

Interpreting MODE Output

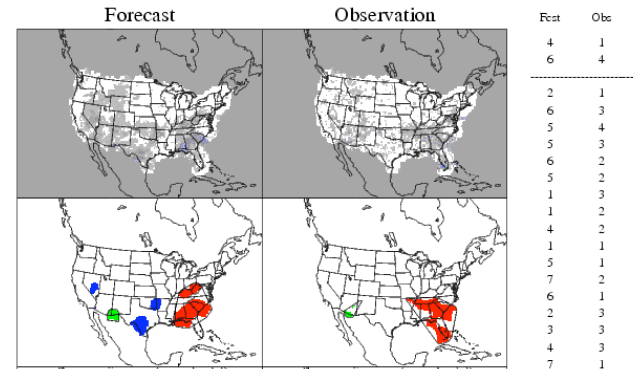
Verifying with Objects



Presenter: Dave Ahijevych

MODE Output

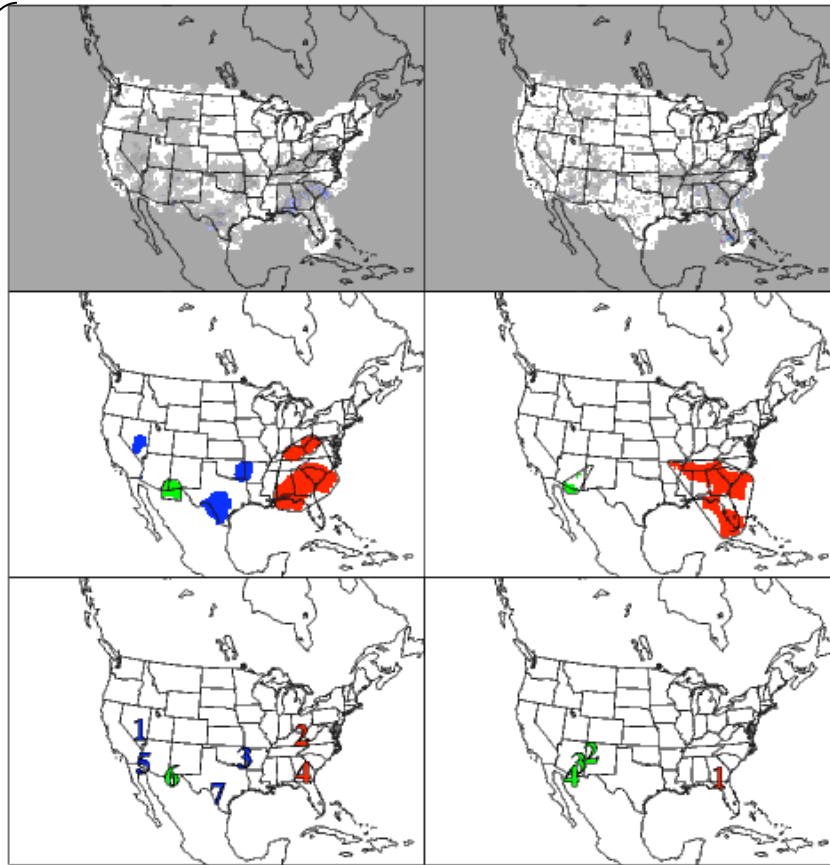
- PostScript
 - object pictures
 - parameter summary
 - total interest for each object pair



MODE: APCP_12 at SFC vs APCP_12 at SFC

Forecast

Observation



object pictures

Fcst	Obs	Interest
4	1	0.9173
6	4	0.8301
<hr/>		
2	1	0.5589
6	3	0.5027
5	4	0.4328
5	3	0.2430
6	2	0.2384
5	2	0.1111
1	3	0.0898
1	2	0.0123
4	2	NA
1	1	NA
5	1	NA
7	2	NA
6	1	NA
2	3	NA
3	3	NA
4	3	NA
7	1	NA
3	1	NA
7	3	NA
1	4	NA
2	4	NA
3	4	NA
4	4	NA
2	2	NA
3	2	NA
7	4	NA

total interest of object pairs

field names
model description

	Forecast	Observation
Model:	WRF	
Field:	APCP_12	APCP_12
Level:	SFC	SFC
Units:	kg/m^2	kg/m^2
Initial:	20050807 00:00:00	20050807 12:00:00
Valid:	20050807 12:00:00	20050807 12:00:00
Accum:	12:00:00	12:00:00

	Forecast	Observation
Mask M/G/P:	on/off/off	on/off/off
Raw Thresh:	>=0.00	>=0.00
Conv Radius:	5 gs	5 gs
Conv Thresh:	>=2.50	>=2.50
Area Thresh:	>=0 gs	>=0 gs
Inten Thresh:	p100>=0.00	p100>=0.00
Merge Thresh:	>=1.25	>=1.25
Merging:	thresh	thresh
Matching:		match/merge
Simple/M/U:	7/3/4	4/4/0
Area:	944 gs	654 gs
Area M/U:	628/316	654/0
Cluster:	2	2
MMI:	0.4328	0.6664
MMI (F+O):		0.5027

definition of objects

- smoothing radius
- intensity threshold
- area threshold

matching and/or merging

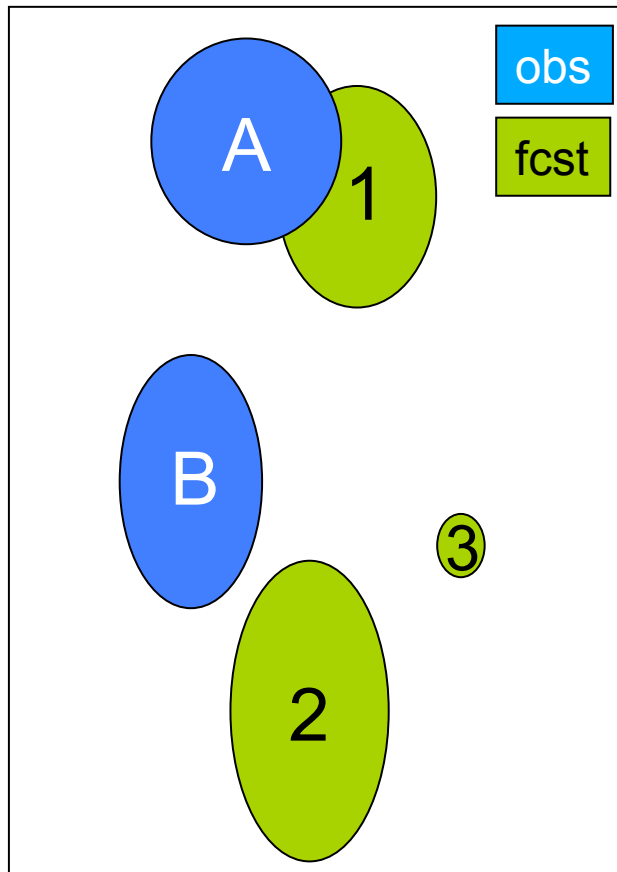
and area of objects

Median Max. Interest (MMI)

weight of object attributes

Centroid/Boundary:	2.00	4.00
Convex Hull/Angle:	0.00	1.00
Area/Intersection Area:	1.00	2.00
Complexity/Intensity:	0.00	0.00
Total Interest Thresh:		0.70

Median of the Max. Interest (MMI*)



Interest Matrix

observed

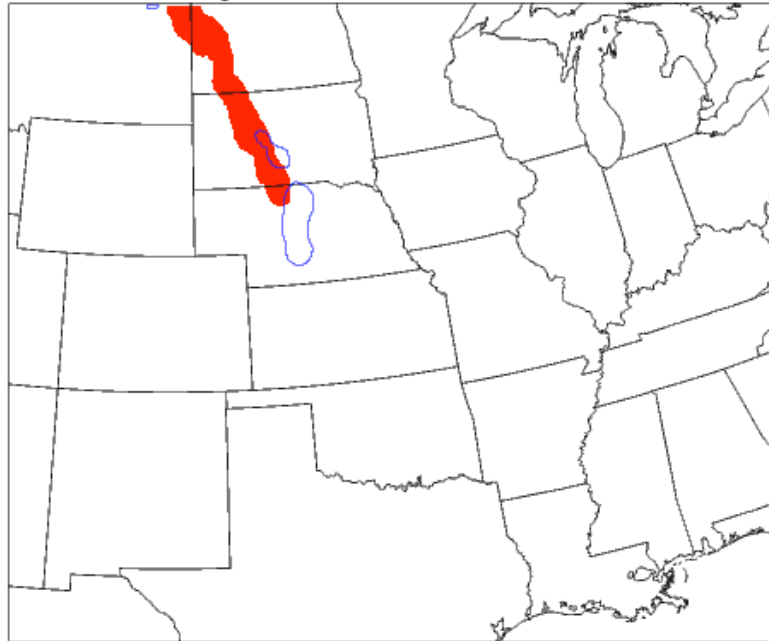
		observed	
		A	B
forecast	1	0.90	0.65
	2	0.50	0.80
	3	0.40	0.55

* Davis et al., 2009: The Method for Object-based Diagnostic Evaluation (MODE) Applied to WRF Forecasts from the 2005 SPC Spring Program. Weather and Forecasting

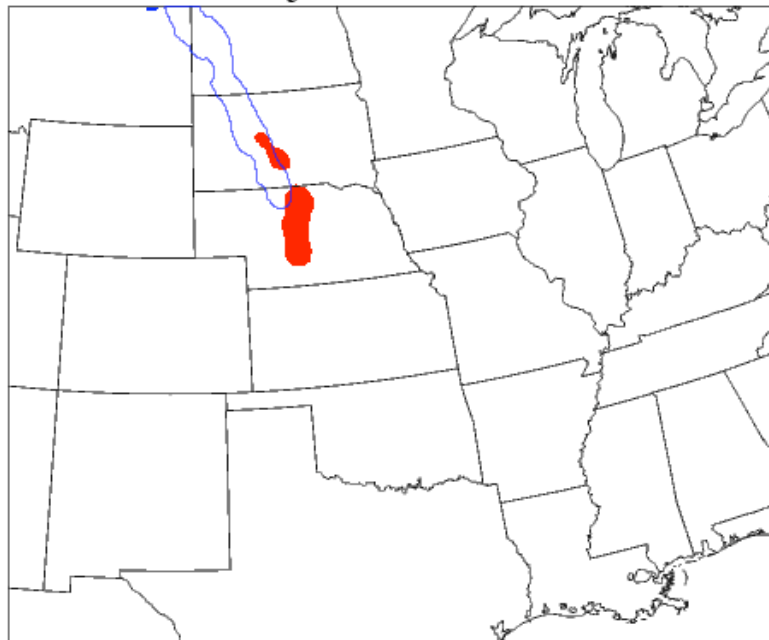
$$\text{MMI} = \text{median} \{ 0.90, 0.80, \overset{\text{maximum interest}}{0.90}, 0.80, 0.55 \} = 0.80$$

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Forecast Objects with Observation Outlines

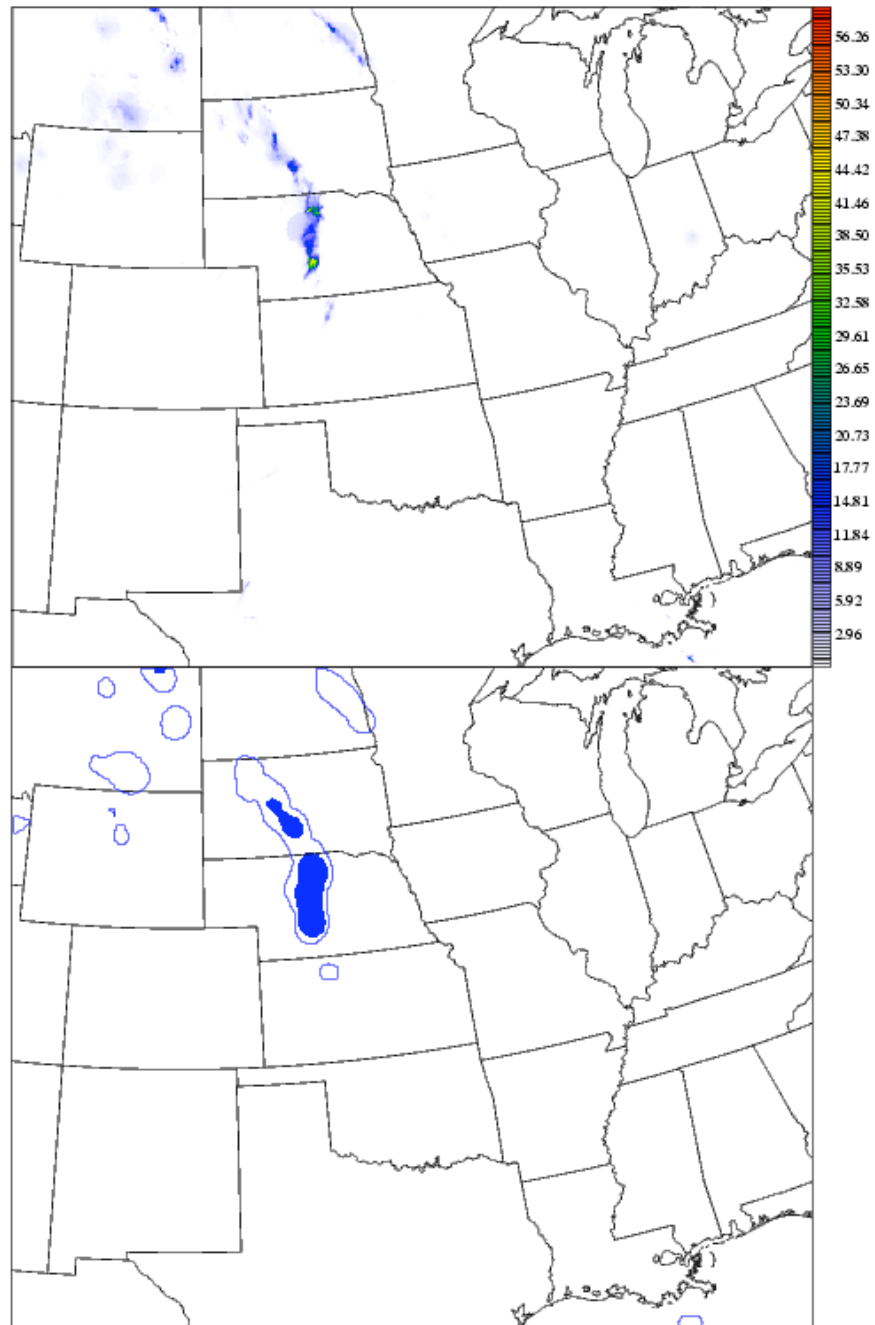


Observation Objects with Forecast Outlines



Merging Objects with Double Threshold

Observation: Threshold Merging

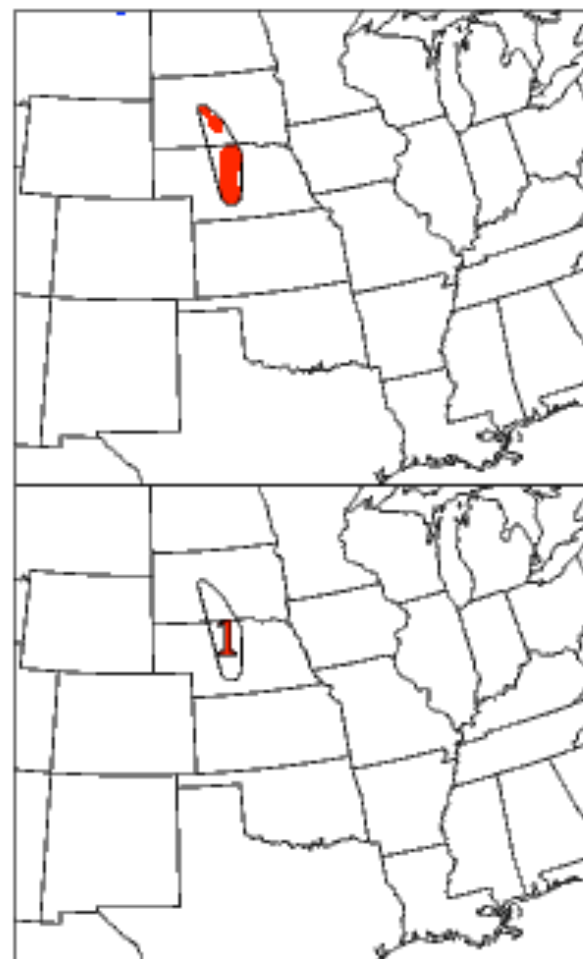


Cluster Object Information

Forecast



Observation



CLUS PAIR	CEN DIST	ANG DIFF	FCST AREA	OBS AREA	INTER AREA	UNION AREA	SYM DIFF	FCST INT50	OBS INT50	FCST INT90	OBS INT90	TOT INTR
1	97.32	12.16	4184	1762	358	5588	5230	5.33	4.06	16.51	15.57	0.7622

MODE Output

- PostScript

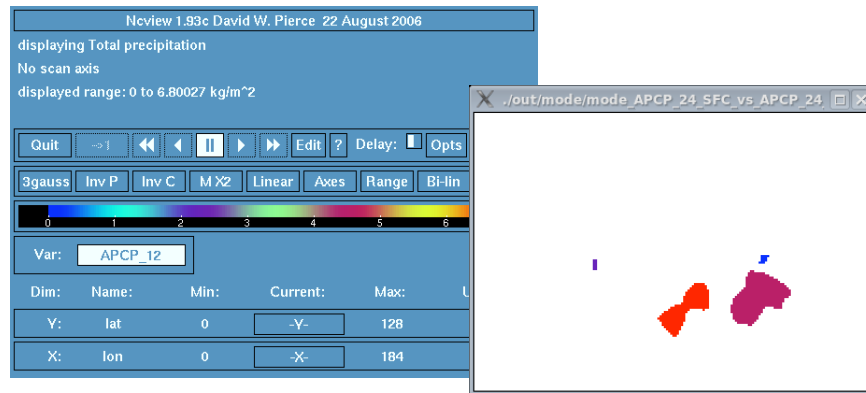
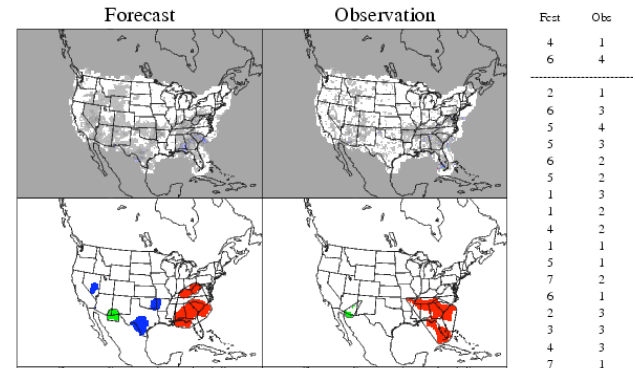
- object pictures
- parameter summary
- total interest for each object pair

- ASCII

- object sizes, shapes, positions
- stats for simple, paired objects and clusters
- standard contingency table stats on smoothed and thresholded fields (objects)

- netCDF

- gridded object fields
- view with ncview

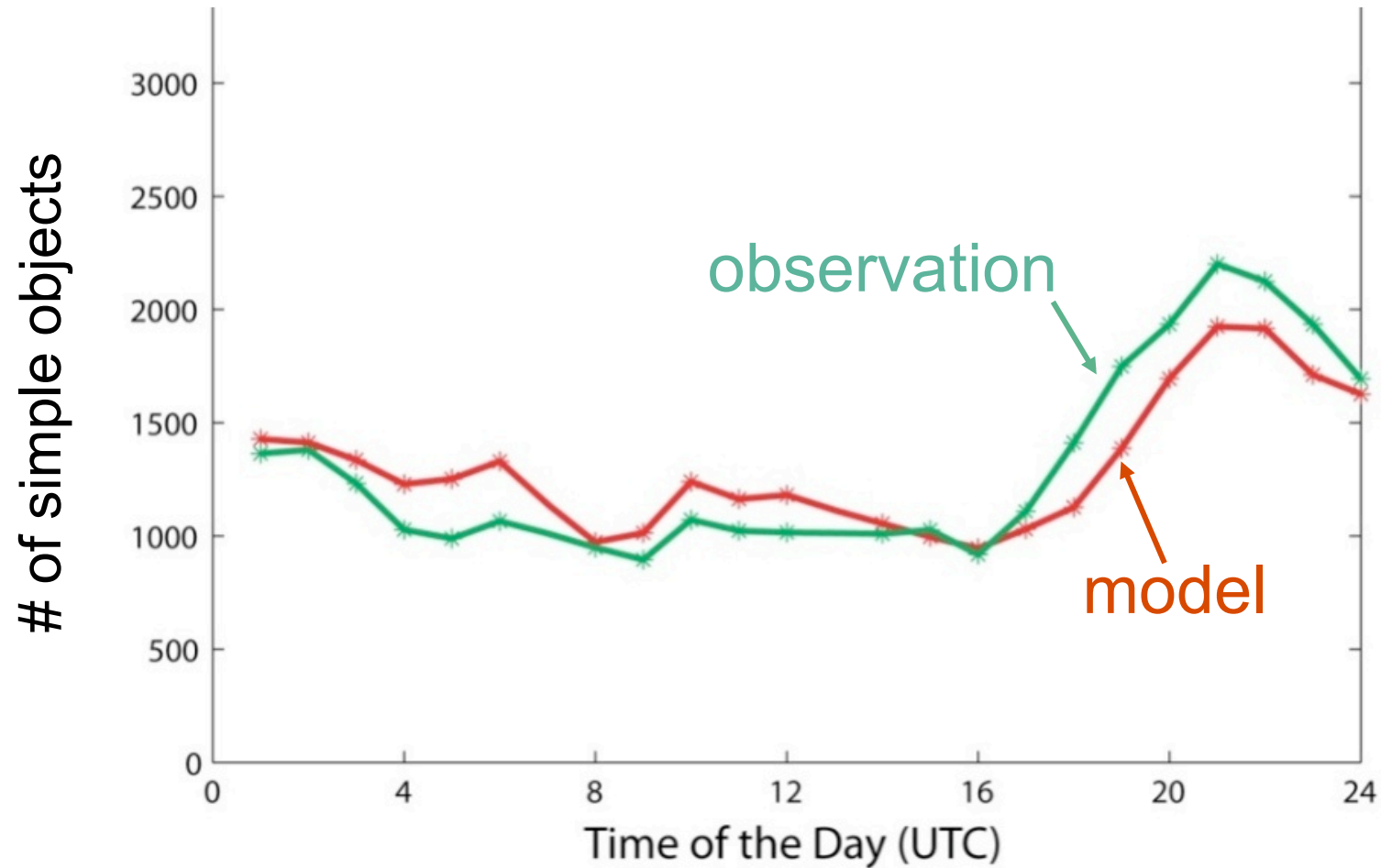


Interpreting MODE Output

Examples of Object-based Diagnostic Evaluation

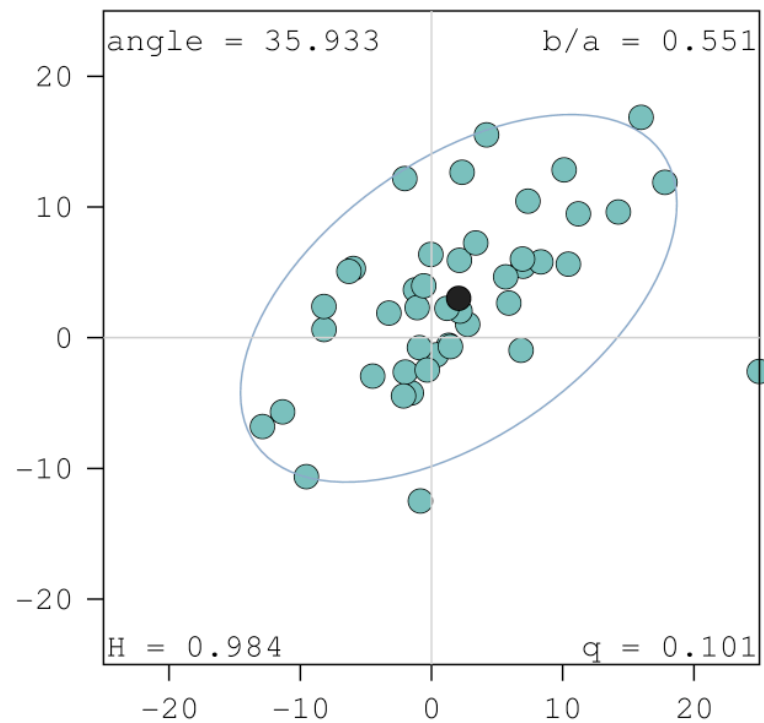
- Diurnal cycle of the number of storms
- Model displacement error
- Quilt plot

Diurnal Cycle of the Number of Storms

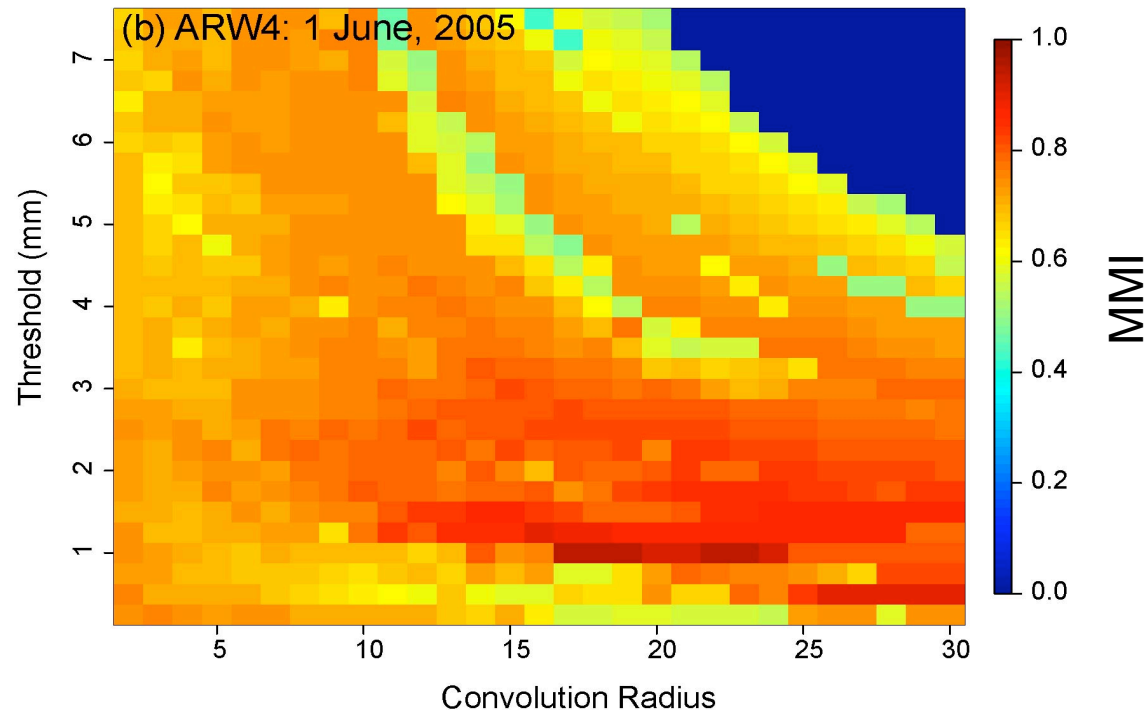


Model Displacement Error

*Composite Object Centroid Differences
over the Appalachian Mountains*



Median of the Max. Interest (MMI) Quilt Plot

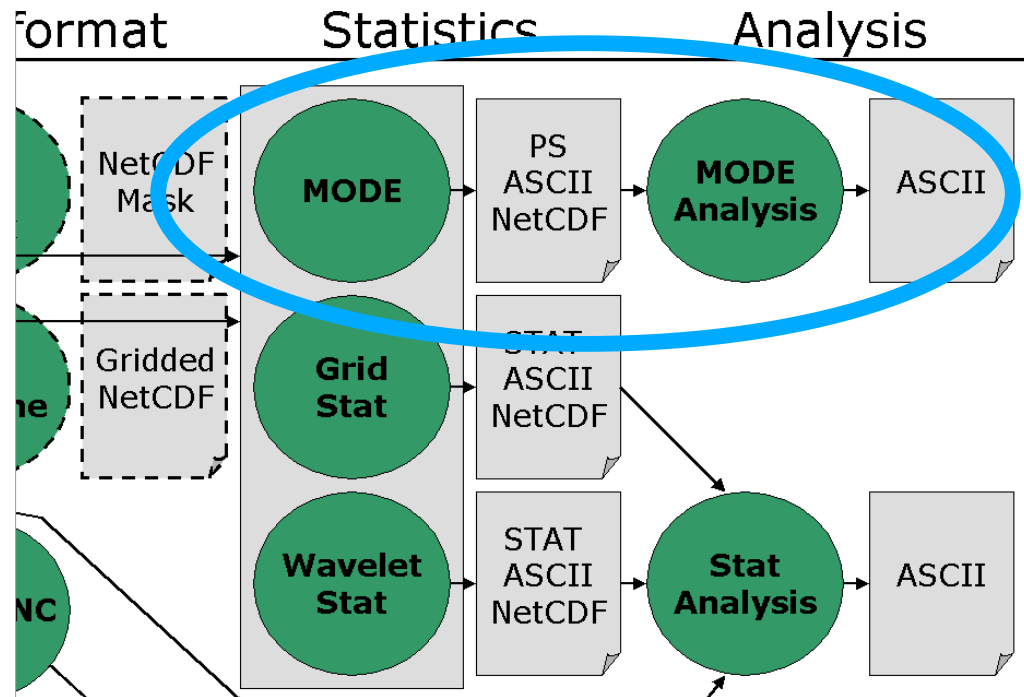


MMI as a function of convolution radius (grid squares) and threshold (mm) for 24-h forecast of 1-h rainfall

- Each pixel is a MODE run.
- This graphic is not in MET, but R code on MET website.

MODE Analysis Tool

- mode_analysis



MODE Analysis Tool

-summary Example

Command Line

```
mode_analysis -summary \  
  -lookin mode_output/wrf4ncep/40km/ge03.\  
  -fcst -cluster \  
  -area_min 100 \  
  -column centroid_lat -column centroid_lon \  
  -column area \  
  -column axis_ang \  
  -column length
```

Output

```
Total mode lines read = 393  
Total mode lines kept = 17
```

Field	N	Min	Max	Mean	StdDev	P10	P25	P50	P75	P90	Sum
centroid_lat	17	31.97	46.24	38.65	3.81	33.89	36.13	38.54	40.12	43.99	657.00
centroid_lon	17	-103.89	-85.20	-96.32	5.91	-103.15	-102.65	-96.26	-93.95	-86.78	-1637.49
area	17	180.00	8393.00	2955.06	2246.49	624.80	1206.00	2662.00	3958.00	5732.20	50236.00
axis_ang	17	-88.63	85.66	12.62	64.35	-70.77	-63.86	35.04	74.37	79.24	214.60
length	17	25.25	234.76	124.41	60.99	48.85	65.37	116.67	169.37	204.57	2114.90

MODE Analysis Tool

-bycase Example

Command Line

```
mode_analysis -bycase -lookin mode_output/wrf4ncep/40km/ge03. \  
-single -cluster \  
-area_min 100
```

Output

```
Total mode lines read = 393  
Total mode lines kept = 17
```

Fcst Valid Time	Area Matched	Area Unmatched	# Fcst Matched	# Fcst Unmatched	# Obs Matched	# Obs Unmatched
Apr 26, 2005 00:00:00	2685	0	1	0	1	0
May 13, 2005 00:00:00	3958	0	1	0	1	0
May 14, 2005 00:00:00	11695	0	2	0	2	0
May 18, 2005 00:00:00	4295	0	1	0	1	0
May 19, 2005 00:00:00	1206	0	1	0	1	0
May 25, 2005 00:00:00	4457	0	2	0	2	0
Jun 1, 2005 00:00:00	8256	0	3	0	3	0
Jun 3, 2005 00:00:00	5319	0	3	0	3	0
Jun 4, 2005 00:00:00	8365	0	3	0	3	0

Interpreting MODE Output

- PostScript, ASCII, and netCDF
- Object-Based Diagnostic Evaluations
- Mode Analysis Tool

