOAT
BECKWOURTH
NIXON
GRAEGLE
HALLELUJAH JUNCTION
GOLD LAKE
LOYALTON
SIERRAVILLE
RENO
HAZEN
STILLWATER
FALLON
INDEPENDENCE LAKE
BLAIRSDEN
FORT CHURCHILL STATE PARK
DAYTON
TAHOE CITY
CARSON CITY
GLENBROOK
JOHNSON LANE
MEEKS BAY
SCHURZ
MASON
GARDNERVILLE RANCHOS
ECHO SUMMIT
SMITH
CAPLES LAKE
I-80

Figure 11


SUSANVILLE
WENDEL
HONEY LAKE
ANTELOPE LAKE
HERLONG
SAND PASS
THE NEEDLE ROCKS
PYRAMID LAKE
GENESEE
DOYLE
SUTCLIFFE
SLOAT
BECKWOURTH
GRAEGLE
GOLD LAKE
SIERRAVILLE
INDEPENDENCE LAKE
BLAIRSDEN
DONNER SUMMIT
TAHOE CITY
MEEKS BAY
GARDNERVILLE RANCHOS
ECHO SUMMIT
INDIAN CREEK RESERVOIR
CAPLES LAKE
WADSWORTH
STILLWATER
FORT CHURCHILL STATE PARK
SCHURZ
MASON
SMITH
OREANA
LOVELOCK
I-80
Fig. 11
krgx Composite Refl (dBZ) Sat 03:22Z 24-May-03