

Gravity Waves and Their Impacts on Convection

Patrick Vieck

Mentors: Ed Shimon & James Auten



Purpose

- Determine how prevalent gravity wave interactions contribute to severe storms.
- Determine the conducive environment for such events
- Become familiar with interrogation methods for finding such waves

List of Cases

Warm Season

- June 5th, 2010 – Elmwood IL
- May 25, 2008 – Parkersburg IA
- April 27th, 2011 – Tuscaloosa AL

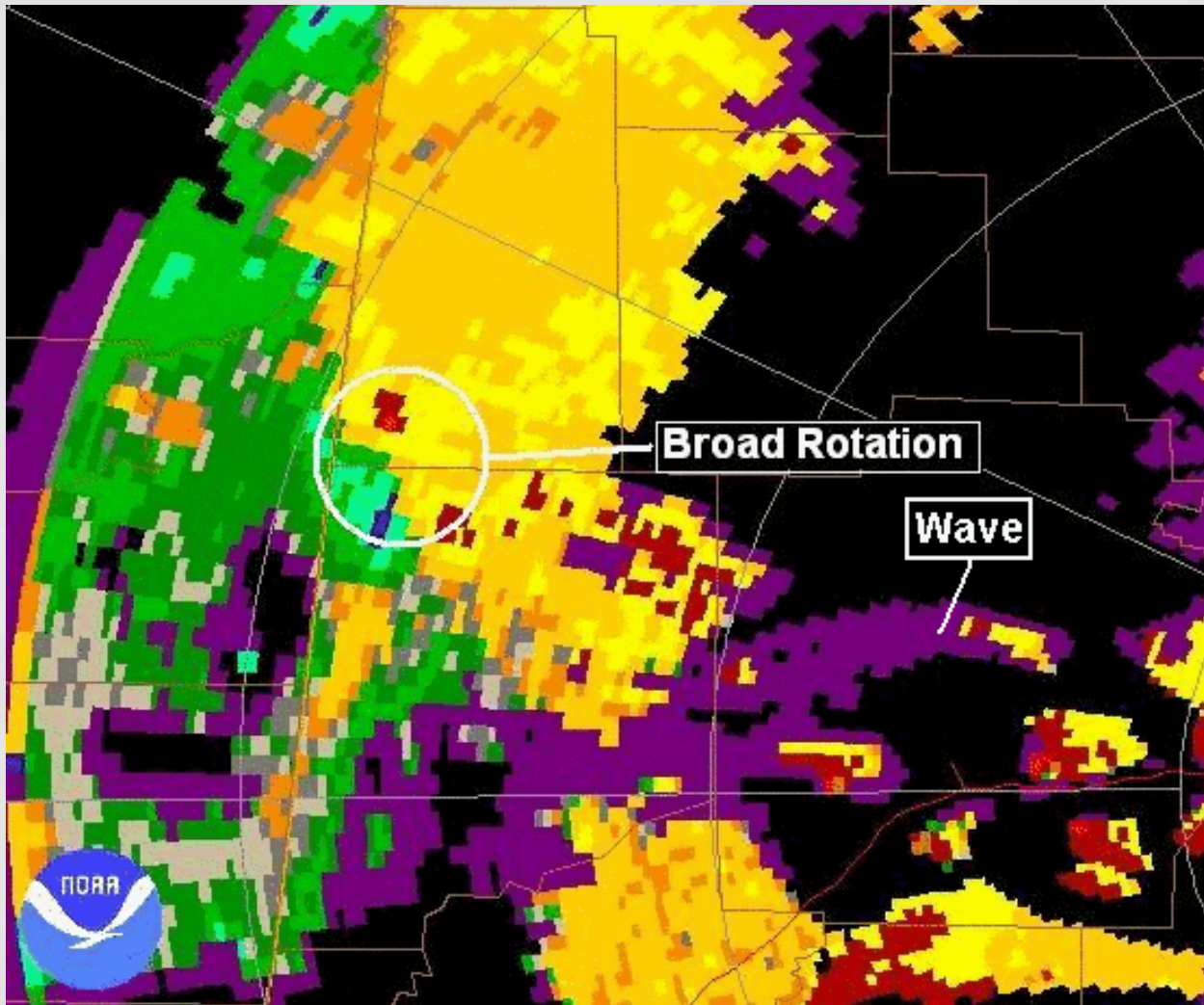
Cool Season

- April 28th, 2014 – Birmingham, AL
- April 22, 2011 – Lambert Airport MO
- December 23rd 2015 – Vincennes, IN
- February 29th, 2012 – Harrisburg IL
- March 2nd, 2012 – Henryville, IN
- February 20th, 2014 – Morrisonville IL
- November 17th, 2013 – Washington IL

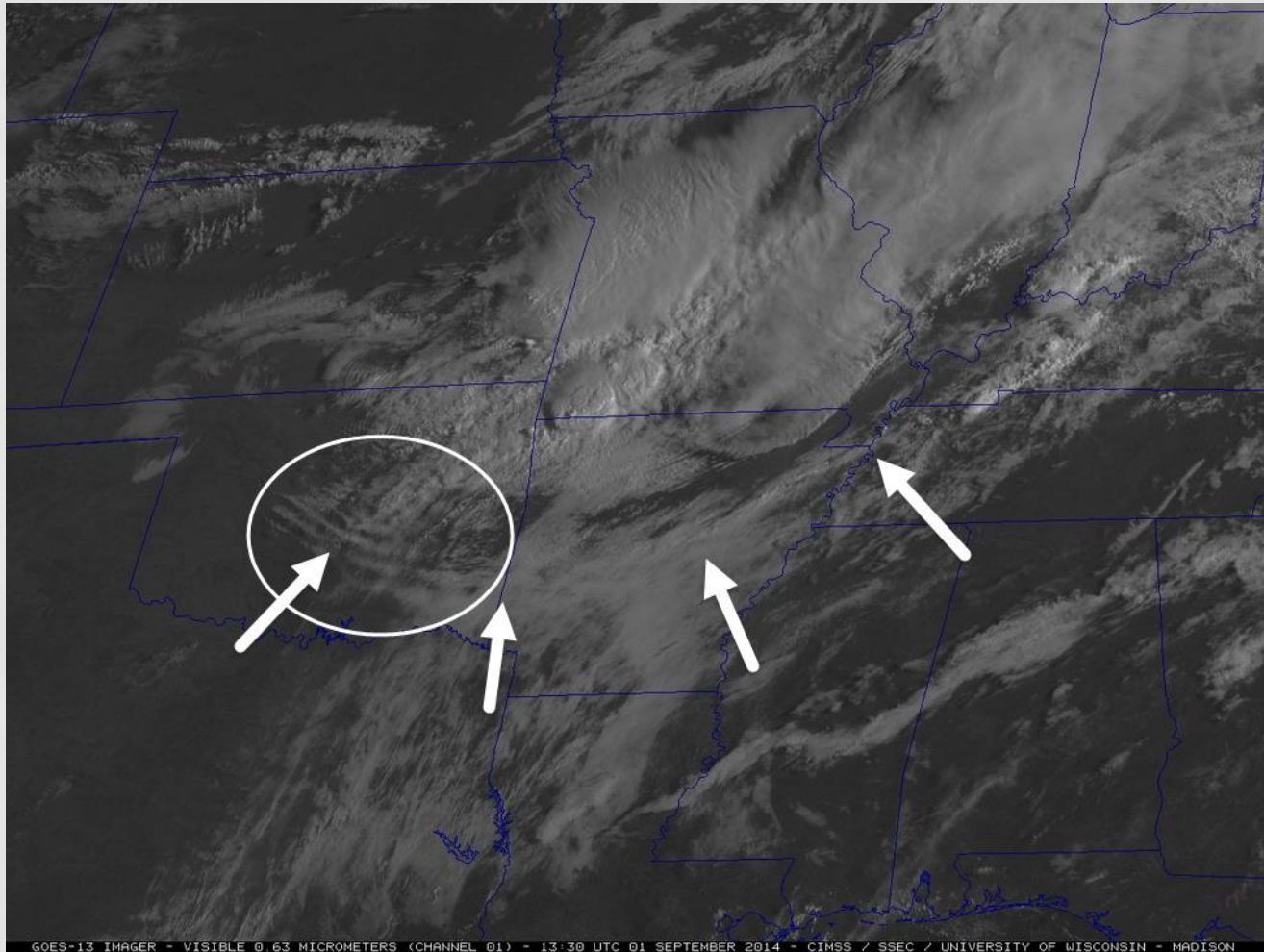
Prior Research

- Barker, L. J., 2006: A Potentially Valuable WSR-88D Severe Storm Pre-cursor Signature in Highly Dynamic, Low Cape, High Shear Environments. Preprints, 23rd Conf. on Severe Local Storms, St. Louis, MO, Amer. Meteor. Soc.
- Coleman T., and K. Knupp, 2006: The interaction of gravity waves with tornadoes and mesocyclones: Theories and observations. Preprints, 23rd Conference on Severe Local Storms, Saint Louis, MO, Amer. Meteor. Soc.
- Coleman, T. A., and K. R. Knupp, 2008: The Interactions of Gravity Waves with Mesocyclones: Preliminary Observations and Theory. Mon. Wea. Rev., 136, 4206–4219
- Shimon, E 2014: Investigating the Role of Wave-like Reflectivity Segments during the 17 November 2013 EF-4 Washington, Illinois Tornado

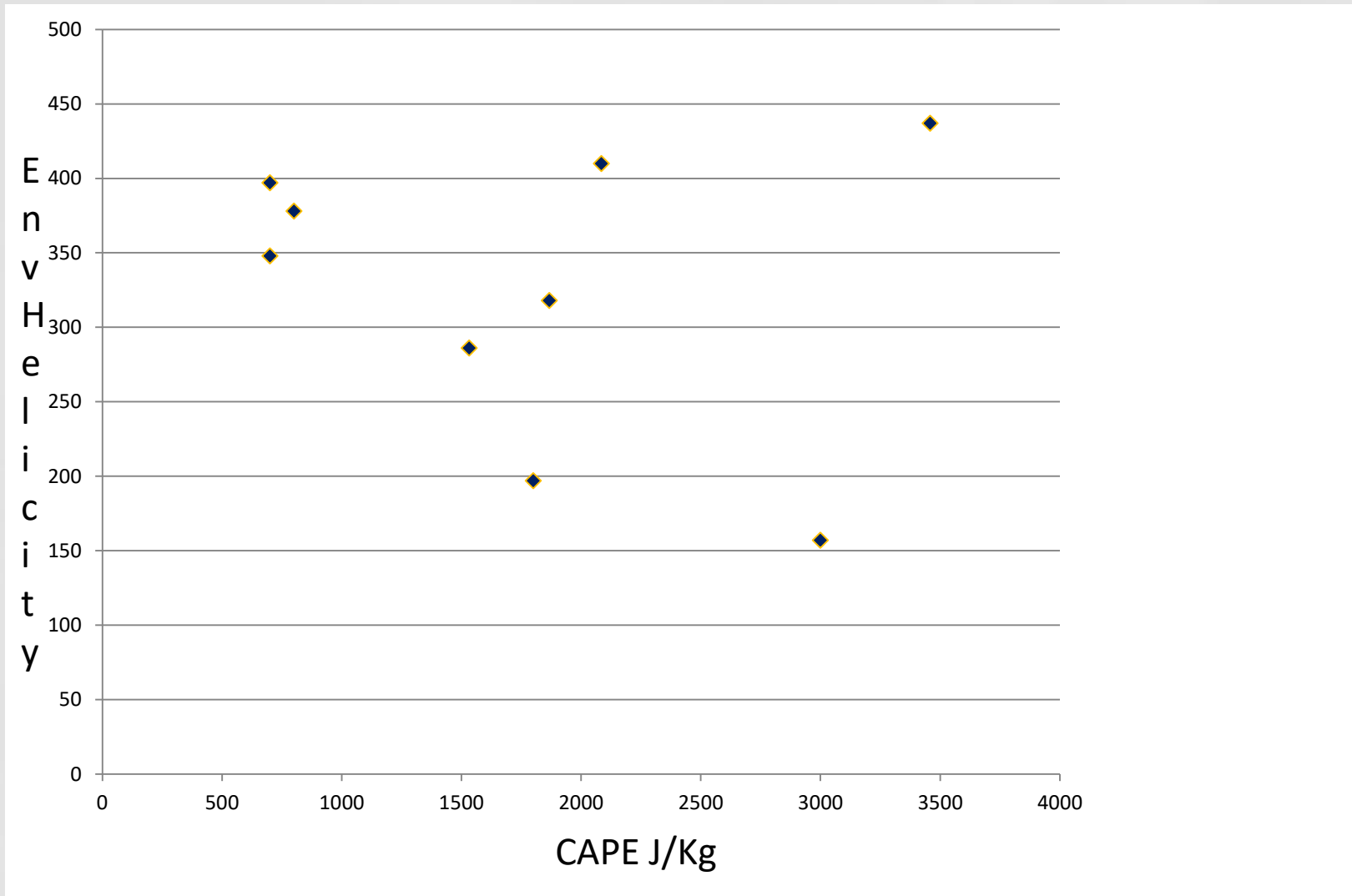
Radar – Jan 22, 1999 NW AL



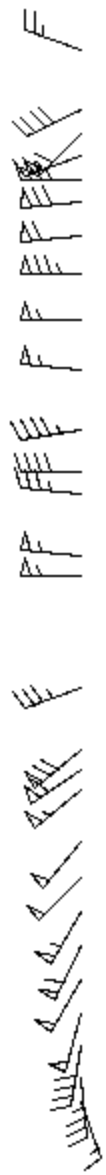
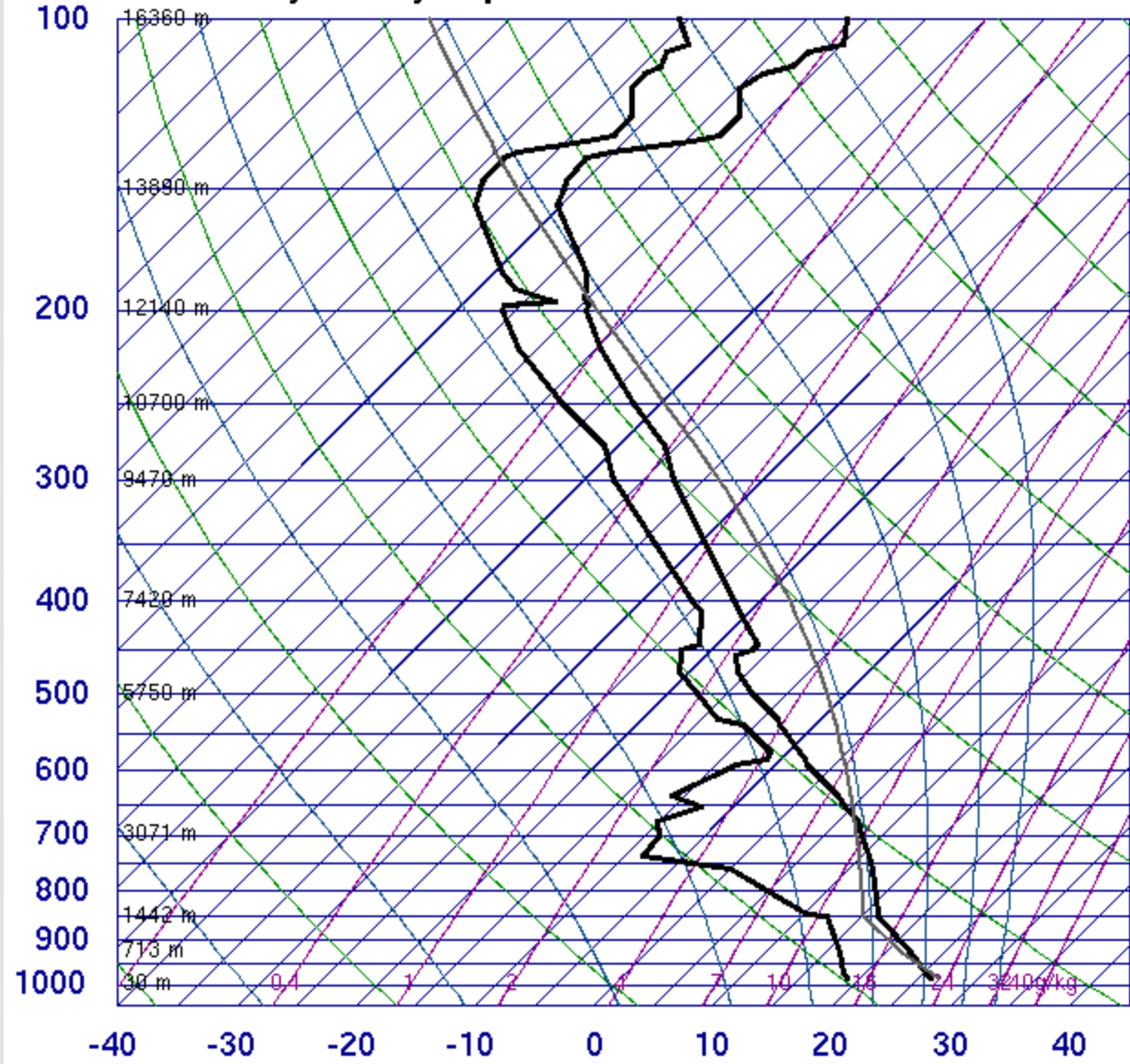
Satellite – Sep 1, 2014



Shear vs CAPE – Cases Studied



72230 BMX Shelby County Airport



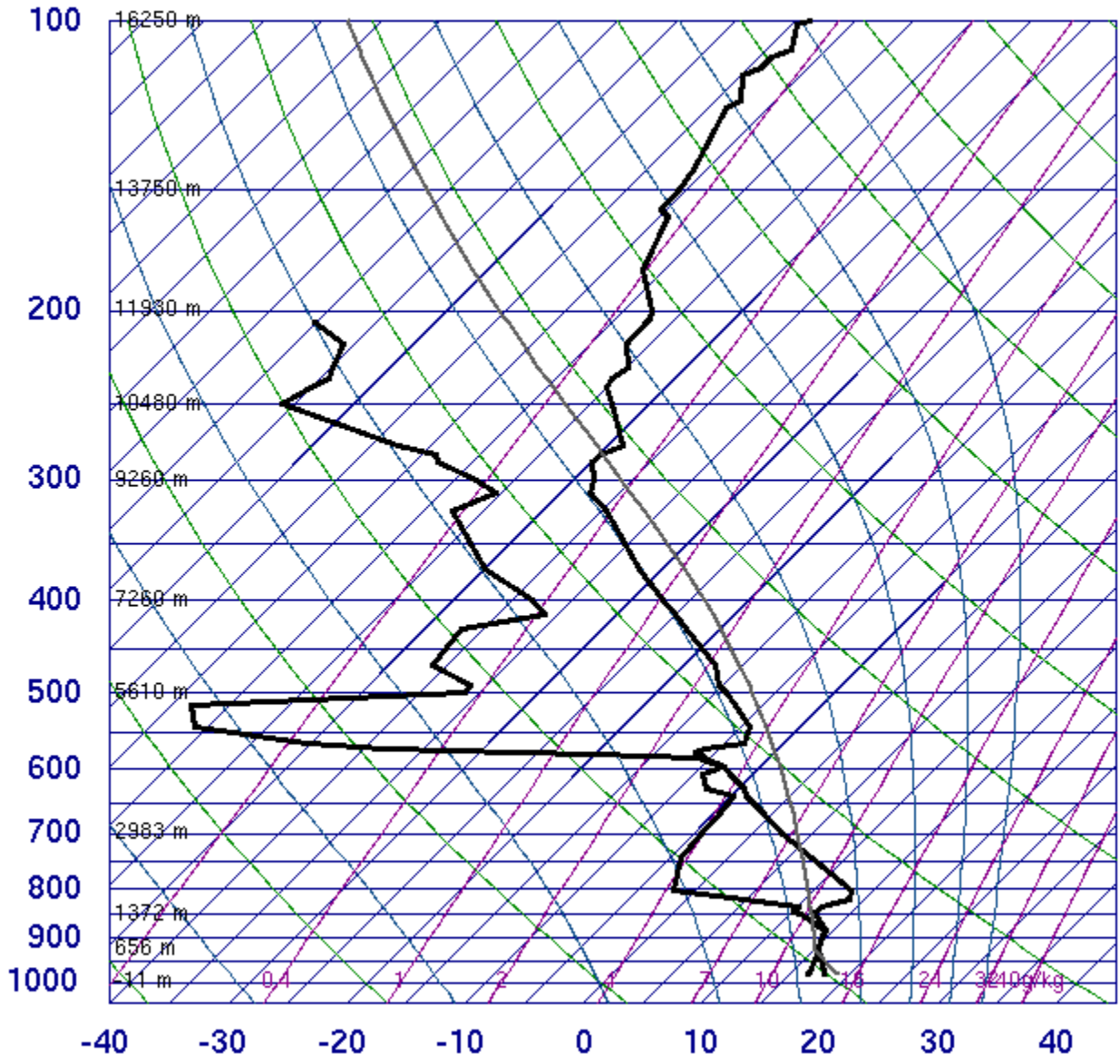
| | |
|------|--------|
| SLAT | 33.16 |
| SLON | -86.76 |
| SELV | 178.0 |
| SHOW | -3.83 |
| LIFT | -6.34 |
| LFTV | -6.79 |
| SWET | 502.5 |
| KINX | 24.40 |
| CTOT | 25.00 |
| VTOT | 29.30 |
| TOTL | 54.30 |
| CAPE | 1275. |
| CAPV | 1378. |
| CINS | -92.0 |
| CINV | -36.6 |
| EQLV | 192.4 |
| EQTV | 192.3 |
| LFCT | 668.8 |
| LFCV | 755.2 |
| BRCH | 10.52 |
| BRCV | 11.37 |
| LCLT | 289.1 |
| LCLP | 867.3 |
| MLTH | 301.1 |
| MLMR | 13.40 |
| THCK | 5720. |
| PWAT | 34.24 |

00Z 29 Apr 2014

University of Wyoming



74560 ILX Lincoln



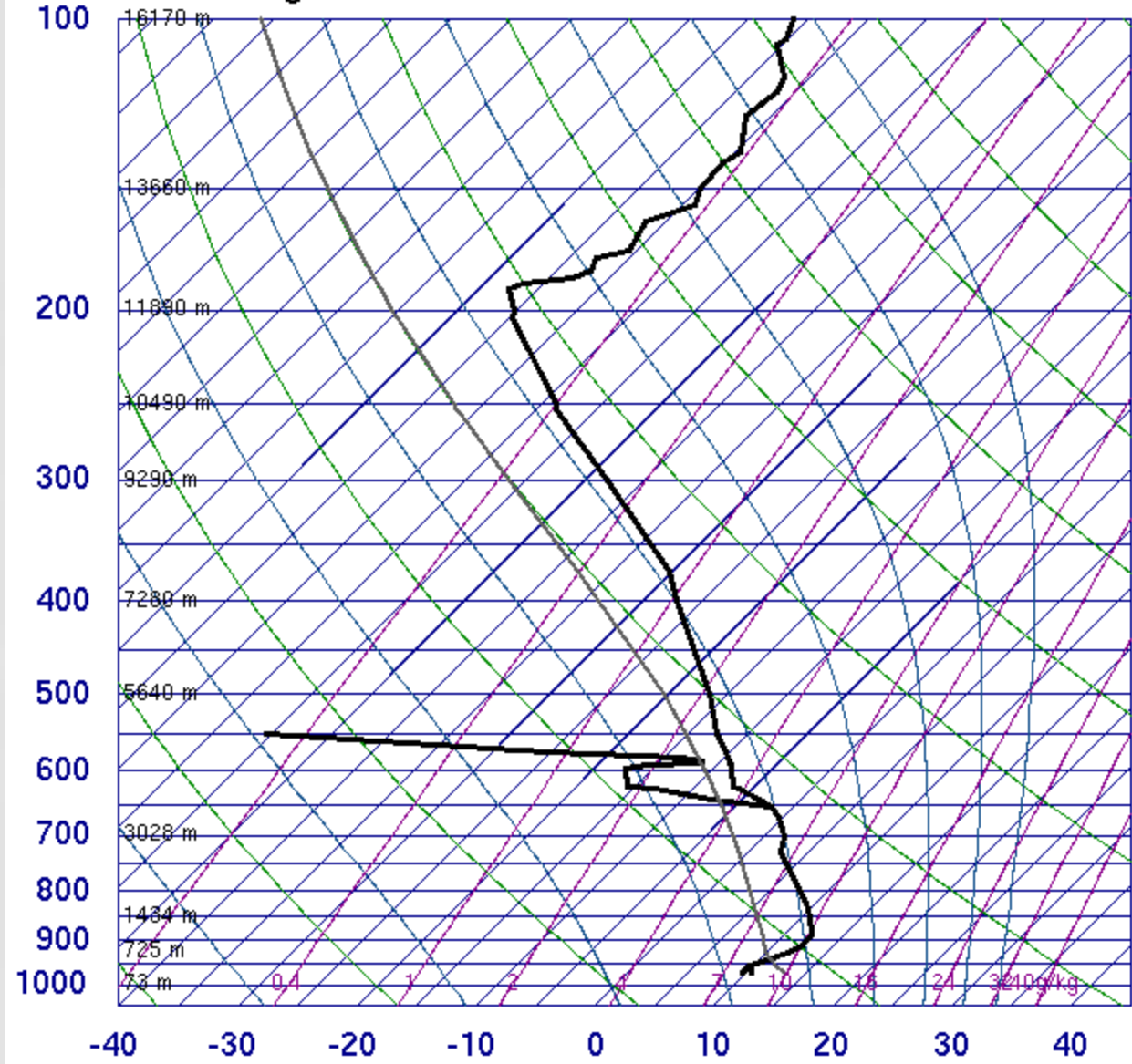
| | |
|------|--------|
| SLAT | 40.15 |
| SLON | -89.33 |
| SELV | 178.0 |
| SHOW | -1.59 |
| LIFT | -2.25 |
| LFTV | -2.69 |
| SWET | 351.7 |
| KINX | 30.20 |
| CTOT | 25.00 |
| VTOT | 26.30 |
| TOTL | 51.30 |
| CAPE | 783.9 |
| CAPV | 864.2 |
| CINS | -105. |
| CINV | -78.7 |
| EQLV | 282.5 |
| EQTV | 282.5 |
| LFCT | 724.8 |
| LFCV | 739.6 |
| BRCH | 5.03 |
| BRCV | 5.54 |
| LCLT | 288.9 |
| LCLP | 940.8 |
| MLTH | 294.0 |
| MLMR | 12.15 |
| THCK | 5621. |
| PWAT | 28.23 |

12Z 17 Nov 2013

University of Wyoming



72426 ILN Wilmington



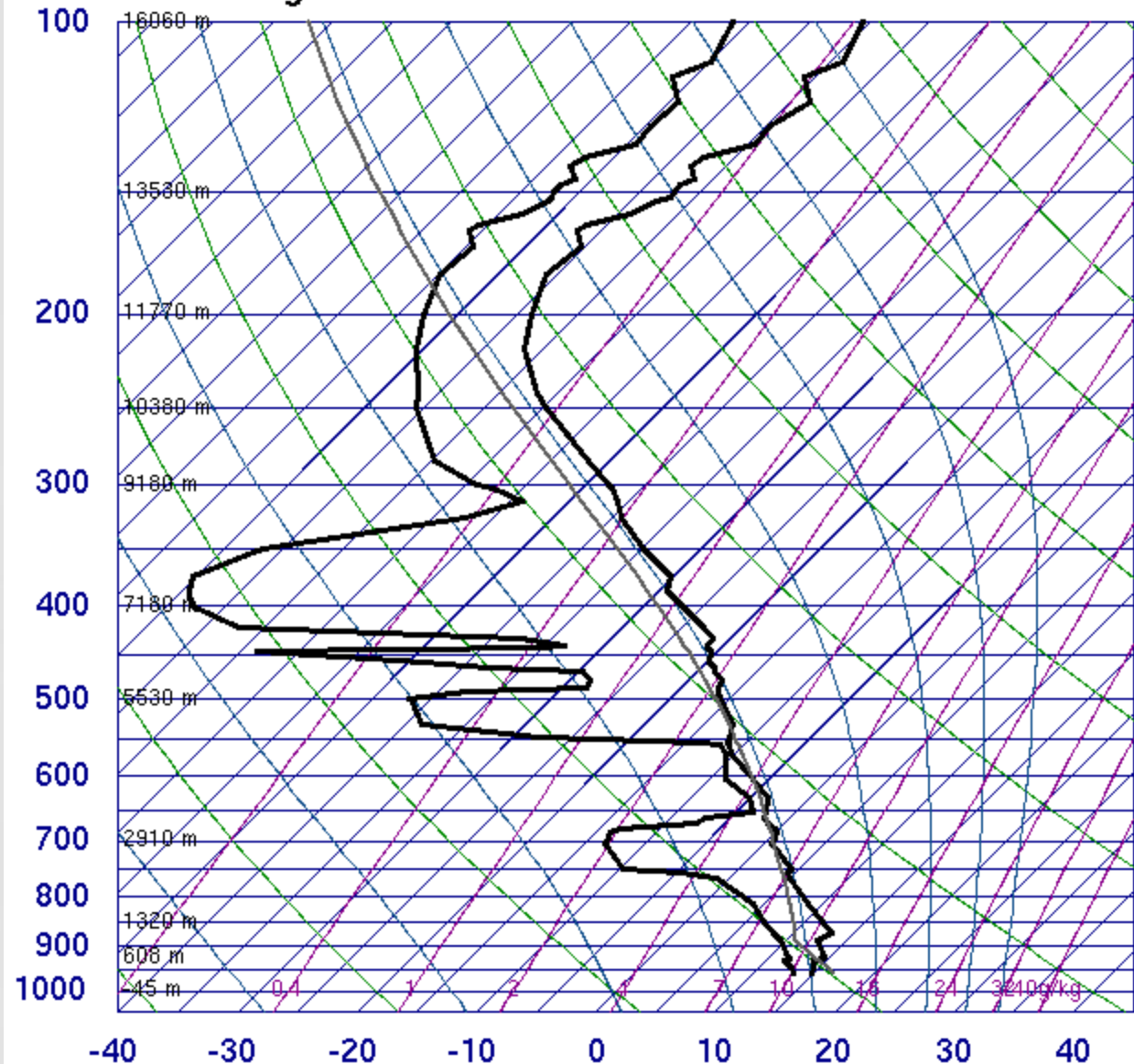
| | |
|------|--------|
| SLAT | 39.41 |
| SLON | -83.81 |
| SELV | 317.0 |
| SHOW | -2.76 |
| LIFT | 3.92 |
| LFTV | 3.69 |
| SWET | 442.1 |
| KINX | 37.70 |
| CTOT | 27.10 |
| VTOT | 27.10 |
| TOTL | 54.20 |
| CAPE | 0.00 |
| CAPV | 0.00 |
| CINS | 0.00 |
| CINV | 0.00 |
| EQLV | -9999 |
| EQTV | -9999 |
| LFCT | -9999 |
| LFCV | -9999 |
| BRCH | 0.00 |
| BRCV | 0.00 |
| LCLT | 283.7 |
| LCLP | 940.8 |
| MLTH | 288.7 |
| MLMR | 8.64 |
| THCK | 5567. |
| PWAT | 28.03 |

12Z 29 Feb 2012

University of Wyoming



72426 ILN Wilmington



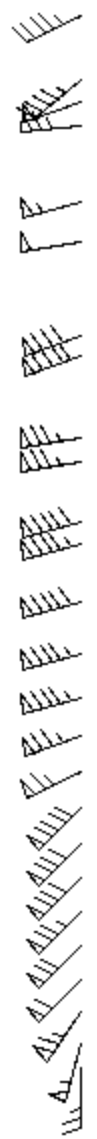
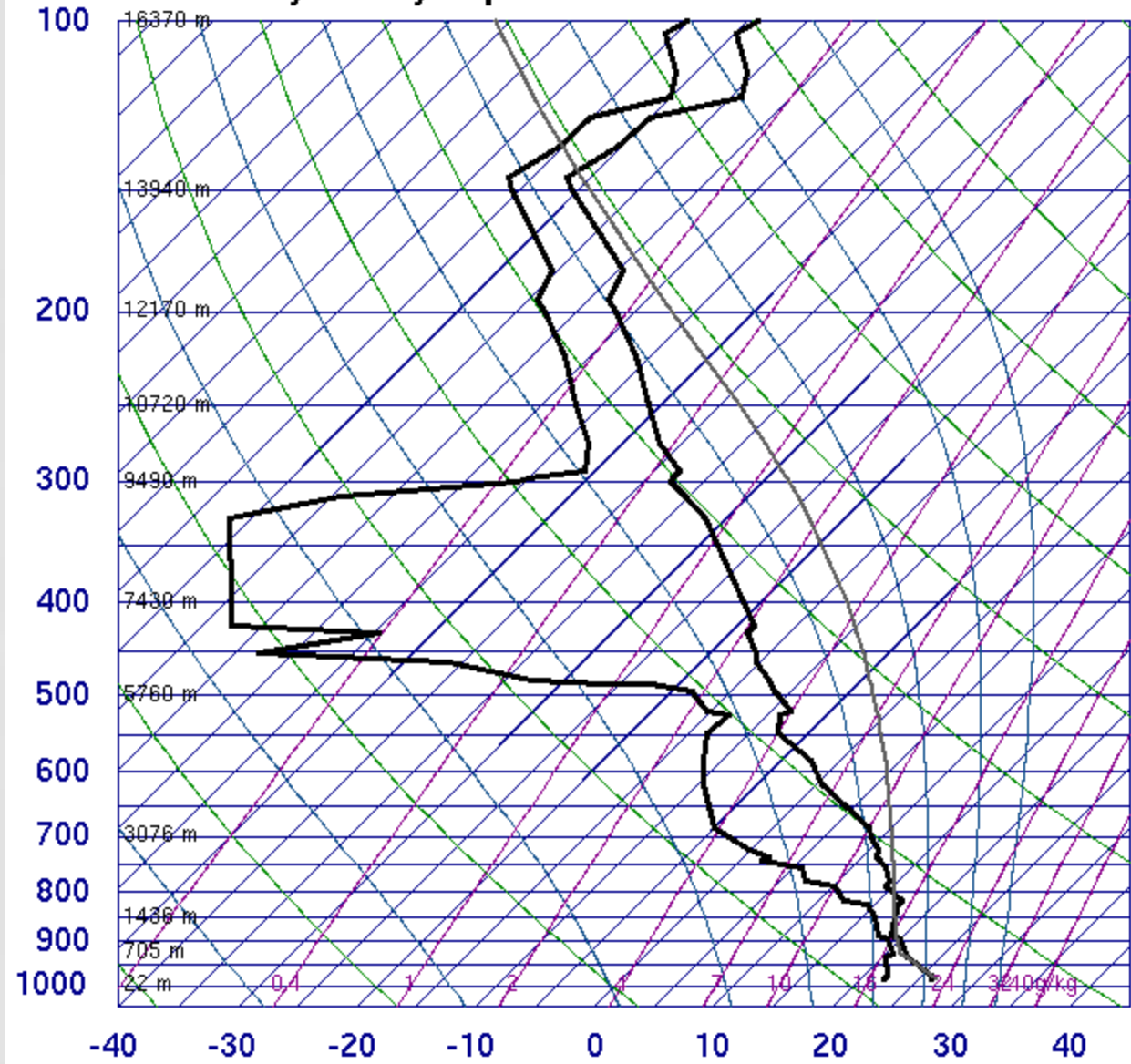
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|------|--------|
| SLAT | 39.41 |
| SLON | -83.81 |
| SELV | 317.0 |
| SHOW | 0.88 |
| LIFT | 0.42 |
| LFTV | 0.11 |
| SWET | 341.1 |
| KINX | 19.90 |
| CTOT | 22.30 |
| VTOT | 27.30 |
| TOTL | 49.60 |
| CAPE | 18.47 |
| CAPV | 36.61 |
| CINS | -94.4 |
| CINV | -74.5 |
| EQLV | 538.9 |
| EQTV | 520.3 |
| LFCT | 714.2 |
| LFCV | 757.3 |
| BRCH | 0.06 |
| BRCV | 0.13 |
| LCLT | 284.3 |
| LCLP | 894.6 |
| MLTH | 293.5 |
| MLMR | 9.41 |
| THCK | 5575. |
| PWAT | 22.13 |

00Z 03 Mar 2012

University of Wyoming



72230 BMX Shelby County Airport



| | |
|------|--------|
| SLAT | 33.16 |
| SLON | -86.76 |
| SELV | 178.0 |
| SHOW | -6.26 |
| LIFT | -8.05 |
| LFTV | -8.78 |
| SWET | 601.9 |
| KINX | 32.70 |
| CTOT | 26.90 |
| VTOT | 28.50 |
| TOTL | 55.40 |
| CAPE | 2944. |
| CAPV | 3172. |
| CINS | -6.19 |
| CINV | -5.23 |
| EQLV | 143.0 |
| EQTV | 143.1 |
| LFCT | 890.2 |
| LFCV | 891.5 |
| BRCH | 14.24 |
| BRCV | 15.35 |
| LCLT | 293.7 |
| LCLP | 917.5 |
| MLTH | 301.0 |
| MLMR | 16.98 |
| THCK | 5738. |
| PWAT | 41.83 |

00Z 28 Apr 2011

University of Wyoming



74455 DVN Davenport

100

200

300

400

500

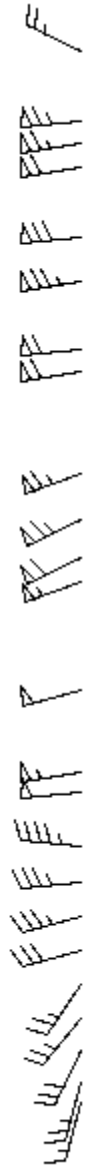
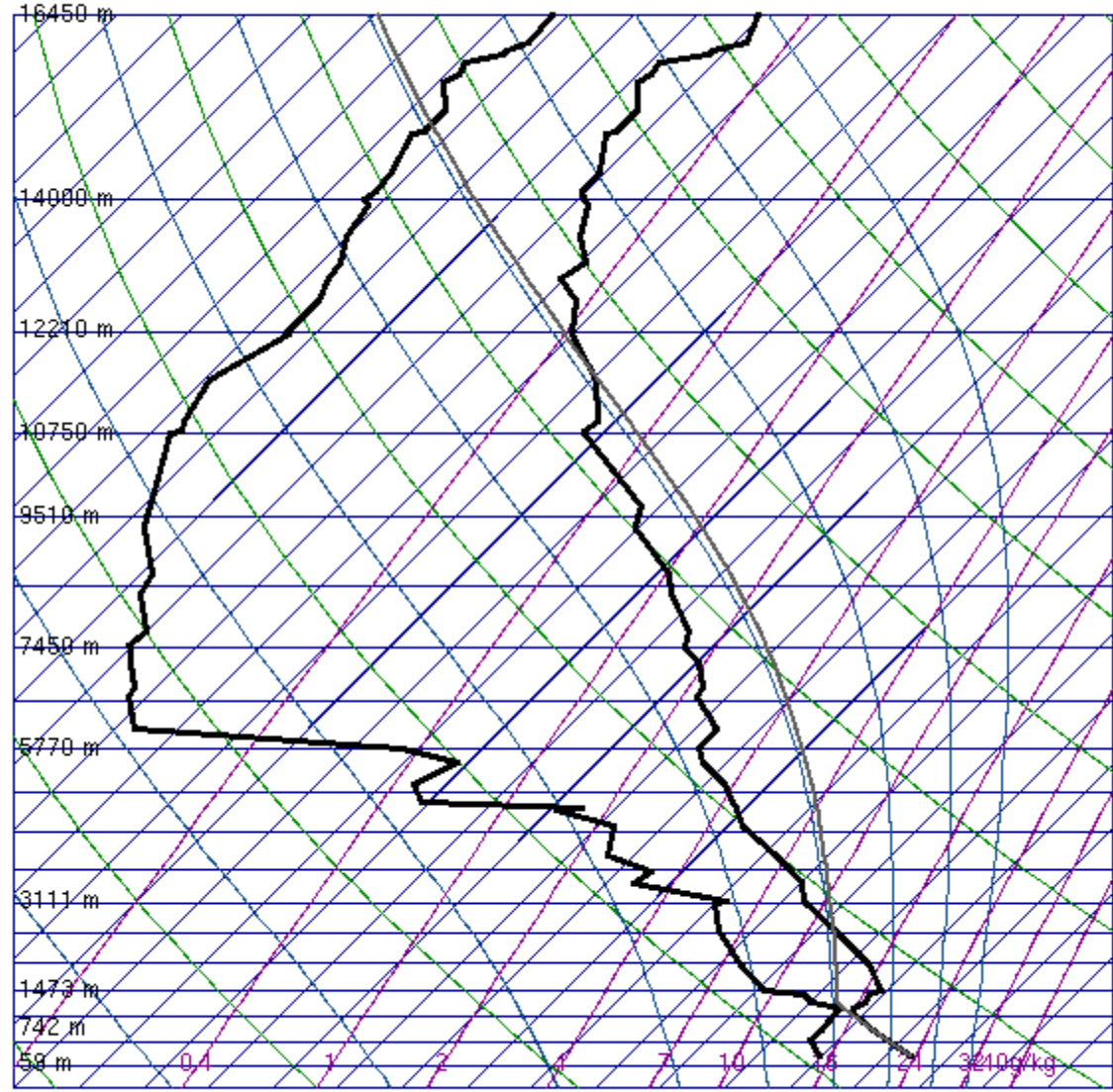
600

700

800

900

1000



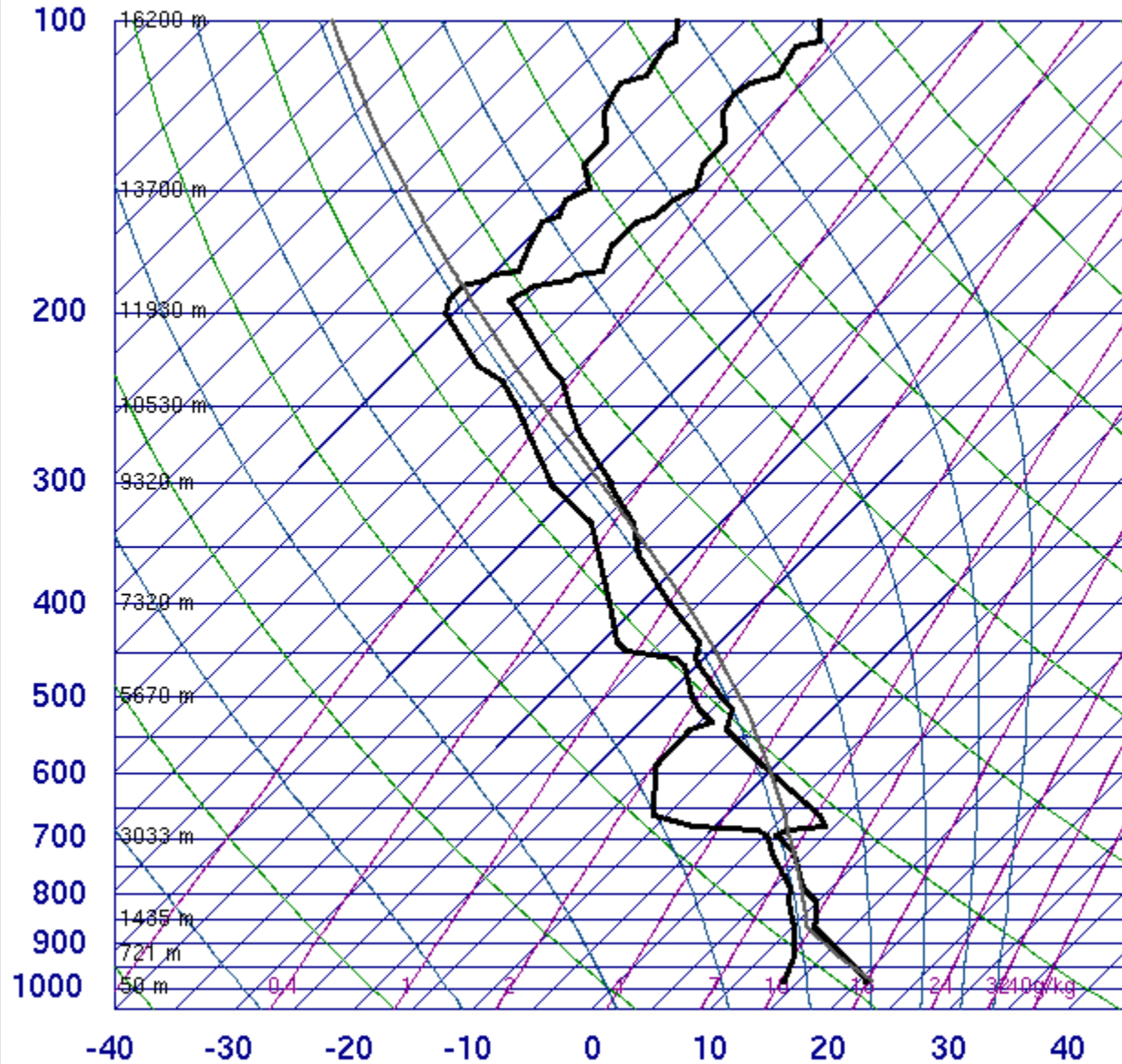
| | |
|------|--------|
| SLAT | 41.61 |
| SLON | -90.58 |
| SELV | 229.0 |
| SHOW | -4.39 |
| LIFT | -7.99 |
| LFTV | -8.79 |
| SWET | 481.5 |
| KINX | 36.30 |
| CTOT | 23.70 |
| VTOT | 32.70 |
| TOTL | 56.40 |
| CAPE | 1619. |
| CAPV | 1795. |
| CINS | -107. |
| CINV | -74.5 |
| EQLV | 219.6 |
| EQTV | 218.7 |
| LFCT | 740.6 |
| LFCV | 761.1 |
| BRCH | 24.68 |
| BRCV | 27.37 |
| LCLT | 290.3 |
| LCLP | 873.6 |
| MLTH | 301.8 |
| MLMR | 14.40 |
| THCK | 5711. |
| PWAT | 33.86 |

00Z 26 May 2008

University of Wyoming



72327 BNA Nashville



| | |
|------|--------|
| SLAT | 36.25 |
| SLON | -86.57 |
| SELV | 180.0 |
| SHOW | -0.95 |
| LIFT | -1.59 |
| LFTV | -1.71 |
| SWET | 380.5 |
| KINX | 35.10 |
| CTOT | 24.70 |
| VTOT | 26.70 |
| TOTL | 51.40 |
| CAPE | 238.3 |
| CAPV | 263.9 |
| CINS | -35.8 |
| CINV | -30.0 |
| EQLV | 334.0 |
| EQTV | 333.8 |
| LFCT | 747.1 |
| LFCV | 778.7 |
| BRCH | 1.83 |
| BRCV | 2.03 |
| LCLT | 285.1 |
| LCLP | 879.3 |
| MLTH | 295.8 |
| MLMR | 10.11 |
| THCK | 562.0 |
| PWAT | 31.56 |

00Z 21 Feb 2014

University of Wyoming

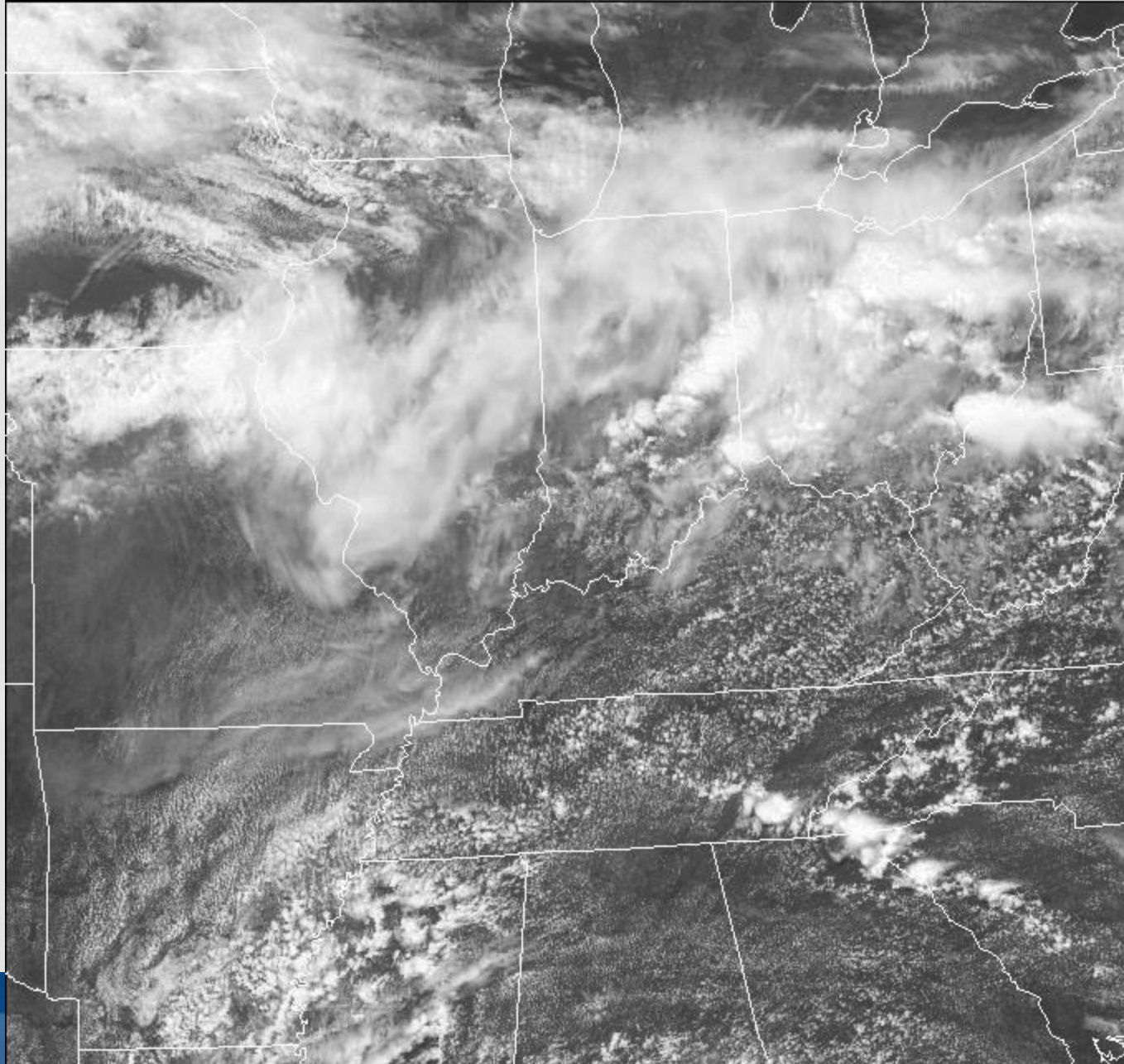


1745 UTC Sat 05 Jun 2010

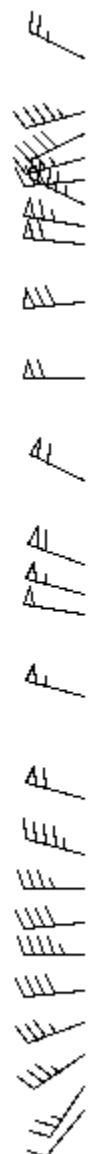
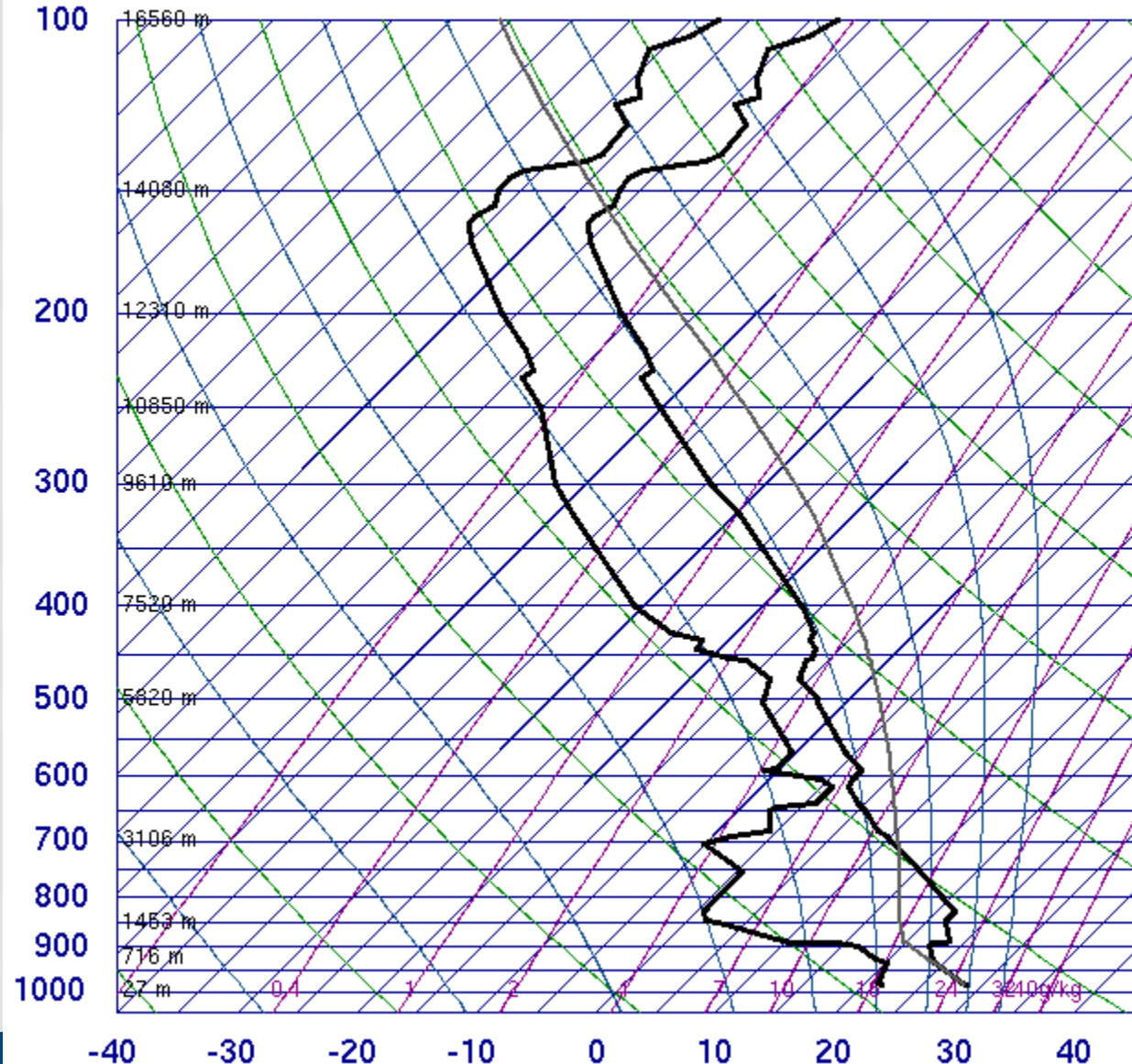
Visible Satellite

<http://adds.aviationweather.gov>

0 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 60 63 66 69 72 75 78 81 84 87 90 93 96 99



74560 ILX Lincoln



| | |
|------|--------|
| SLAT | 40.15 |
| SLON | -89.33 |
| SELV | 178.0 |
| SHOW | 5.40 |
| LIFT | -5.28 |
| LFTV | -5.84 |
| SWET | 279.0 |
| KINX | 17.30 |
| CTOT | 10.50 |
| VTOT | 29.50 |
| TOTL | 40.00 |
| CAPE | 2096. |
| CAPV | 2247. |
| CINS | -199. |
| CINV | -102. |
| EQLV | 156.4 |
| EQTV | 156.4 |
| LFCT | 710.0 |
| LFCV | 742.5 |
| BRCH | 20.76 |
| BRCV | 22.25 |
| LCLT | 292.5 |
| LCLP | 883.3 |
| MLTH | 303.1 |
| MLMR | 16.36 |
| THCK | 5793. |
| PWAT | 37.41 |

00Z 06 Jun 2010

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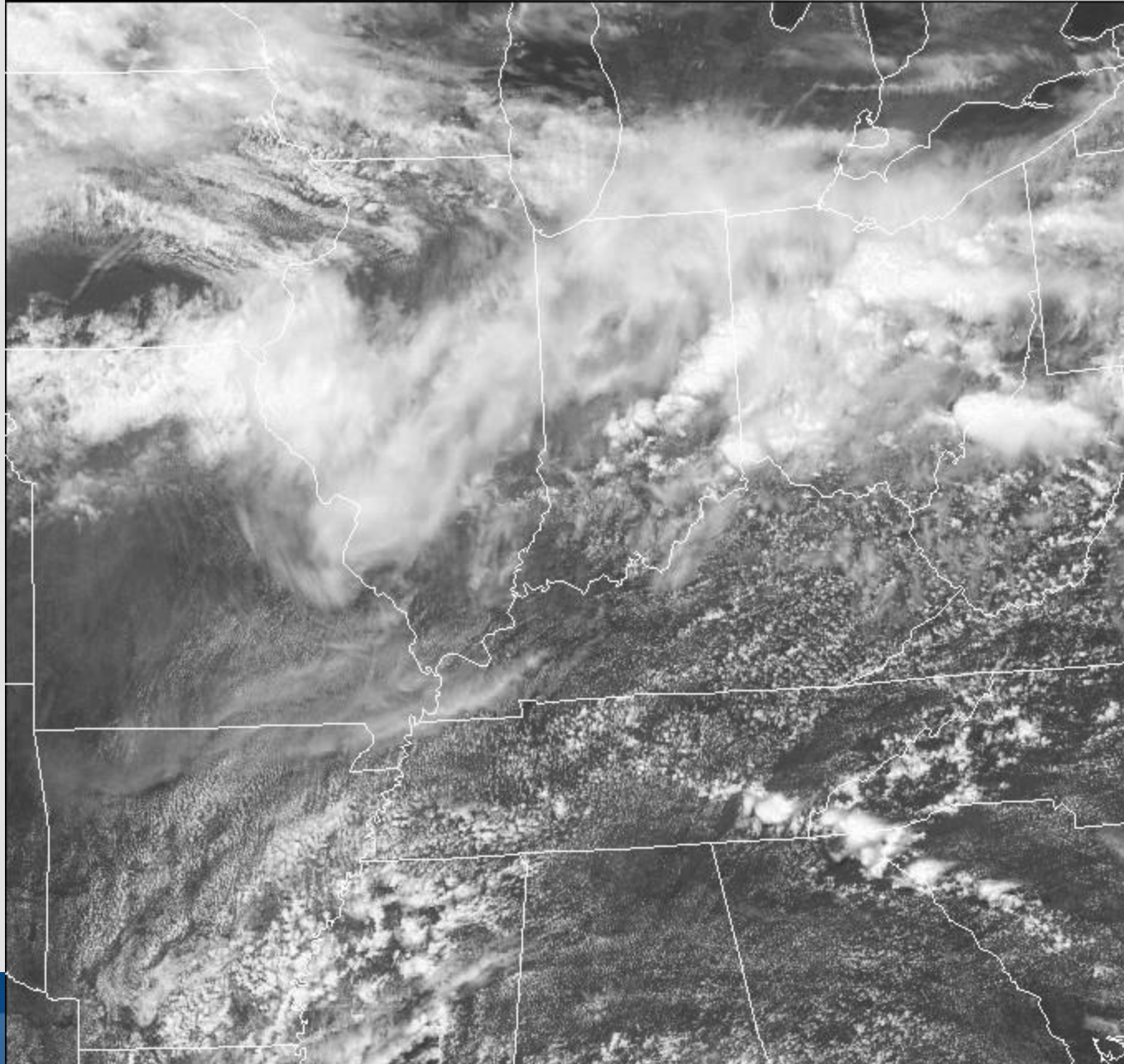


1745 UTC Sat 05 Jun 2010

Visible Satellite

<http://adds.aviationweather.gov>

0 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 60 63 66 69 72 75 78 81 84 87 90 93 96 99

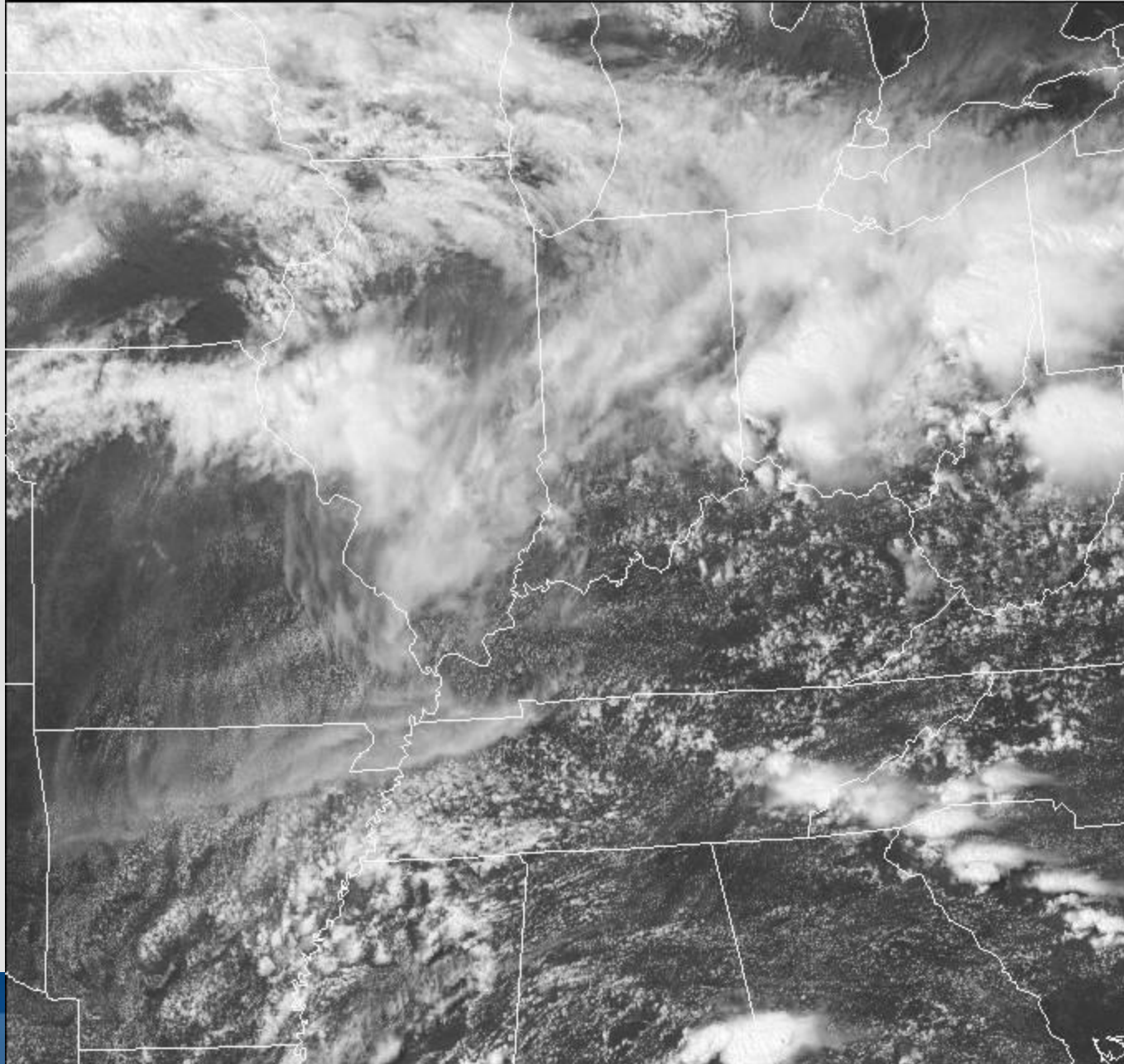


1915 UTC Sat 05 Jun 2010

Visible Satellite

<http://adds.aviationweather.gov>

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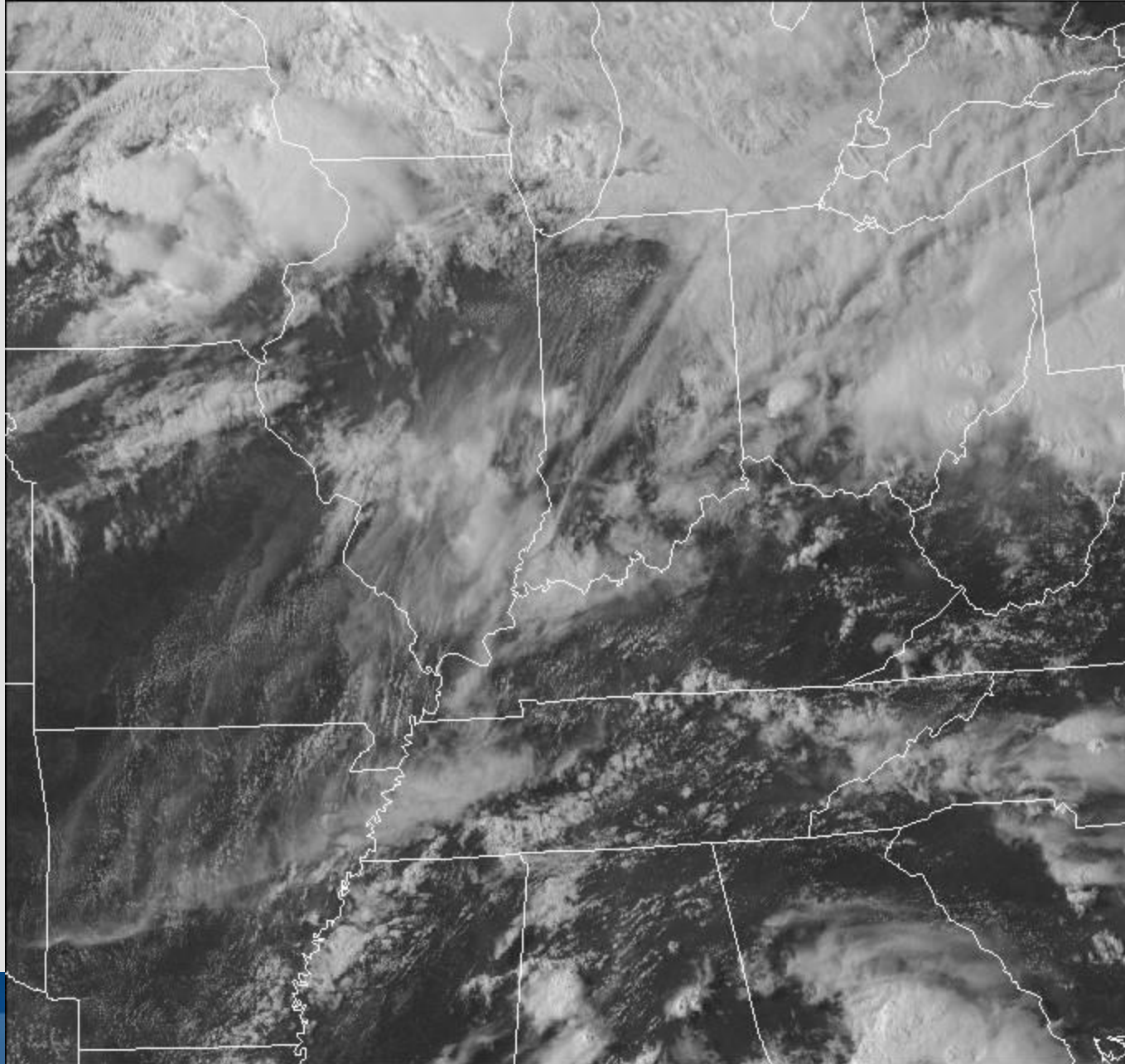


2145 UTC Sat 05 Jun 2010

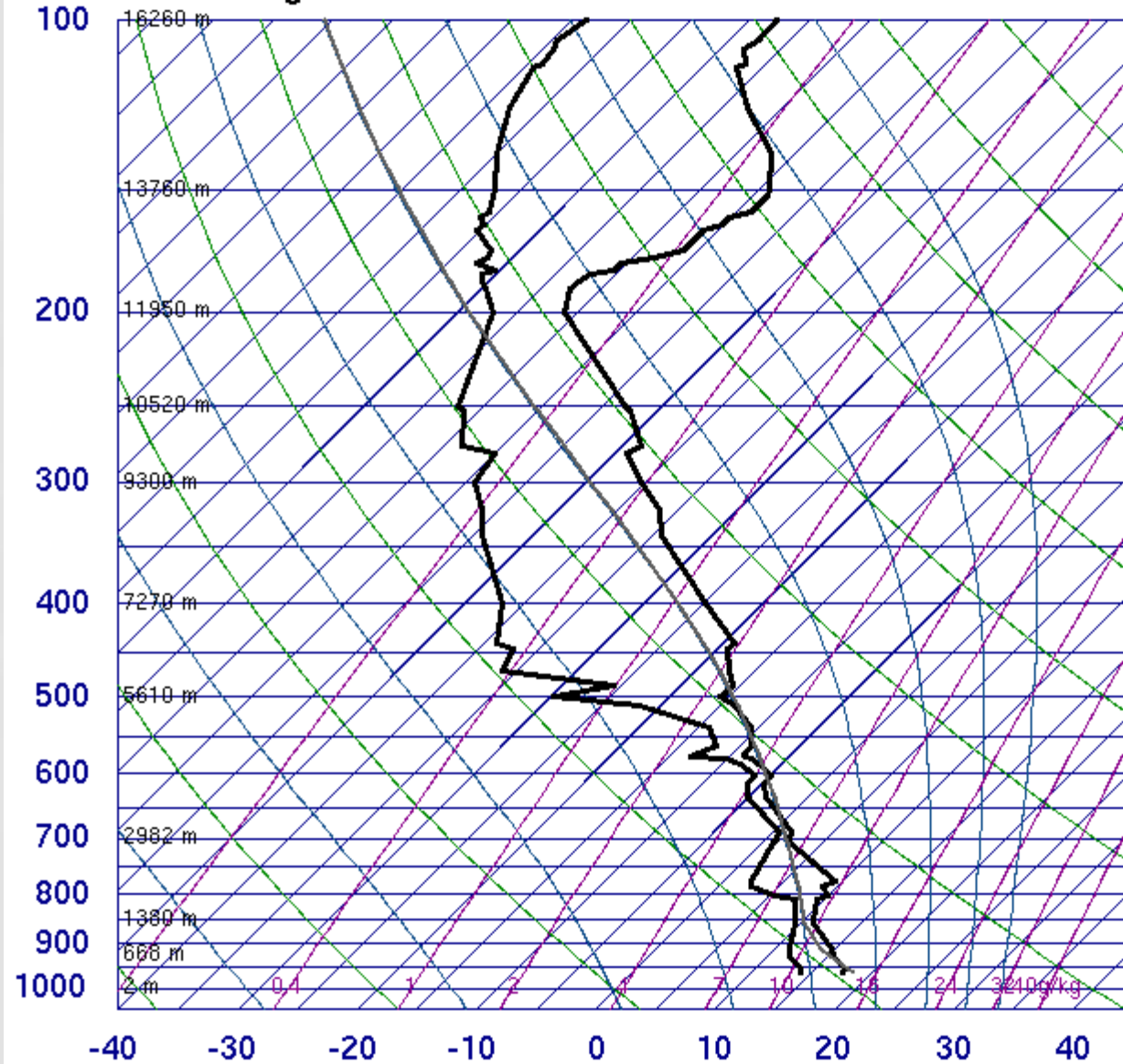
Visible Satellite

<http://adds.aviationweather.gov>

0 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 60 63 66 69 72 75 78 81 84 87 90 93 96 99



72426 ILN Wilmington



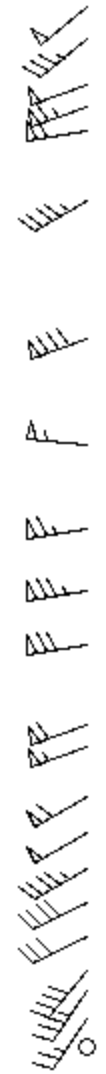
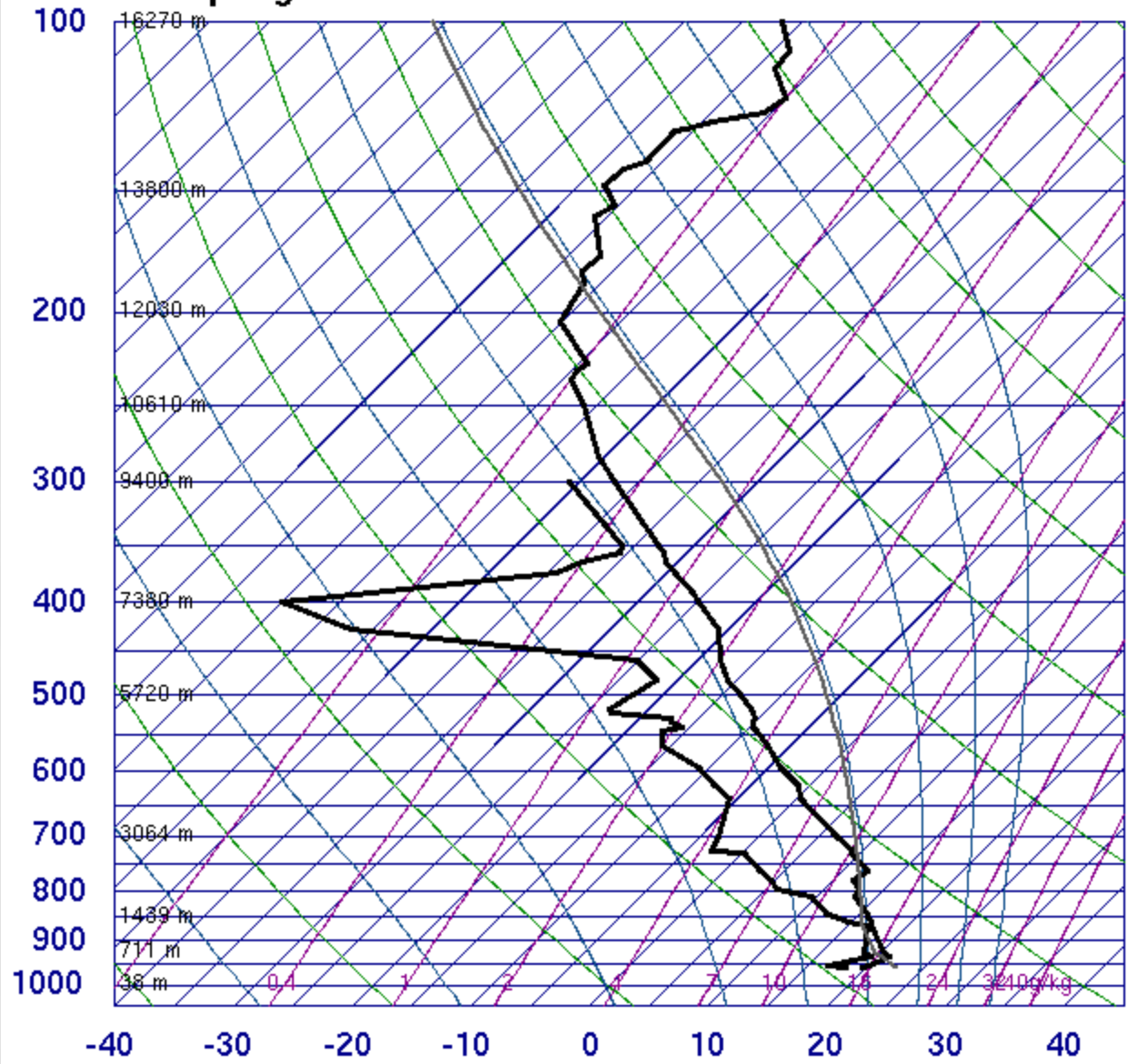
| | |
|------|--------|
| SLAT | 39.41 |
| SLOE | -83.81 |
| SELV | 317.0 |
| SHOW | -0.89 |
| LIFT | -1.05 |
| LFTV | -1.33 |
| SWET | 353.6 |
| KINX | 34.60 |
| CTOT | 25.00 |
| VTOT | 26.50 |
| TOTL | 51.50 |
| CAPE | 30.69 |
| CAPV | 41.65 |
| CINS | -113. |
| CINV | -101. |
| EQLV | 490.3 |
| EQTV | 488.4 |
| LFCT | 666.4 |
| LFCV | 668.8 |
| BRCH | 0.23 |
| BRCV | 0.31 |
| LCLT | 284.8 |
| LCLP | 886.5 |
| MLTH | 294.8 |
| MLMR | 9.86 |
| THCK | 5608. |
| PWAT | 29.02 |

00Z 24 Dec 2015

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72440 SGF Springfield



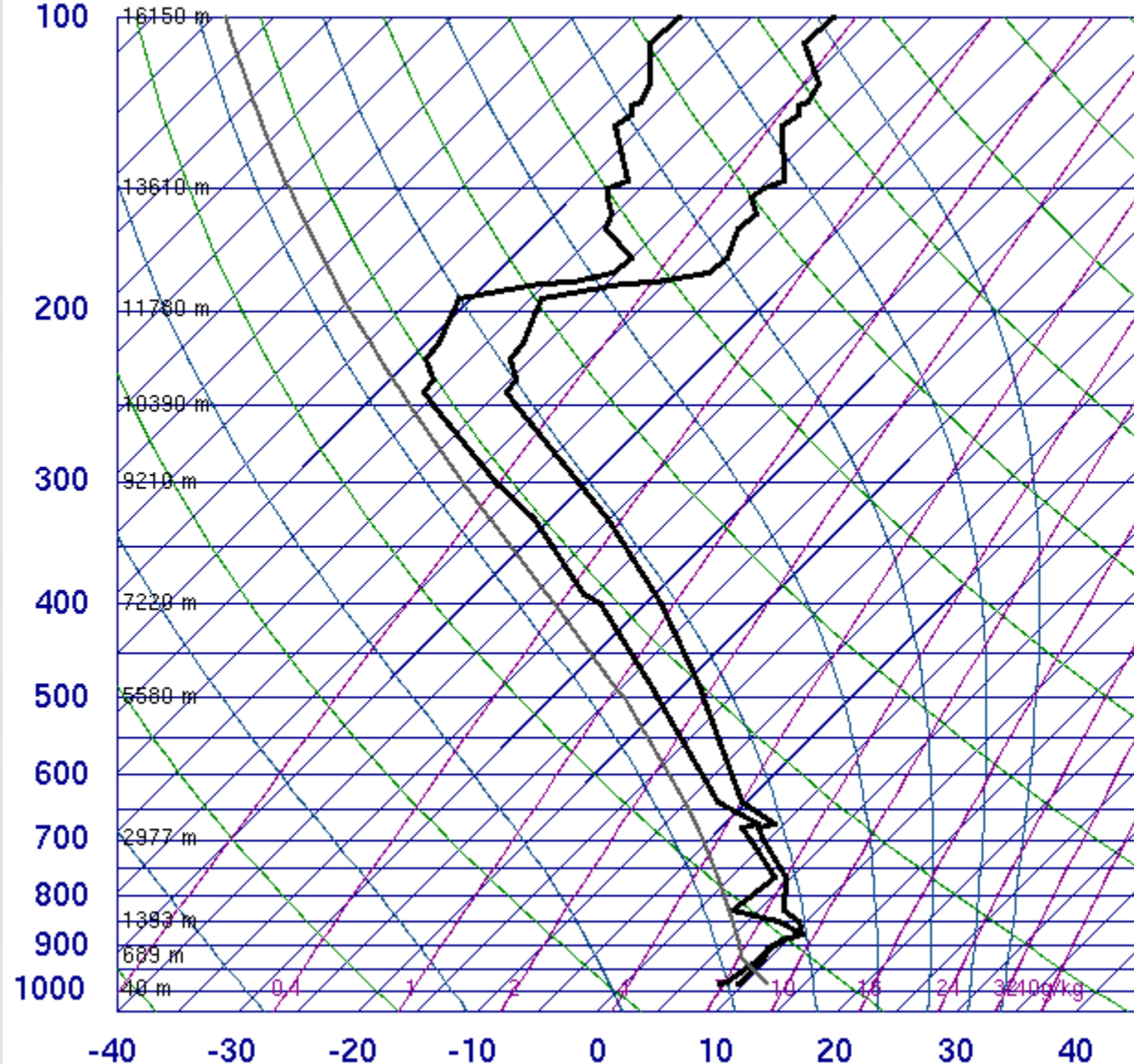
| | |
|------|--------|
| SLAT | 37.23 |
| SLON | -93.38 |
| SELV | 387.0 |
| SHOW | -5.34 |
| LIFT | -7.32 |
| LFTV | -7.90 |
| SWET | 529.2 |
| KINX | 32.80 |
| CTOT | 26.80 |
| VTOT | 29.50 |
| TOTL | 56.30 |
| CAPE | 2492. |
| CAPV | 2650. |
| CINS | -18.8 |
| CINV | -16.3 |
| EQLV | 188.3 |
| EQTV | 188.3 |
| LFCT | 828.1 |
| LFCV | 842.5 |
| BRCH | 29.85 |
| BRCV | 31.74 |
| LCLT | 291.0 |
| LCLP | 906.1 |
| MLTH | 299.3 |
| MLMR | 14.50 |
| THCK | 5682. |
| PWAT | 33.70 |

00Z 23 Apr 2011

University of Wyoming



74560 ILX Lincoln



| | |
|------|--------|
| SLAT | 40.15 |
| SLON | -89.33 |
| SELV | 178.0 |
| SHOW | -0.22 |
| LIFT | 6.65 |
| LFTV | 6.70 |
| SWET | 380.7 |
| KINX | 33.20 |
| CTOT | 25.00 |
| VTOT | 26.70 |
| TOTL | 51.70 |
| CAPE | 0.00 |
| CAPV | 0.00 |
| CINS | 0.00 |
| CINV | 0.00 |
| EQLV | -9999 |
| EQTV | -9999 |
| LFCT | -9999 |
| LFCV | -9999 |
| BRCH | 0.00 |
| BRCV | 0.00 |
| LCLT | 281.7 |
| LCLP | 943.8 |
| MLTH | 286.4 |
| MLMR | 7.49 |
| THCK | 554.0 |
| PWAT | 27.51 |

12Z 31 Dec 2010

University of Wyoming



Conclusion

- Gravity waves interact with convection relatively frequently
- Stable layer needed for ducting
- Possible in the warm season as well as the cool season
- Looping of images important for detection and evolution
- Most favored during high shear low cape environments