ANALYSIS OF CONVECTION OVER NORTHEAST NEVADA ON MAY 13, 2003 USING THE WEATHER EVENT SIMULATOR

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Introduction

At 2330 UTC on May 13, 2003, convection developed across northeast Nevada in southeast Elko county and northern White Pine county. By 0000 UTC 24 May, thunderstorms had begun to develop in southern Elko county with the greatest concentration of lightning strikes occurring around 0100 UTC. The thunderstorms remained in southern Elko county until 0130 UTC before slowly dissipating and moving east. The Weather Event Simulator (WES) was used in Displaced Real Time (DRT) mode to help the forecast staff focus in on the location with the highest probability for thunderstorm development. Another goal of the simulation was to give the entire staff more proficiency in starting and running a convective scenario in DRT.

Synoptic and Mesoscale Overview

The water vapor satellite imagery for 0000 UTC, 14 May 2003, indicated a well defined upper low off the central California coast with a shortwave ridge axis located over central Nevada and southwest flow at 500 mb (Fig. 1). The main moisture axis was located well south near the subtropical jet over southern Nevada while a shortwave was ejecting through Wyoming. A time lapse of the water vapor satellite images revealed a low level circulation feature moving east through central Nevada (denoted by the red x).

The GFS at 0000 UTC, 14 May 2003, initialized well with the synoptic scale upper level satellite features with little jet support over northeast Nevada. The 500 mb level indicated a shortwave ridge with no identifiable shortwaves or vorticity features. The low level circulation feature moving through central Nevada was initialized by the GFS as a weak 850-700 mb circulation nearly 100 miles southwest of the water vapor satellite position over southwest Nevada. Although the GFS did not show the correct placement of this circulation feature, it did indicate a 700 mb wind convergence axis extending across central Nevada into Elko county. In addition to the convergence axis, the 300 mb flow showed some divergence over the eastern third of Nevada. A GFS 700-300 mb convergence/divergence couplet image was constructed, and showed a well defined couplet maximum in southern Elko county (Fig. 2)

Thunderstorm Development

Convective development began around 2330 UTC, with the most rapid intensification occurring in southern Elko county at 0000 UTC, 14 May 2003 (Fig. 3). The KLRX WSR-88D indicated the highest reflectivity cores directly in the 700-300 mb couplet maximum initialized by the 0000 UTC GFS. The 5 minute lightning plot began to show lightning strikes within the Elko county convection at 0005 UTC while the convection farther south and west began to dissipate. In addition to the 700-300 mb couplet location, the GFS indicated ample low level instability with a Lifted Index maximum of -3.6 in the area of rapid thunderstorm development (Fig. 4). The moisture fields did not indicate deep layered moisture with 50-60% mean relative humidity up to 500 mb. A weak 700 mb Theta-E ridge did extend along the main axis of instability and wind convergence.

Low Level Circulation

The water vapor satellite image clearly indicated a low level circulation feature farther northeast than the GFS initialization. To help resolve the feature better, the RUC40 700 mb analysis was selected at 0100 UTC. The height and wind field clearly showed a weak, but well defined 700 mb trough axis extending from central Nevada east into southern Elko county (Fig. 5). When looking closer toward the surface at 850 mb, the RUC40 showed a weak 850 mb low pressure area with a moisture convergence axis extending into the thunderstorm development area at 0100 UTC (Fig. 6). Both features matched the water vapor signature and indicated that this would likely aid convective development as the circulation ejected east.

By 0100 UTC, thunderstorms in southern Elko county had reached their maximum intensity with the 5 minute lightning plot showing 12 negative strikes and reflectivity cores of 40-45dbz (Fig. 7). The thunderstorms remained in southeast Elko county before weakening with the last lightning strike reported at 0130 UTC. The remaining convection moved east and dissipated after 0230 UTC with the loss of maximum heating and weakening of the low level circulation.

Discussion and Conclusion

Convergence signatures in complex terrain are important features in the determination of where convection will develop and/or intensify. In this case, the GFS did indicate a 700 mb wind convergence feature matching the 300 mb upper divergent flow for the best vertical forcing. The GFS also indicated a pooling of the available moisture and instability along the convergence axis. It did not, however, indicate the proper position of the low level circulation feature as supported by the RUC40 analysis and water vapor satellite signature. This may or may not have been a factor in enhancing the initial convection in southern Elko county.

This simulation proved that meteorologists must analyze all available data sets to make the most accurate weather forecast. The combination of real time satellite, radar, and point data, along with contributions from each model are integral components of a complete forecast. Running the simulation in DRT mode gave the forecast staff time to focus on the features contributing to the proper location of thunderstorm development.

Fig. 1. Water Vapor satellite image with GFS 500mb heights showing the upper low off California coast and short wave ridge over Nevada, 0000 UTC 14 May 2003. The red X denotes lower level circulation feature.

Fig. 2. GFS 700mb-300mb wind convergence/divergence couplet image showing maximum over southern Elko county, 0000 UTC 14 May 2003.

Fig. 3. KLRX 0.5 deg reflectivity overlaid with visible satellite image and 5 minute lightning plot, 0000 UTC 14 May 2003. The convection formed around 2330 UTC.

Fig. 4. GFS Computed Lifted Index and 700 mb Theta-E image showing moisture and instability over southern Elko county, 0000 UTC 14 May 2003.

Fig. 5. RUC40 analysis of 700 mb height and wind showing well defined trough axis extending from central Nevada east into Elko County, 0100 UTC 14 May 2003.

Fig. 6. RUC40 850-700 mb layered moisture convergence with 850 mb height and wind showing low level convergence extending from central Nevada into southern Elko county, 0100 UTC 14 May 2003.

Fig. 7. KLRX 0.5 deg reflectivity overlaid with visible satellite image and 5 minute lightning plot, 0100 UTC 14 May 2003. The thunderstorms dissipated at 0200 UTC.

Figure 1

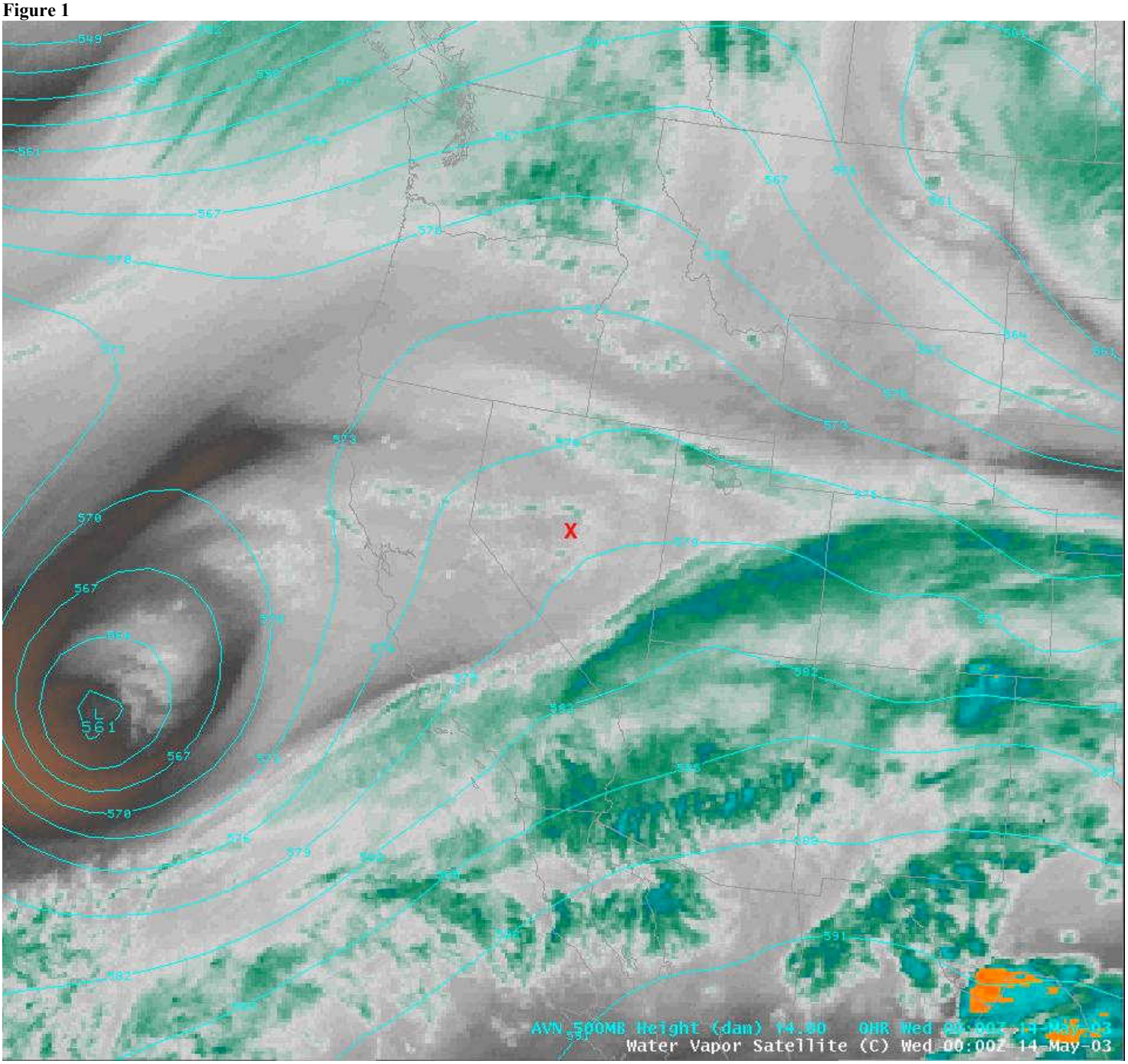


Figure 2

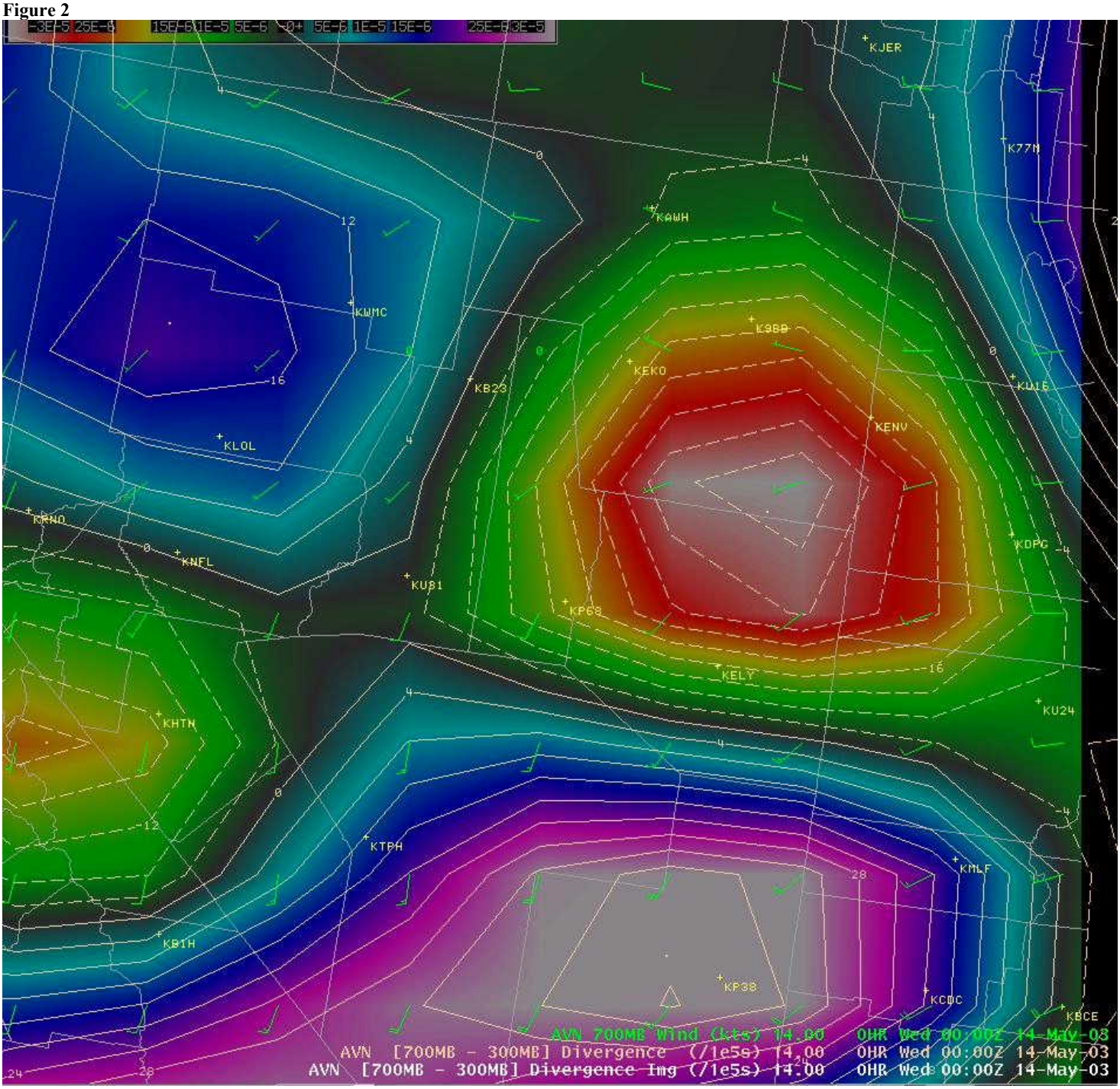
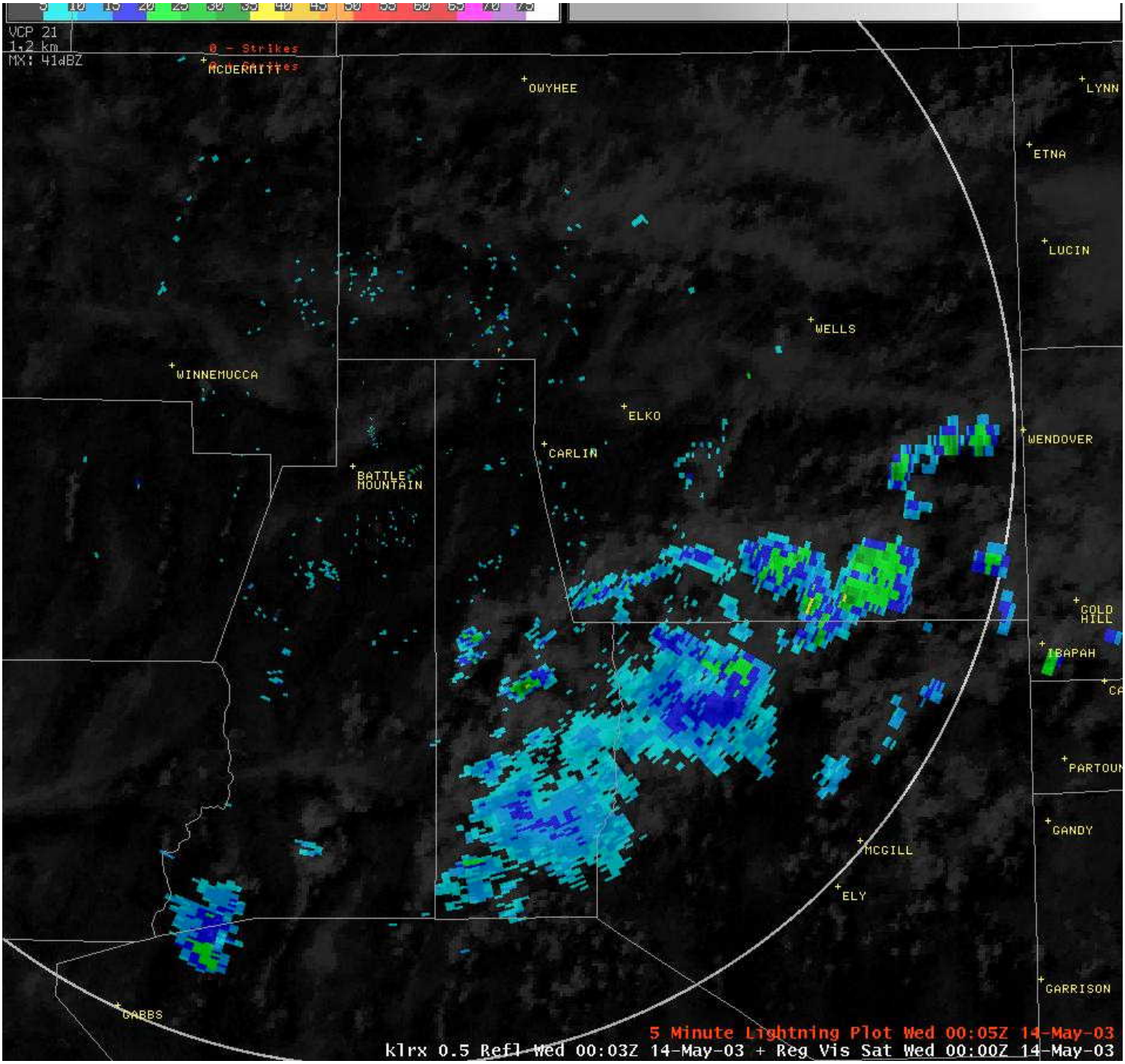


Figure 3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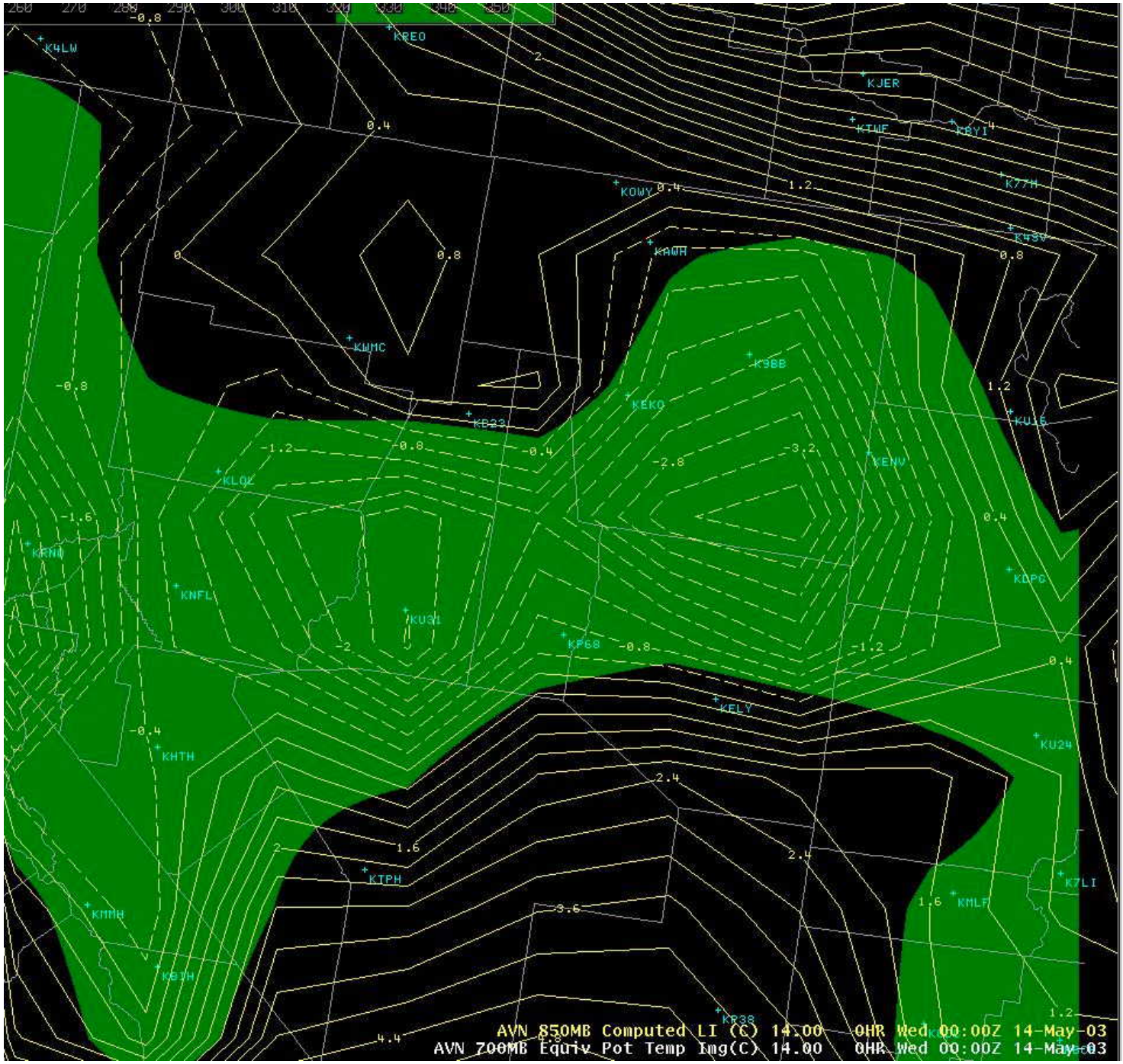
OWYHEE
LYNN
ETNA
LUCIN
WELLS
WINNEMUCCA
ELKO
CARLIN
WENDOVER
BATTLE MOUNTAIN
GOLD HILL
IBAPAH
PARTOUN
GANDY
MCGILL
ELY
GARRISON
DARBS
5 Minute Lightning Plot Wed 00:05Z 14-May-03
klrx 0.5 Refl Wed 00:03Z 14-May-03 + Reg Vis Sat Wed 00:00Z 14-May-03

Figure 4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AVN 700MB Equiv Pot Temp Img(C) 14.00 0HR Wed 00:00Z 14-May-03

Figure 5

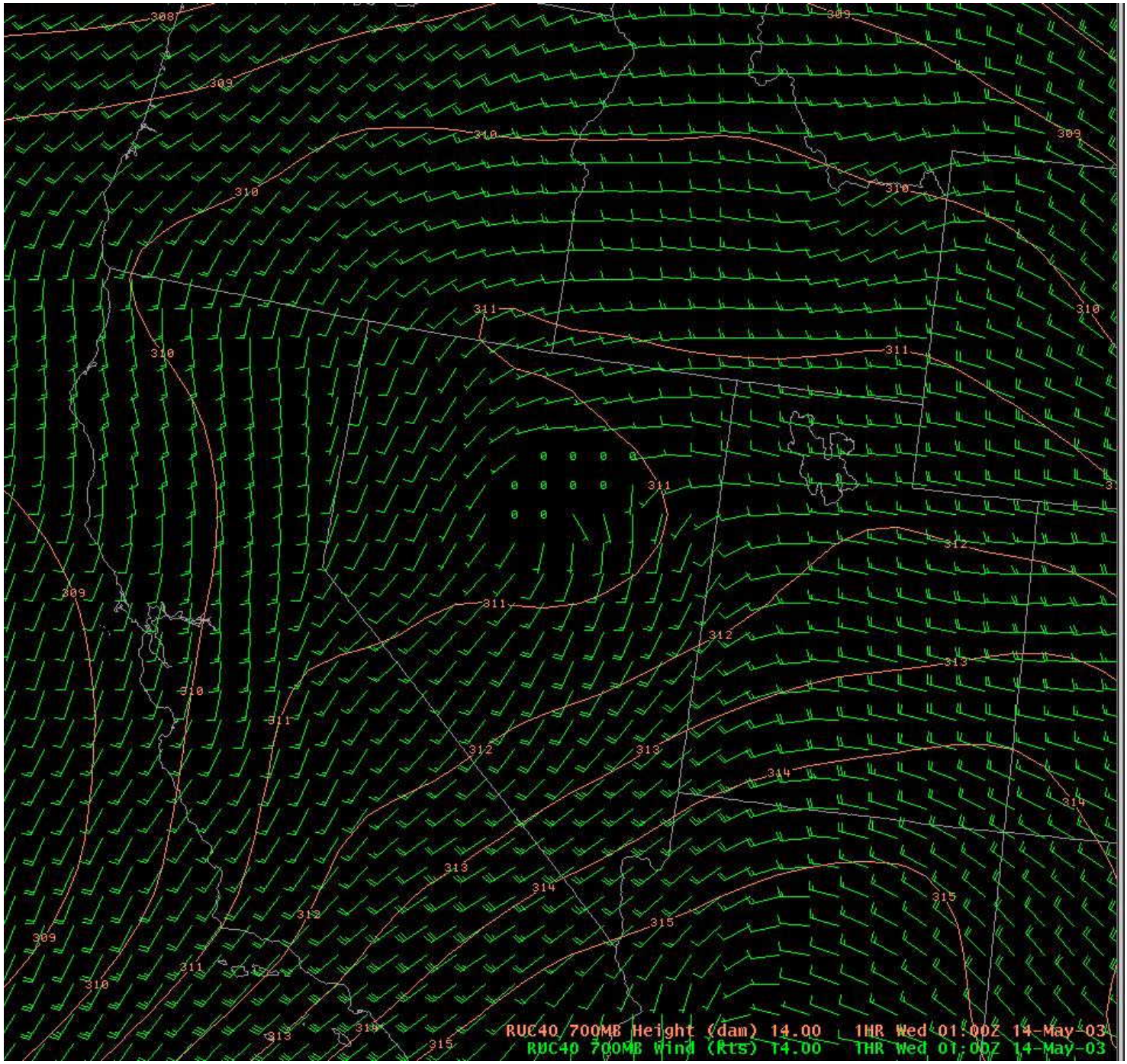
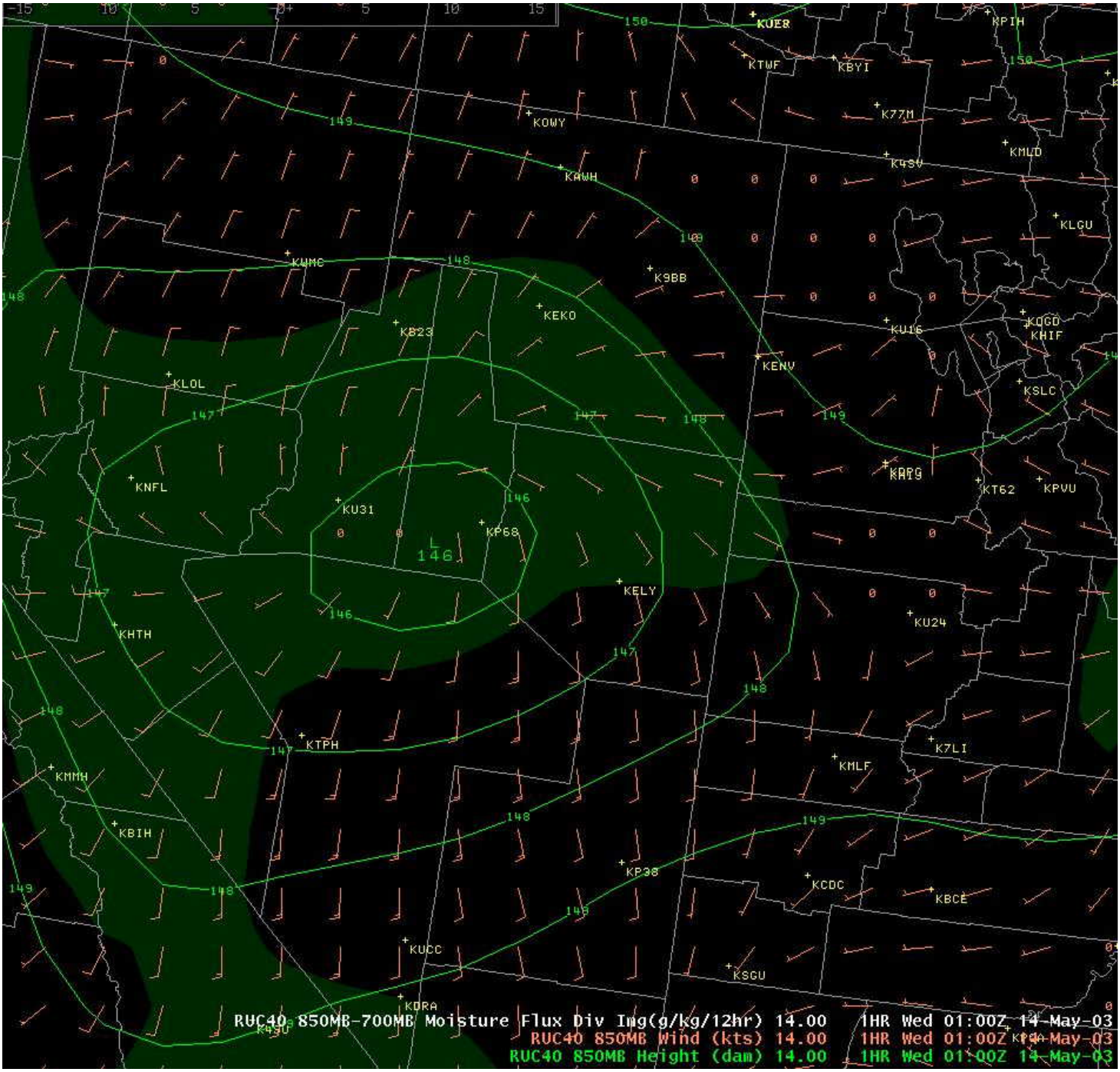

RUC40 700MB Height (dam) 14.00 1HR Wed 01:00Z 14-May-03
RUC40 700MB Wind (Kts) T4.00 THR Wed 01:00Z 14-May-03

Figure 6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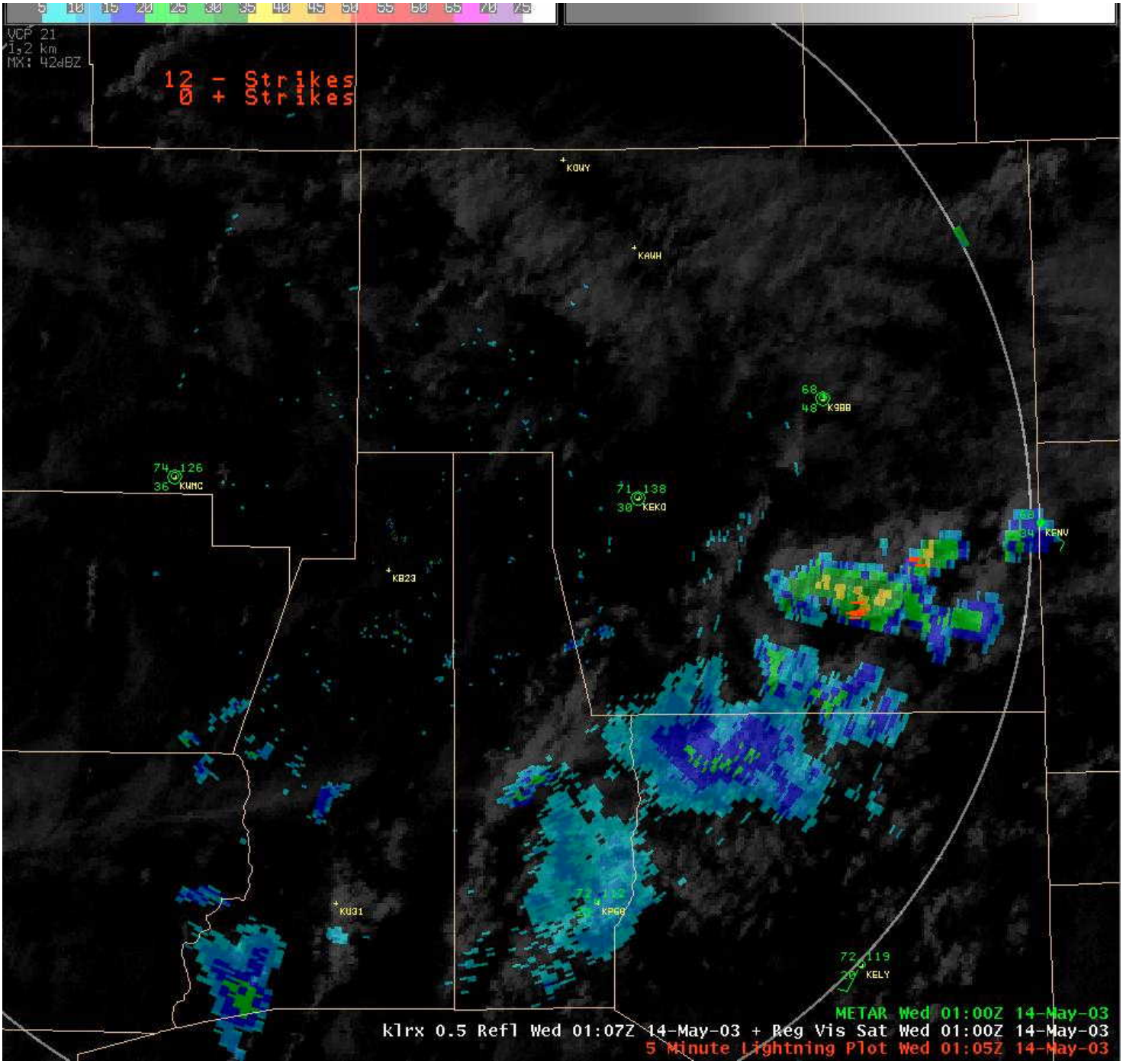
KELY
KU24
KHTH
KTPH
K7LI
KMLF
KMMH
KBIH
KP38
KCDC
KBCE
KUCC
KSGU
KDRA
RUC40 850MB-700MB Moisture Flux Div Img(g/kg/12hr) 14.00 1HR Wed 01:00Z 14-May-03
RUC40 850MB Wind (kts) 14.00 1HR Wed 01:00Z 14-May-03
RUC40 850MB Height (dam) 14.00 1HR Wed 01:00Z 14-May-03

Figure 7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MXI 42dBZ
12 - Strikes
0 + Strikes
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KAWH
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K98B
74
126
36
KWNC
71
138
30
KEKQ
KENV
KB23
KU31
KPGB
72
119
KELY
METAR Wed 01:00Z 14-May-03
klrx 0.5 Refl Wed 01:07Z 14-May-03 + Reg Vis Sat Wed 01:00Z 14-May-03
5 Minute Lightning Plot Wed 01:05Z 14-May-03