IEM Potpourri

(combine a bunch of unrelated stuff and see if it smells good at the end)

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The next 50 minutes of your life will consist of:

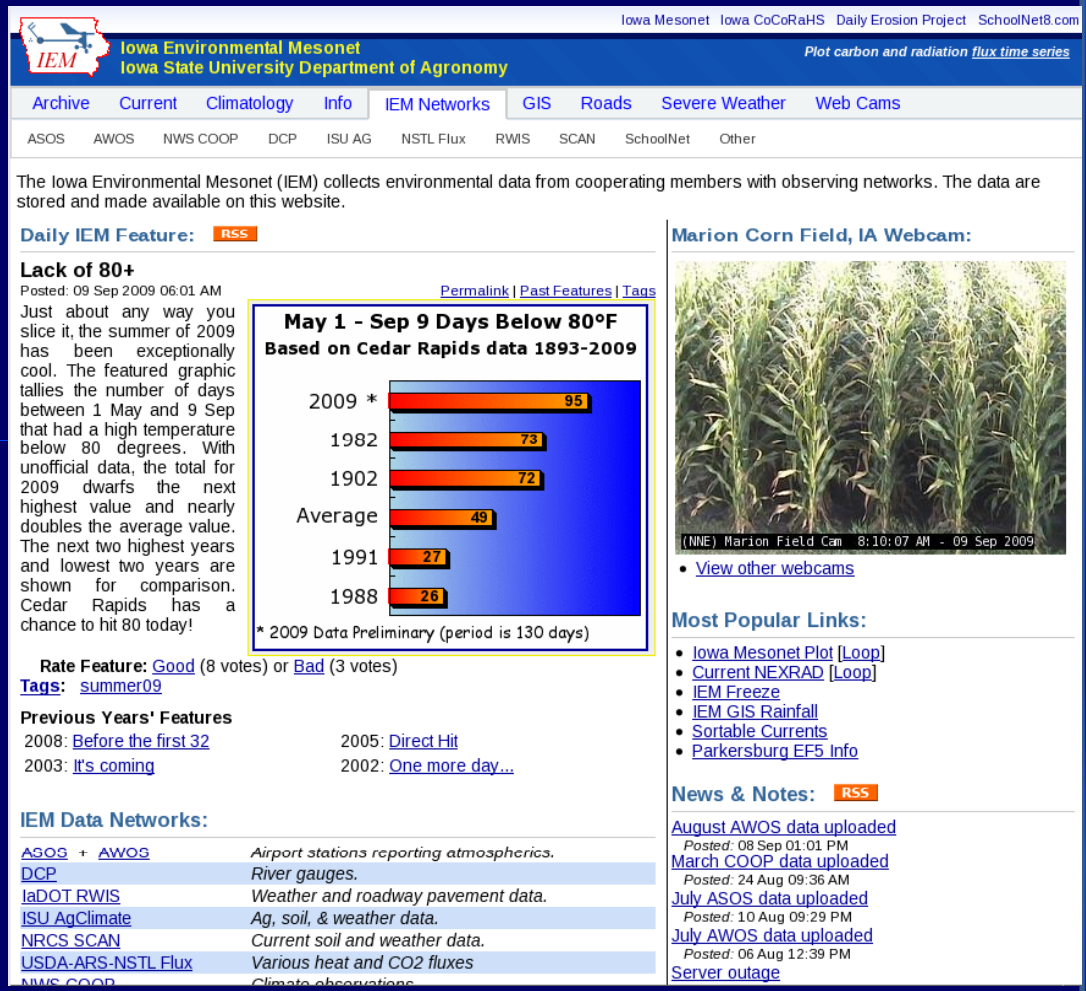
- The IEM and its many daily features
- Fun with ASOS data
- Assembling unique datasets
- NWS Storm Based Warning verification
- A movie, if you are lucky

http://mesonet.agron.iastate.edu

Ooooo, I have a website….

- ~ 100 interactive web applications of IEM Data
- 2 terabytes of "stuff"
- 70 gigabytes daily input
- 150 gigabytes daily output

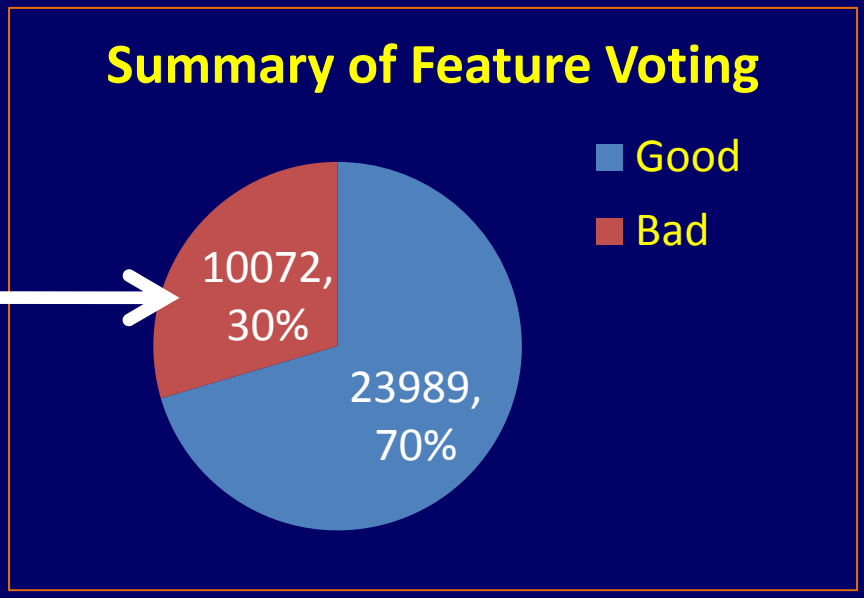
Website Hits Per Day



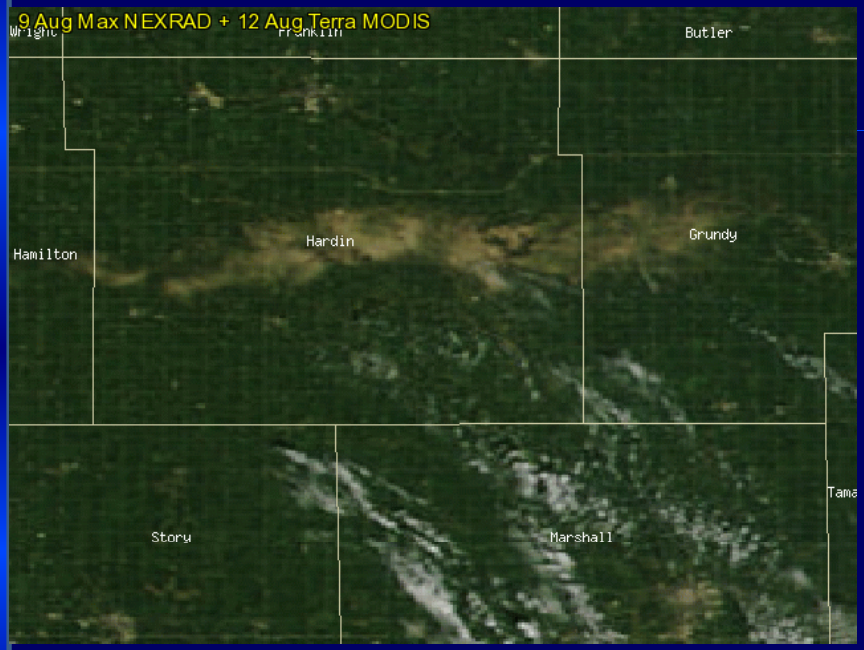
IEM Daily Feature

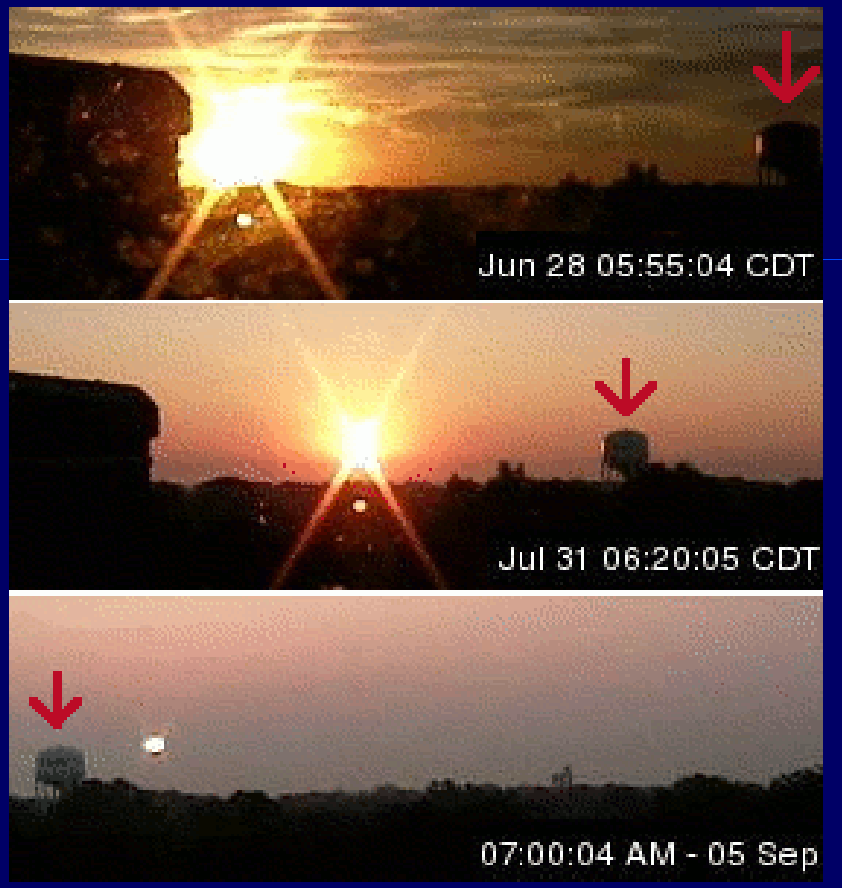
- Daily “blog” post of something hopefully interesting
- Generated 1905 of these since 2002
- Users can rate the feature as “good” or “bad”

Most bad votes come from this guy…

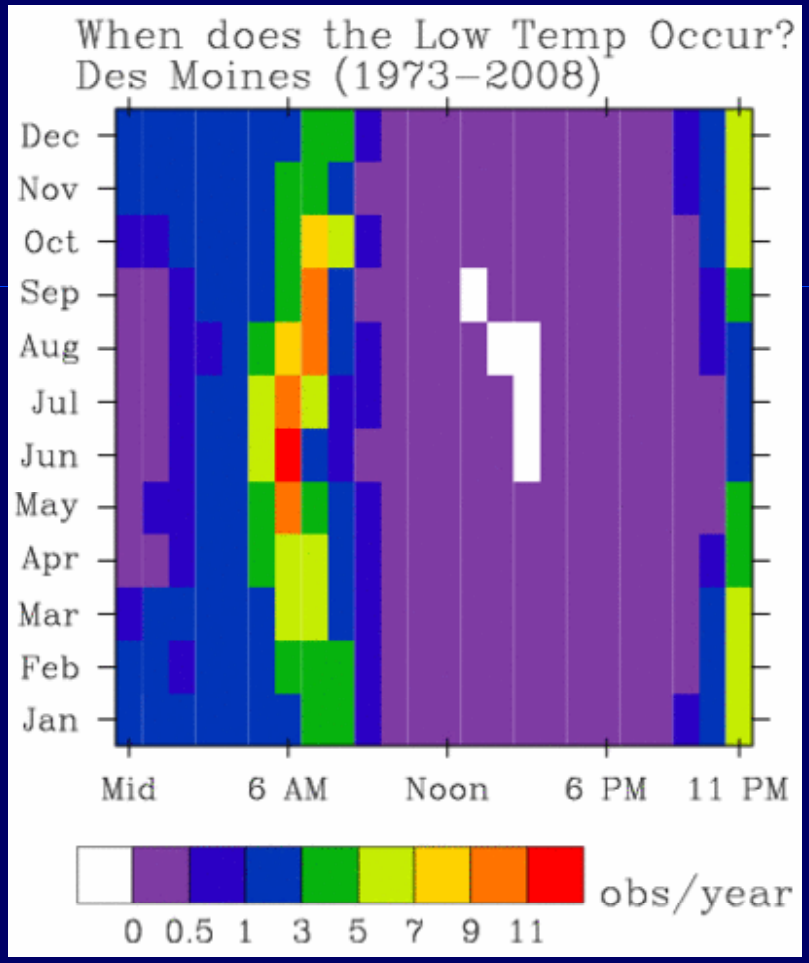


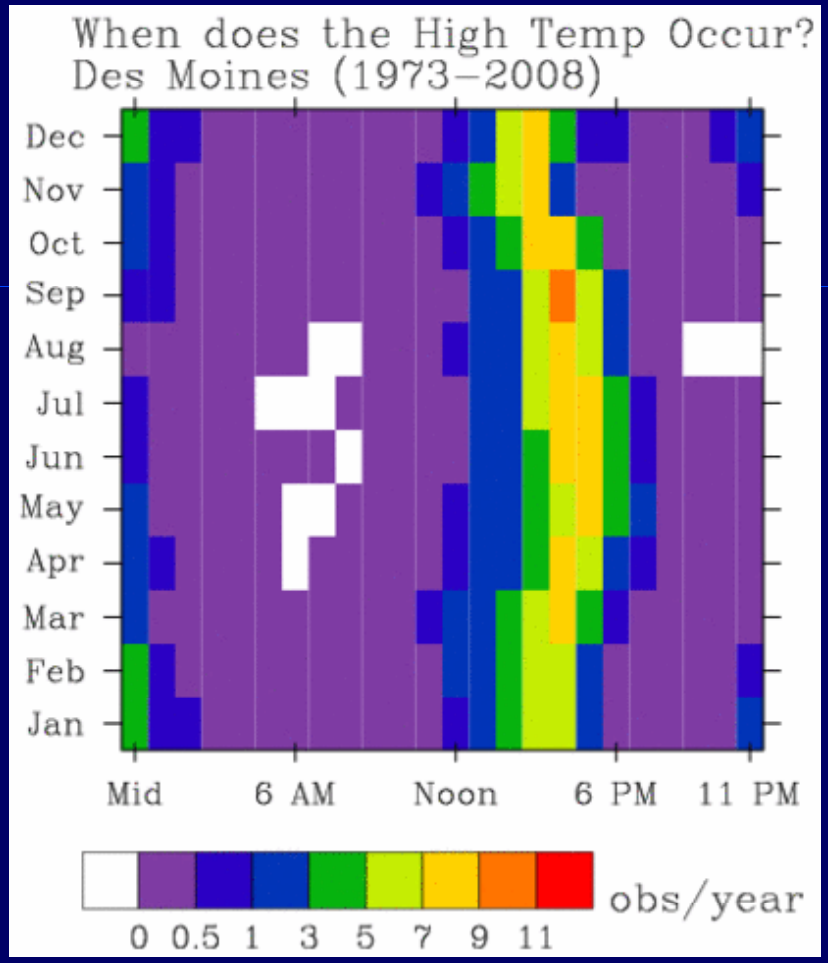
Show Something Interesting



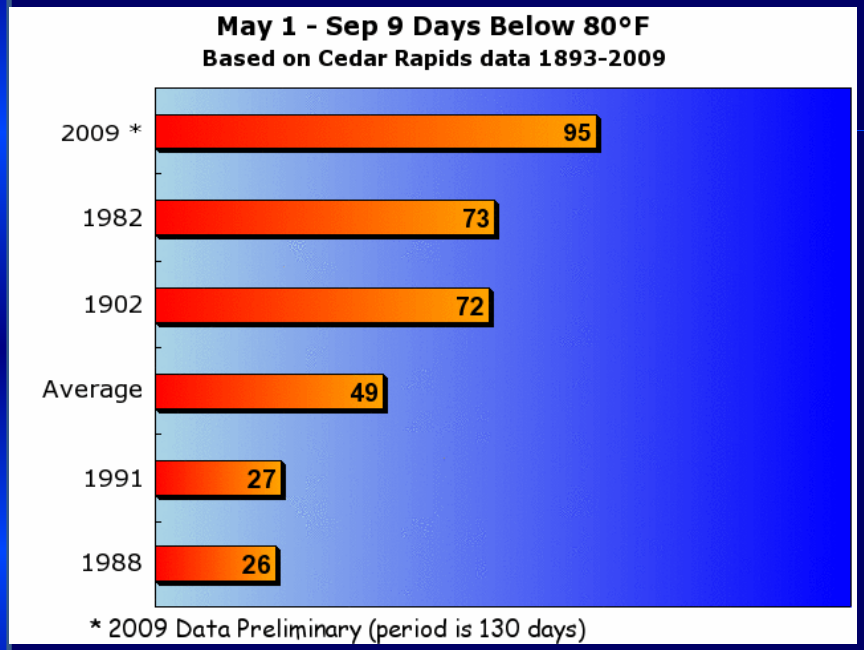


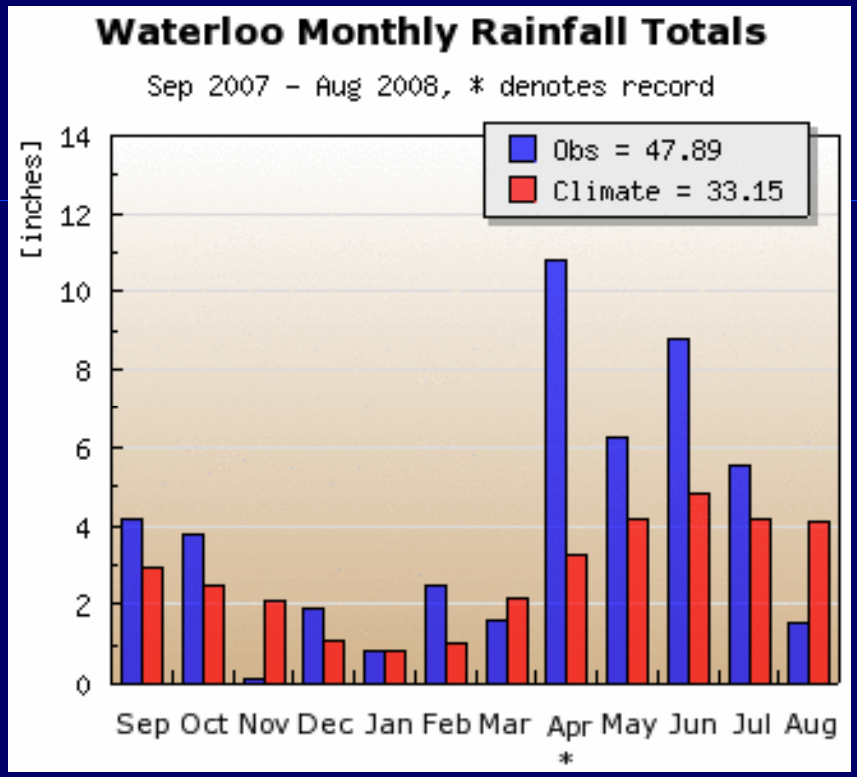
Climate Features





Comparison Features





Fun with ASOS Temperatures

- ASOS weather stations are the high end sensors at larger airports
- We've all seen the hourly METARs

KDSM 091354Z 00000KT 10SM CLR **20/14** A3014
RMK AO2 SLP202 T02000144

- What units and precision are the temperatures reported in? What are they actually internally recorded in?

KDSM 091354Z 00000KT 10SM CLR **20/14** A3014
RMK AO2 SLP202 T02000144

- The “T-group” implies a precision of 0.1°C
- Running a script against a database of observations yields these distinct values:

  22.8 22.2 21.7 21.1 20.6 20.0 19.4
  18.9 18.3 17.8 17.2 16.7 16.1
- What is 14°C in °F -> 57.2
- What is 14.4°C in °F -> 57.9
- The ASOS guide also notes the sensor accuracy at 0.9°F on air temp

Distinct Celsius Values reported in “T-group”	Converted To Fahrenheit	Which is actually in F
22.8	73.04	73
22.2	71.96	72
21.7	71.06	71
21.1	69.98	70
20.6	69.08	69
20.0	68	68
19.4	66.92	67
18.9	66.02	66
18.3	64.94	65
17.8	64.04	64

“These 5-minute averages are rounded to the nearest degree Fahrenheit, converted to the nearest 0.1 degree Celsius, and reported…”

– ASOS Users Guide 1998

The T-group is necessary to make sure the Fahrenheit conversion works.

Thought Experiment: What was the "average temperature" on 26 Jul 2009 for Cedar Rapids?

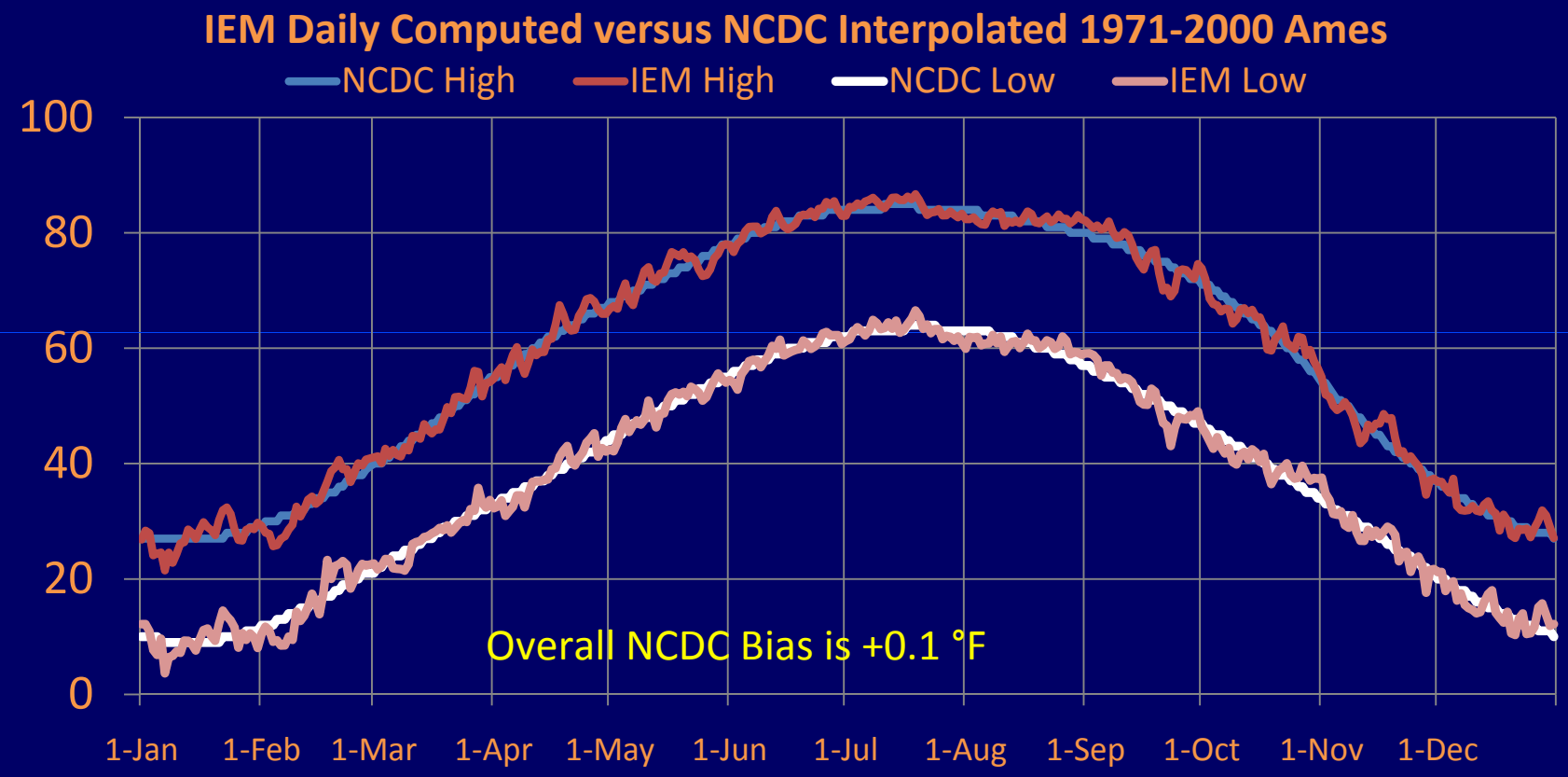
Hourly Obs: 60, 60, 59, 58, 59, 58, 58, 62, 66, 70, 73, 75, 75, 77, 79, 76, 79, 78, 75, 72, 68, 66, 65, 63

- Sum of the obs was 1631, so which is right?
  - 1631 / 24 = 67
  - 1631.0 / 24.0 = 67.96
- Or what about mean of high and low?
  - (79 + 56) / 2 = 67
  - (79.0 + 56.0) / 2.0 = 67.5
- Or using the 1 minute interval data?
  - 97781 / 1440 = 67
  - 97781.0 / 1440.0 = 67.9
- Who remembers the "Significant Figures" rules? What a buzz-kill….

One Minute Interval Archives

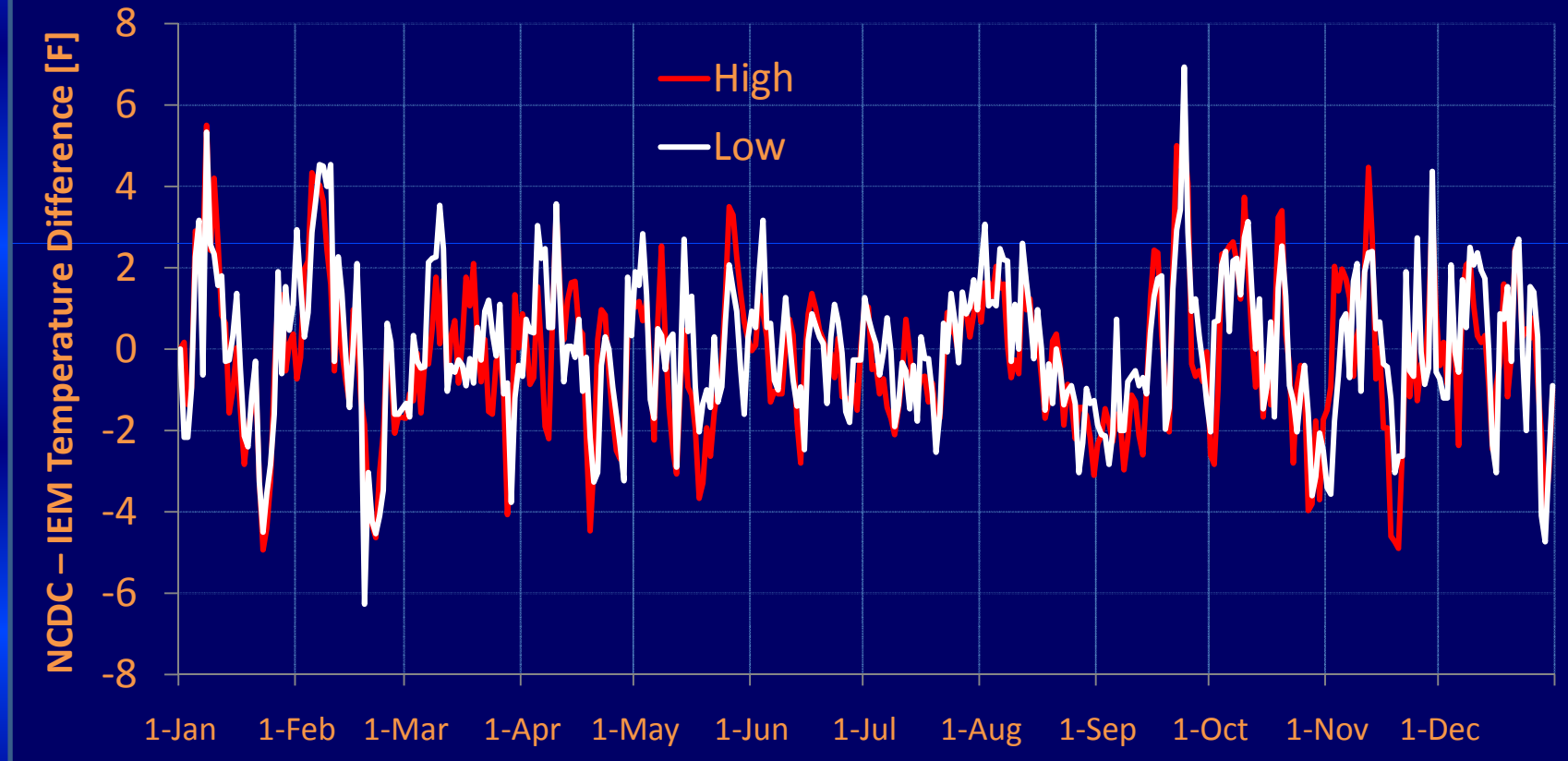
- ASOS (At the larger airports) [2000-]
  - Provided once monthly by NCDC
- AWOS (Smaller airports, non Federal) [1995-]
  - Provided once monthly by the Iowa DOT
- SchoolNets [2002-]
  - Collected in real time
  - 6 second interval data available as well

What about the daily “normals”?

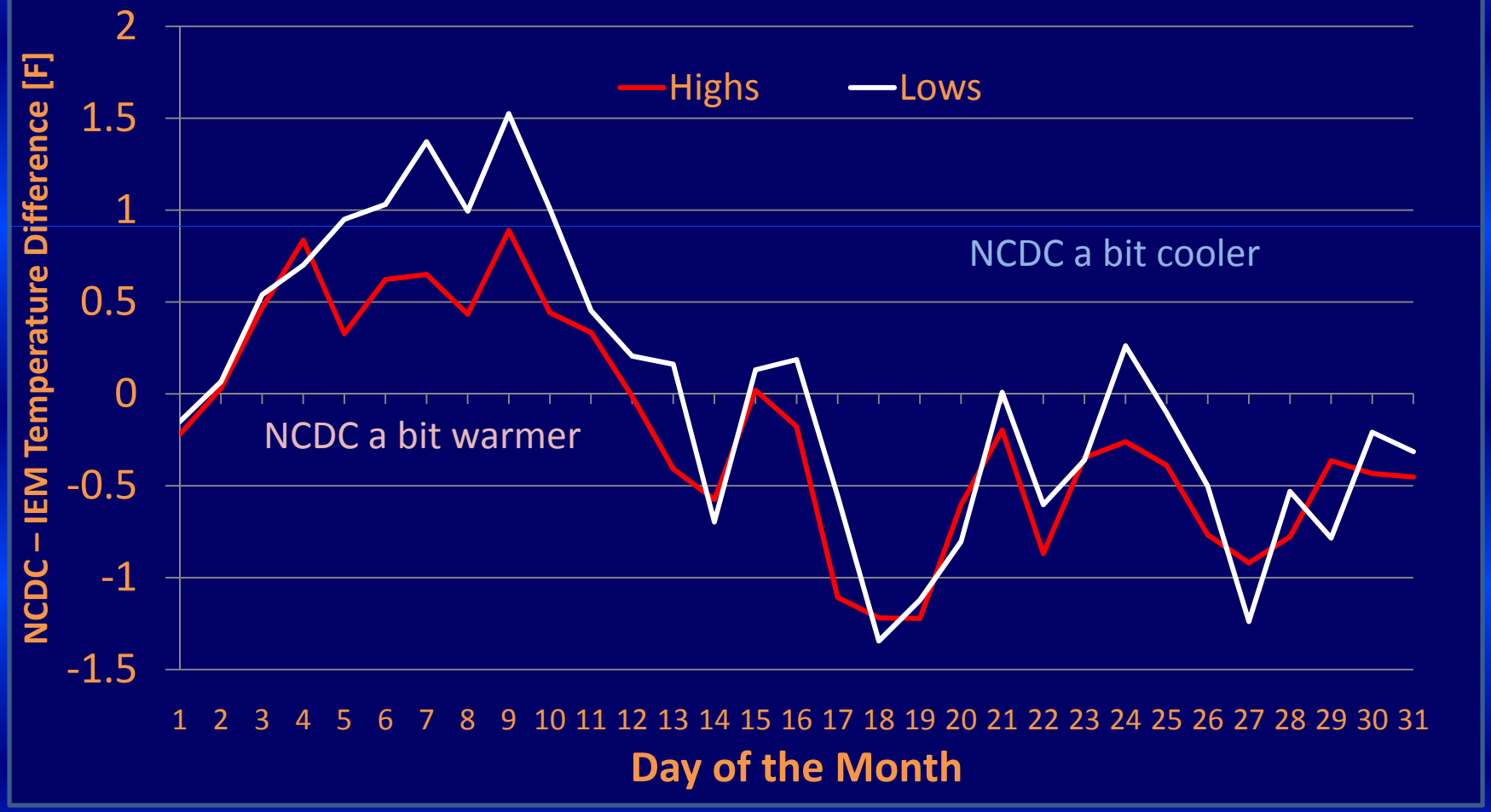


NCDC – *“The daily normals are derived by statistically fitting smooth curves through monthly values; daily data were **not** used to compute daily normals.”*

Daily NCDC Departure



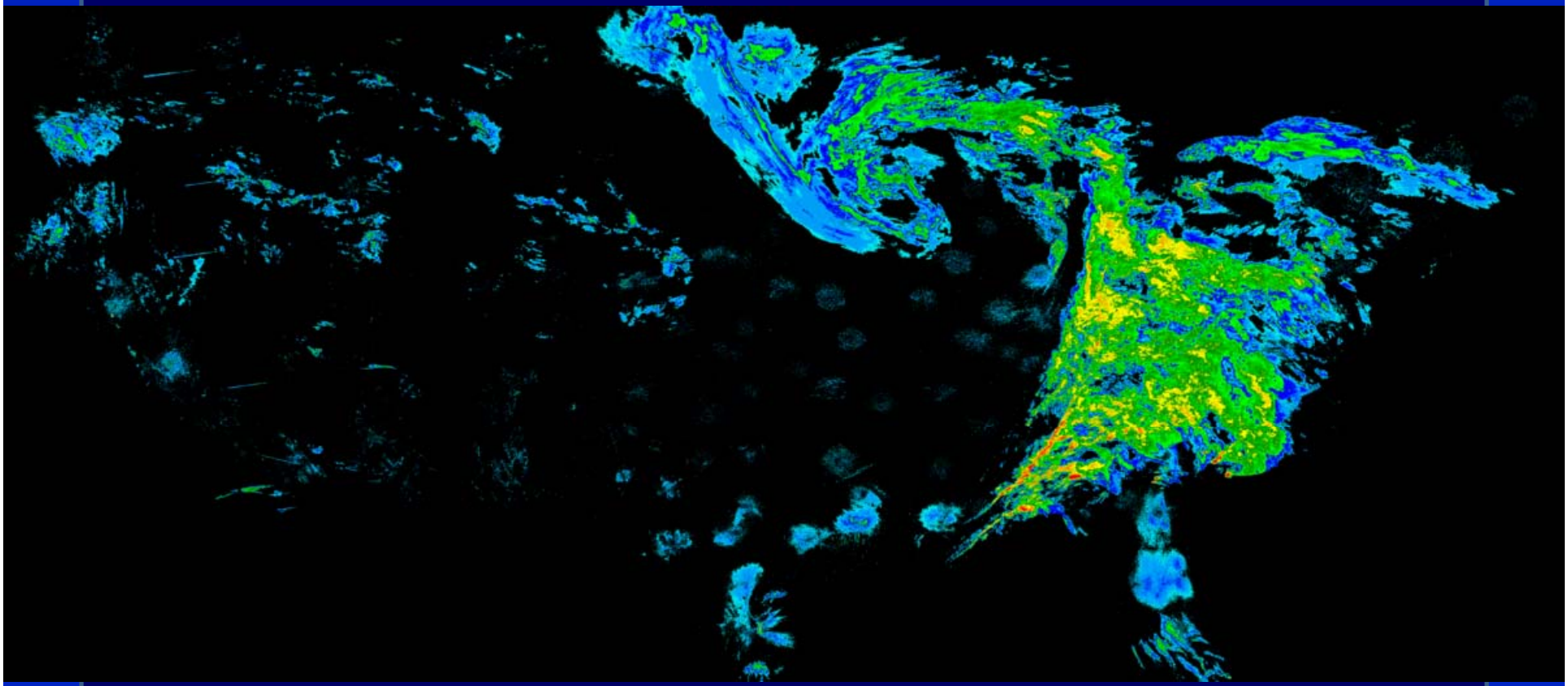
NCDC Mean Bias per Day of Month



Authorities on the Subject

- NCDC's July Report
  - For the contiguous United States the average temperature of 73.5°F was 0.8°F below the 20th century average…
- Iowa's State Climatologist / IEM News Item for March
  - The statewide average temperature was 36.7 °F or 0.7 °F above normal.
- Wikipedia
  - People who are not experts in metrology or statistics can overestimate the usefulness of significant figures. The topic receives much more emphasis in high-school and undergraduate chemistry texts than it does in real-world research laboratories.
- Mark Twain: "There are three kinds of lies: lies, damned lies, and statistics."
- Moral: While it is debatable if ASOS can sense a 0.7 °F change, it certainly **can not report it**.

1995-Present NEXRAD Composites



1 March 2007 7:35 PM

Processing Steps

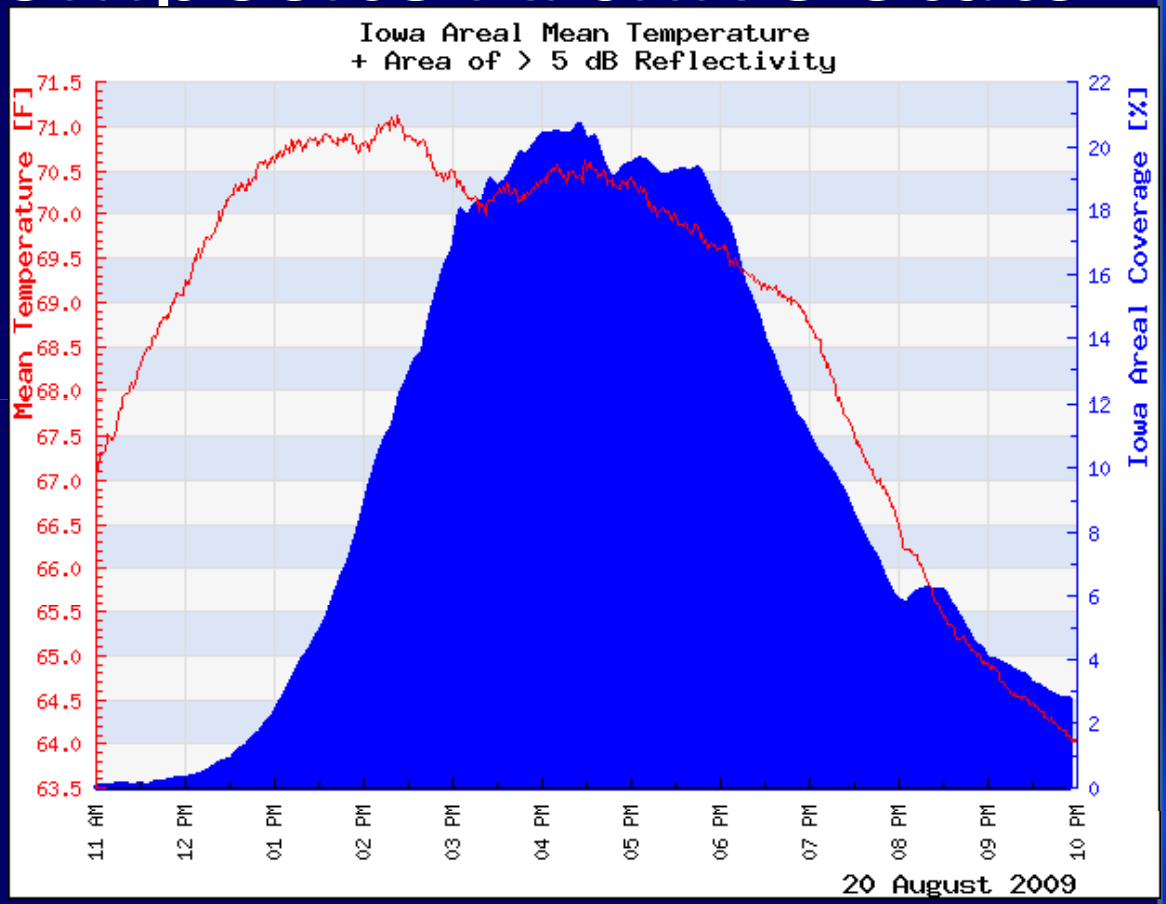
- Combine base reflectivity of individual WSR-88Ds onto a common grid (0.01° Lat/Lon)
- Compare this product against a gridded analysis of RUC surface temperatures (stop clutter suppression in the winter)
- Where above freezing, compare against the "Net Echo Tops" composite to filter out clutter
- Convert to a number of different formats for further web and local processing

Backfilling the archive

- National Climatic Data Center kindly provided their entire NIDS archive (1.4 TB) to run my scripts against to backfill to 1995.
- Took around 6-8 months for a handful of machines to process.
- Clutter suppression was done for APR-SEP for years after 2003 (when NET product was available), no RUC temperature filter.

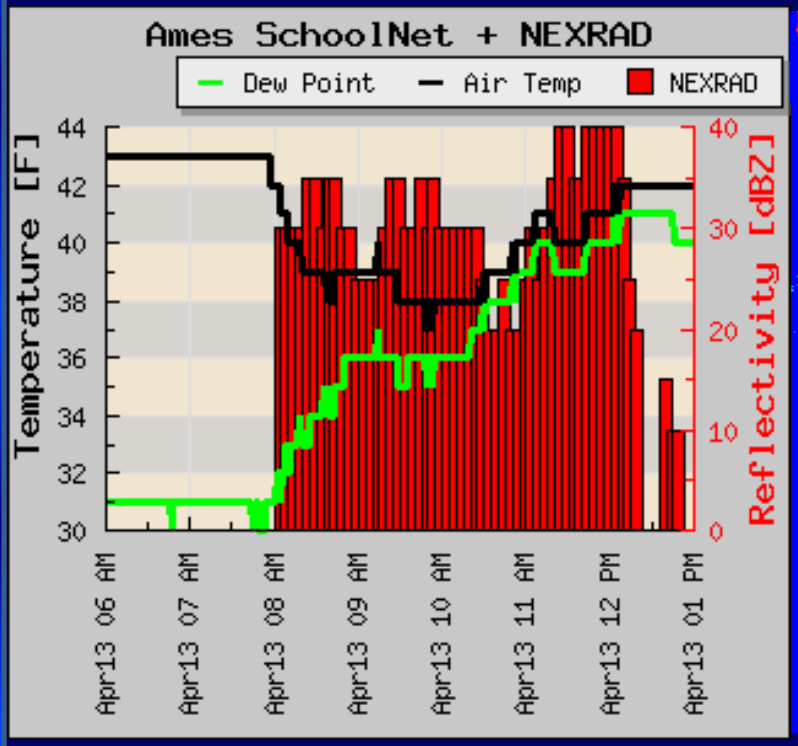
NEXRAD Composite Archive Stats

- ~ 1x1 km composite for the CONUS
- 1995 - Now
- Valid every 5 minutes
- 1.5 million images
- 500 GB total size
- Updated in real-time with a ‘re-analysis’ done each hour.

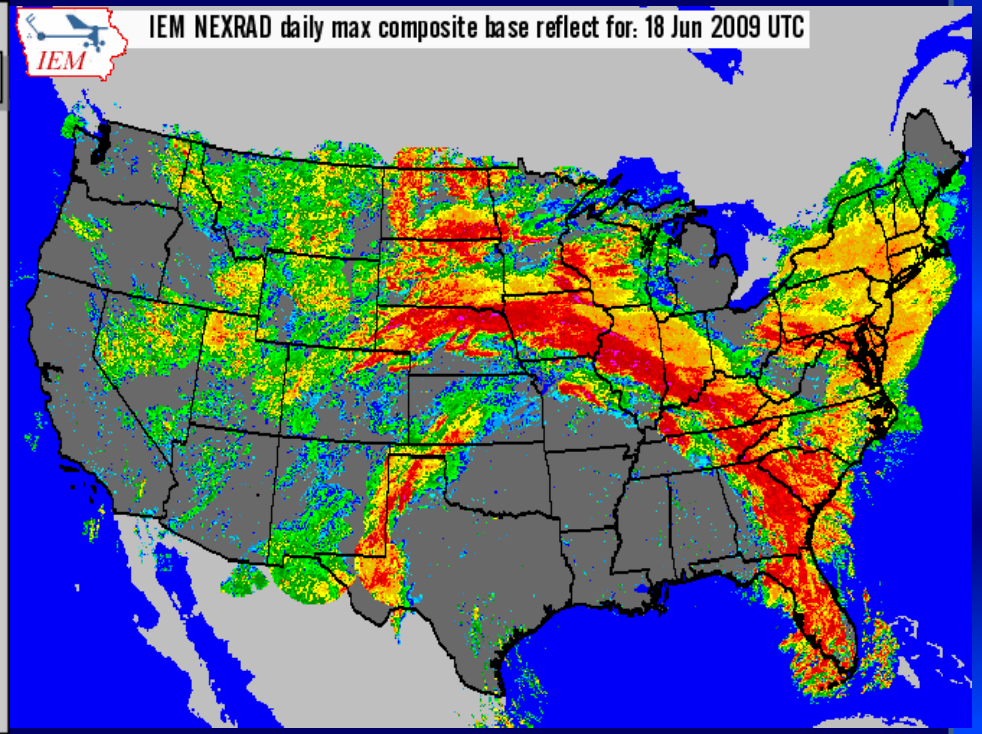


Example analysis showing the Iowa areal coverage of NEXRAD reflectivity on a day marked by summertime afternoon showers.

Makes a great data source for the "Daily Feature"

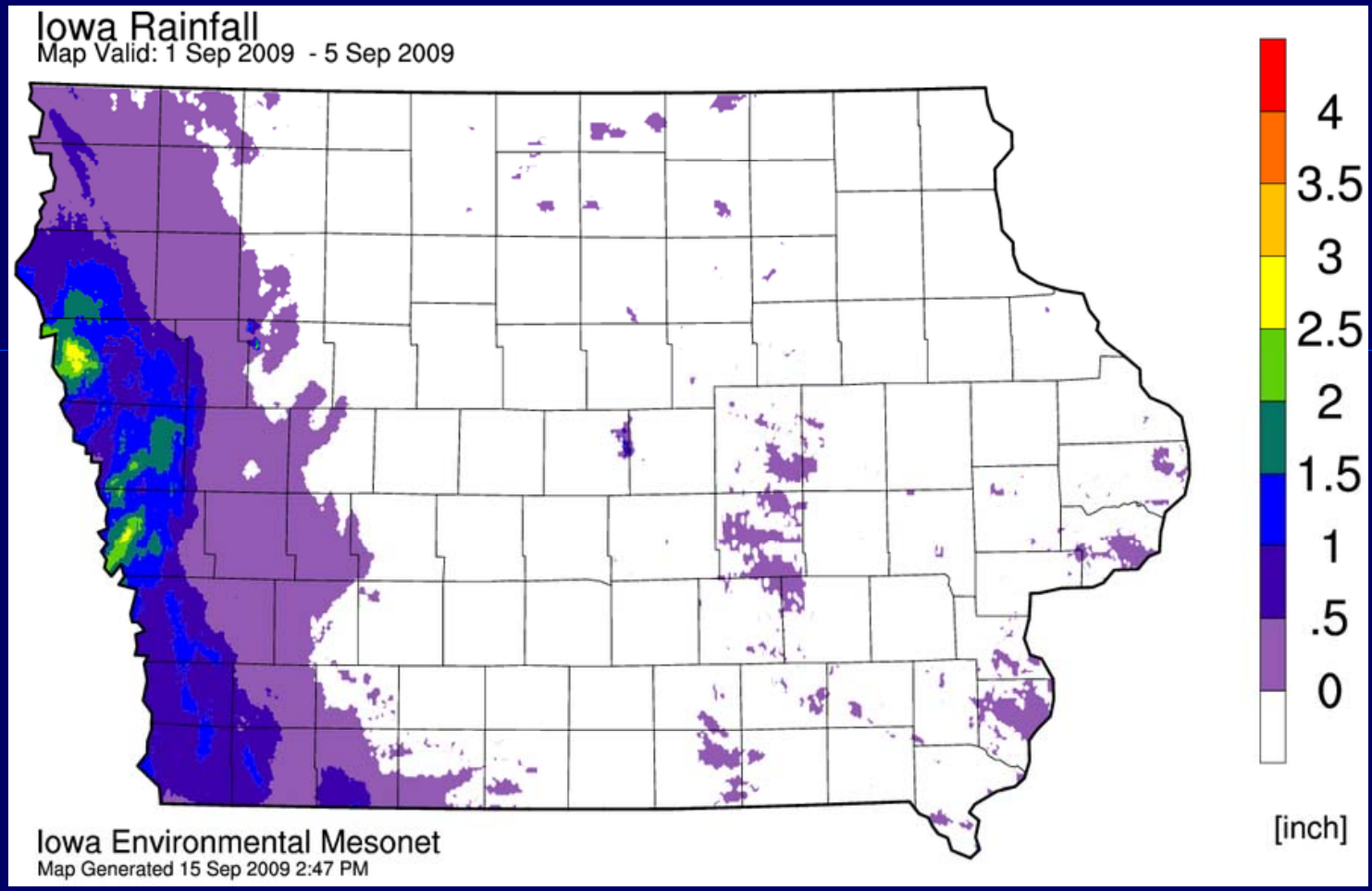


Combine NEXRAD with 1 minute observations to show a wet bulb illustration.



"Ring of Fire" illustrated by computing the daily maximum reflectivity.

Apply a Z-R and have fun!



Come on Darly, why don't you gauge correct this product?

Gauge Correction is not easy!

"Real time" METARs from Cedar Rapids on 27 August 2009

METAR KCID 272052Z 06017KT 1SM +RA BR BKN009 OVC036 17/17
A3000 RMK AO2 SLP158 **P0075** 60091 T01720172 55000

METAR KCID 272152Z 07010KT 1SM +RA BR BKN007 OVC036 17/17
A3000 RMK AO2 SLP157 **P0058** T01720172

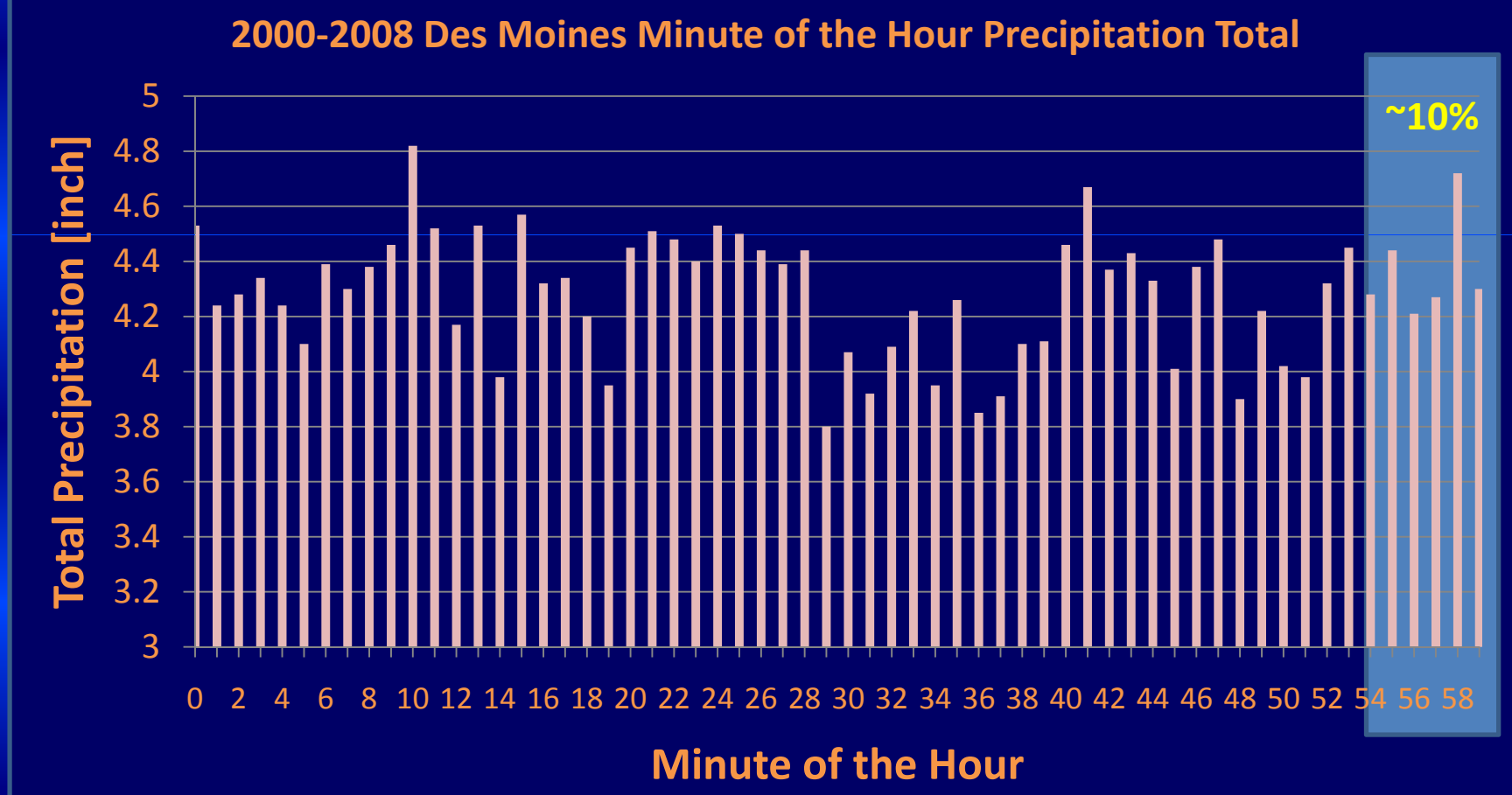
"Delayed" Daily Summary Message arrives later that evening (period to 6 UTC!)

KCID DS 27/08 641527/ 602359// 64/ 60//9981724/535/45/81/33/27/03/06/
28/14/19/68/17/01/01/17/**80**/**60**/34/01/00/00/00/00/00/00/131/06221336/
07261507/1=

The numbers do not match as they represent different hourly windows:

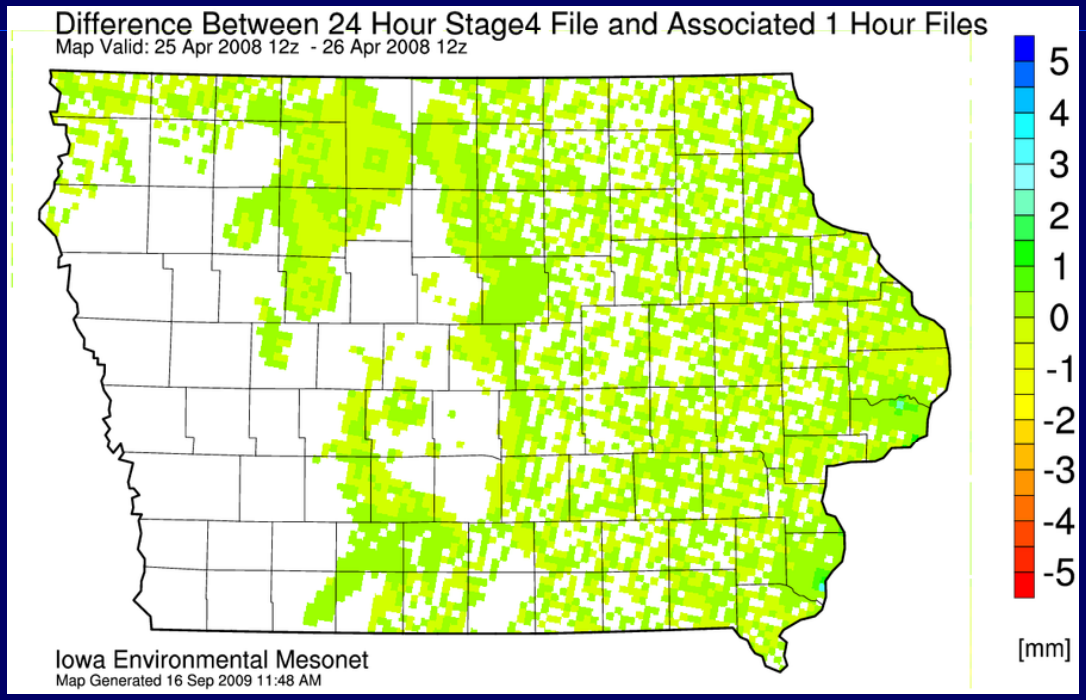
METAR: :52 to :52 Daily Summary Message: :00 to :00

How much precipitation per minute?



Why not use NCEP's stage4 precip?

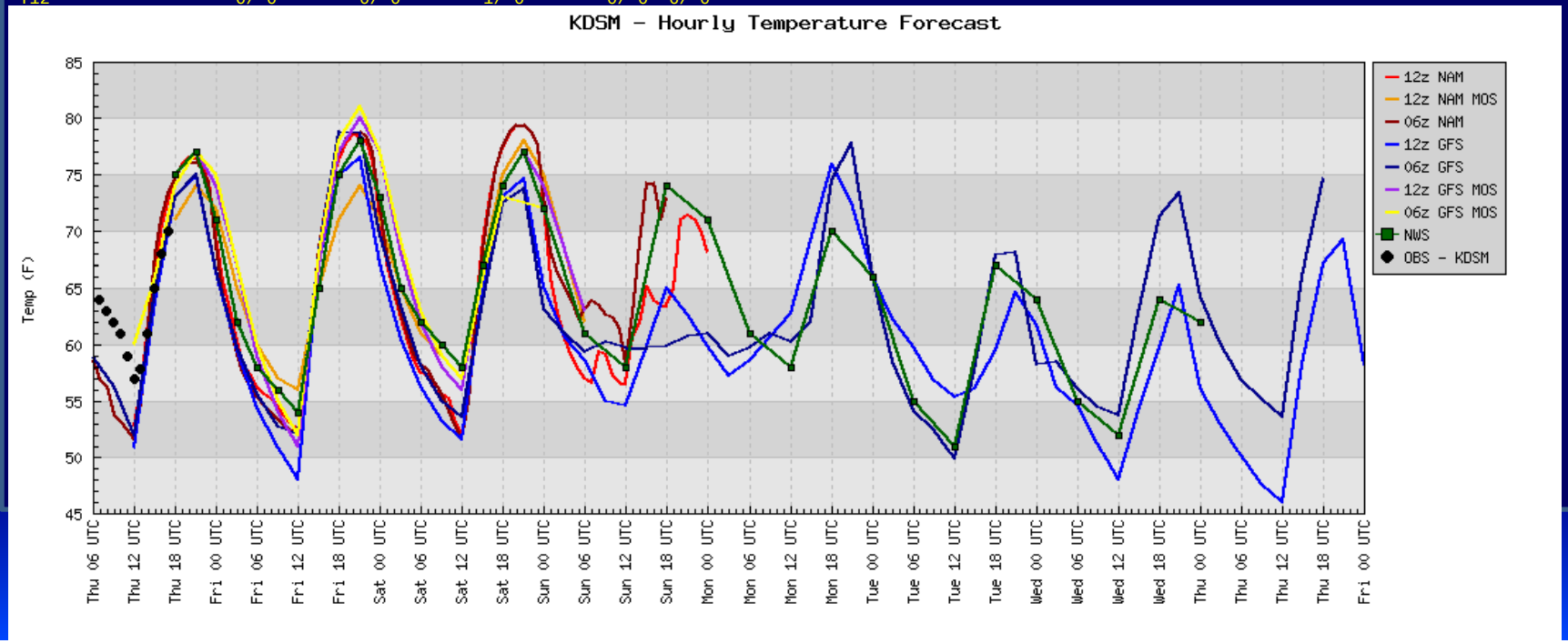
- *The Stage IV 6-hourlies are not simple summations of the hourlies…. Some of the hourlies we receive are only the automated runs (no QC), while for the 6-hourlies we almost always receive the QC'd version.* - source: NCEP Stage4 FAQ



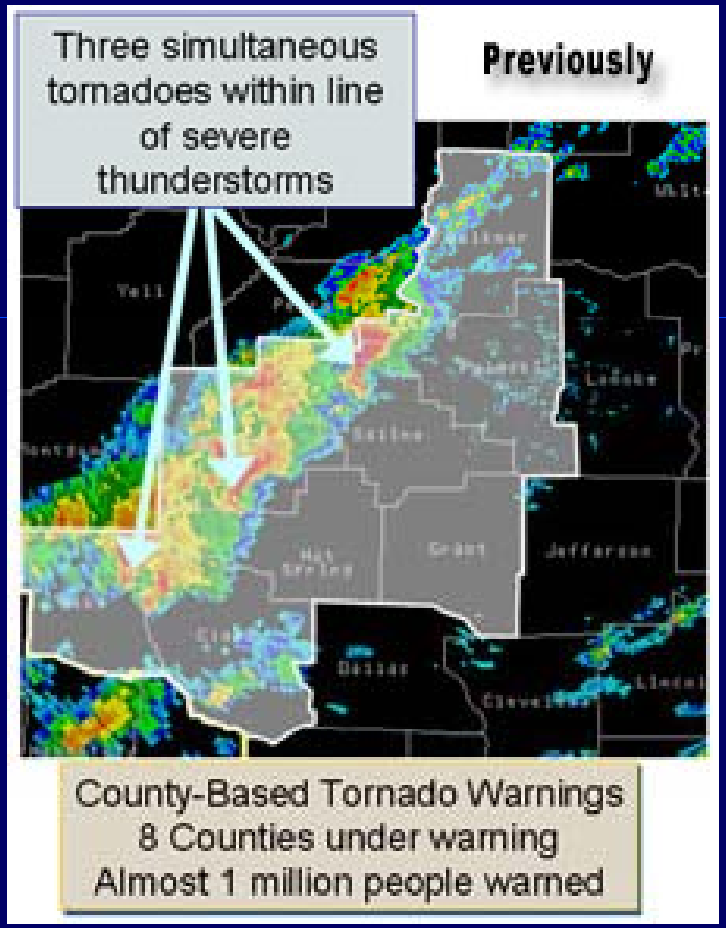
Model Output Statistics Archive

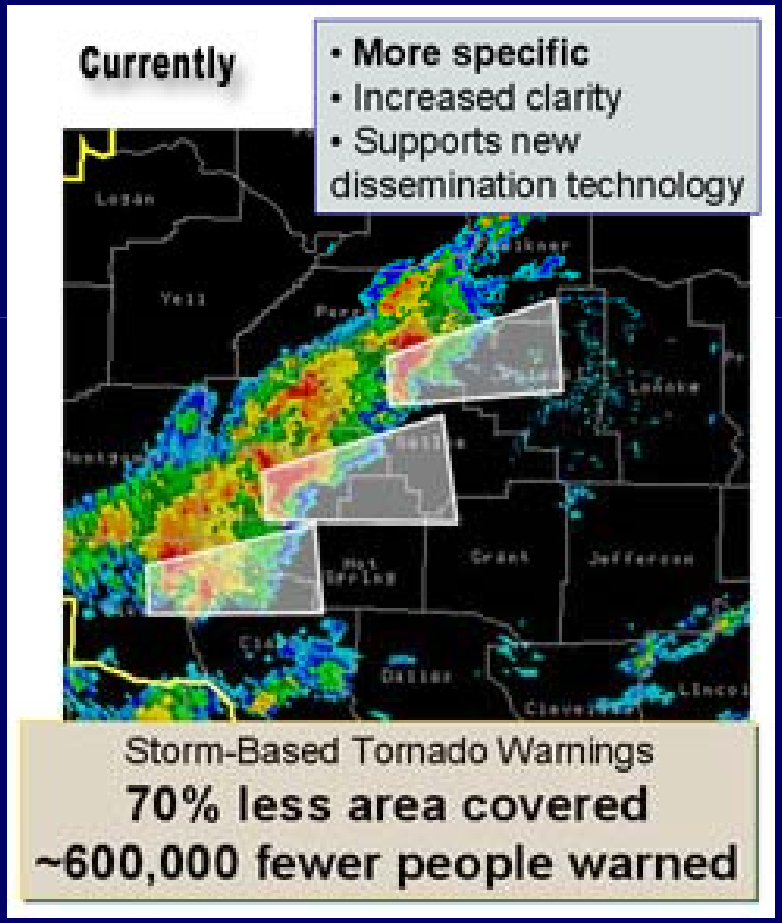
```
145
FOUS23 KWNO 170600
MAVNC1
KDSM    GFS MOS GUIDANCE    9/17/2009  0600 UTC
DT /SEPT 17      /SEPT 18                /SEPT 19                /
HR   12 15 18 21 00 03 06 09 12 15 18 21 00 03 06 09 12 15 18 00 06
X/N              78          51          82          56          77
TMP  60 66 74 77 75 67 60 55 52 68 78 81 77 69 63 59 57 66 73 72 63
DPT  55 55 54 54 54 54 50 49 48 55 56 55 56 56 54 53 52 55 55 56 56
CLD  FW FW FW FW CL CL CL CL CL CL CL FW CL CL CL CL CL CL CL BK OV
WDR  10 07 05 05 08 12 14 15 19 08 08 09 11 11 12 11 10 12 11 11 11
WSP  02 03 05 05 05 04 03 02 01 03 05 06 06 06 05 04 05 07 08 06 05
P06         1     1     0     3     3     2     3     3     8 11 27
P12               3           3           3           3       14
Q06         0     0     0     0     0     0     0     0     0  0  0
Q12               0           0           0           0       0
T06      0/ 0  0/ 0  0/ 0  0/ 0  0/ 0  0/ 0  1/ 0  0/ 0  0/ 0  6/ 0
T12                  0/ 0        0/ 0        1/ 0        0/ 0  6/ 0
```

- Database the NAM/GFS MOS data for all locations.
- Mostly complete back to early 2007



NWS Storm Based Warning Verification





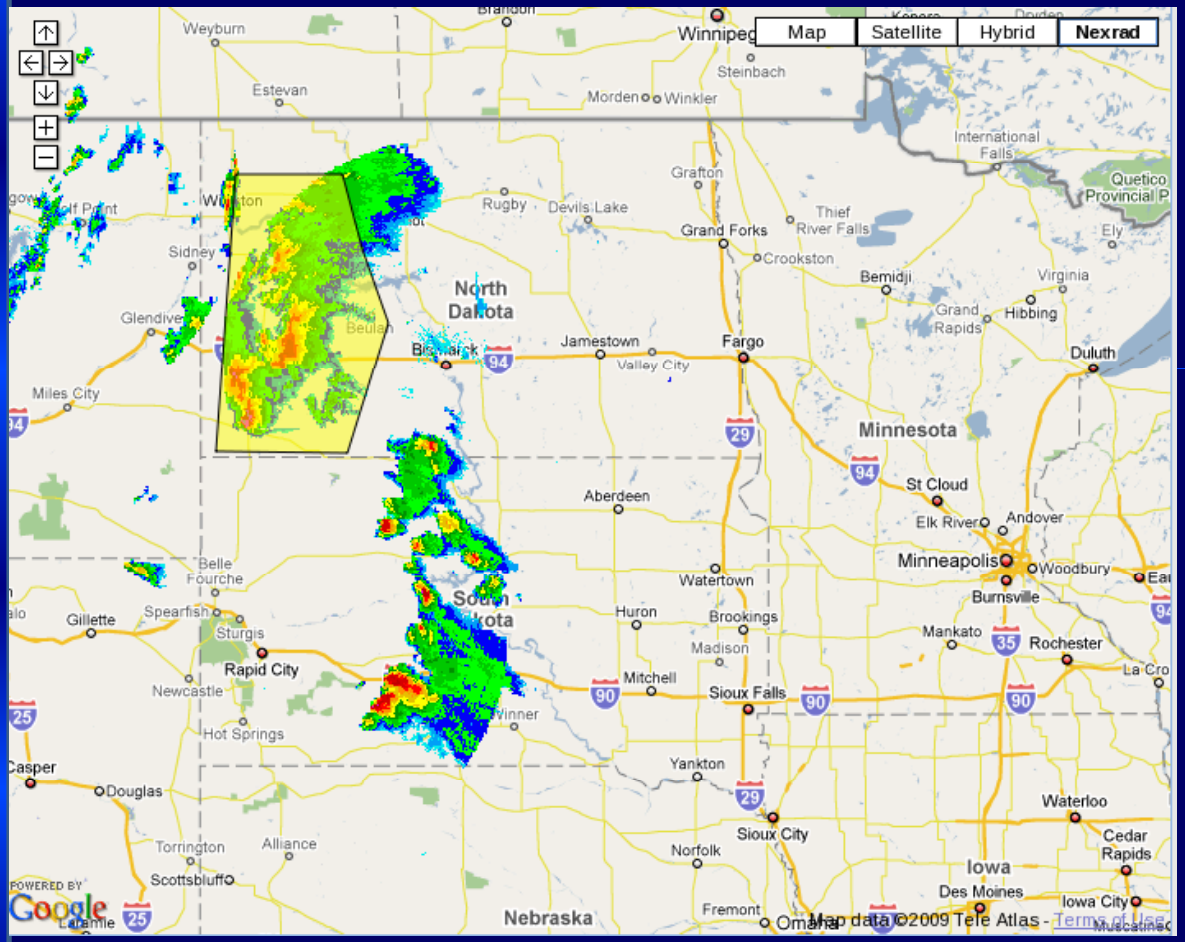
Images from: http://www.weather.gov/sbwarnings/

Components of a NWS Warning

UGC (County/Zones Impacted) P-VTEC String Storm Based warning Polygon

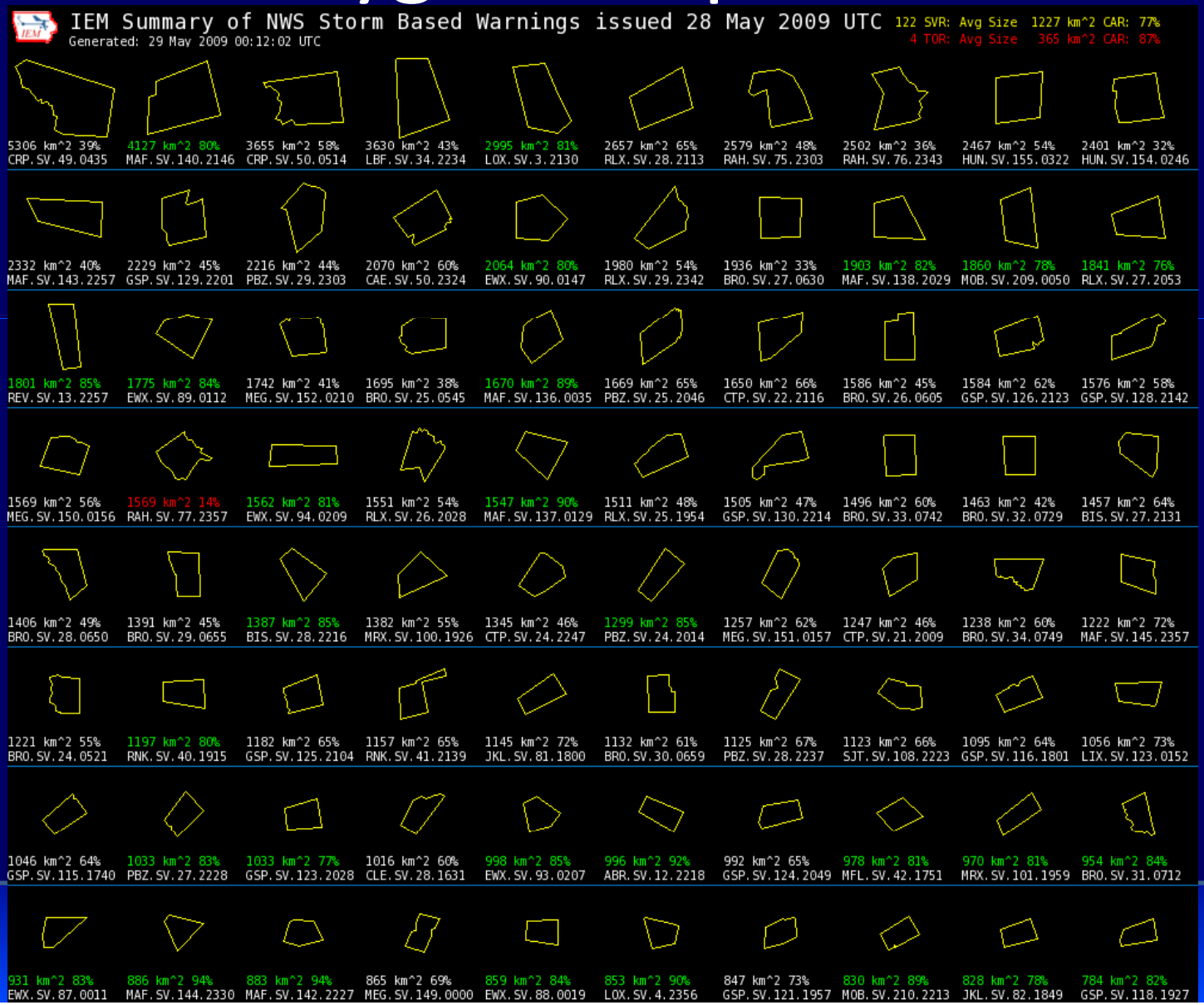
```
210
WFUS53 KDMX 252145
TORDMX
IAC023-075-252230-
/O.NEW.KDMX.TO.W.0013.080525T2146Z-080525T2230Z/

BULLETIN - EAS ACTIVATION REQUESTED
TORNADO WARNING
NATIONAL WEATHER SERVICE DES MOINES IA
446 PM CDT SUN MAY 25 2008

THE NATIONAL WEATHER SERVICE IN DES MOINES HAS
    ISSUED A

* TORNADO WARNING FOR...
  NORTHERN GRUNDY COUNTY IN CENTRAL IOWA...
  SOUTHEASTERN BUTLER COUNTY IN NORTH CENTRAL
    IOWA...

* UNTIL 530 PM CDT.

* AT 441 PM CDT...NATIONAL WEATHER SERVICE DOPPLER
    RADAR INDICATED A
  SEVERE THUNDERSTORM CAPABLE OF PRODUCING A TORNADO
    7 MILES
  SOUTHWEST OF APLINGTON...OR 33 MILES WEST OF
    WATERLOO...MOVING
  NORTHEAST AT 36 MPH.

* THE TORNADO WILL BE NEAR...
  APLINGTON BY 455 PM CDT...
  PARKERSBURG BY 500 PM CDT...
  ALLISON BY 510 PM CDT...
  SHELL ROCK AND CLARKSVILLE BY 520 PM
    CDT...

THIS IS A HAZARDOUS SITUATION. SEEK
    SHELTER IN A BASEMENT...OR IN AN
INTERIOR ROOM. STAY AWAY FROM WINDOWS.
    IF YOU ARE OUTSIDE OR IN A
CAR...SEEK SHELTER IN A REINFORCED
    BUILDING.

A TORNADO WATCH REMAINS IN EFFECT UNTIL
    900 PM CDT SUNDAY EVENING FOR
NORTHWESTERN IOWA.

LAT...LON 4249 9256 4247 9302 4267 9303
    4287 9256
TIME...MOT...LOC 2146Z 238DEG 31KT 4256
    9295
```

Polygon Size FAIL



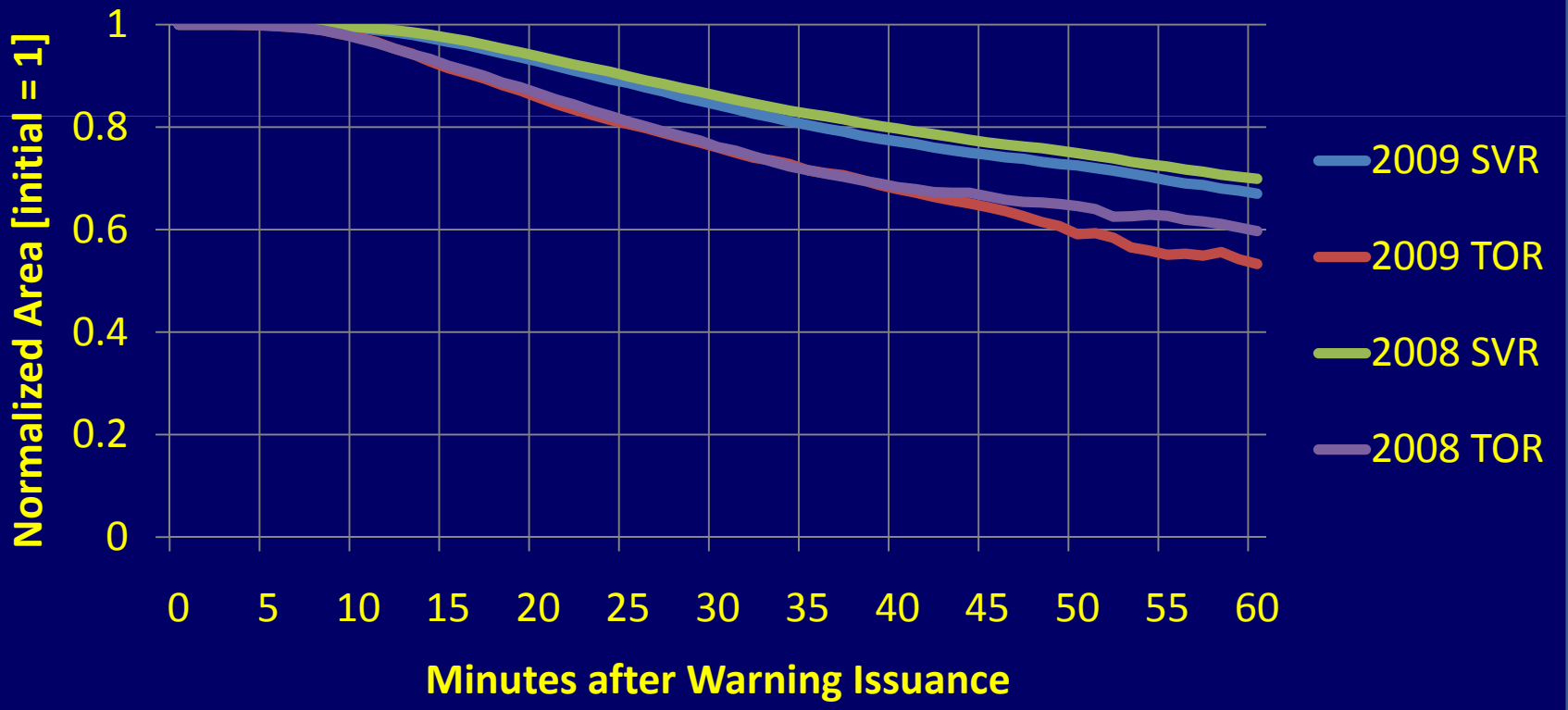
- ~40,000 sq km Severe Thunderstorm Warning issued in July 2009
- Covering portions of 16 counties

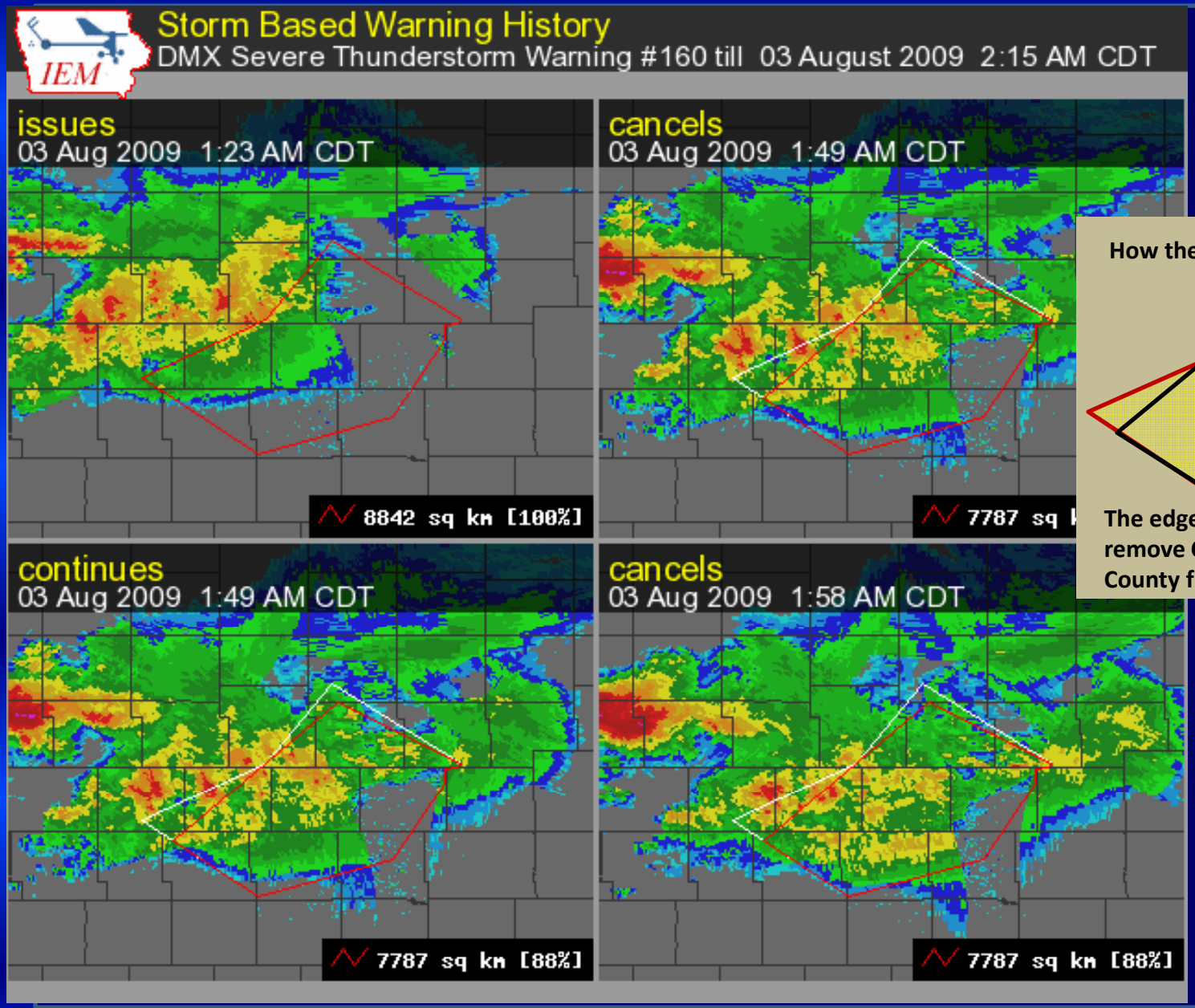
Polygon Shape FAIL



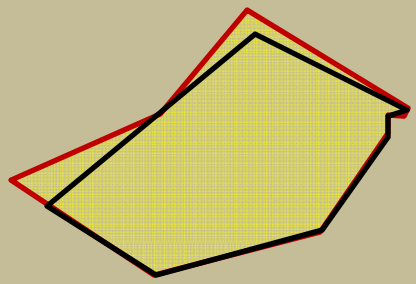
Polygon Time FAIL

Storm Based Warning
Normalized Size Change with SVS update
[all 2008, 2009 thru 13 Aug]





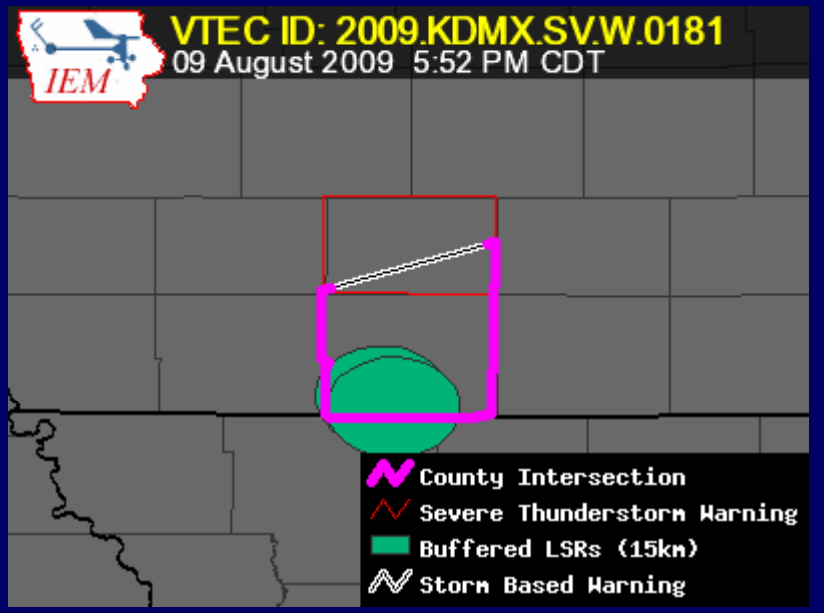
How the Polygon Changed

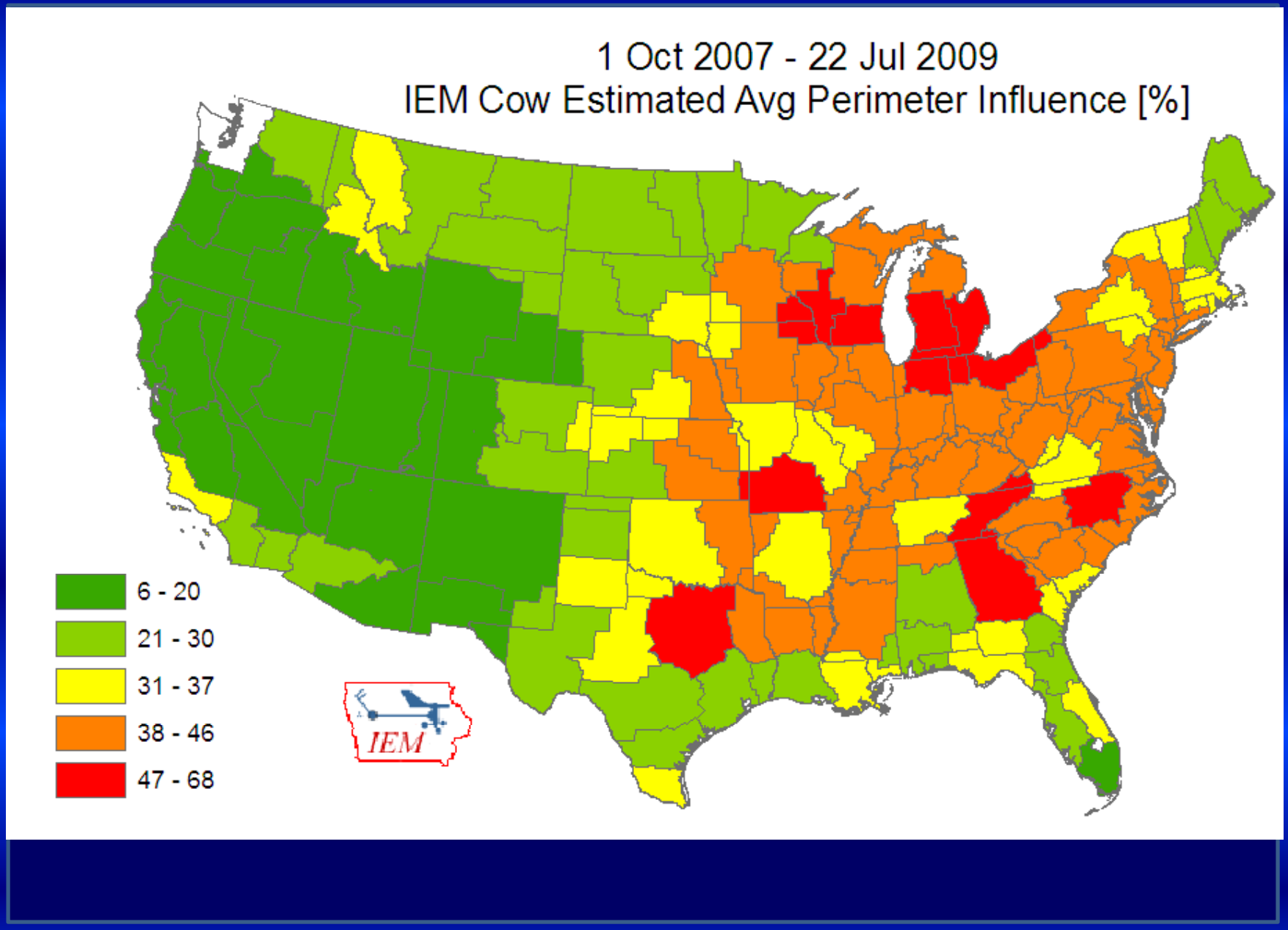


The edges were clipped to remove Carroll and Wright County from the warning.

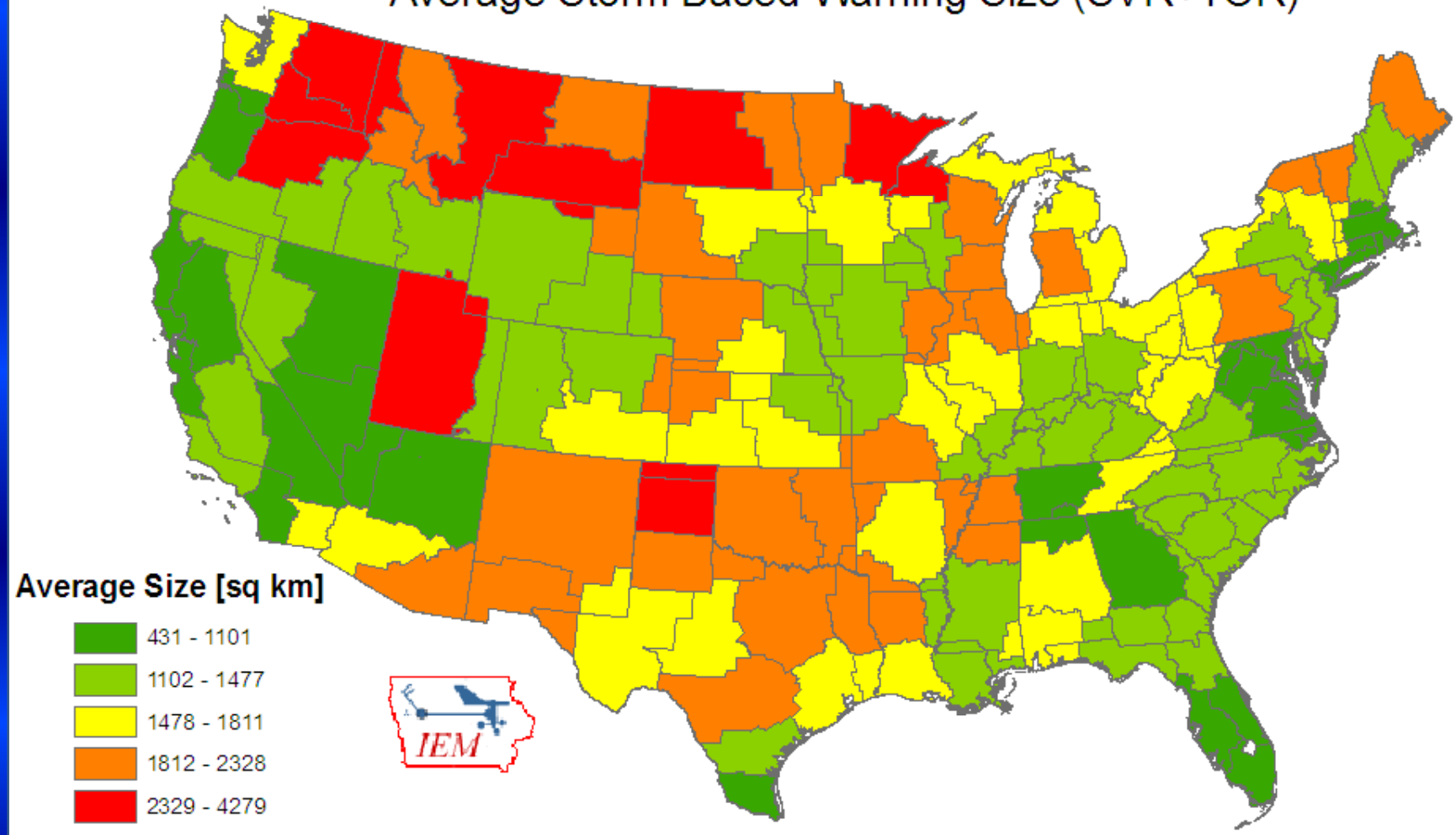
Introduce some metrics “IEM Cow”

- Perimeter Ratio
  - The coincident SBW border with county border
- Size Reduction
  - The decreased amount of warned area
- Area Verified
  - Storm reports are buffered and then composited. The composite area is compared to the SBW size.



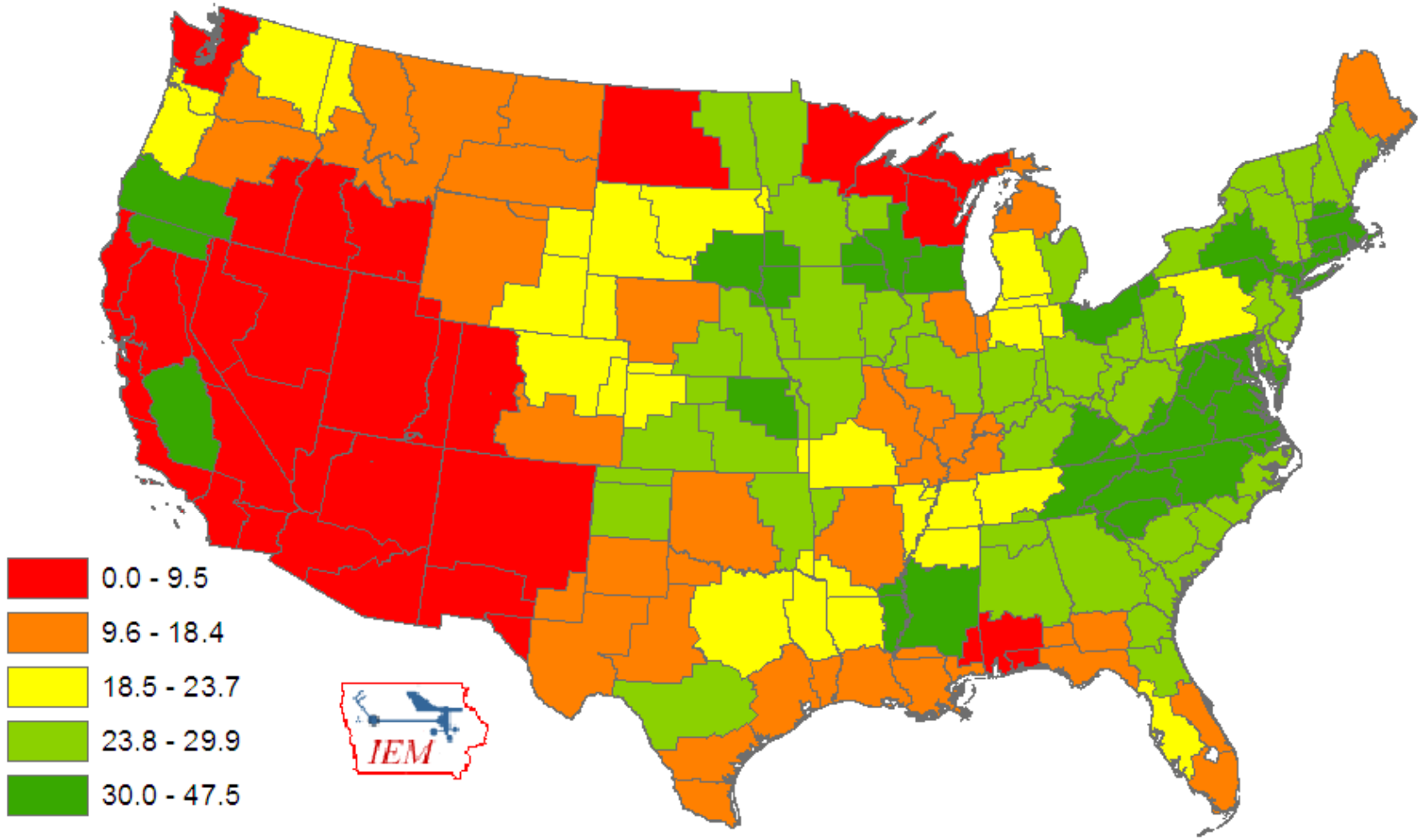

1 Oct 2007 - 22 Jul 2009
IEM Cow Estimated Avg Perimeter Influence [%]
6 - 20
21 - 30
31 - 37
38 - 46
47 - 68
IEM

1 Oct 2007 - 22 Jul 2009
Average Storm Based Warning Size (SVR+TOR)



1 Apr 2008 - 10 Aug 2009

IEM Cow Estimated SVR+TOR Areal Verification (15 km) [%]



Storm Based Warning Summary Stats

	*2007 TOR+SVR	2008 TOR+SVR	2009 TOR+SVR
Total Warnings	22399	31262	22908
Polygon Size versus County Based	72%	72%	73%
Areal Verification (15km buffer)	23%	23%	23%
Perimeter Ratio	35%	33%	32%
Average Size	1229 sq km	1615 sq km	1650 sq km
Critical Success Index [CSI]	0.39	0.44	0.44
Probability of Detection [POD]	0.70	0.80	0.80
False Alarm Ratio [FAR]	0.54	0.50	0.51

* Unofficial data computed by the IEM, 2009 data thru 21 Sep
* 2007 Data prior to 1 Oct 2007 using issued polygons, when Storm Based Warnings started

Enough Complaining, Solutions?

1. Remove UGC requirement in warnings. This would free the warnings to resemble actual storm tracks.
2. Generating software should limit the number of vertices of polygon to prevent confusing shapes. (Maybe 6, currently around 20)
3. Remove odd policies preventing TOR/SVR warnings from being issued over marine zones.
4. Allow offices to issue warnings for areas outside of their CWA. Completely eliminate political boundaries from warnings.

Data Archives Summary

- SPC Convective Watches [1997-]
- NEXRAD Composite Reflectivity [1995 -]
- 1 minute interval obs
  - ASOS [2000-]
  - AWOS [1995-]
  - SchoolNet [2002-]
- Raw MOS Output [2007-]
- Stage4 Precipitation [1997-]
- NWS Warnings, back to 1996 coming soon!

That's all folks…. Questions?

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