



Changes to SPC Experimental Enhanced Thunderstorm Probability Forecasts

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NOAA-NWS Storm Prediction Center

Norman, OK

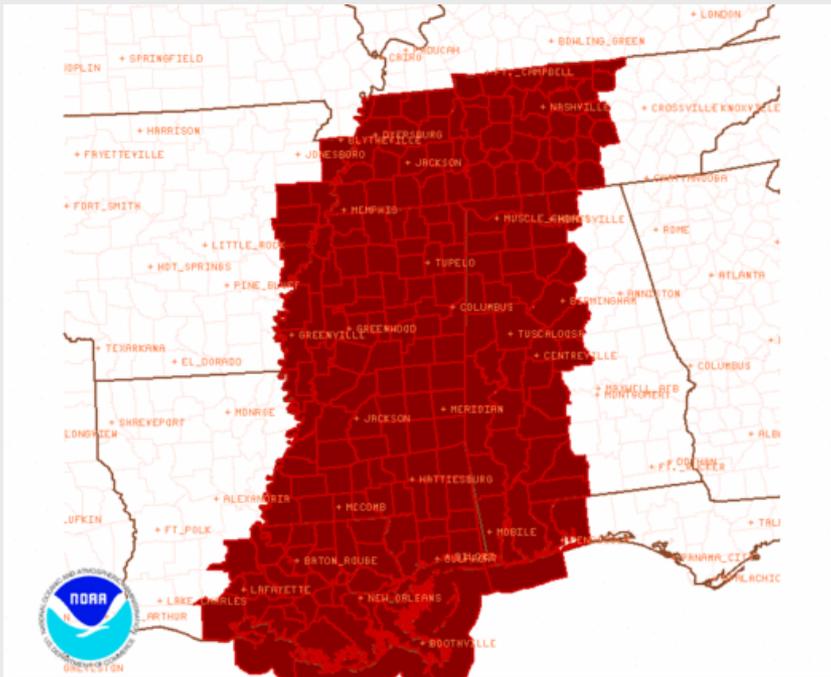


April 2009



WATCH-BY-COUNTY

started 2004



Tornado Watch # 44 - Valid from 730 AM until 600 PM CST

NOAA/NWS/Storm Prediction Center

Updated: 20070301/1331 UTC

WOUS64 KWNS 011325

WOU4

BULLETIN - IMMEDIATE BROADCAST REQUESTED
TORNADO WATCH OUTLINE UPDATE FOR WT 44
NWS STORM PREDICTION CENTER NORMAN OK
730 AM CST THU MAR 1 2007

TORNADO WATCH 44 IS IN EFFECT UNTIL 600 PM CST FOR THE
FOLLOWING LOCATIONS

ALC003-007-009-021-023-025-033-035-043-047-053-057-059-063-065-
073-075-077-079-083-089-091-093-097-099-103-105-107-117-119-125-
127-129-131-133-020000- /O.NEW.KWNS.TO.A.0044.070301T1330Z-
070302T0000Z/

AL

ALABAMA COUNTIES INCLUDED ARE

BALDWIN

CHILTON

COLBERT

DALLAS

FRANKLIN

JEFFERSON

BIBB

CHOCTAW

CONECUH

ESCAMBIA

GREENE

LAMAR

BLOUNT

CLARKE

CULLMAN

FAYETTE

HALE

LAUDERDALE

ARC035-037-077-093-107-123-020000-

/O.NEW.KWNS.TO.A.0044.070301T1330Z-070302T0000Z/

AR

ARKANSAS COUNTIES INCLUDED ARE

— // — // — // — // — // — //

CW

ADJACENT COASTAL WATERS INCLUDED ARE

COASTAL WATERS FROM LOWER ATCHAFALAYA RIVER TO
INTRACOASTAL CITY LA OUT 20 NM

WATCH-BY-COUNTY Products

Aviation Watch -- Watch Probabilities



Watch Hazard Probabilities

Tornado (2+ reports): High (>95%)

EF2+ Tornado: High (70%)

Wind (10+ reports): High (80%)

75 mph Wind: High (70%)

Hail (10+ reports): High (70%)

2"+ Hail: Mod (60%)

Hail & Wind (6+ reports): High (>95%)

Note: The Aviation Watch (SAW) is an approximation to the watch area. The actual watch is the shaded area.

Internet Test this Spring ...

Vary Wording of Watch (SELxx) with Hazard Probabilities

Numerical Weather Models (NWP) and Ensemble Systems



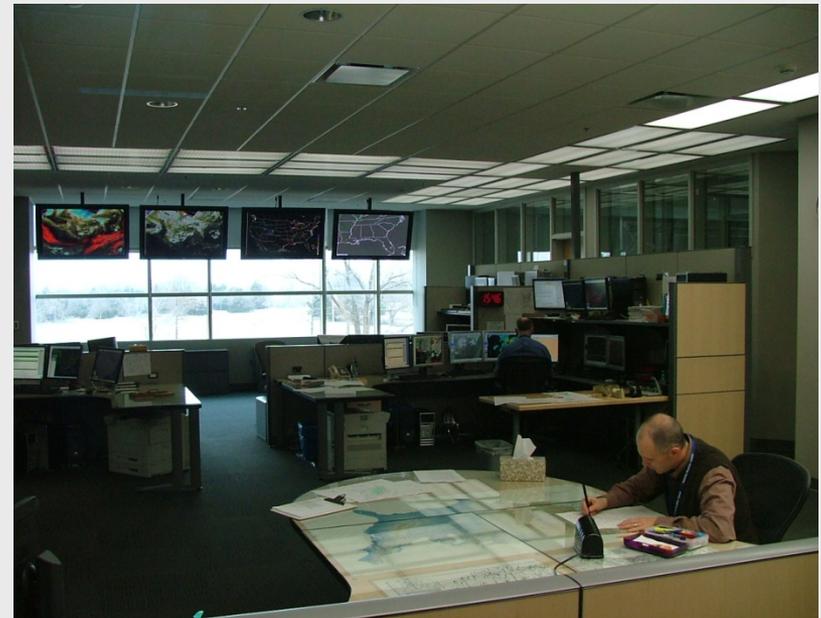
*Weather forecasting: It's impossible
to be certain all of the time!*

- Numerical weather models...
 - All forecasts contain errors (either in physics or initial analysis) that increase with time
 - Doubling time of small initial errors ~1 to 2 days
 - Maximum large-scale (synoptic) predictability ~10 to 14 days
- Ensembles...
 - A collection of models providing information on a range of plausible forecasts, statistical measures of confidence, and extend predictability
 - Scale to the problem of interest
 - Requires “tools” to view the large number of models using a slightly different approach (statistical)



Ensemble Guidance at the SPC

- **Specialized guidance developed for specific applications (severe weather, thunder, fire weather, winter weather)**
- **Design guidance that provides:**
 - ** a blend of deterministic and ensemble approaches
 - ** basis for probabilistic forecasting
 - ** aid for deterministic forecasts
 - ** a range of plausible scenarios
 - ** diagnostic analysis (not just a statistical black-box)
 - ** a “first-guess” forecast that can be easily modified if necessary



SPC Operations (Circa 2008)





The High-Impact Challenge



- **The Challenge**: Hazardous events often occur on time and space scales below the resolvable resolution of most observing and forecasting systems.
- **Key premise**: All objective forecast schemes will mishandle some pathologic weather situations, human oversight is necessary.
- **Objective**: Use our knowledge of the environment along with conceptual models to determine the spectrum of *possible* hazards, when and where they *may* occur, and how they *may* evolve over time.



Photo Copyright Bevin Shively





Goal to Improved Temporal Thunder Forecasts

- Base on current SPC SHRF 22 members (21 members of NCEP SREF plus the operational WRF-NAM)
- Give more precise timing of convective initiation and more specific location of greatest thunderstorm coverage
- Serve as another source of guidance for the AWC issued CCFP product
- Provide users in severe weather risk areas (slight, moderate, high) more precise information on convection (and consequently severe weather)





FY07 & FY08 SPC Enhanced Thunder Forecast Times and Valid Periods

Issue Time (UTC)	Valid Time 1st Pd (UTC)	Valid Time 2nd Pd (UTC)
0630	1200-0300	0300-1200
1300	1300-0300	0300-1200
1700	1630-0300	0300-1200
2030	2000-0300	0300-1200
0130		0300-1200

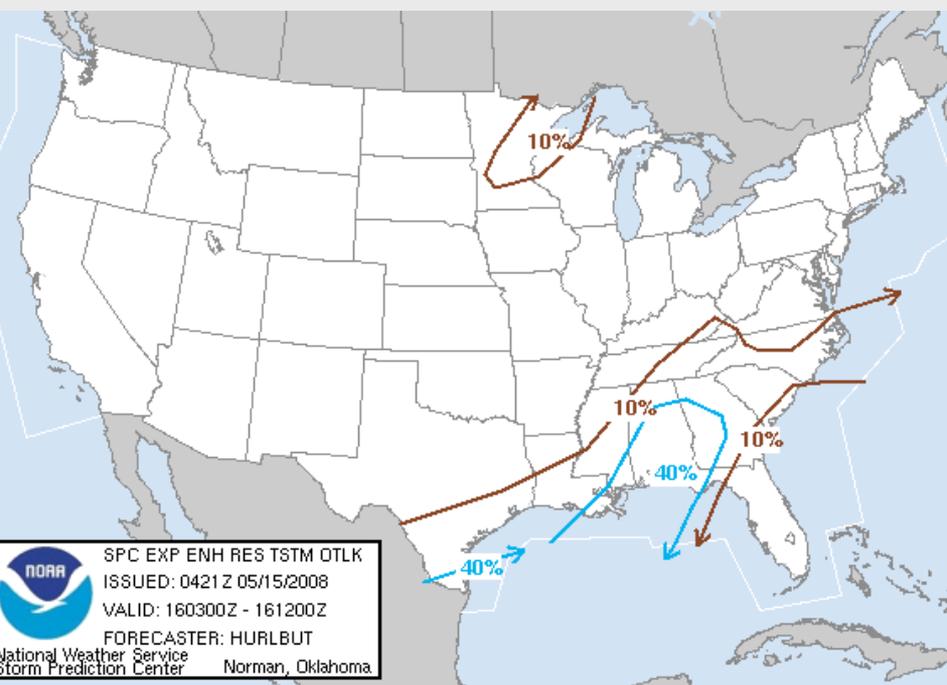
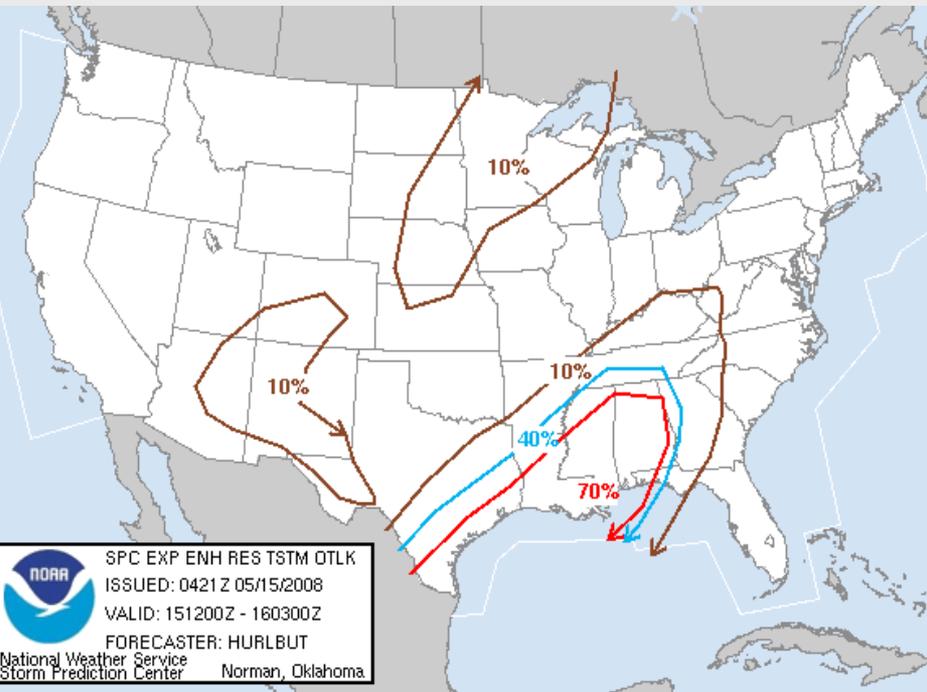
Forecast Probabilities 10%, 40% and 70%

Forecaster issued products with main input from the SREF



Example of Last Year's Enhanced Thunder Forecasts

12- 03 UTC



03-12 UTC

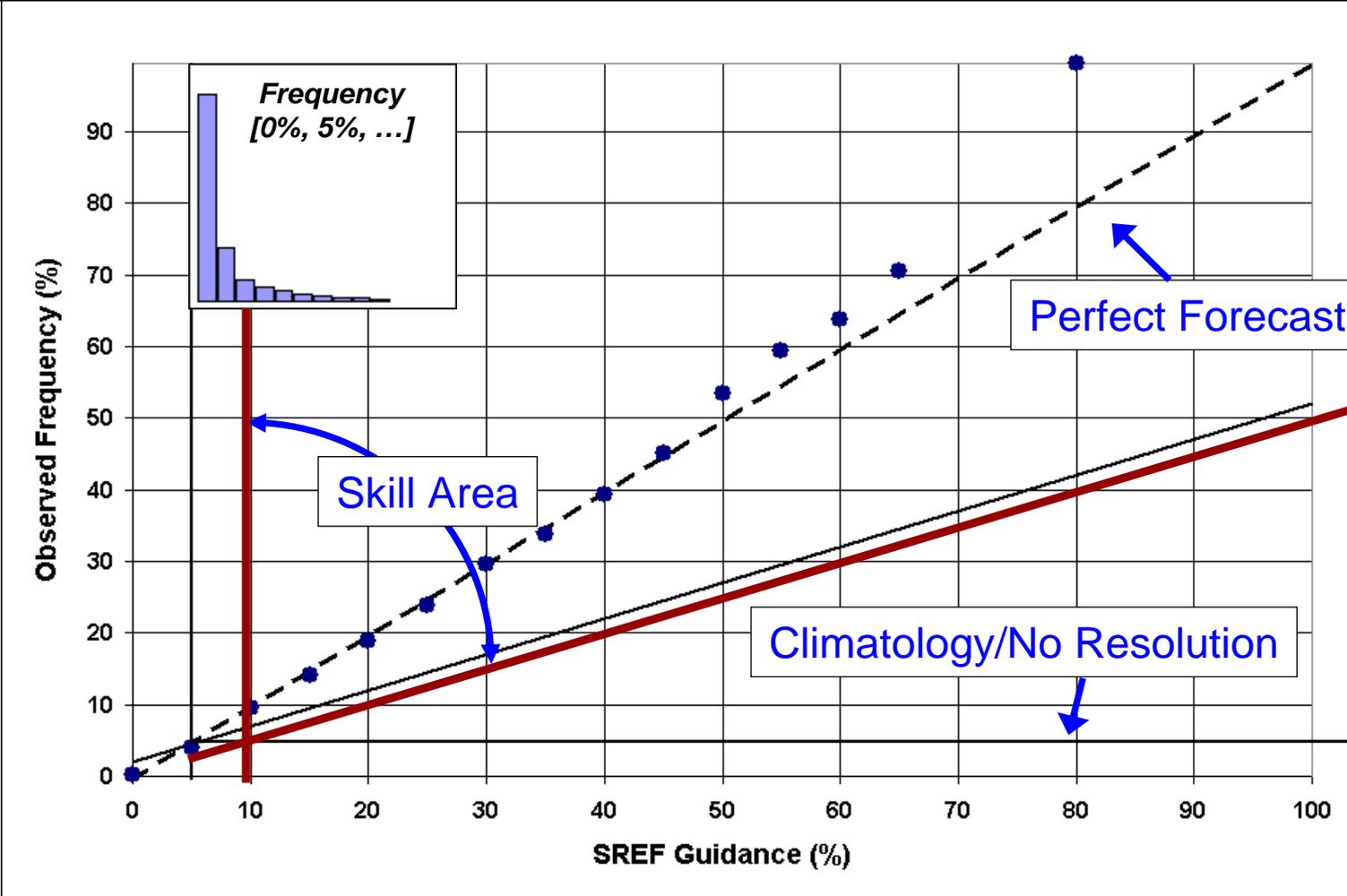


How reliable is SPC SREF Based guidance?



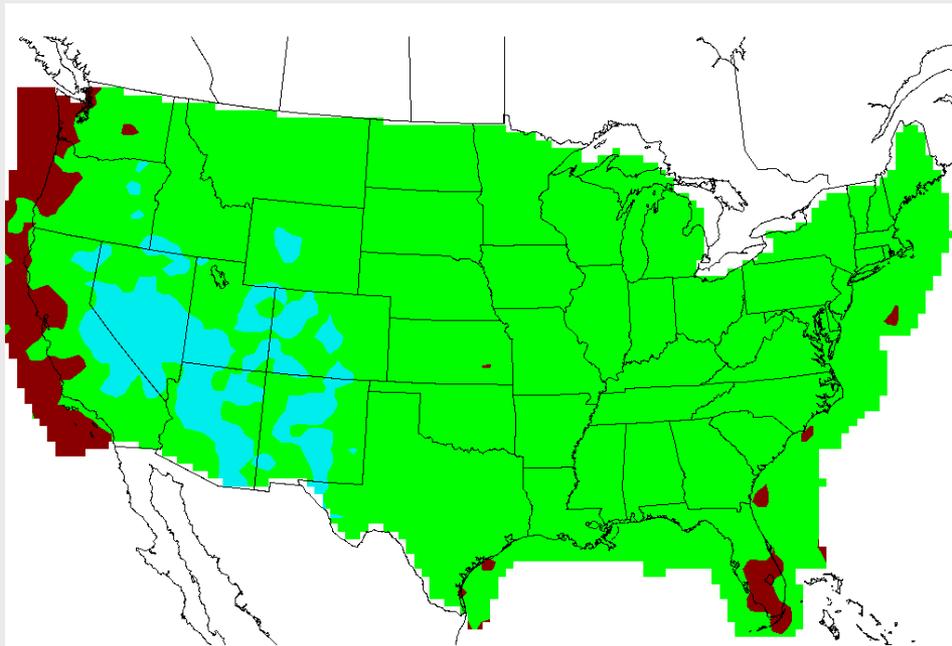
Calibrated 3-Hour SREF Thunderstorm Reliability

The 3-hour guidance is weighted spatially and matched to a one year occurrence frequency to extend to 12 hours



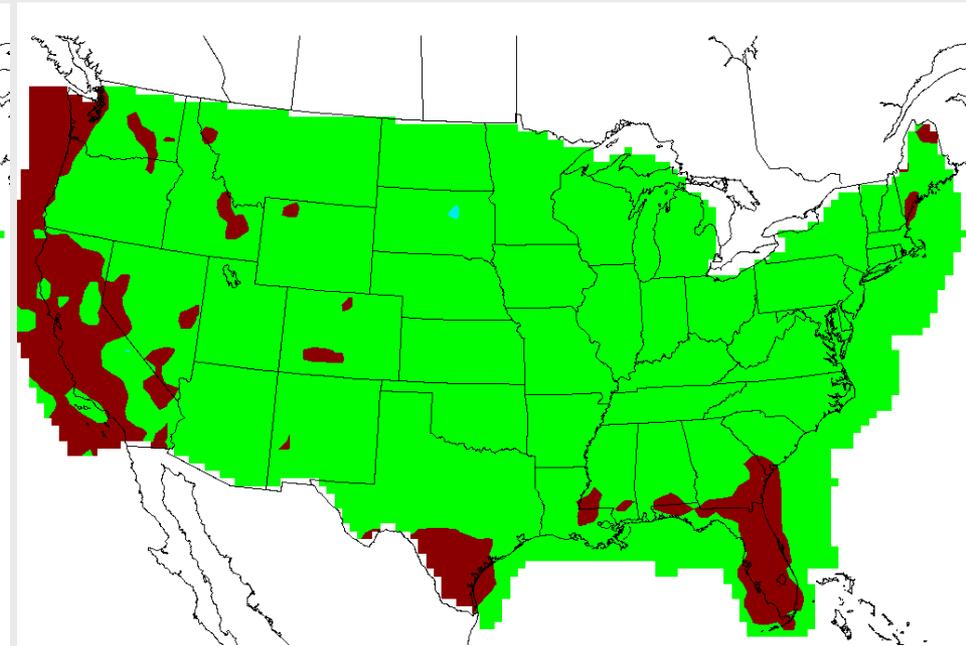
Reliability 10% (Entire Year)

09 UTC SREF Only (1630 UTC ENHT Guidance)



"Reliability (Blue: Underfcst; Green: OK; Red: Overfcst)"; "All Seasons"; "10% Fcst";

1st Period: 12-03 UTC



"Reliability (Blue: Underfcst; Green: OK; Red: Overfcst)"; "All Seasons"; "10% Fcst";

2nd Period: 03-12 UTC

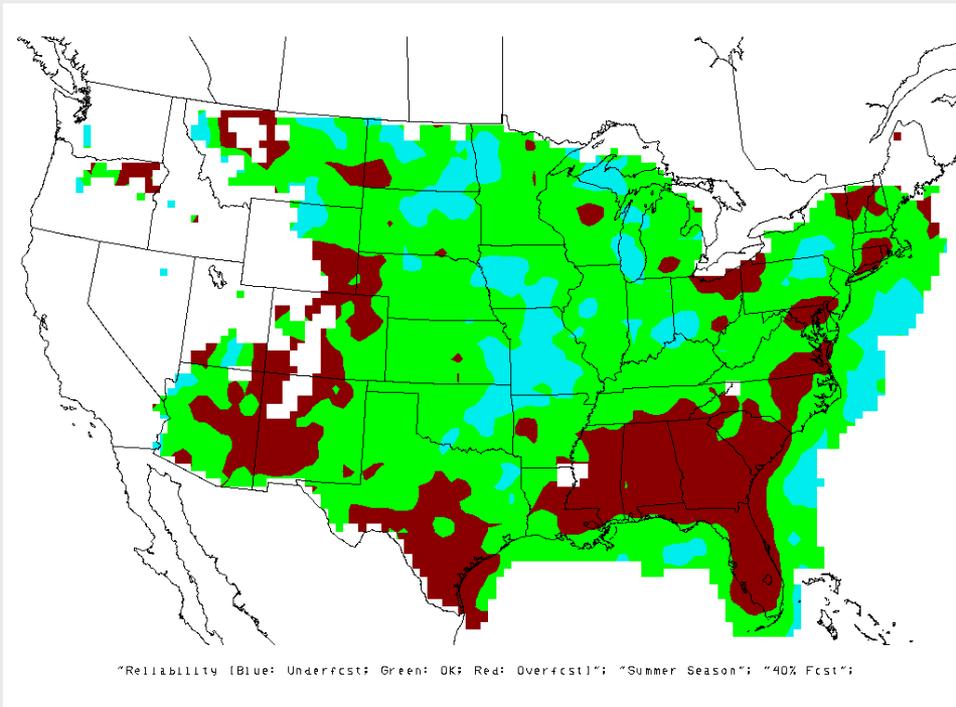
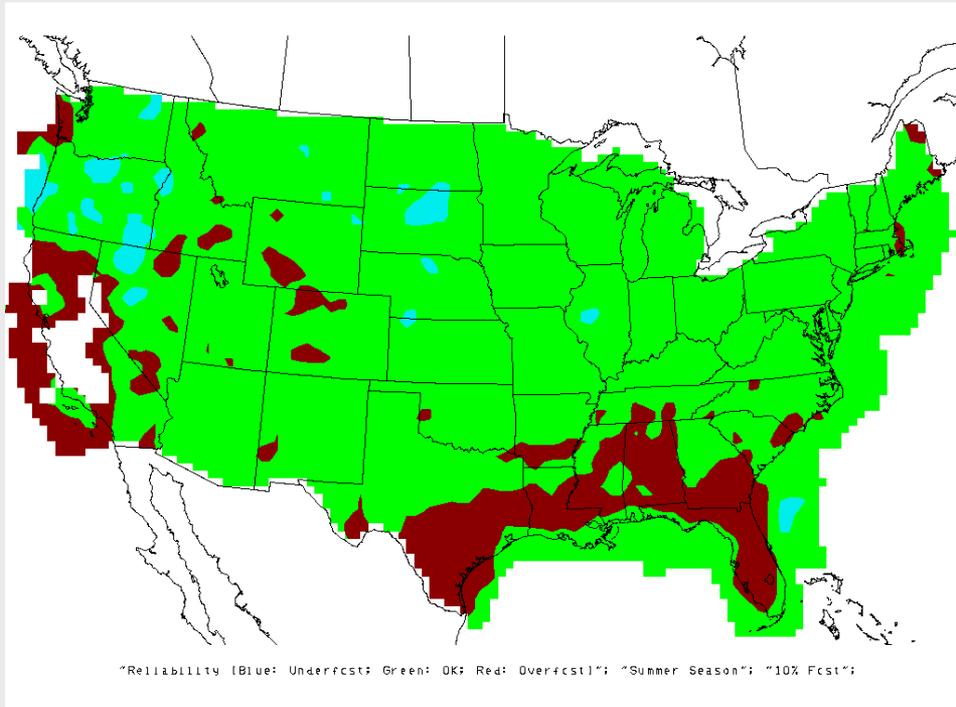
Green = Reliable
Blue = Under-forecast
Red = Over-forecast

Long-term Sample

Summer Reliability 10% and 40%

09 UTC SREF Only (1630 UTC ENHT Guidance)

June, July, August



10% Percent Reliability
2nd Period: 03-12 UTC

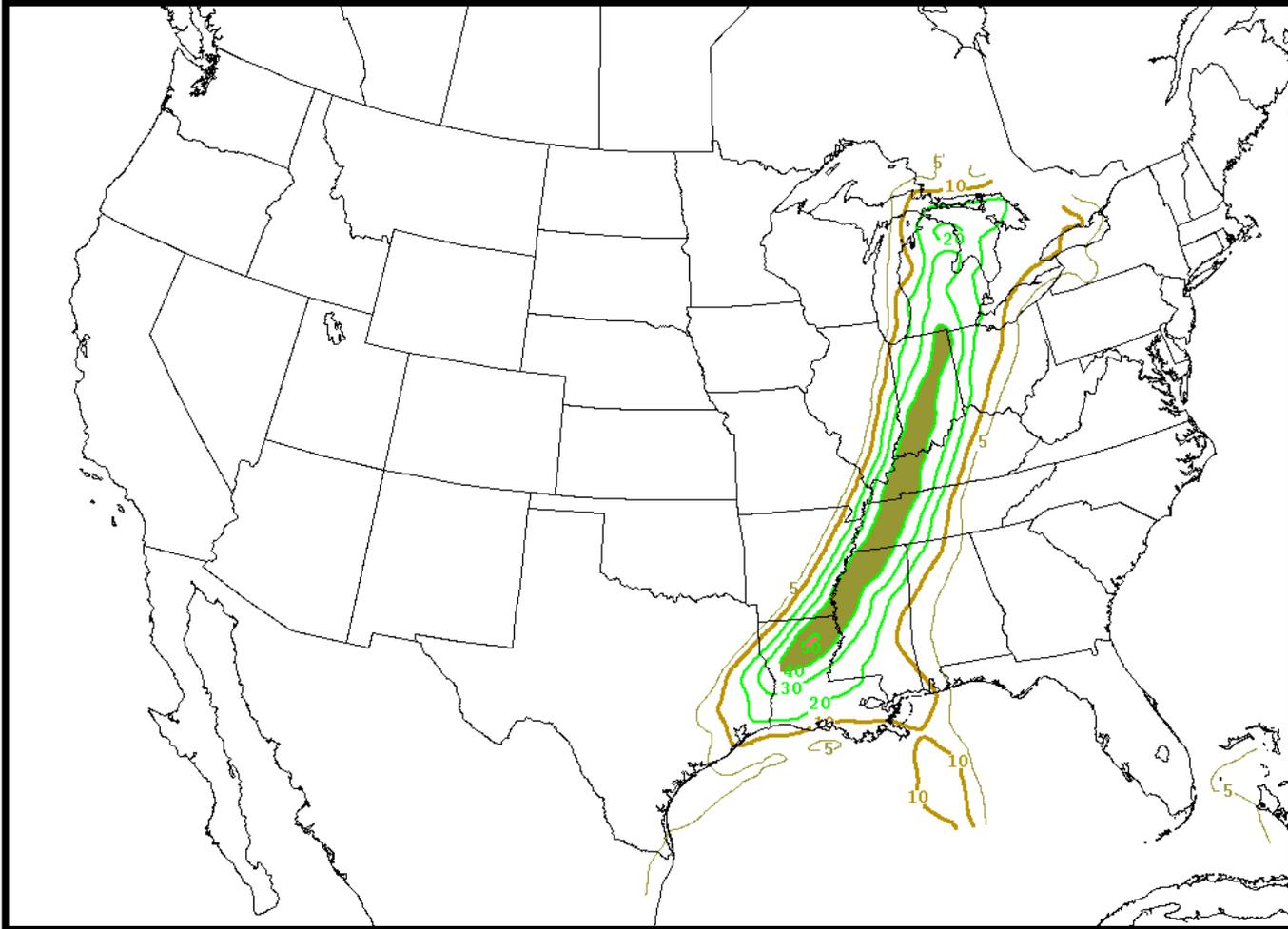
40% Percent Reliability
2nd Period: 03-12 UTC

Green = Reliable
Blue = Under-forecast
Red = Over-forecast

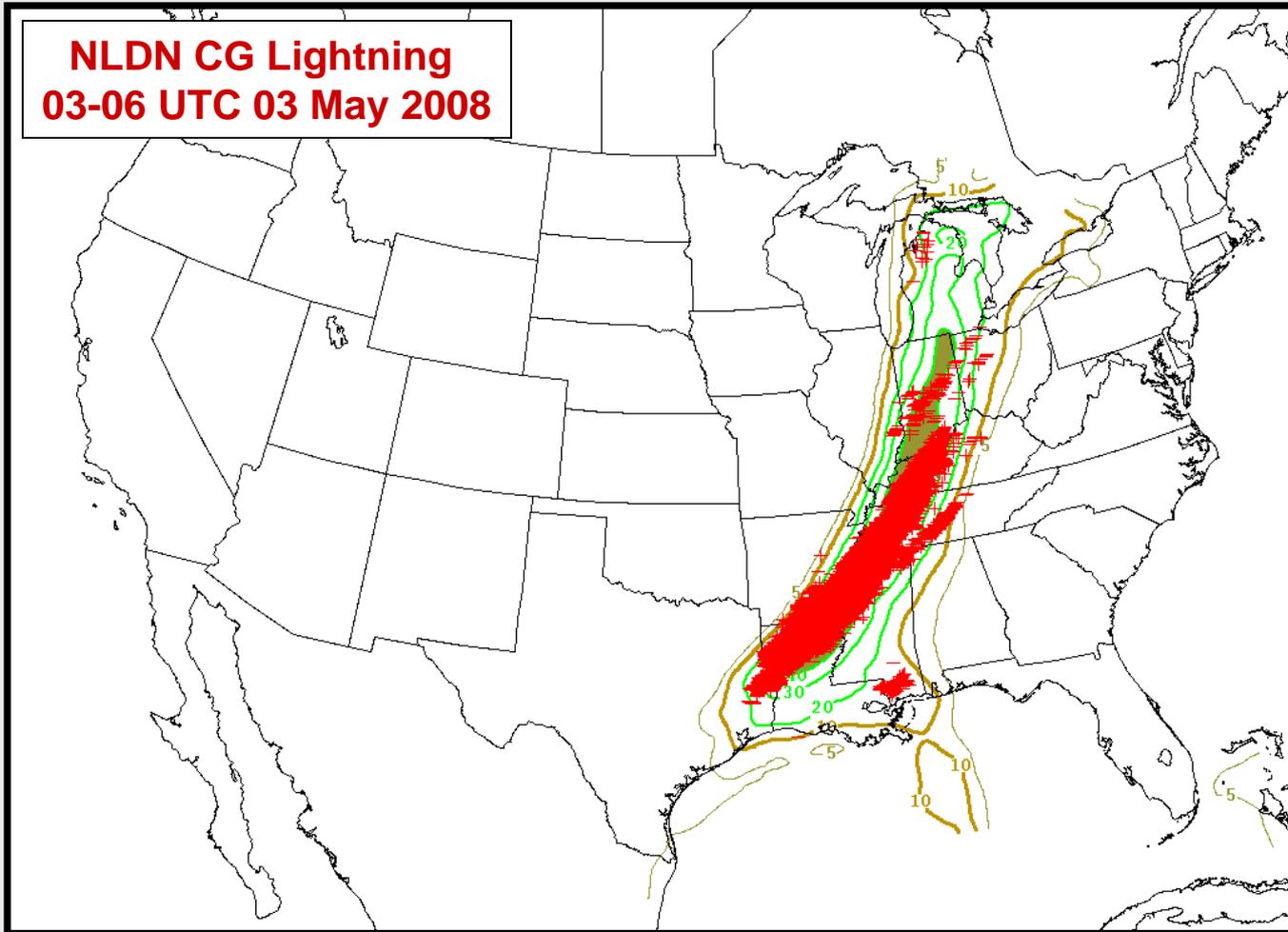
Long-term Sample

Example of 39 Hour SREF Calibrated Thunderstorm Forecast

Valid: 03-06 UTC 03 May 2008



SREF 39 Hour Thunderstorm Forecast + Actual Lightning Occurrence

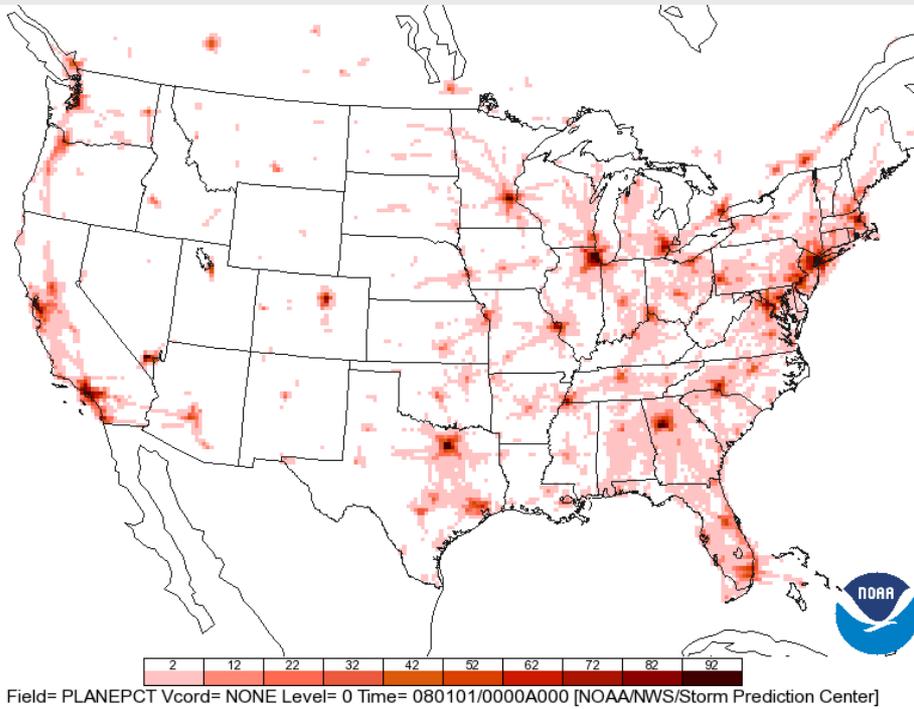


However Aviation needs even higher temporal resolution thunderstorm forecasts

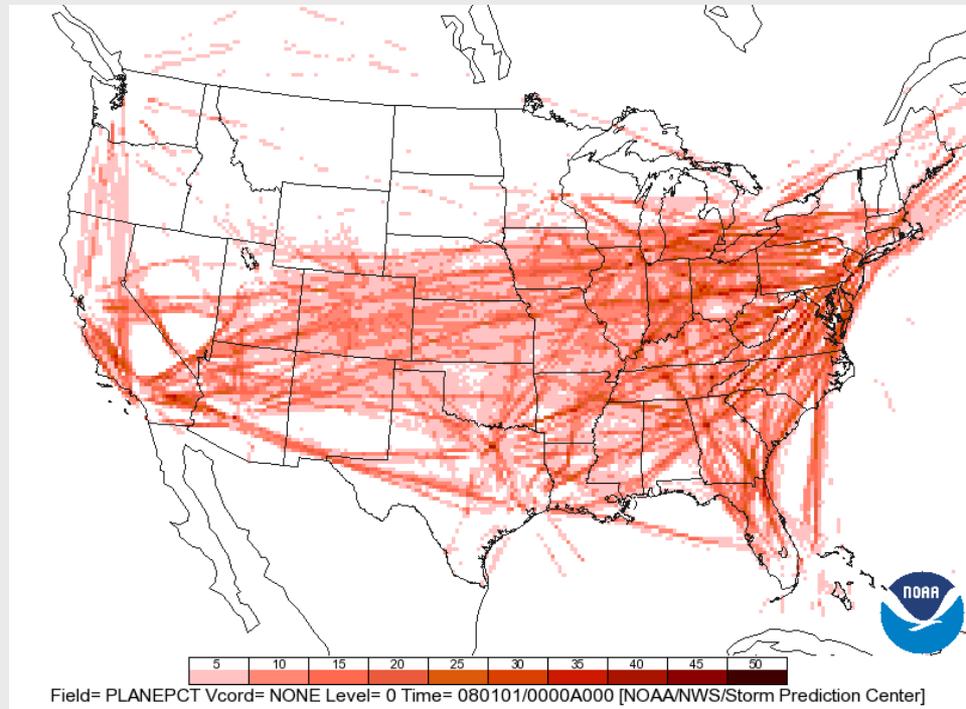


Thunder and Aviation

All 00Z Flights \leq 10,000 Feet



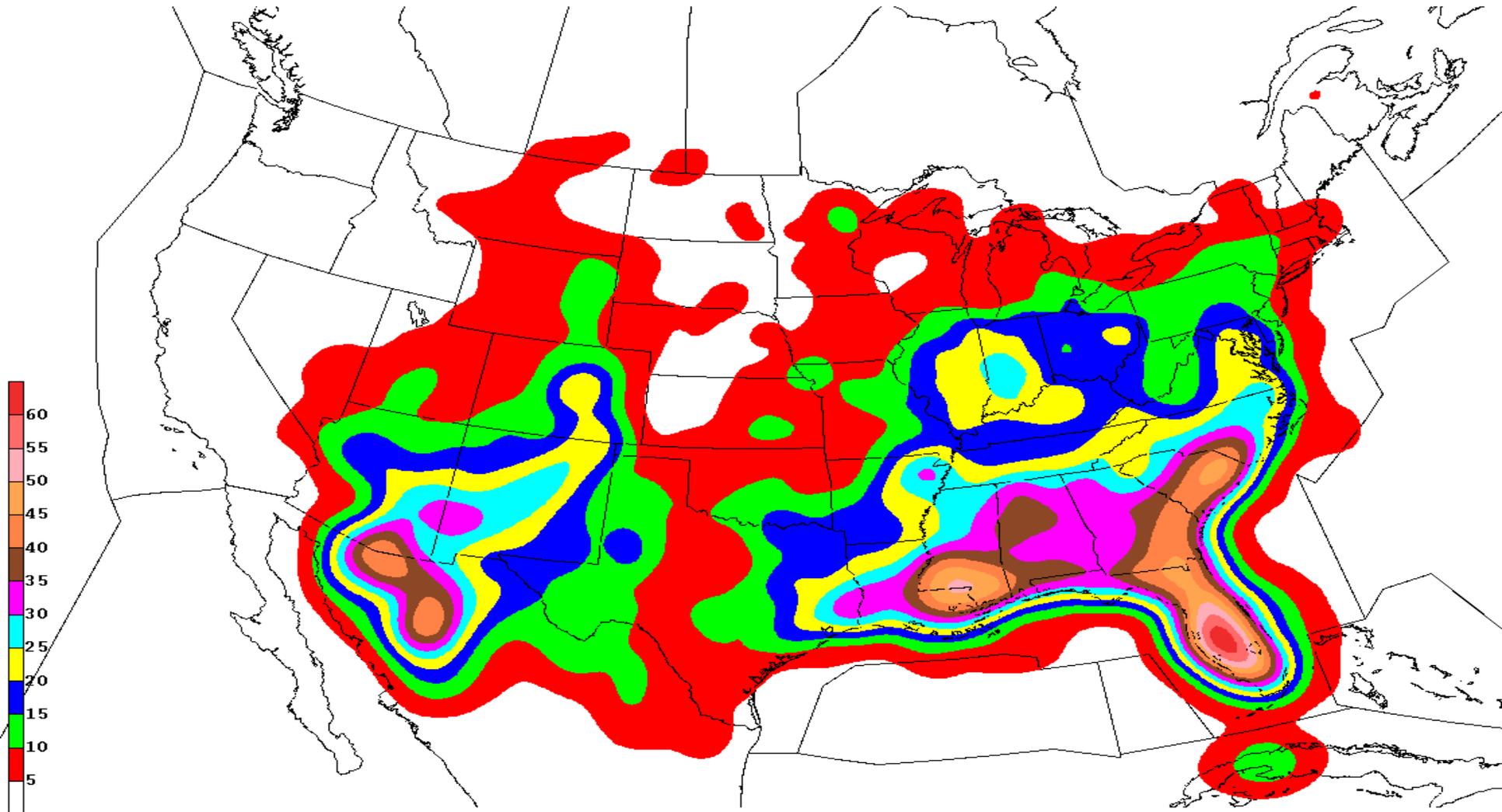
All 00Z Flights \geq 25,000 Feet



Snapshot probability of an aircraft inside the 20 km (AWIPS 215) grid box

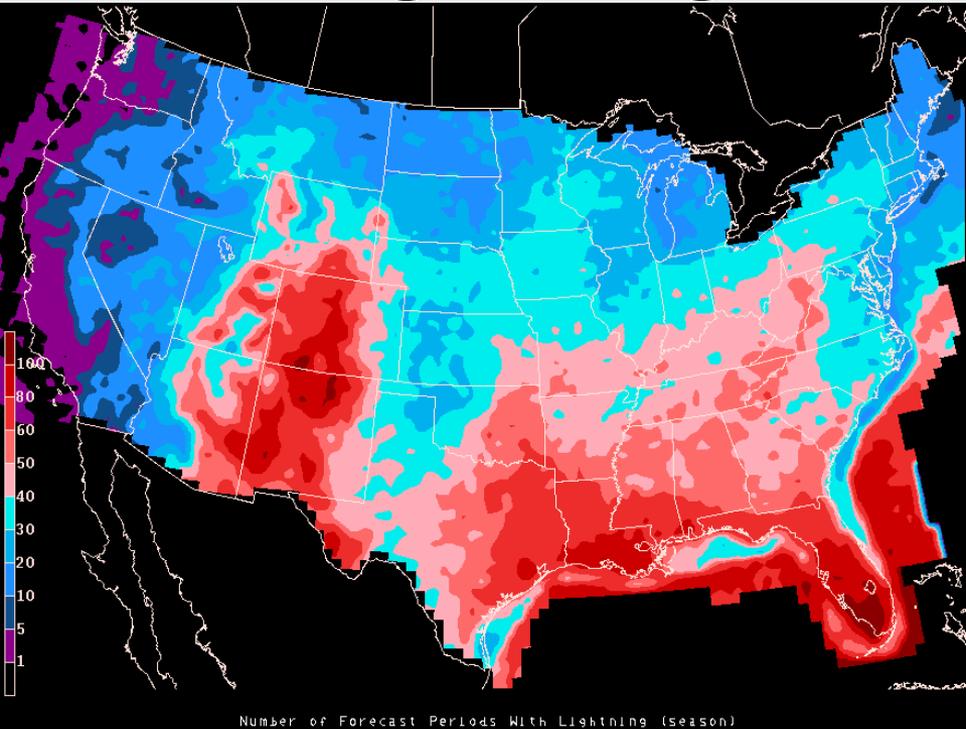
Avg Probability of 1 or more Lightning Strikes any hour of the day June 1 – Aug 31

(Note relatively low values in Northeast Corridor)



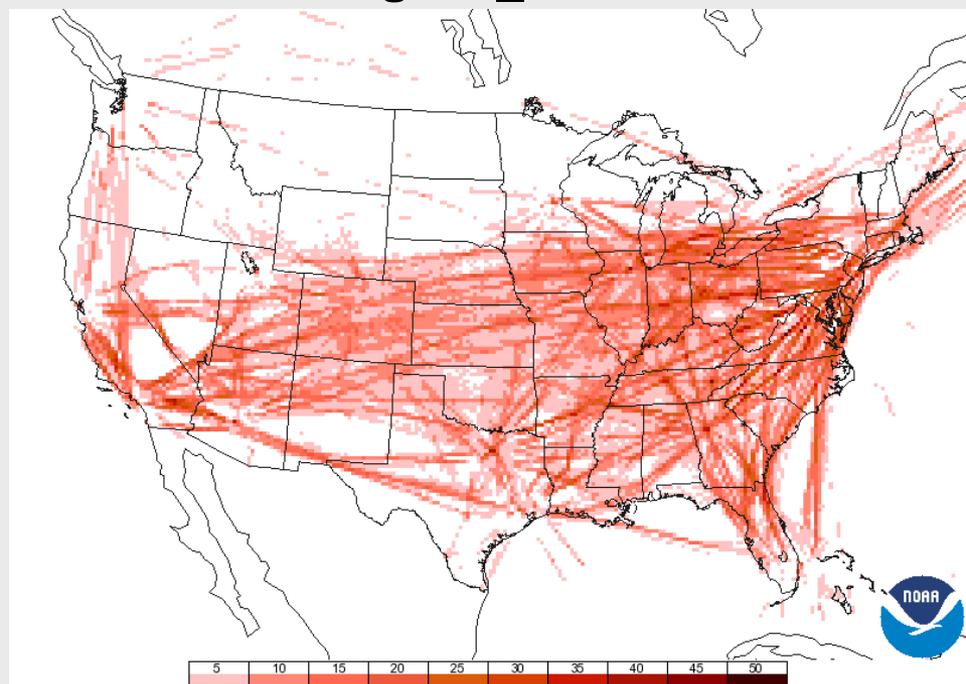
MAX number of flashes (21-00UTC) June 1 to August 31

Number of Days in 2008 with Lightning between 12-03 UTC



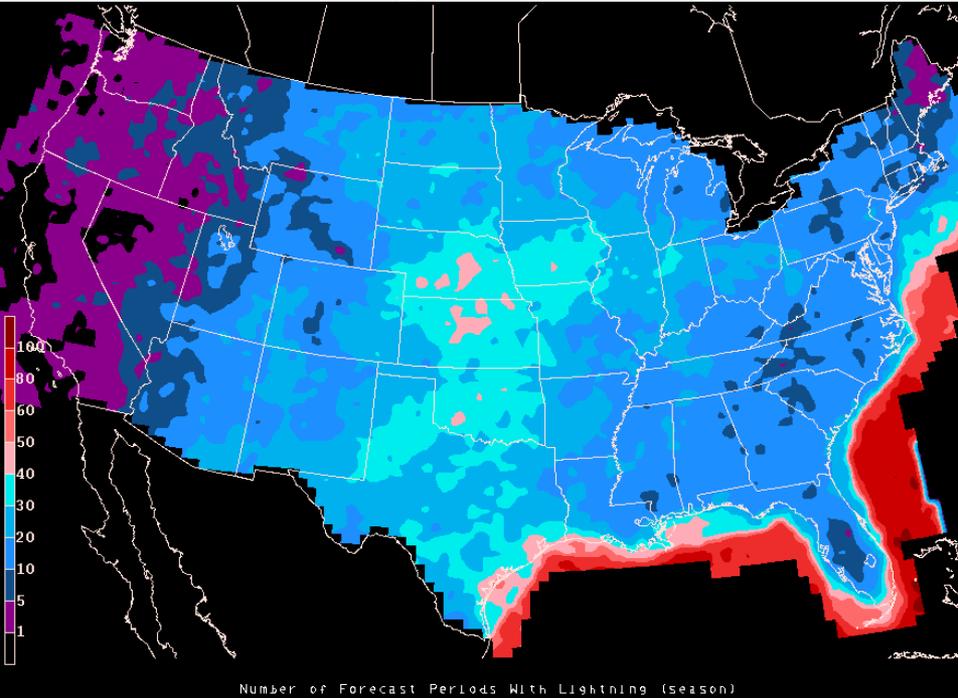
Number of Forecast Periods With Lightning (season)

All 00Z Flights \geq 25,000 Feet



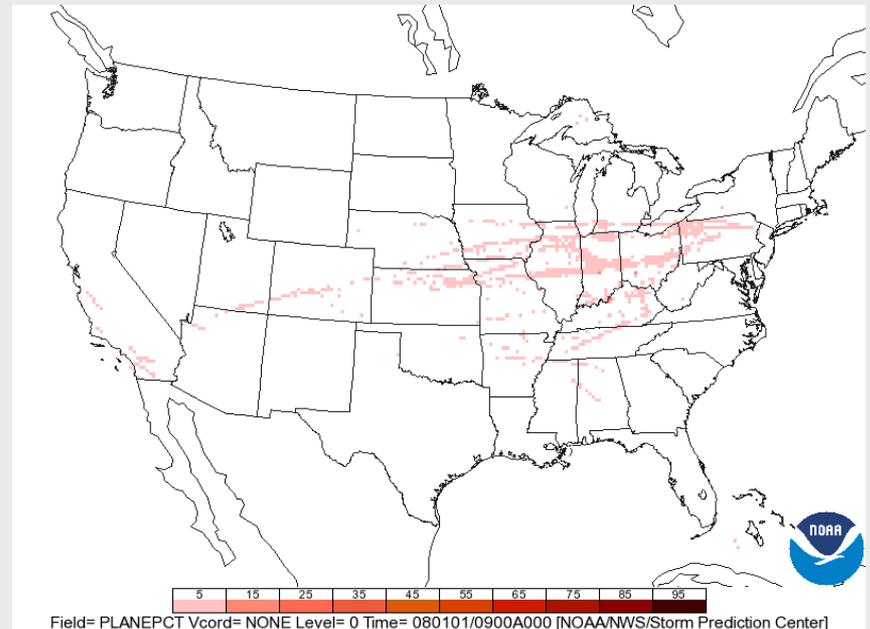


Number of Days in 2008 with Lightning between 03-12 UTC



Number of Forecast Periods With Lightning (Season)

All 09Z Flights \geq 25,000 Feet



Field= PLANEPT Vcord= NONE Level= 0 Time= 080101/0900A000 [NOAA/NWS/Storm Prediction Center]



Improved SPC Temporal Thunderstorm Forecasts Starting Late Spring 2009

Issue Time (UTC)	Valid Period (UTC)	Valid Period (UTC)	Valid Period (UTC)	Valid Period (UTC)
0600	1600-2000	2000-0000	0000-0400	---
1300	1600-2000	2000-0000	0000-0400	---
1630	---	2000-0000	0000-0400	0400-1200
2000	---	---	0000-0400	0400-1200
0100	---	---	---	0400-1200

← 4-hr Forecasts | 8-hr Outlook



Forecaster-in-the-Loop Concept

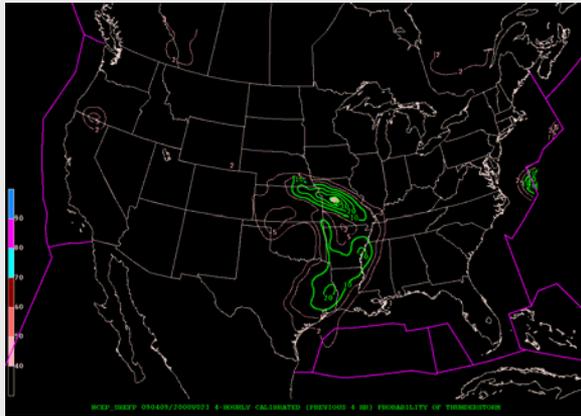
- **SREF model outputs four-hourly forecasts of thunder at 10%, 40%, and 70% intervals provide “first-guess”**
- **SPC forecasters make adjustments, as needed, based on model trends, observations, experience, etc.**
- **Combining reliable SREF model output with expert forecaster input yields a more accurate forecast product**

Start with Hourly SREF Output

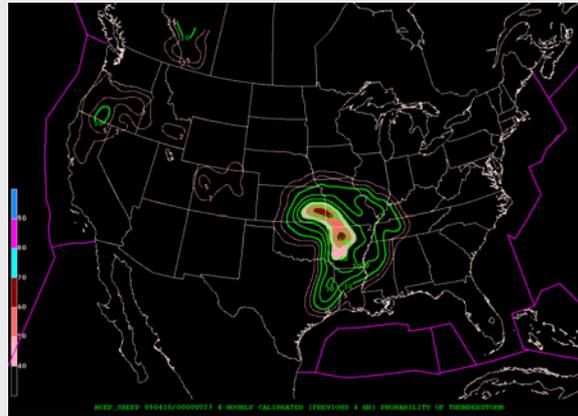
SREF is run every 3 hours (00UTC, 03UTC, 06UTC,...)
Output Available to forecasters ~ 5 hours after nominal run time

e.g. the 0600 UTC forecast is based on 21UTC Model Run

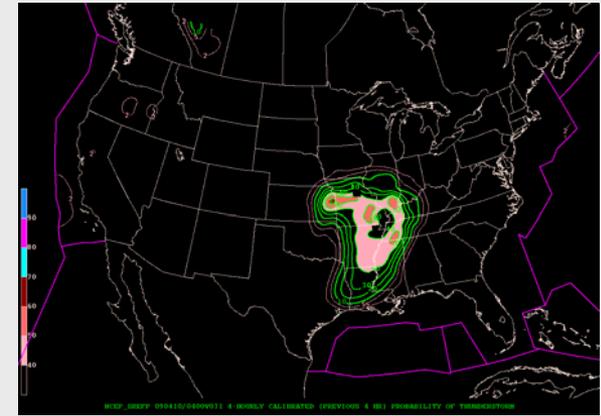
2100UTC 8 April 2009 (used for 0600 UTC Forecast)



Valid 16Z-20Z



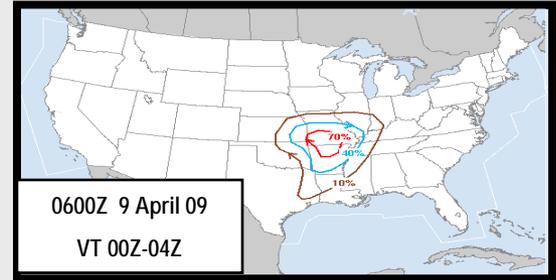
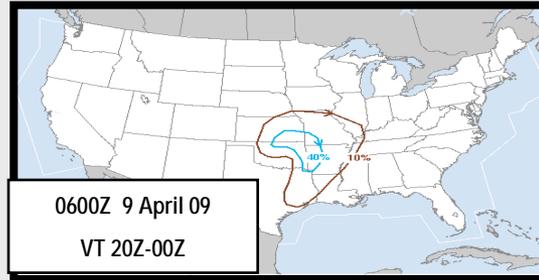
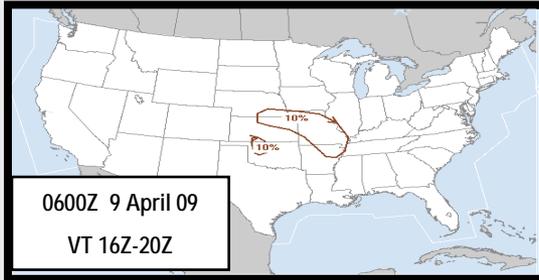
Valid 20Z-00Z



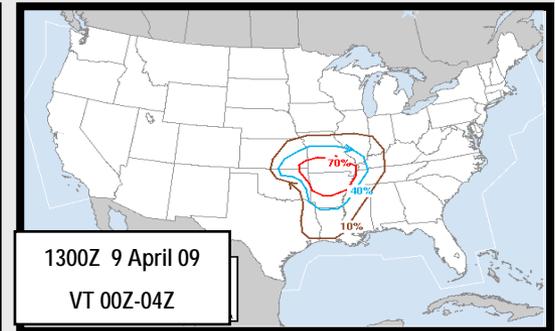
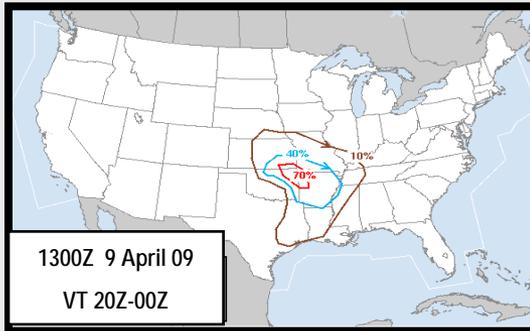
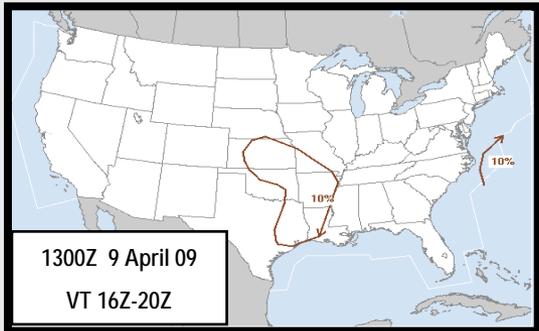
Valid 00Z-04Z

Then Forecasters Make Needed Adjustments

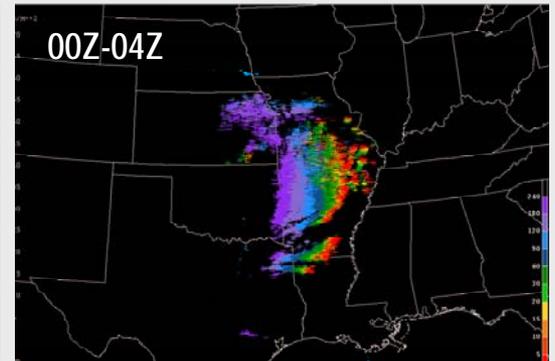
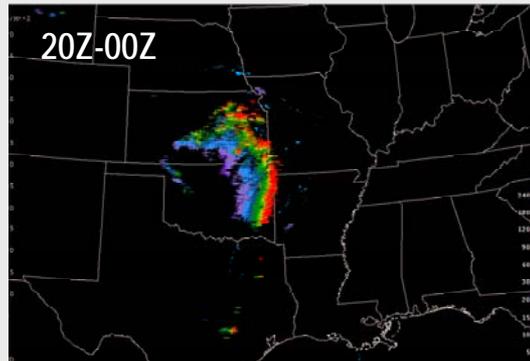
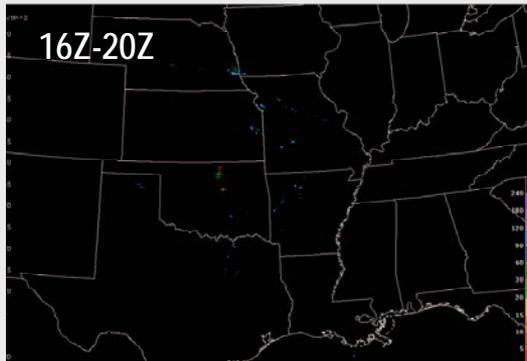
0600UTC 9 April 2009



1300UTC 9 April 2009



Observed Cloud-to-Ground Lightning





Implementation Plans

- ✓ **Two period Enhanced Thunder Forecasts ended Feb 27th, 2009**
- ✓ **Internal testing of 4 and 8 hour period thunder forecast began - March 11th
provided to AWC for feedback - April 7th**
- **Forecasts to be available on the SPC web page (spc.noaa.gov) for all interested NWS partners ~ May 5th, 2009**



Summary of New Enhanced Thunder Product

- Available on SPC web page around May 5th
- 16-04 UTC Forecasts are for 4 hour time windows
- 04-12 UTC Forecasts are an 8 hour time window
- Issued 5 times daily
- Another guidance tool for AWC collaborated CCFP product and for use by other NWS partners



www.spc.noaa.gov