Event Probabilities

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"Uncertainty is thus a fundamental characteristic of hydrometeorological prediction, and no forecast is complete without a description of its uncertainty. "

NRC Report, "Completing the Forecast…," 2006

Meteorological Development Laboratory
National Weather Service
September 19, 2007

Model Output Statistics (MOS)

- MOS provides objective forecast guidance for sensible weather elements
- Need historical record of observations
- Regression equations are applied to future runs of similar forecast model
- MOS post-processing ensures values are statistically consistent

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- MOS post-processing ensures values are statistically consistent
- **Produces probability forecasts from a single run of NWP model**

Statistical Post-Processing

- Advantages
  - Reflect the predictability of the event
  - Removal of some of the systematic model bias
  - Reliable probabilities
    - unbiased over the entire range of forecasts
  - Specific elements and site forecasts

- Disadvantages
  - Short samples
  - Changing NWP models
  - Availability & quality of observations

Explicit Probability Guidance

KPHL GFS MOS GUIDANCE 2/14/2007 0000 UTC

DT	/FEB						/FEB								/FEB						/
HR	06	09	12	15	18	21	00	03	06	09	12	15	18	21	00	03	06	09	12	18	00
X/N							32				15				26				13		29
TMP	23	24	25	29	29	28	26	22	18	17	16	19	24	25	23	19	17	16	15	27	25
DPT	20	23	25	29	28	23	16	8	6	4	3	2	0	0	0	2	3	4	4	5	5
CLD	OV	OV	OV	OV	OV	OV	OV	OV	FW	CL	SC	SC	SC	BK	BK	BK	SC	SC	SC	BK	CL
WDR	06	06	05	02	34	31	30	30	29	29	28	29	29	28	28	28	27	27	27	28	27
WSP	15	16	19	17	19	24	25	24	21	18	15	19	20	20	14	13	13	13	13	20	15
P06			100		84		32		0		0		0		0		0		0	0	0
P12							85				2				0				0		0
Q06			5		5		1		0		0		0		0		0		0	0	0
Q12							4				0				0				0		0
T06		3/	0	1/	24	2/	0	0/	0	1/	1	1/	19	0/	6	0/	3	0/	0	0/	0
T12				3/	24			2/	26			1/	19			1/	23		0/	21	
POZ	69	61	50	36	19	20	20	7	1	1	0	0	0	3	0	0	0	0	0	3	0
POS	16	12	10	25	30	45	64	76	84	99	85	97	97	86	88	85	81	100	93	91	94
TYP	Z	Z	Z	Z	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
SNW											1								0		
CIG	4	3	3	3	3	4	6	6	6	8	8	8	8	8	8	8	8	8	8	8	8
VIS	7	5	4	3	5	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
OBV	N	BR	BR	BR	BR	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Hidden Probability Guidance

KPHL GFS MOS GUIDANCE 2/14/2007 0000 UTC

DT	/FEB	14					/FEB	15						/FEB	16					/
HR	06	09	12	15	18	21	00	03	06	09	12	15	18	21	00	03	06	09	12	18	00
X/N							32				15				26				13		29
TMP	23	24	25	29	29	28	26	22	18	17	16	19	24	25	23	19	17	16	15	27	25
DPT	20	23	25	29	28	23	16	8	6	4	3	2	0	0	0	2	3	4	4	5	5
CLD	OV	OV	OV	OV	OV	OV	OV	OV	FW	CL	SC	SC	SC	BK	BK	BK	SC	SC	SC	BK	CL
WDR	06	06	05	02	34	31	30	30	29	29	28	29	29	28	28	28	27	27	27	28	27
WSP	15	16	19	17	19	24	25	24	21	18	15	19	20	20	14	13	13	13	13	20	15
P06			100			84		32			0			0			0			0	0	0
P12								85				2					0			0	0
Q06				5			5		1			0			0			0		0	0
Q12								4				0					0			0	0
T06			3/ 0			1/24		2/ 0		0/ 0		1/ 1		1/19		0/ 6		0/ 3		0/ 0	0/ 0
T12						3/24				2/26				1/19				1/23		0/21	
POZ	69	61	50	36	19	20	20	7	1	1	0	0	0	3	0	0	0	0	0	3	0
POS	16	12	10	25	30	45	64	76	84	99	85	97	97	86	88	85	81	100	93	91	94
TYP	Z	Z	Z	Z	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
SNW											1								0		
CIG	4	3	3	3	3	4	6	6	6	8	8	8	8	8	8	8	8	8	8	8	8
VIS	7	5	4	3	5	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
OBV	N	BR	BR	BR	BR	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

Available MOS Probability Guidance

Probability	Event
6-, 12-, 24-h Prob. Of Precipitation Liquid equiv. ≥ 0.01”	Yes/No
3-h 20-km Thunderstorm 1 or more CG lightning strikes in grid box	Yes/No
3-, 6-, 12-, 24-h 40-km Thunderstorm 1 or more CG lightning strikes in grid box	Yes/No
6-, 12-, 24-h 40-km Severe Thunderstorm (conditional on thunderstorms) (unconditional = tstm*csvr) (hail, damaging winds, tornado)	Yes/No
1-, 3-h Precipitation occurring on the hour	Yes/No

Available MOS Probability Guidance

Probability	Event
6-h Quantitative Precipitation Forecast	0.01″, 0.1″, 0.25″, 0.5″, 1″ +
12-, 24-h Quantitative Precipitation Forecast	0.01″, 0.1″, 0.25″, 0.5″, 1″, 2″ +
Precipitation type (Conditional on Precipitation)	Freezing, Frozen, Liquid
24-h Snow Amount*	>T, 2″+, 4″+, 6″+, 8″+
Precipitation Characteristics (Conditional on Precipitation)	Drizzle, Continuous, Showers

* Conditioned on precip occurrence and precip being frozen

Available MOS Probability Guidance

Probability	Event
Ceiling (feet)	<200, 200-400, 500-900, 1000-1900, 2000-3000, 3100-6500, 6600-12000, >12000 or unlimited)
Visibility (mi)	< ½, <1, <2, <3, ≤5, ≤6, >6
Obstruction to Vision	None, Haze/Smoke, Mist, Fog, Blowing Phenomena
Total Sky Cover (Octets)	Clear 0/8, Few 1/8-2/8, Sct 3/8-4/8, Bkn 5/8-7/8, Ovc 8/8

Probability Forecast Considerations

MOS forecasts can be:

- Point Probabilities

  METAR-based PoPs, QPF, Precip Type, Sky Cover…

- Areal Probabilities

  remotely sensed observations (lightning) - gridded T-storms

Probability Forecast Considerations

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Something to keep in mind:

Assessment of probability is ***EXTREMELY*** dependent upon how predictand "event" is defined:

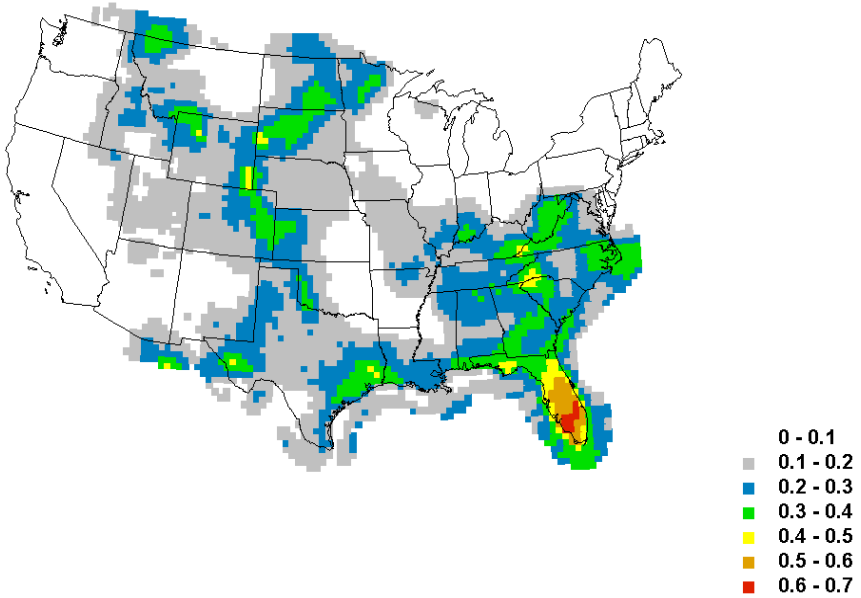
- Time period of consideration
- Area of occurrence

Areal Probabilities

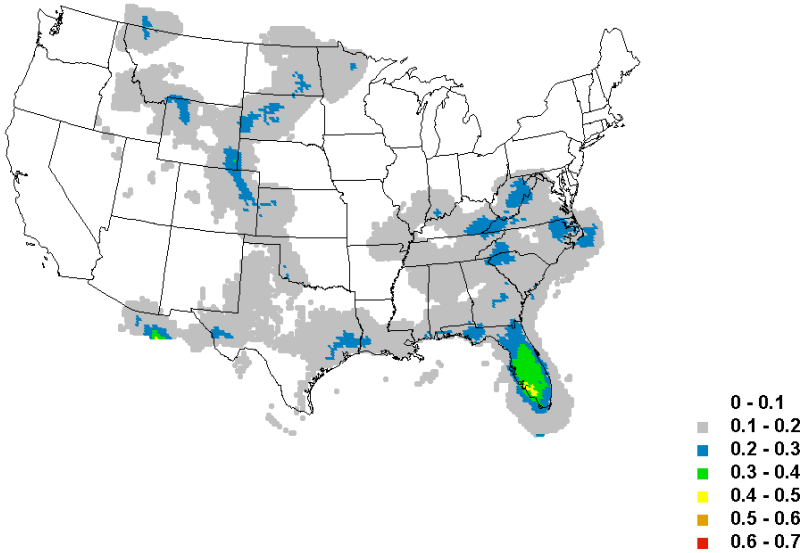
What is “appropriate” for thunderstorms?

- *Time period?*
  - **1 hour**
  - **2 hours**
  - **3 hours**
  - **6 hours**
  - **12 hours**
- *Grid size?*
  - **2.5 km**
  - **10 km**
  - **20 km**
  - **40 km**
  - **95 km**

40-km contoured 10%



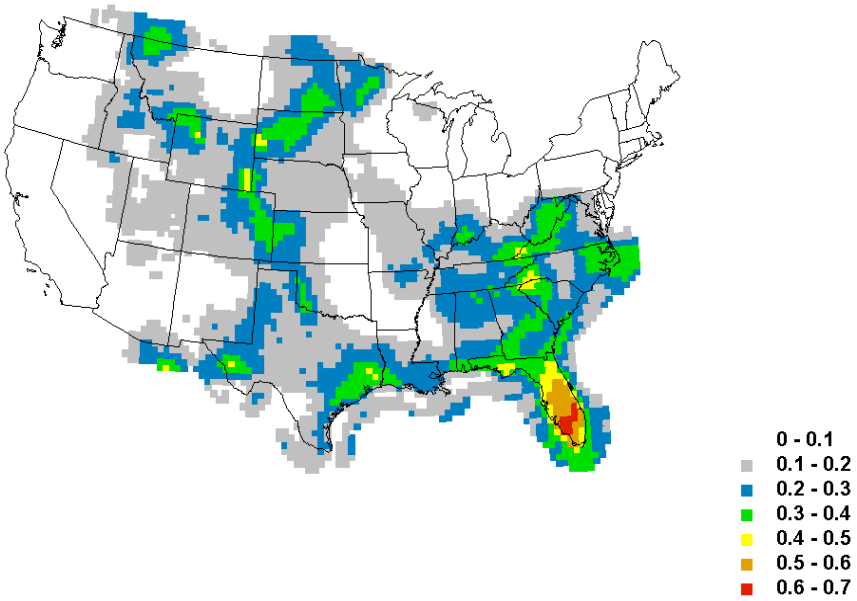
20-km contoured 10%



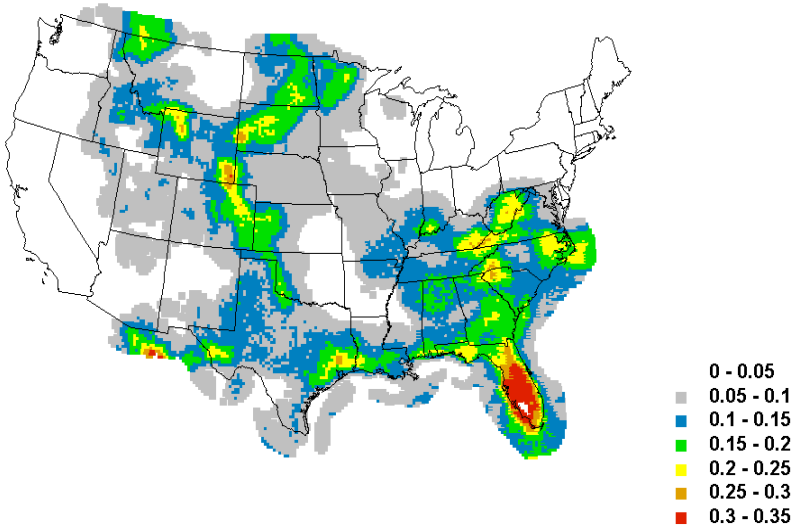
Probability of 1 or more cloud-to-ground lightning strikes in a grid box over a 3-h period

Identical techniques, different horizontal resolutions

40-km contoured 10%



20-km contoured 5%



Magnitude of the probabilities is proportional to the grid spacing, similar behavior with length of time periods

Conversion of Probability Forecasts

The MOS system …produces probability forecasts for discrete precipitation amount classes. The publicly issued precipitation amount forecasts were then derived by converting the underlying probabilities to the nonprobabilistic format by choosing one and only one of the possible categories.

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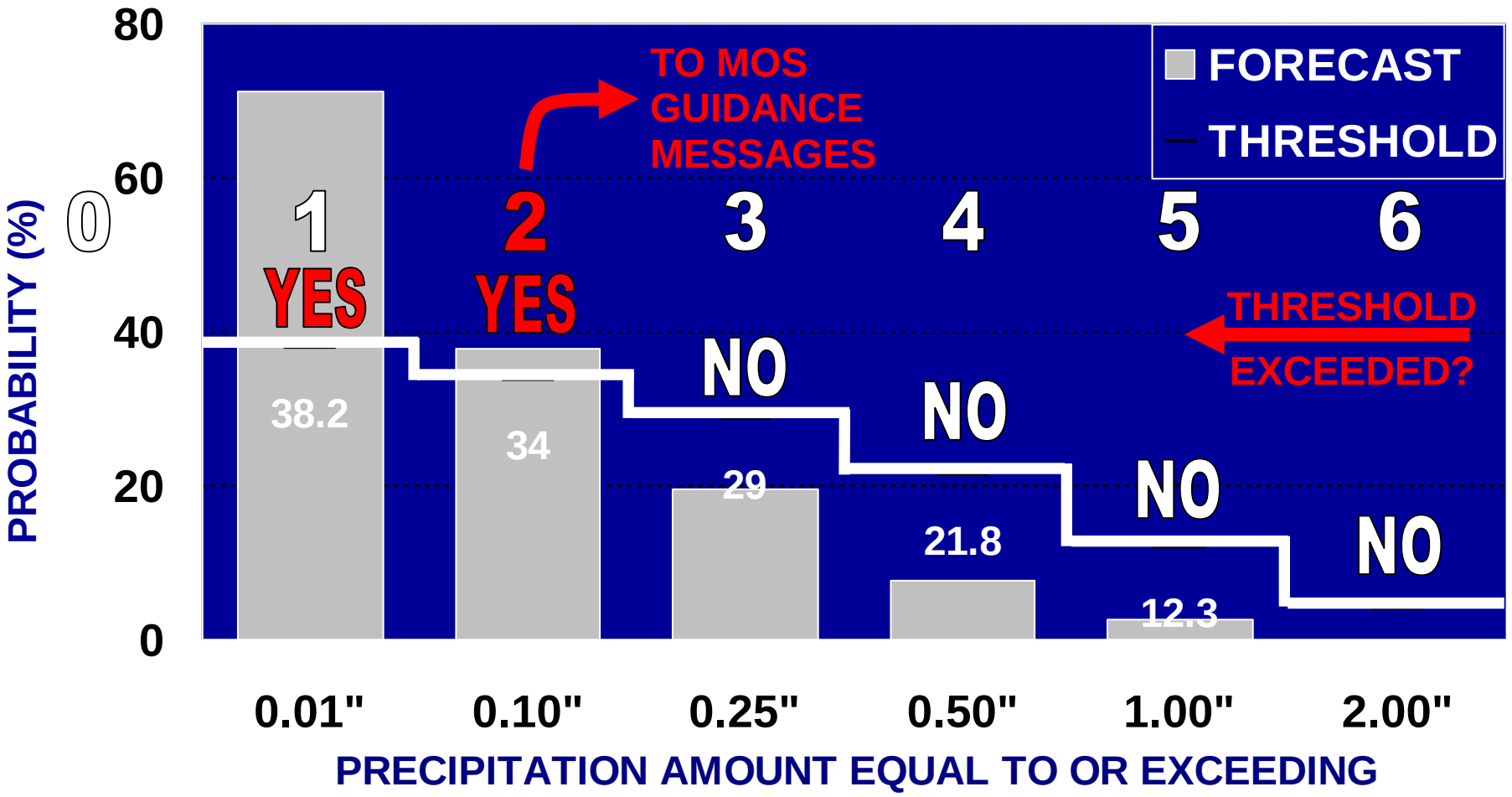
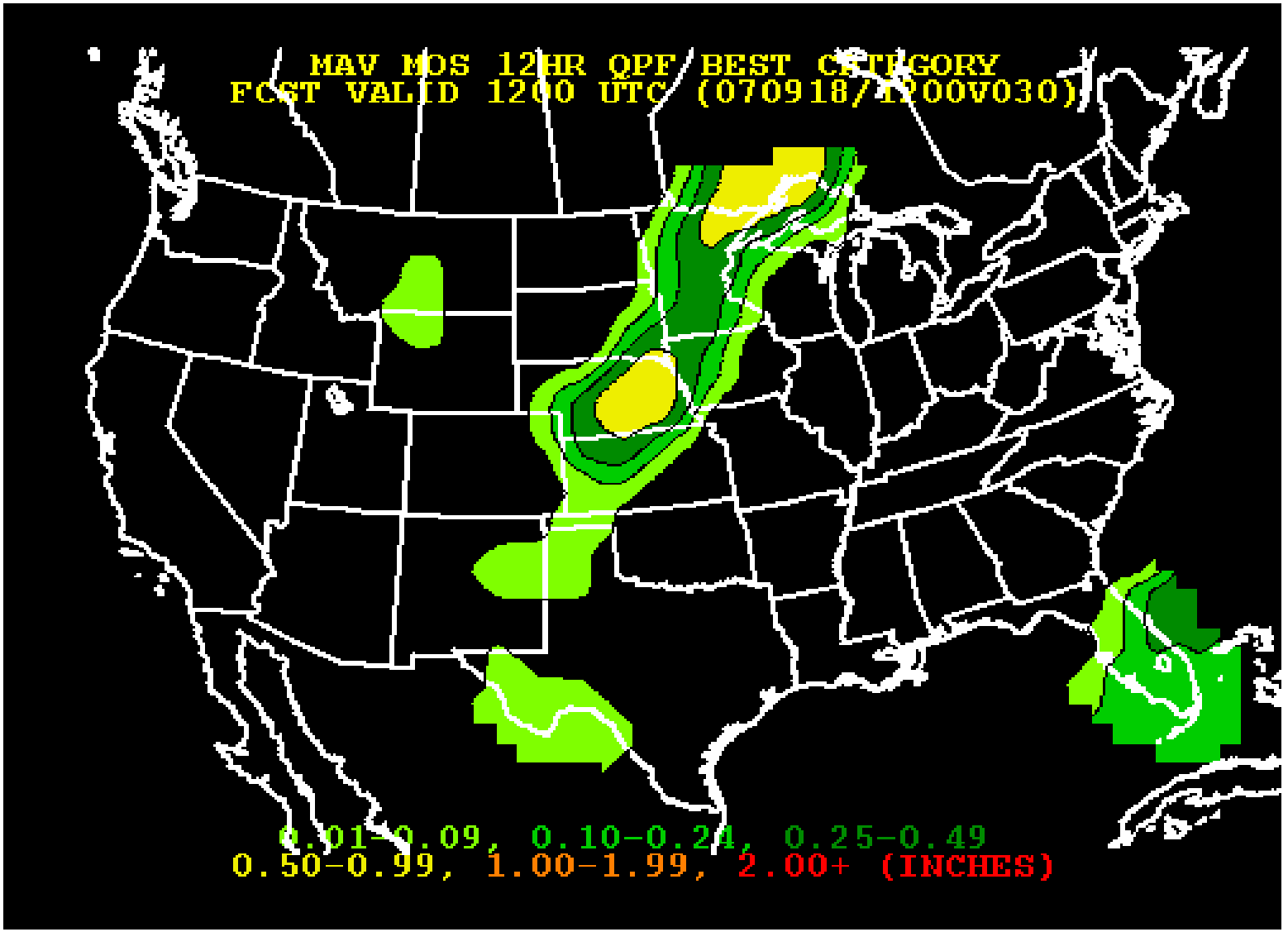
from Statistical Methods in Atmospheric Sciences, 2006, Daniel S. Wilks

MOS Best Category Selection

QPF Probability Example



Example of the Best Category Selection



Conversion of Probability Forecasts

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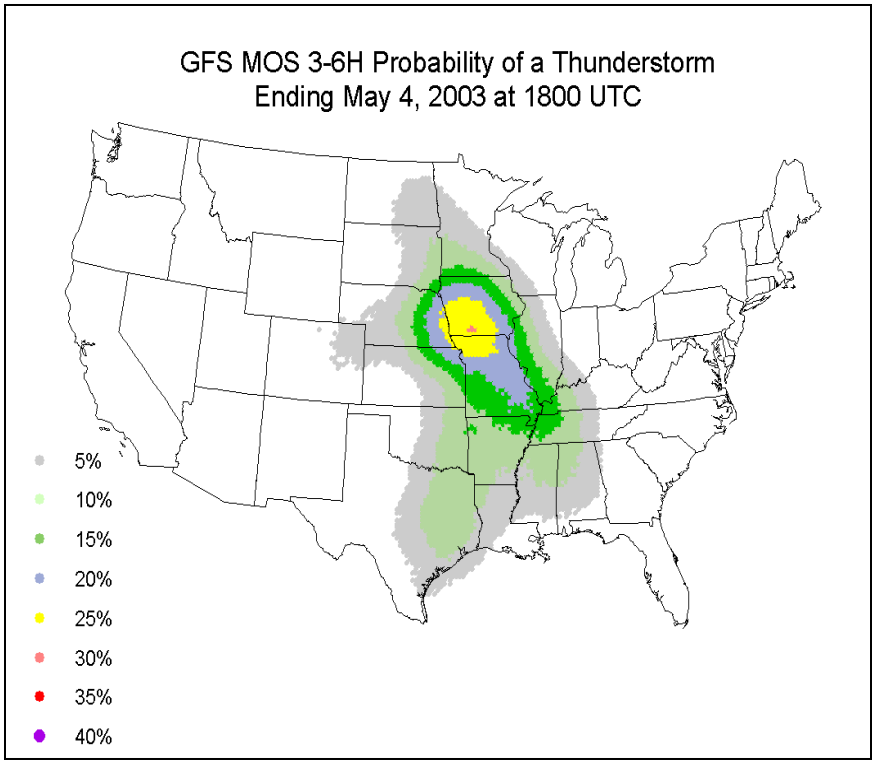
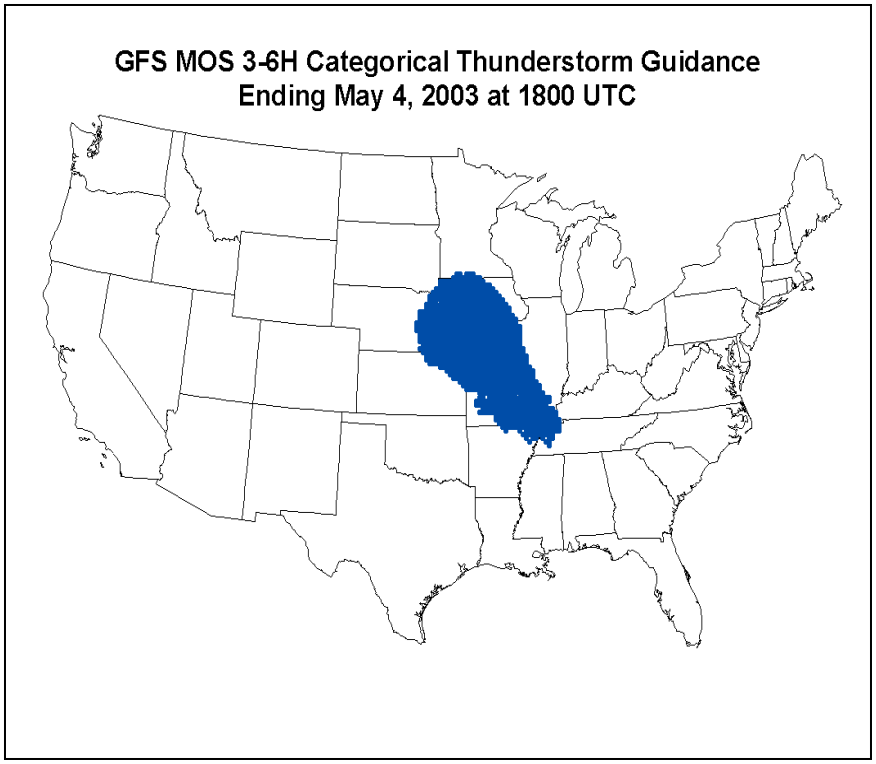
Conversion of Probability Forecasts

The MOS system …produces probability forecasts for discrete precipitation amount classes. The publicly issued precipitation amount forecasts were then derived by converting the underlying probabilities to the nonprobabilistic format by choosing one and only one of the possible categories. **This unfortunate procedure is practiced with distressing frequency, and advocated under the rationale that nonprobabilistic forecasts are easier to understand. However, the conversion from probabilities inevitably results in a loss of information, to the detriment of the users of the forecasts**.

from Statistical Methods in Atmospheric Sciences, 2006, Daniel S. Wilks

Example of the “Unfortunate Procedure”



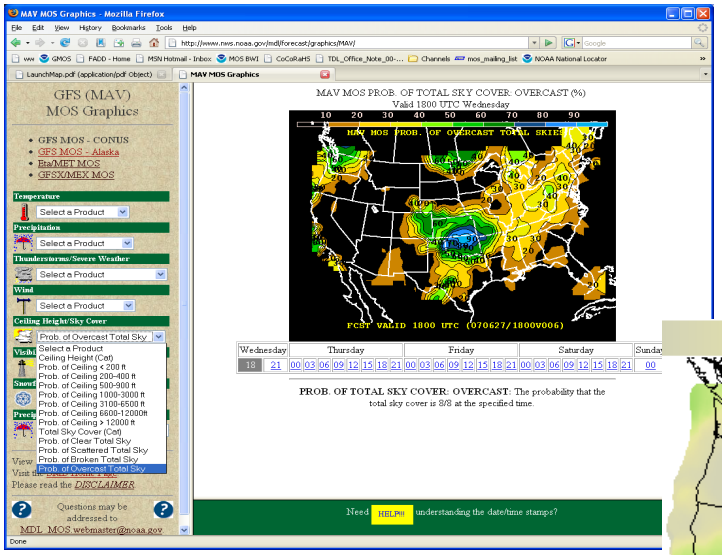


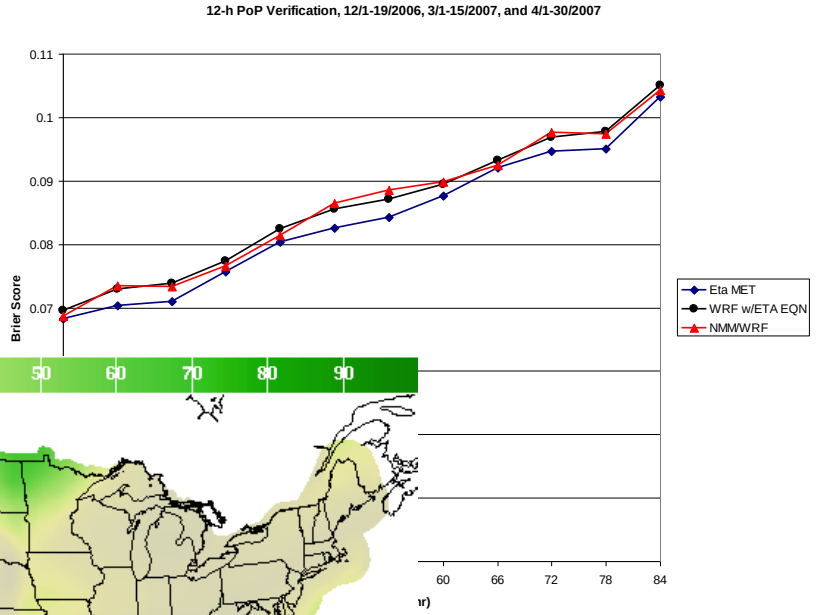
Probabilistic

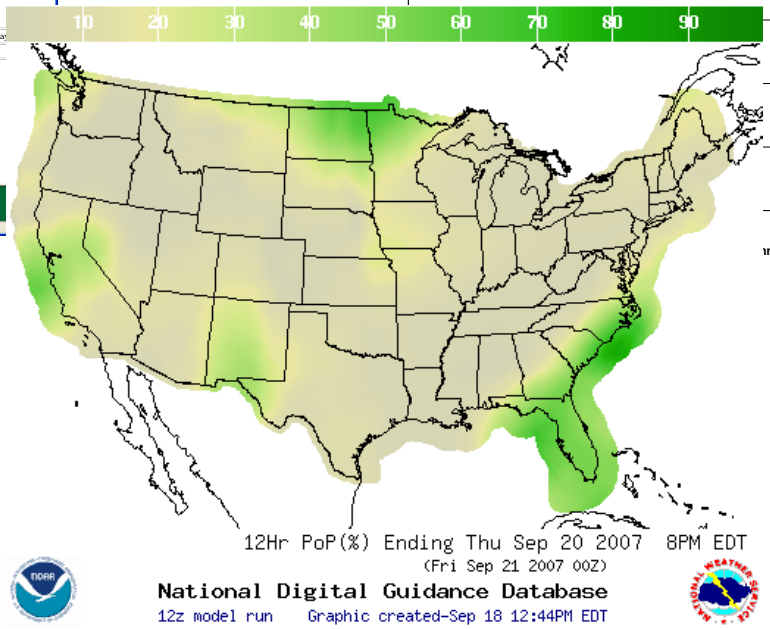
Categorical

Threshold value ~ 16%

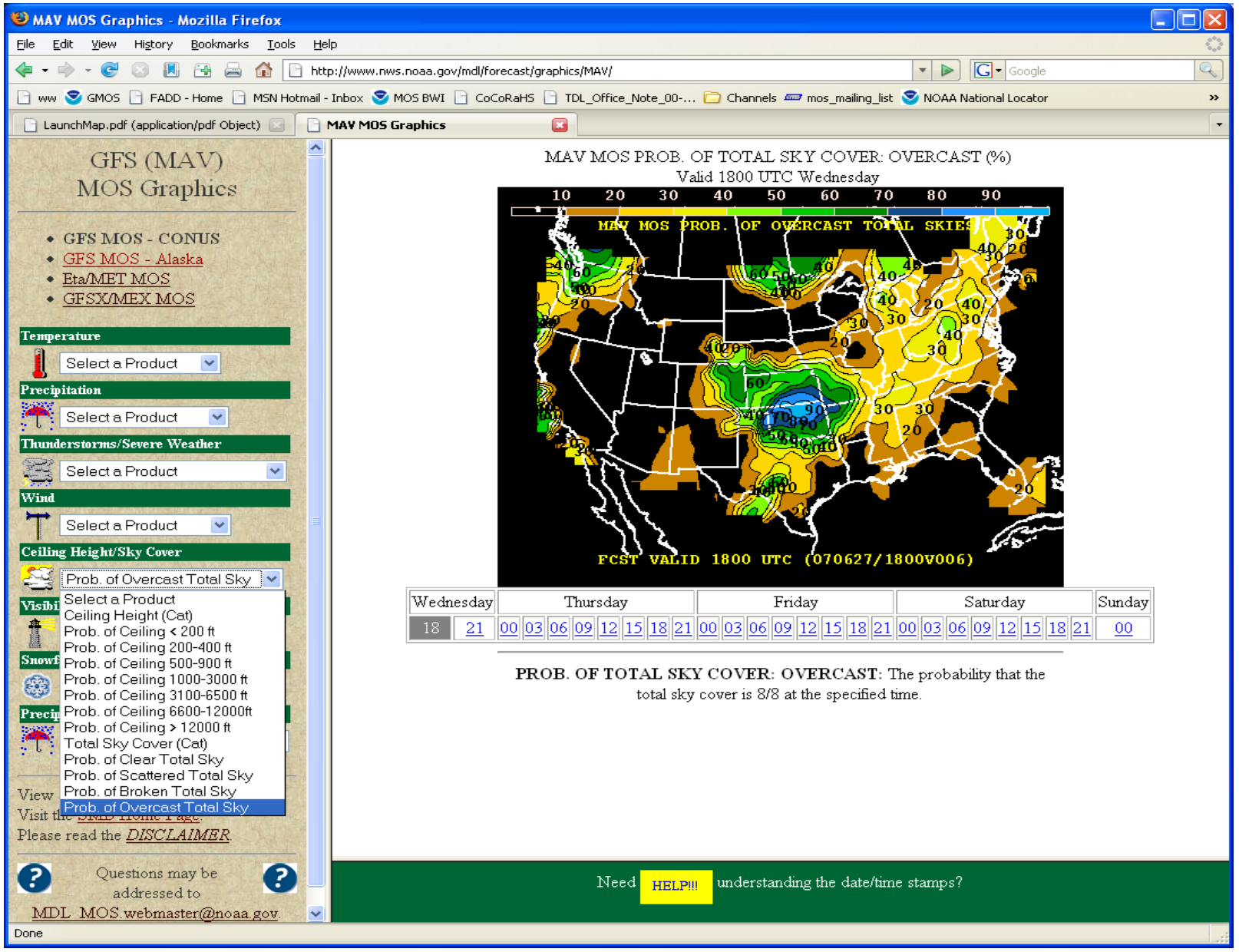
Sample Products, etc...







Graphics Products Available from weather.gov



Alaska MAV MOS Graphics - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.nws.noaa.gov/mdl/forecast/graphics/MAVAK/

noaa library

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Probability Forecasting | Current NWS MOS Forecast Products | Alaska MAV MOS Graphics | i1520-0493-135-6-2379.pdf (applic...

ALASKA GFS (MAV) MOS Graphics

- GFS MOS - Alaska
- GFS/MAV MOS CONUS
- Eta/MET MOS
- GFSX/MEX MOS

Temperature

Select a Product

Precipitation

Select a Product

Select a Product
01H PoPO
03H PoPO
06H PoP
06H QPF (Best Cat.)
06H Prob. >= 0.10 in.
06H Prob. >= 0.25 in.
06H Prob. >= 0.50 in.
06H Prob. >= 1.00 in.
12H PoP
12H QPF (Best Cat.)
12H Prob. >= 0.10 in.
12H Prob. >= 0.25 in.
12H Prob. >= 0.50 in.
12H Prob. >= 1.00 in.
12H Prob. >= 2.00 in.
24H PoP
24H QPF (Best Cat.)
24H Prob. >= 0.10 in.
24H Prob. >= 0.25 in.

Wind

Ceilin

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Precip

Precip

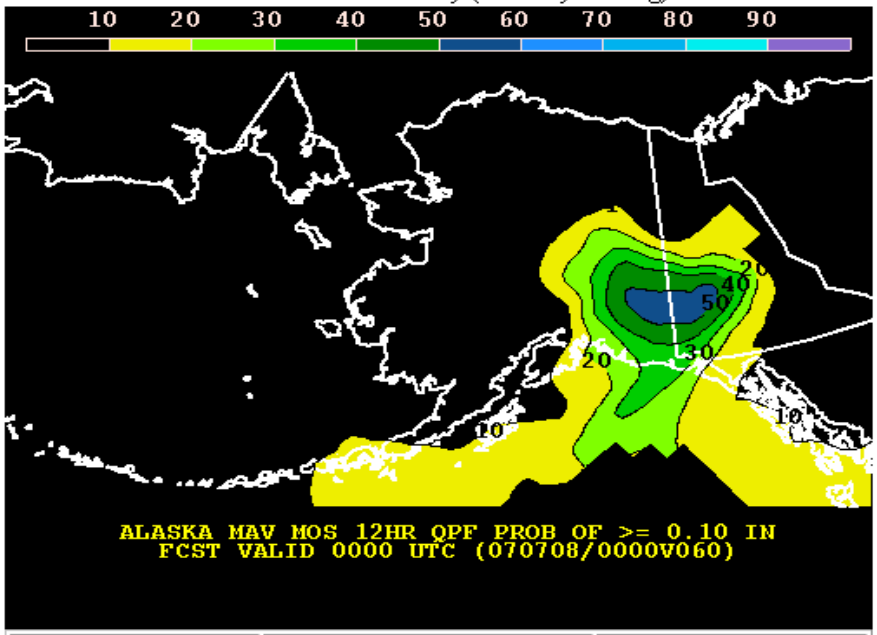
View

Visit the SMB Home Page.

Please read the *DISCLAIMER*.

MAVAK MOS PROB. OF >= 0.10" OF PRECIP. (%)

Valid 0000 UTC Sunday (Saturday Evening)



Friday		Saturday		Sunday
12		00	12	00	12

PROB. OF >= 0.10" OF PRECIP.: The probability that 0.10 inches or more of liquid-equivalent precipitation will fall during the 12 hour period ending at the specified time.

Need HELP!!! understanding the date/time stamps?

Done

NOAA Graphical Forecast for CONUS Area - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.weather.gov/mdl/synop/gridded/sectors/conus.php#

grandson of saul

http://weather.gov/mdl/synop/gridded/sectors

This map shows GFS MOS Guidance for the United States. This is a product of the National Digital Guidance Database, produced by NOAA's National Weather Service. Public comments and suggestions are encouraged.

Warnings & Forecasts | Graphical Forecasts | National Maps | Radar | Water | Air Quality | Satellite | Climate

GFS-MOS - CONUS Area

Daily View | Weekly View | Loops

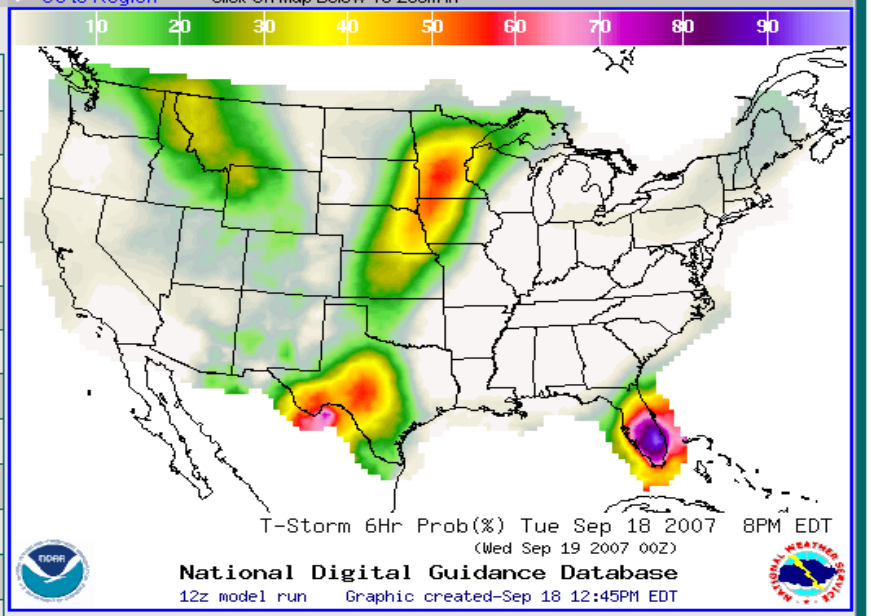
Image List | Help | Metric Units | Compare

Mouse over the table below to change the forecast image.

Today	-12Hrs	+12Hrs
Max/Min Temperature	High	
6Hr Prob. of Precipitation	6 hr. probability	6 hr. probability
12Hr Prob. of Precipitation	12 hr. probability	
6Hr Amount of Precip.	QPF	QPF
12Hr Amount of Precip.	QPF	QPF
24Hr Snow Amount	Snow Amount	
Temperature	8am 11am 2pm 5pm	
Dewpoint	8am 11am 2pm 5pm	
Sky Cover	8am 11am 2pm 5pm	
Relative Humidity	8am 11am 2pm 5pm	
Wind Speed & Direction	8am 11am 2pm 5pm	
Wind Gust	8am 11am 2pm 5pm	
3Hr Prob. of Thunderstorm	8am 11am 2pm 5pm	
6Hr Prob. of Thunderstorm	6 hr. T-Storm	6 hr. T-Storm
12Hr Prob. of Thunderstorm	12hr. T-Storm	12hr. T-Storm
Next Image		

Table MouseOver Effect On

Go to Region Click On Map Below To Zoom In



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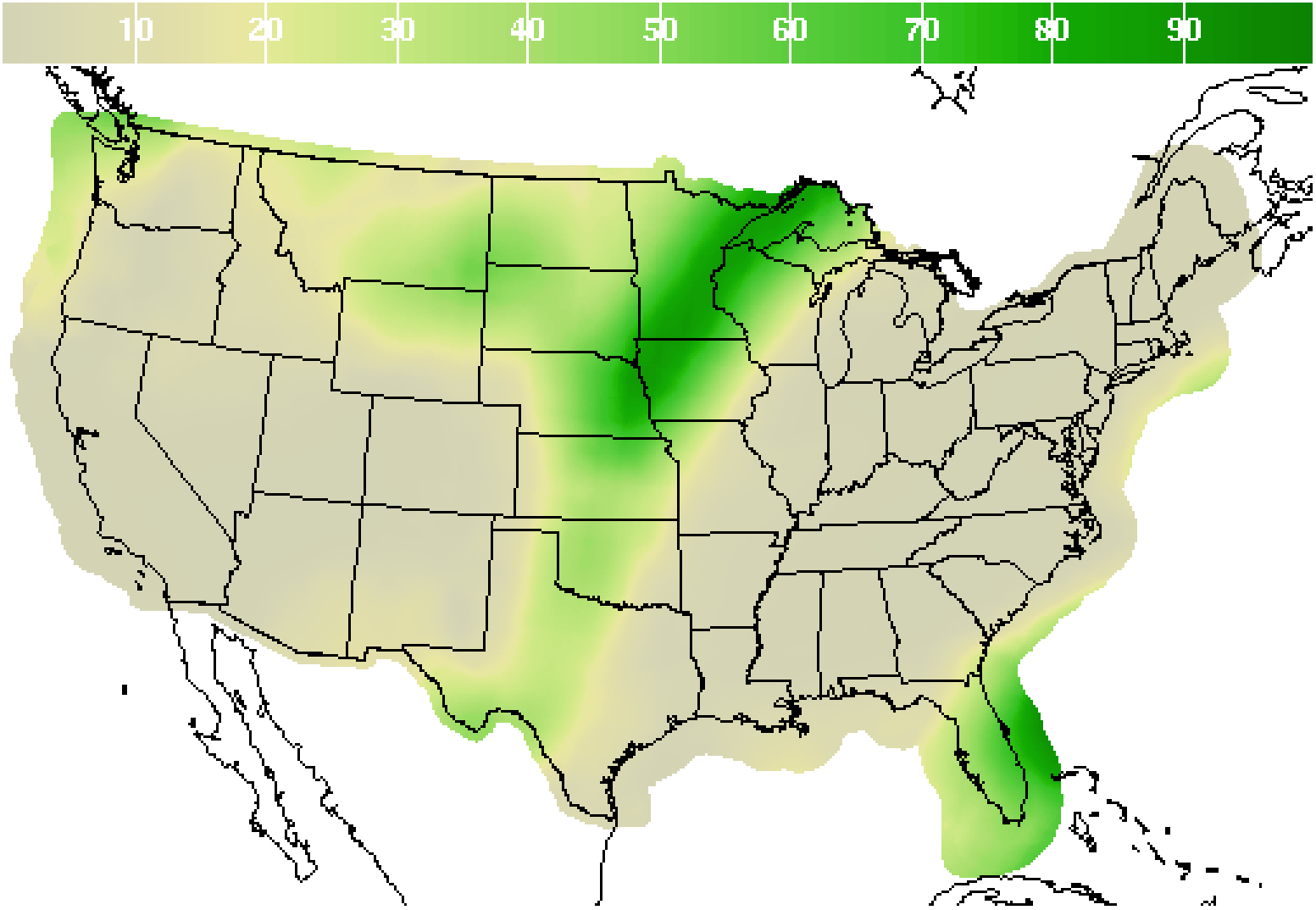
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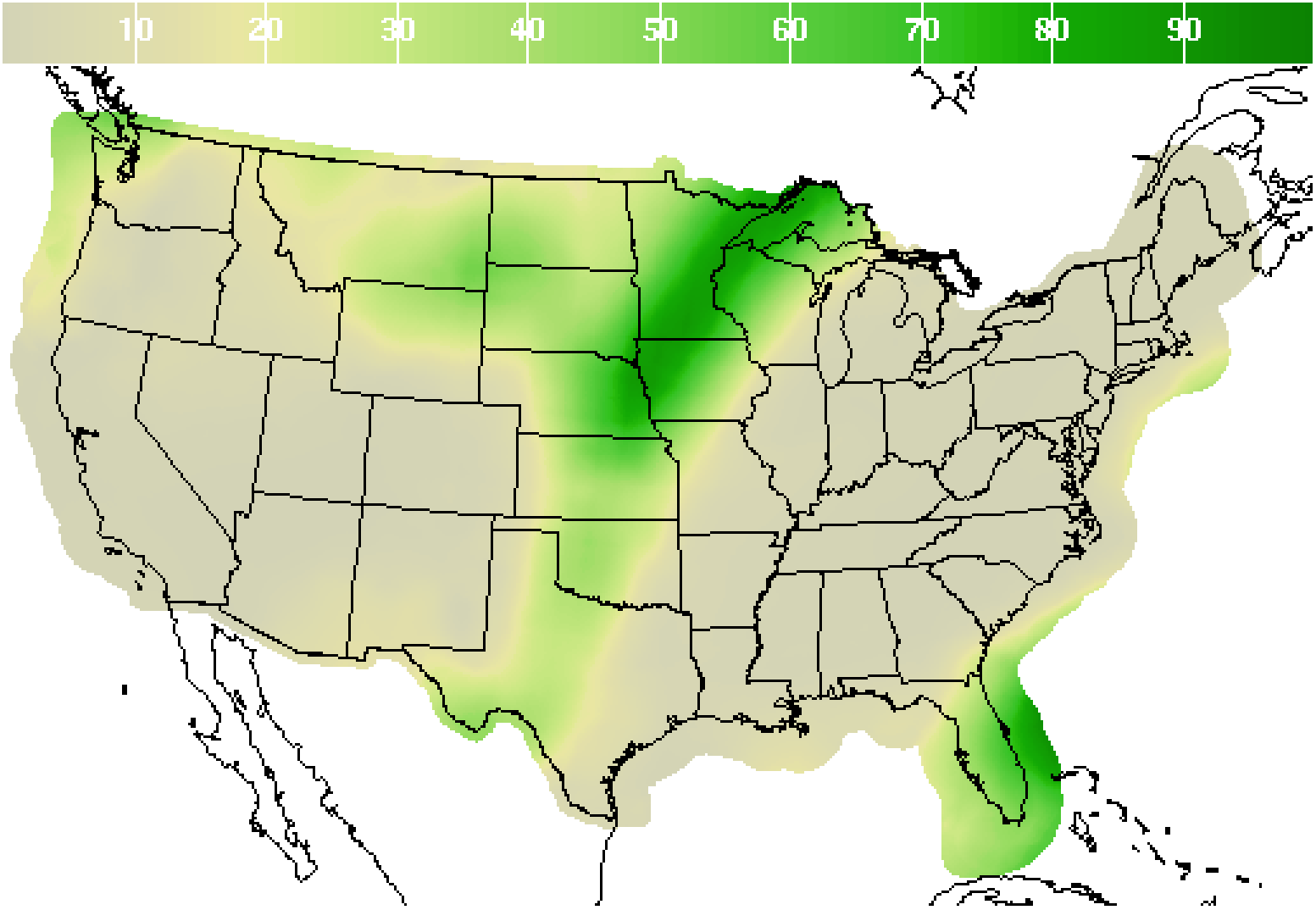
12Hr PoP(%) Ending Tue Sep 18 2007 8PM EDT
(Wed Sep 19 2007 00Z)
National Digital Guidance Database
00z model run
Graphic created-Sep 18 3:45AM EDT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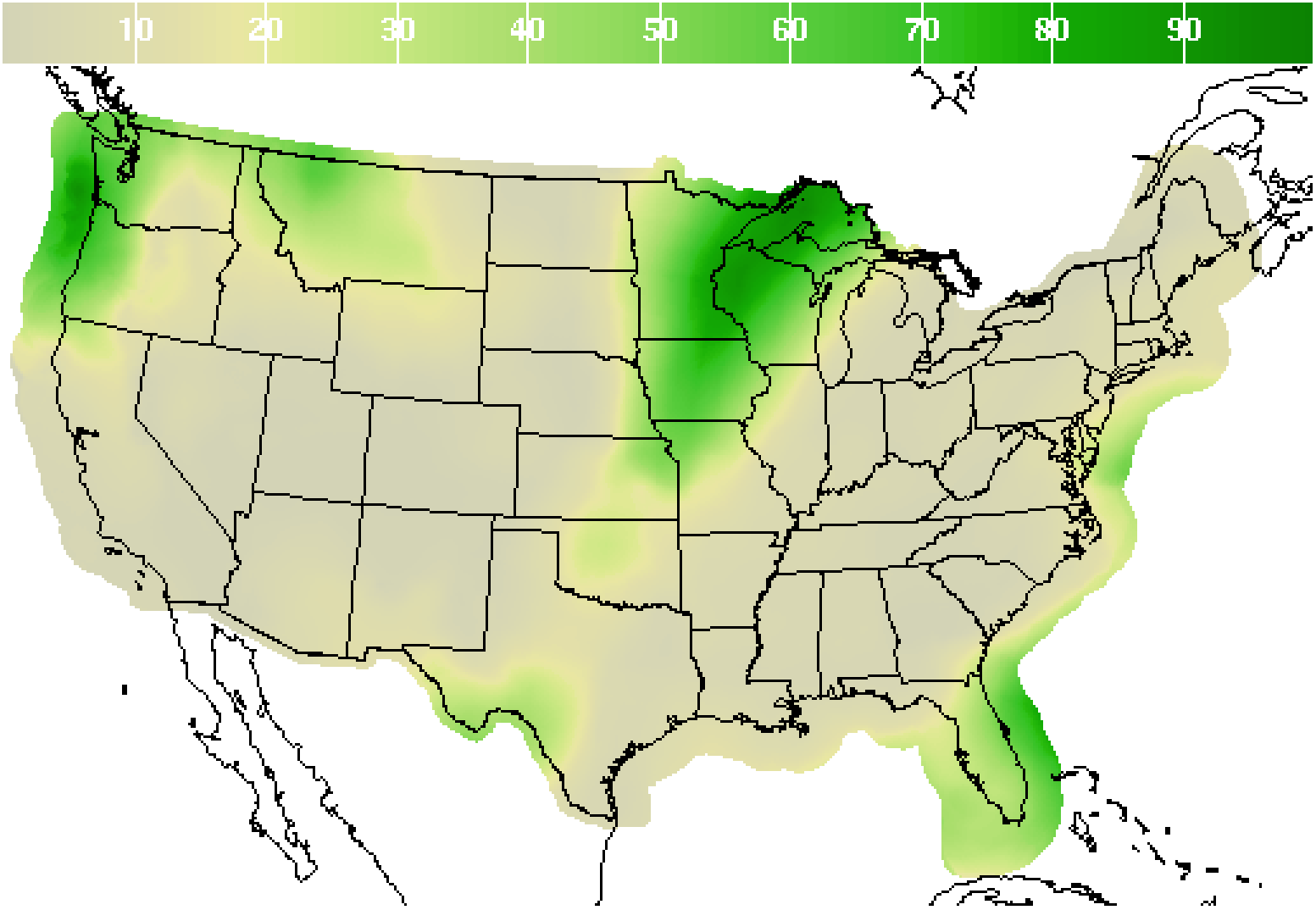
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12Hr PoP(%) Ending Wed Sep 19 2007 8AM EDT
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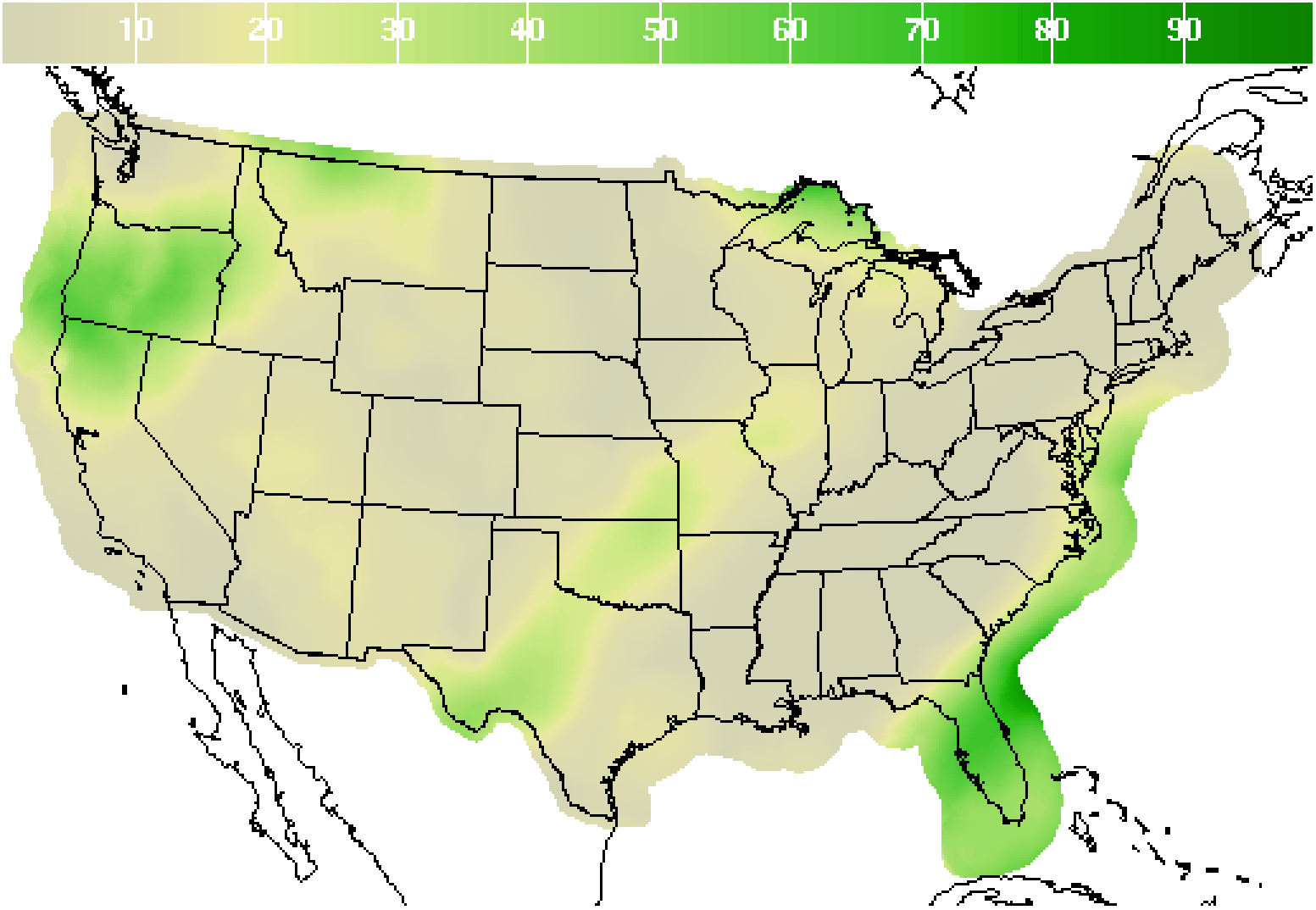
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12Hr PoP(%) Ending Wed Sep 19 2007 8PM EDT
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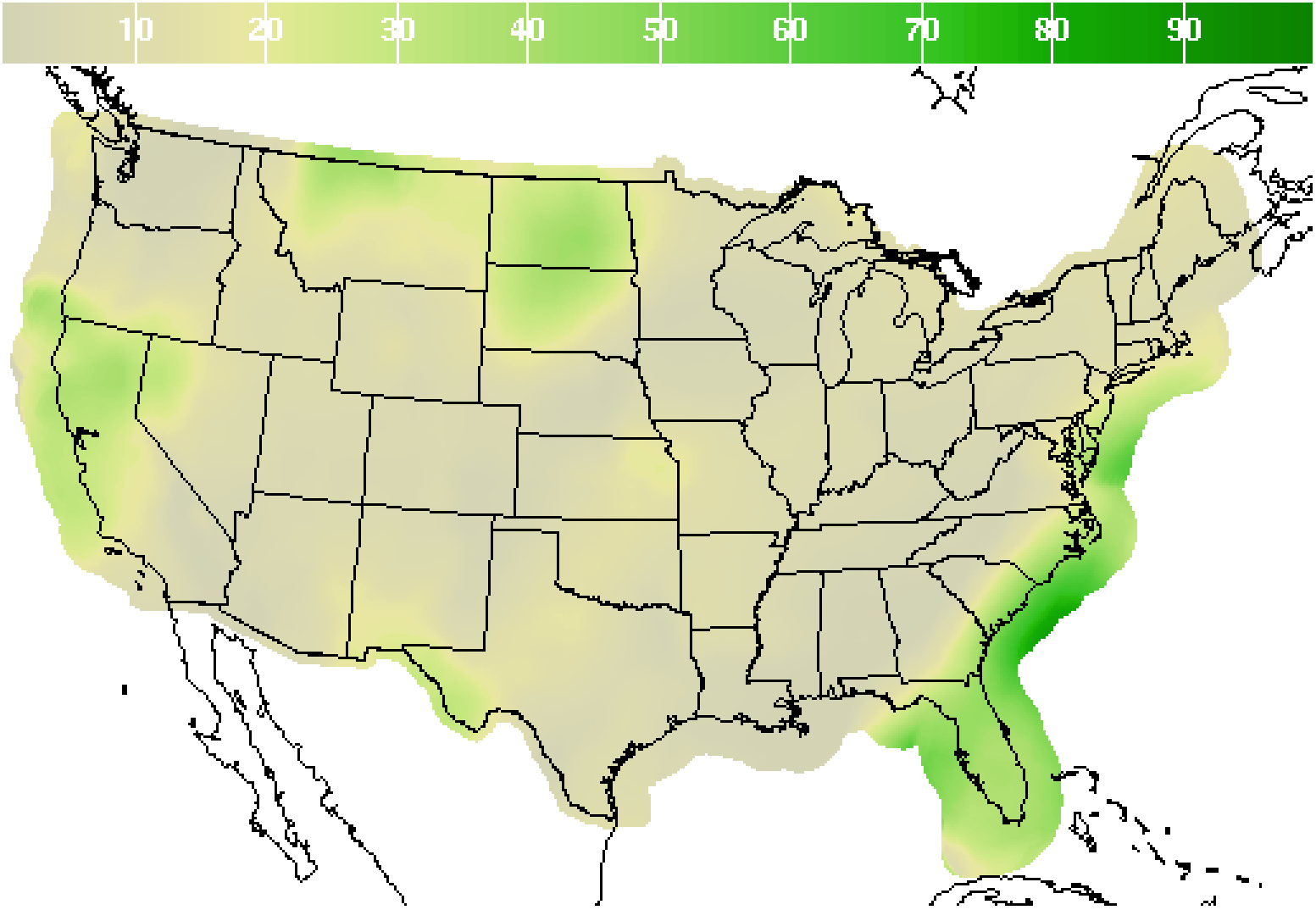
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12Hr PoP(%) Ending Thu Sep 20 2007 8AM EDT
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National Digital Guidance Database
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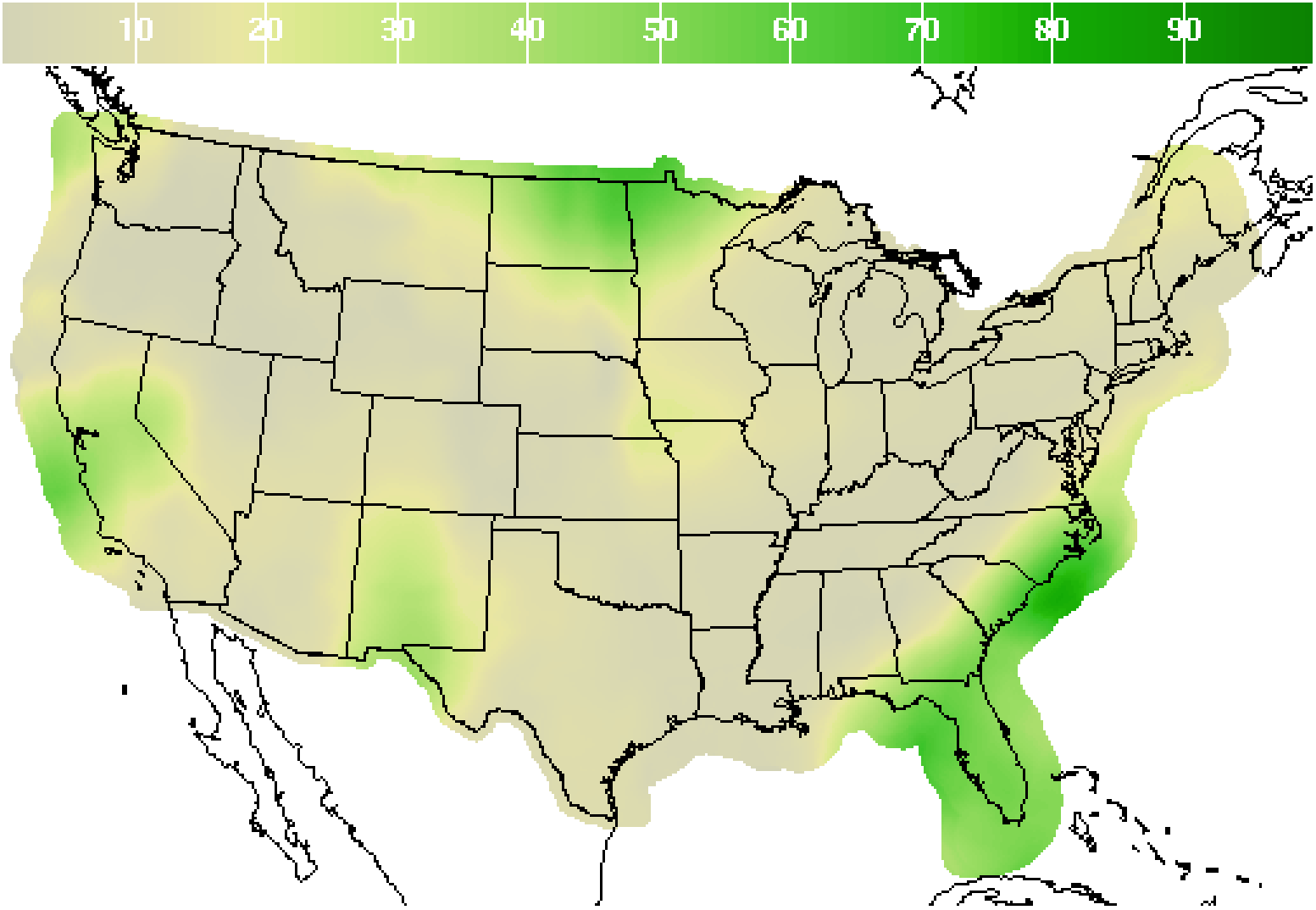
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12Hr PoP(%) Ending Thu Sep 20 2007 8PM EDT
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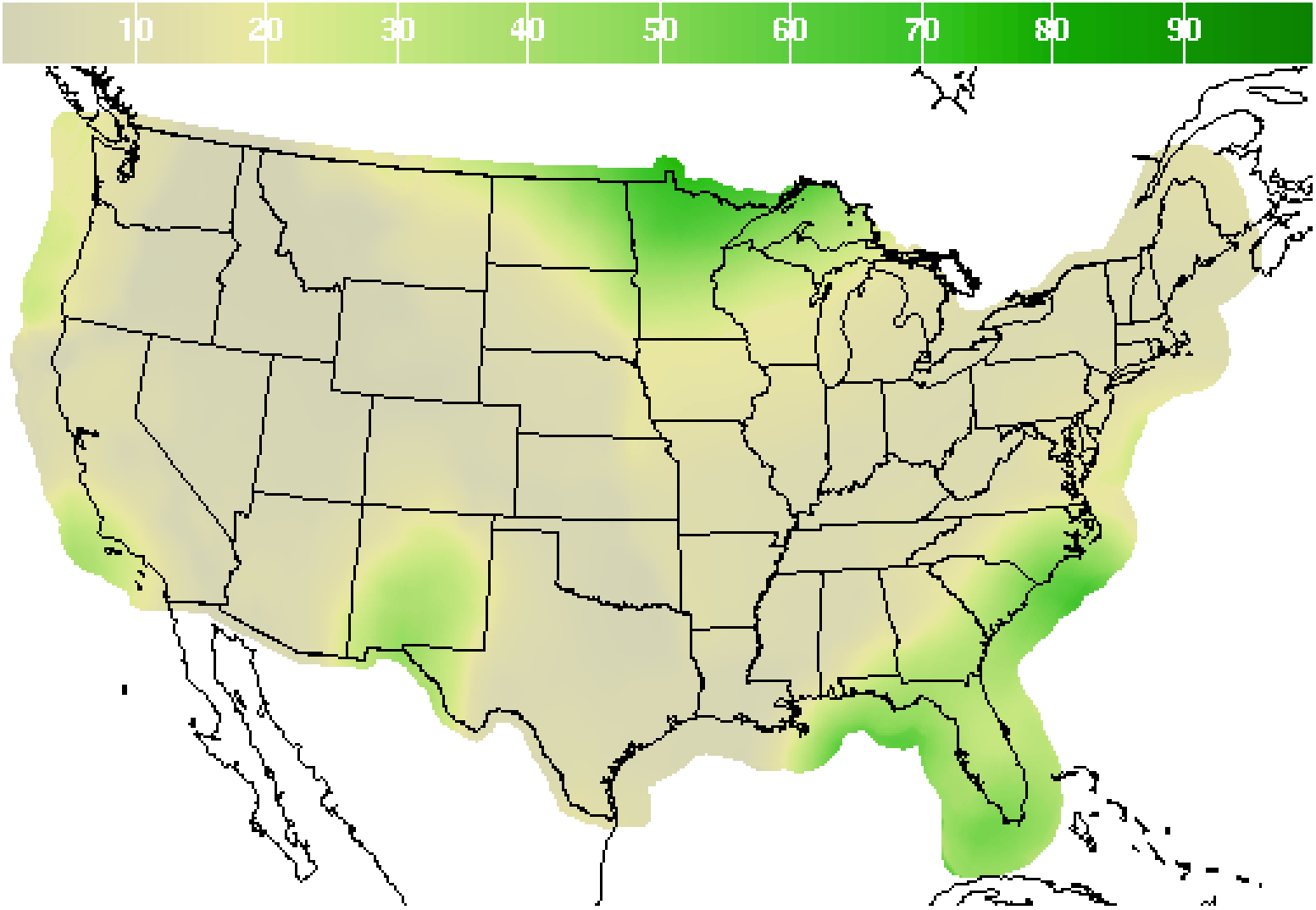
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12Hr PoP(%) Ending Fri Sep 21 2007 8AM EDT
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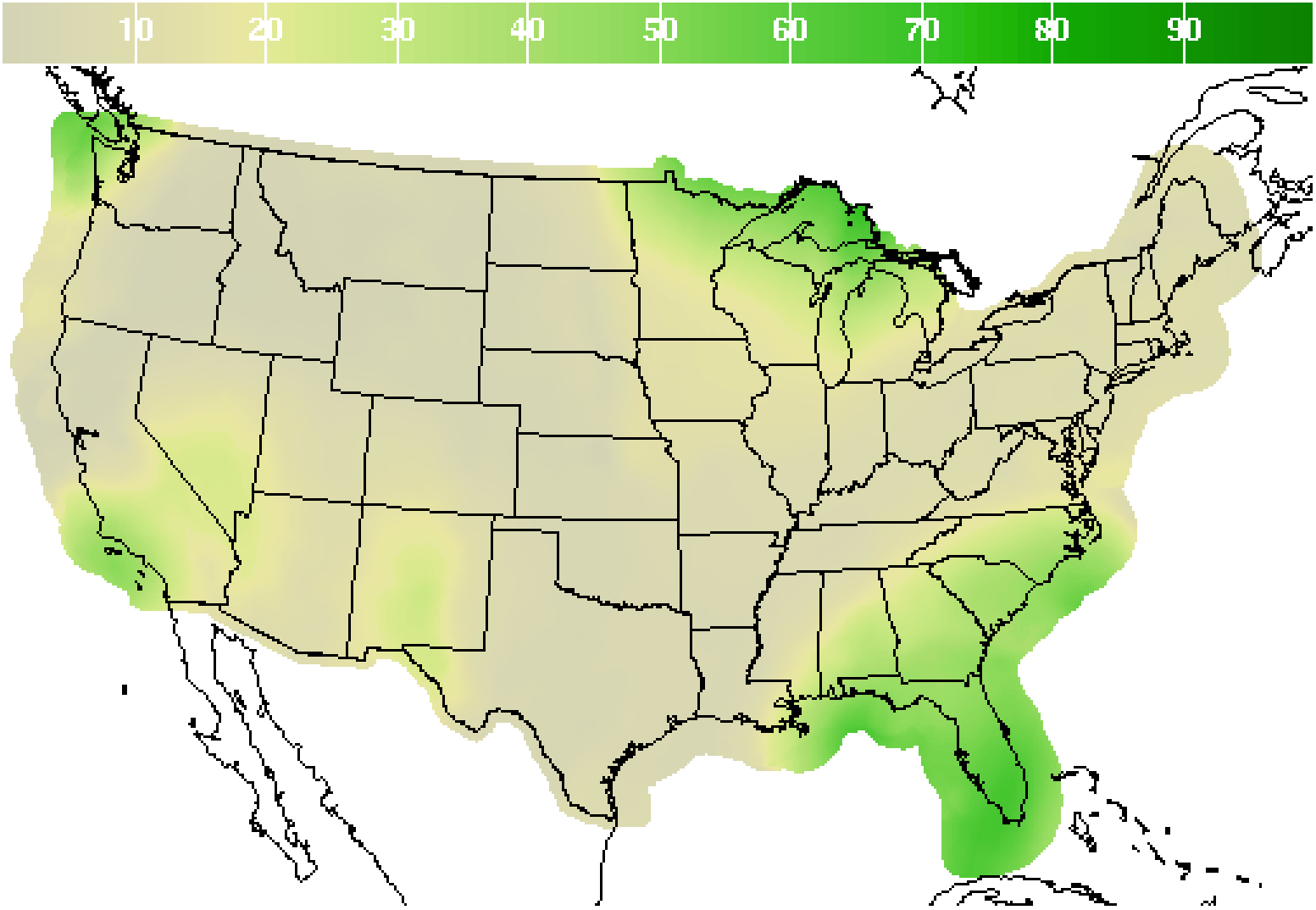
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12Hr PoP(%) Ending Fri Sep 21 2007 8PM EDT
(Sat Sep 22 2007 00Z)
National Digital Guidance Database
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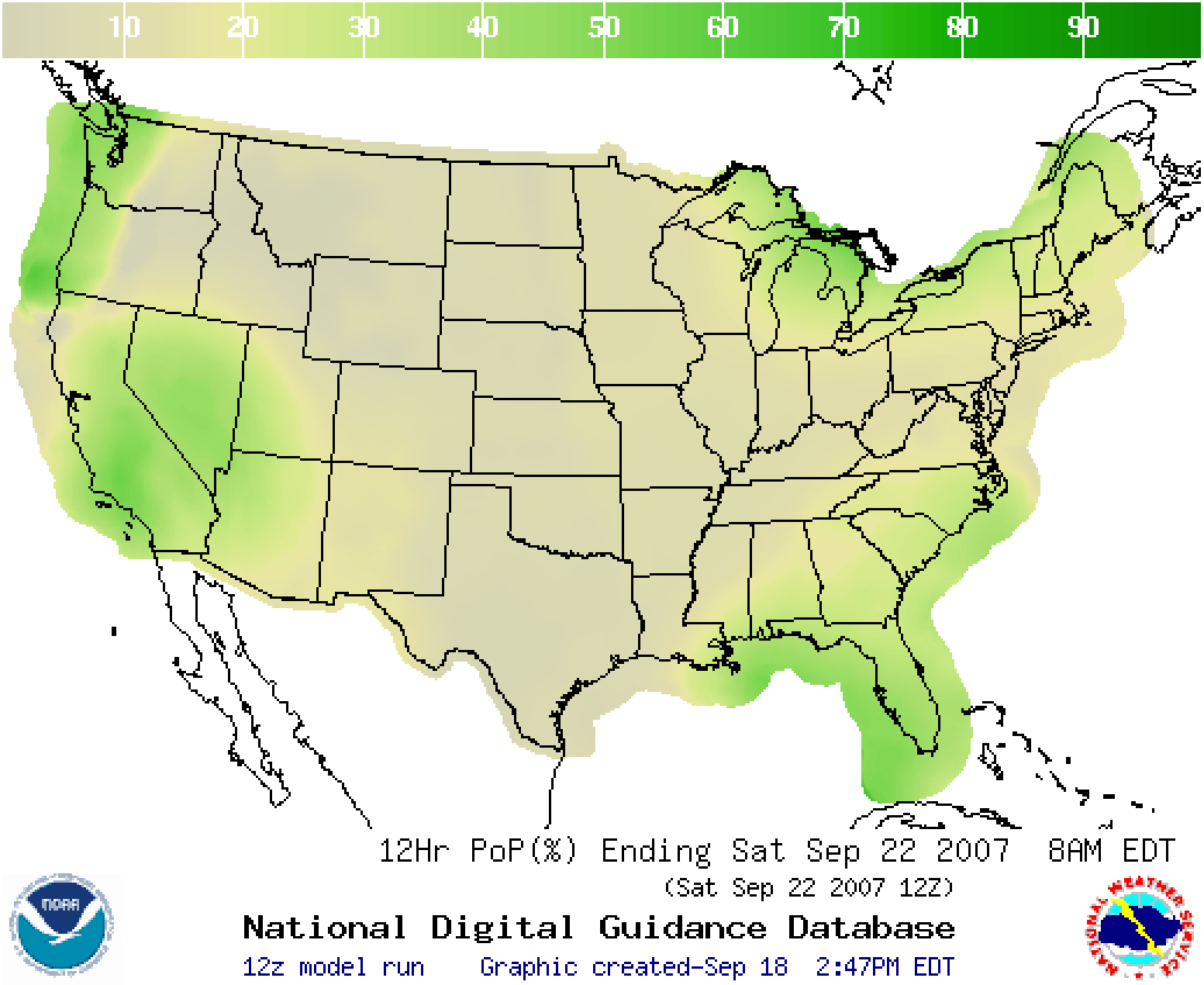
Graphic created-Sep 18 2:47PM EDT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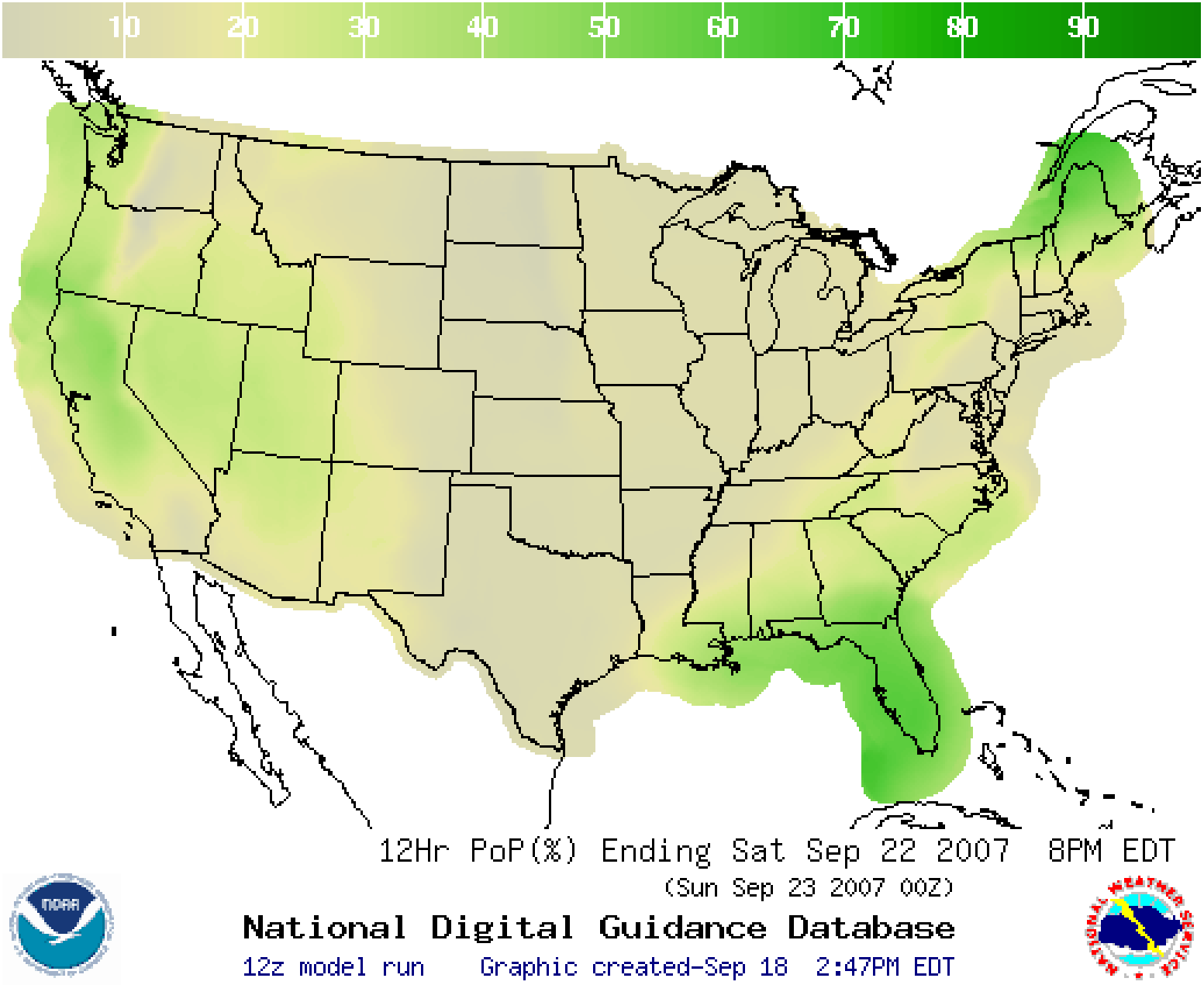
12Hr PoP(%) Ending Sat Sep 22 2007 8AM EDT
(Sat Sep 22 2007 12Z)
National Digital Guidance Database
12z model run
Graphic created-Sep 18 2:47PM EDT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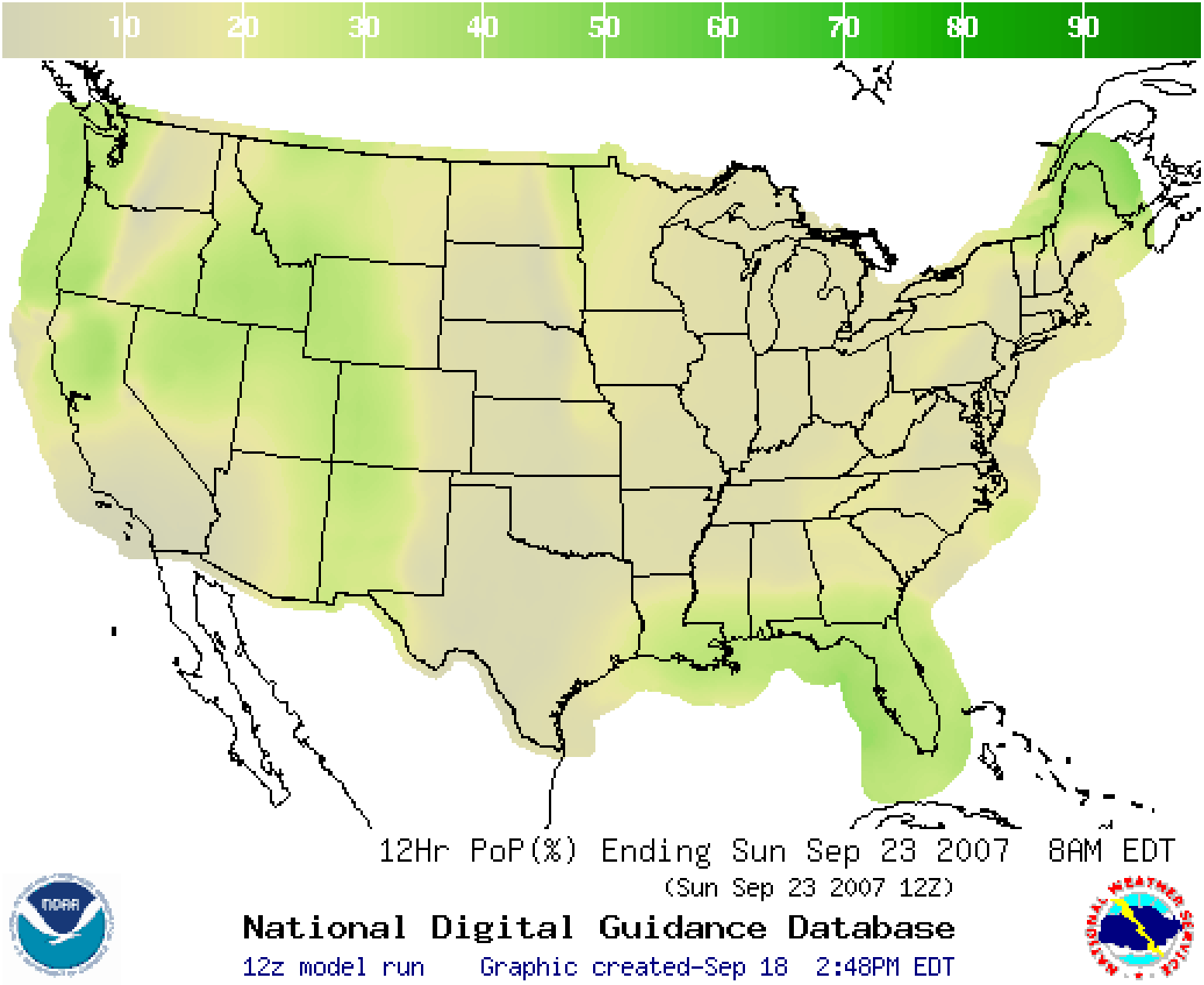
12Hr PoP(%) Ending Sat Sep 22 2007 8PM EDT
(Sun Sep 23 2007 00Z)
National Digital Guidance Database
12z model run
Graphic created-Sep 18 2:47PM EDT


10
20
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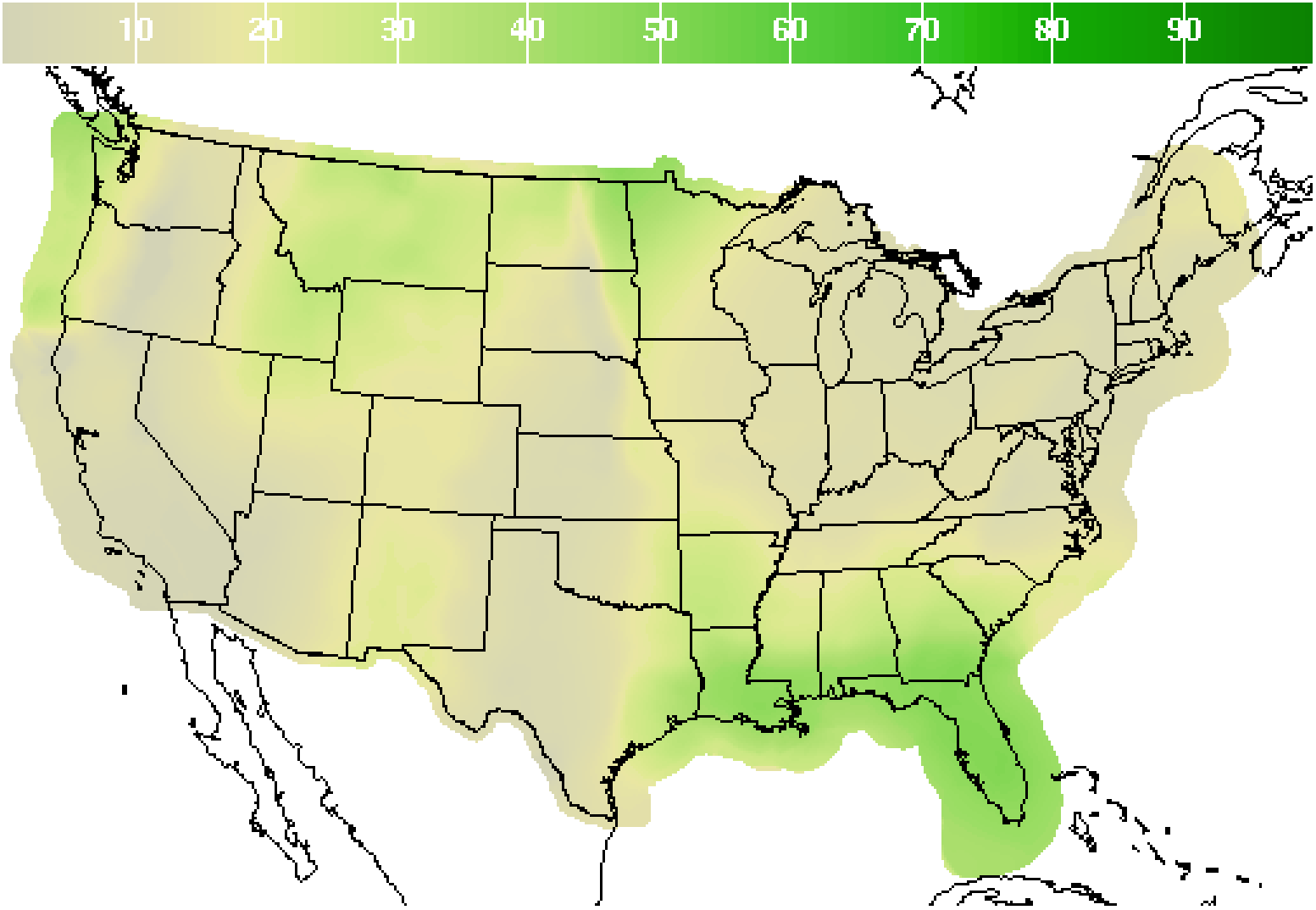
12Hr PoP(%) Ending Sun Sep 23 2007 8AM EDT
(Sun Sep 23 2007 12Z)
National Digital Guidance Database
12z model run
Graphic created-Sep 18 2:48PM EDT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12Hr PoP(%) Ending Sun Sep 23 2007 8PM EDT
(Mon Sep 24 2007 00Z)
National Digital Guidance Database
12z model run
Graphic created-Sep 18 2:48PM EDT

Forecast Performance

almost finished

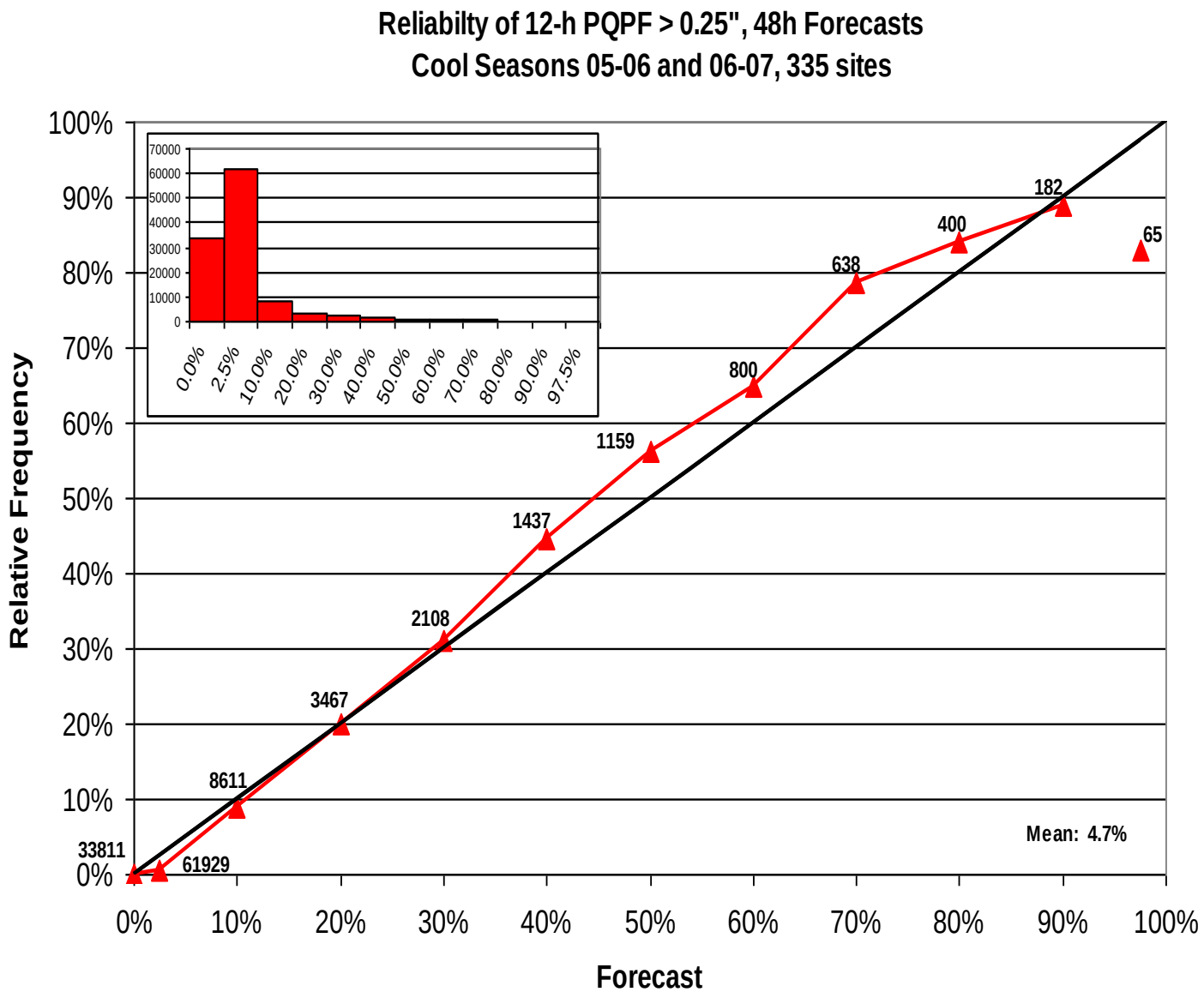
Reliability Diagram

how well are we calibrated?

Brier Score

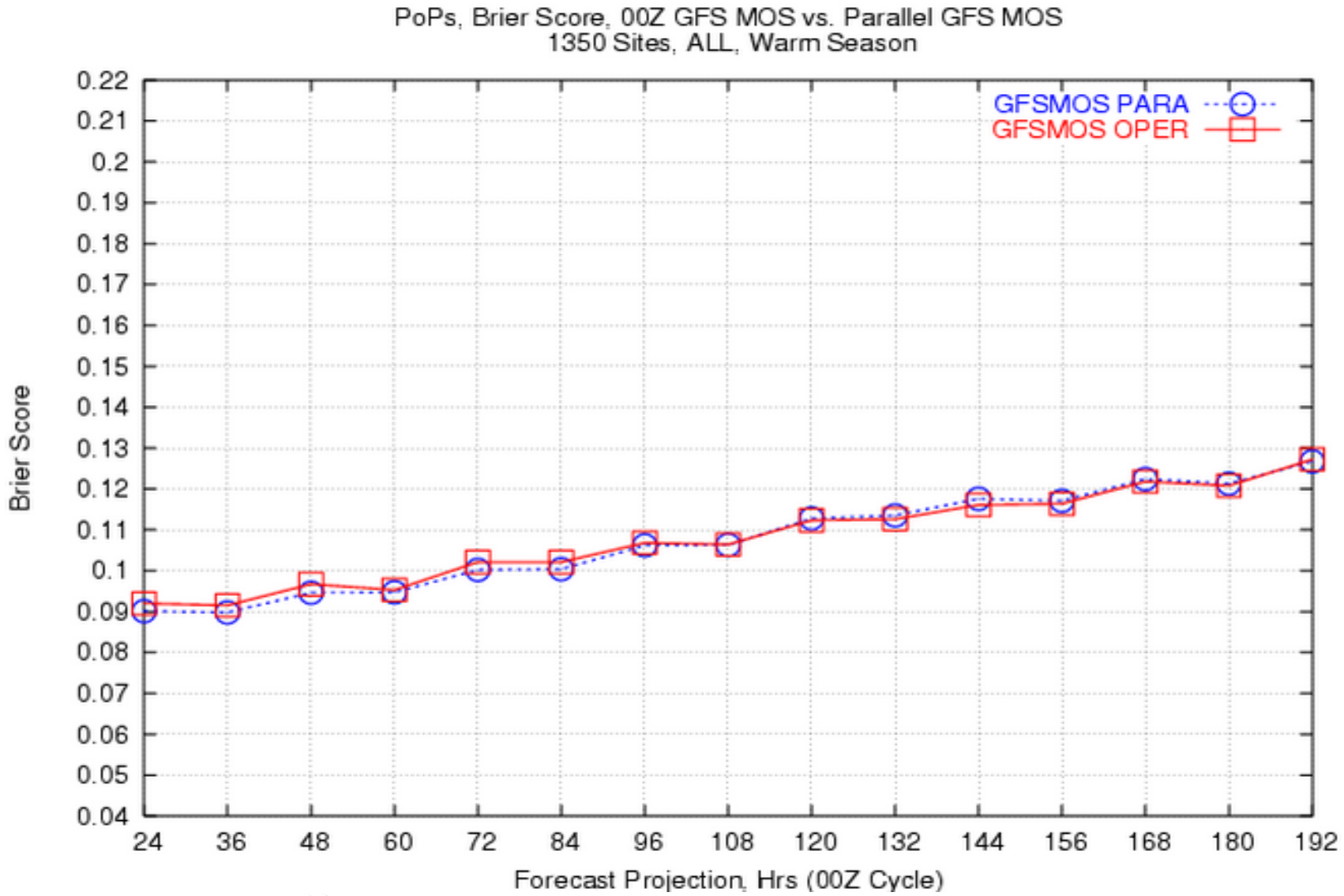
a measure of accuracy,
mean squared error of the forecasts

Probability of Quantitative Precip ≥ .25”



Brier Score, Warm Season, GFS MOS 12-h PoP

Independent data, July – October 2005, Sept 2006



Available MOS Probability Products

Alphanumeric Bulletins

- PoP, Thunderstorm, C SevereTstm, Snow, Freezing

Station guidance in BUFR format

- Contains all MOS probabilities

Gridded MOS guidance in graphical and GRIB2 format (NDGD)

- 3-, 6- and 12-h thunderstorm probabilities
- 6- and 12-h probability of precipitation

Web graphics of most MOS probability products

http://www.nws.noaa.gov/mdl/synop/products.shtml

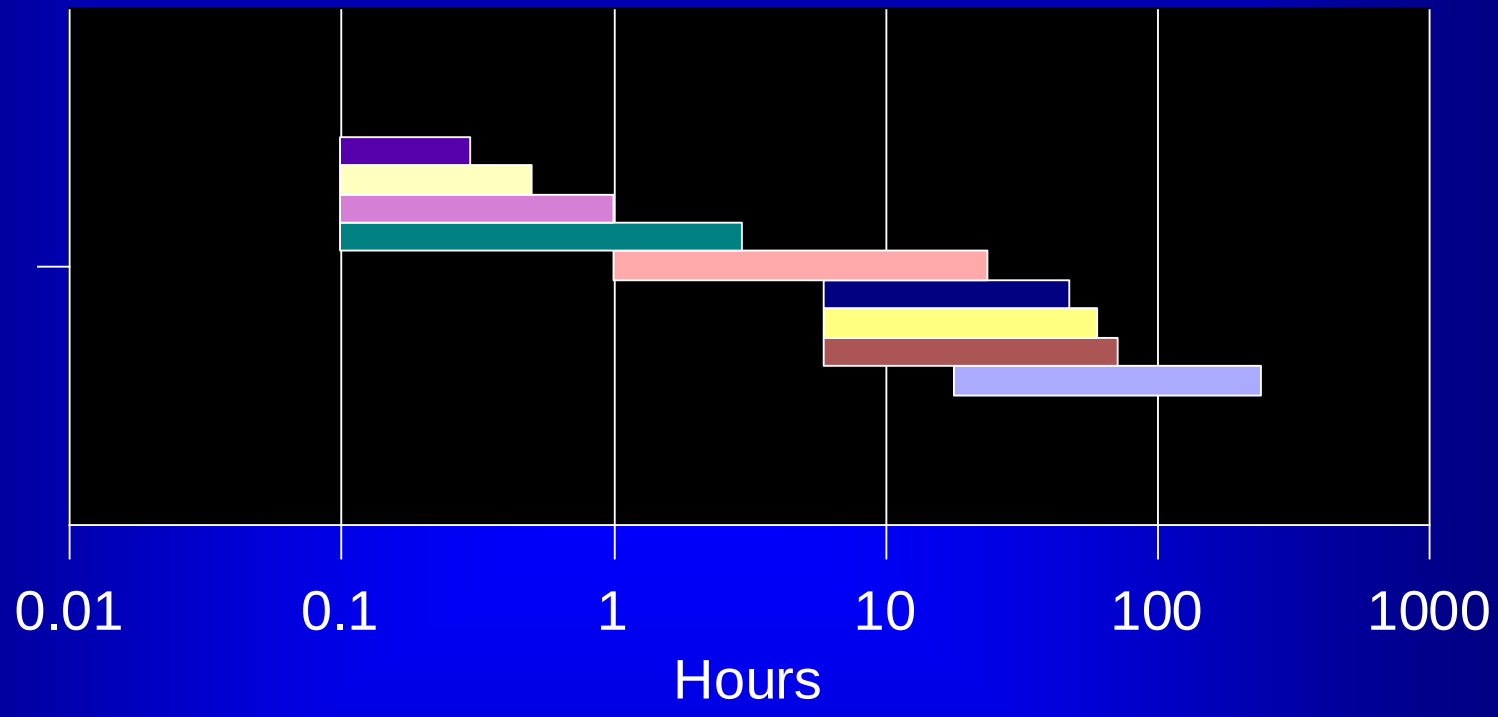
…and now for Judy's talk about LAMP

"Completing the Forecast:
Characterizing and Communicating Uncertainty for Better Decisions Using Weather and Climate Forecasts" (NRC Report 2006)

- "By providing mainly singlevalued categorical information, the hydrometeorological prediction community denies its users much of the value of the information it produces—information that could impart economic benefits and lead to greater safety and convenience for the nation."

- "With the availability of uncertainty information, users— each with their own sensitivity to costs and losses and with varying thresholds for taking protective action—could better decide for themselves whether to take action and the appropriate level of response to hydrometeorological situations."

MDL Forecast Guidance Spectrum



- High Resolution Radar Mosaics
- Radar Cell Diagnostics
- 0-1 hr Precipitation Nowcast
- 0-3 hr QPF/Ltg/SvrWx
- LAMP
- Coastal-Marine Storm Surge
- Eta/NGM MOS
- AVN MOS
- MRF MOS

Localized Aviation MOS Program (LAMP) Background

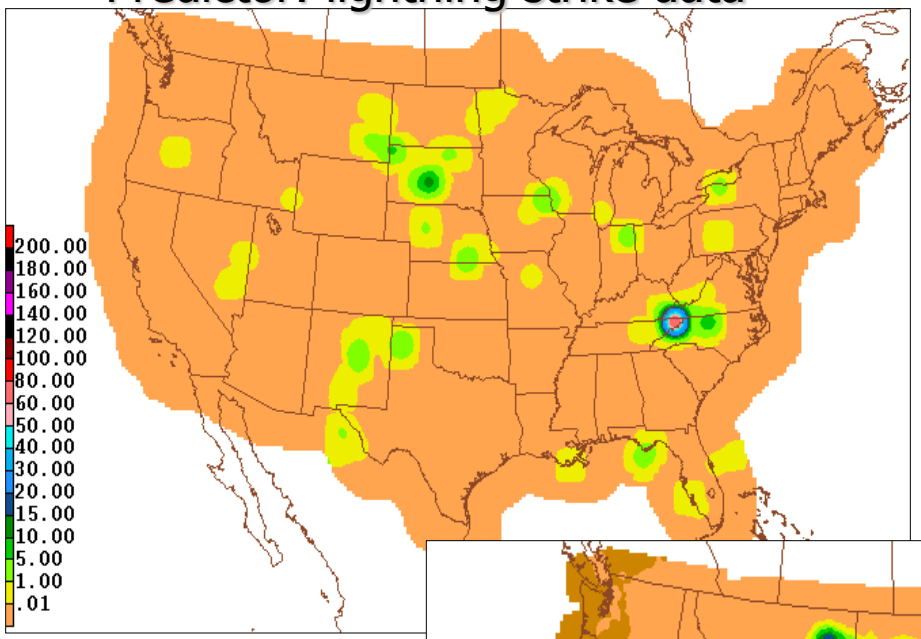
- LAMP is a system of objective analyses, simple models, regression equations, and related thresholds which together provide guidance for sensible weather forecasts
- LAMP acts as an update to MOS guidance
- Guidance is both probabilistic and deterministic
- LAMP provides guidance for aviation elements
- LAMP bridges the gap between the observations and the MOS forecast
    - Good quality recent surface observations help to decrease the uncertainty in the short term. As the observations become less predictive later in the forecast period, the uncertainty increases.
    - Verification shows improvement on MOS in the first hours, then skill comparable to MOS

Localized Aviation MOS Program (LAMP) Background

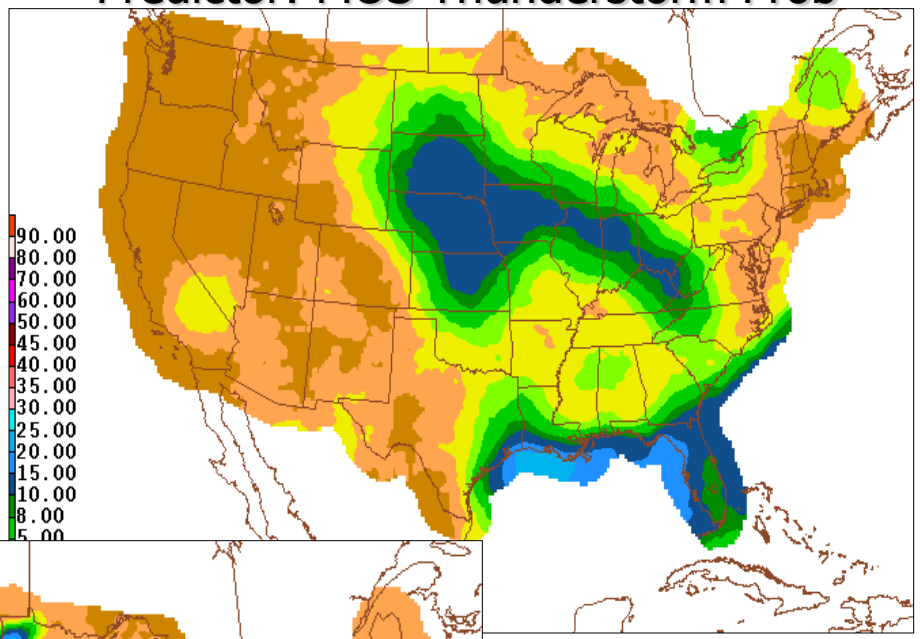
- LAMP guidance
  - goes out 25 hours in 1 hour projections
  - Station Guidance
    - All elements
    - ~1600 stations
    - CONUS, Alaska, Hawaii, Puerto Rico
  - Gridded Guidance
    - Thunderstorms: Probability/Best Category Y/N of thunderstorm occurrence in a 2 hour period in a 20km gridbox
    - CONUS
  - Eventually will run 24 times a day (every hour)

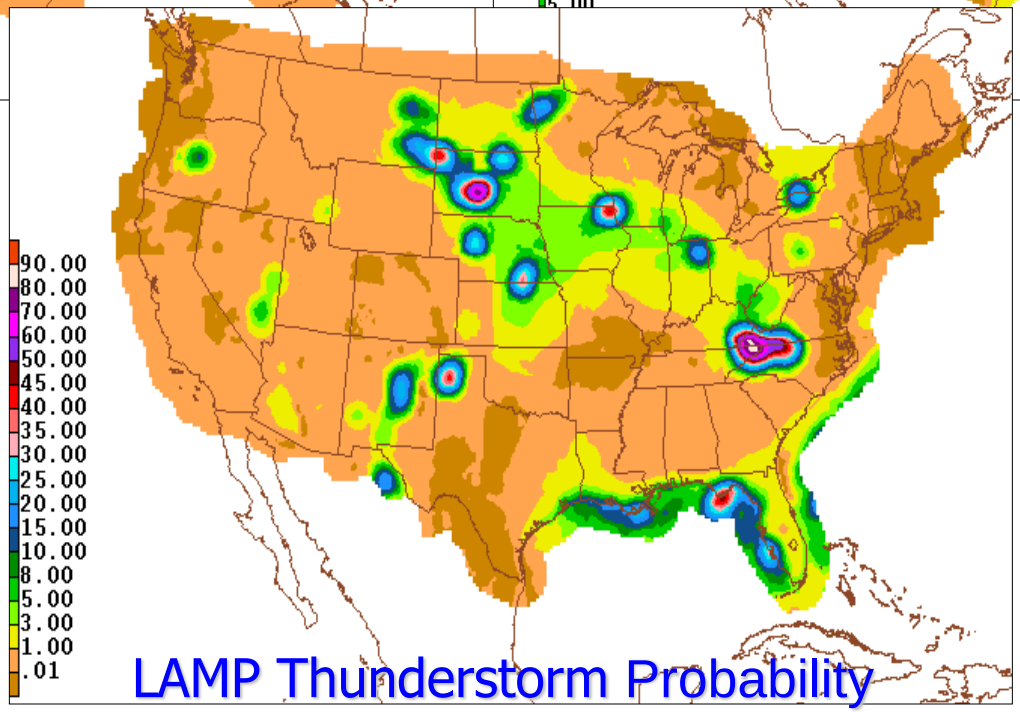
1-3 hr LAMP Thunderstorm forecast

Predictor: lightning strike data



Predictor: MOS Thunderstorm Prob

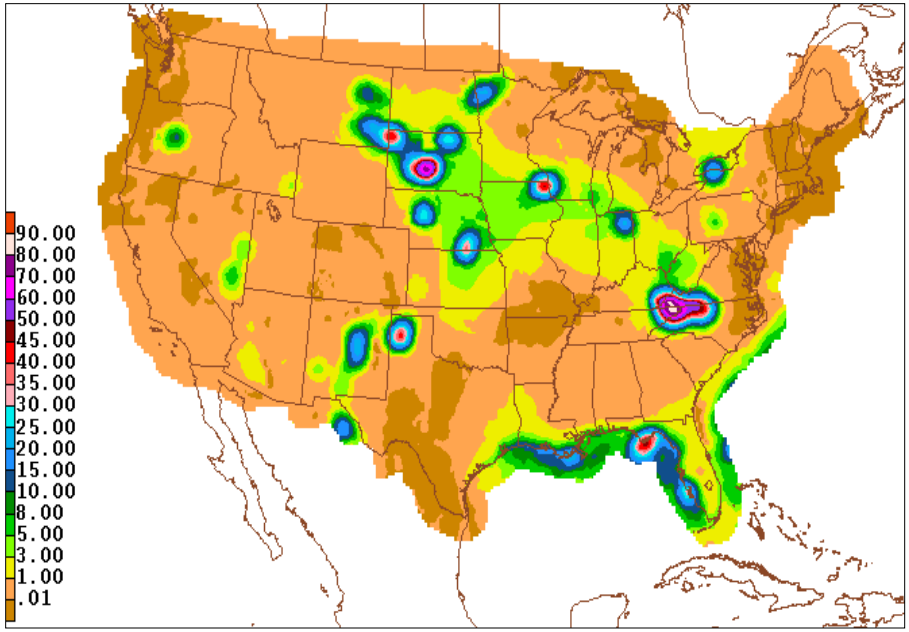




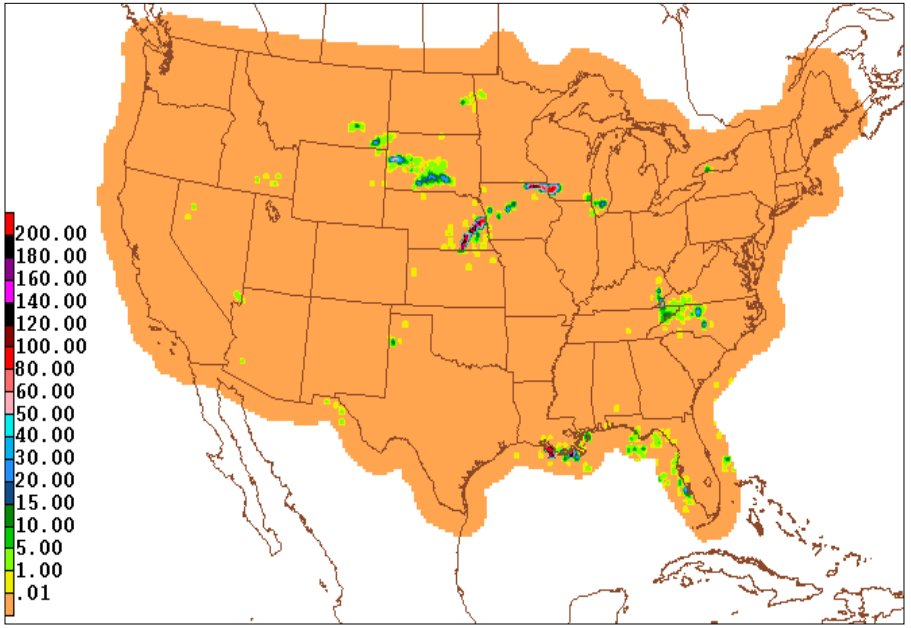
LAMP Thunderstorm Probability

1-3 hr LAMP Thunderstorm forecast

LAMP Thunderstorm Probability



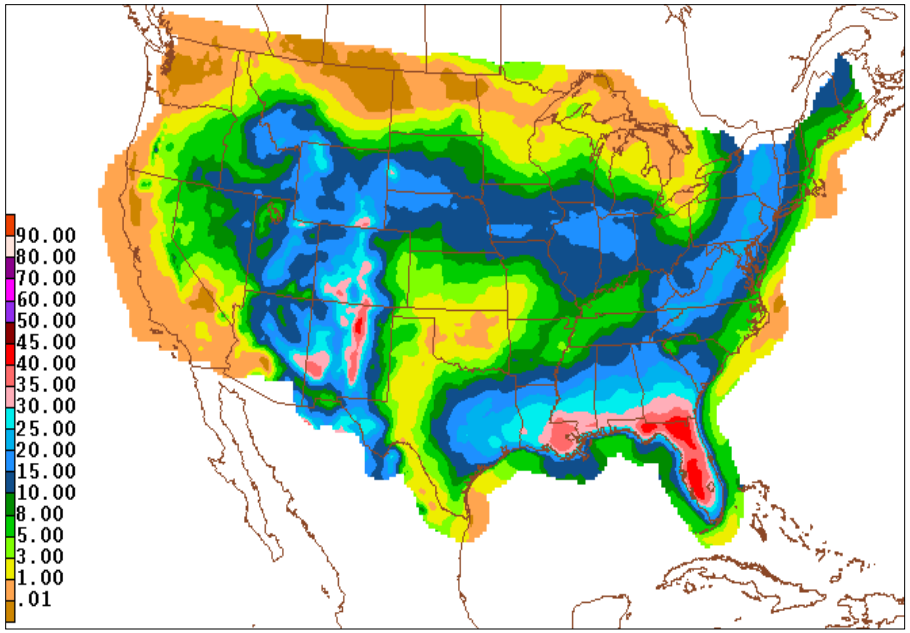
Verifying lightning



11-13 hr LAMP Thunderstorm forecast

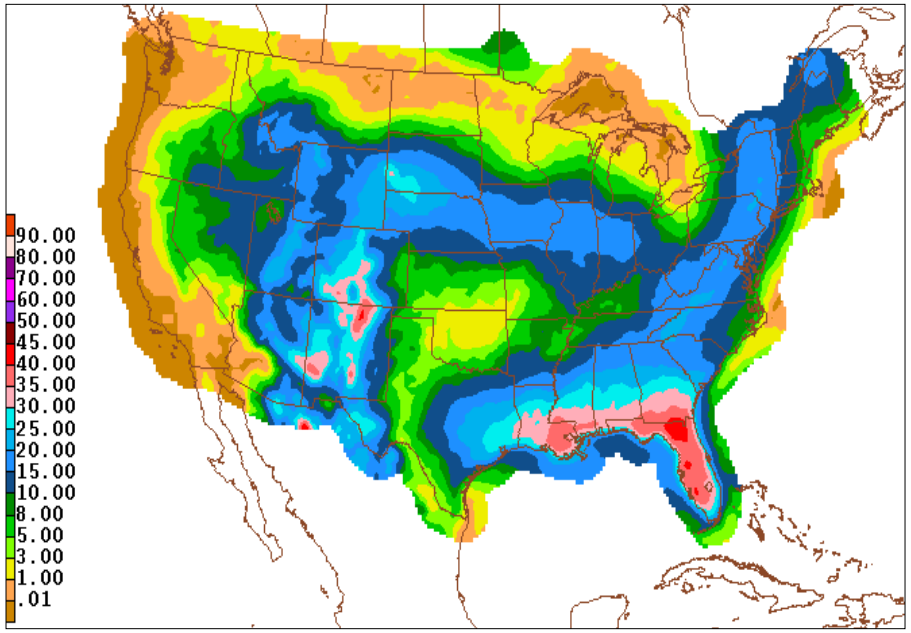
LAMP

Thunderstorm Probability

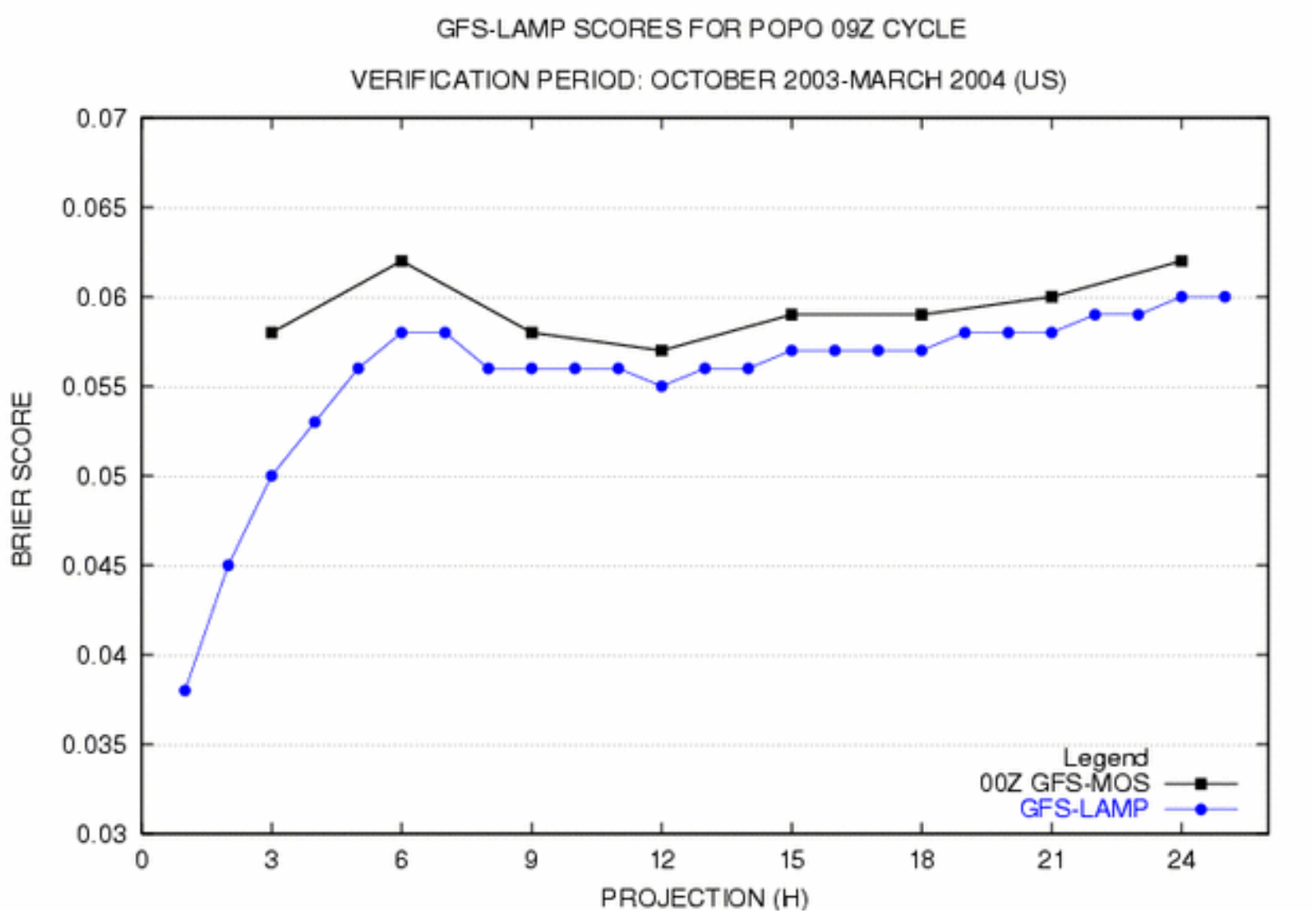


Predictor: MOS

Thunderstorm Probability



LAMP Verification



GFS LAMP Bulletin

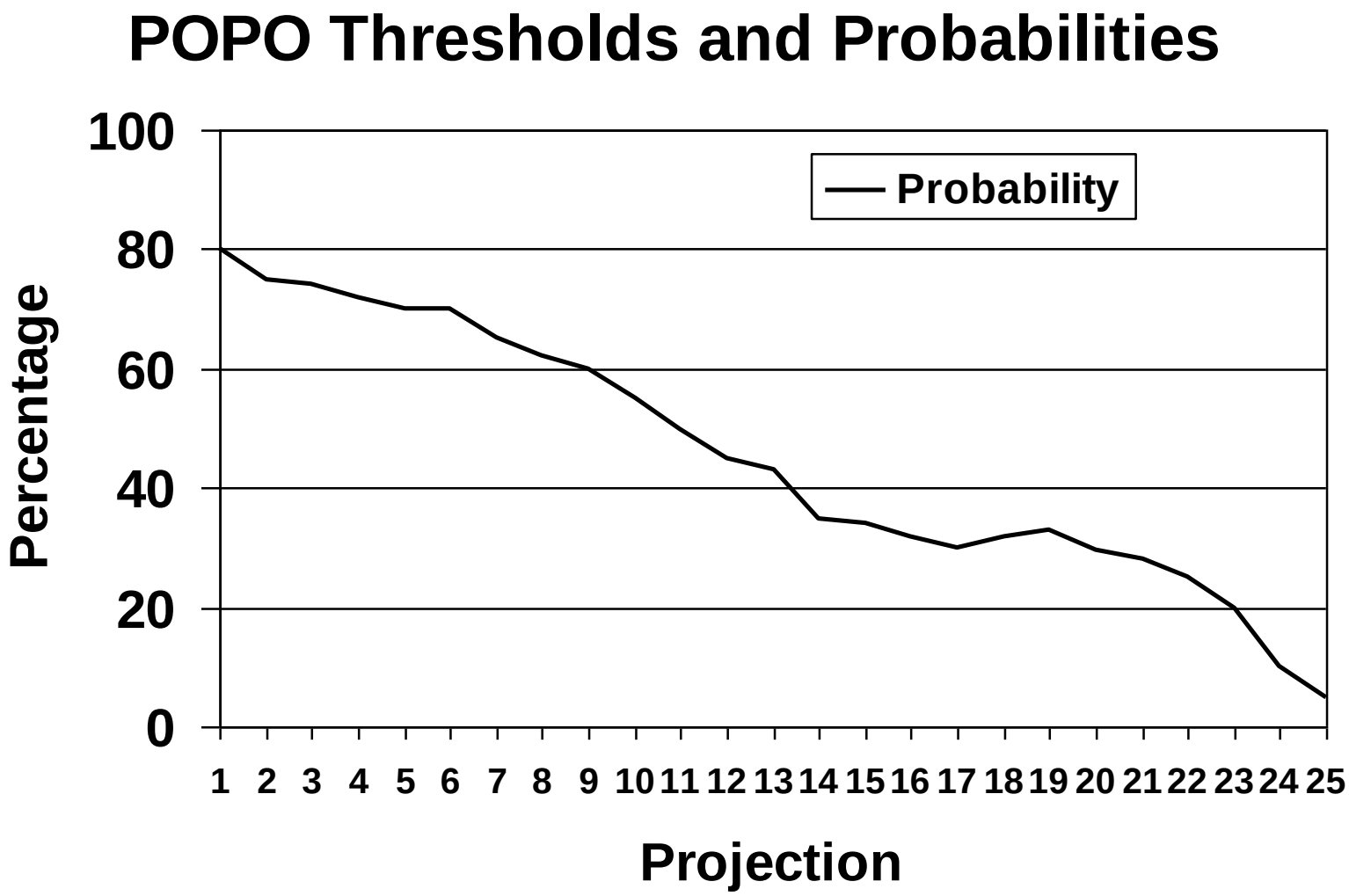
KRDU GFS LAMP GUIDANCE 9/14/2007 2100 UTC

UTC	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22
TMP	75	74	72	72	71	71	70	70	69	68	68	67	67	67	67	69	71	73	74	75	75	76	76	76	75
DPT	72	72	72	71	71	71	70	70	69	68	68	67	67	67	67	67	65	64	63	61	59	58	57	55	55
WDR	10	11	09	08	08	11	15	25	26	27	28	29	31	30	31	35	36	01	01	36	01	36	36	01	02
WSP	04	04	03	04	04	04	03	03	03	04	03	03	02	02	02	04	06	07	08	07	08	08	08	08	07
WGS	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG
PPO	52	48	61	35	33	29	32	28	20	19	16	14	8	5	4	2	0	0	0	0	1	2	1	1	0
PCO	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
P06									57						27						6				
TP2			33	14	1	0	1		0		0		0		0		0		0		0		0		0
TC2			Y	N	N	N	N		N		N		N		N		N		N		N		N		N
POZ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
POS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TYP	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CLD	OV	OV	OV	OV	OV	OV	OV	OV	OV	OV	OV	OV	OV	OV	OV	BK	SC	SC	SC	SC	SC	SC	SC	SC	FW
CIG	6	6	6	6	6	6	6	5	5	4	4	4	4	4	5	6	8	8	8	8	8	8	8	8	8
CCG	6	6	6	5	5	5	5	5	4	4	4	4	4	4	5	5	5	5	5	6	6	6	6	6	6
VIS	7	7	7	7	6	7	5	5	5	6	6	6	6	5	6	7	7	7	7	7	7	7	7	7	7
CVS	6	5	7	5	5	5	5	5	5	5	5	5	5	5	5	5	7	7	7	7	7	7	7	7	7
OBV	N	N	N	N	N	N	N	BR	BR	BR	BR	HZ	BR	BR	BR	N	N	N	N	N	N	N	N	N	N

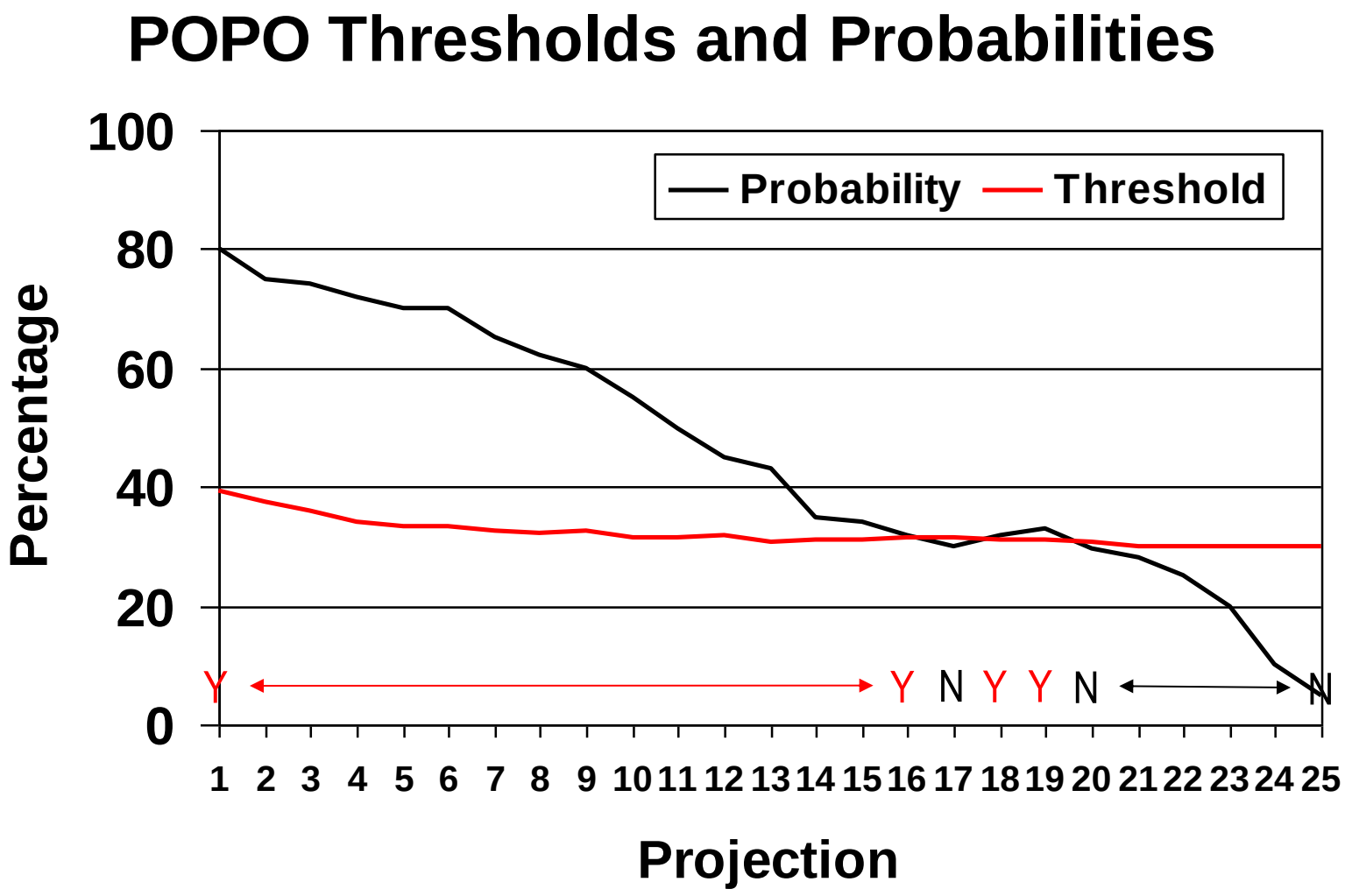
Thresholding

- LAMP makes best category deterministic forecasts based on the probabilities and the thresholds
- Thresholds are determined based on achieving unit bias or maximizing the threat score within a bias range
- Thresholds can help interpret the probabilities
- Thresholds vary by location, projection, cycle time, and season
- Technique identical to MOS thresholding

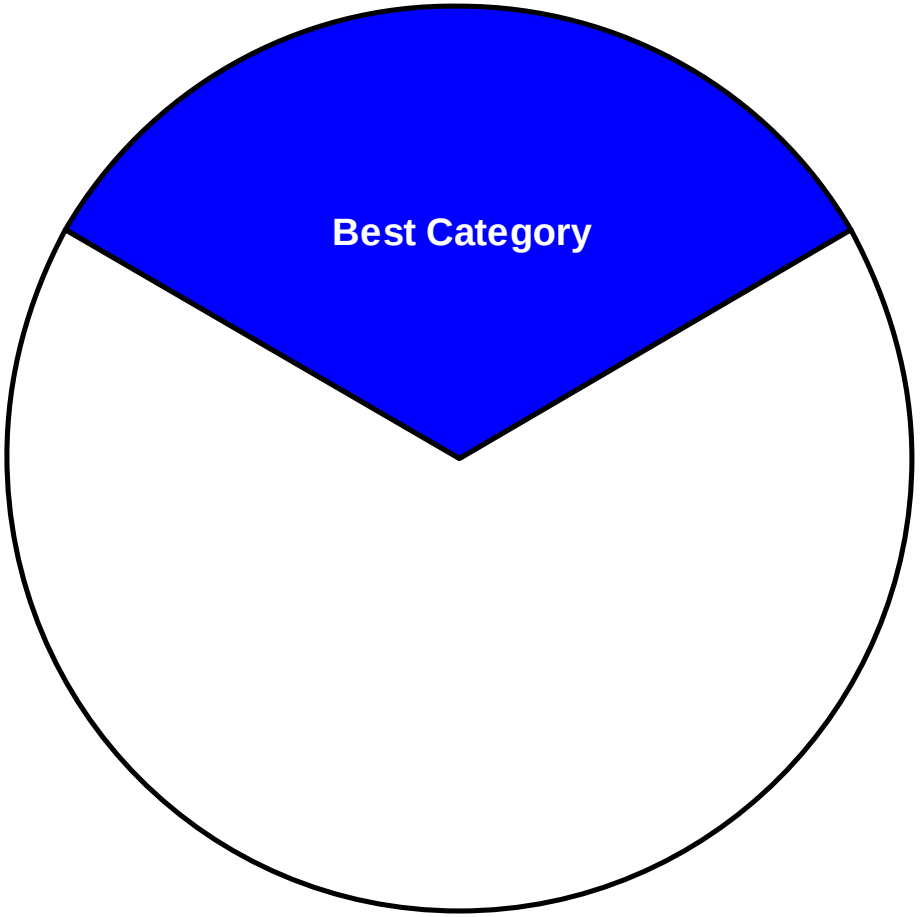
Thresholding



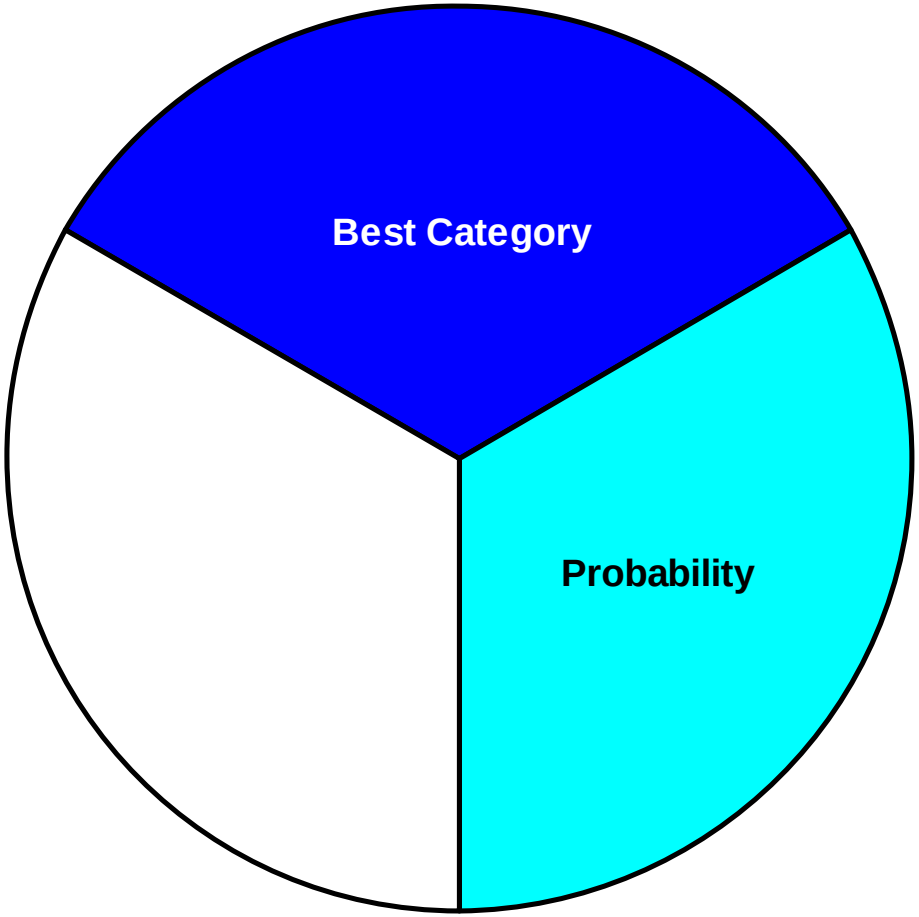
Thresholding



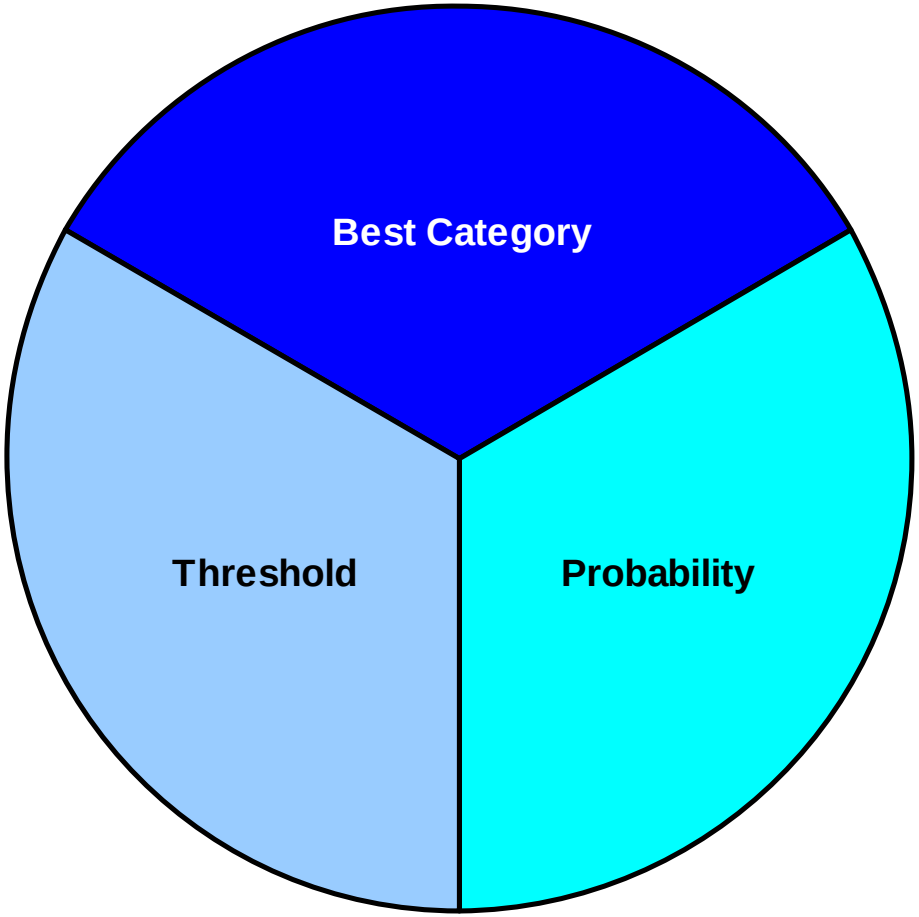
Pieces of the puzzle



Pieces of the puzzle



Pieces of the puzzle



LAMP Probabilities

Probability of:	Event
Liquid Equivalent Precip. ≥ 0.01 inch during past 6 hours/12 hours	Yes/No
Precipitation occurring on the hour	Yes/No
Precipitation type (Conditional on Precipitation)	Freezing Frozen Liquid
Precipitation Characteristics (Conditional on Precipitation)	Drizzle Continuous Showers

LAMP Probabilities

Probability of:	Event
Thunderstorms during 2 hr period in 20km gridbox	Yes/No
Total Sky Cover	0/8 (Clear) 1/8 – 2/8 (Few) 3/8 – 4/8 (Sct) 5/8 – 7/8 (Bkn) 8/8 (Ovc)
Obstruction to Vision	No obstruction to vision Haze/Smoke Mist Fog Blowing Phenomena

LAMP Probabilities

Probability of:	Event
Ceiling Height	< 200 feet 200 – 400 feet 500 – 900 feet 1000 – 1900 feet 2000 – 3000 feet 3100 – 6500 feet 6600 – 12,000 feet > 12,000 feet
Ceiling Height (Conditional on Precipitation)	Same as above

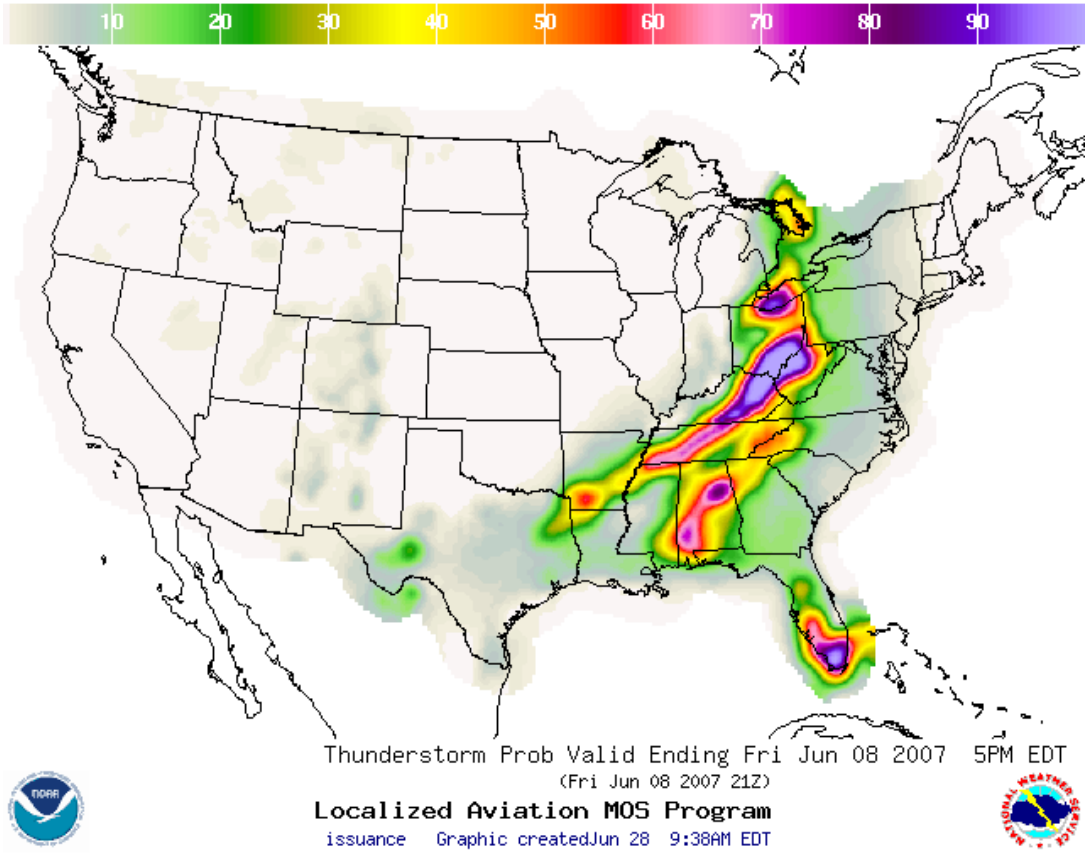
LAMP Probabilities

Probability of:	Event
Visibility	< ½ mile < 1 mile < 2 miles < 3 miles ≤ 5 miles ≤ 6 miles
Conditional Visibility (Conditional on Precipitation)	Same as above

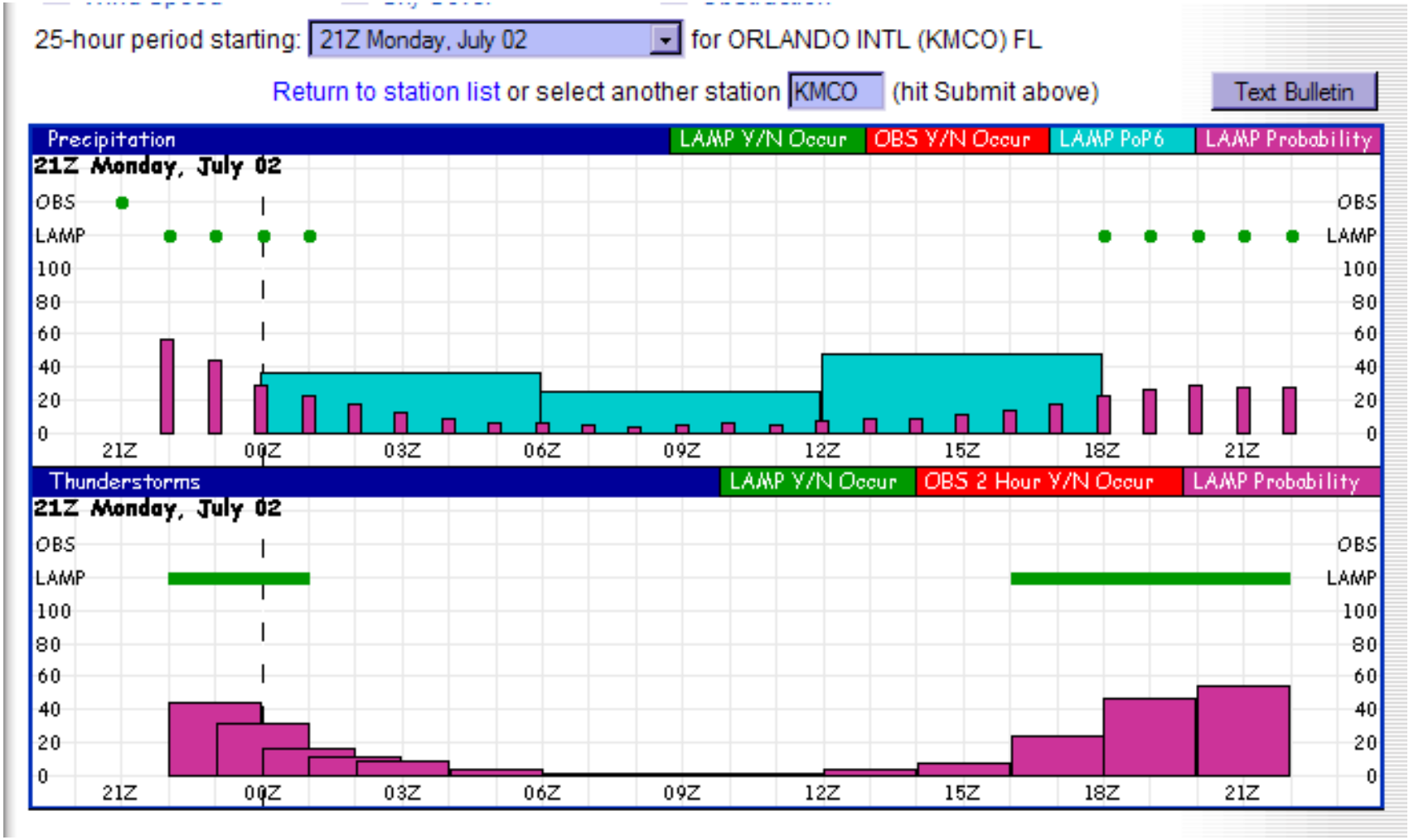
LAMP Probabilistic Products

- SBN/NOAAPort/NWS FTP server products:
  - Alphanumeric bulletin guidance
  - Station guidance in BUFR format
    - Contains all probabilities made by LAMP
  - Gridded thunderstorm guidance in GRIB2 format (NDGD)
    - 2hr thunderstorm probabilities
- Graphical products on weather.gov:
  - Gridded thunderstorm images, including probabilities
  - Station plots of POPO
  - Meteograms, including probabilities found in bulletin

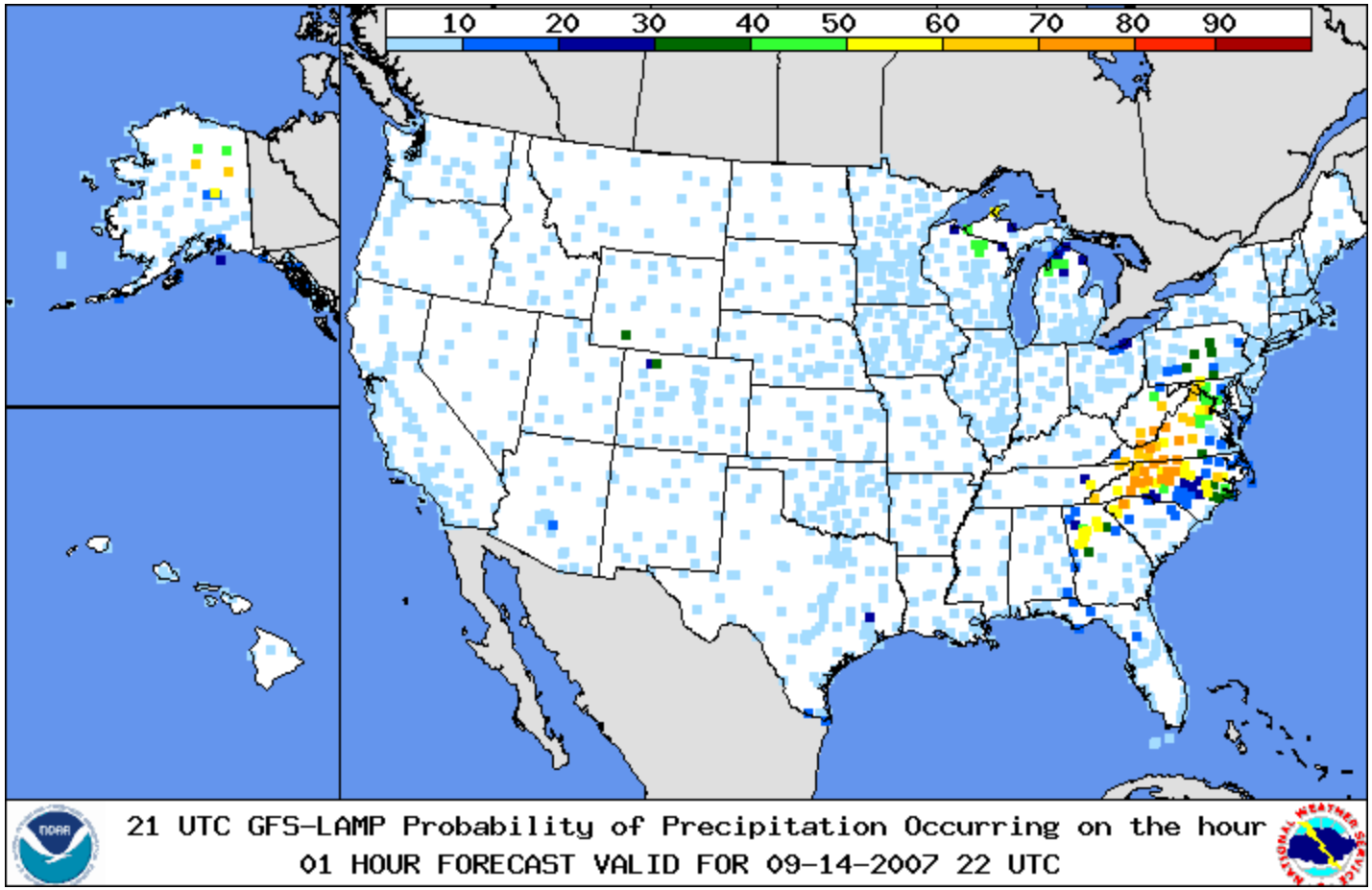
LAMP Thunderstorm Probabilities



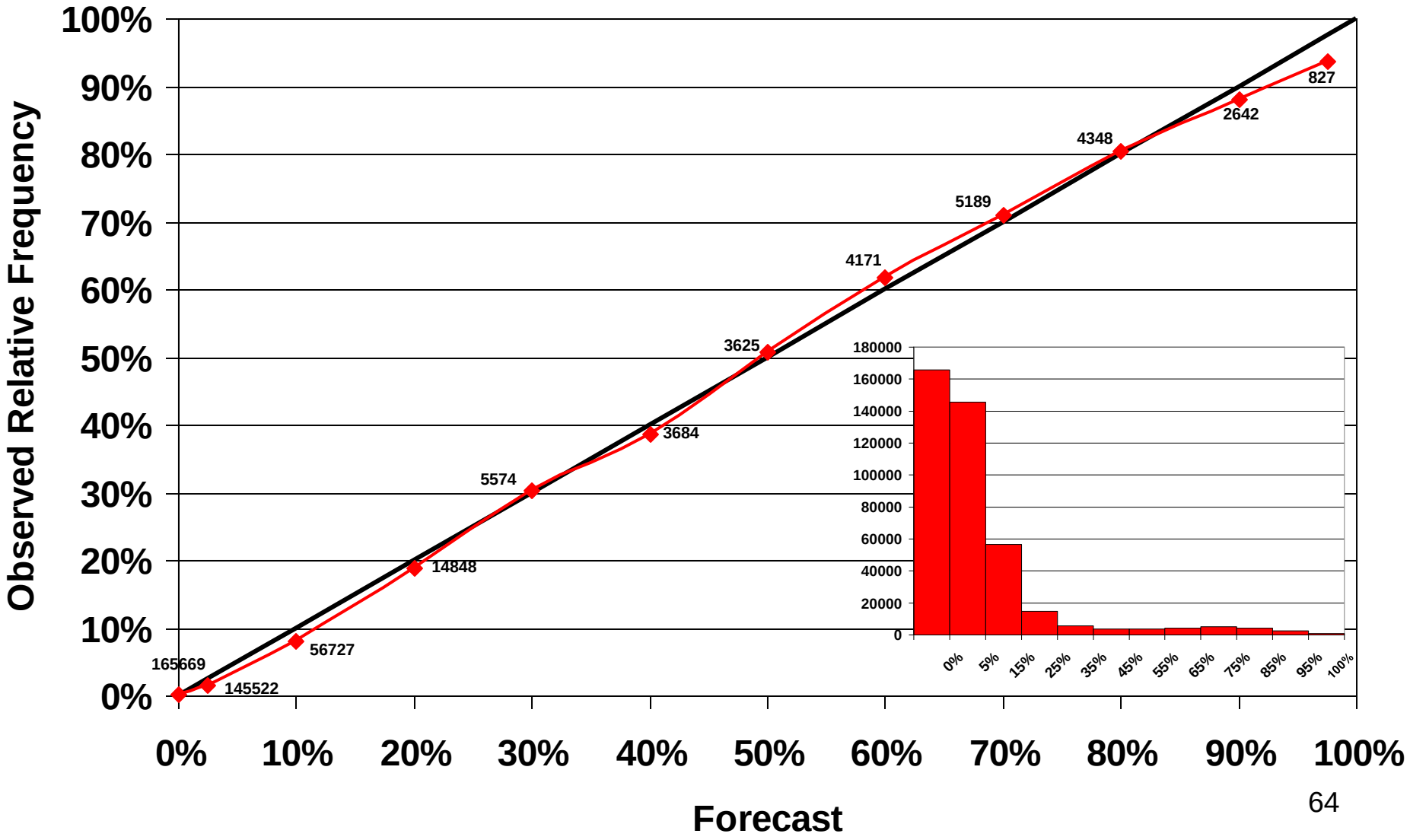
LAMP Meteogram Products



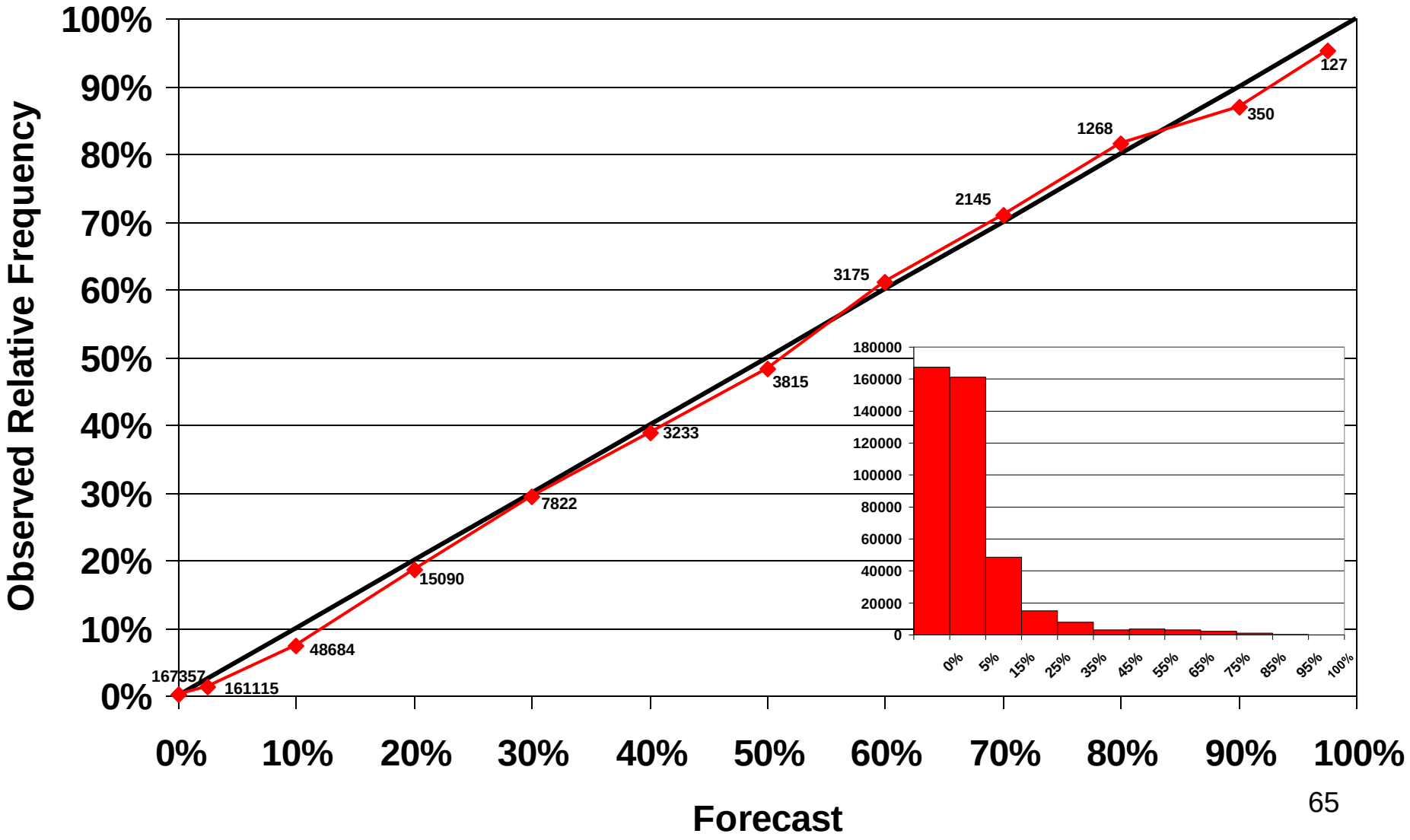
LAMP Probability of Precipitation
Available on weather.gov/mdl/lamp



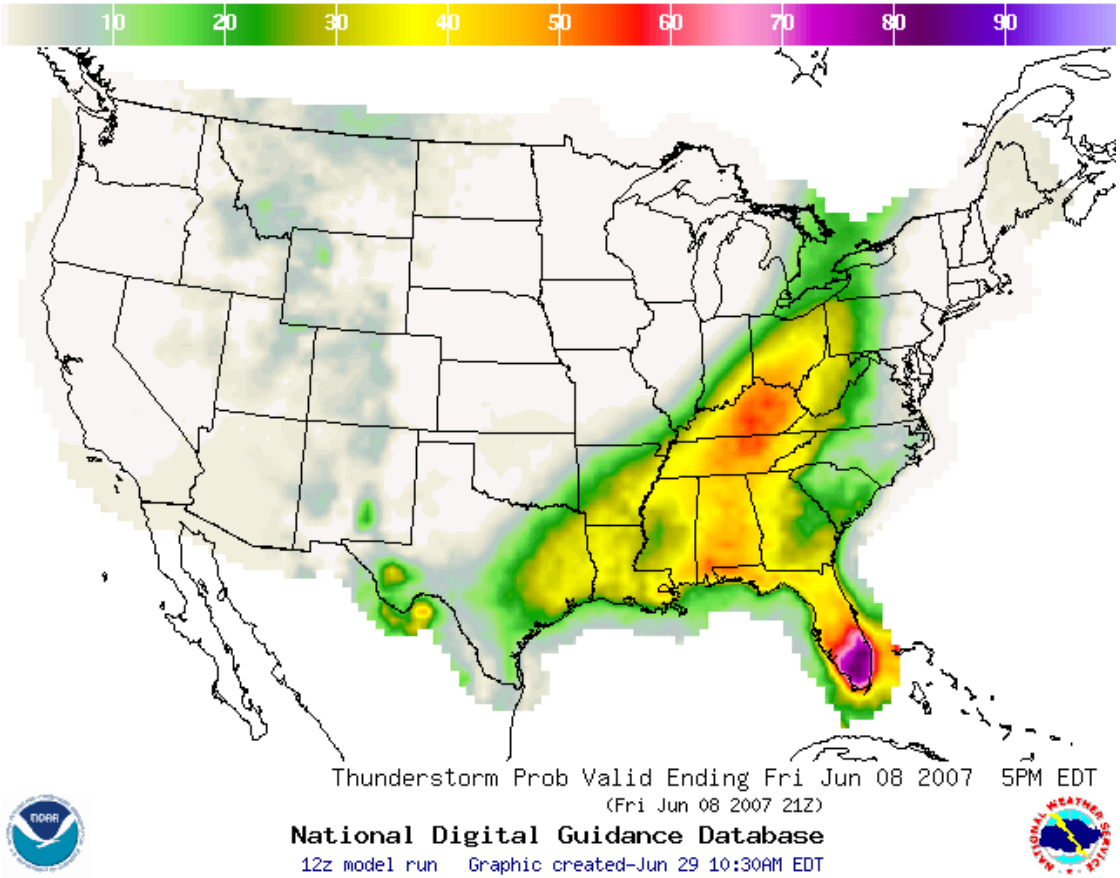
GFSLAMP
Reliability of 0300 UTC 03-h Ceiling < 1000 feet
2006 Aug - 2007 May, 1522 sites



GFSLAMP
Reliability of 0300 UTC 03-h Visibility < 3 miles
2006 Aug - 2007 May, 1522 sites

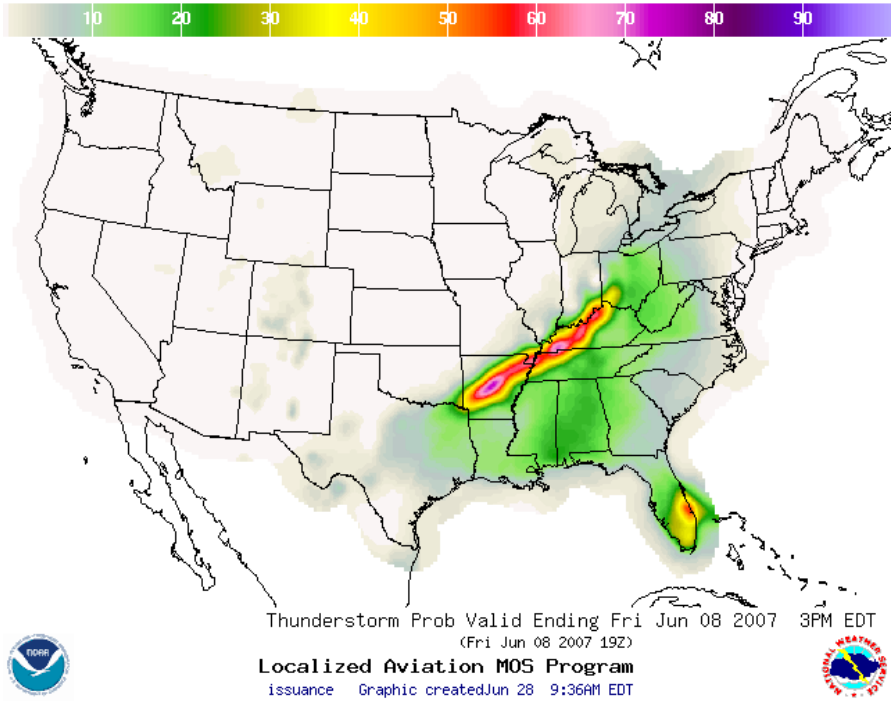


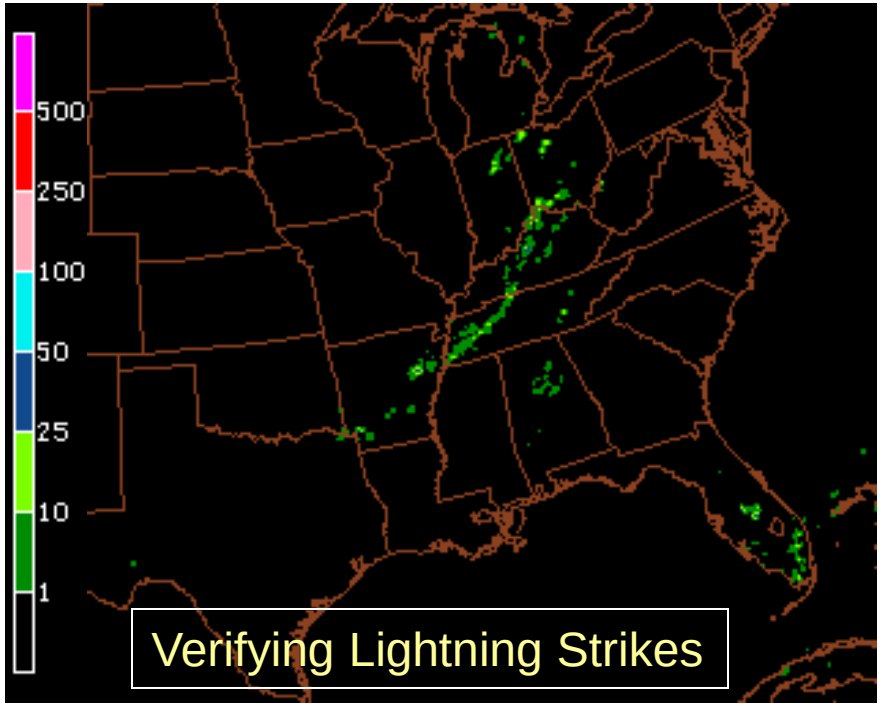
June 8, 2007



GMOS 03h forecast
Available ~16:45 UTC
Valid 18-21 UTC

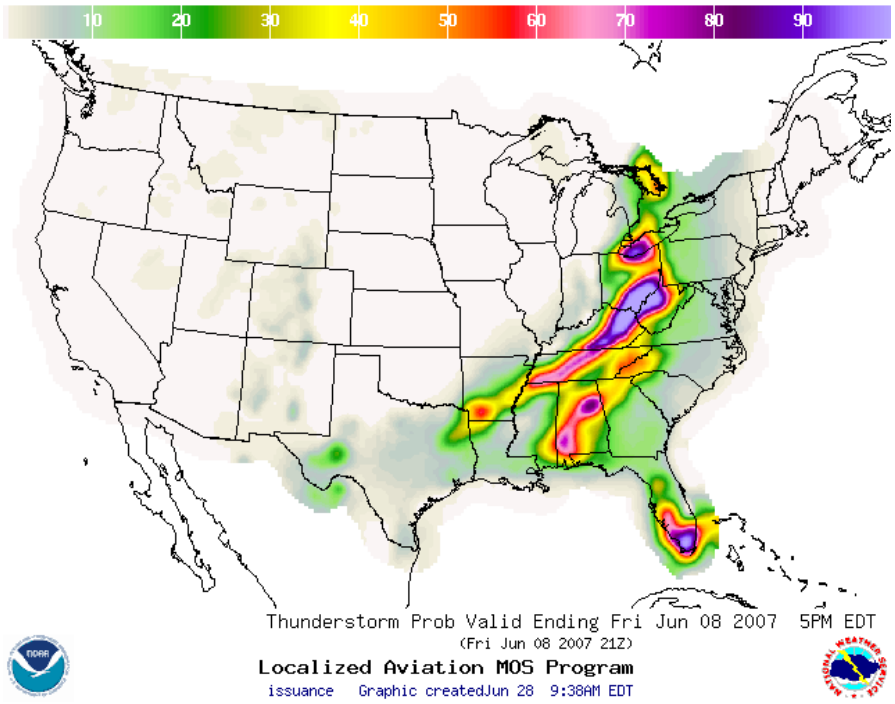
June 8, 2007 1500 UTC LAMP forecast

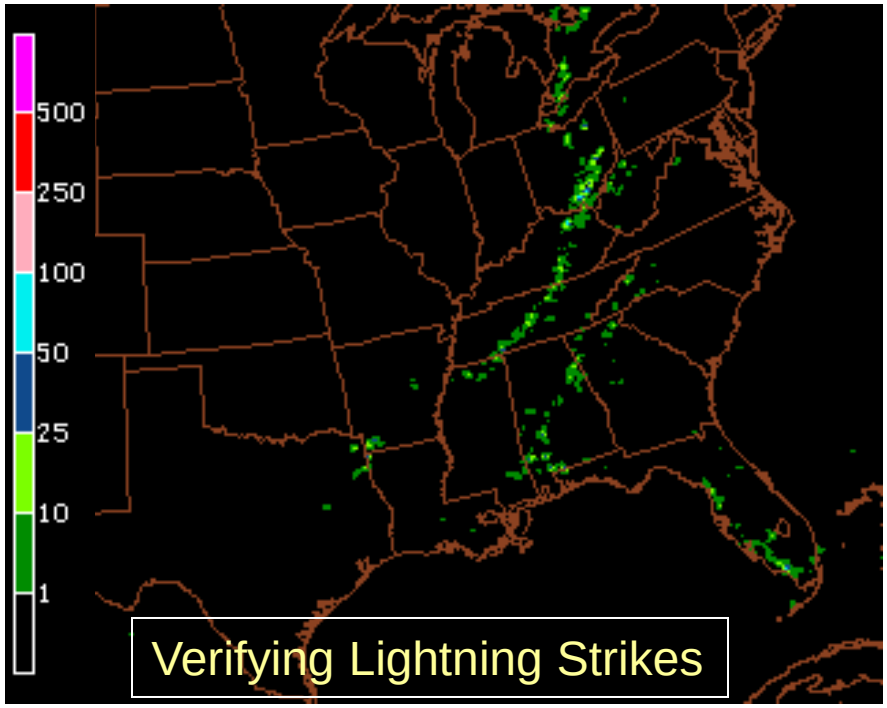




LAMP 02h forecast
Available ~15:45 UTC
Valid 17-19 UTC

June 8, 2007 1800 UTC LAMP forecast





LAMP 02h forecast
Available ~18:45 UTC
Valid 19-21 UTC

Uses of LAMP probabilities

- As input to AvnFPS in making Terminal Aerodrome Forecasts (TAF)
  - "PROB: Probability of occurrence of a thunderstorm or other precipitation event, with associated weather elements as necessary (wind, visibility, and/or sky condition) whose occurrences are directly related to, and contemporaneous with, the thunderstorm or precipitation event. Only PROB30 (30% probability of the specified element occurring) groups will be used in NWS TAFs." (NWSI 10-813)
- As guidance to WFO forecasters in making the TAFs and to AWC forecasters in making the convective products
- Aviation Planning – Keith and Leyton (WAF August 2007) found "that utilizing statistically derived probabilistic forecasts to determine fuel carriage results in a significant cost savings compared to the deterministic TAF forecasts."
- WFO smart tools (e.g., Charleston WV)

GFS LAMP Status

- Operational Status:
  - First 4 cycles operational July 2006

Available LAMP cycles (UTC)

00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23

GFS LAMP Status

- Operational Status:
  - First 4 cycles operational July 2006
  - Next 4 cycles operational May 2007

Available LAMP cycles (UTC)

00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23

GFS LAMP Status

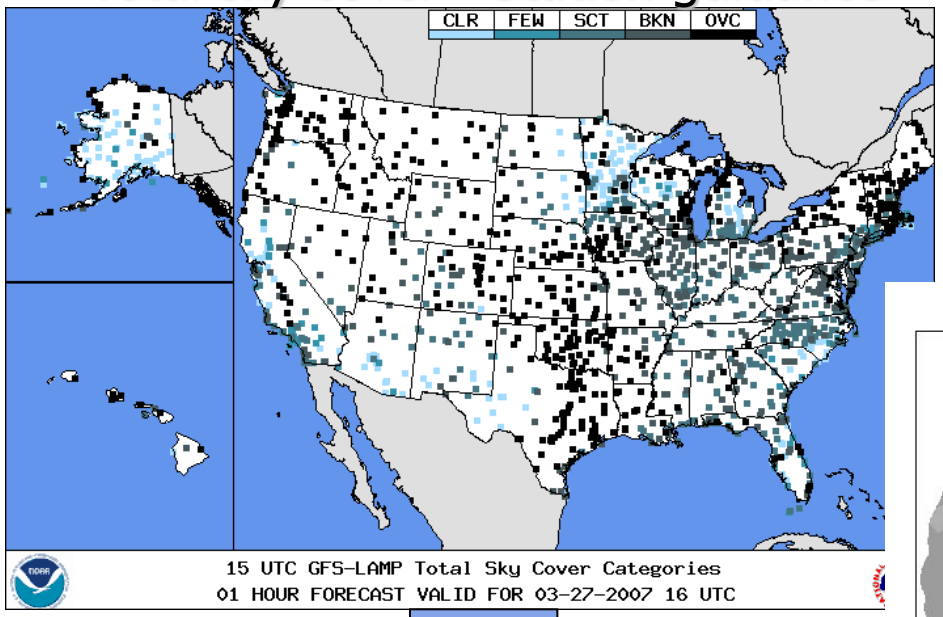
- Operational Status:
  - First 4 cycles operational July 2006
  - Next 4 cycles operational May 2007
  - 4 new cycles to be operational September 26, 2007

Available LAMP cycles (UTC)

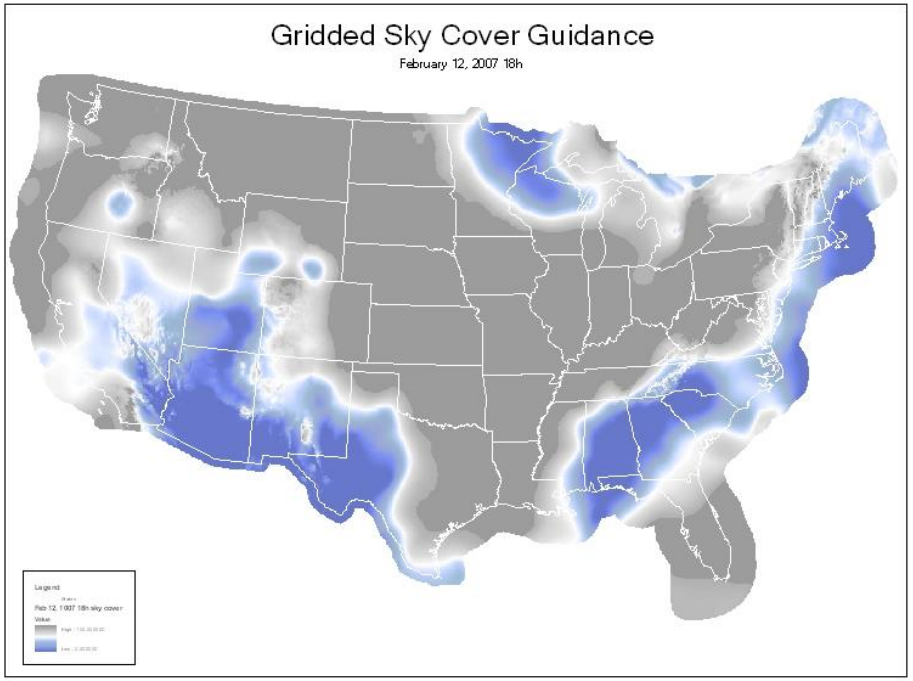
00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23

GFS LAMP- the Future

Total sky cover - Station guidance

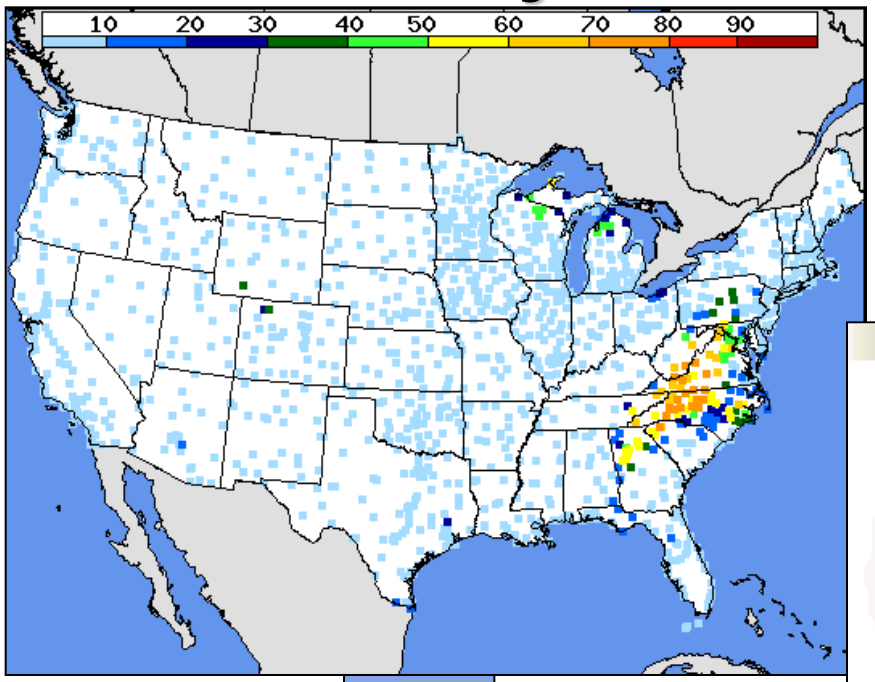


Total sky cover - Gridded guidance

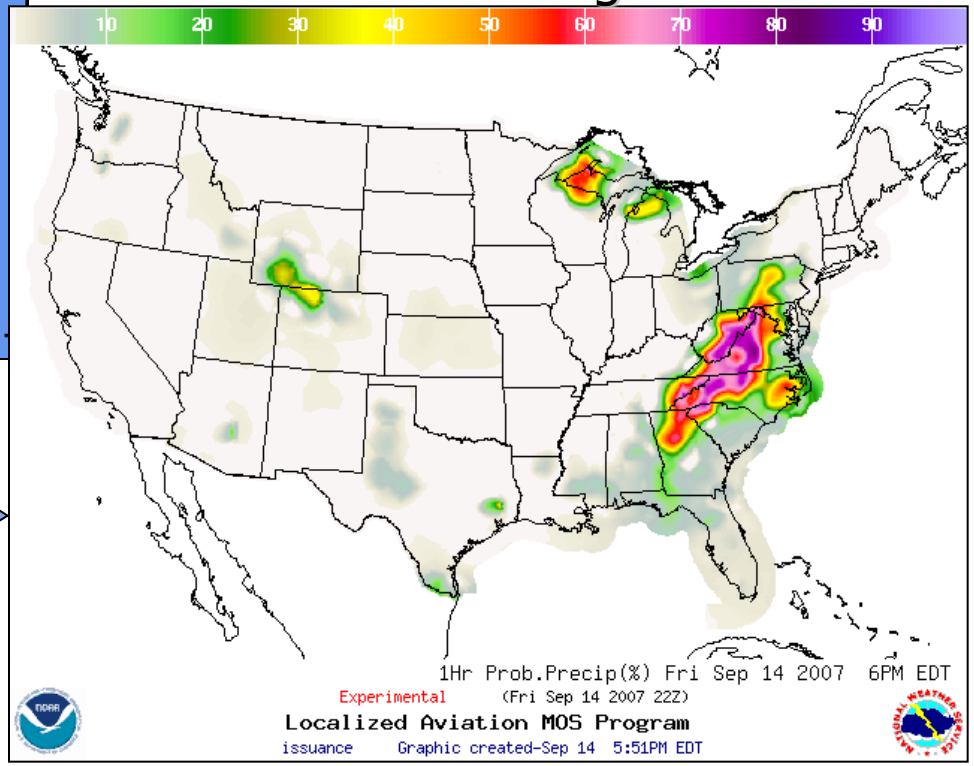


GFS LAMP- the Future

POPO - Station guidance



POPO - Gridded guidance



MDL MOS and LAMP Products on the Web

MOS Products

http://www.nws.noaa.gov/mdl/synop/products.shtml

LAMP Products

http://www.weather.gov/mdl/lamp/