VISTAS Meteorological Modeling

Additional Evaluation Products

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Introduction

- Prior analyses focused on full grids or RPO regions.
- Air quality (AQ) analyses focused on Class 1 areas
  - Relatively few air quality monitors
  - AQ analyses use different methodologies
    - Layer 1 values used exclusively
    - No vertical "interpolations"
  - Desire to better "synch up" AQ/met analyses
- Potential SIP work requires finer scale analyses

Additional Analyses

-
- http://www.baronams.com/projects/VISTAS/select_annual_product.html
- Finer scale analyses products require better quality control of the observations
  - Focused on sites which are outliers in the spatial statistics plots
- State surface statistics
  - Annual Bakergrams
  - Monthly Bakergrams
  - Tabulated statistics
    - 5-day segment
    - Monthly

Additional Analyses (continued)

- Class 1 area analyses
  - Stats from all stations (TDL and AQ) within ~100 km of the site
    - Both with temp adjusted for terrain offsets, and without
    - IMPROVE day bar charts
    - 20% best/worst Bakergrams
  - Time Series for all sites within the statistical area of interest

State Analyses

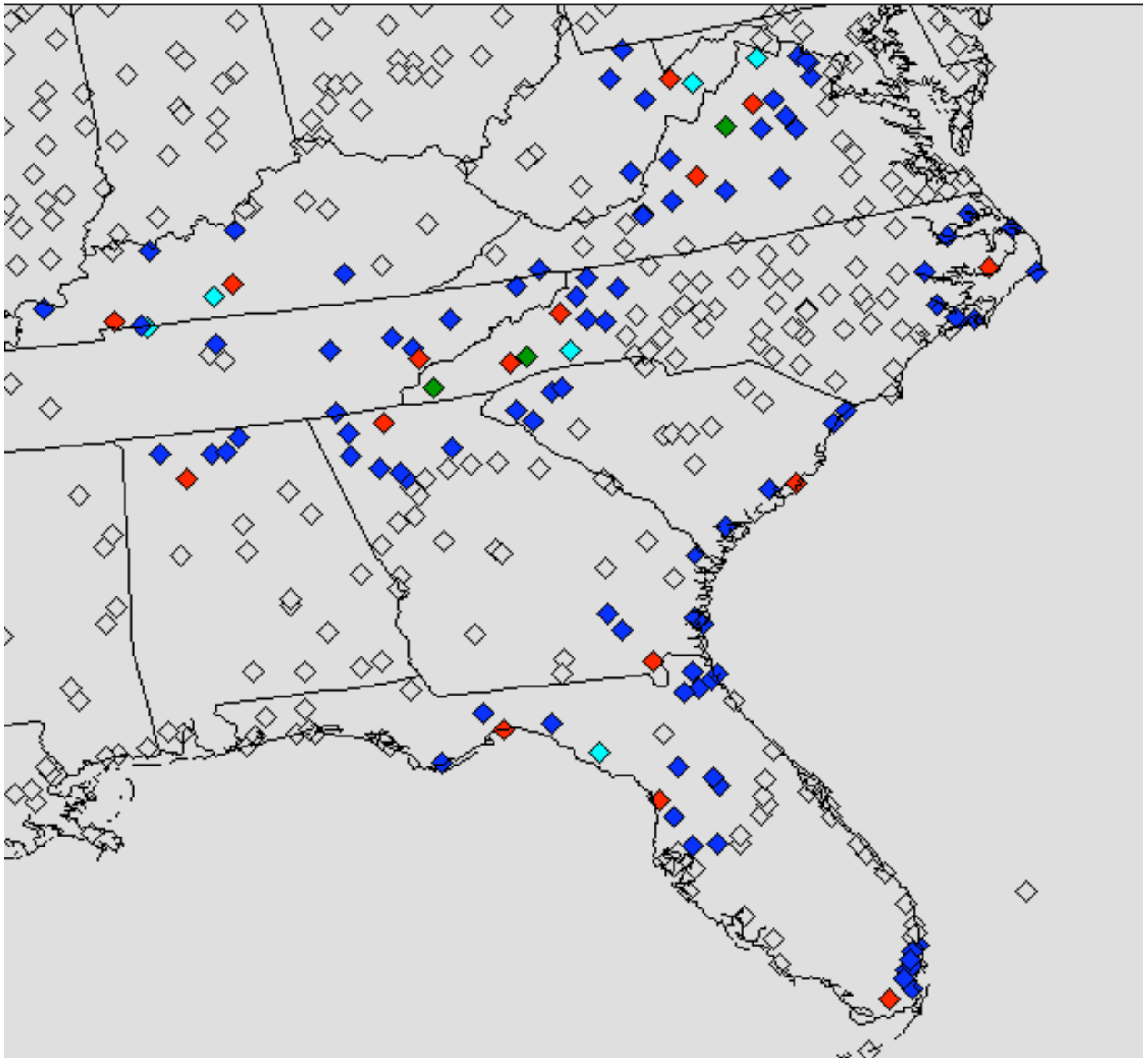
- Results consistent with prior evaluation
  - General cold bias in winter (worse in northern states)
  - Positive cloud bias (at night) in summer
    - Especially in MS
  - Positive wind speed bias (mainly at night when calms are prevalent)
  - Autumnal dry bias
    - Especially in NC/VA
  - Overall “good” performance

Class 1 Analyses

- Statistics calculated on all available sites near the Class 1 site (see image on next slide)
  - All stats calculated in LST for IMPROVE days only
  - Limited number of obs sites reduces value of higher order stats, so focus is on bias/error
- Results presented in bar charts for:
  - Temperature, both with elev adj and without
    - The elevation adjustment makes very little difference
  - Mixing Ratio
  - Wind Speed
  - Wind Direction
  - Cloud Cover
  - Relative Humidity

Class 1 sites (red)

(tdl stn near 1 class 1 site: blue;)
(... near 2 sites: light blue; near 3 sites: green)

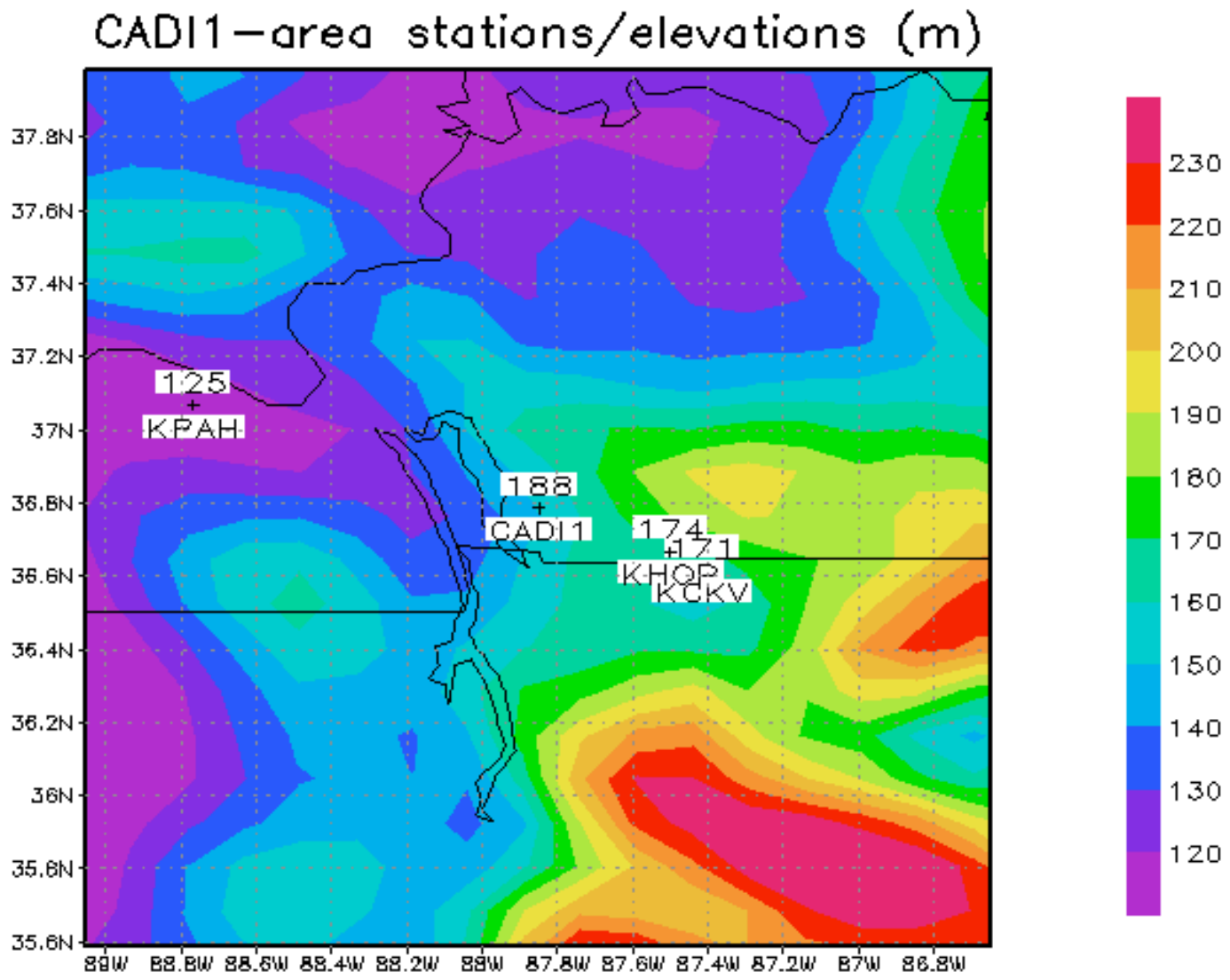


Class 1 Area Site-Specific Maps

- Station id and elevation are plotted against the 12-km MM5 terrain heights (after interpolating to a GrADS-friendly format of similar resolution)
- Useful to determine how representative the observations at/near the Class 1 area are in depicting the likely met conditions at the class 1 site itself
  - Also useful to note how representative the MM5 elevations are compared with the available obs
  - Some sites (e.g. SHEN1, SHRO1) are clear outliers
    - Ramifications for met and air quality analyses
- GrADS: http://grads.iges.org/grads/grads.html

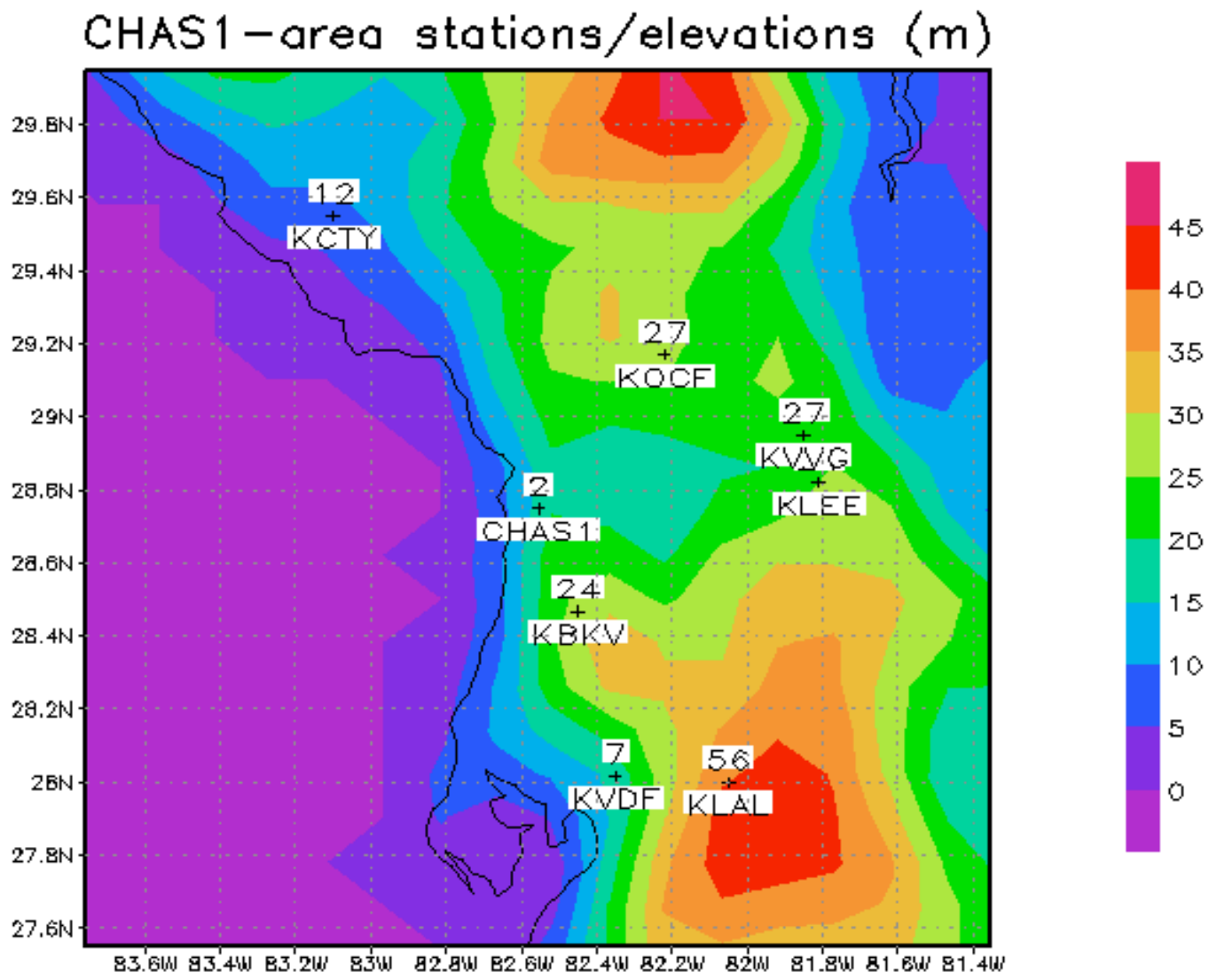
VISTAS Class 1 Sites

- CADI1: Cadiz, KY
- CHAS1: Chassahowitzka, FL
- COHU1: Cohutta, GA
- DOSO1: Dolly Sods, WV
- EVER1: Everglades, FL
- GRSM1: Great Smoky Mountains, TN
- JARI1: James River, VA
- LIGO1: Linville Gorge, NC
- MACA1: Mammoth Cave, KY
- OKEF1: Okefenokee, GA
- ROMA1: Cape Romain, SC
- SAMA1: St. Marks, FL
- SHEN1: Shenandoah, VA
- SHRO1: Shining Rock, NC
- SIPS1: Sypsy, AL
- SWAN1: Swanquarter, NC



GrADS: COLA/IGES

2005-03-31-12:20



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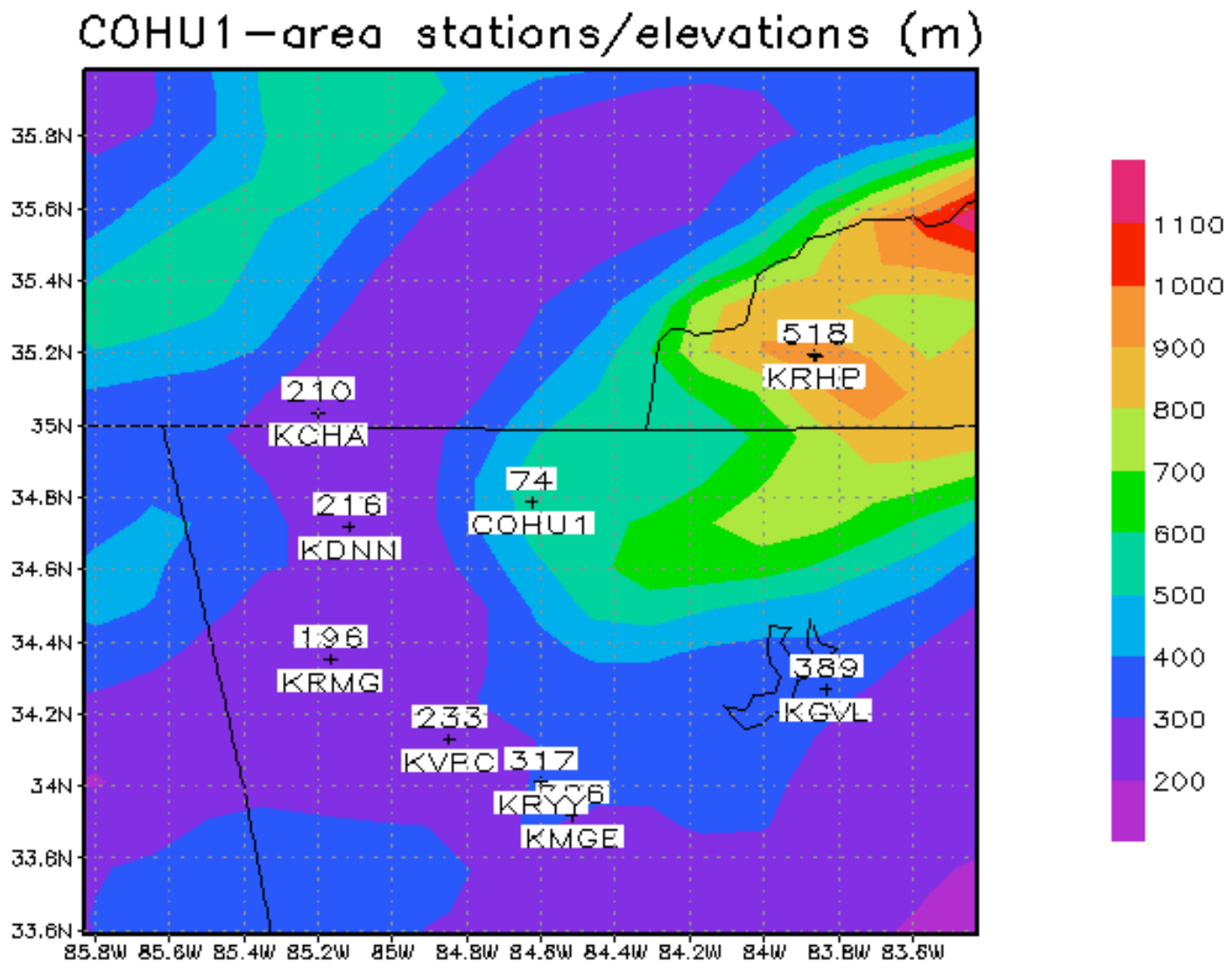

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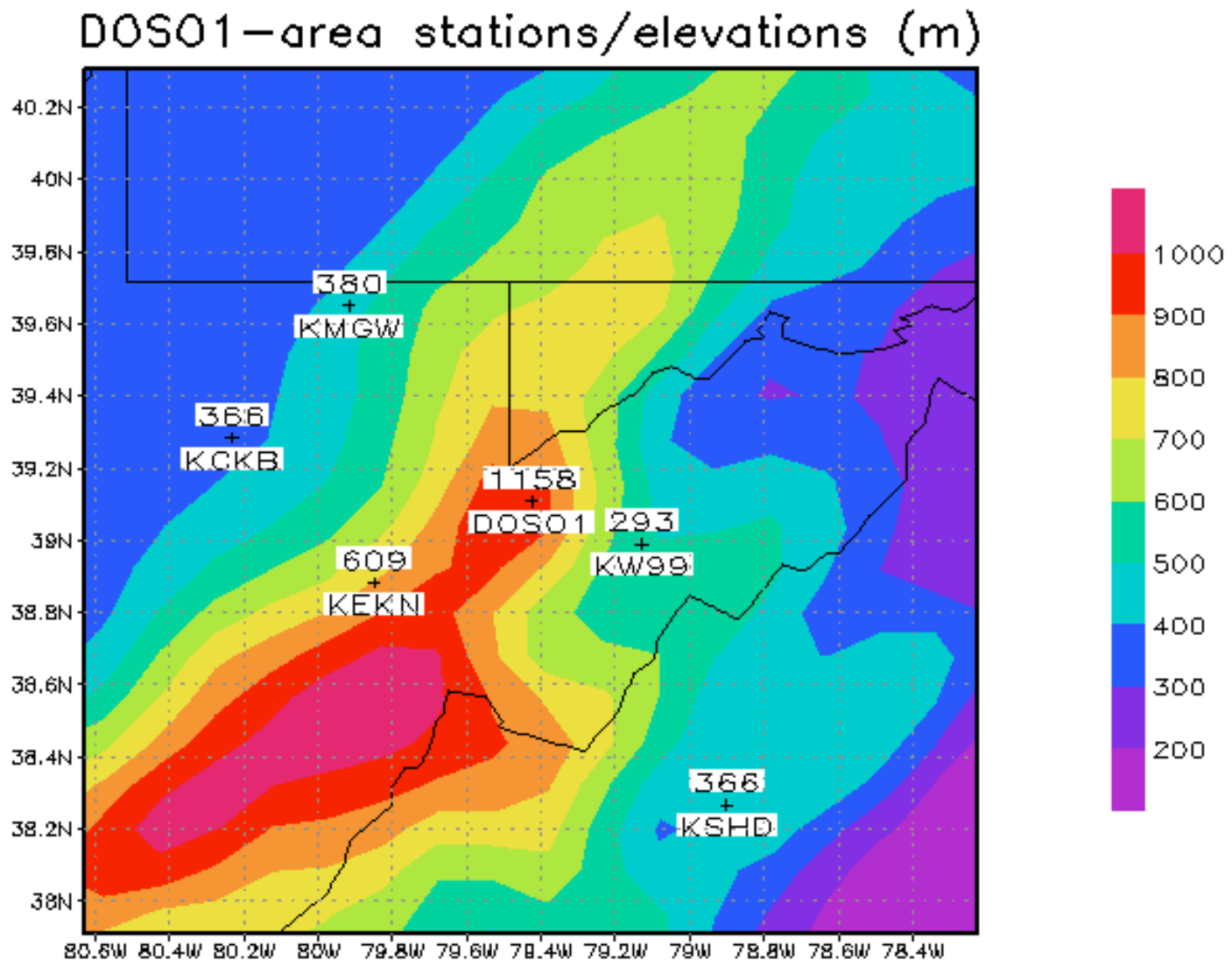

GrADS: COLA/IGES

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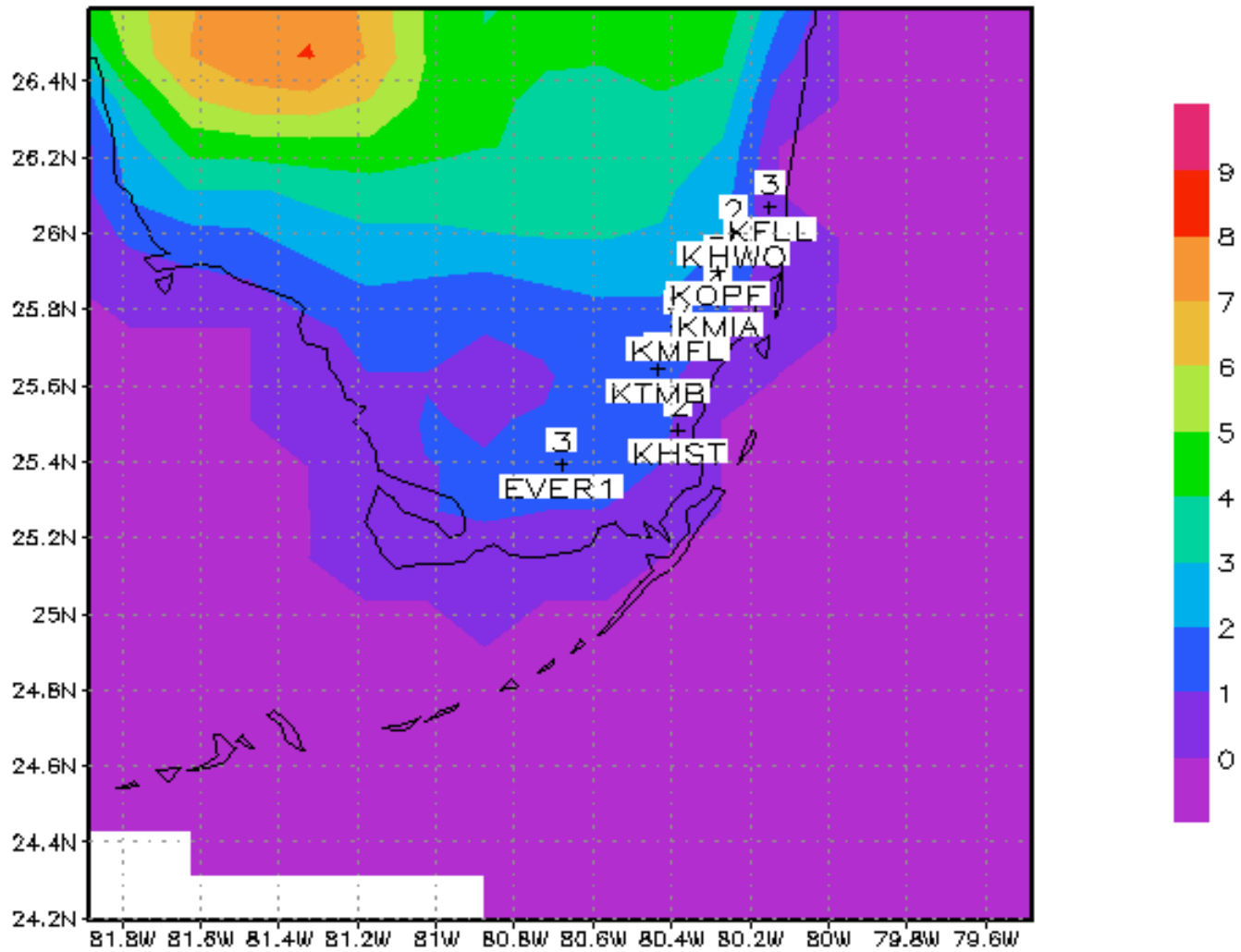
EVER1–area stations/elevations (m)



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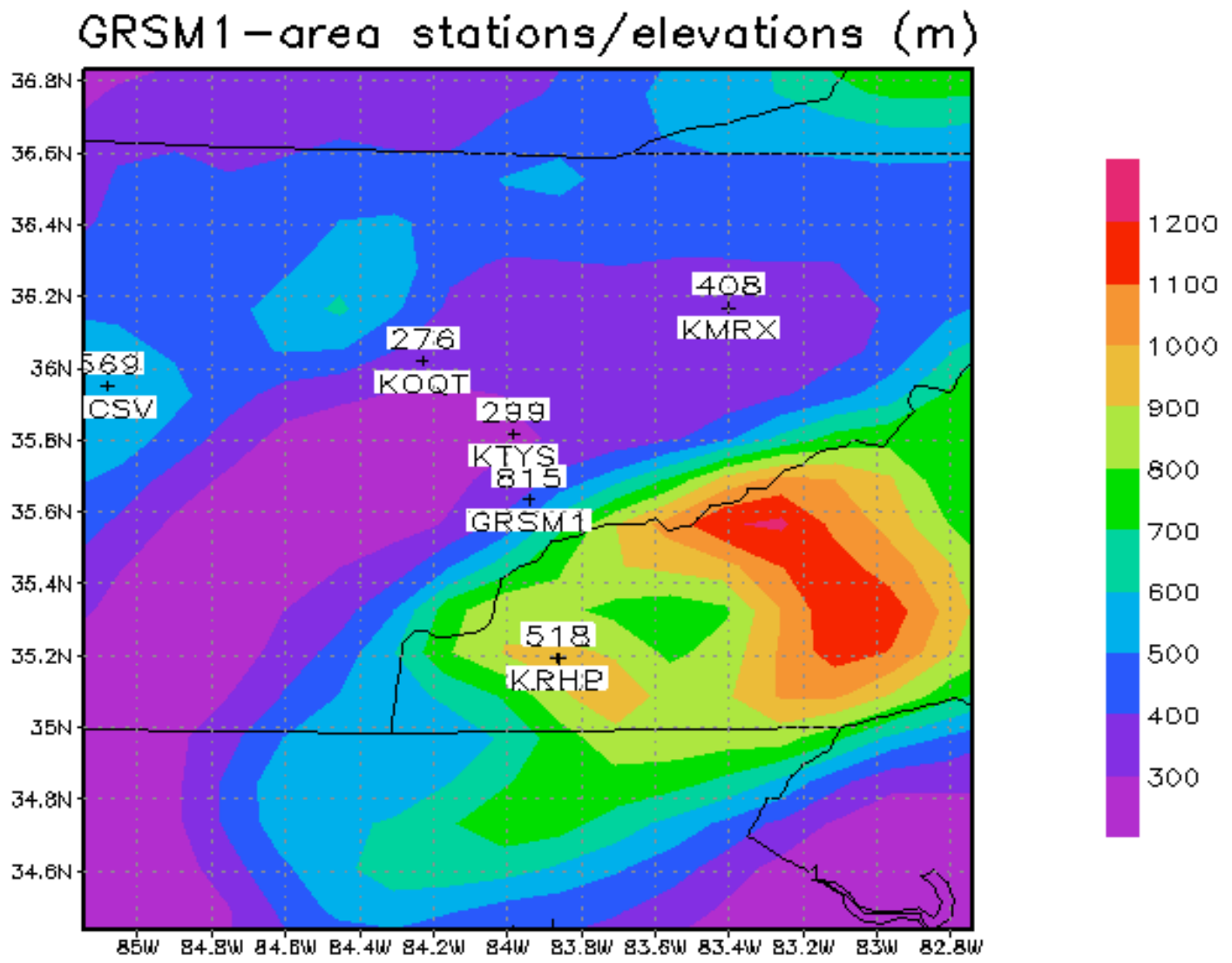

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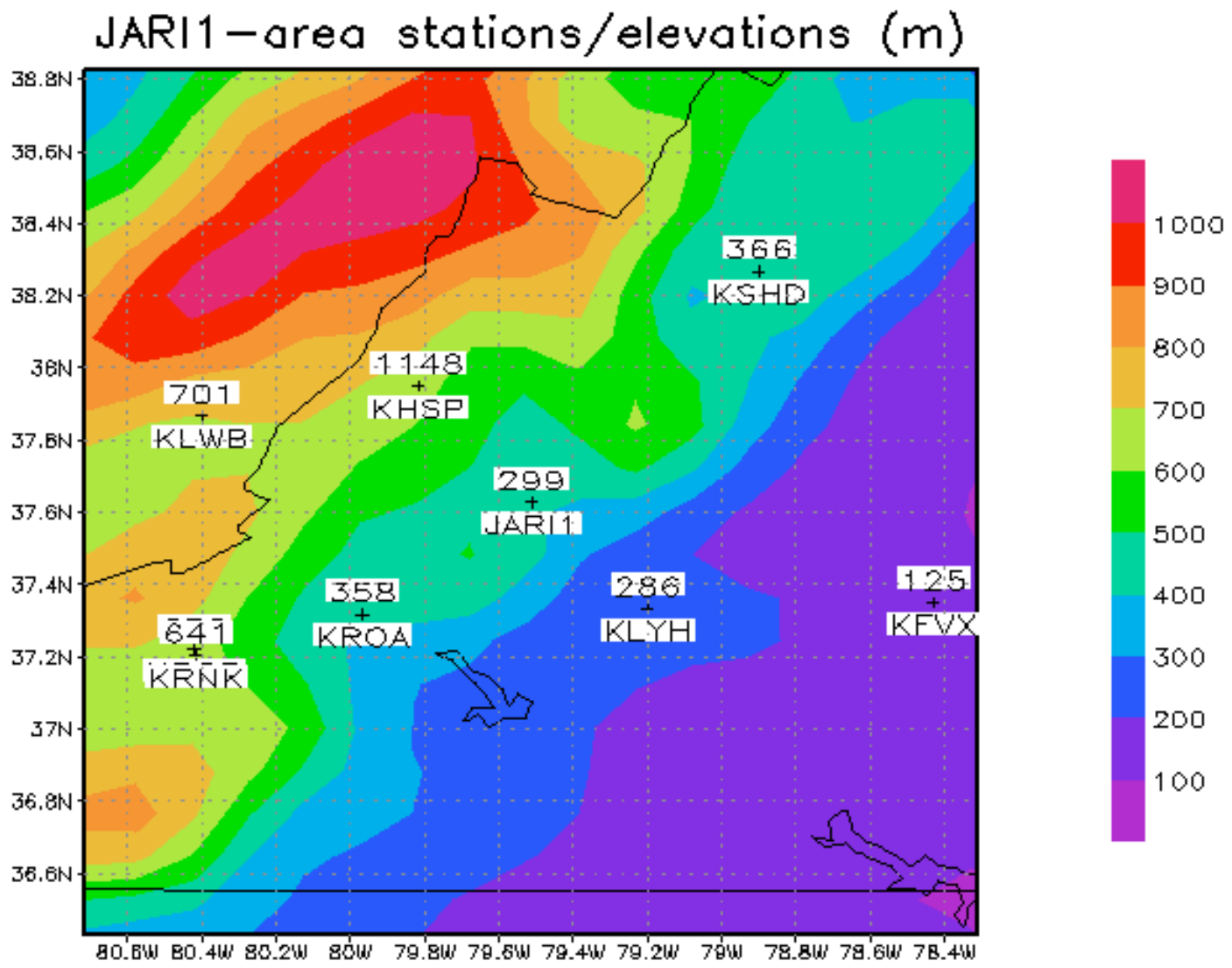

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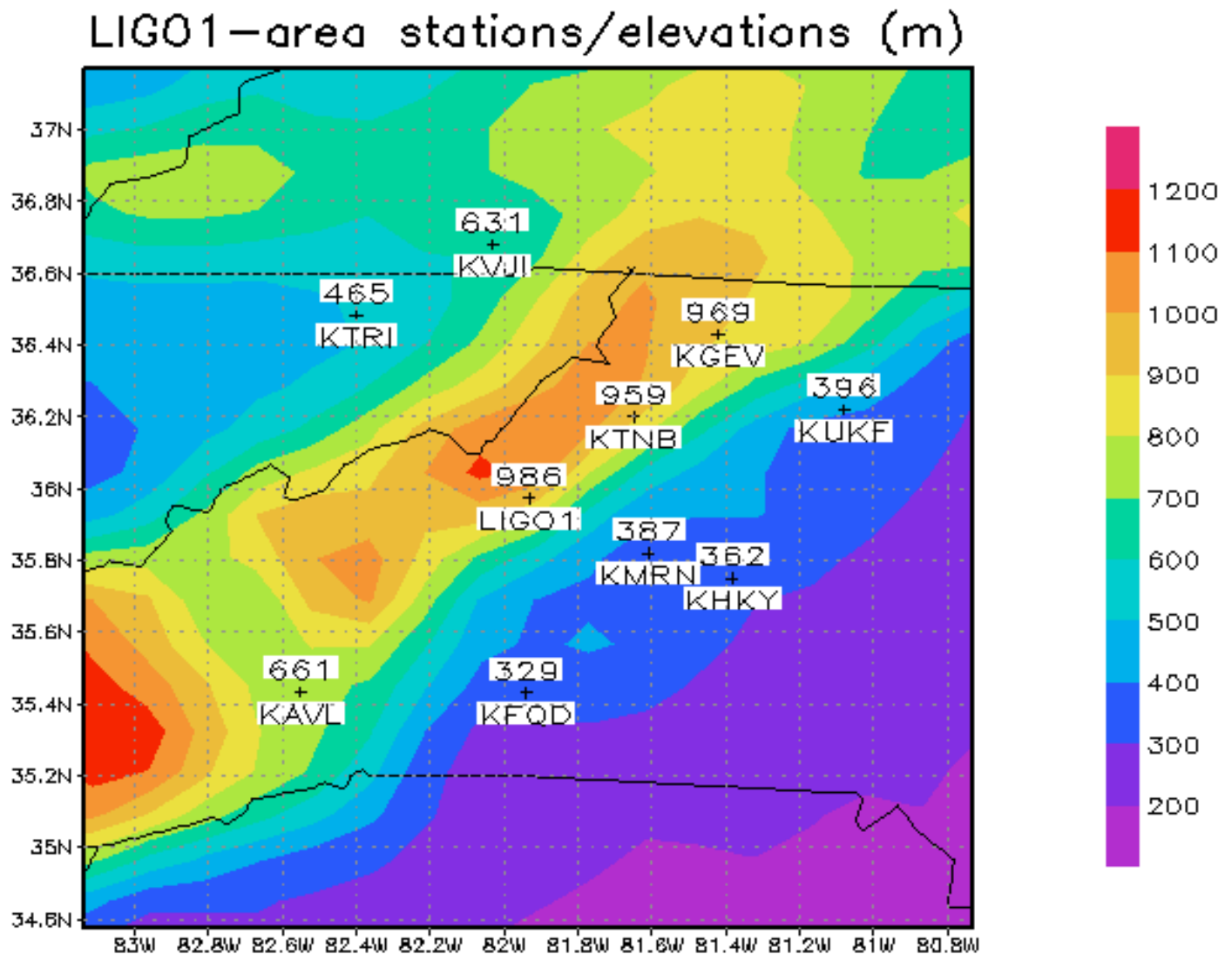

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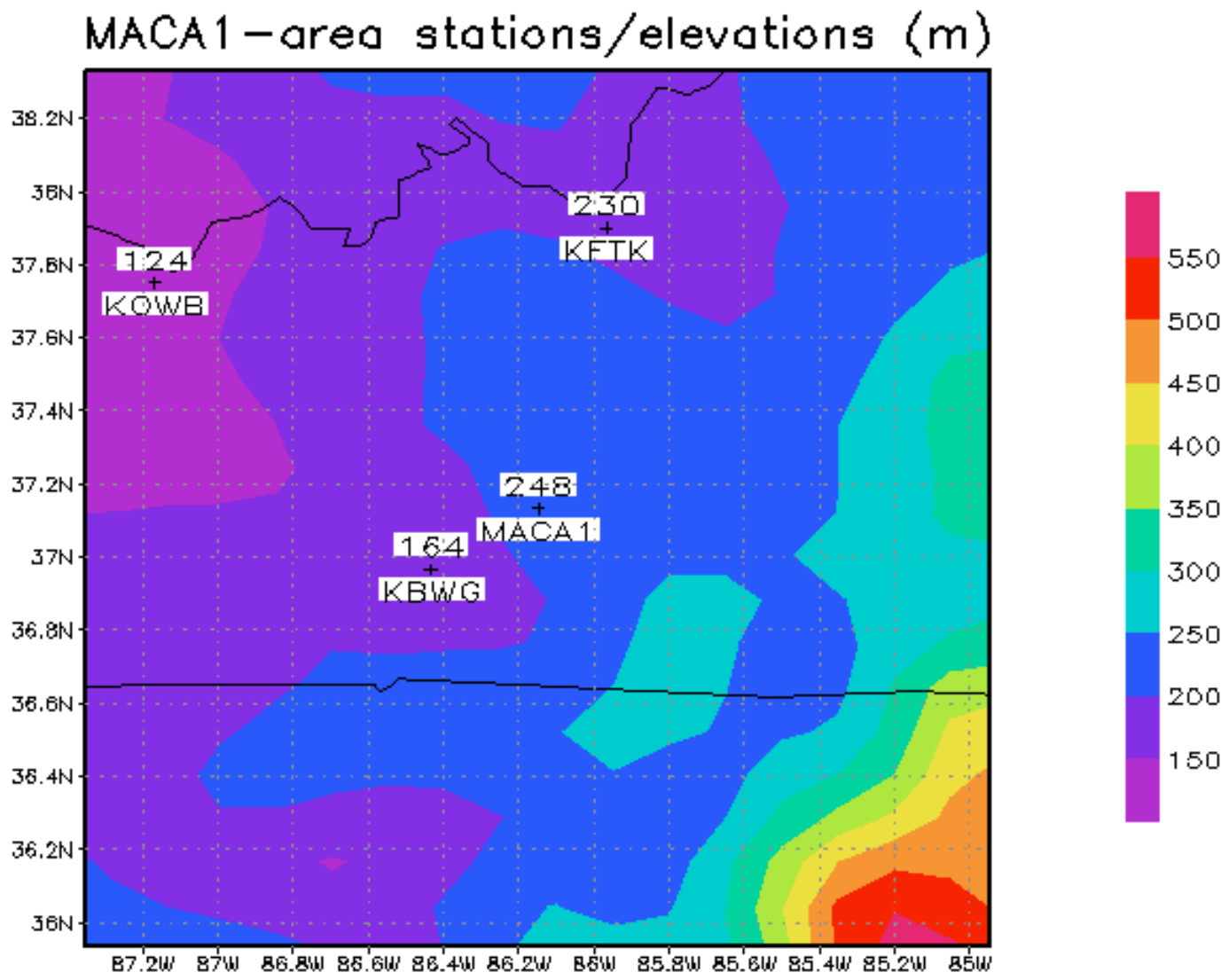

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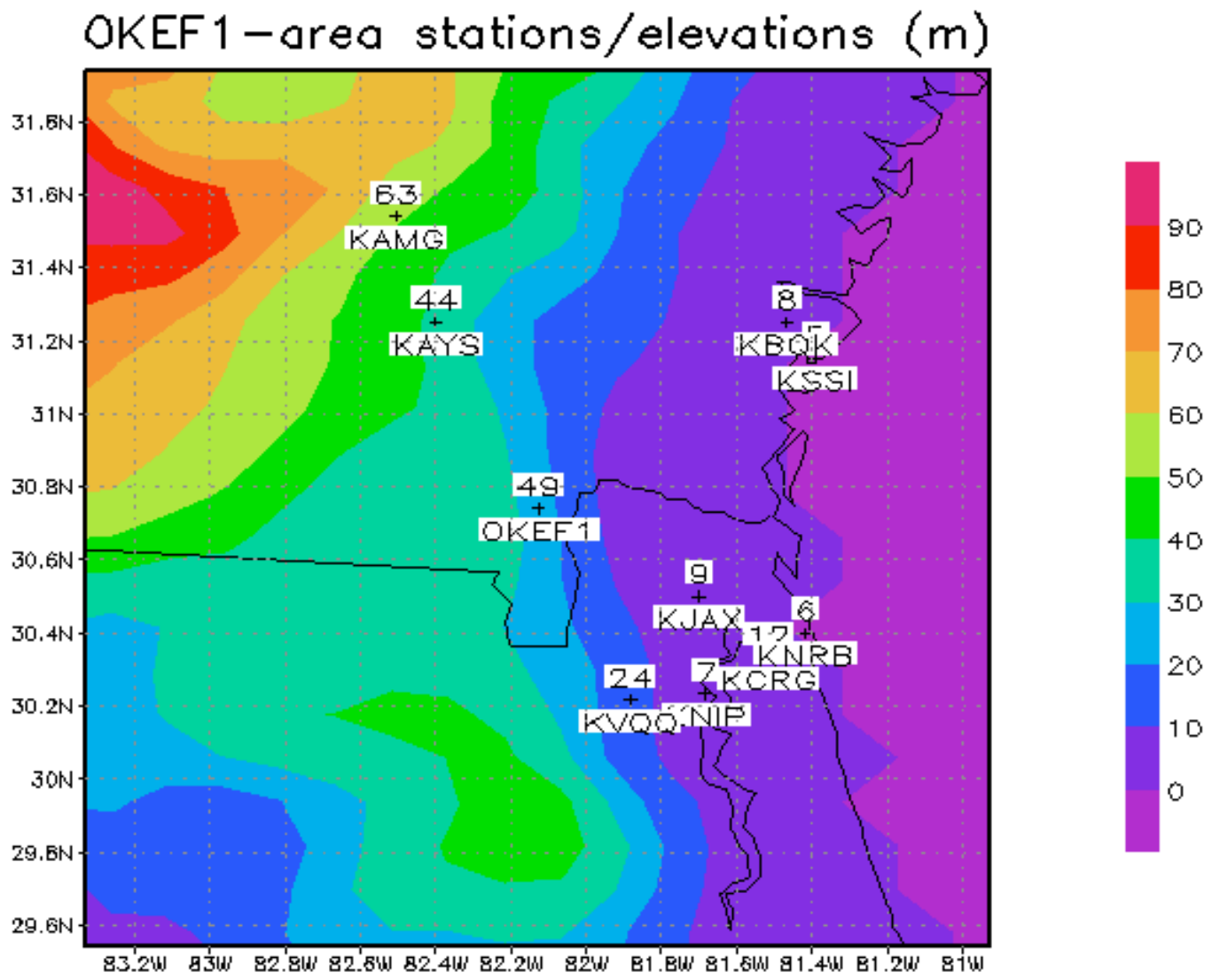

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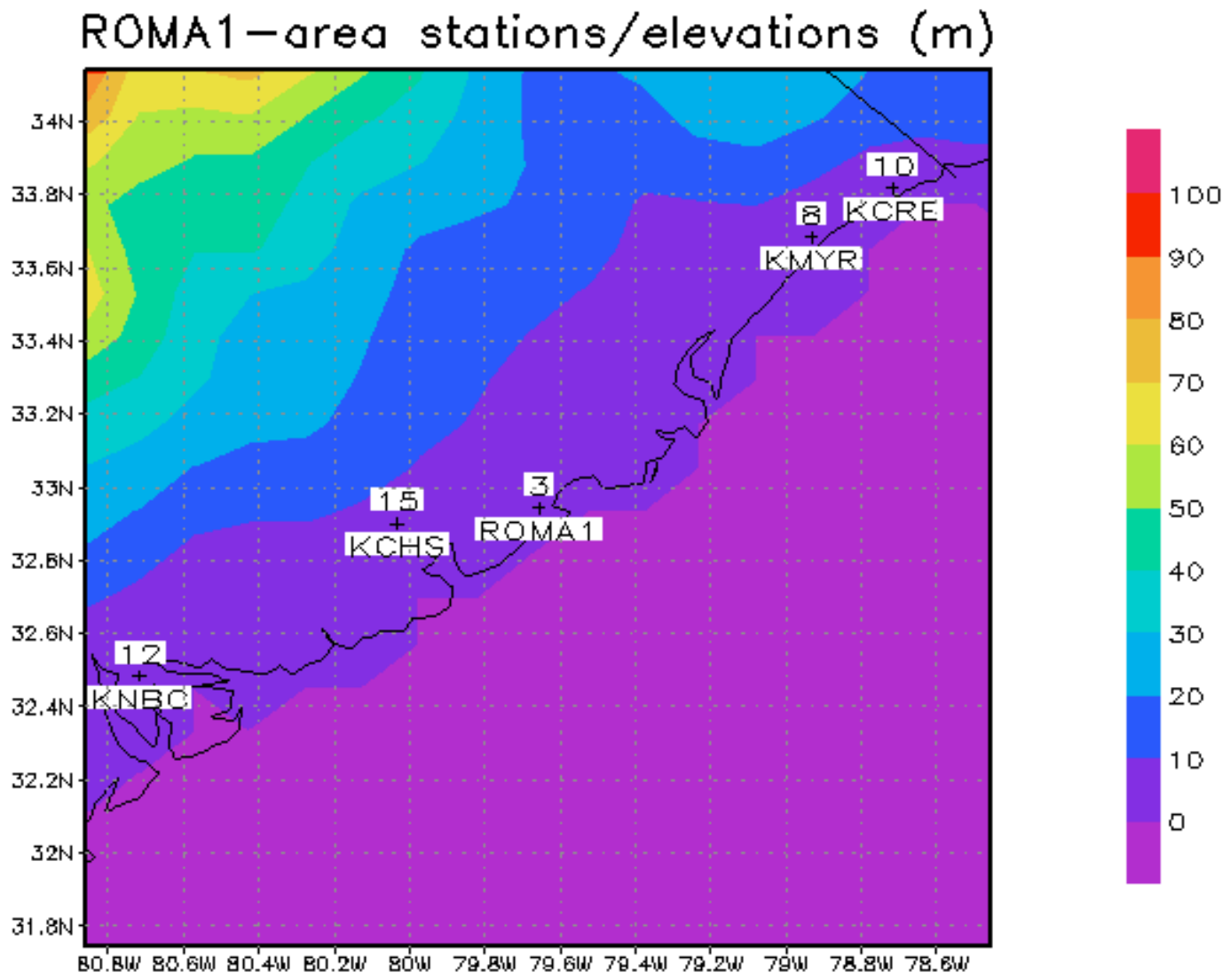

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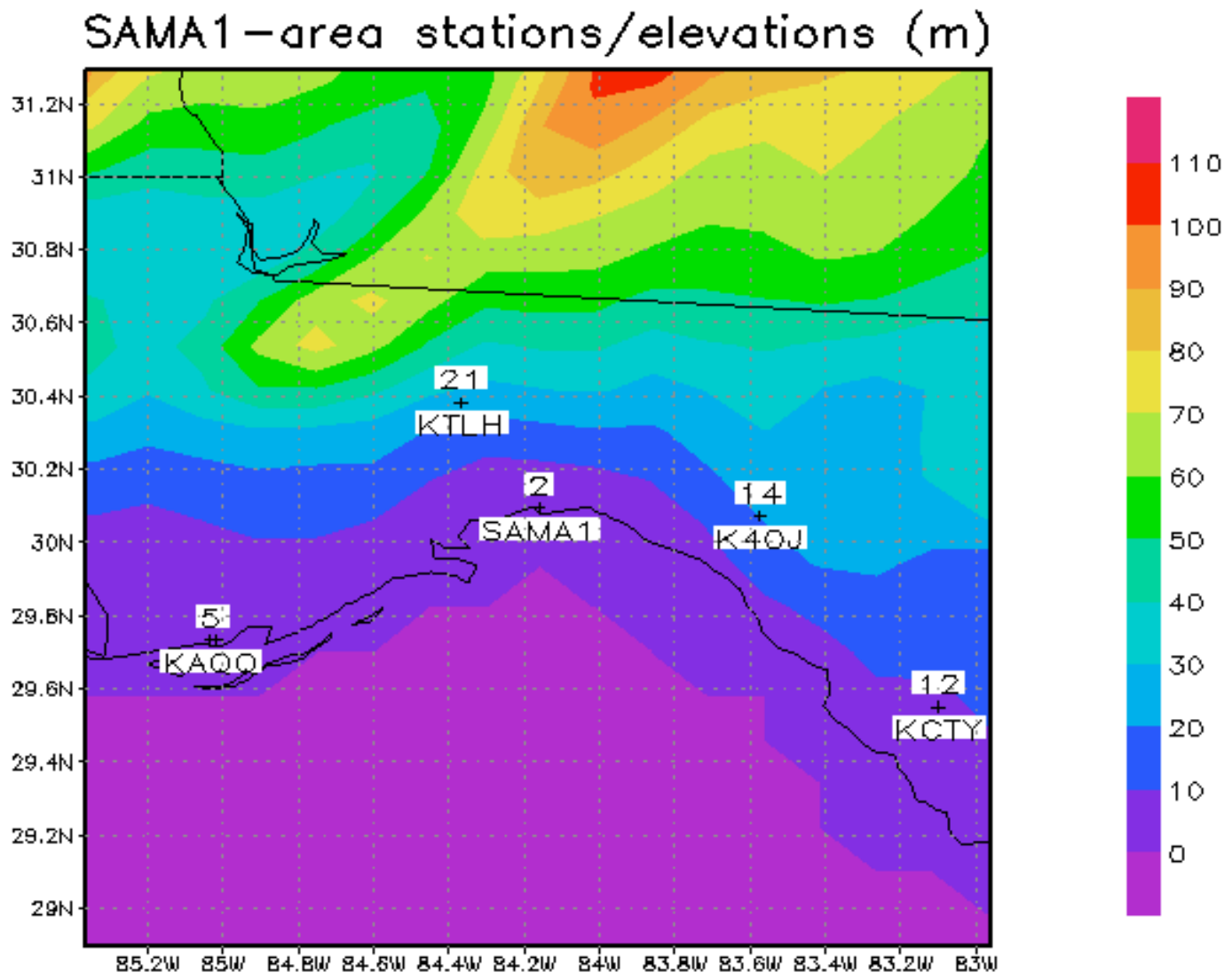

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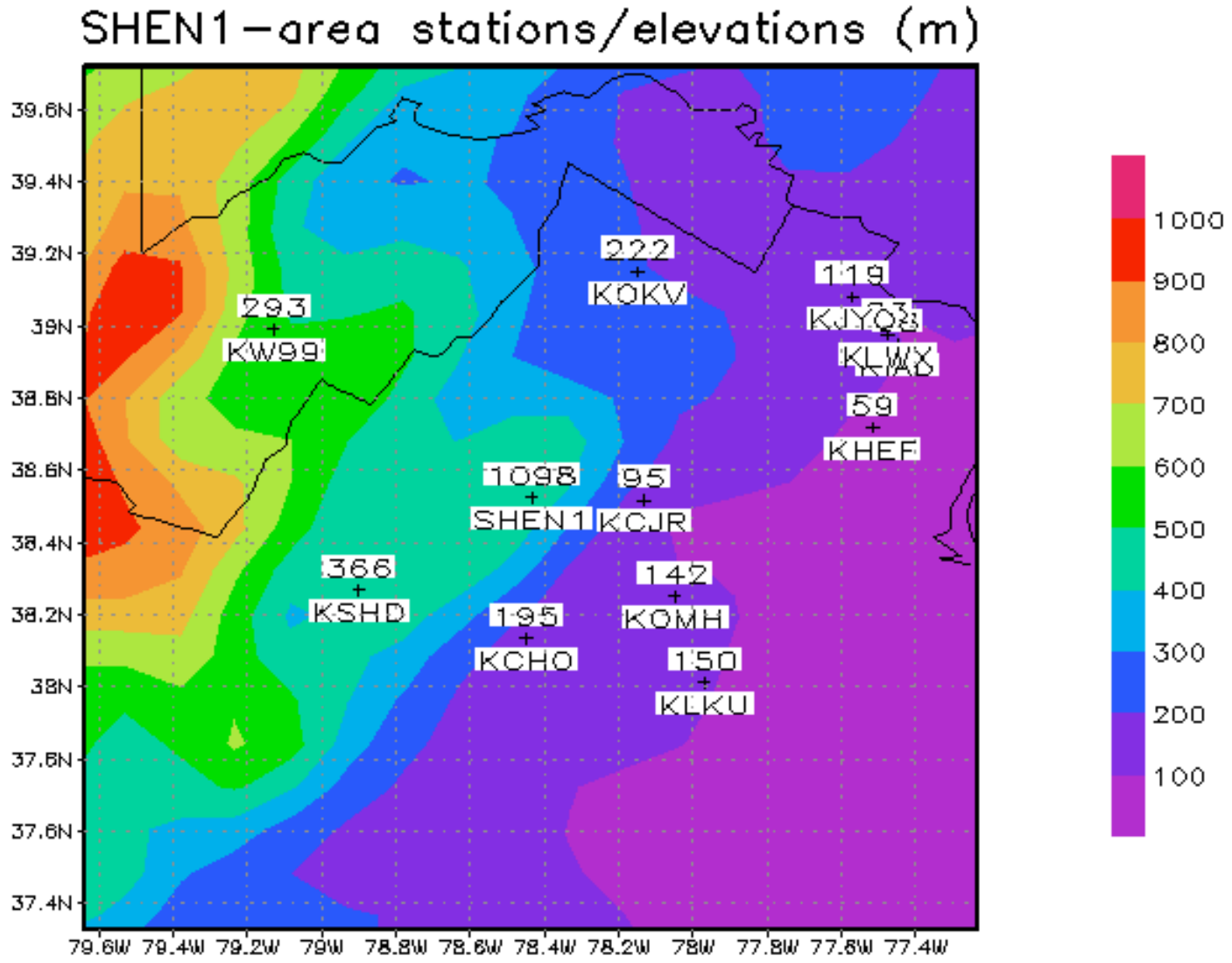

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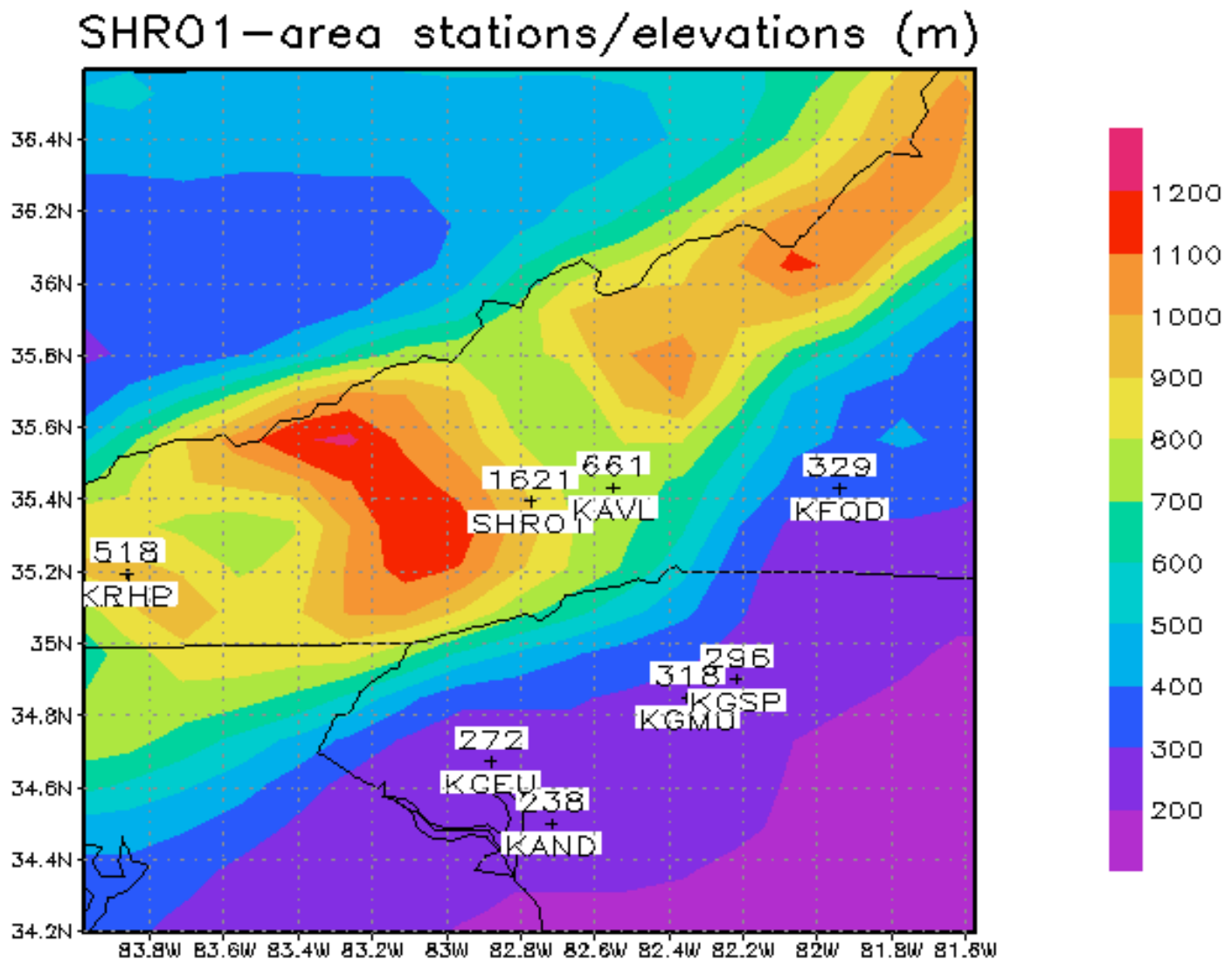

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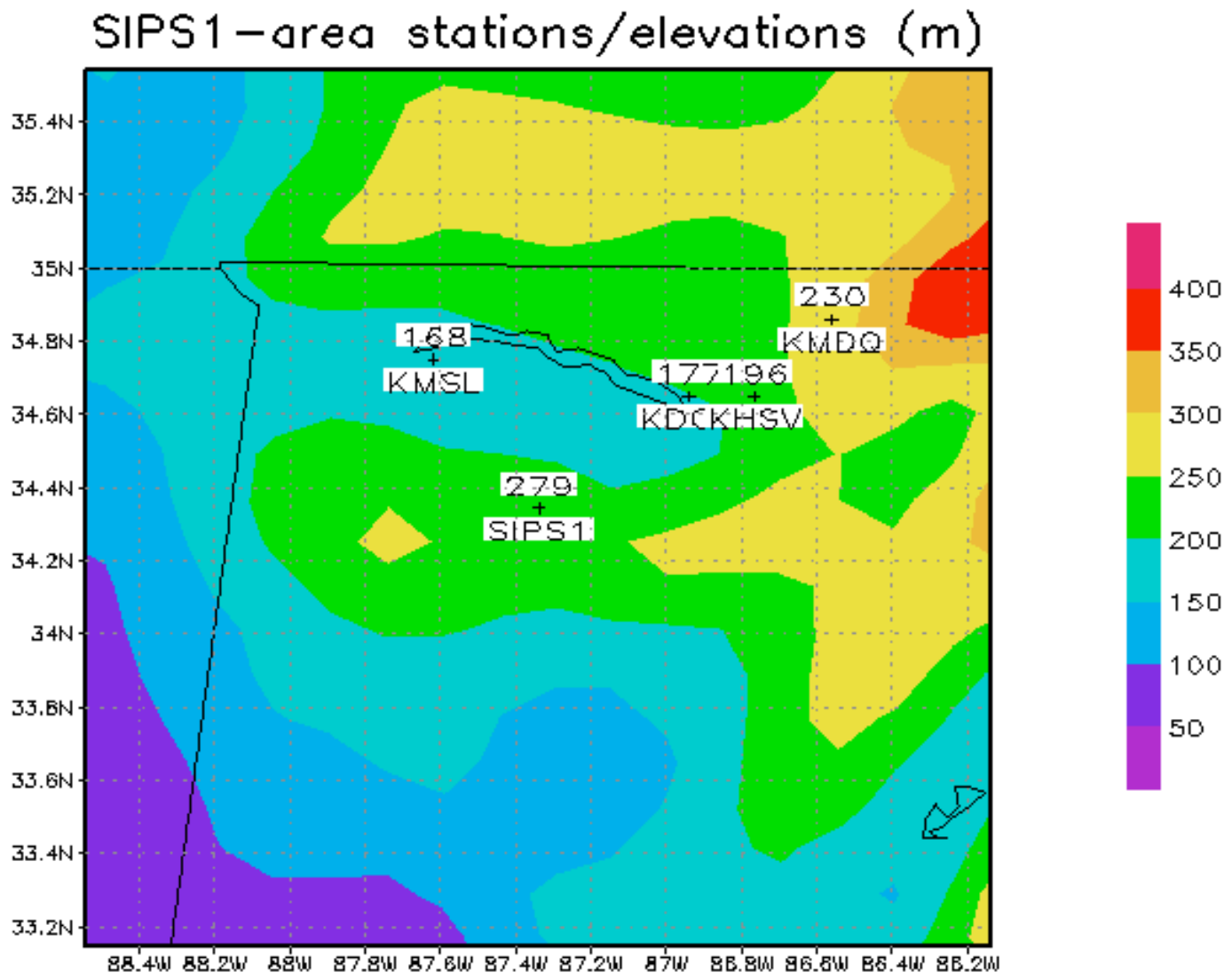

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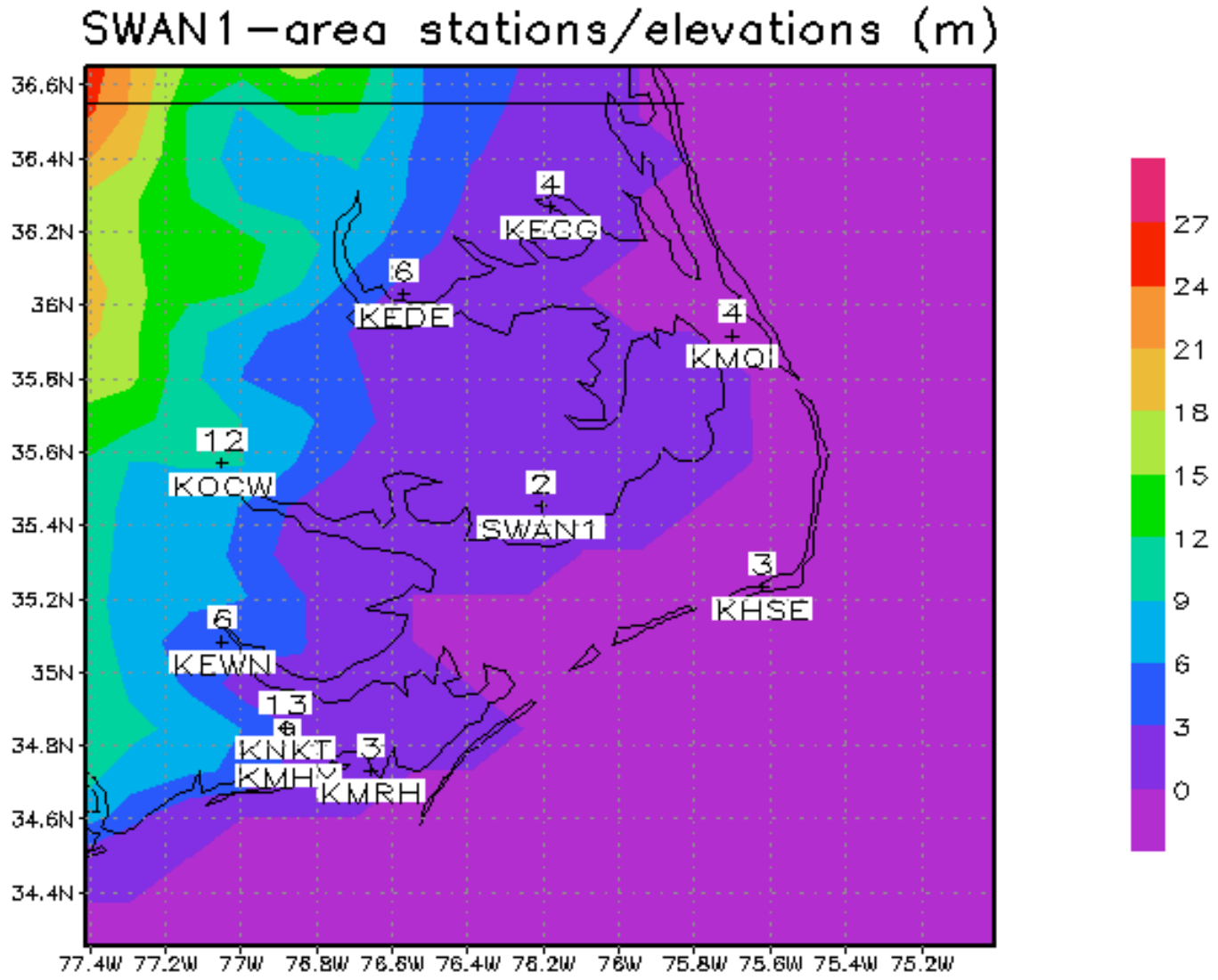


GrADS: COLA/IGES

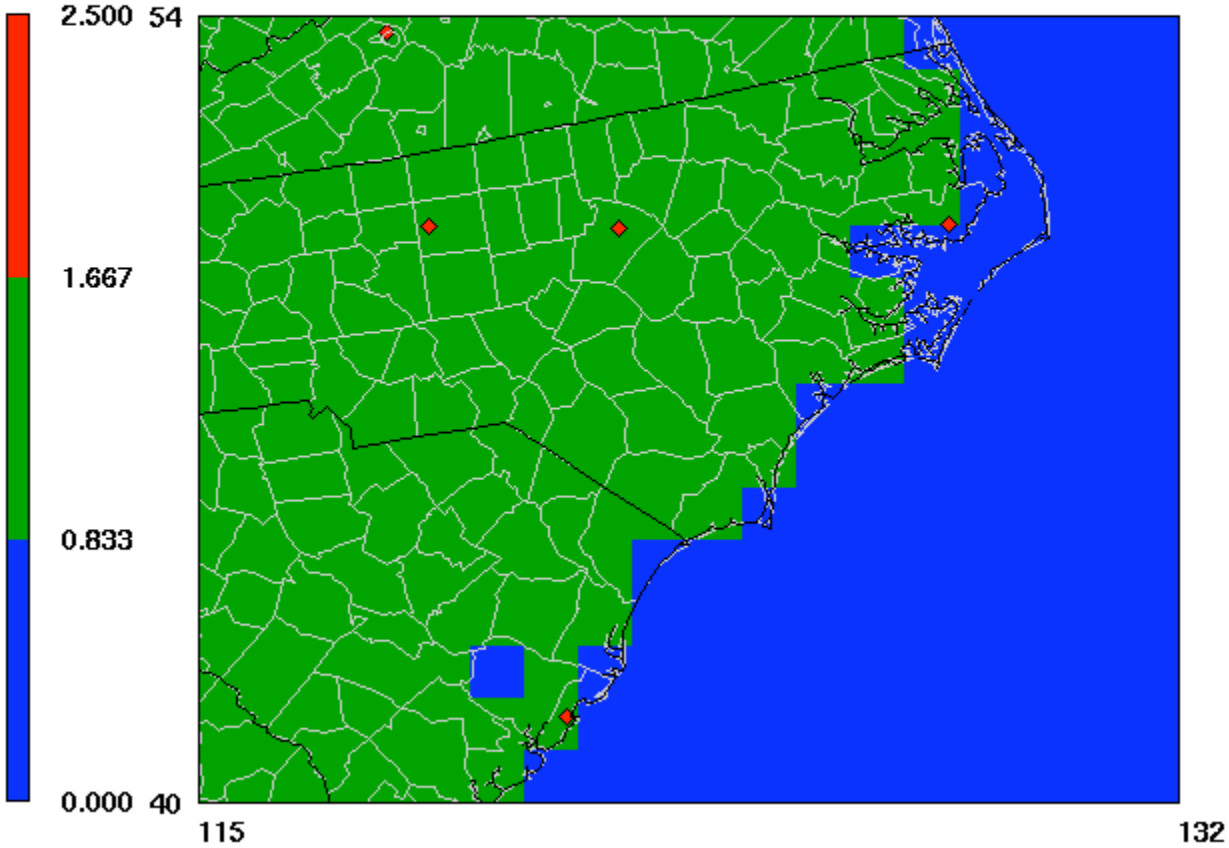
2005-03-31-12:20

File Interact Control Map Plot Overlay

Cell Range (127,49)->(129,51)

Layer 1 LMASKc

Cape Romain, SC (land); Swanquarter, NC (50/50 land/water)
c=PCP_MASK.36km



PAVE by MCNC

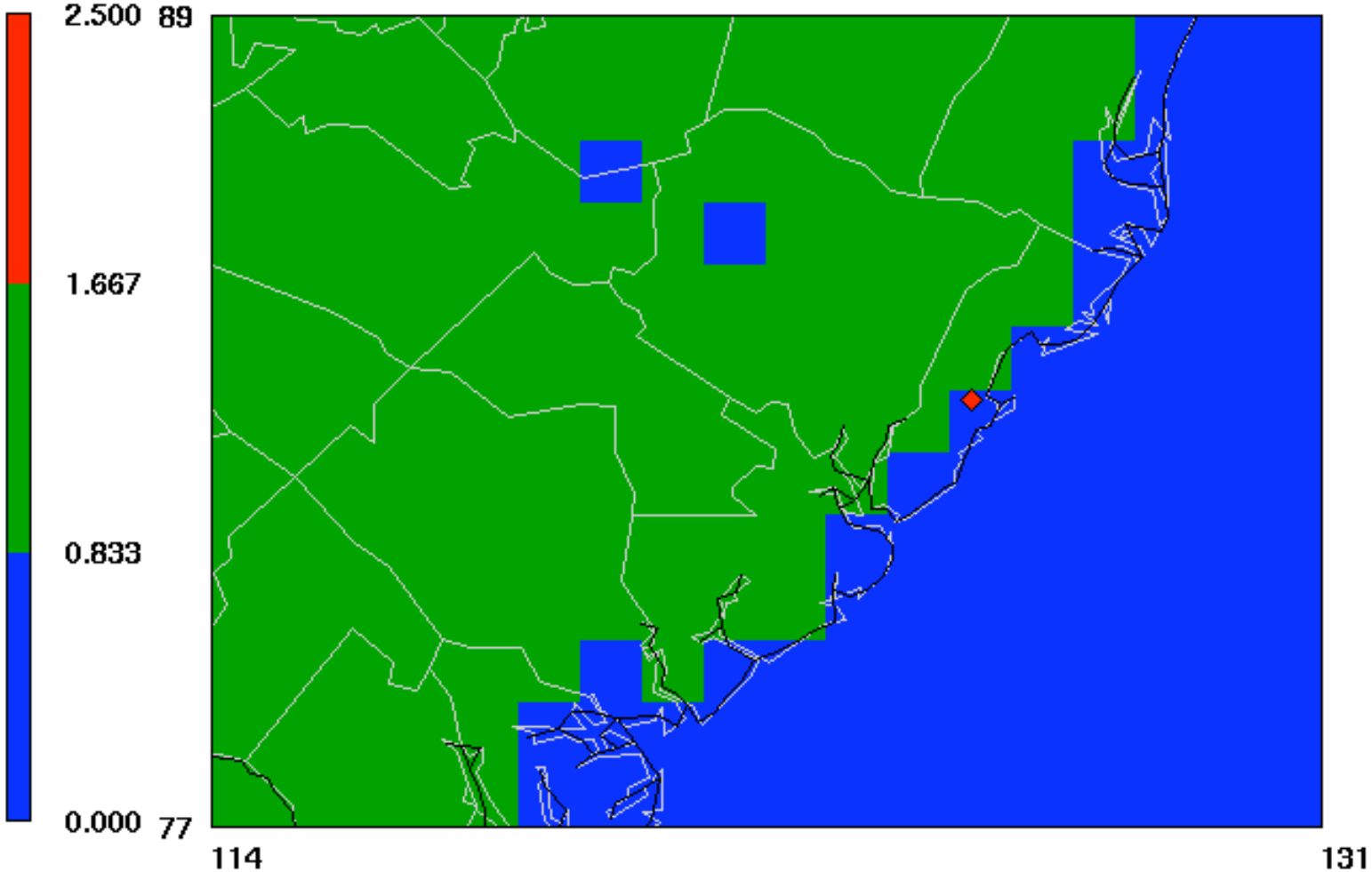
Hour: 00
Min= 0.000 at (121,40), Max= 1.000 at (115,40)

File Interact Control Map Plot Overlay

Cell Range (114,76)->(130,89)

Layer 1 LMASKb

Cape Romain, SC (zoomed)
b=PCP_MASK.12km



PAVE by MCNC

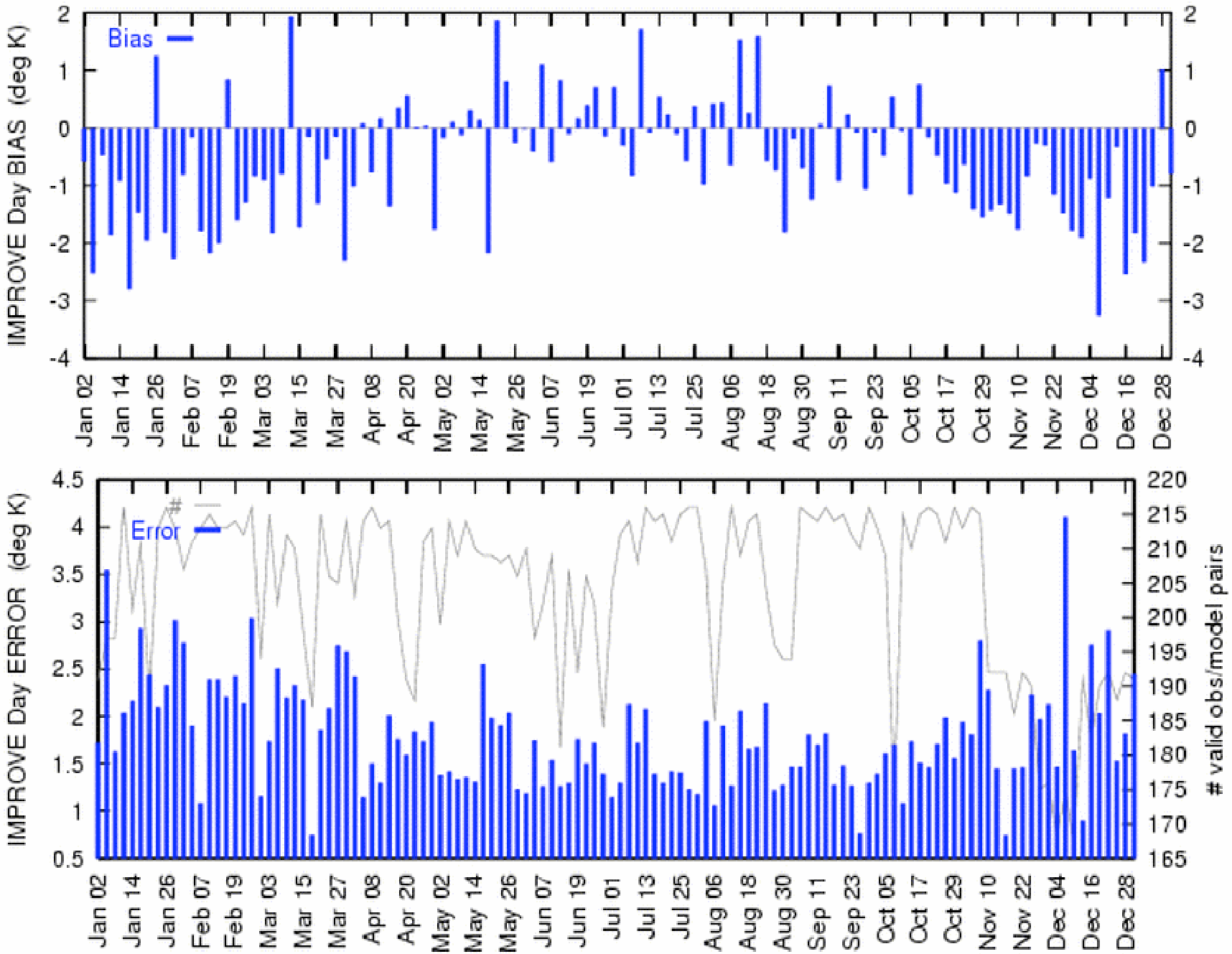
Hour: 00
Min= 0.000 at (119,77), Max= 1.000 at (114,77)

Class 1 Analysis (continued)

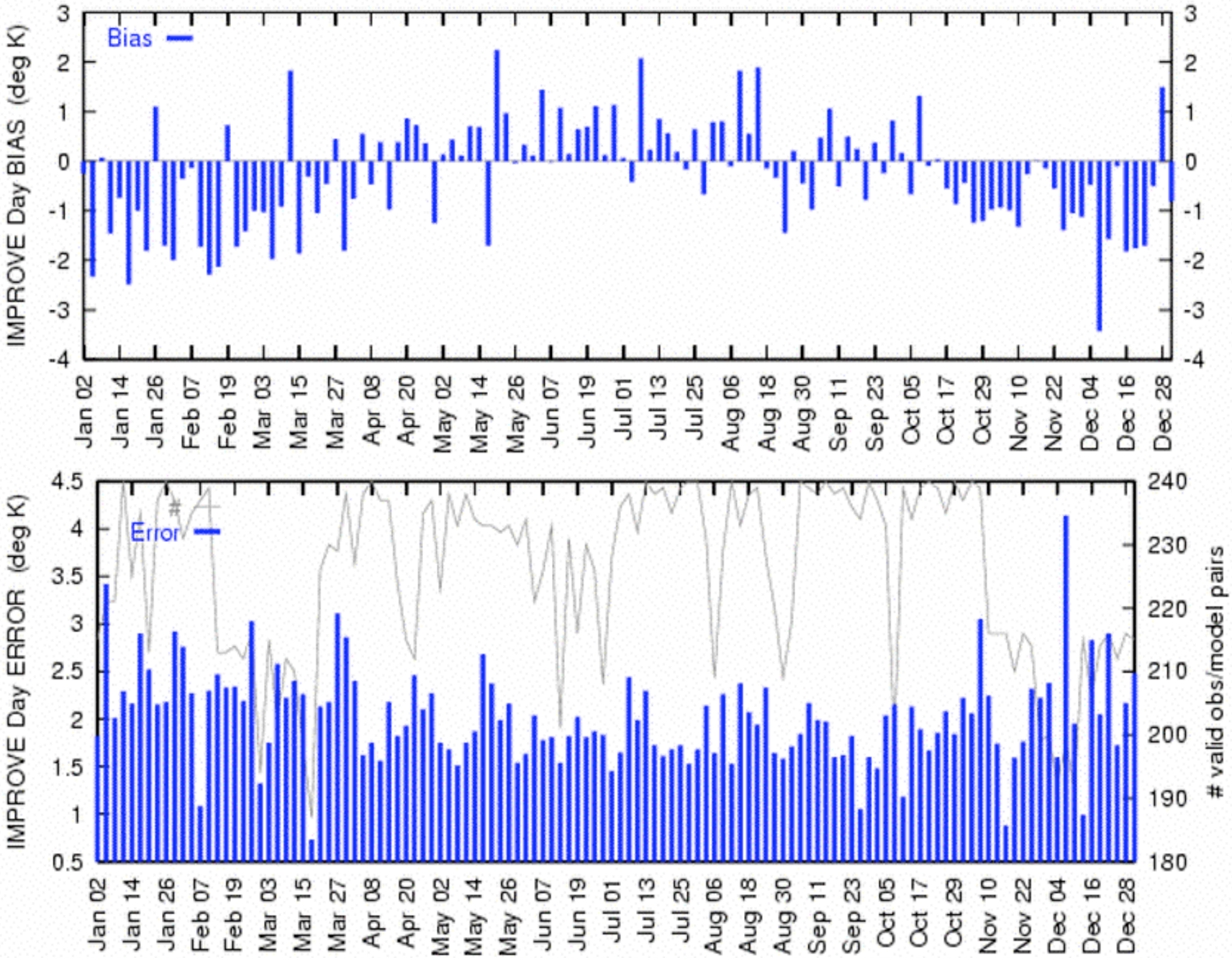
- Results generally fall in line with expectations based on prior evaluation. Exceptions are:
  - CHAS1: Notable positive bias in mixing ratio, RH, and clouds
    - Water effect?
  - DOSO1, GRSM1, LIGO1: Summertime dry bias
  - JARI1, SHEN1, SHRO1: Year-round dry bias
  - SAMA1: Year-round moist bias
  - SWAN1: General positive cloud bias, but no positive moisture bias(water effect?)
- Wind direction biases calculated from mean u,v:
  - Small values can lead to very large (but practically meaningless) biases

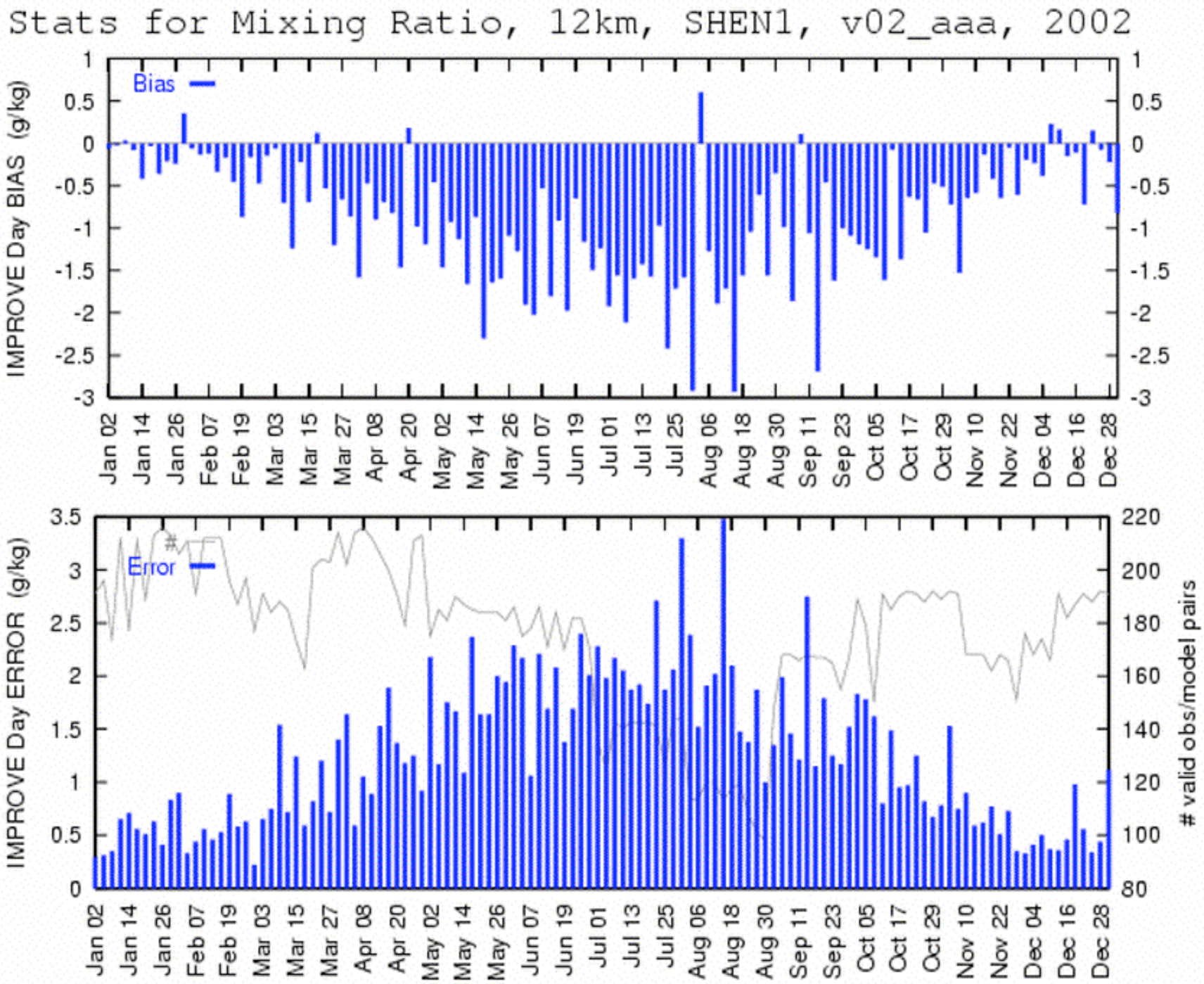
Shenandoah, VA (SHEN1)

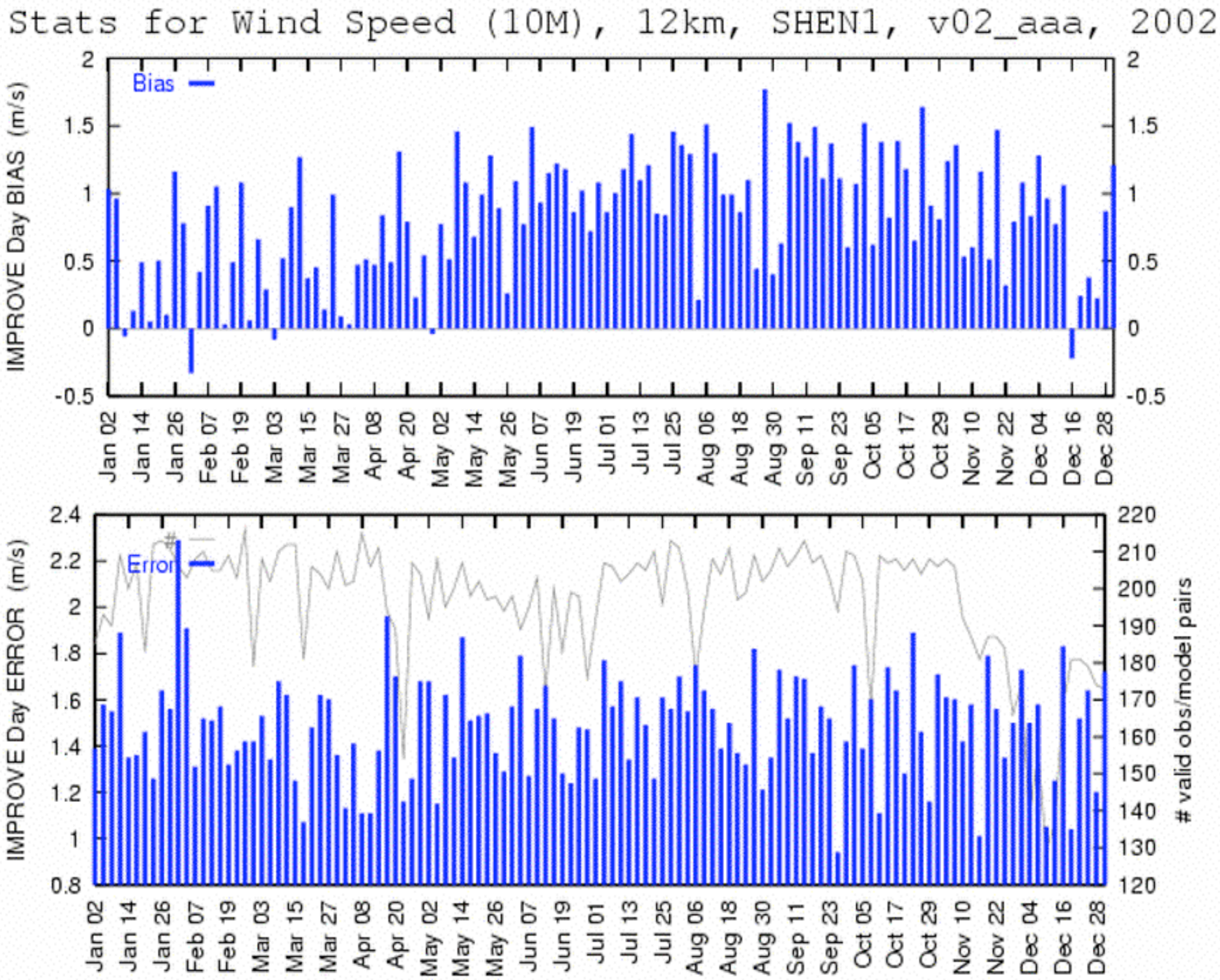
Stats for Temp (1.5M), 12km, SHEN1, v02_aaa, 2002

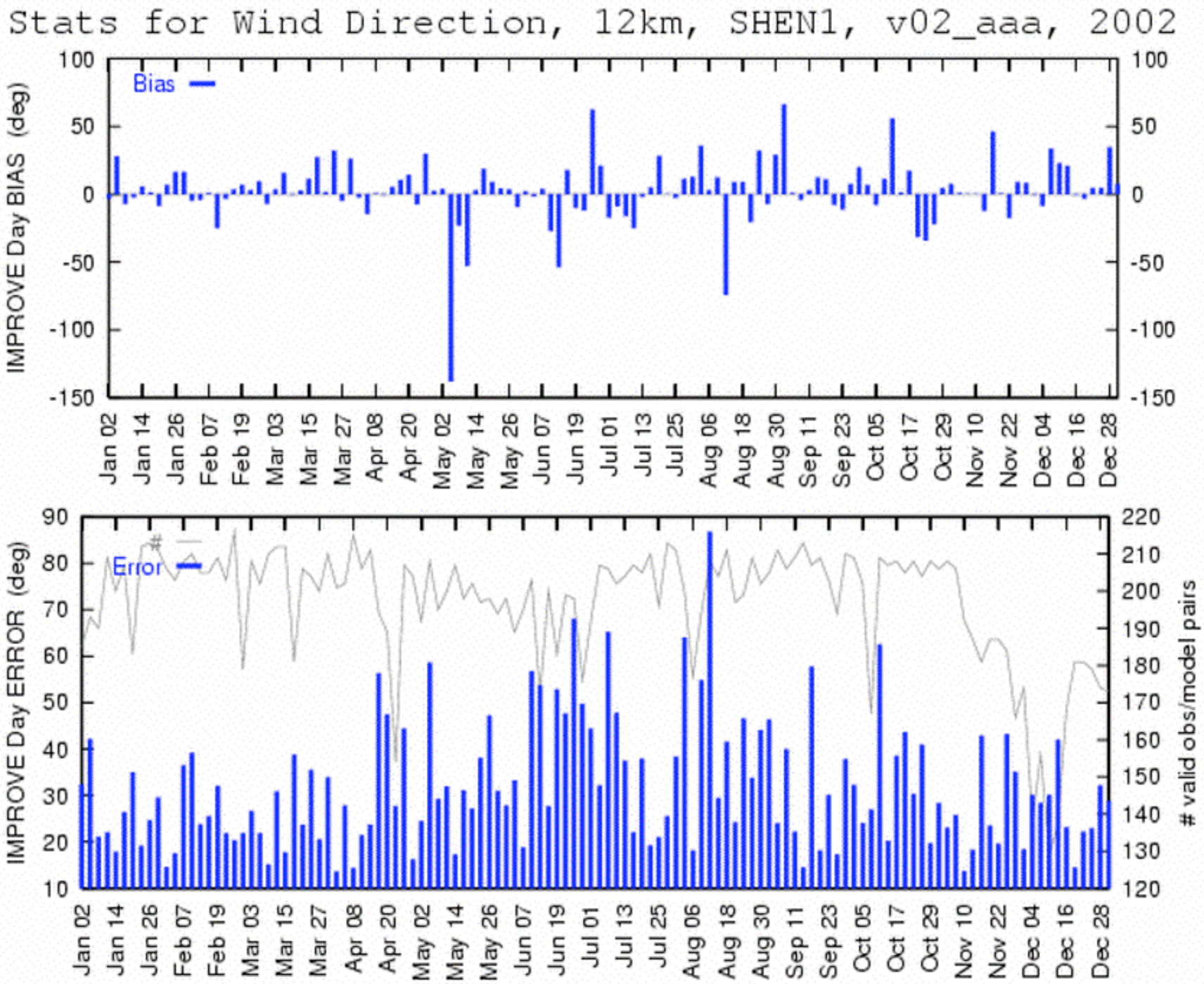


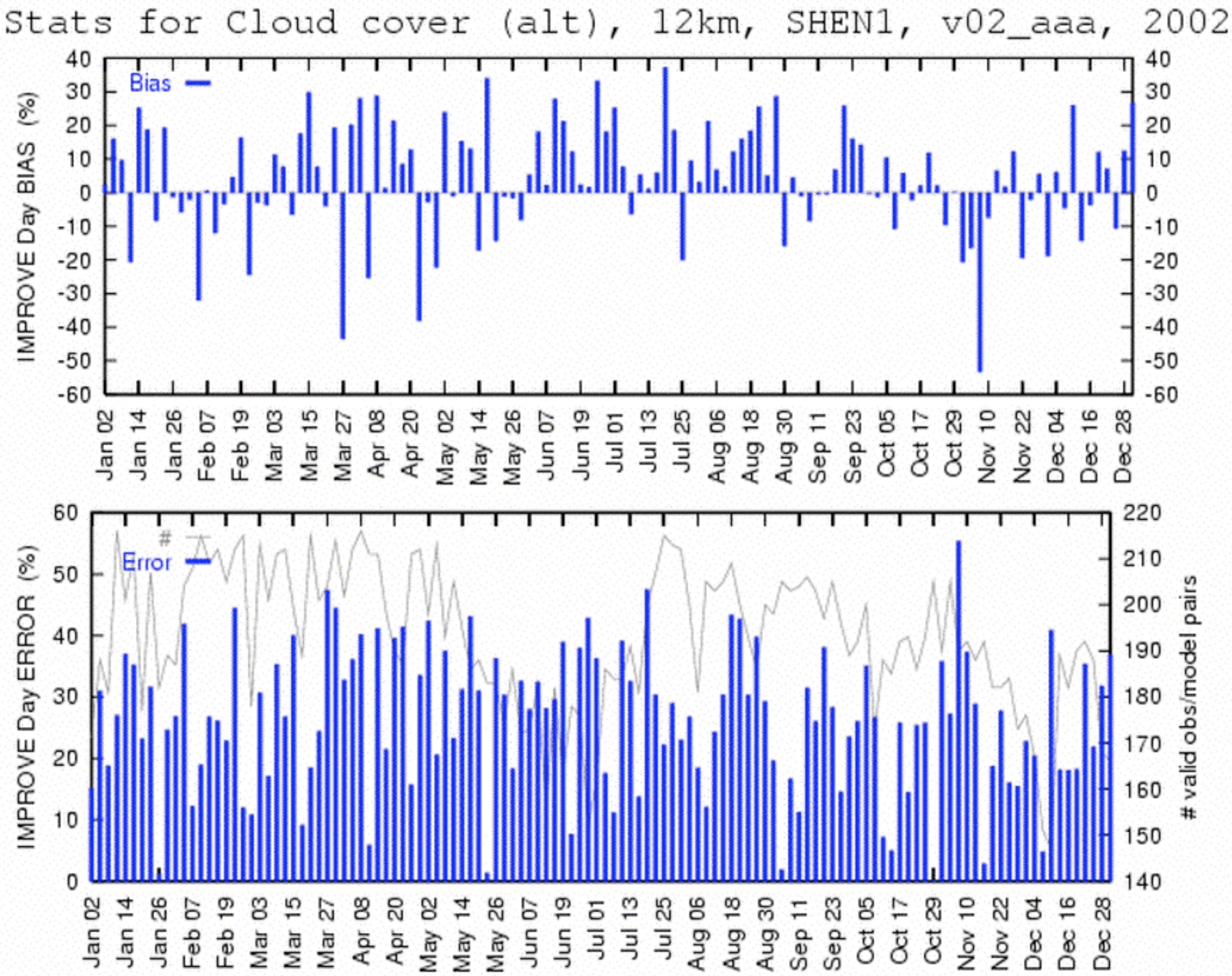
Stats for Temp (1.5M)-no elev adj, 12km, SHEN1, v02_aaa, 2002



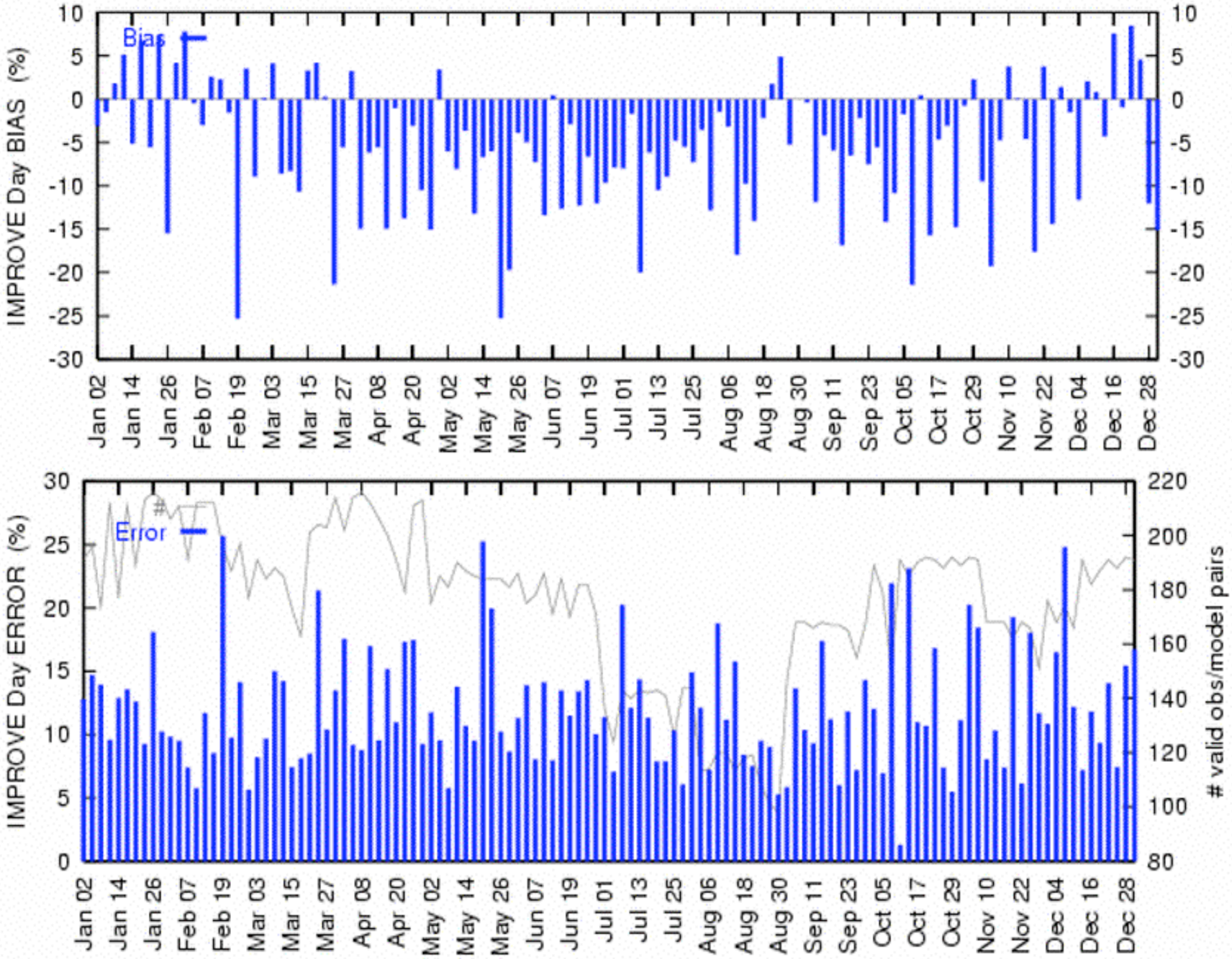

Stats for Mixing Ratio, 12km, SHEN1, v02_aaa, 2002
Bias
IMPROVE Day BIAS (g/kg)
Error
#
IMPROVE Day ERROR (g/kg)
valid obs/model pairs
Jan 02
Jan 14
Jan 26
Feb 07
Feb 19
Mar 03
Mar 15
Mar 27
Apr 08
Apr 20
May 02
May 14
May 26
Jun 07
Jun 19
Jul 01
Jul 13
Jul 25
Aug 06
Aug 18
Aug 30
Sep 11
Sep 23
Oct 05
Oct 17
Oct 29
Nov 10
Nov 22
Dec 04
Dec 16
Dec 28


Stats for Wind Speed (10M), 12km, SHEN1, v02_aaa, 2002
Bias
IMPROVE Day BIAS (m/s)
Error
#
IMPROVE Day ERROR (m/s)
valid obs/model pairs
Jan 02
Jan 14
Jan 26
Feb 07
Feb 19
Mar 03
Mar 15
Mar 27
Apr 08
Apr 20
May 02
May 14
May 26
Jun 07
Jun 19
Jul 01
Jul 13
Jul 25
Aug 06
Aug 18
Aug 30
Sep 11
Sep 23
Oct 05
Oct 17
Oct 29
Nov 10
Nov 22
Dec 04
Dec 16
Dec 28


Stats for Wind Direction, 12km, SHEN1, v02_aaa, 2002
Bias
IMPROVE Day BIAS (deg)
100
50
0
-50
-100
-150
Jan 02
Jan 14
Jan 26
Feb 07
Feb 19
Mar 03
Mar 15
Mar 27
Apr 08
Apr 20
May 02
May 14
May 26
Jun 07
Jun 19
Jul 01
Jul 13
Jul 25
Aug 06
Aug 18
Aug 30
Sep 11
Sep 23
Oct 05
Oct 17
Oct 29
Nov 10
Nov 22
Dec 04
Dec 16
Dec 28
Error
#
IMPROVE Day ERROR (deg)
90
80
70
60
50
40
30
20
10
valid obs/model pairs
220
210
200
190
180
170
160
150
140
130
120


Stats for Cloud cover (alt), 12km, SHEN1, v02_aaa, 2002
Bias
IMPROVE Day BIAS (%)
Error
#
IMPROVE Day ERROR (%)
valid obs/model pairs
Jan 02
Jan 14
Jan 26
Feb 07
Feb 19
Mar 03
Mar 15
Mar 27
Apr 08
Apr 20
May 02
May 14
May 26
Jun 07
Jun 19
Jul 01
Jul 13
Jul 25
Aug 06
Aug 18
Aug 30
Sep 11
Sep 23
Oct 05
Oct 17
Oct 29
Nov 10
Nov 22
Dec 04
Dec 16
Dec 28

Stats for Relative Humidity, 12km, SHEN1, v02_aaa, 2002



20% Best/Worst Bakergrams

- Hourly (00-23 LST) values for the 20% best or 20% worst days of 2002
- Very few obs/model pairs exist per output hour
  - Only simple stats are presented for t (elev adjusted and unadjusted), q, s, d, rh, c
    - Bias
    - Error
    - Obs average
    - Model average
- Hours with no valid obs/model pairs are white in color

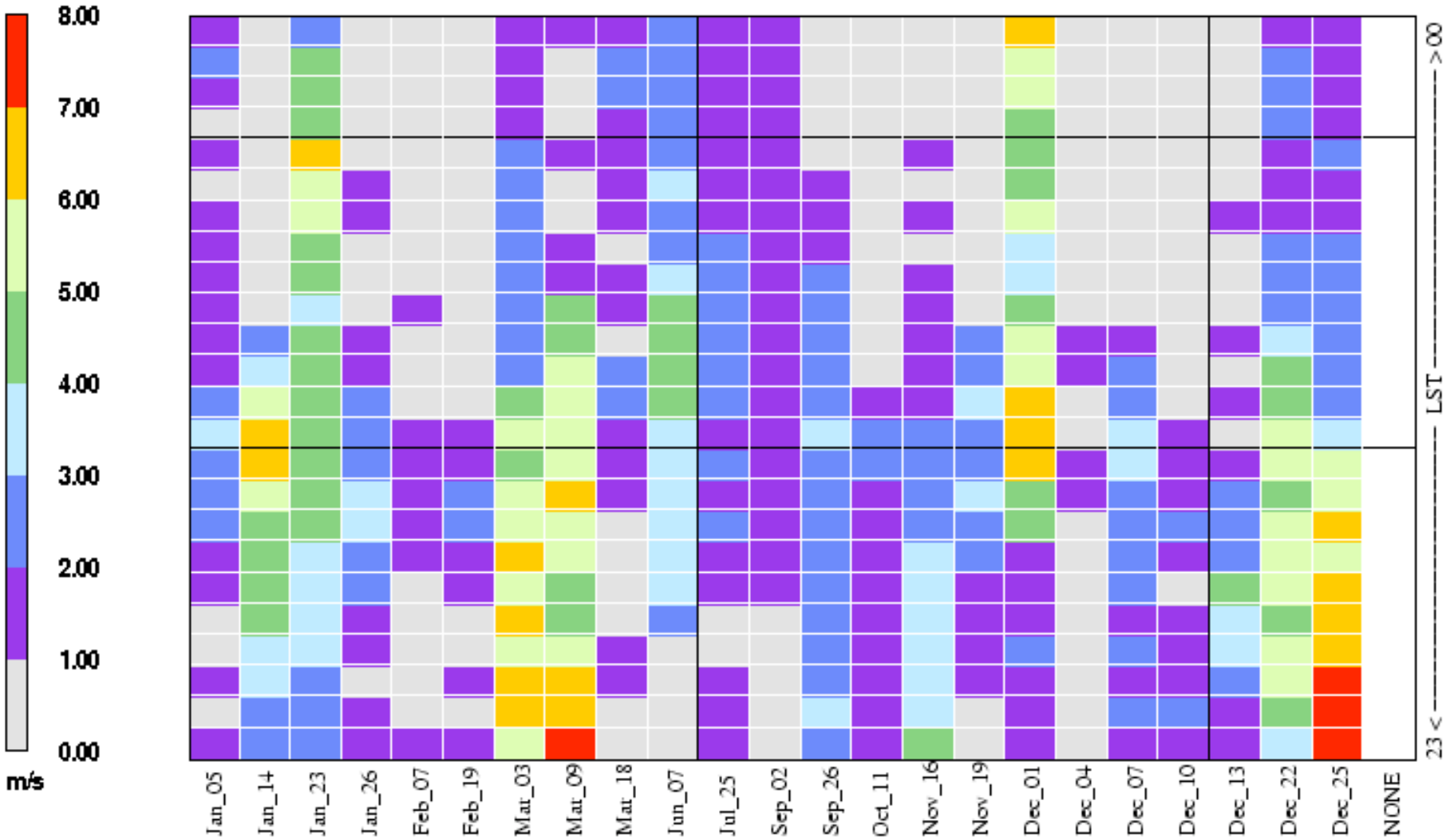
20% Best/Worst Bakergrams (continued)

- Only mean wind speed for obs/model is shown here
  - Wind speeds generally very light on 20% worst days
  - MM5 has a difficult time calming the winds as much as the obs do, even allowing for the instrument threshold issue
- Generally character of plots is similar to results presented beforehand

Shenandoah, VA (SHEN1)

Avg Observed Wind Speed

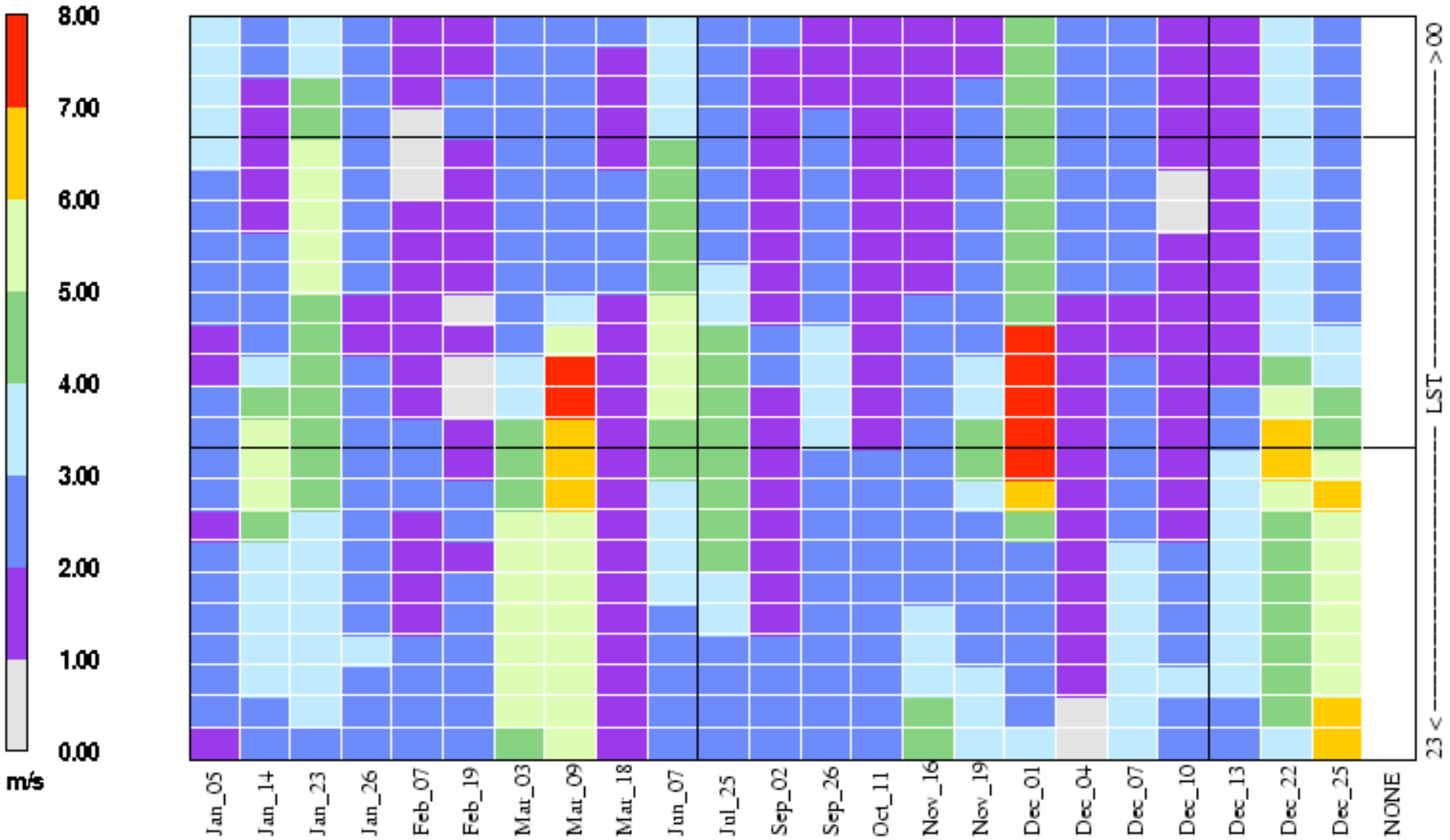
(2002, SHEN1: 12km, v02_aaa, 10m, 20% cleanest days)



Min= 0.00 at (18,7), Max= 8.05 at (23,1)

Avg Modeled Wind Speed

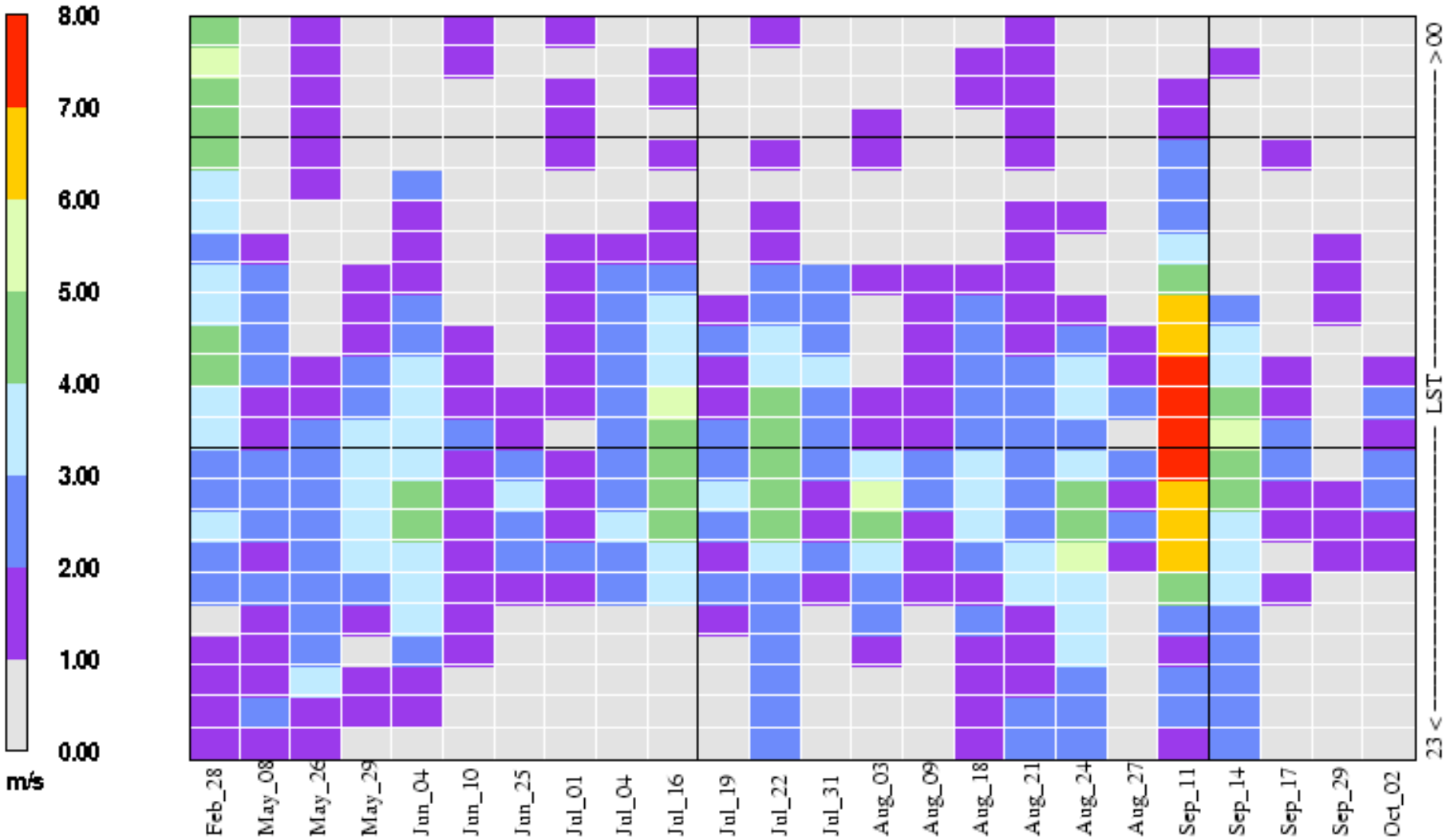
(2002, SHEN1: 12km, v02_aaa, 10m, 20% cleanest days)



Min= 0.60 at (20,18), Max= 8.36 at (17,13)

Avg Observed Wind Speed

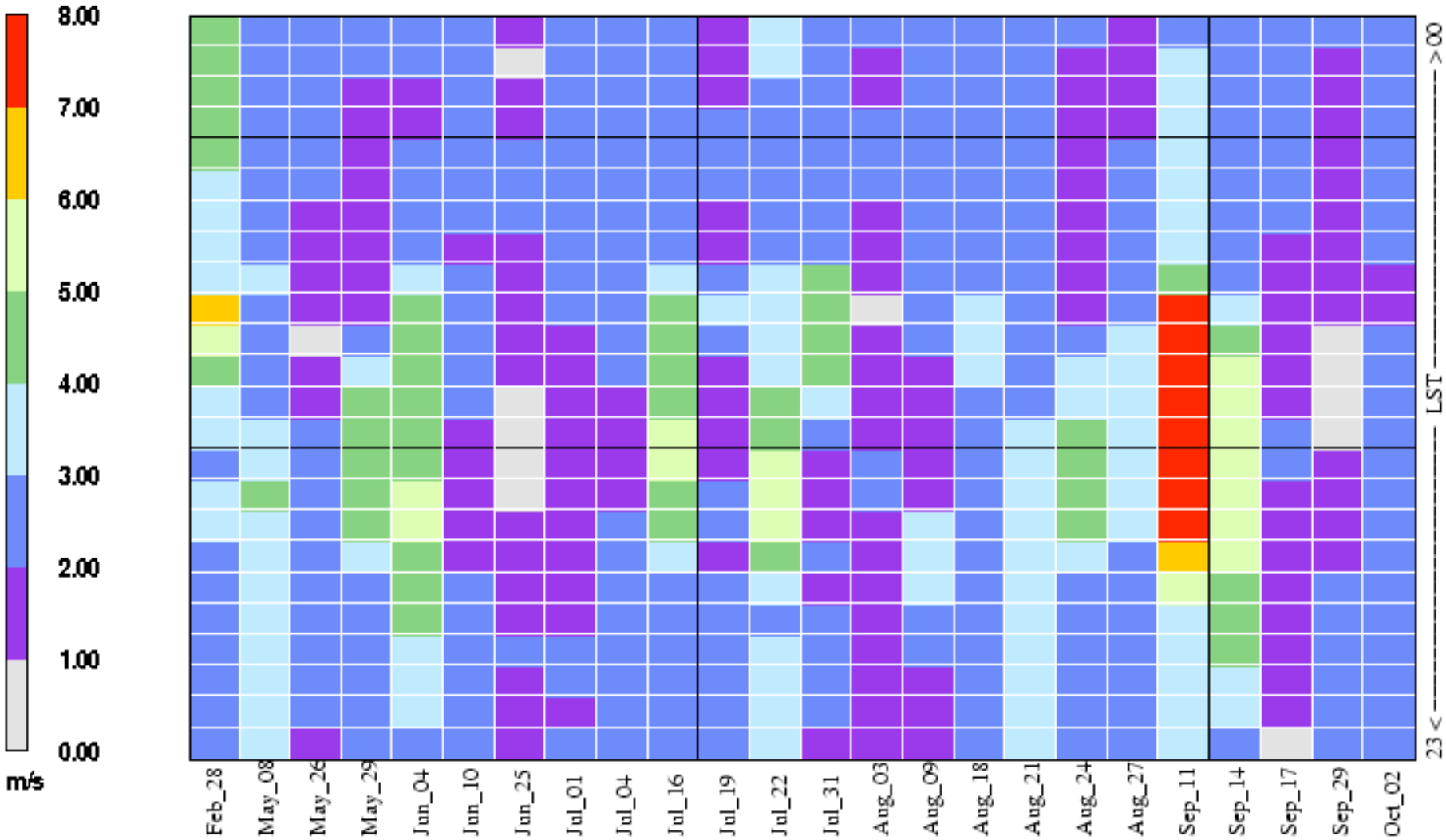
(2002, SHEN1: 12km, v02_aaa, 10m, 20% dirtiest days)



Min= 0.00 at (13,1), Max= 8.84 at (20,12)

Avg Modeled Wind Speed

(2002, SHEN1: 12km, v02_aaa, 10m, 20% dirtiest days)



Min= 0.59 at (7,11), Max= 9.38 at (20,13)

Time Series Near Class 1 Sites

- Time series available for every 5-day modeling segment
- Sites usually located within 100 kms of class 1 site
  - May extend range to accept a minimum of three additional stations
  - May exclude stations if deemed "not representative" (i.e. inland stations for a coastal Class 1 site)
- Not all prospective TDL sites report data
  - Sites determined from a master list covering parts of 1999, 2001, and 2002
    - Sites may have been inactive for 2002
    - Sites may have been discarded for QC

Summary

- The additional evaluation products generally show the same modeling signatures as previously reported
- Detailed individual site evaluation beyond the scope of this work
- These products are designed to "synch up" the meteorological evaluation products with the air quality evaluation products
- Best used by individual states (or responsible parties) to understand performance (met and AQ) at the state/Class 1 area of interest.