3.4 Thanksgiving 1996 Lake Effect Snow in the Lake Champlain Valley

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Acknowledgements

- Robert Deal and NWS Burlington office

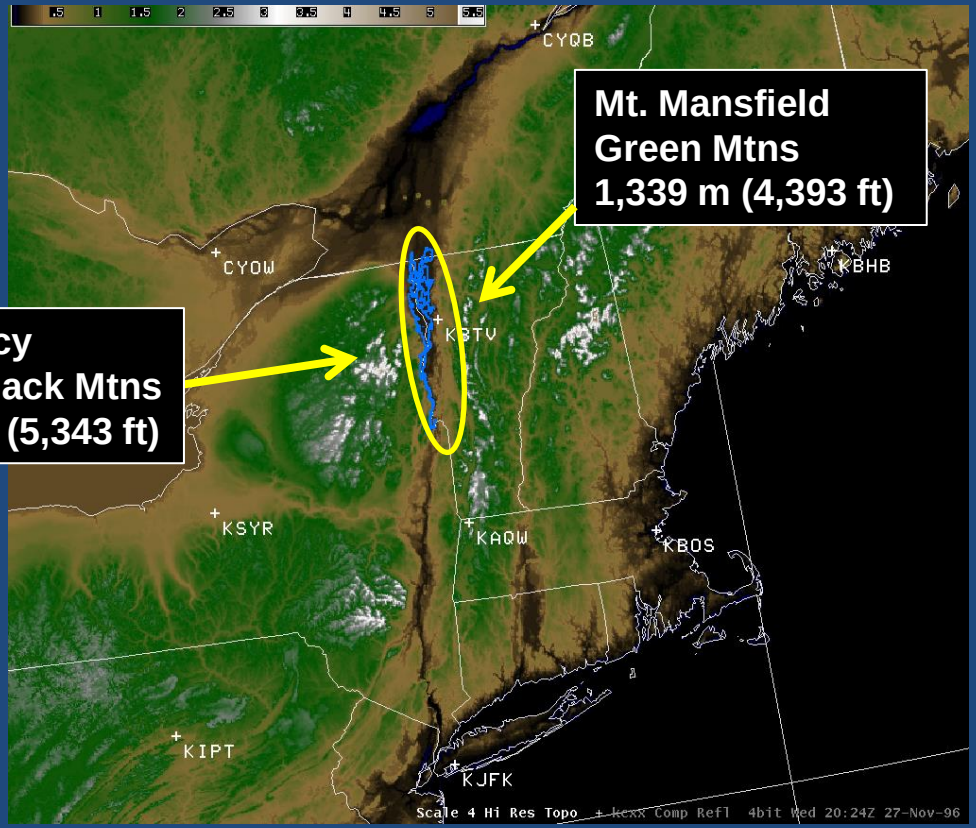
- Dr. Robert Rozumalski - NOAA/NWS Science and Training Resource Center (STRC) and Unified Environmental Modeling System (UEMS) Coordinator

Outline

- Can we expect high-resolution models to reproduce Lake Champlain lake-effect snow in time to make operational forecasts?

- Previous work - climatology
- Case of 26-27 November 1996
- WRF model results
- Summary

Lake Champlain Vermont /New York

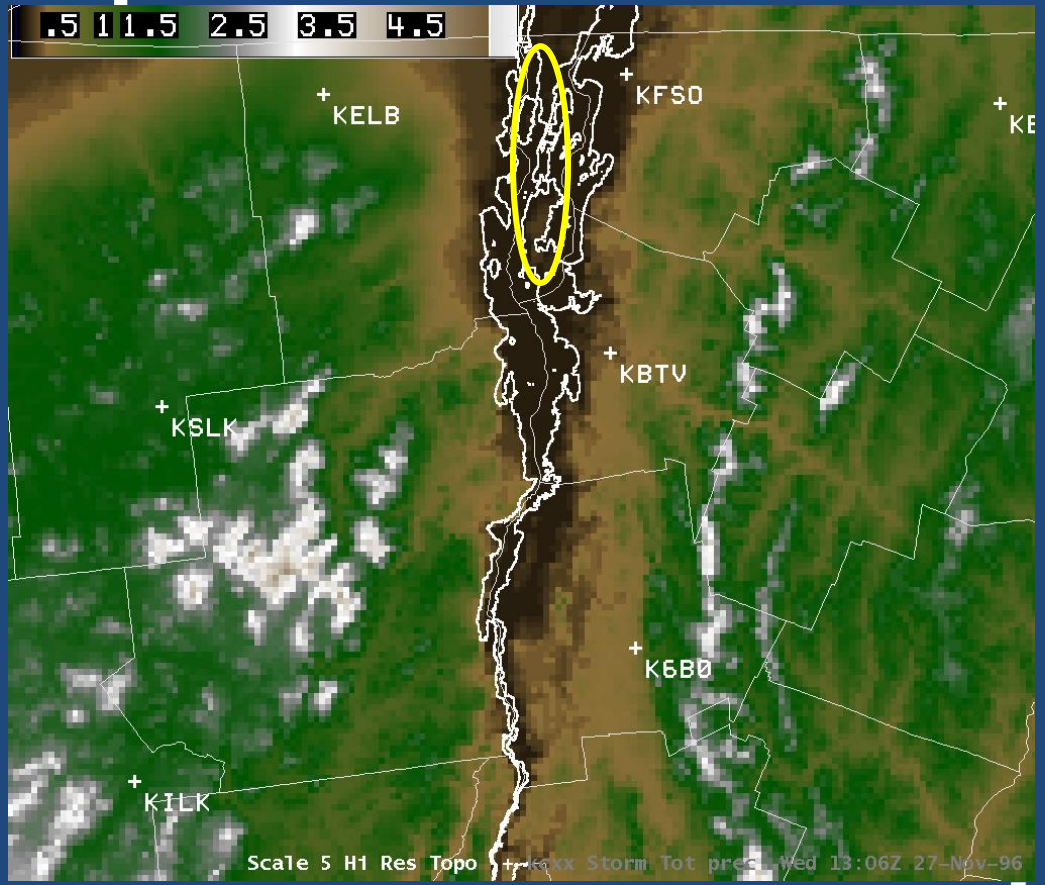


Mt. Mansfield
Green Mtns
1,339 m (4,393 ft)

Mt. Marcy
Adirondack Mtns
1,629 m (5,343 ft)

Lake Champlain

- Length 200 km (125 mi)
- Max width 23 km (14 mi)
- Max depth 120 m (400 ft)
- Avg depth 20 m (66 ft)
- **Lake Champlain Islands**



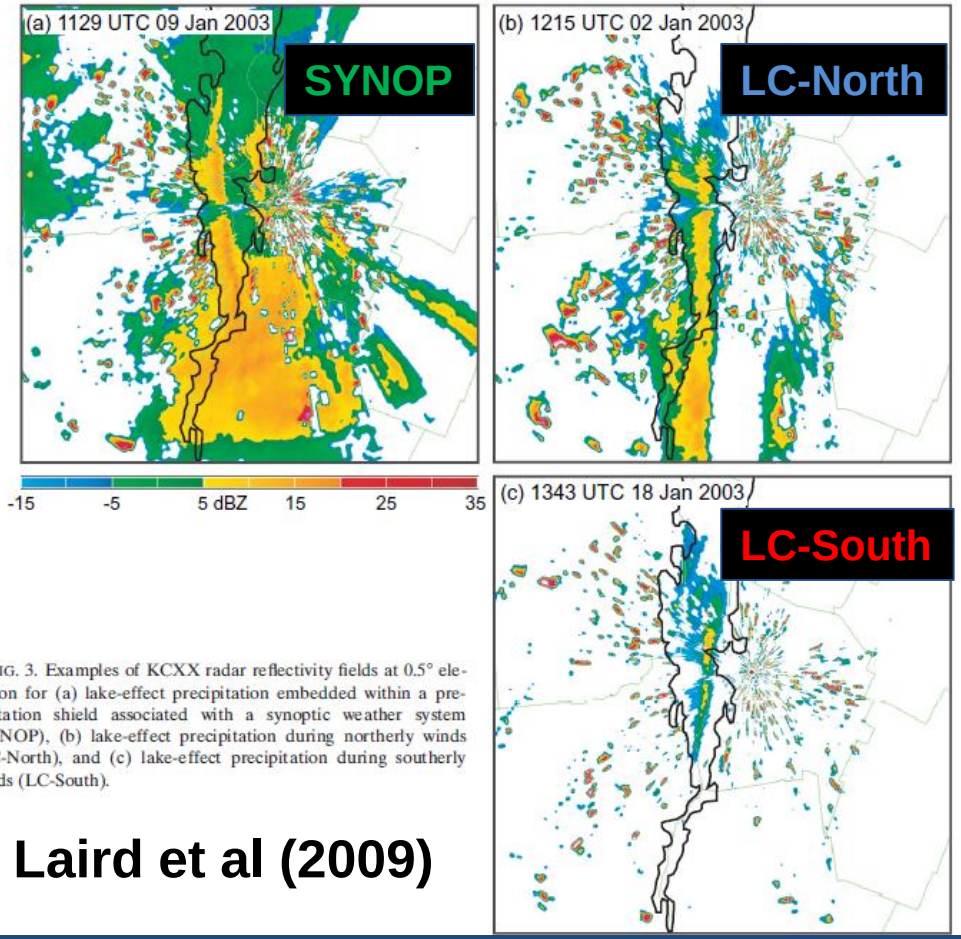


FIG. 3. Examples of KCXX radar reflectivity fields at 0.5° elevation for (a) lake-effect precipitation embedded within a precipitation shield associated with a synoptic weather system (SYNOP), (b) lake-effect precipitation during northerly winds (LC-North), and (c) lake-effect precipitation during southerly winds (LC-South).

Laird et al (2009)

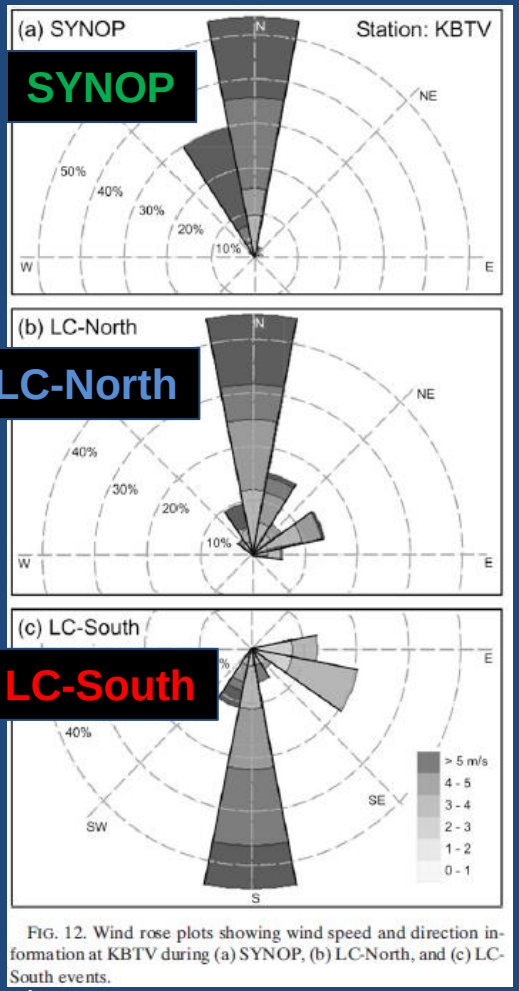
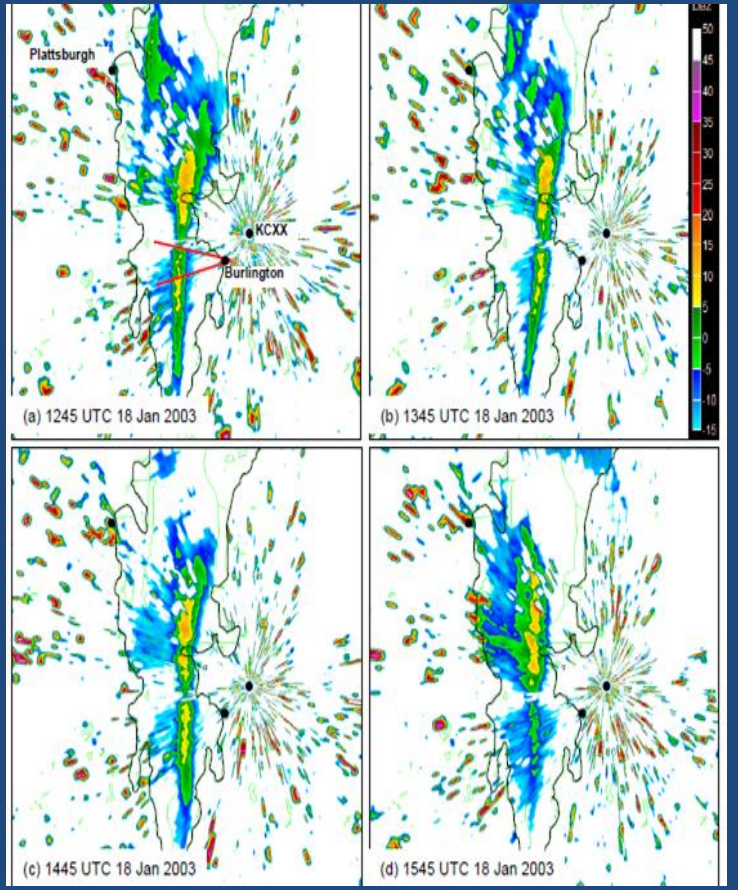


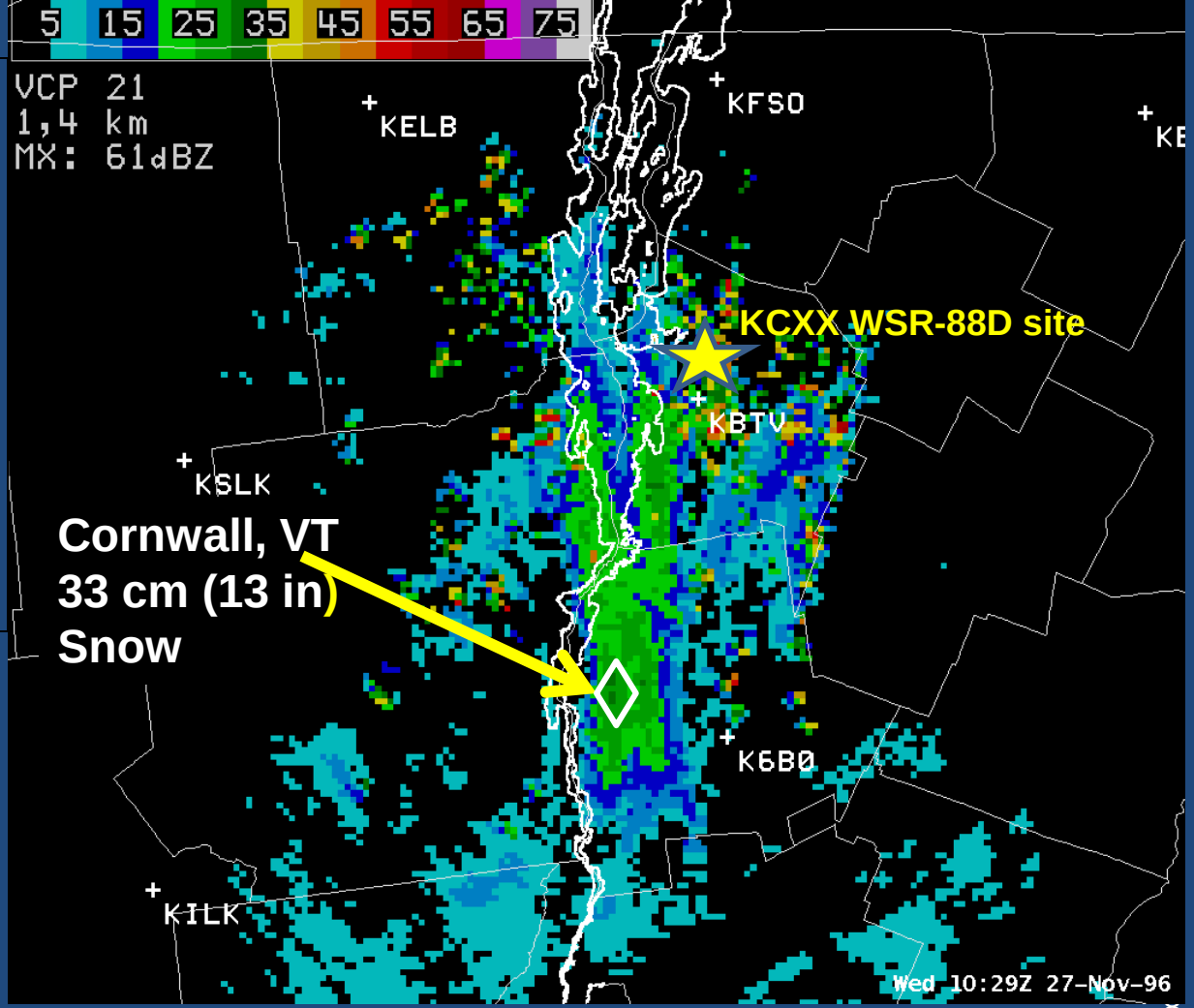
FIG. 12. Wind rose plots showing wind speed and direction information at KBTV during (a) SYNOP, (b) LC-North, and (c) LC-South events.

Lake Champlain South Event



(Payer et al 2007)

Thanksgiving Holiday 1029 UTC 27 Nov 1996



(Tardy 2000)

WRF v 3.7.1

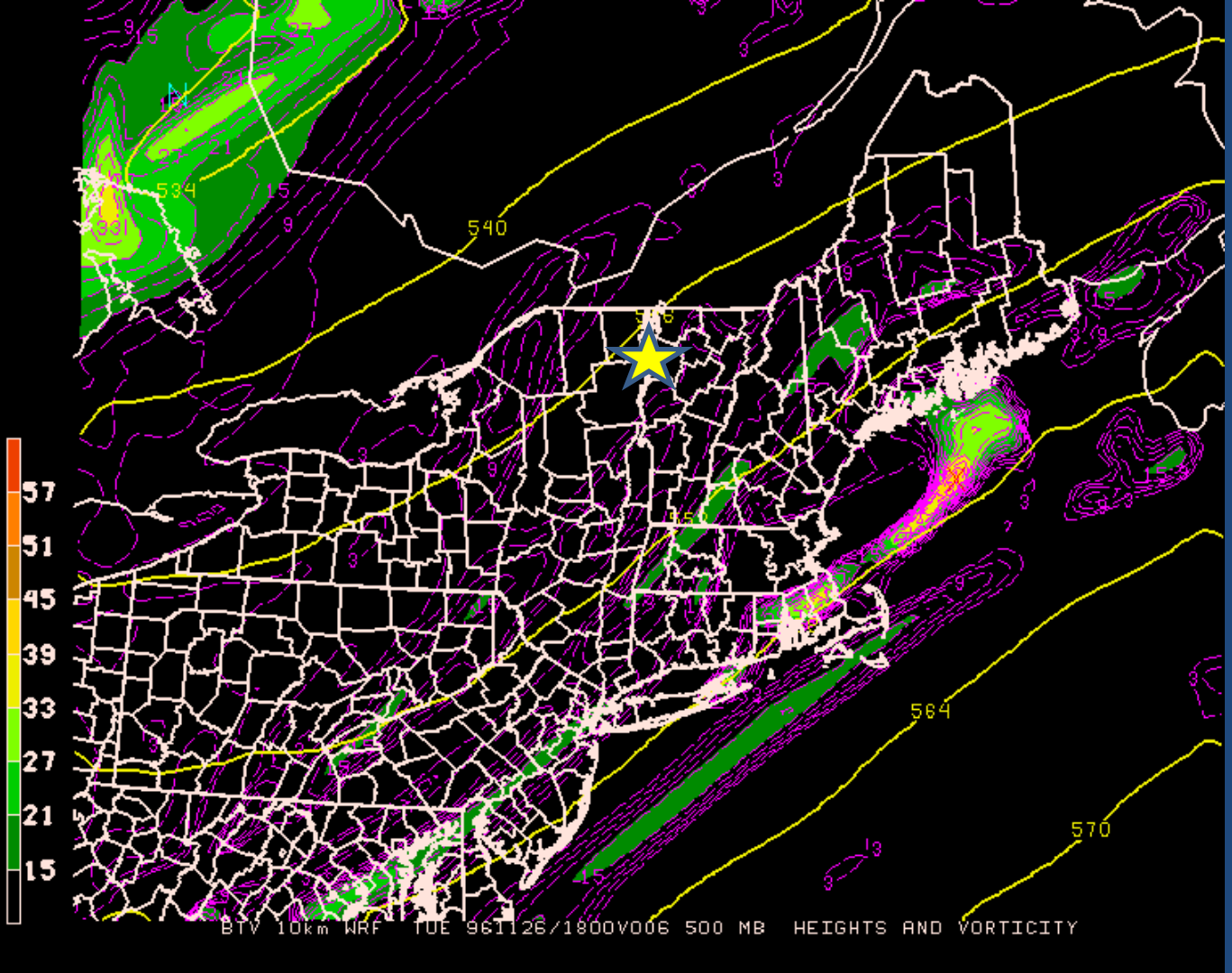
- National Center for Atmospheric Research (NCAR) Advanced Research WRF (ARW) 3.7.1 dynamical core

- 10, 3.3, and1.1-km one-way nests
- 45 vertical layers
- Initial/lateral boundary: The Climate Forecast System Reanalysis (CFSR)
- Multiscale Kain-Fritsch Cumulus parameterization (10 km only)
- Yonsei State University BL Physics
- Rapid Radiative Transfer Model longwave and shortwave radiation
- Thompson et al. (2008) microphysics
- Unified NOAH Land-Surface

10-km WRF 500 hPa Heights Absolute Vorticity

18 UTC 26 Nov – 12 UTC 27 Nov 1996

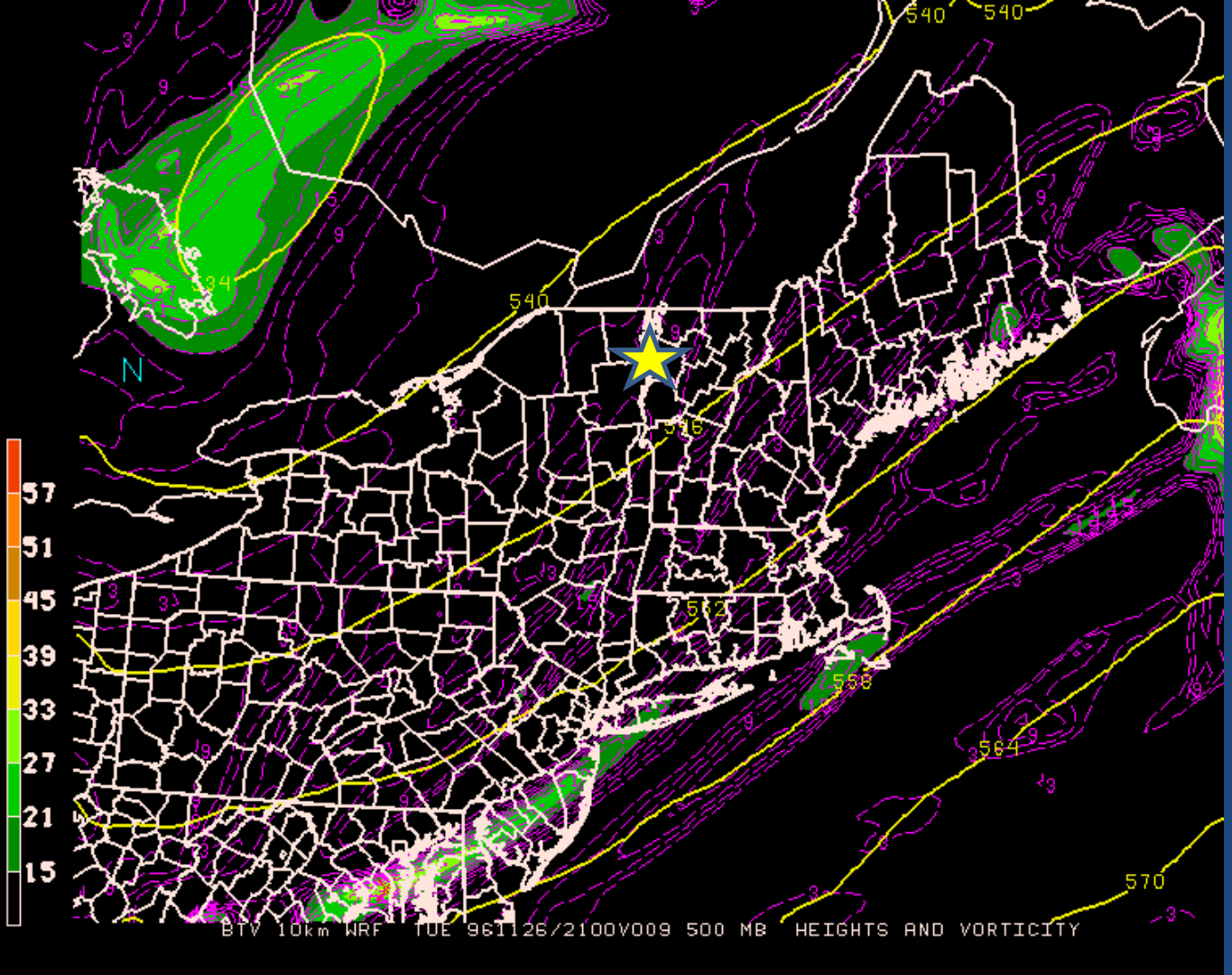
★ Burlington VT



18 UTC
26 Nov 96

500 hPa
Hgt (dm)
AbsVort ($s^{-1} \times 10^5$)

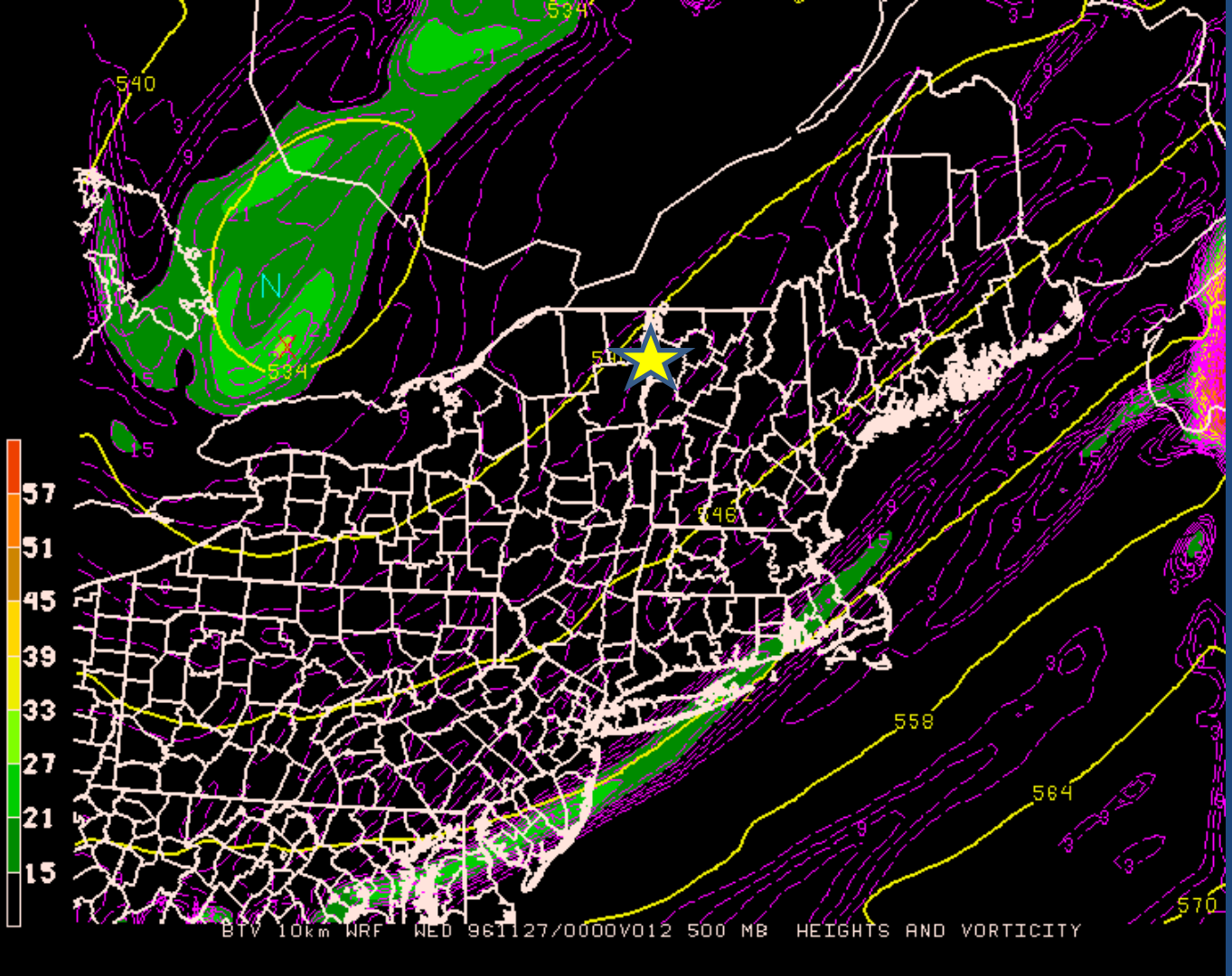
★ Burlington VT



21 UTC
26 Nov 96

500 hPa
Hgt (dm)
AbsVort ($s^{-1} \times 10^5$)

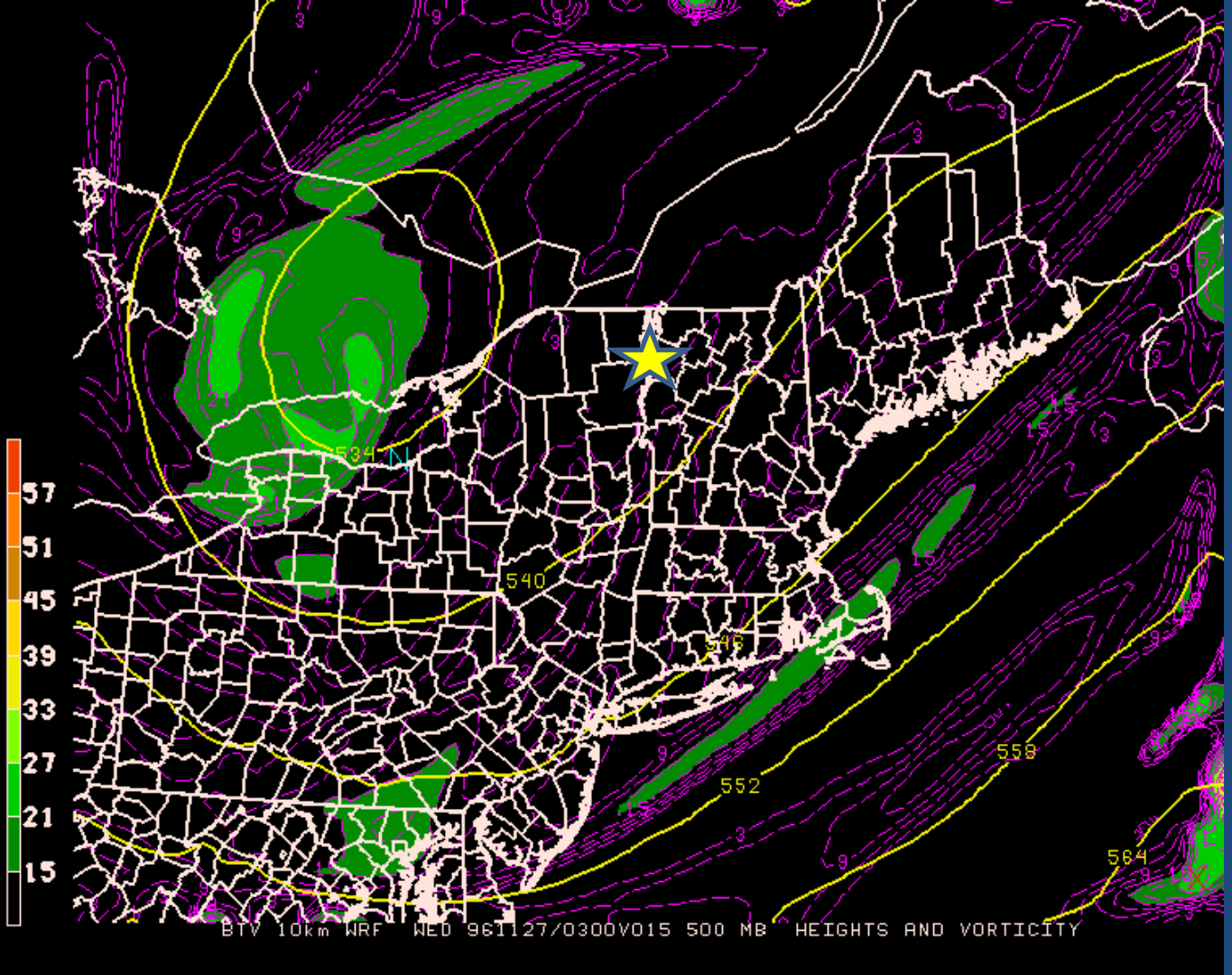
★ Burlington VT



00 UTC
27 Nov 96

500 hPa
Hgt (dm)
AbsVort ($s^{-1} \times 10^5$)

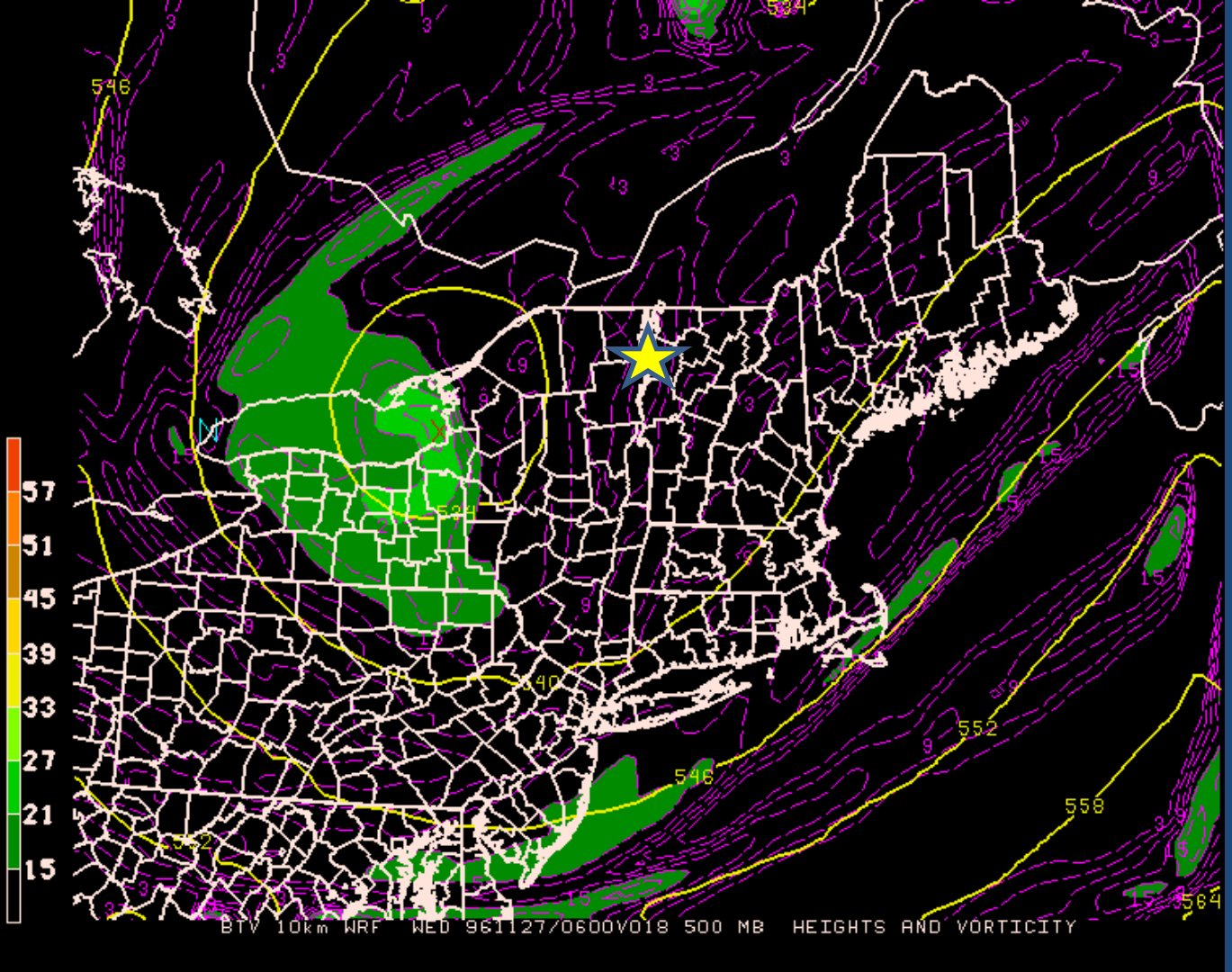
★ Burlington VT



03 UTC
27 Nov 96

500 hPa
Hgt (dm)
AbsVort ($s^{-1} \times 10^5$)

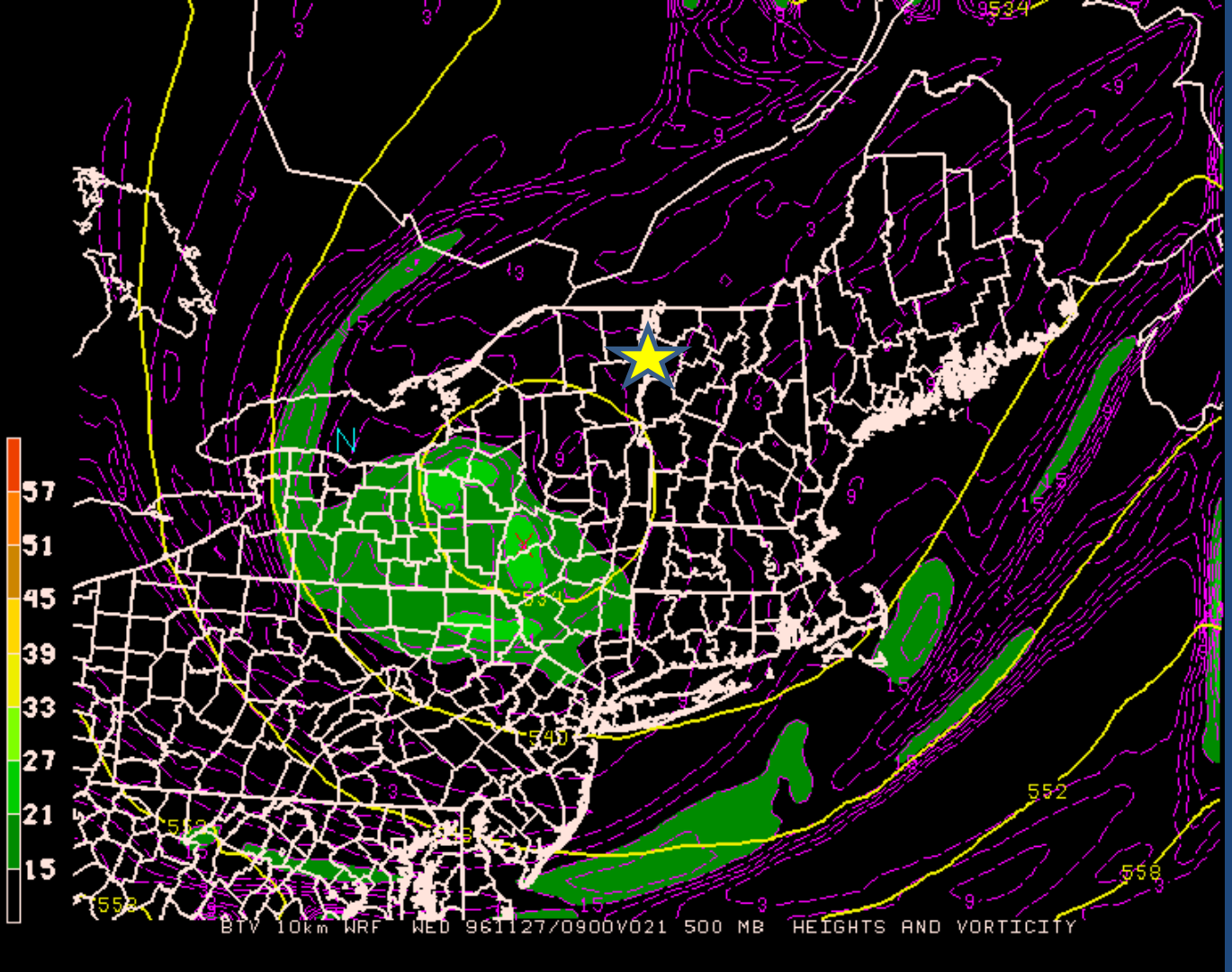
★ Burlington VT



06 UTC
27 Nov 96

500 hPa
Hgt (dm)
AbsVort ($s^{-1} \times 10^5$)

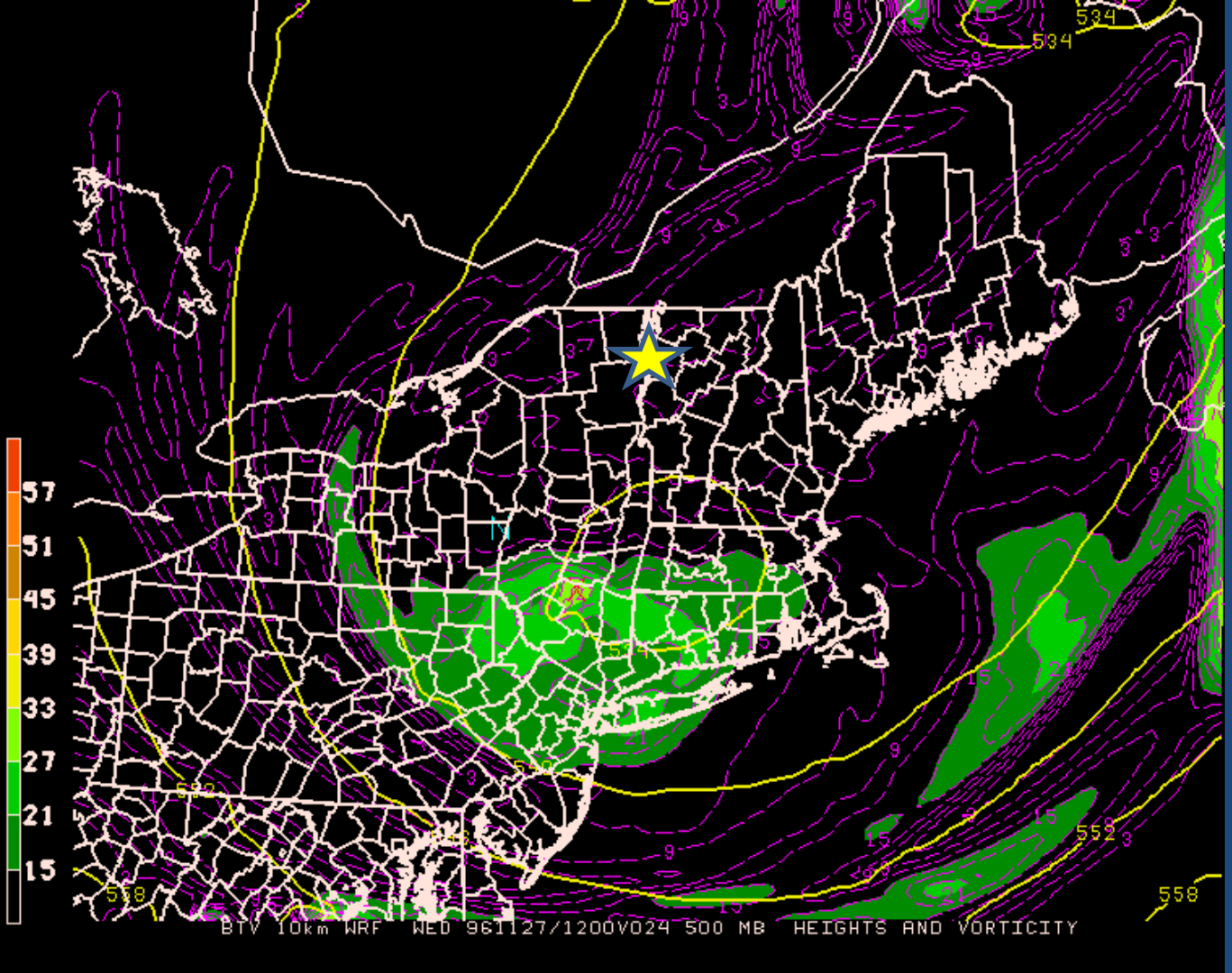
★ Burlington VT



09 UTC
27 Nov 96

500 hPa
Hgt (dm)
AbsVort ($s^{-1} \times 10^5$)

★ Burlington VT



12 UTC
27 Nov 96

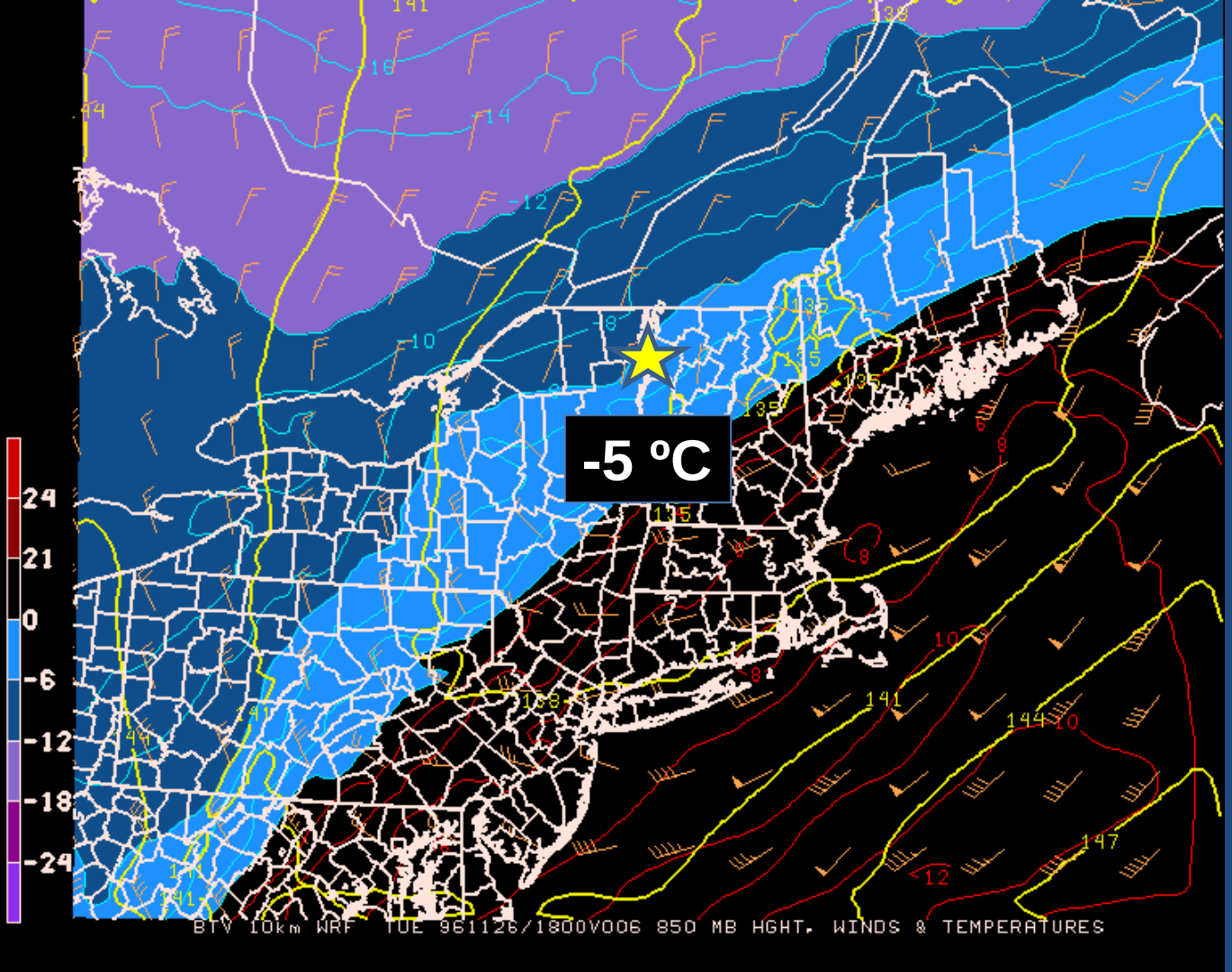
500 hPa
Hgt (dm)
AbsVort ($s^{-1} \times 10^5$)

★ Burlington VT

10-km WRF 850 hPa Heights Temperature and Wind

18 UTC 26 Nov 1996 – 12 UTC 27 Nov 1996

★ Burlington VT

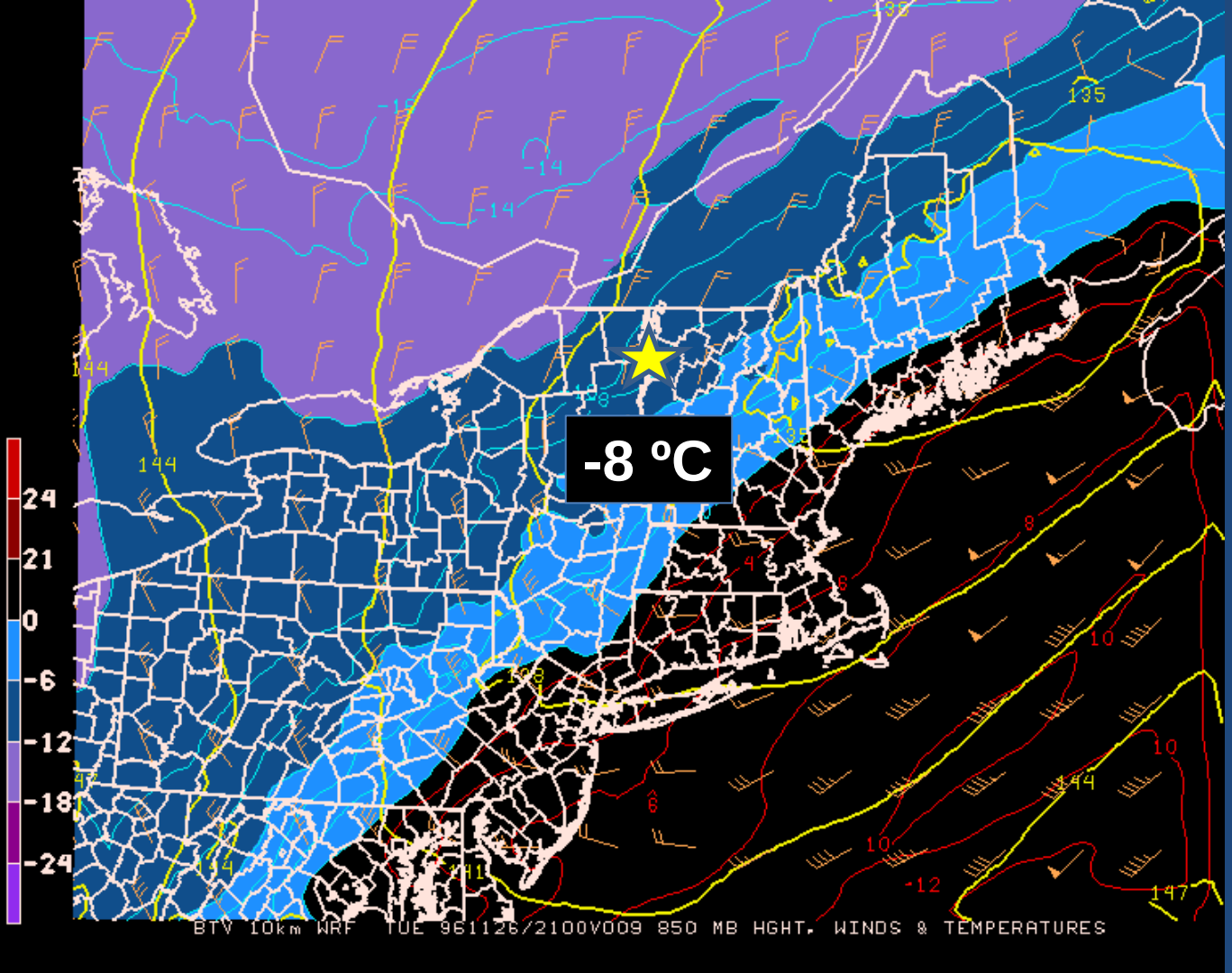


18 UTC
26 Nov 96

850 hPa
Hgt (dm)
Temp (ºC)
Wind (kt)

★ Burlington VT

Lake Water 7ºC

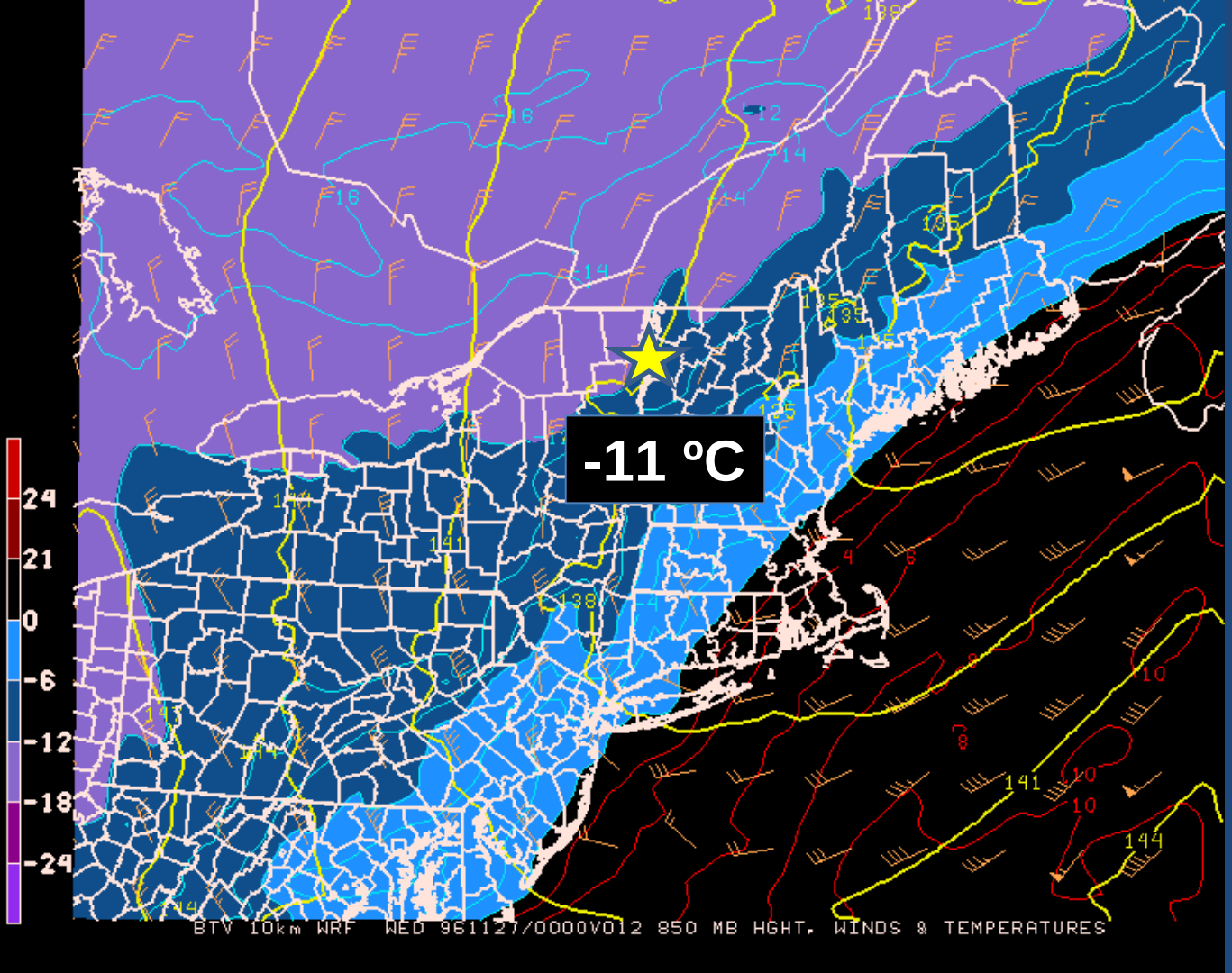


21 UTC
26 Nov 96

850 hPa
Hgt (dm)
Temp (ºC)
Wind (kt)

★ Burlington VT

Lake Water 7ºC

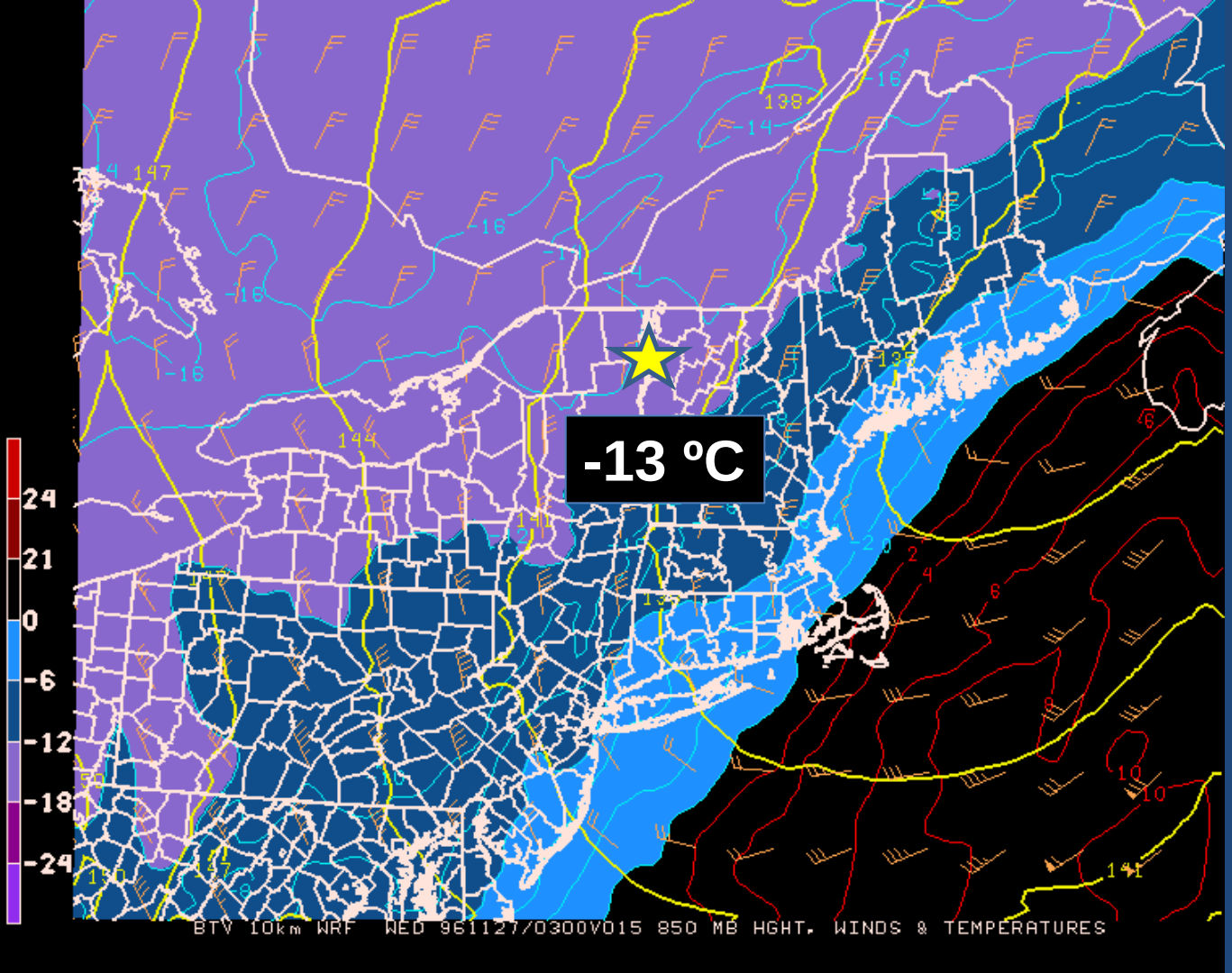


00 UTC
27 Nov 96

850 hPa
Hgt (dm)
Temp (ºC)
Wind (kt)

★ Burlington VT

Lake Water 7ºC

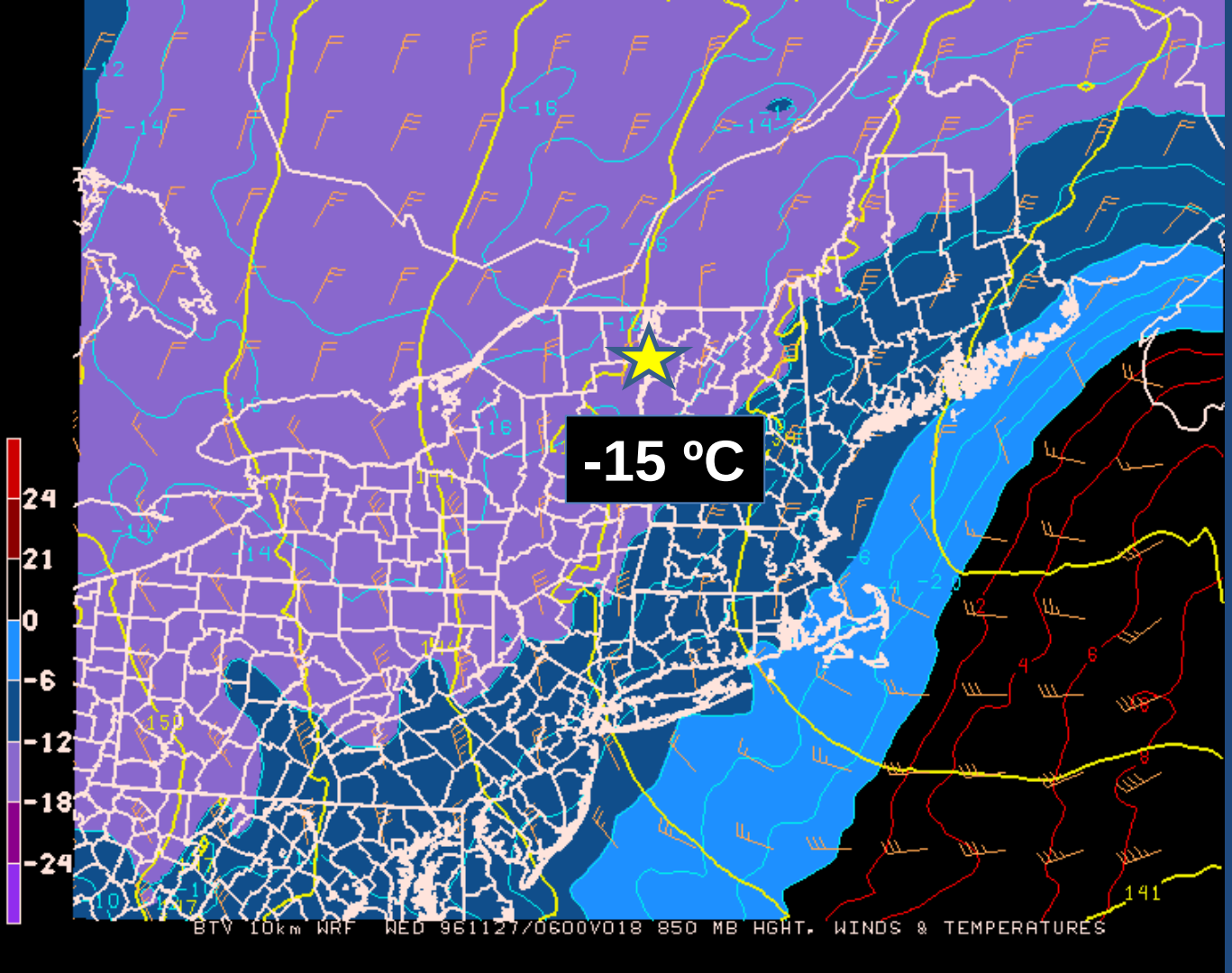


03 UTC
27 Nov 96

850 hPa
Hgt (dm)
Temp (ºC)
Wind (kt)

★ Burlington VT

Lake Water 7ºC

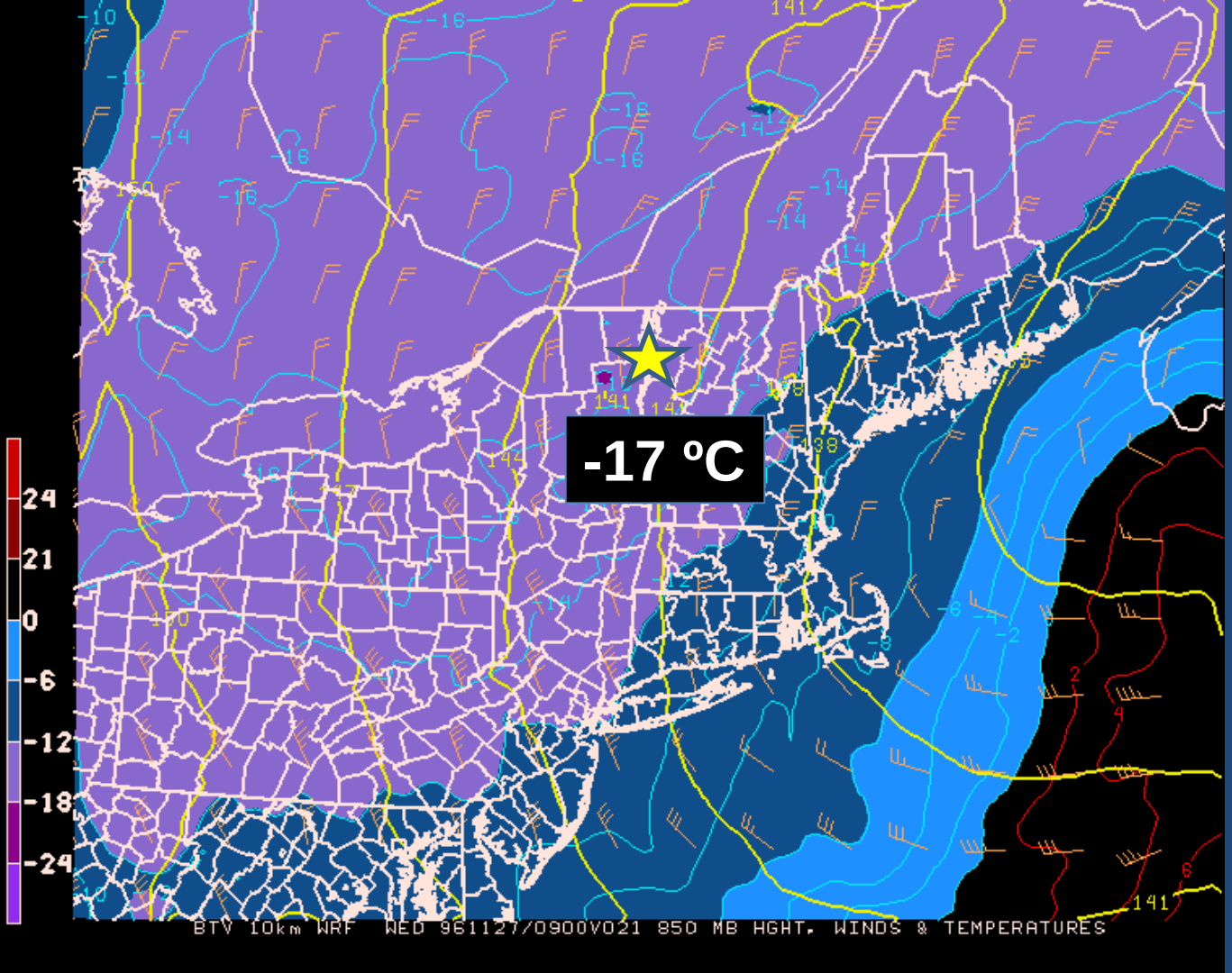


06 UTC
27 Nov 96

850 hPa
Hgt (dm)
Temp (ºC)
Wind (kt)

★ Burlington VT

Lake Water 7ºC

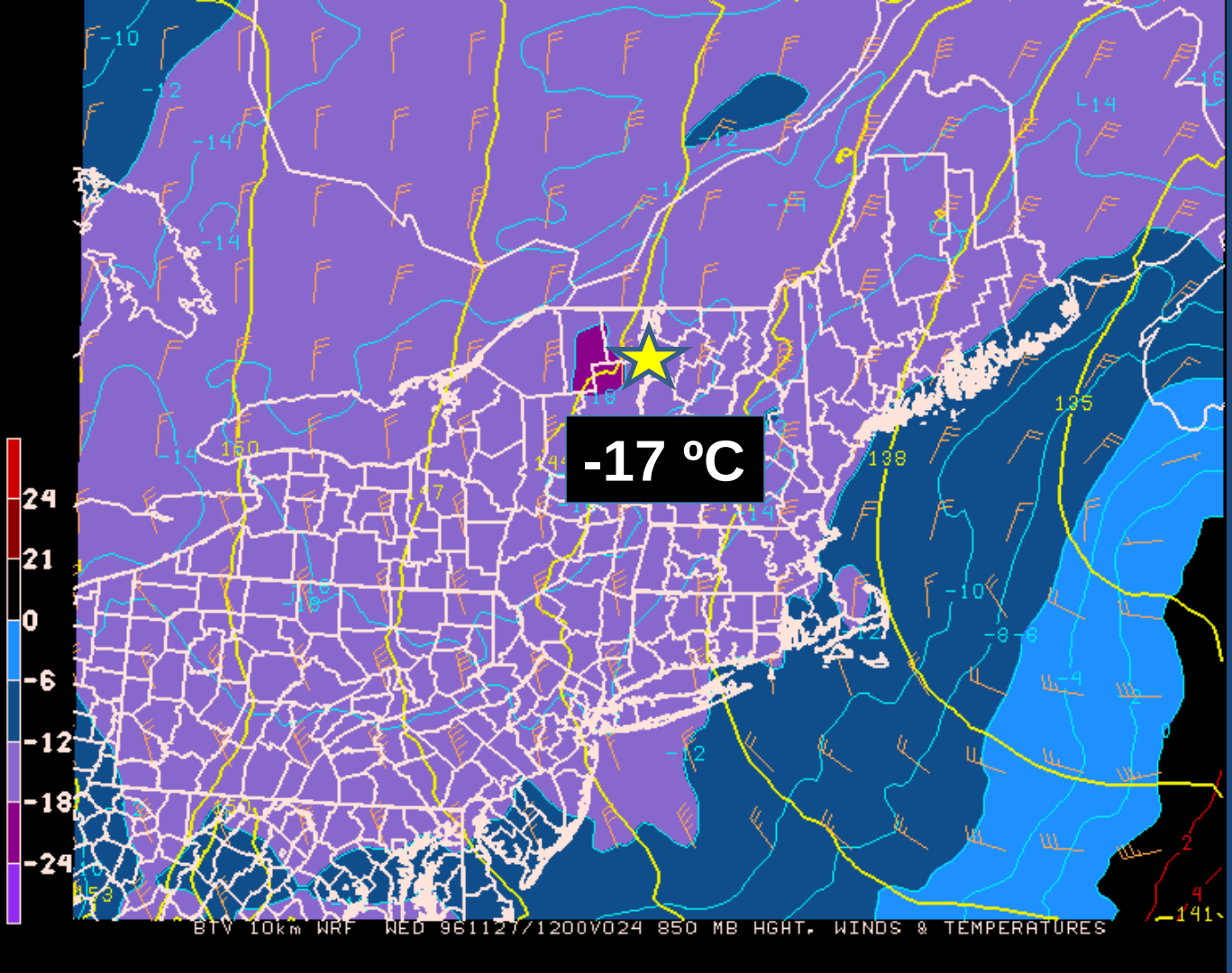


09 UTC
27 Nov 96

850 hPa
Hgt (dm)
Temp (ºC)
Wind (kt)

★ Burlington VT

Lake Water 7ºC

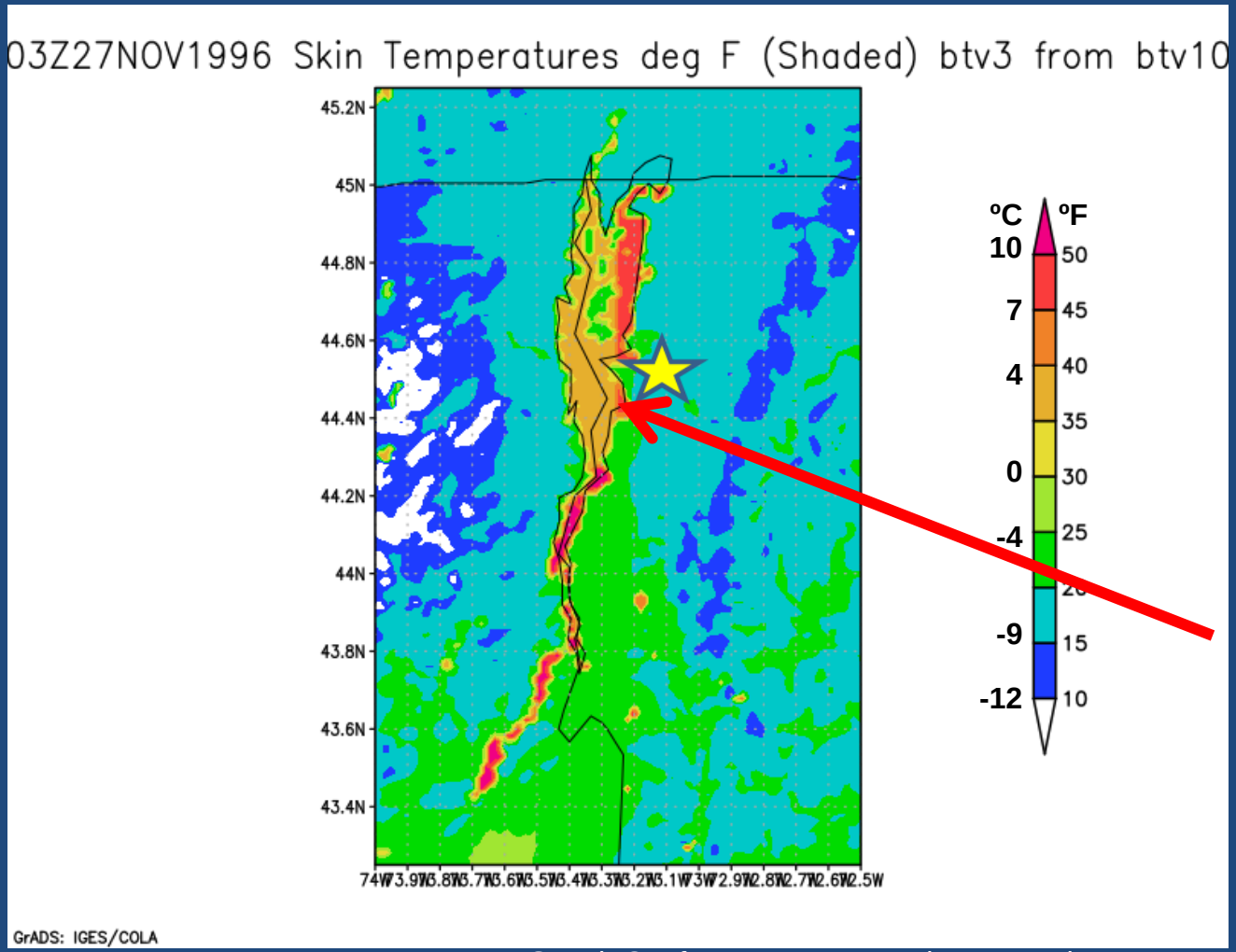


12 UTC
27 Nov 96

850 hPa
Hgt (dm)
Temp (ºC)
Wind (kt)

★ Burlington VT

Lake Water 7ºC



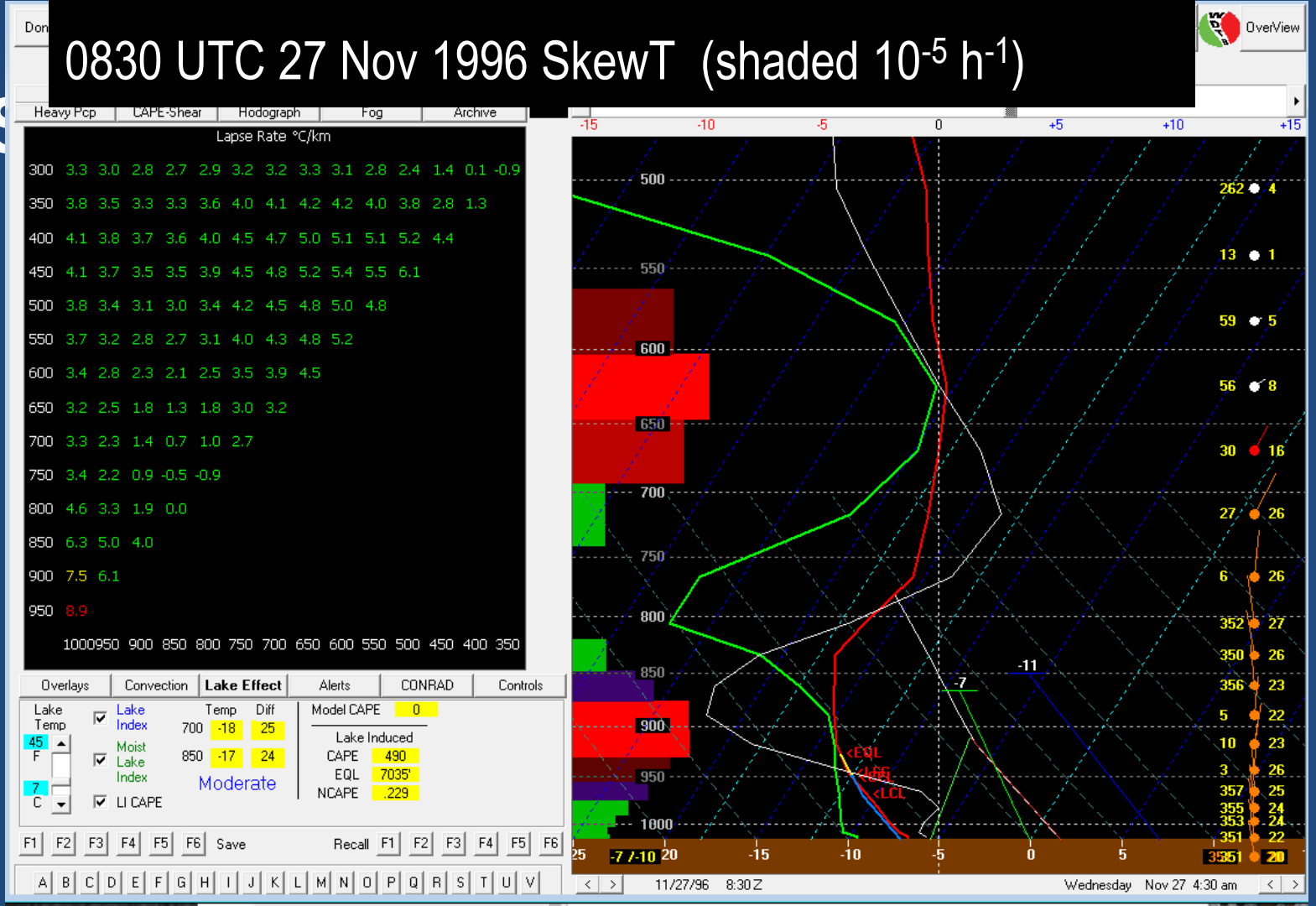
03 UTC
27 Nov 96

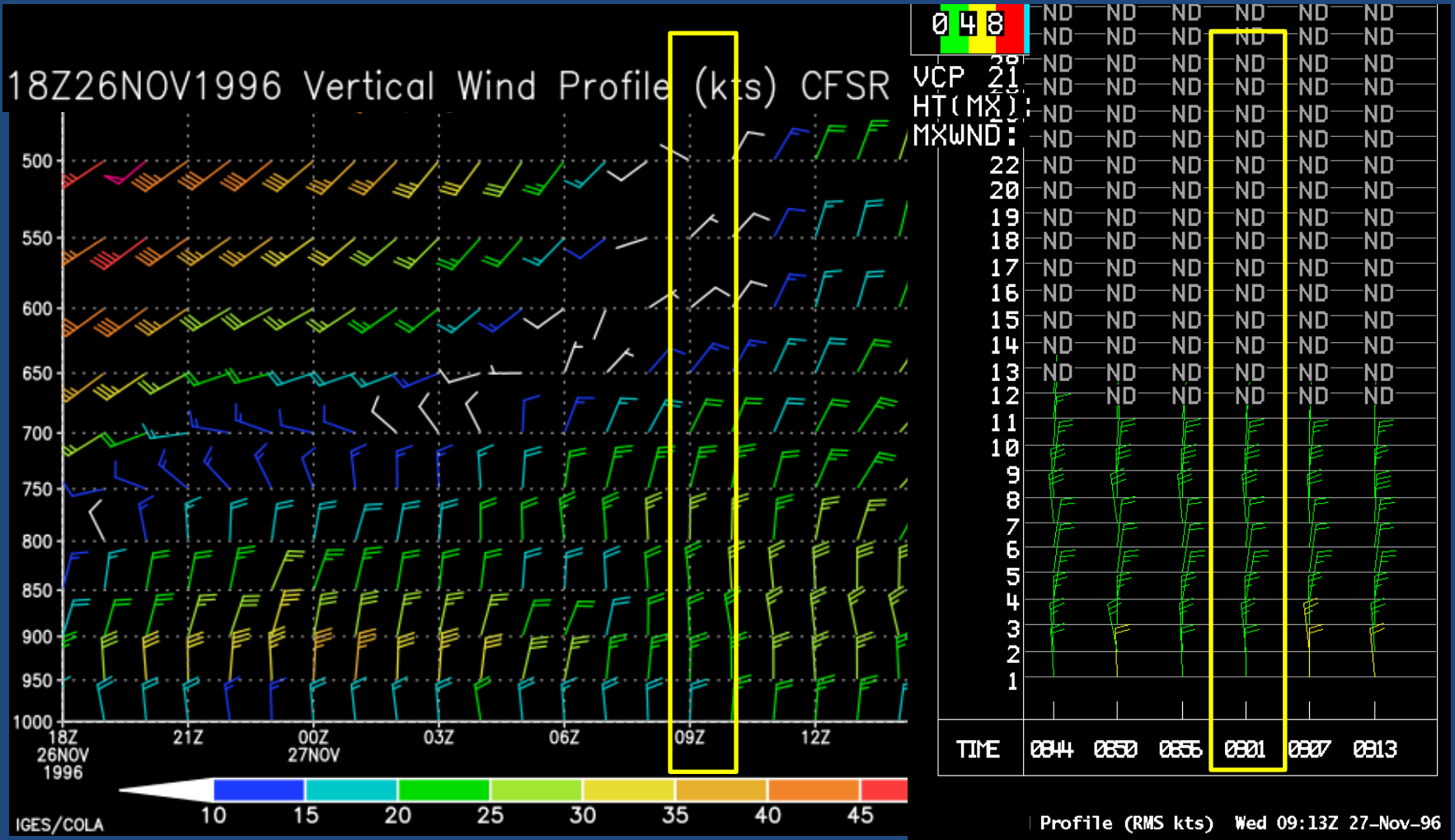
Model Skin Temp (ºC)

★ Burlington VT

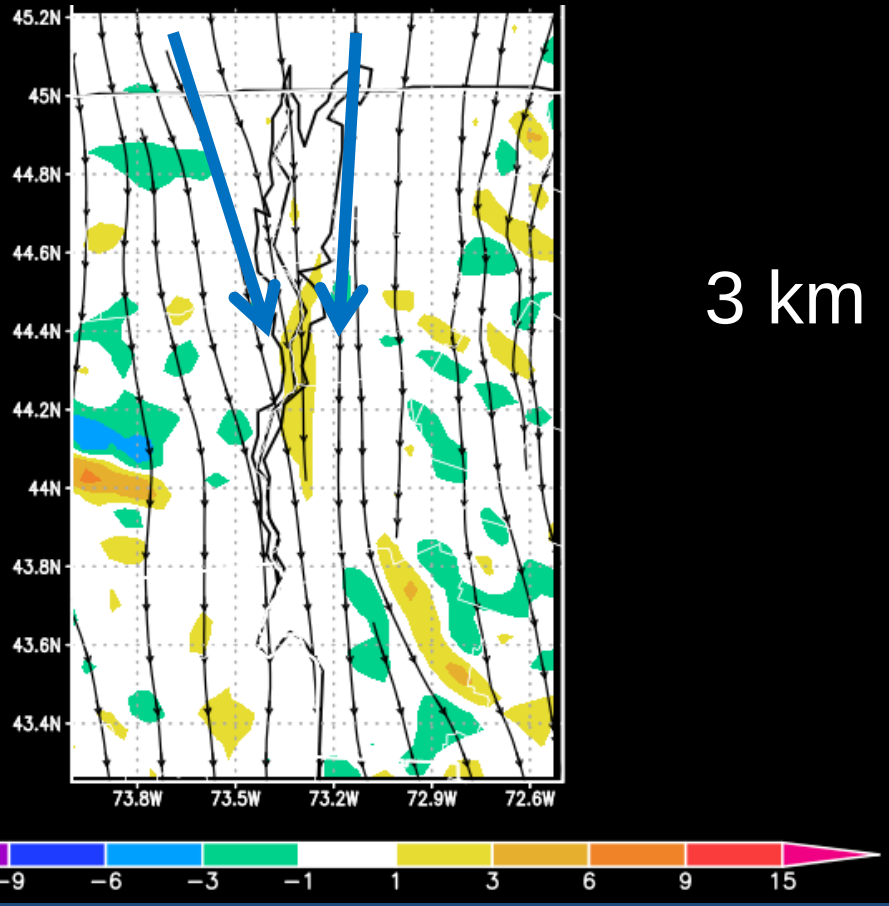
Observed Lake Water = 7ºC (45ºF)

0830 UTC 27 Nov 1996 SkewT (shaded 10^{-5} h^{-1})



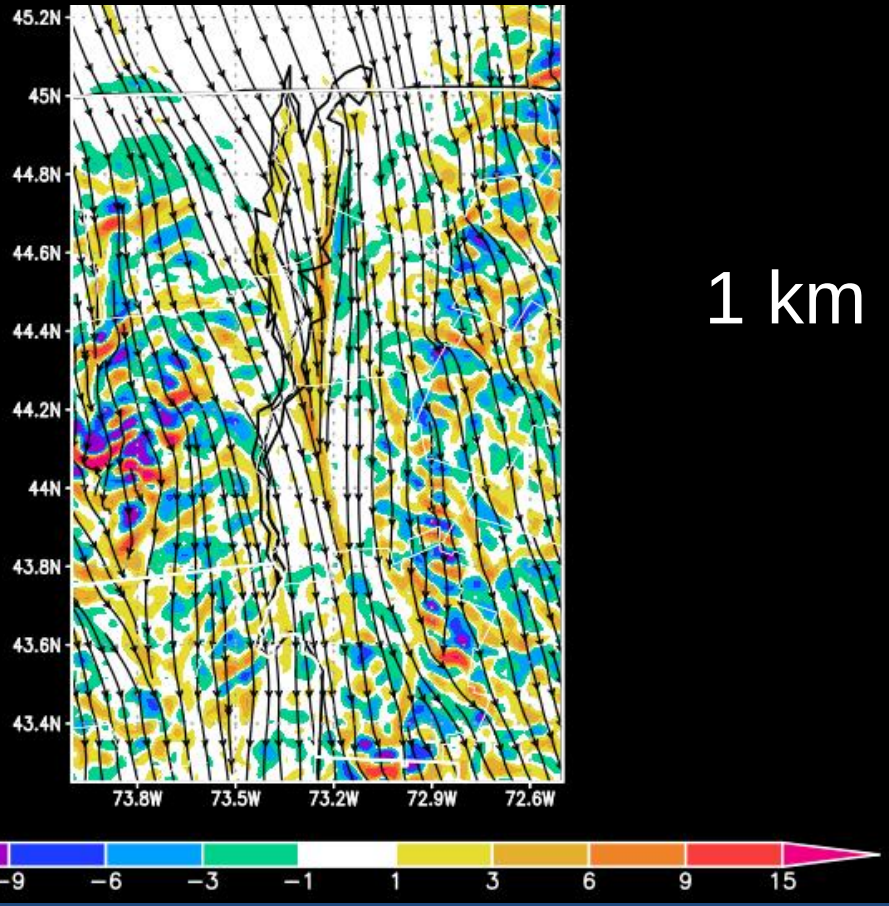

18Z26NOV1996 Vertical Wind Profile (kts) CFSR
500
550
600
650
700
750
800
850
900
950
1000
18Z 26NOV 1996
21Z
00Z 27NOV
03Z
06Z
09Z
12Z
10 15 20 25 30 35 40 45
IGES/COLA
0 4 8
VCP 21
HT(MX):
MXWND:
ND
22
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
TIME
0844 0850 0856 0901 0907 0913
Profile (RMS kts) Wed 09:13Z 27-Nov-96

09 UTC 27 Nov 1996 Convergence (shaded 10^{-5} h^{-1})



3 km

09 UTC 27 Nov 1996 Convergence (shaded 10^{-5} h^{-1})



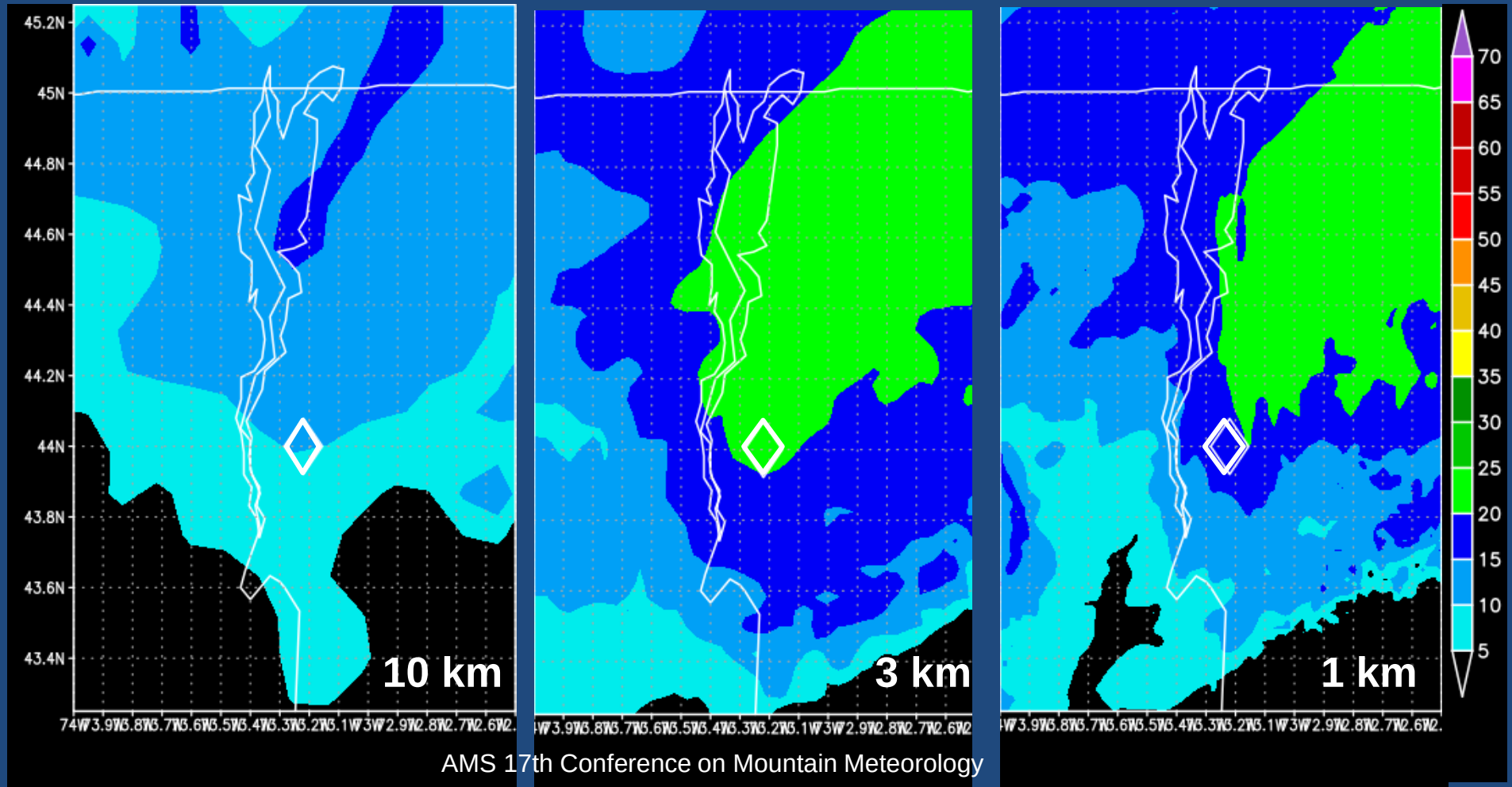
1 km

10, 3, 1-km Simulated Composite Reflectivity (shaded dBZ)

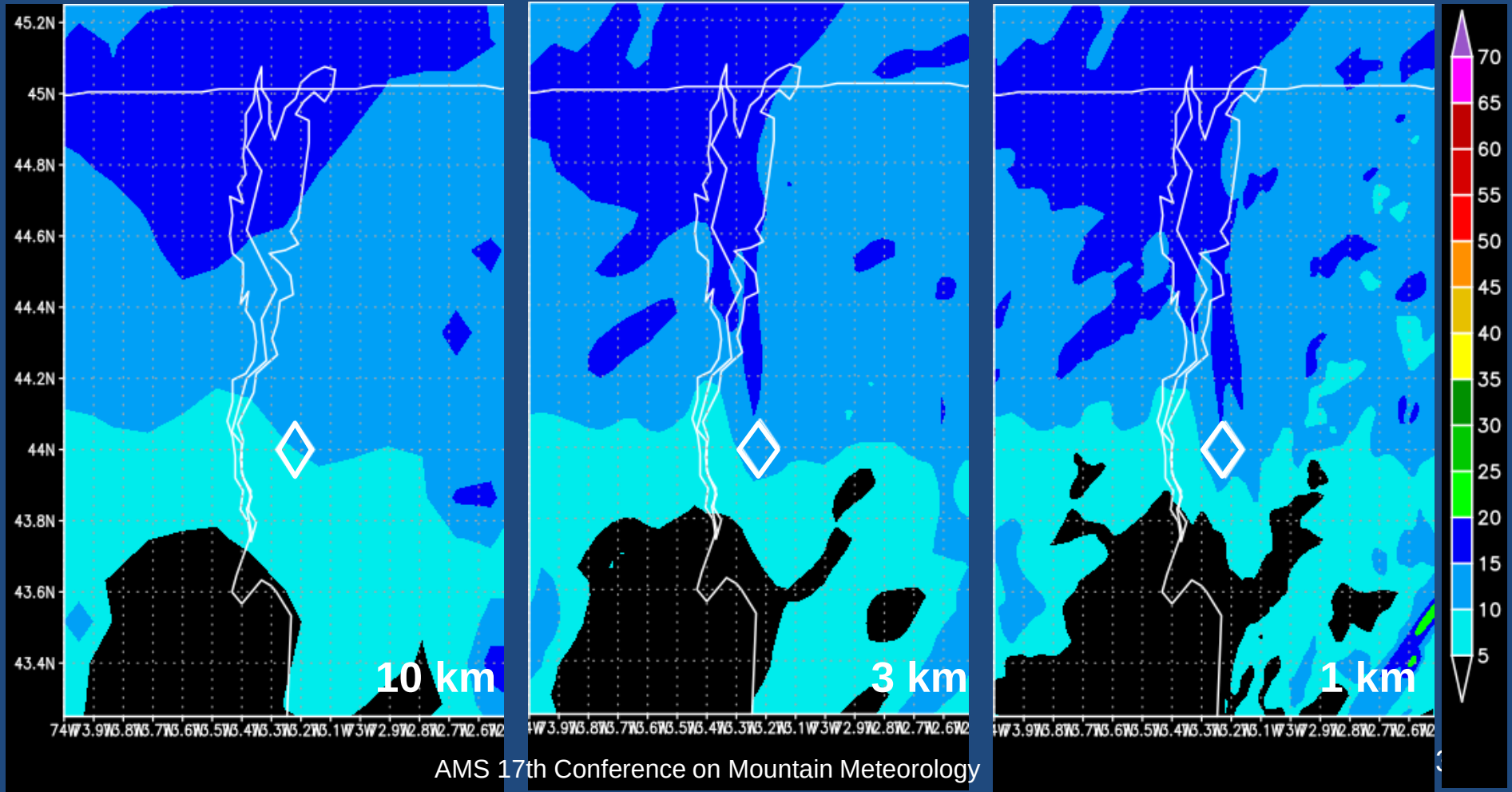
18 UTC 26 Nov – 12 UTC 27 Nov 1996

- Cornwall VT

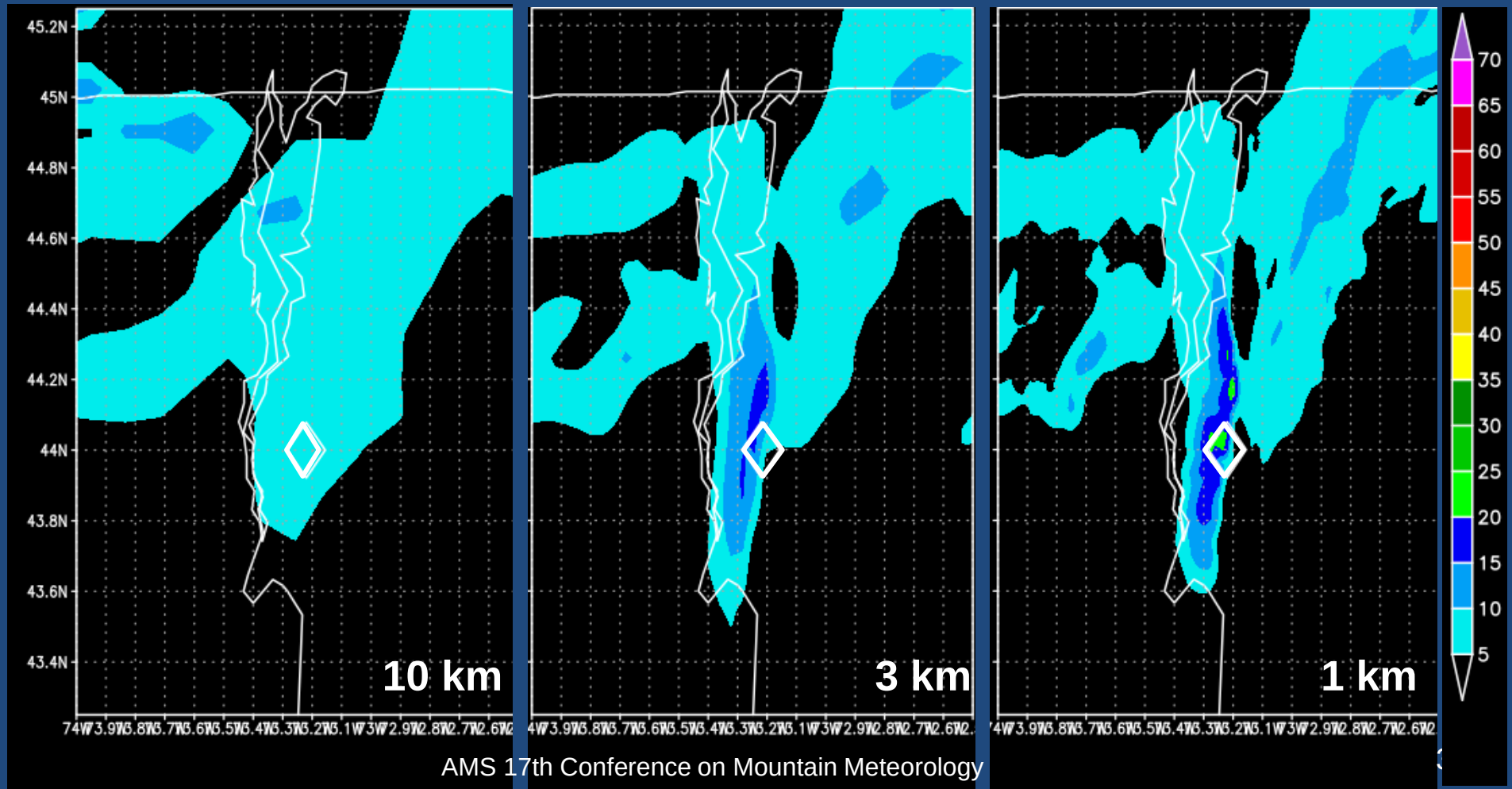
18 UTC 26 Nov 1996 Max Composite Reflectivity (shaded dBZ)



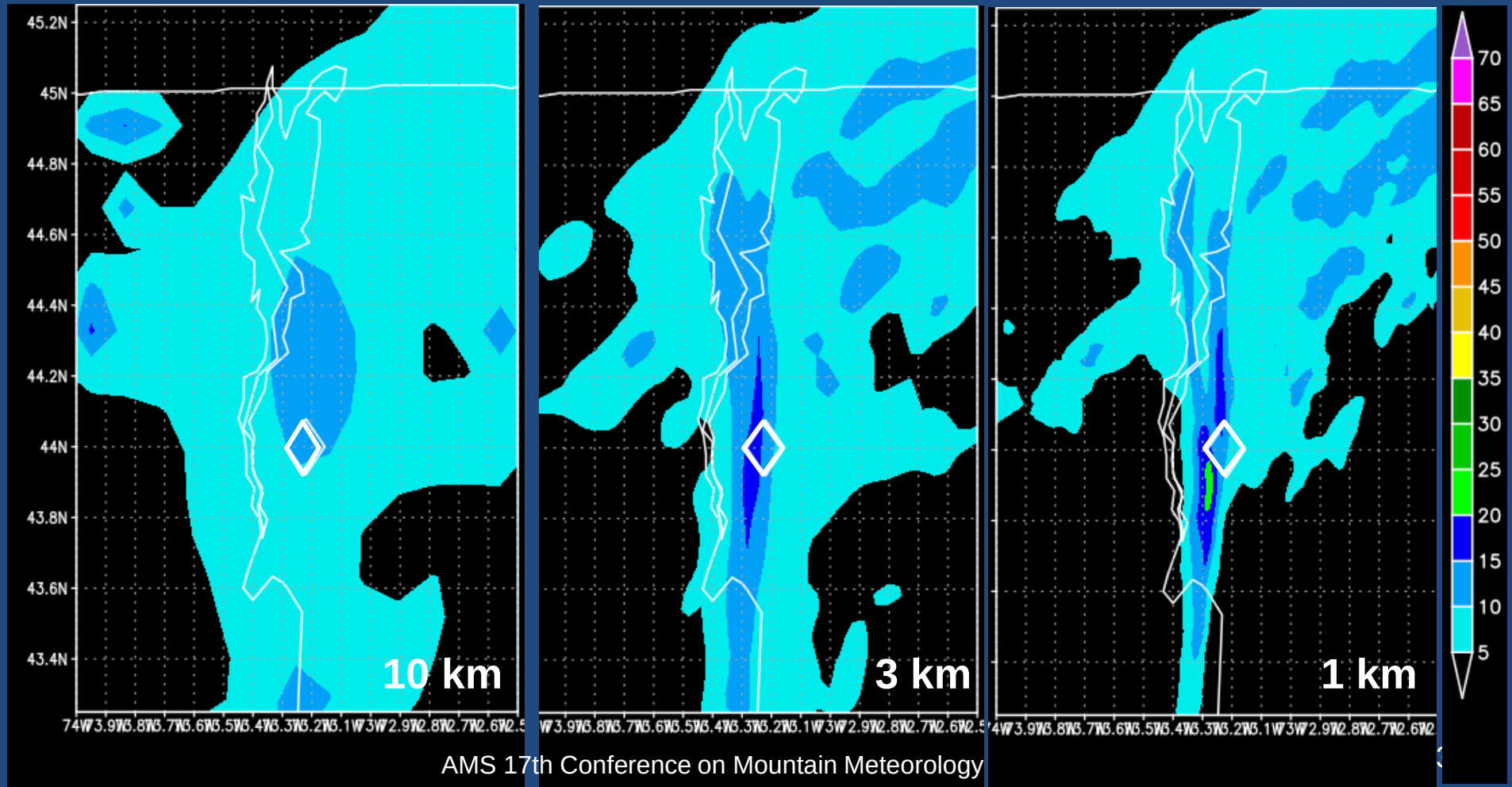
21 UTC 26 Nov 1996 Max Composite Reflectivity (shaded dBZ)



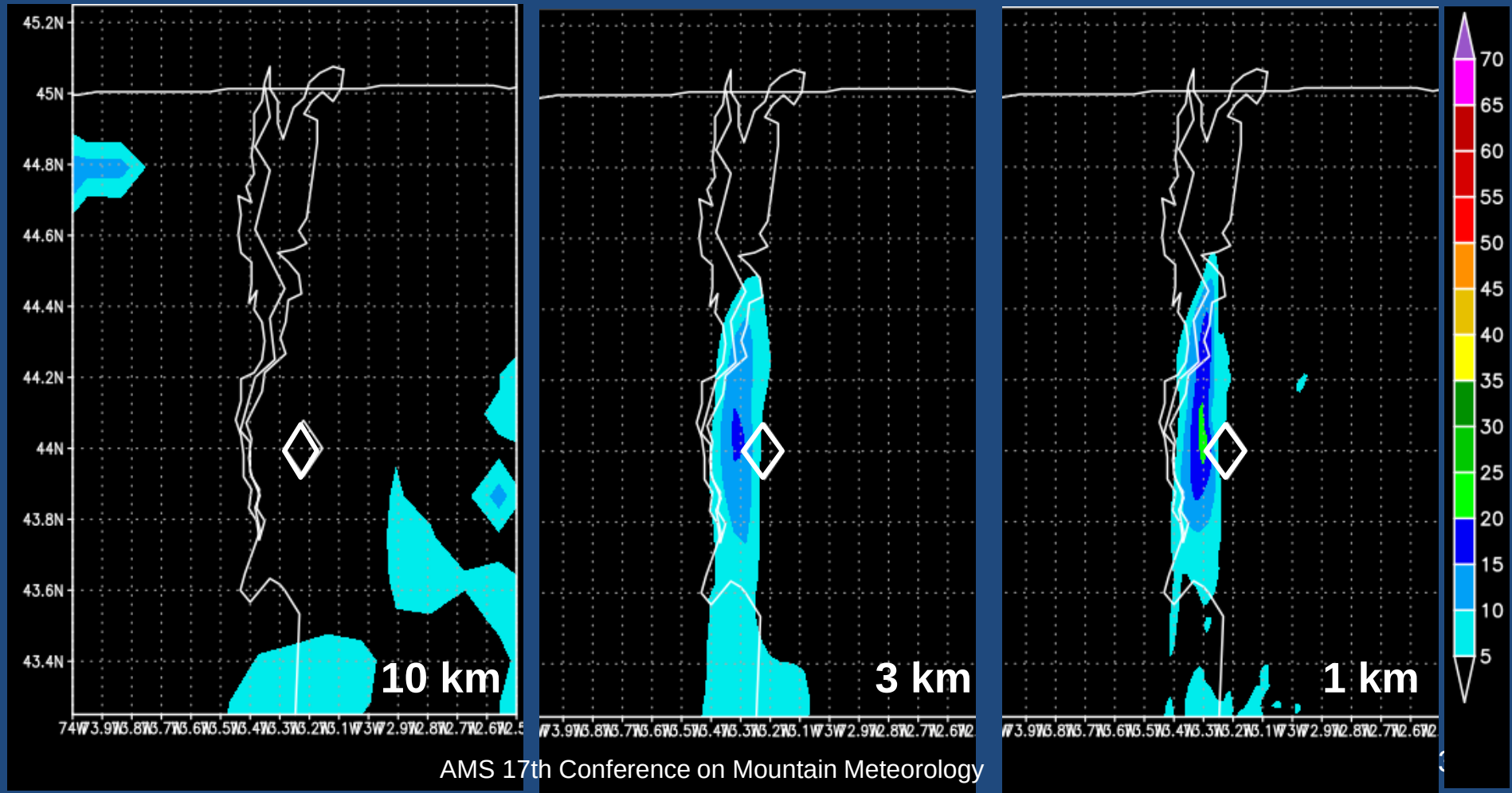
00 UTC 27 Nov 1996 Max Composite Reflectivity (shaded dBZ)



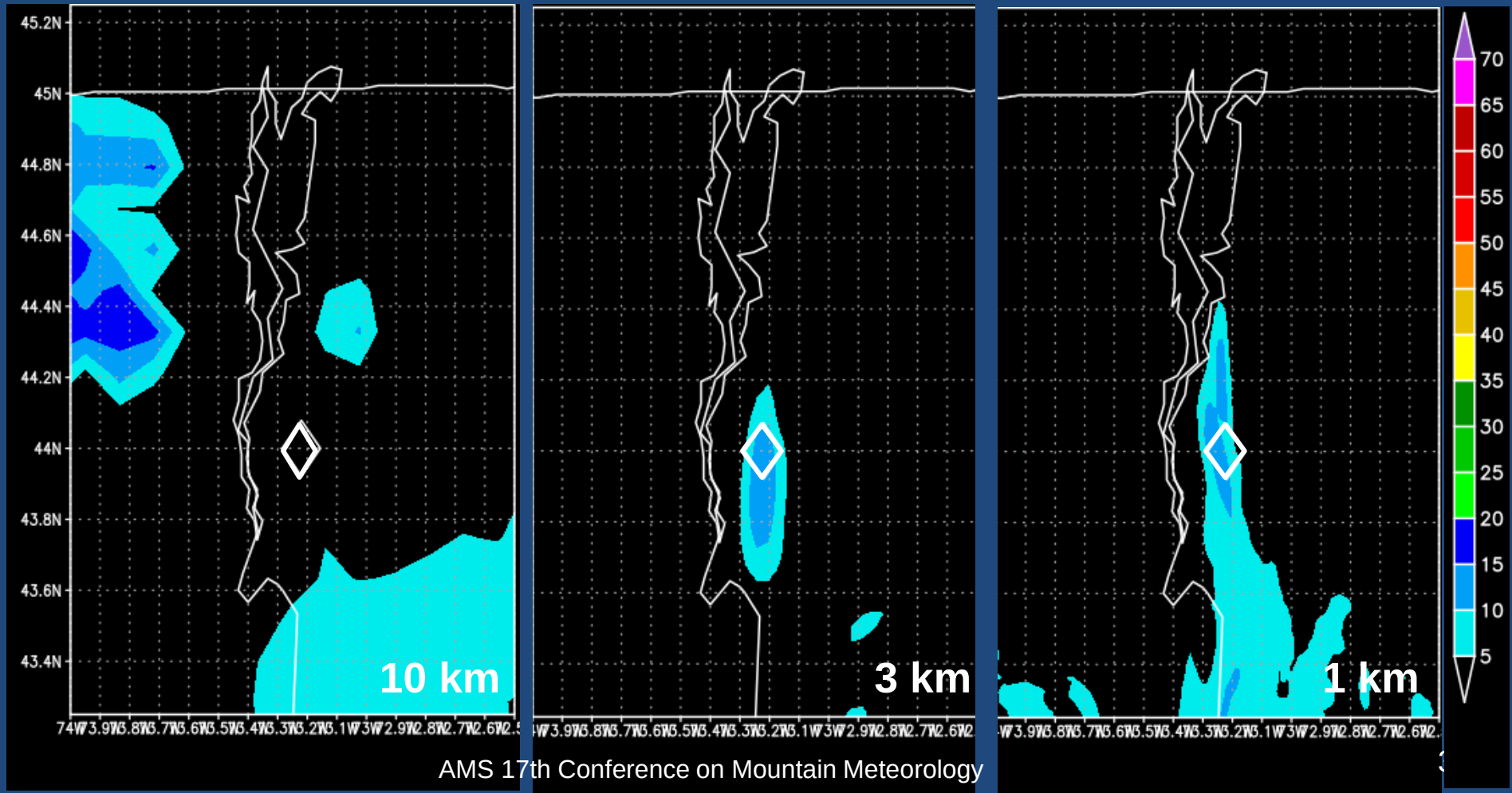
03 UTC 27 Nov 1996 Max Composite Reflectivity (shaded dBZ)



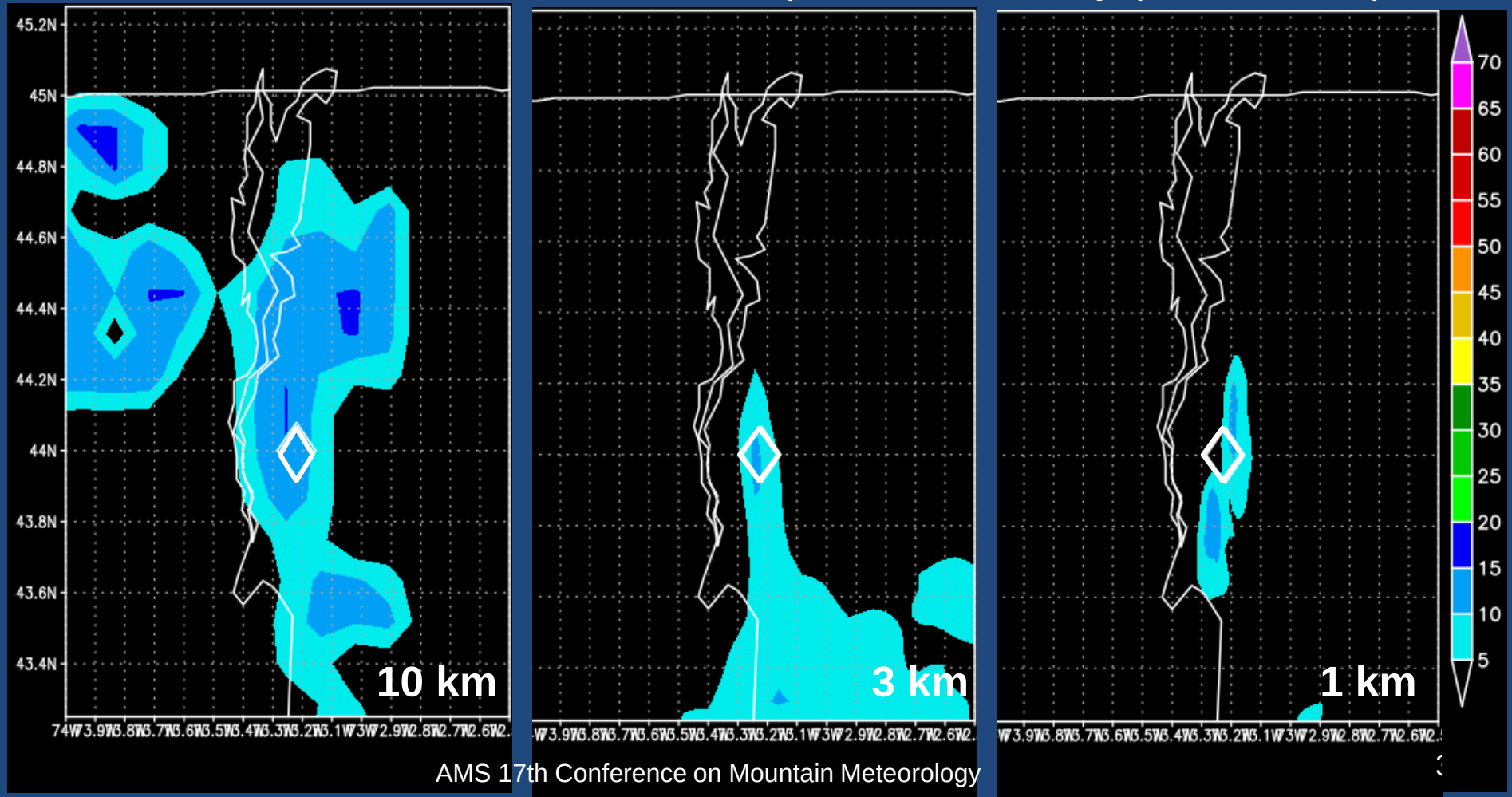
06 UTC 27 Nov 1996 Max Composite Reflectivity (shaded dBZ)



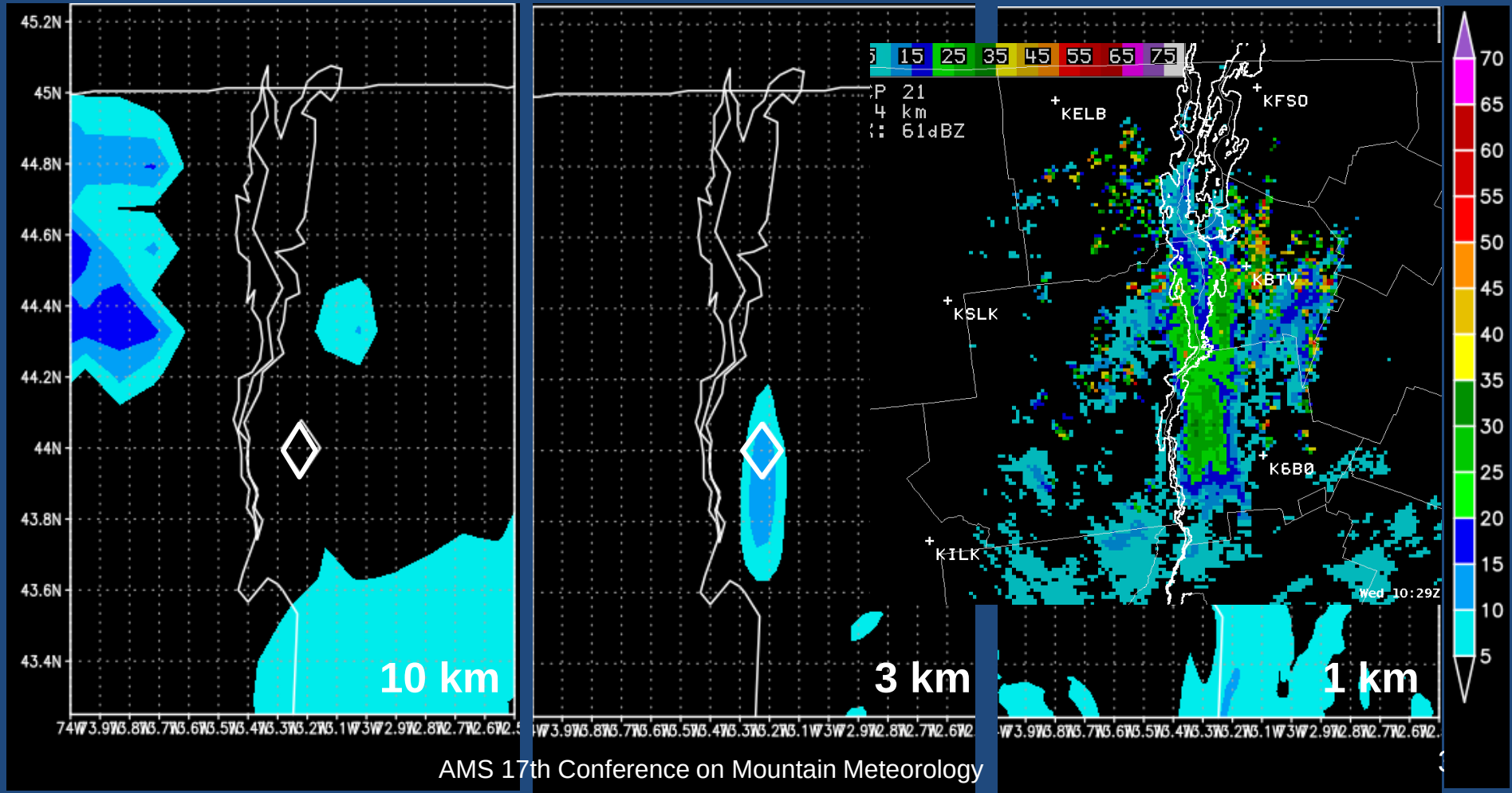
09 UTC 27 Nov 1996 Max Composite Reflectivity (shaded dBZ)

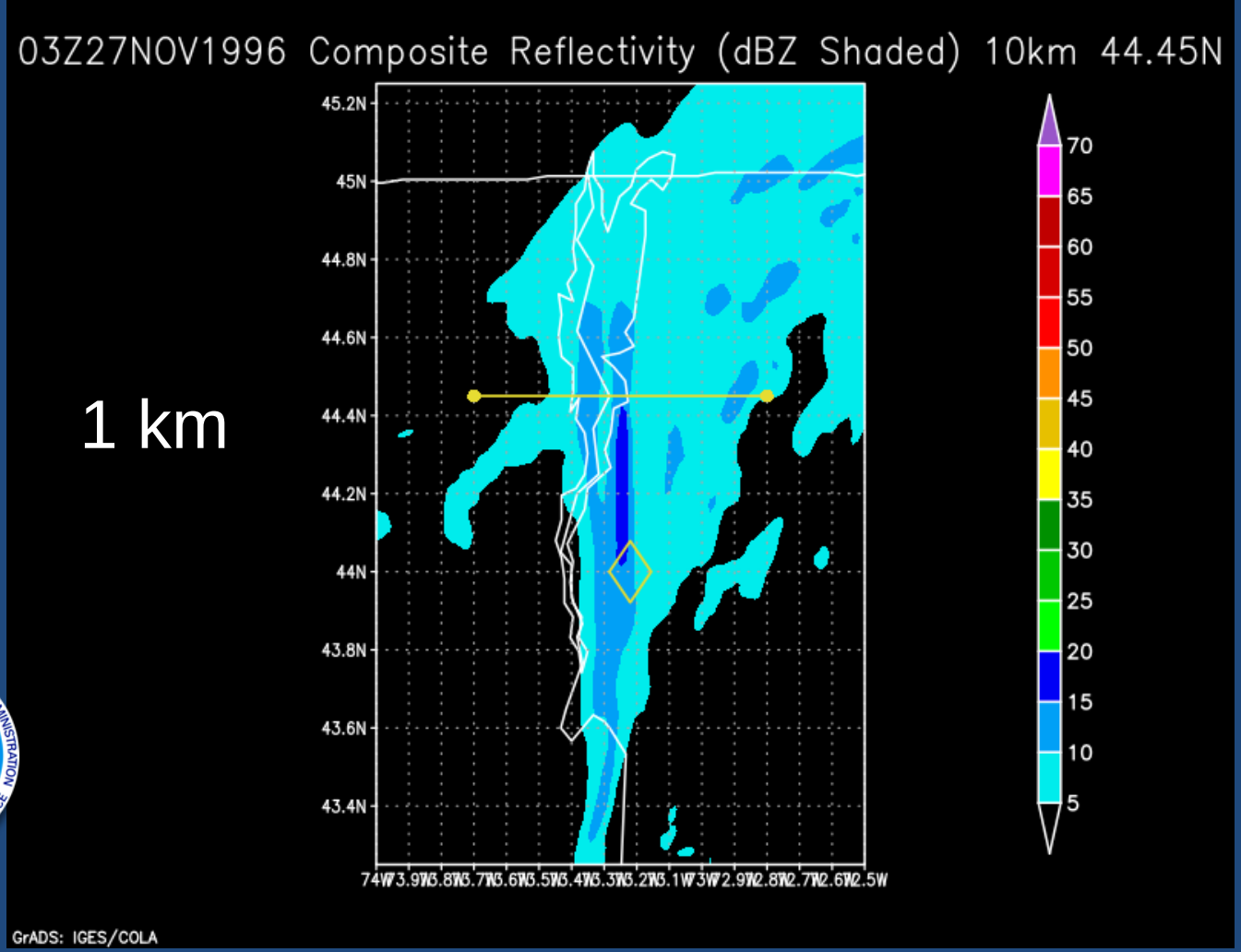


12 UTC 27 Nov 1996 Max Composite Reflectivity (shaded dBZ)



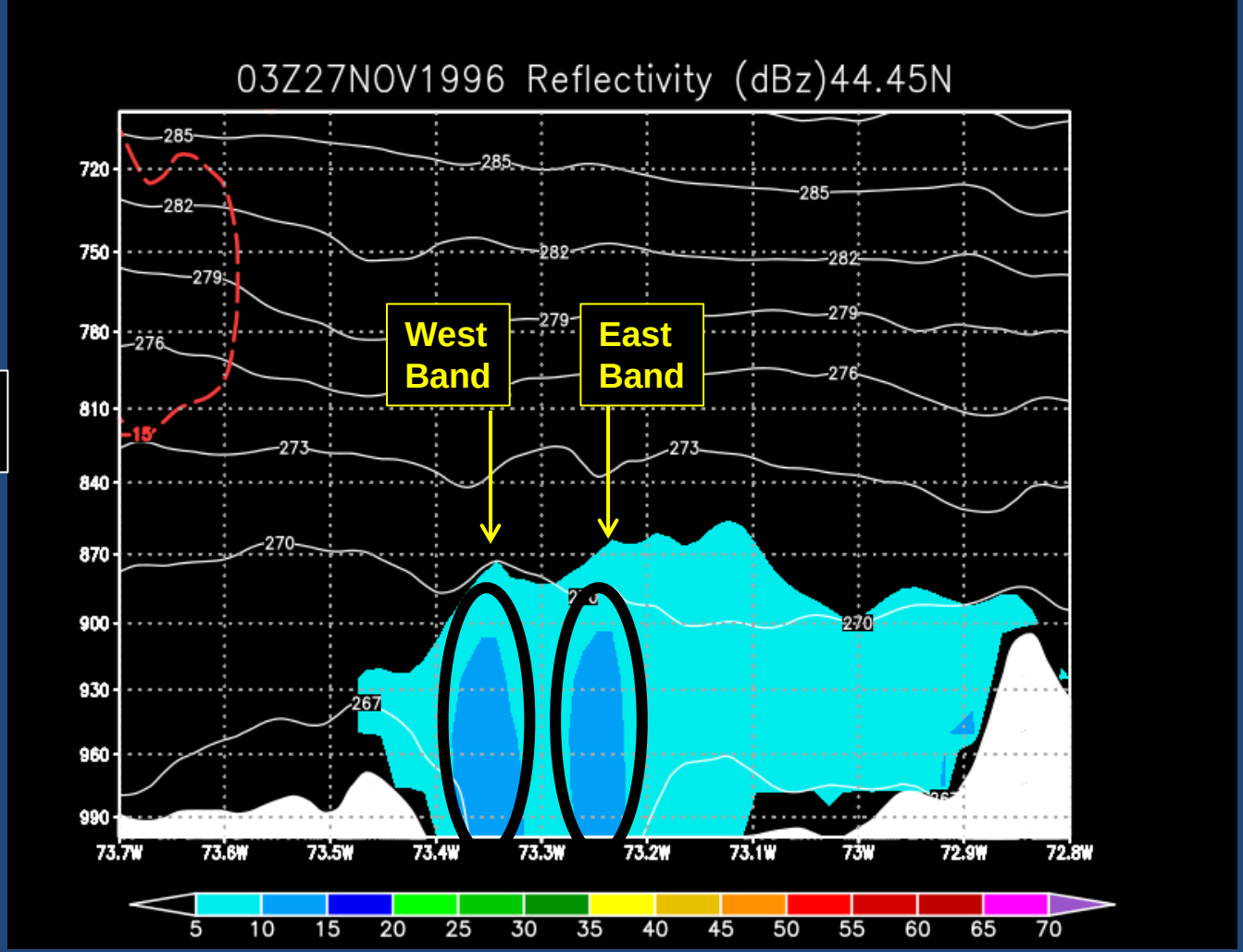
09 UTC 27 Nov 1996 Max Composite Reflectivity (shaded dBZ)




03Z27NOV1996 Composite Reflectivity (dBZ Shaded) 10km 44.45N
45.2N
45N
44.8N
44.6N
44.4N
44.2N
44N
43.8N
43.6N
43.4N
74W 3.9W 3.8W 3.7W 3.6W 3.5W 3.4W 3.3W 3.2W 3.1W 3W 2.9W 2.8W 2.7W 2.6W 2.5W
70
65
60
55
50
45
40
35
30
25
20
15
10
5
GrADS: IGES/COLA

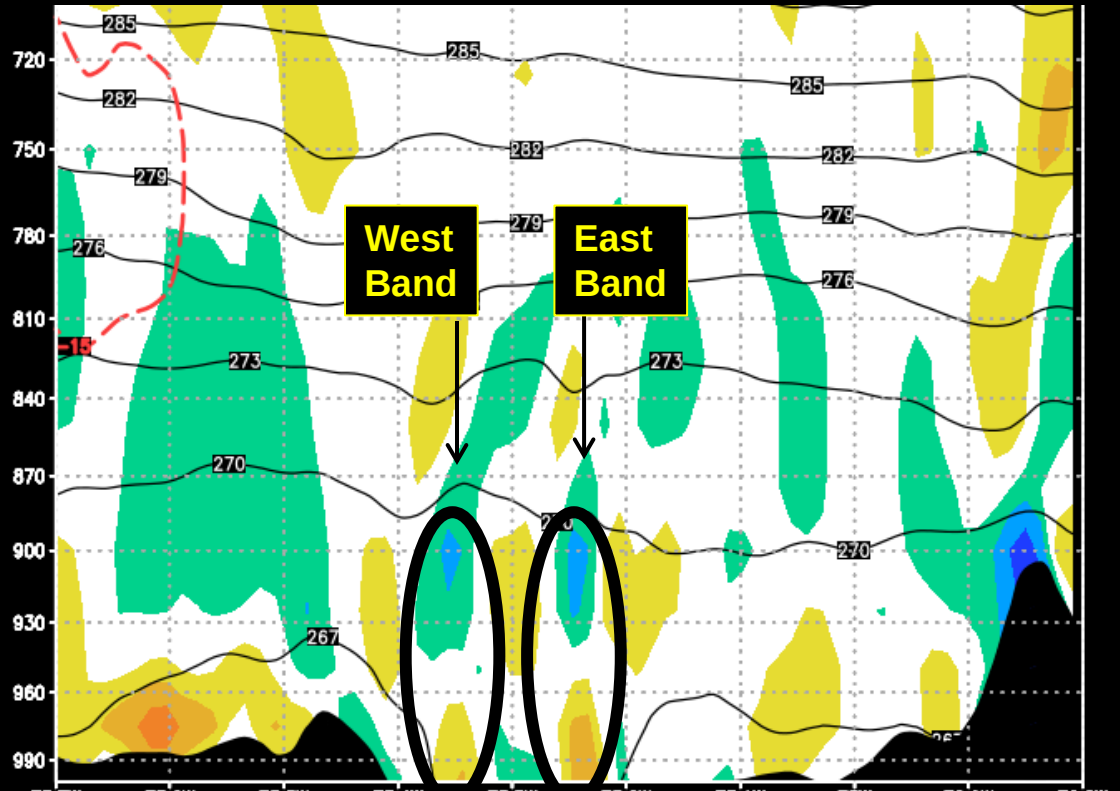
1 km

1 km

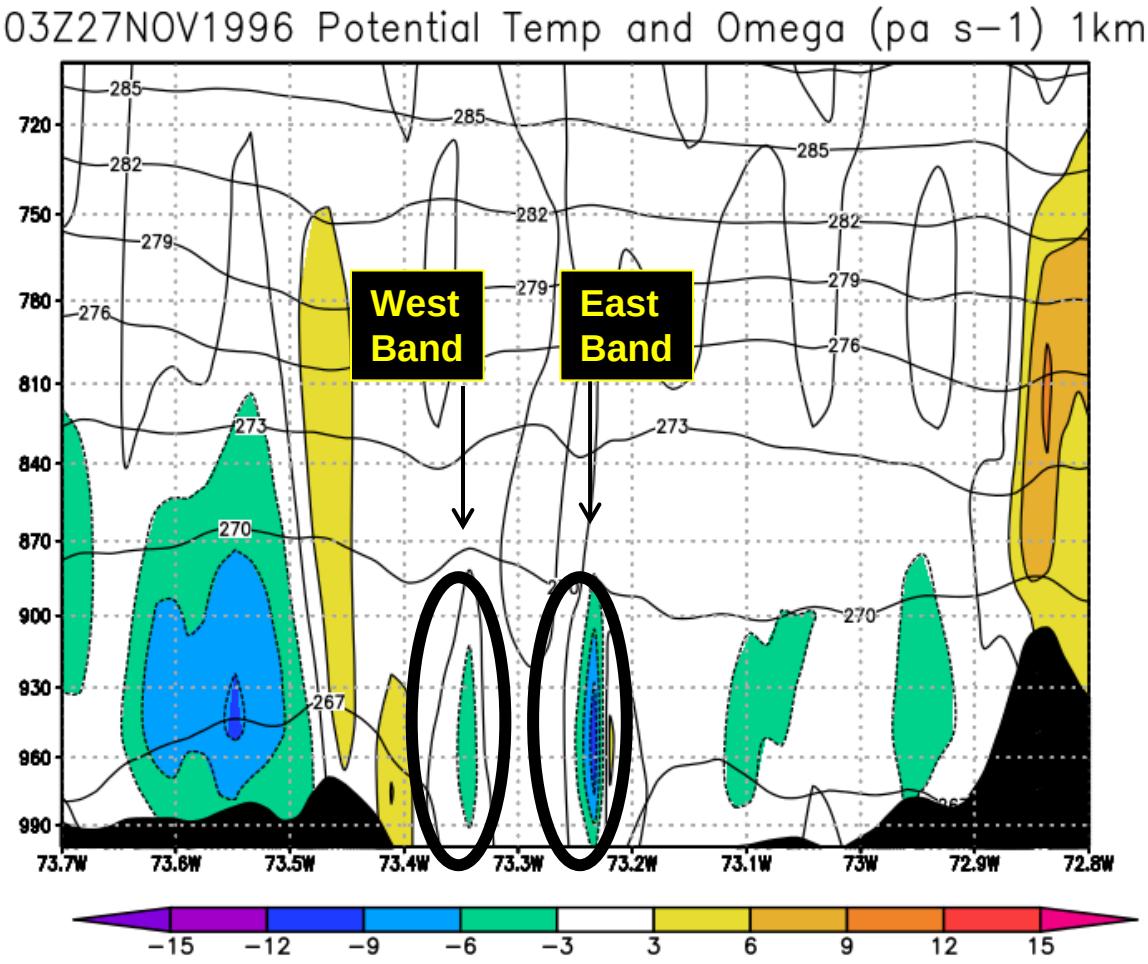

03Z27NOV1996 Reflectivity (dBz)44.45N
West Band
East Band
285
282
279
276
273
270
267
720
750
780
810
840
870
900
930
960
990
73.7W
73.6W
73.5W
73.4W
73.3W
73.2W
73.1W
73W
72.9W
72.8W
5
10
15
20
25
30
35
40
45
50
55
60
65
70

03 UTC 27 Nov 1996 Convergence (shaded 10^{-5} h^{-1})

1 km



1 km


03Z27NOV1996 Potential Temp and Omega (pa s−1) 1km
West Band
East Band
720
750
780
810
840
870
900
930
960
990
285
282
279
276
273
270
267
73.7W
73.6W
73.5W
73.4W
73.3W
73.2W
73.1W
73W
72.9W
72.8W
−15
−12
−9
−6
−3
3
6
9
12
15

Summary

- Convergence in Champlain Valley
- Reproduced the dual band structure
- Under predicted intensity of the band
- Operational Models at 3km or less is needed.
- Forecasters can expect some degree of success predicting Lake Champlain events using high resolution model forecasts
  - 3km High Resolution Rapid Refresh (HRRR)
  - 1km NCEP or local model nests)

Future work

- Vary configurations to match operational models
- Vary Water Temperature

Thank you.

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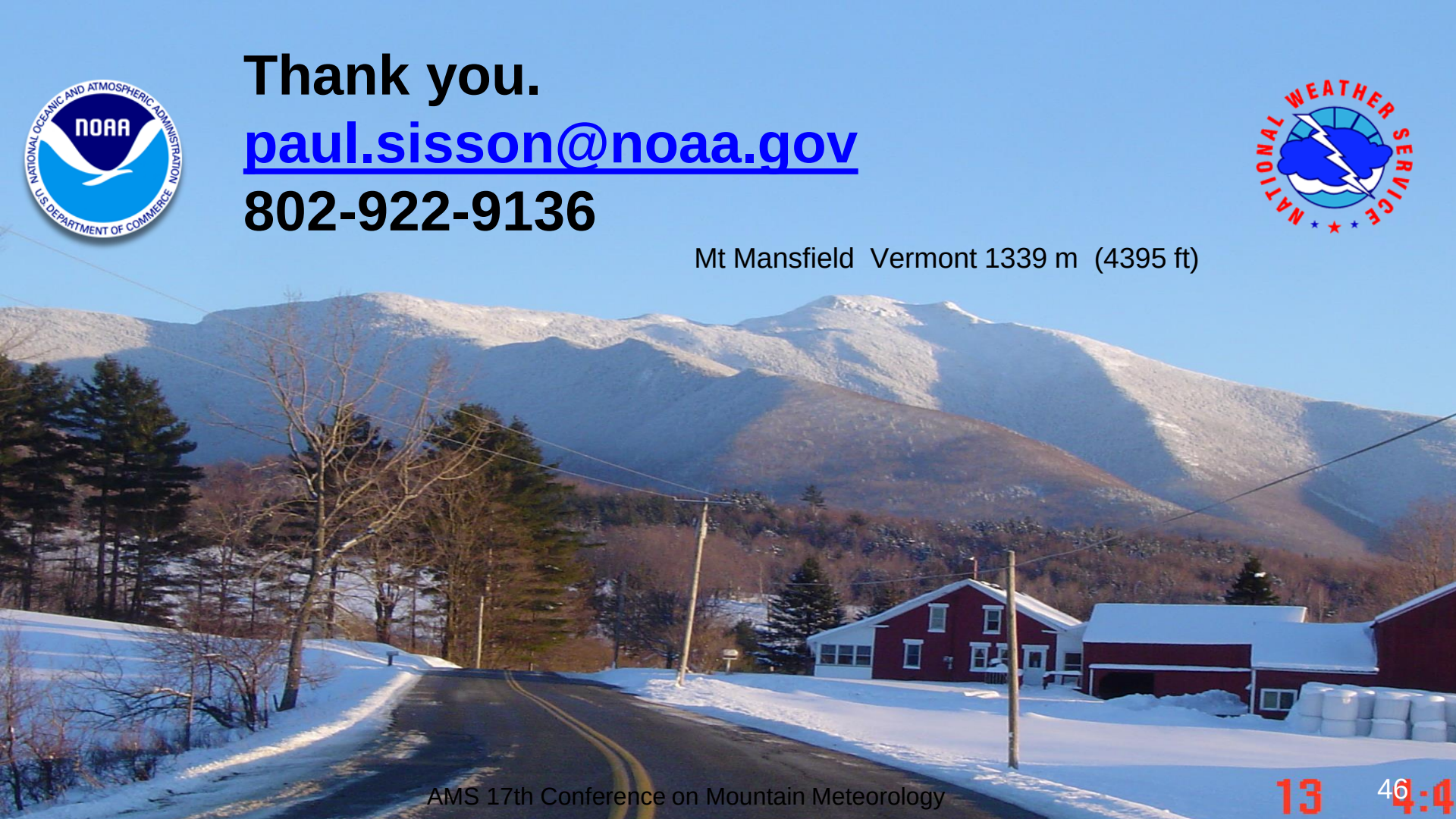
Mt Mansfield Vermont 1339 m (4395 ft)



References:

Alcott, T. I., and W. J. Steenburgh, 2013: Orographic influences on a Great Salt Lake–effect snowstorm. Mon. Wea. Rev., 141, 2432–2450, doi:10.1175/MWR-D-12-00328.1.

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