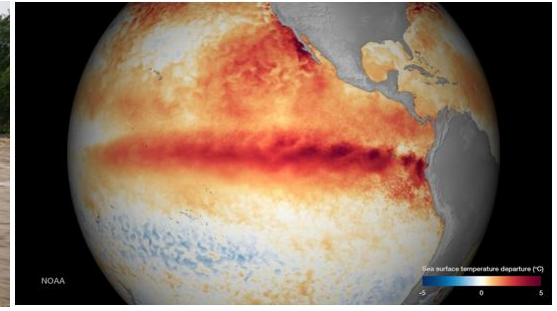


Meteorological Memories of 2015



Greg Carbin

NOAA/NWS Storm Prediction Center



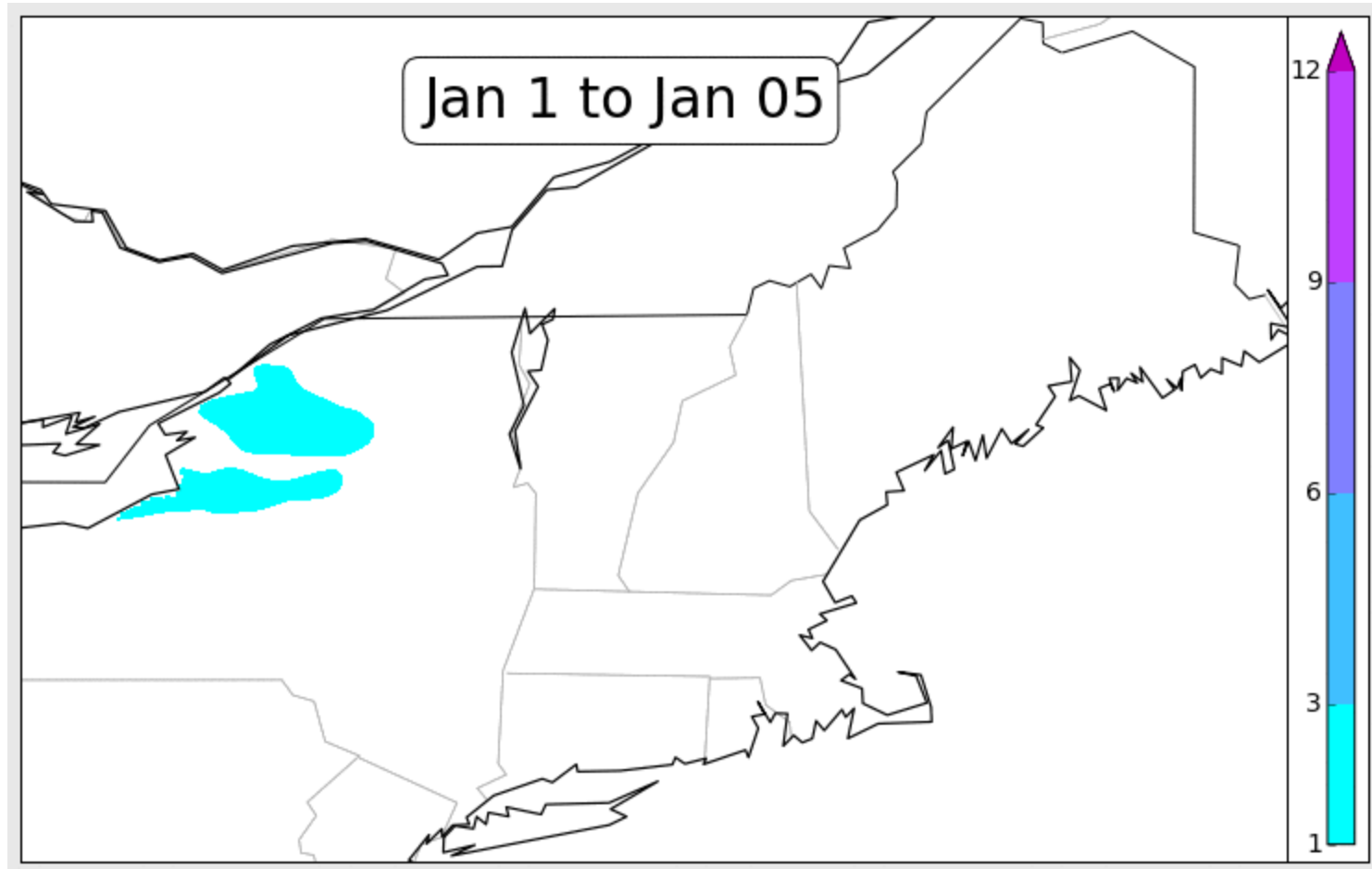
#1

Boston Snowfall Records Buried

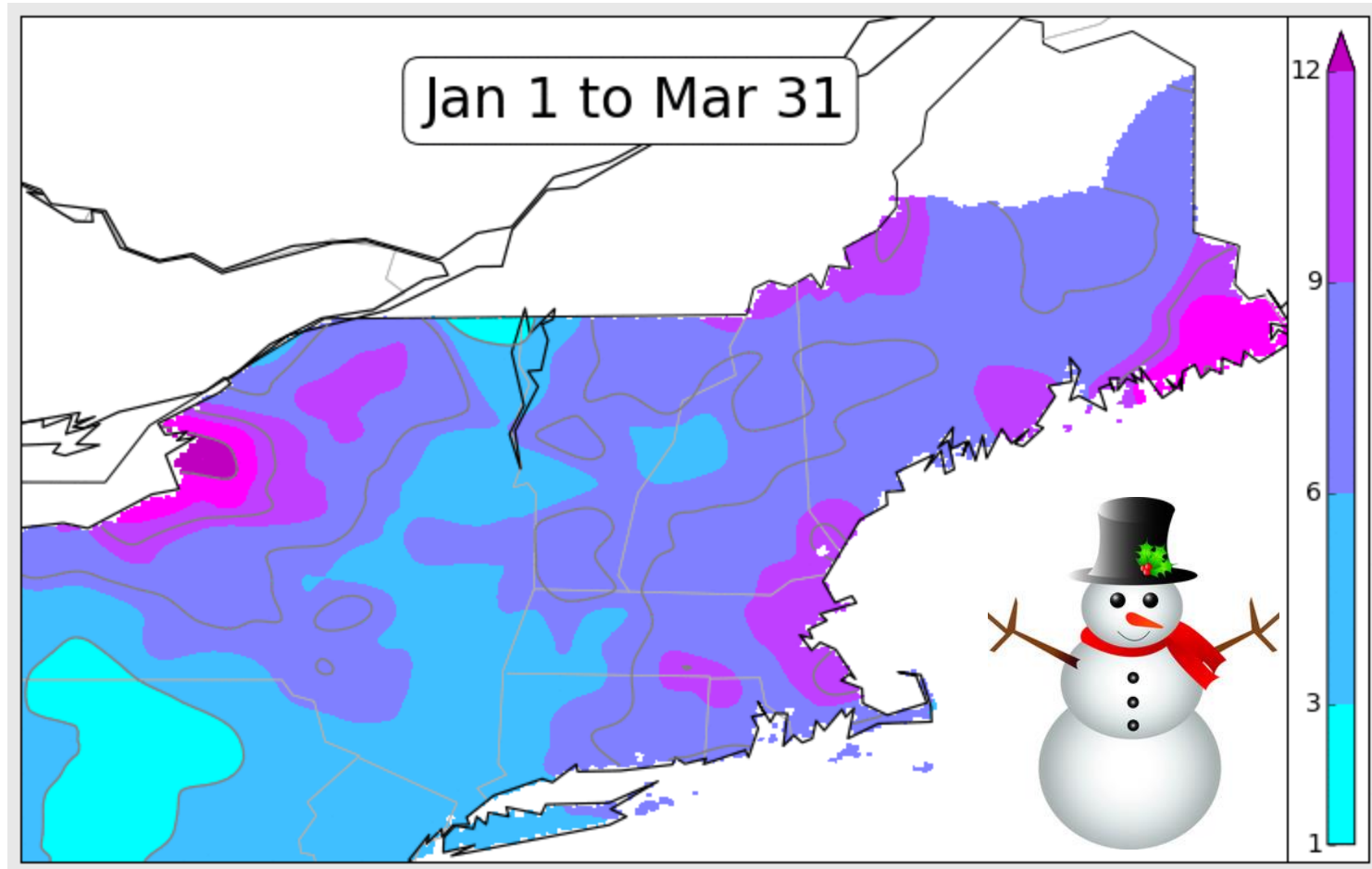


Stan Grossfeld/Boston Globe

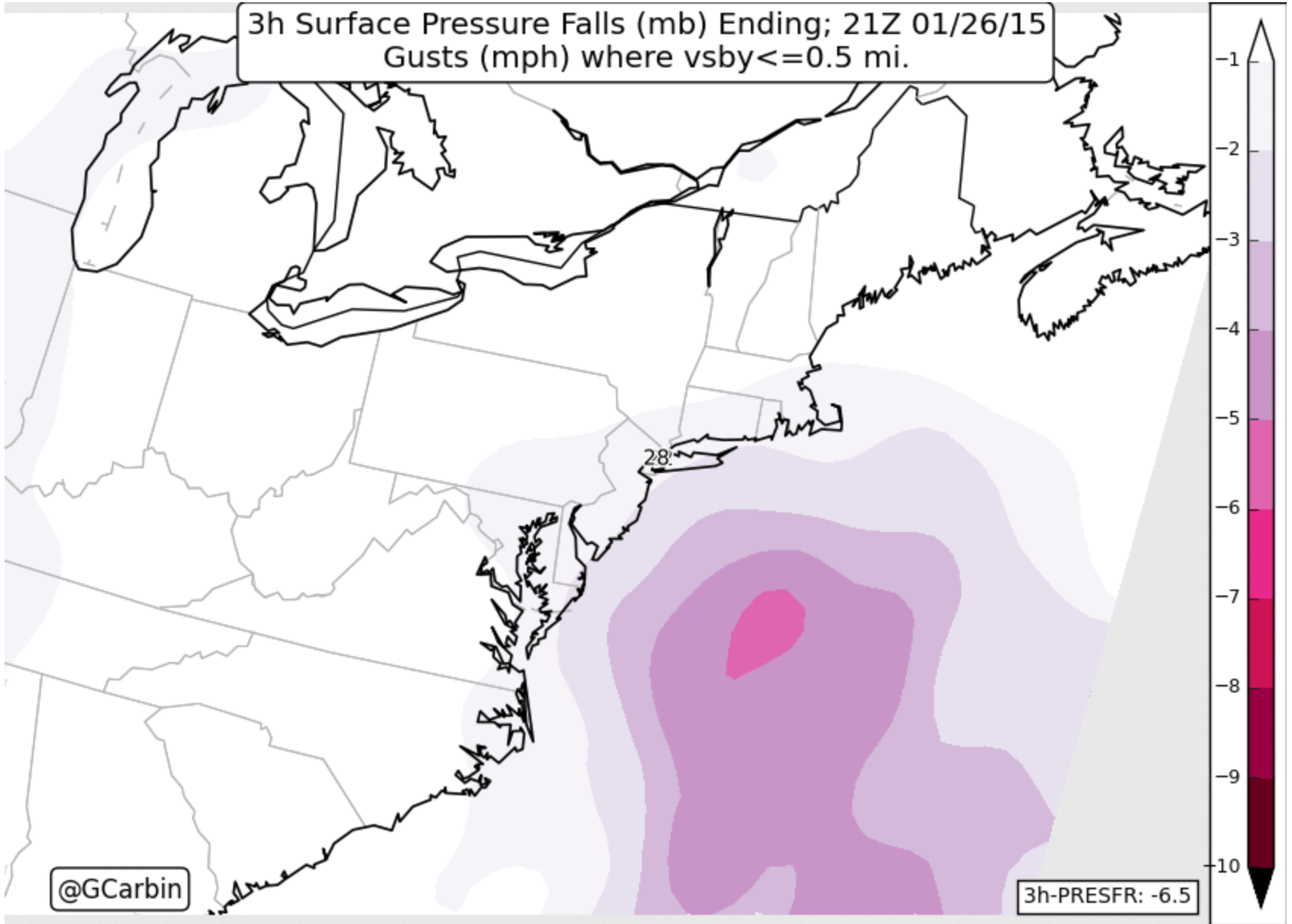
January 1 through March 31, 2015 Total Snow in Feet



January 1 through March 31, 2015 Total Snow in Feet



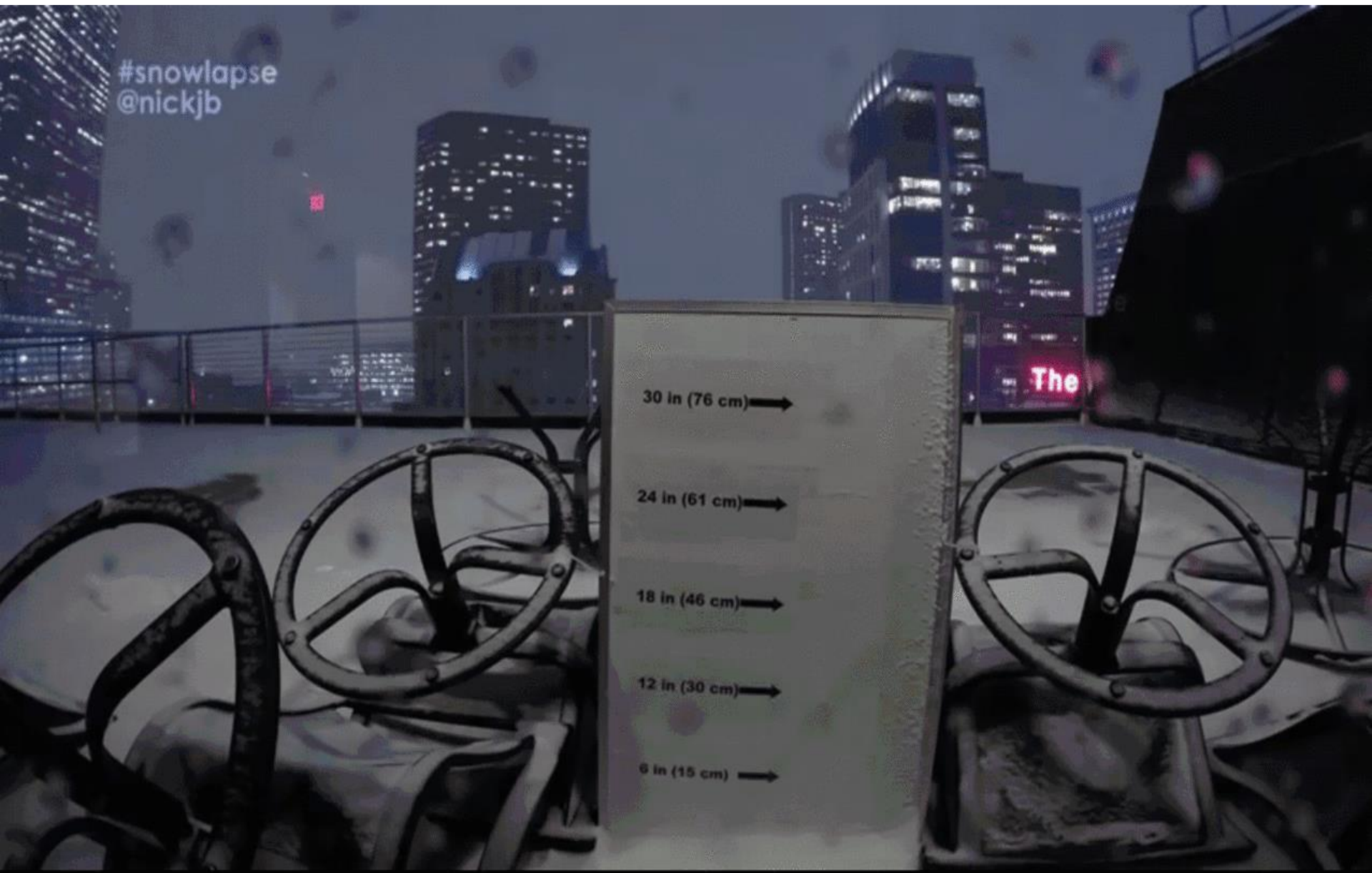
3h Surface Pressure Falls (mb) Ending; 21Z 01/26/15
Gusts (mph) where vsby \leq 0.5 mi.



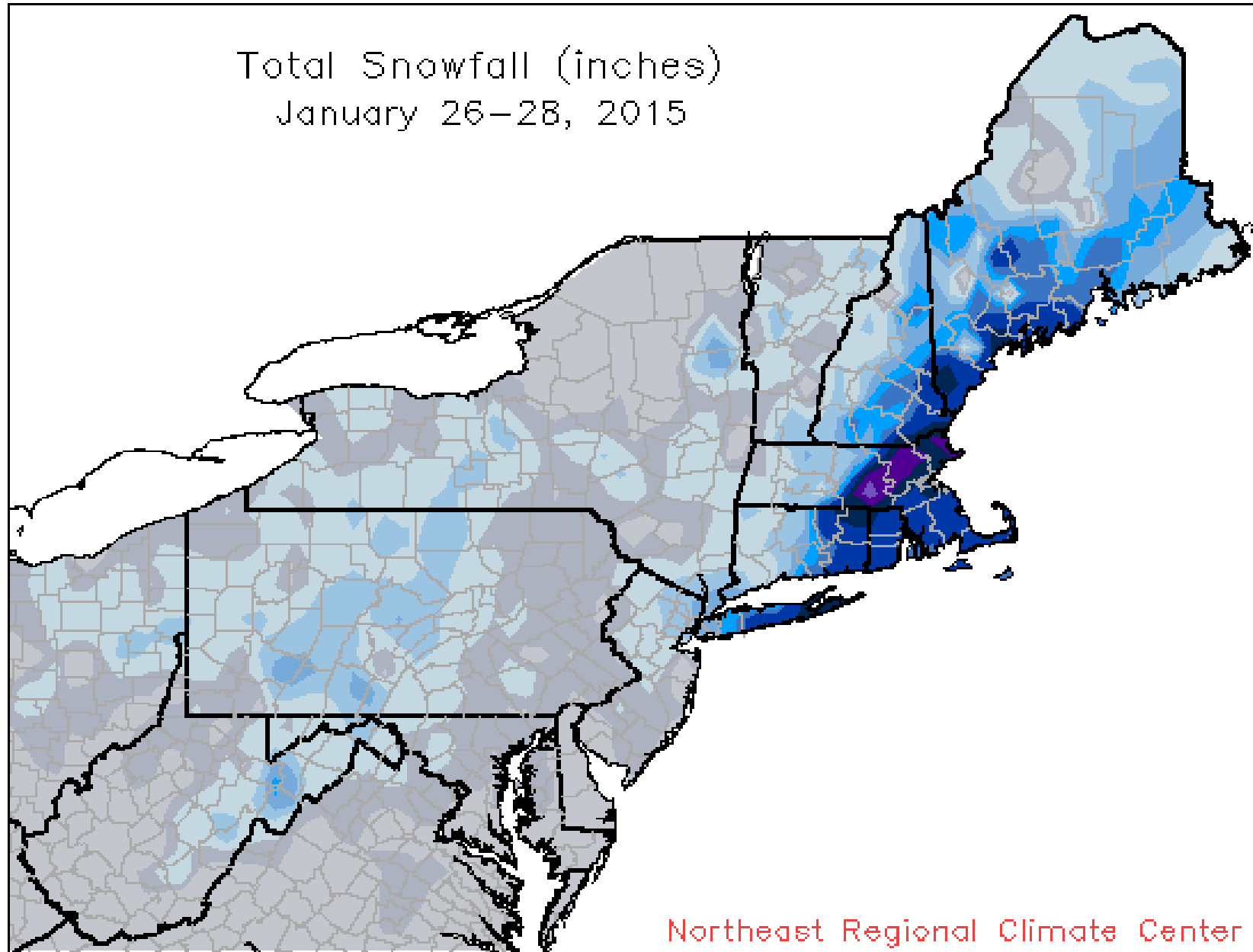
@GCarbin

3h-PRESFR: -6.5

From Nick Barber Snowlapse Video January 26-28, 2015



Total Snowfall (inches)
January 26-28, 2015





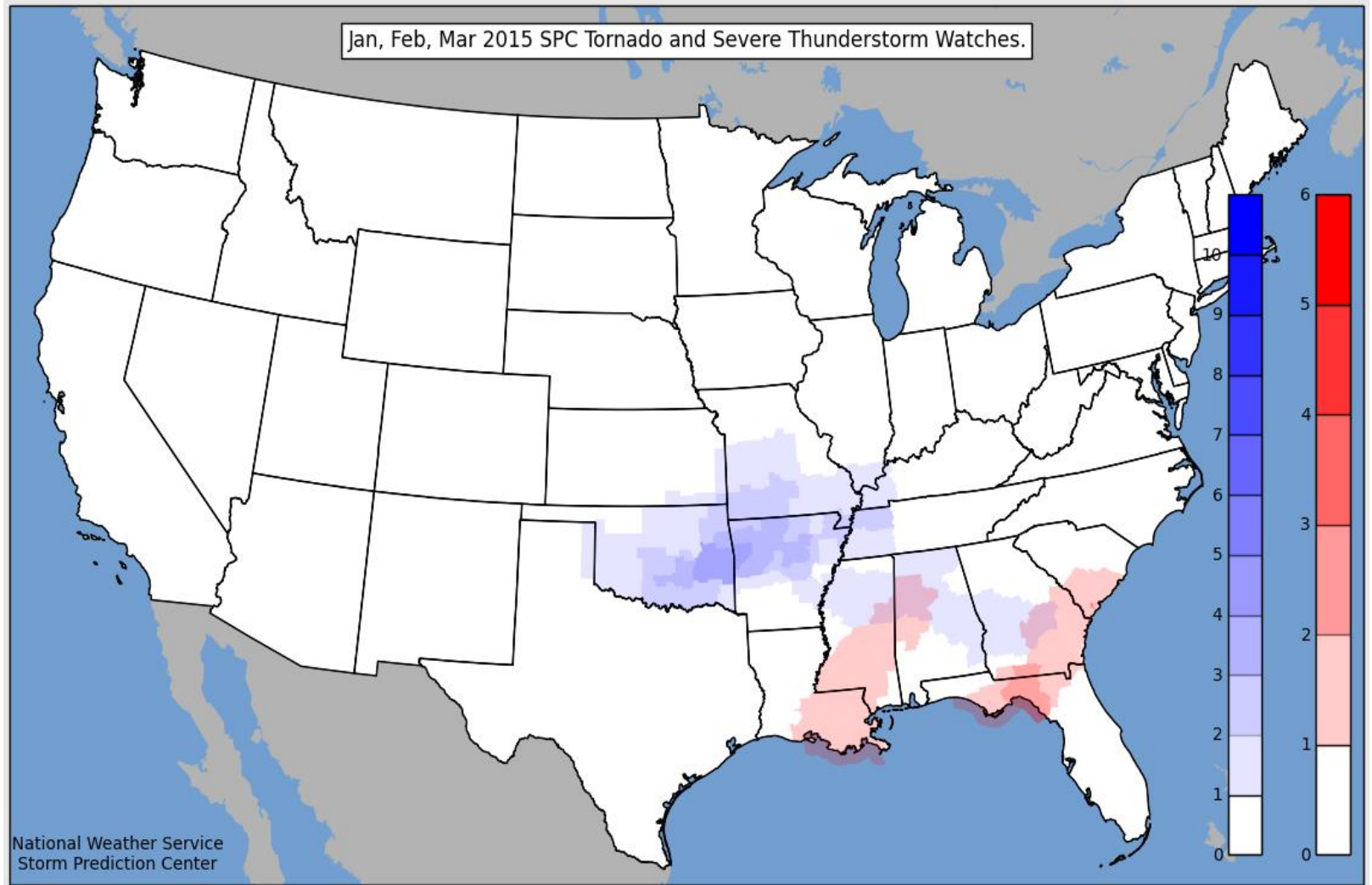
#1

Boston Snowfall Records Buried

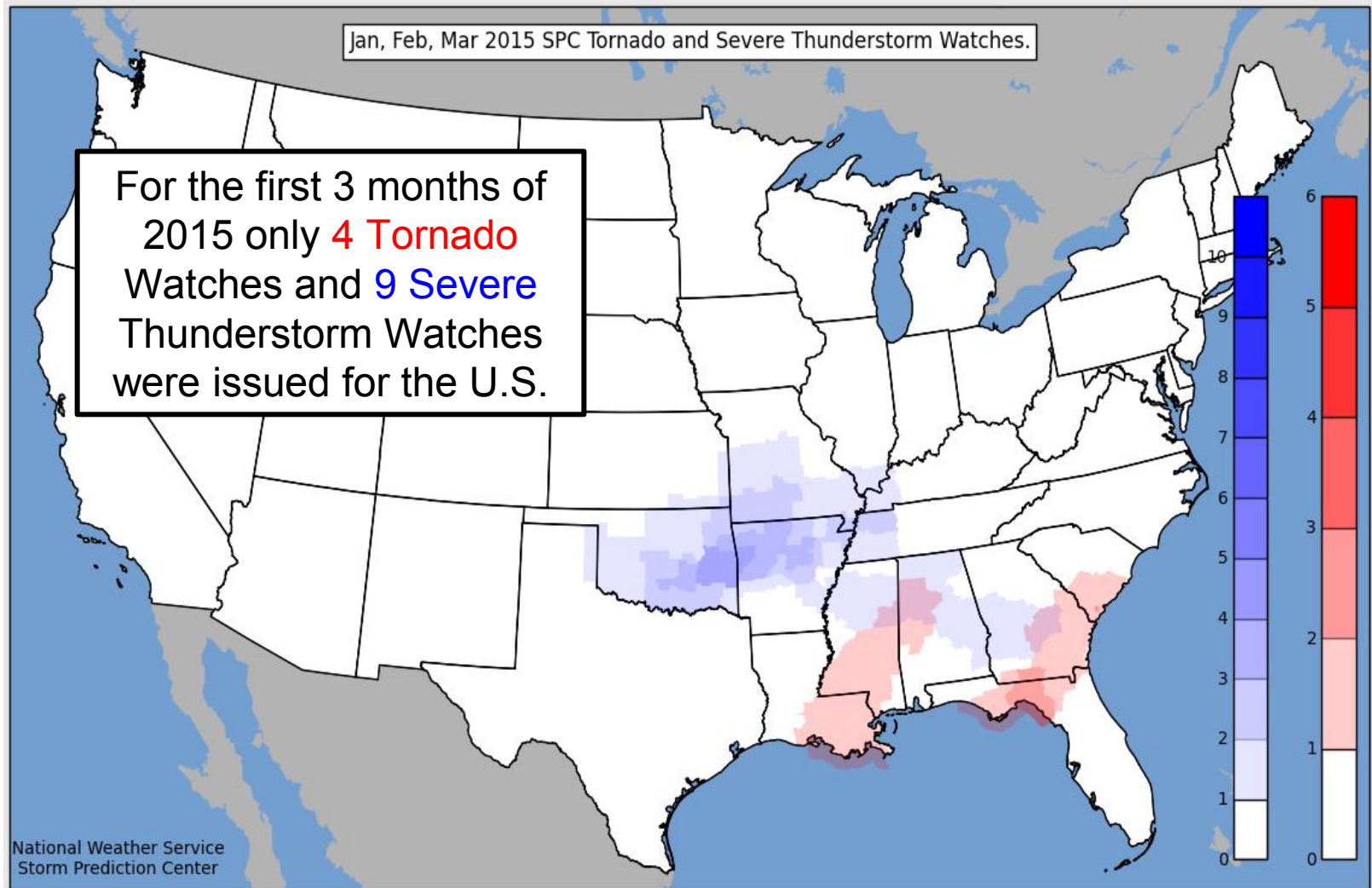
- **Wicked Cold! (<40F for Record 43 Days)**
- **Snowiest Winter for Boston (110.6")**
- **Snowiest February in Boston (64.8")**
- **Most Consecutive Days with Snowfall (16)**

#2

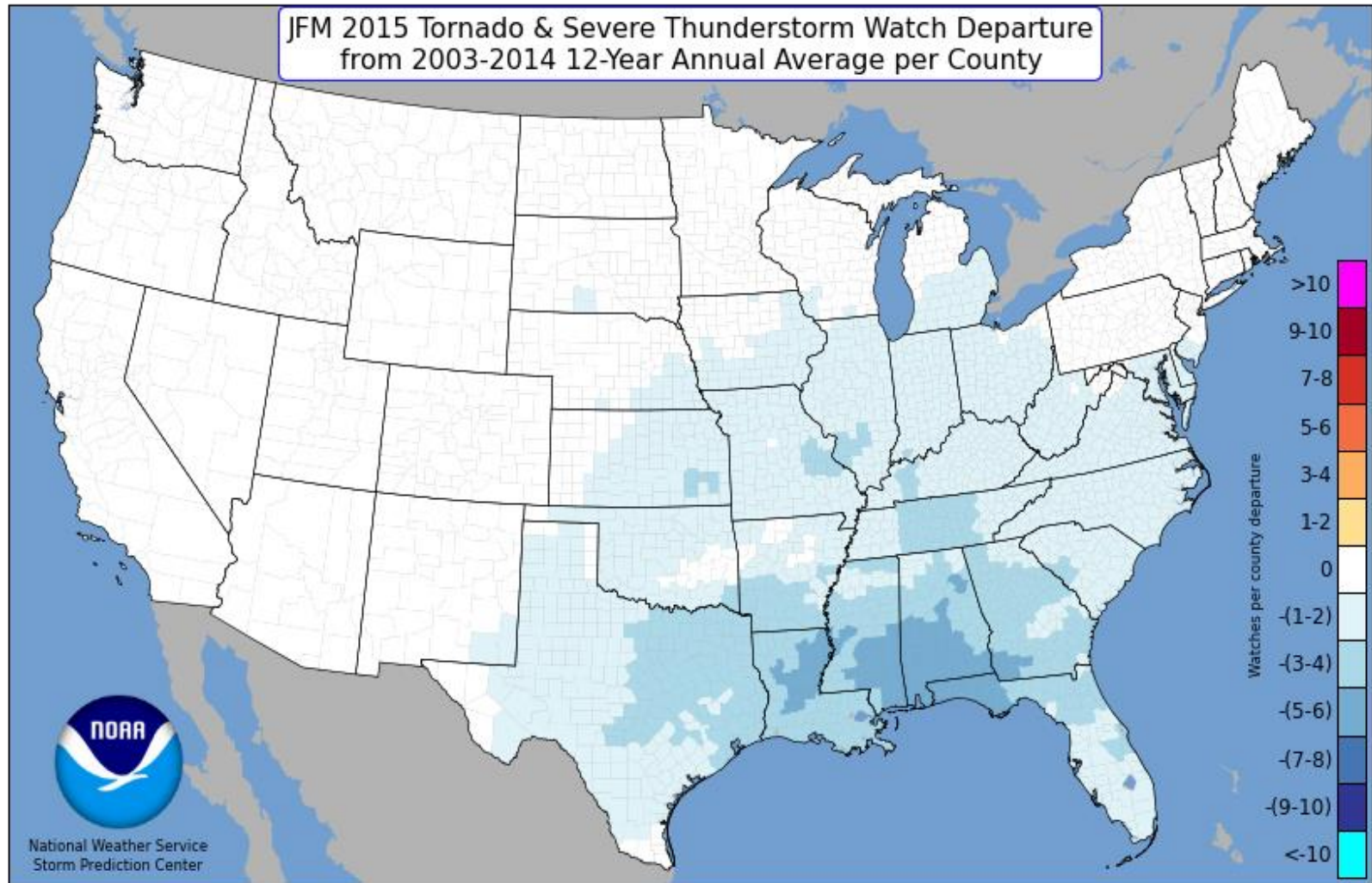
A Nearly Watchless Winter



January, February, March 2015



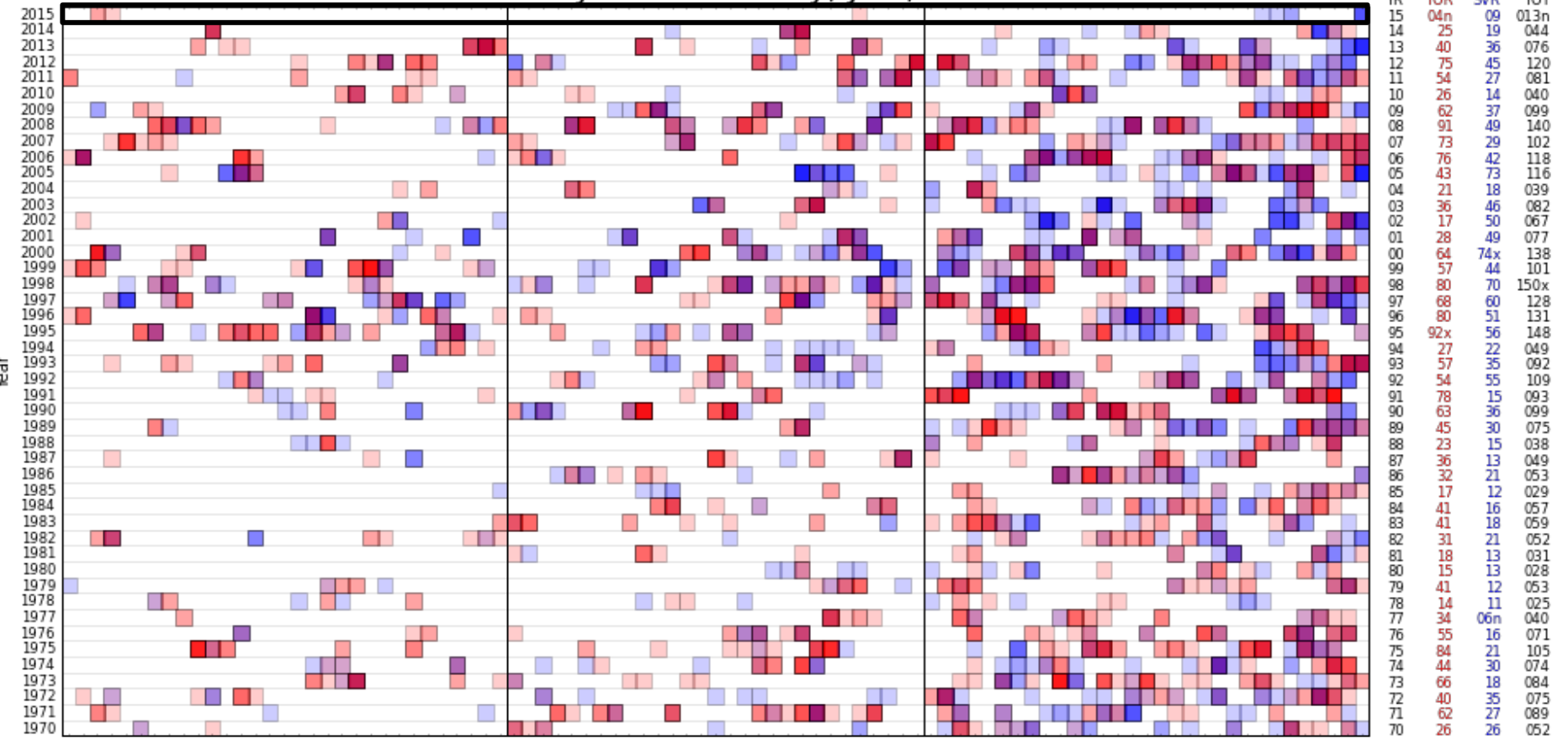
Departure from 12-year Average Watches per County



JFM 2015 Slowest Start of Any Year 1970-2015

SPC Watches by Calendar Day, JFM, 1970-2015

■ Tornado WW per day
■ Severe WW per day



YR	TOR	SVR	TOT
15	04n	09	013n
14	25	19	044
13	40	36	076
12	75	45	120
11	54	27	081
10	26	14	040
09	62	37	099
08	91	49	140
07	73	29	102
06	76	42	118
05	43	73	116
04	21	18	039
03	36	46	082
02	17	50	067
01	28	49	077
00	64	74x	138
99	57	44	101
98	80	70	150x
97	68	60	128
96	80	51	131
95	92x	56	148
94	27	22	049
93	57	35	092
92	54	55	109
91	78	15	093
90	63	36	099
89	45	30	075
88	23	15	038
87	36	13	049
86	32	21	053
85	17	12	029
84	41	16	057
83	41	18	059
82	31	21	052
81	18	13	031
80	15	13	028
79	41	12	053
78	14	11	025
77	34	06n	040
76	55	16	071
75	84	21	105
74	44	30	074
73	66	18	084
72	40	35	075
71	62	27	089
70	26	26	052

n=min, x=max

G. Carbin, NWS/SPC

January

February

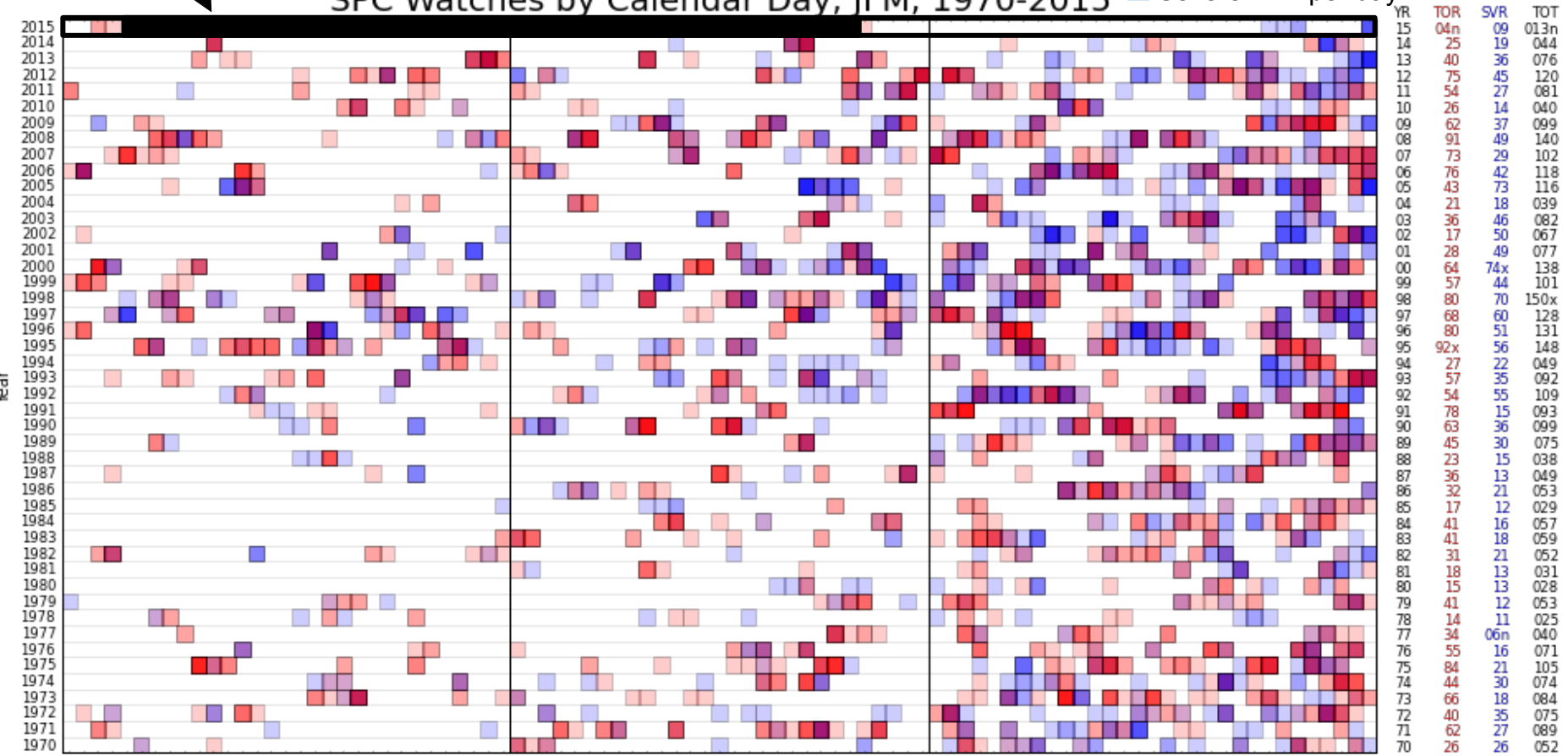
March

51 days without a watch!

Longest watch-free span of days in 29 years

SPC Watches by Calendar Day, JFM, 1970-2015

■ Tornado WW per day
■ Severe WW per day



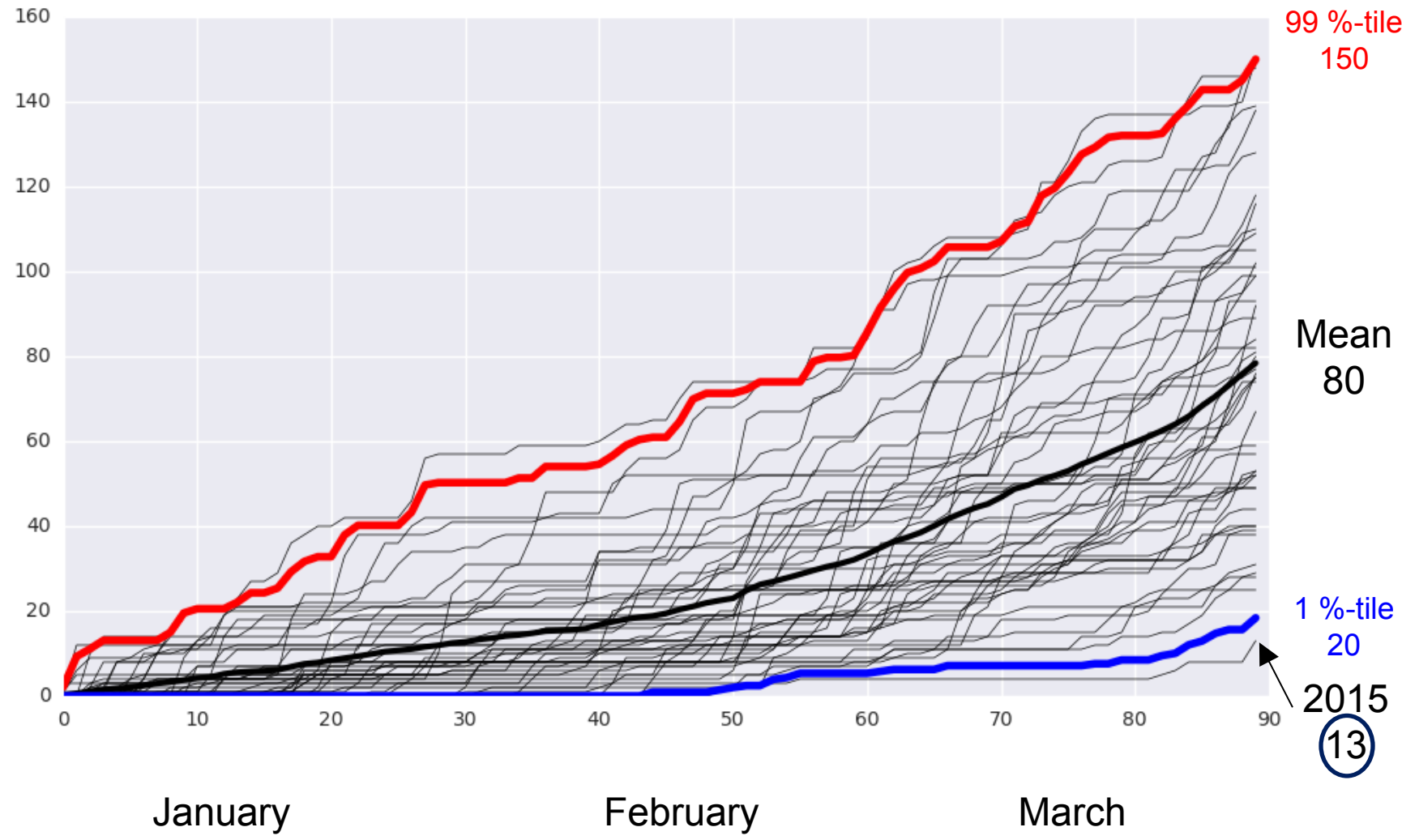
January

February

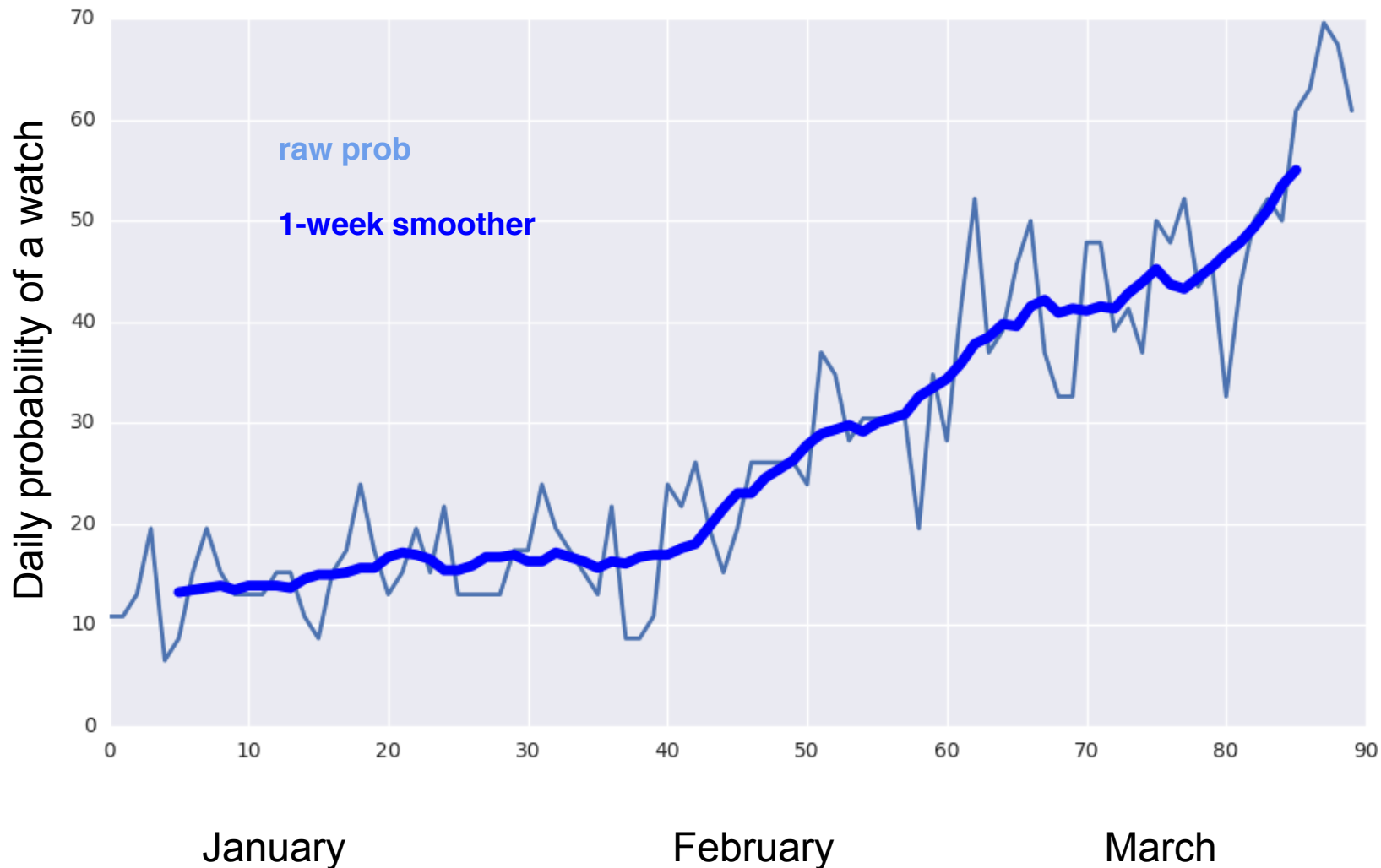
March

n=min, x=max
G. Carbin, NWS/SPC

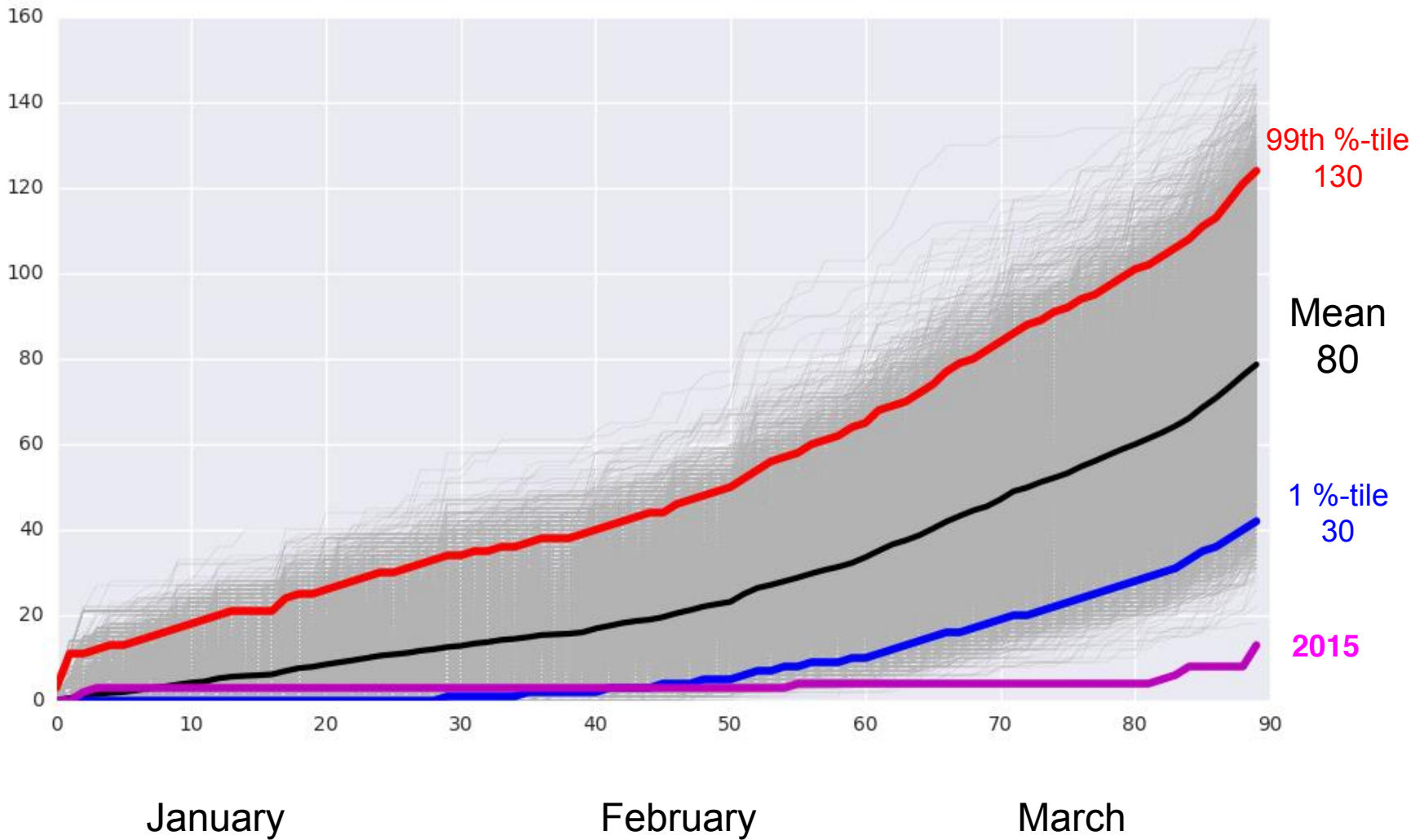
JFM Daily Watch Counts (summed), 1970-2015



Daily Probability, At Least One Watch (1970-2015)



25,000-year simulation of watches summed through March



#2

A Nearly Watchless Winter

- **Very Anomalous Low Watch Count JFM**
- **51-day Span Jan/Feb, Longest in 29 Years**
- **Record Watch-free Span in March (23 days)**

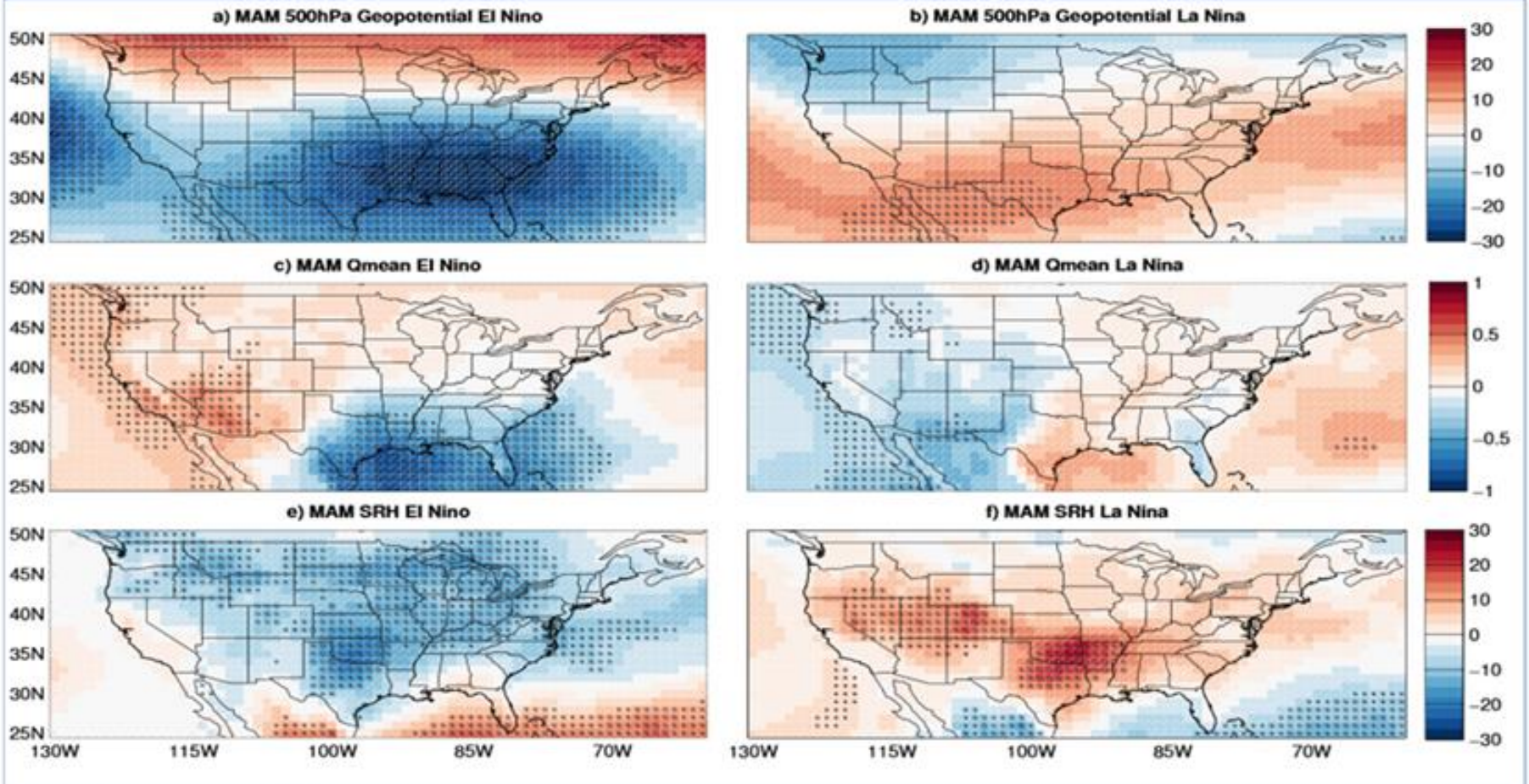
#3

A Seasonal Severe Wx Forecast



Connecting MAM Severe to DJF ENSO Phase

ENSO Teleconnection MAM – Synoptic and Environment

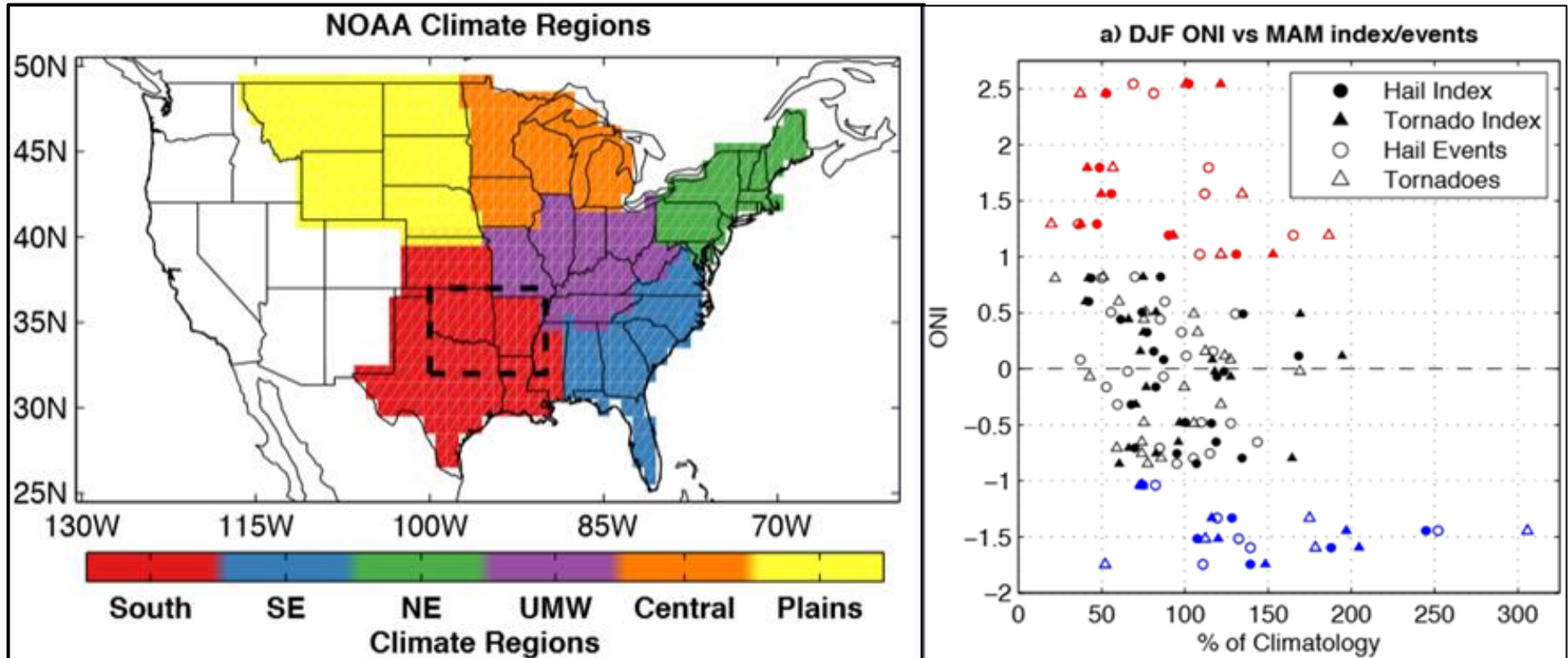


John T. Allen, M.K. Tippett, A.H. Sobel in March 2015 issue of *Nature Geoscience*

MAM 2015 Seasonal Outlook from ENSO



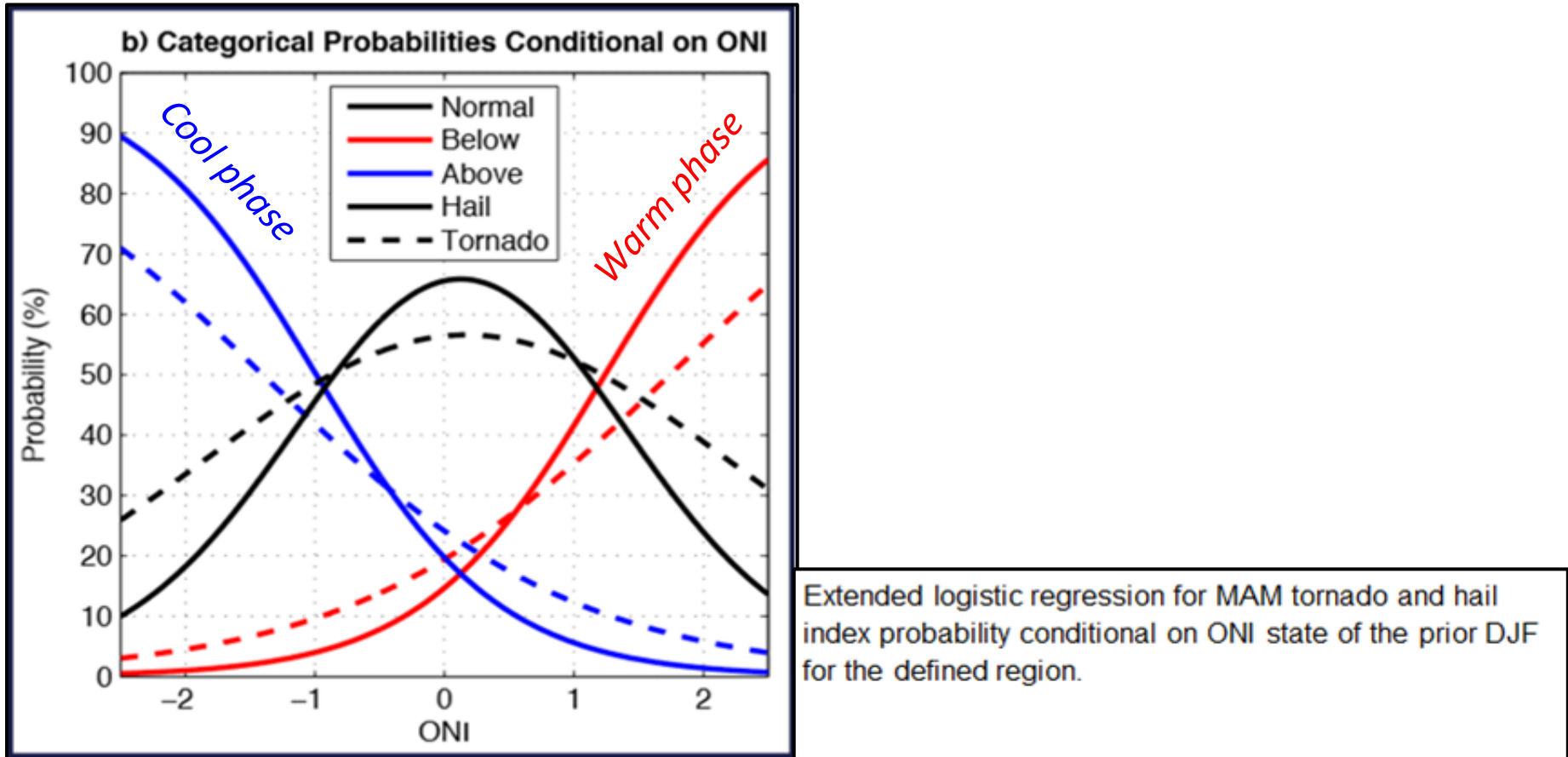
Change in MAM hail/tornado events and environmental indices related to DJF ONI.



John T. Allen, M.K. Tippett, A.H. Sobel in March 2015 issue of *Nature Geoscience*

MAM 2015 Seasonal Outlook from ENSO

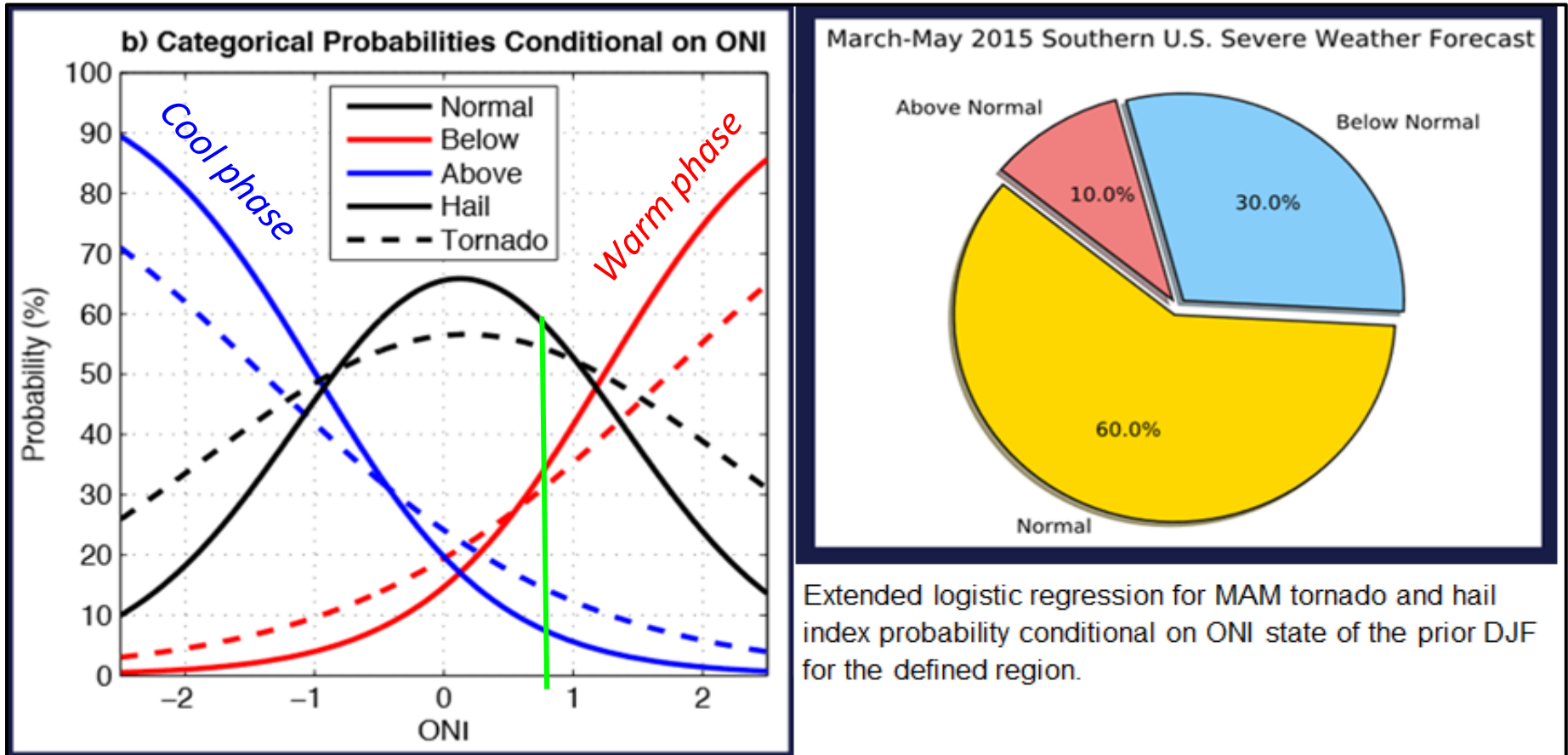
Logistical regression used to develop DJF ONI to severe probability curves



John T. Allen, M.K. Tippett, A.H. Sobel in March 2015 issue of *Nature Geoscience*

MAM 2015 Seasonal Outlook from ENSO

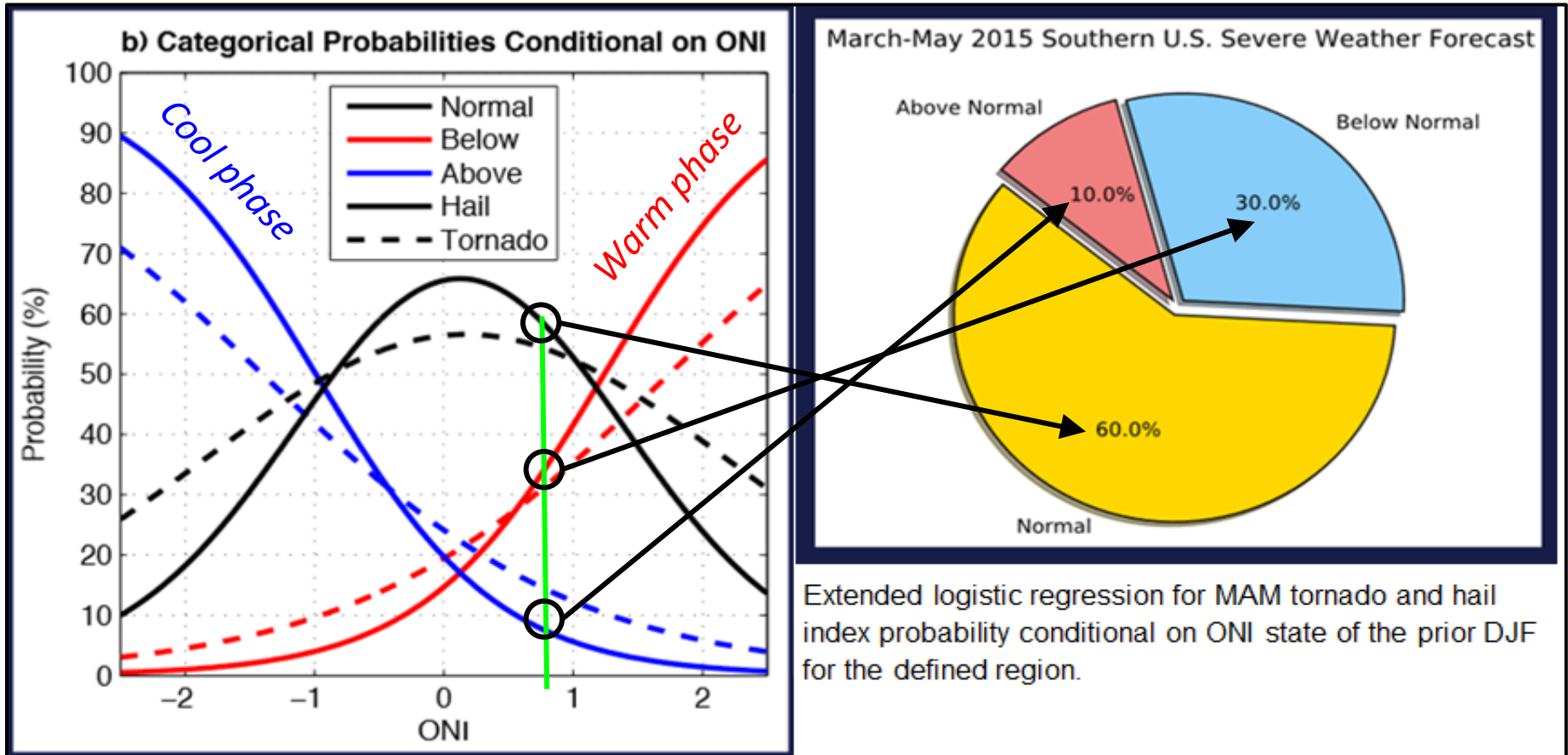
2014-2015 DJF ONI shown ($>0 < 1$)



John T. Allen, M.K. Tippett, A.H. Sobel in March 2015 issue of *Nature Geoscience*

MAM 2015 Seasonal Outlook from ENSO

2014-2015 DJF ONI shown ($>0 < 1$)

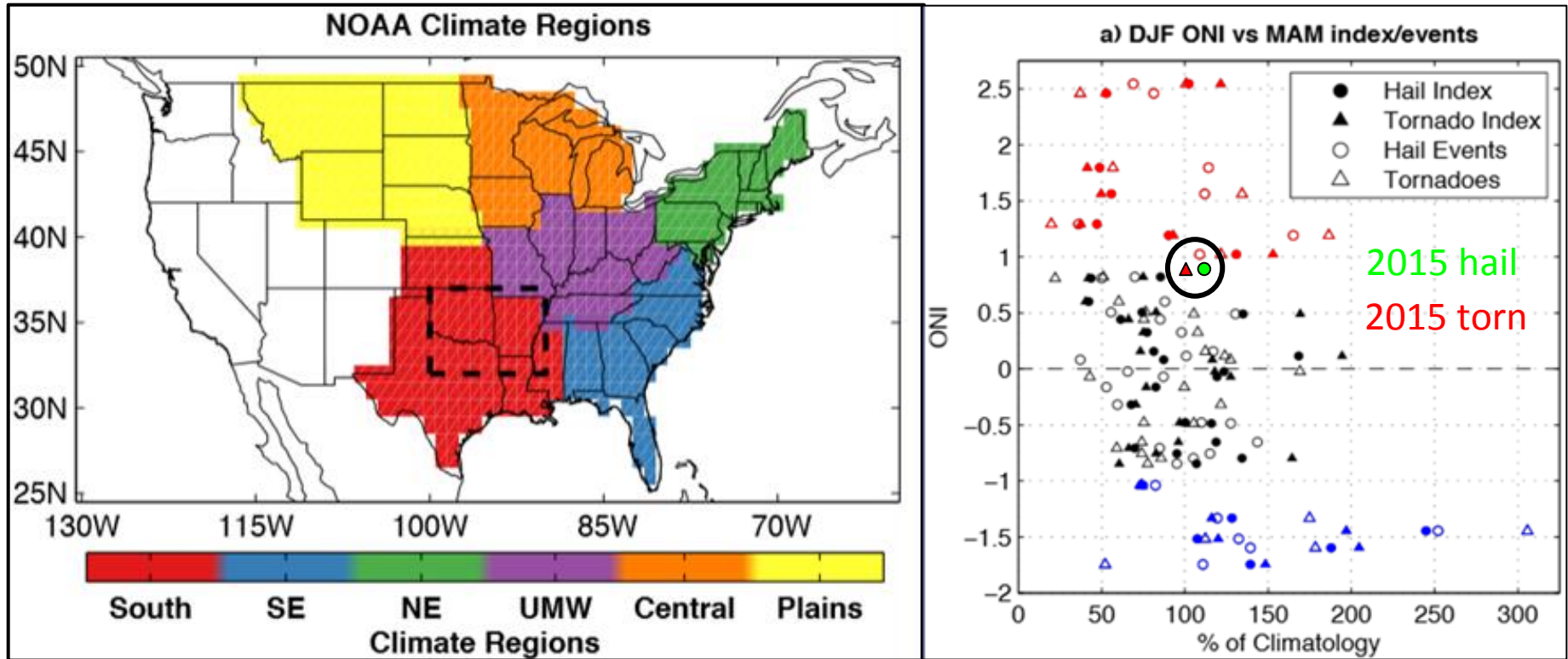


John T. Allen, M.K. Tippett, A.H. Sobel in March 2015 issue of *Nature Geoscience*

Verification by MAM 2015 Storm Events

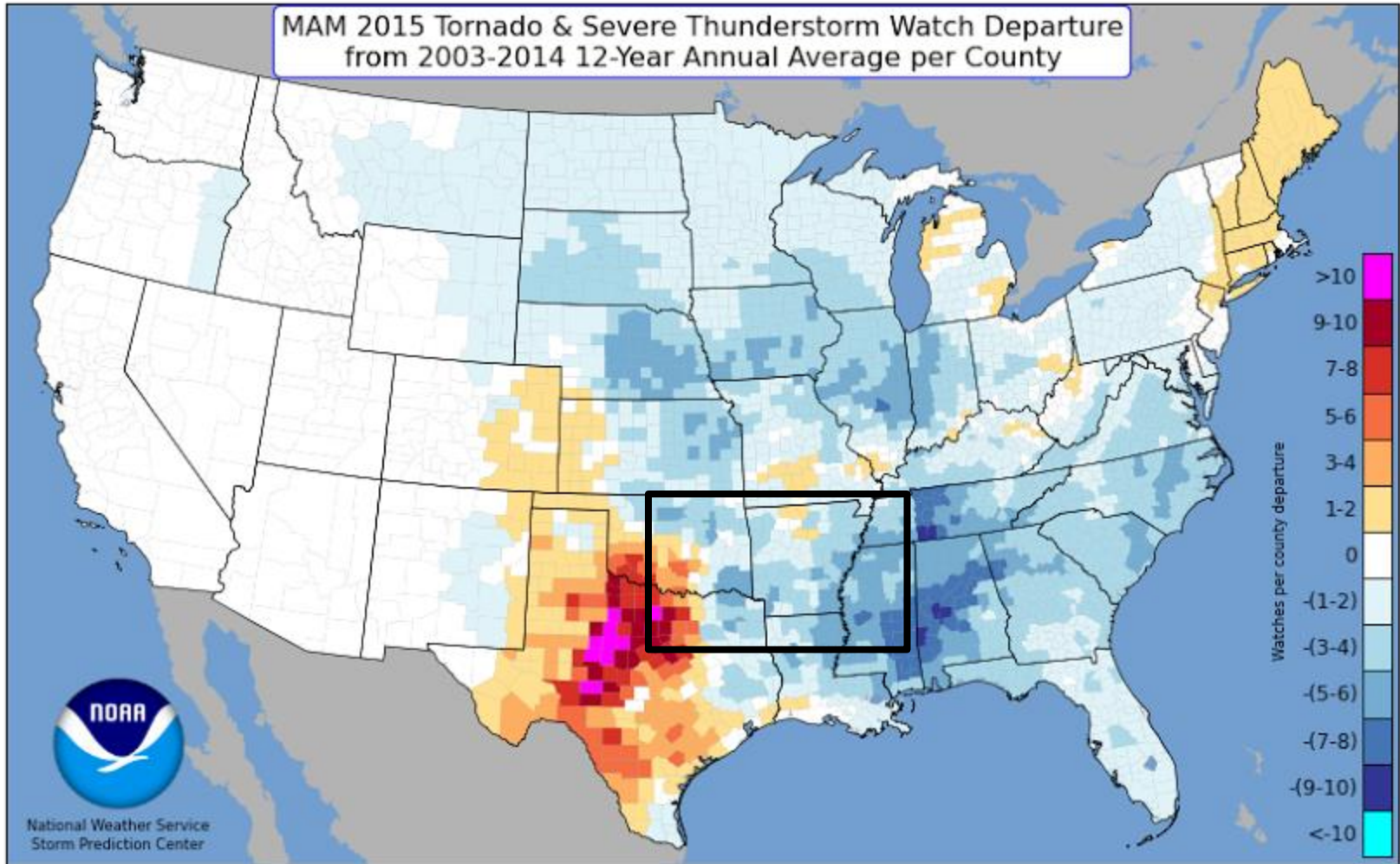


Tornadoes and hail events (MAM) in domain from NWS records (climo=2007-2015)



John T. Allen, M.K. Tippett, A.H. Sobel in March 2015 issue of *Nature Geoscience*

Verification by MAM 2015 SPC Watches



#3

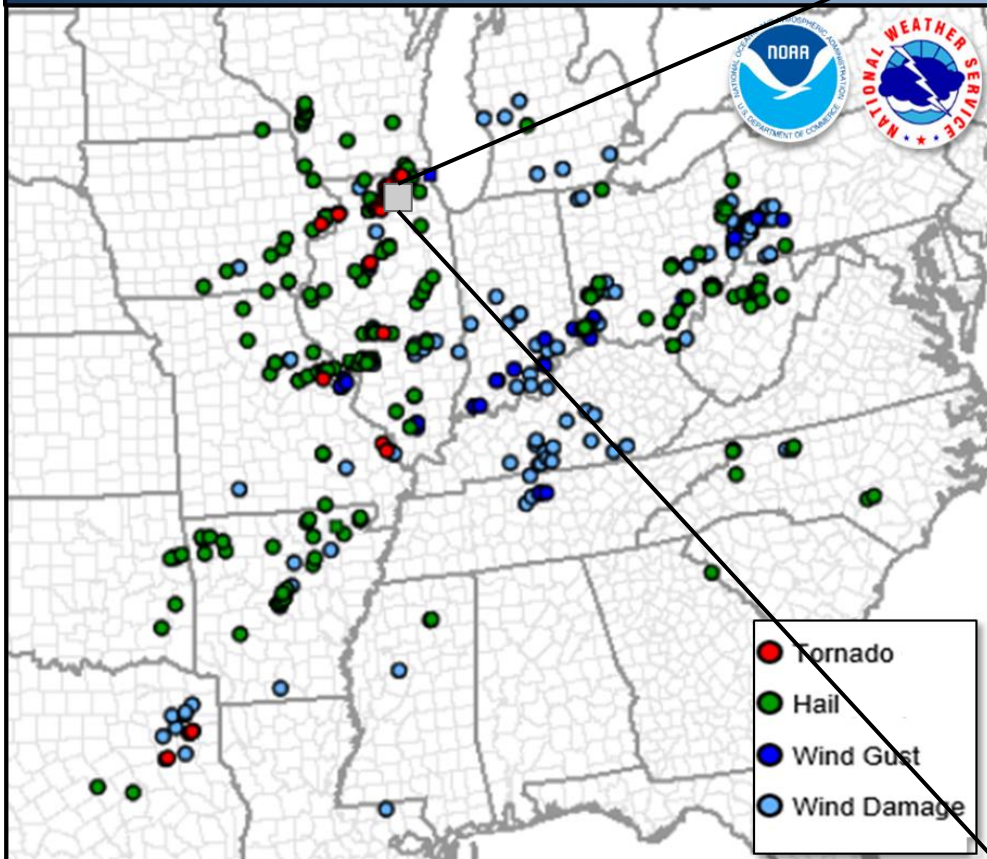
A Seasonal Forecast for Severe Wx

- Allen, et. al. Pioneer A Way Forward
- Good Preliminary Verification
- Just the Beginning...More to Come

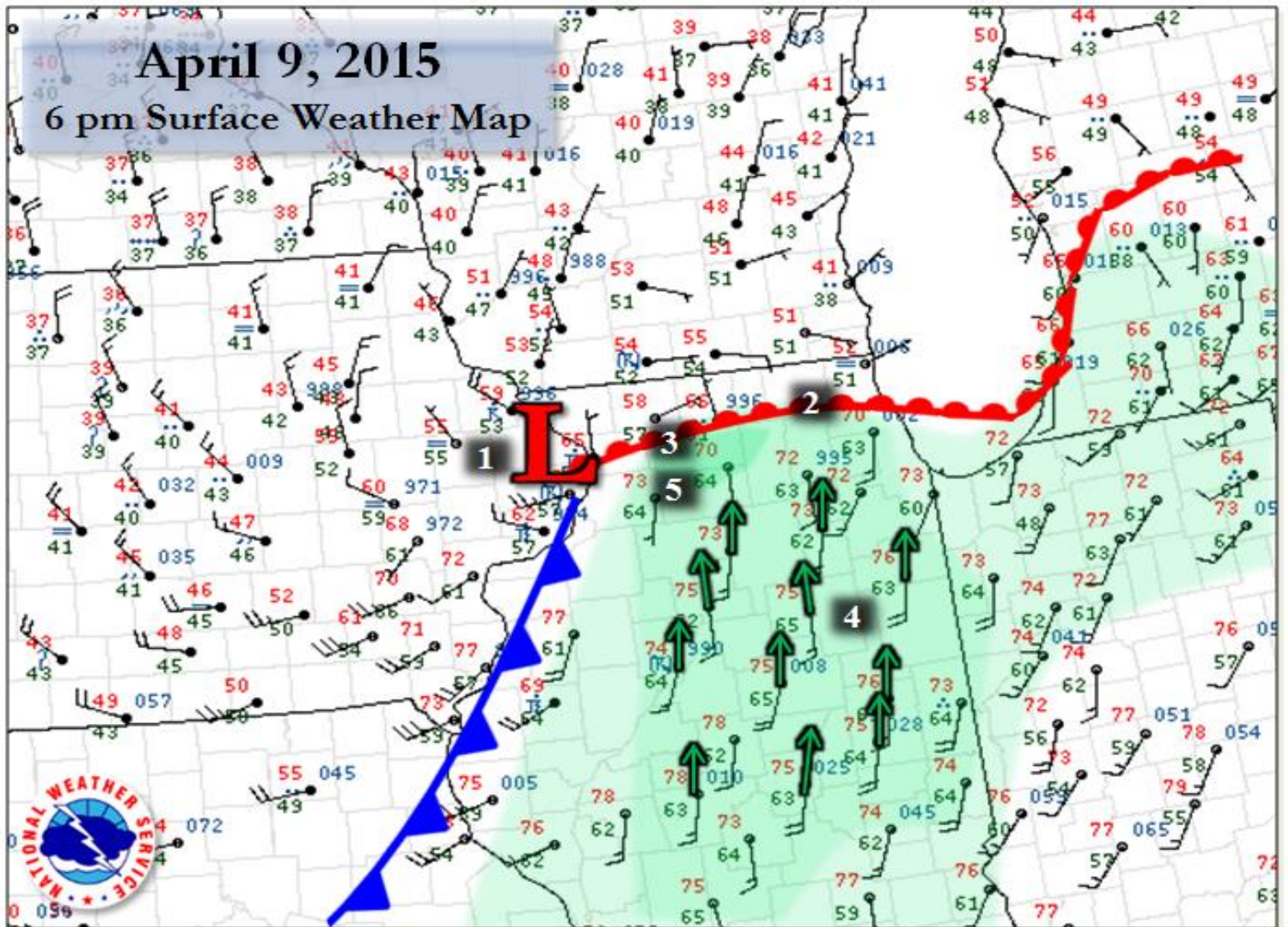
#4

April 9 Fairdale, IL EF4 Tornado

April 9, 2015 U.S. Storm Reports

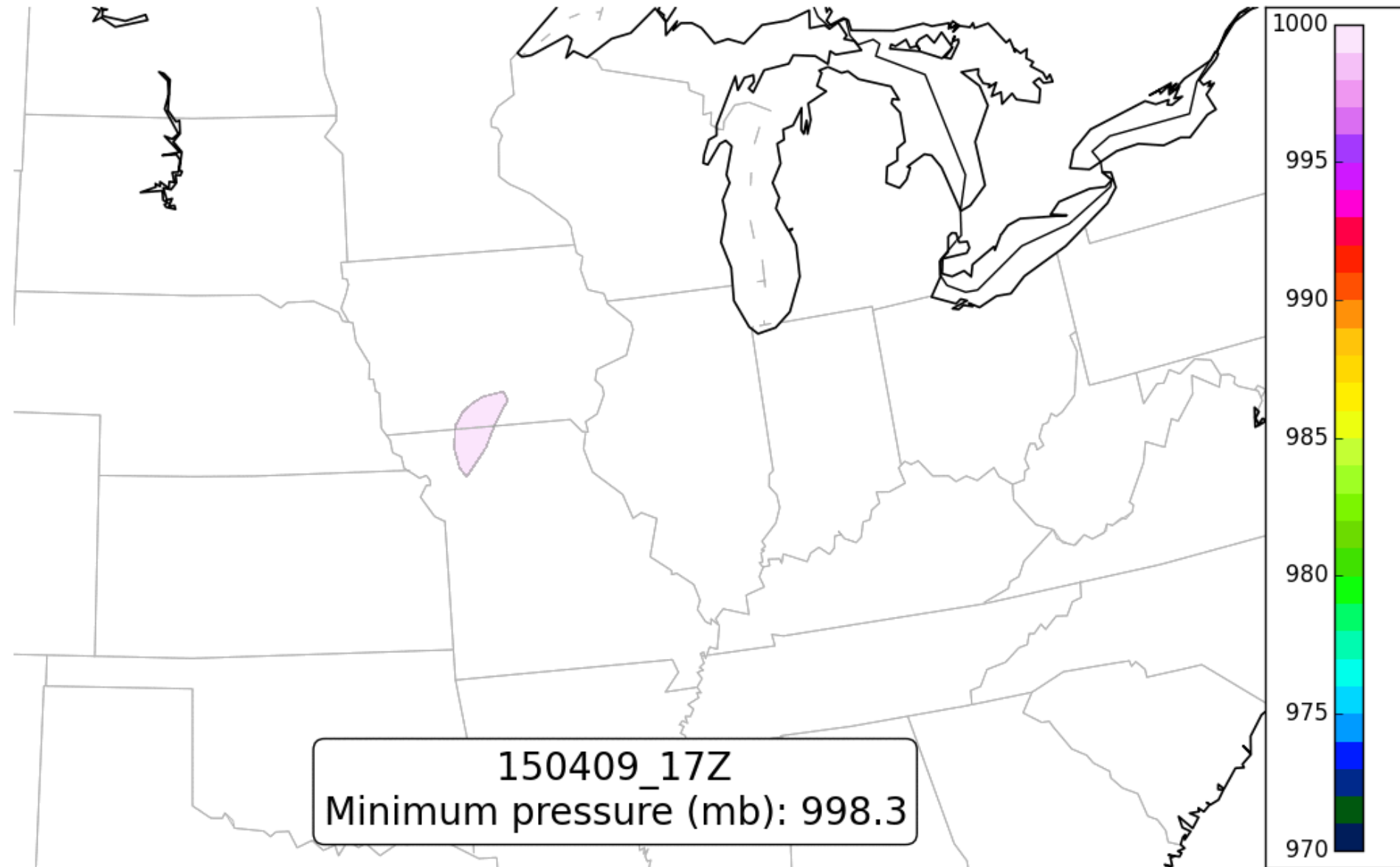


April 9, 2015 6 pm Surface Weather Map



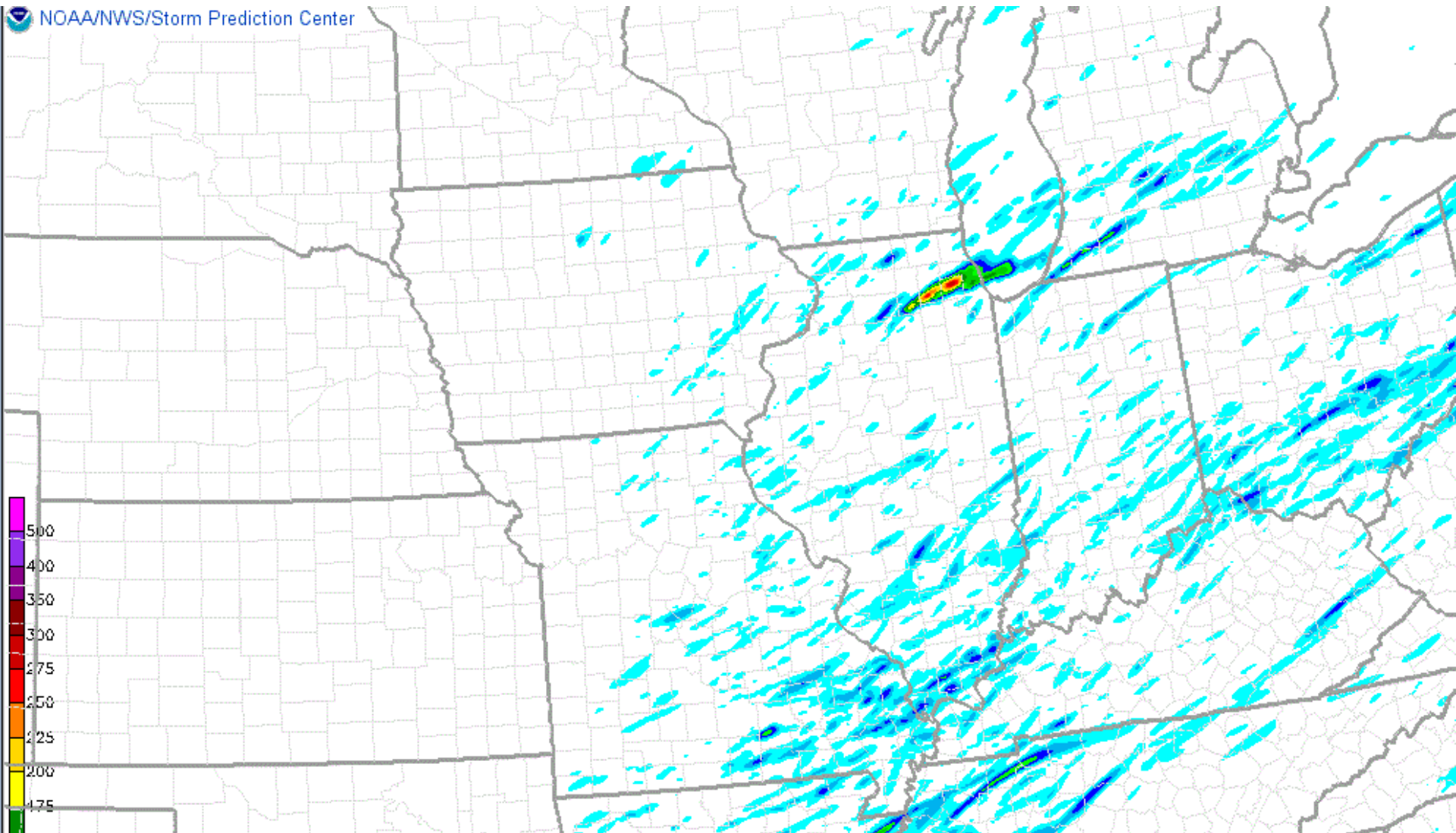
Courtesy NWS Chicago

Hourly Sea-Level Pressure Loop and Storm Reports



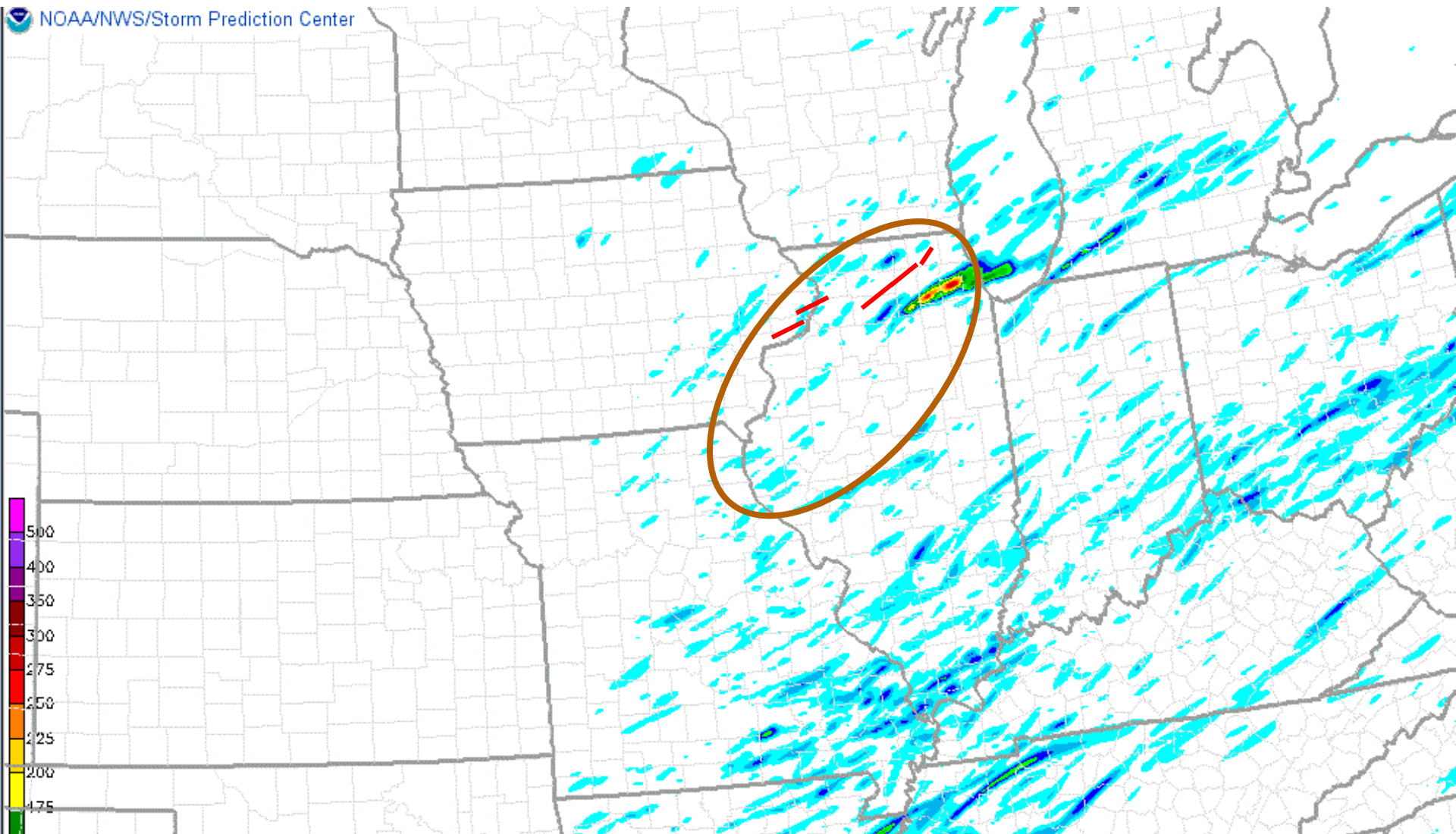
An Exceptional Storm-Scale Forecast (Max UH Tracks)

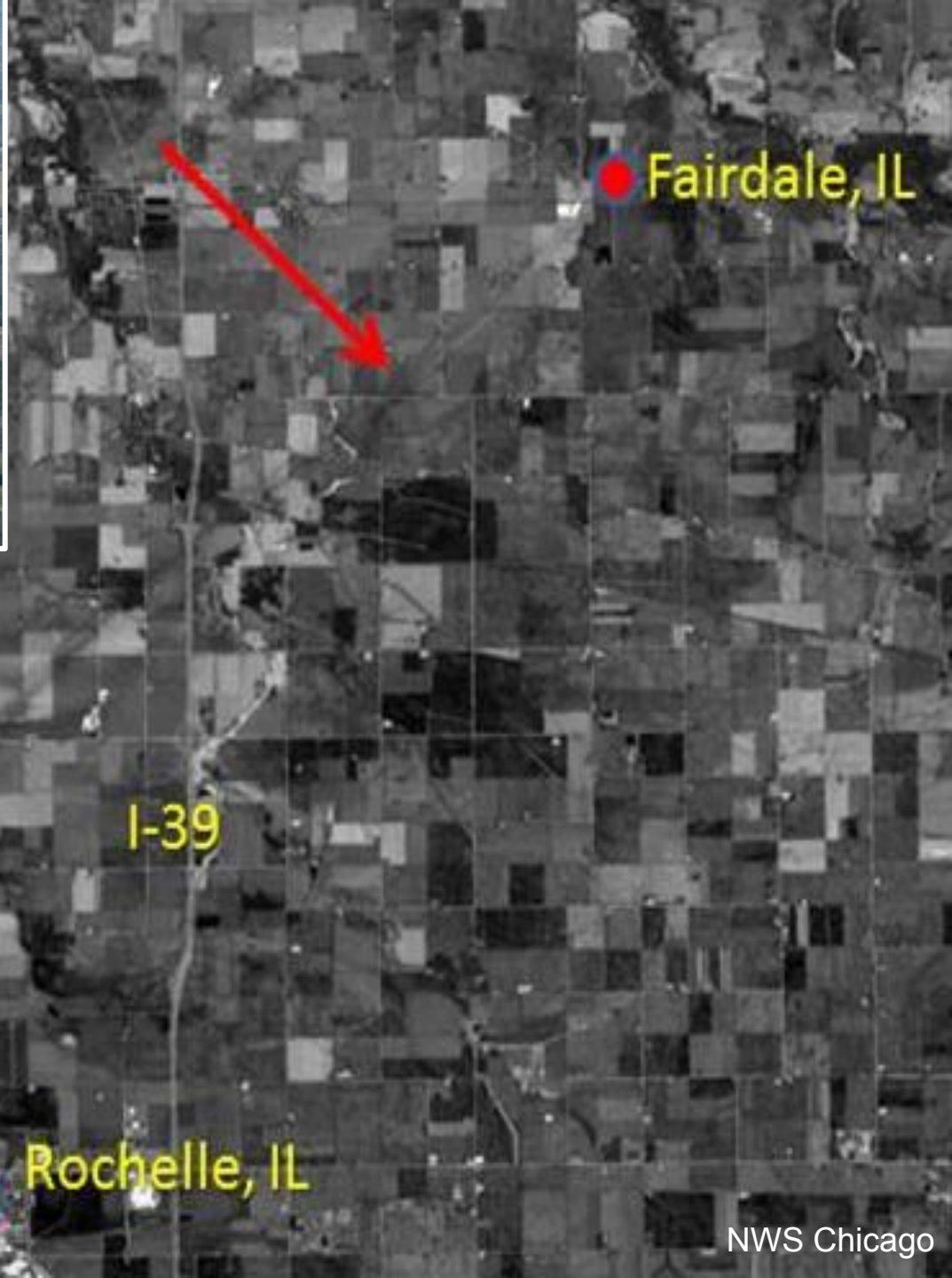
NOAA/NWS/Storm Prediction Center



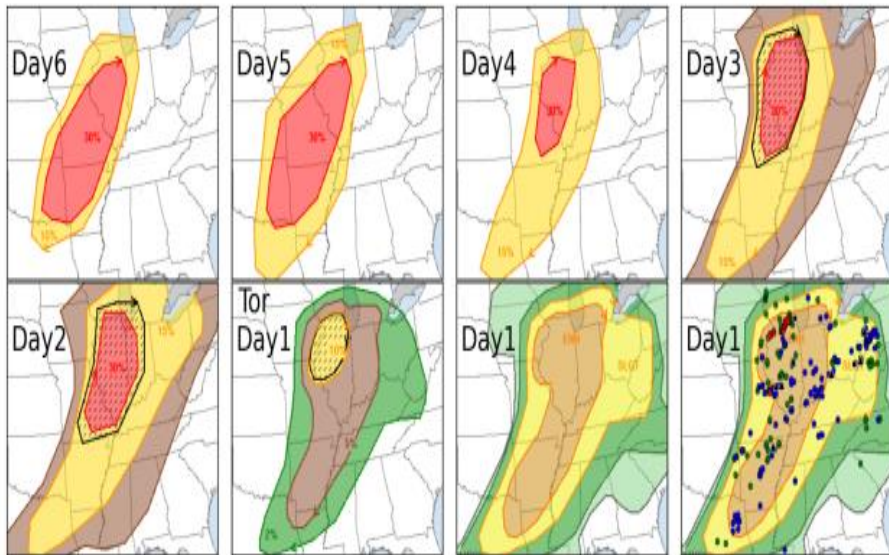
Verification of Storm-Scale Guidance (**tracks**)

SPC 10% Probability of Significant Tornado





SPC SEVERE WEATHER OUTLOOK/DISCUSSION CHRONOLOGY



Courtesy: Larissa Sebree



Courtesy NWS Chicago



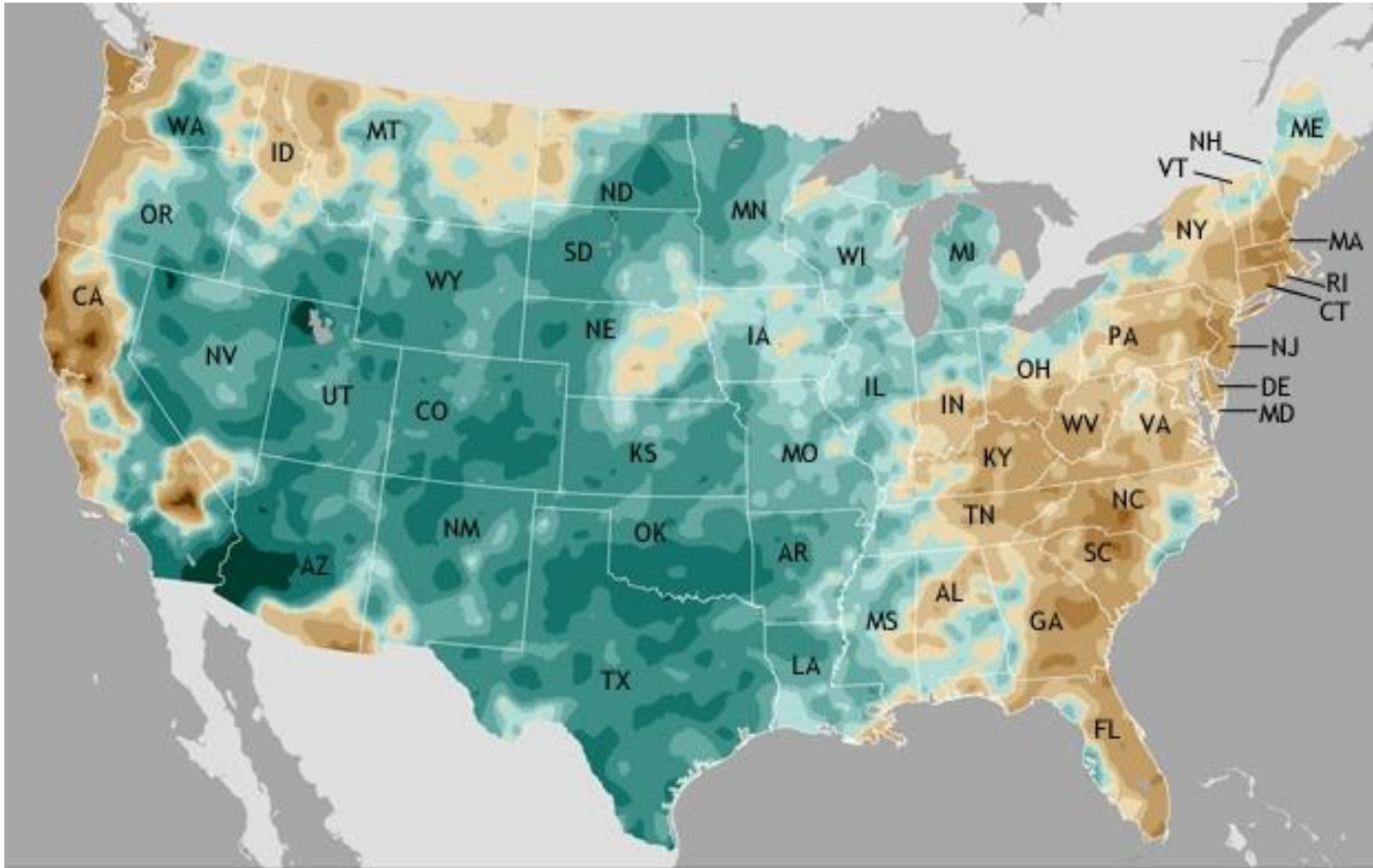
From Twitter

#4

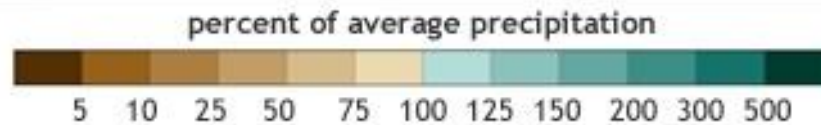
April 9 Fairdale, Illinois EF4 Tornado

- **Highest Rated Tornado of 2015**
- **Last EF4+ in Illinois: Nov. 2013**
- **Two Deaths, 22 Injuries, 30 Mile Track**

#5 Wettest Month on Record (CONUS)



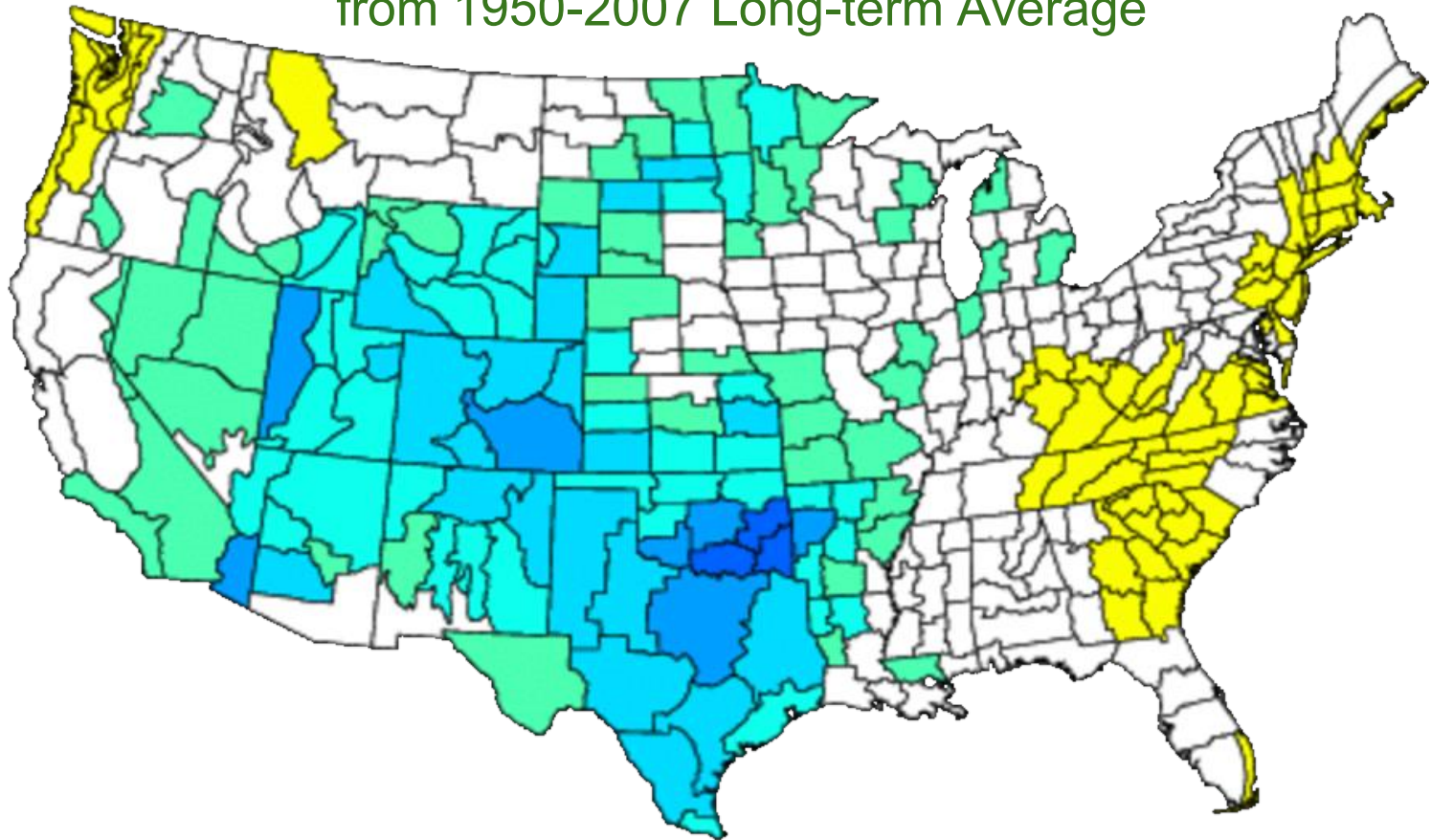
May 2015
compared to
20th century average
4.36" wettest in 121-years



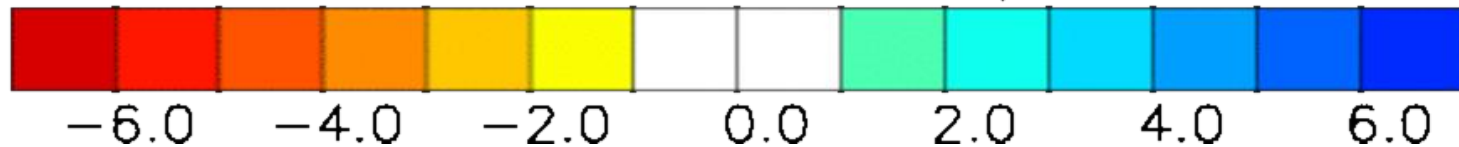
NOAA Climate.gov
Data: NCEI
Previous wettest May: 1957
Previous wettest month: Oct. 2009

Where Was it Wettest?

Climate Division Standardized Anomalies
from 1950-2007 Long-term Average

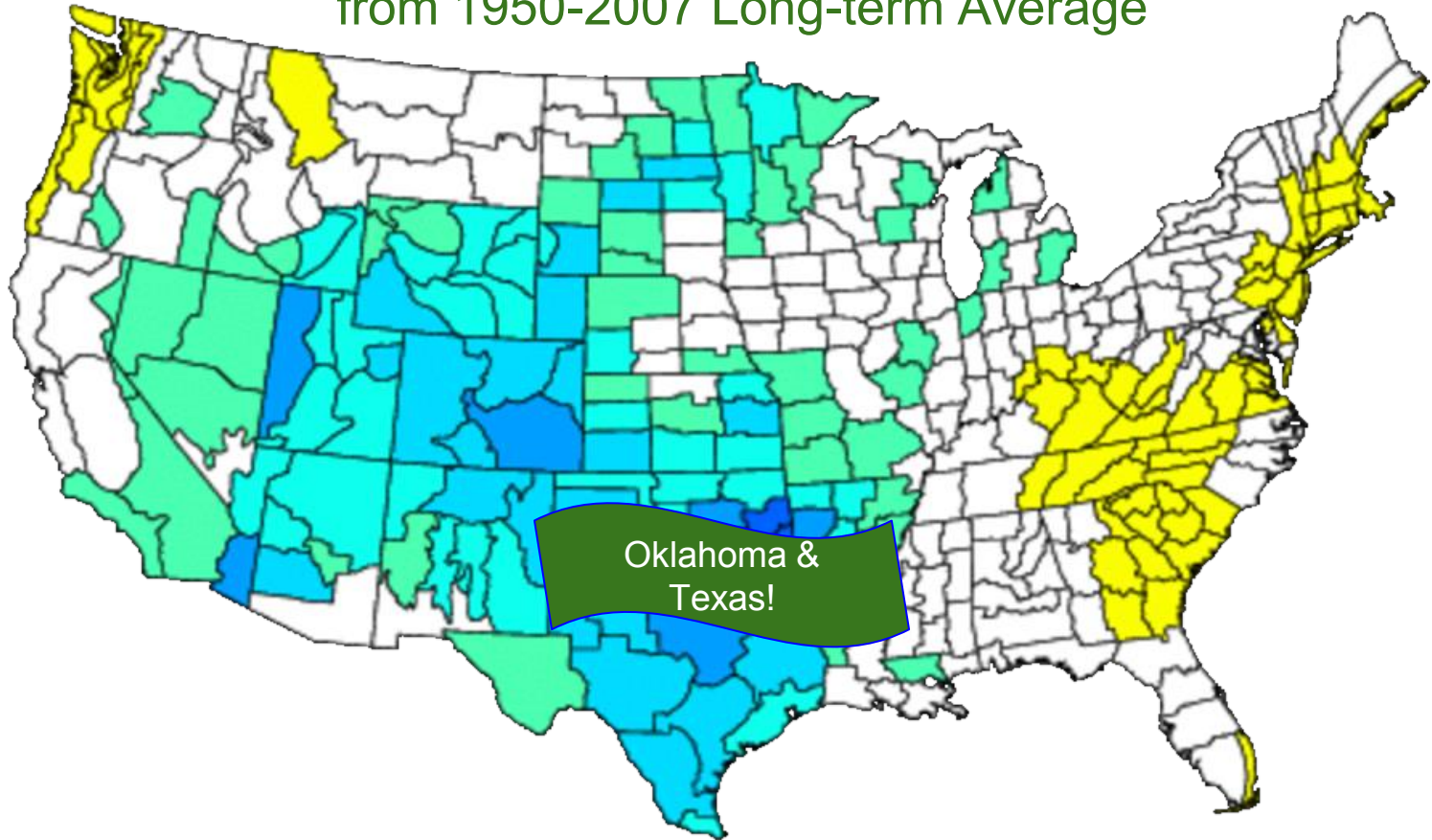


NOAA/ESRL PSD and CIRES-CU

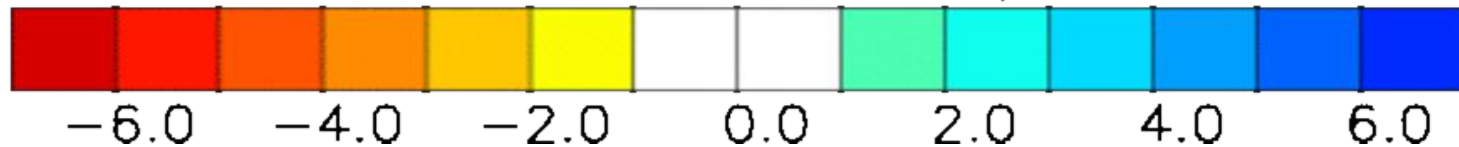


Where Was it Wettest?

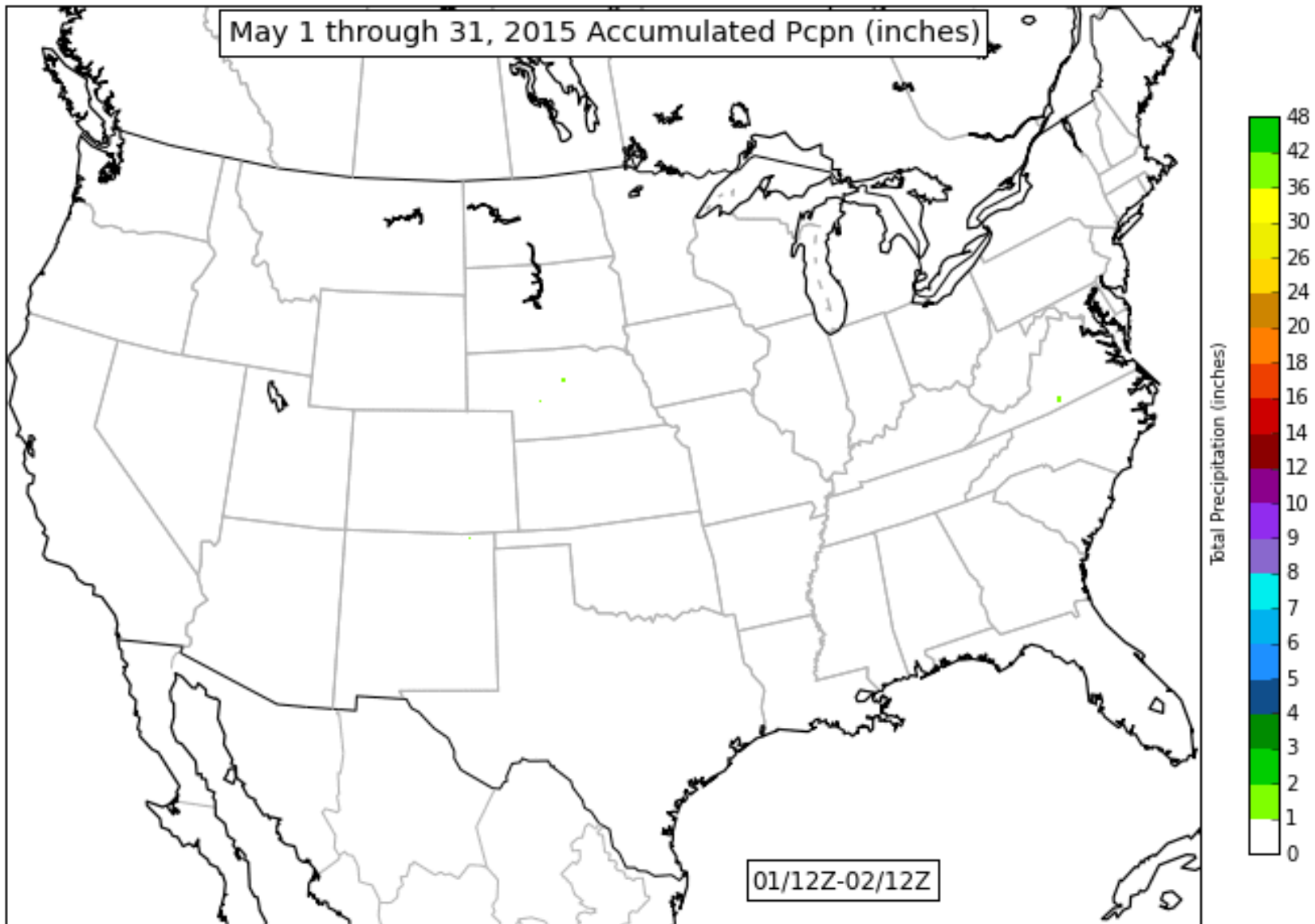
Climate Division Standardized Anomalies
from 1950-2007 Long-term Average



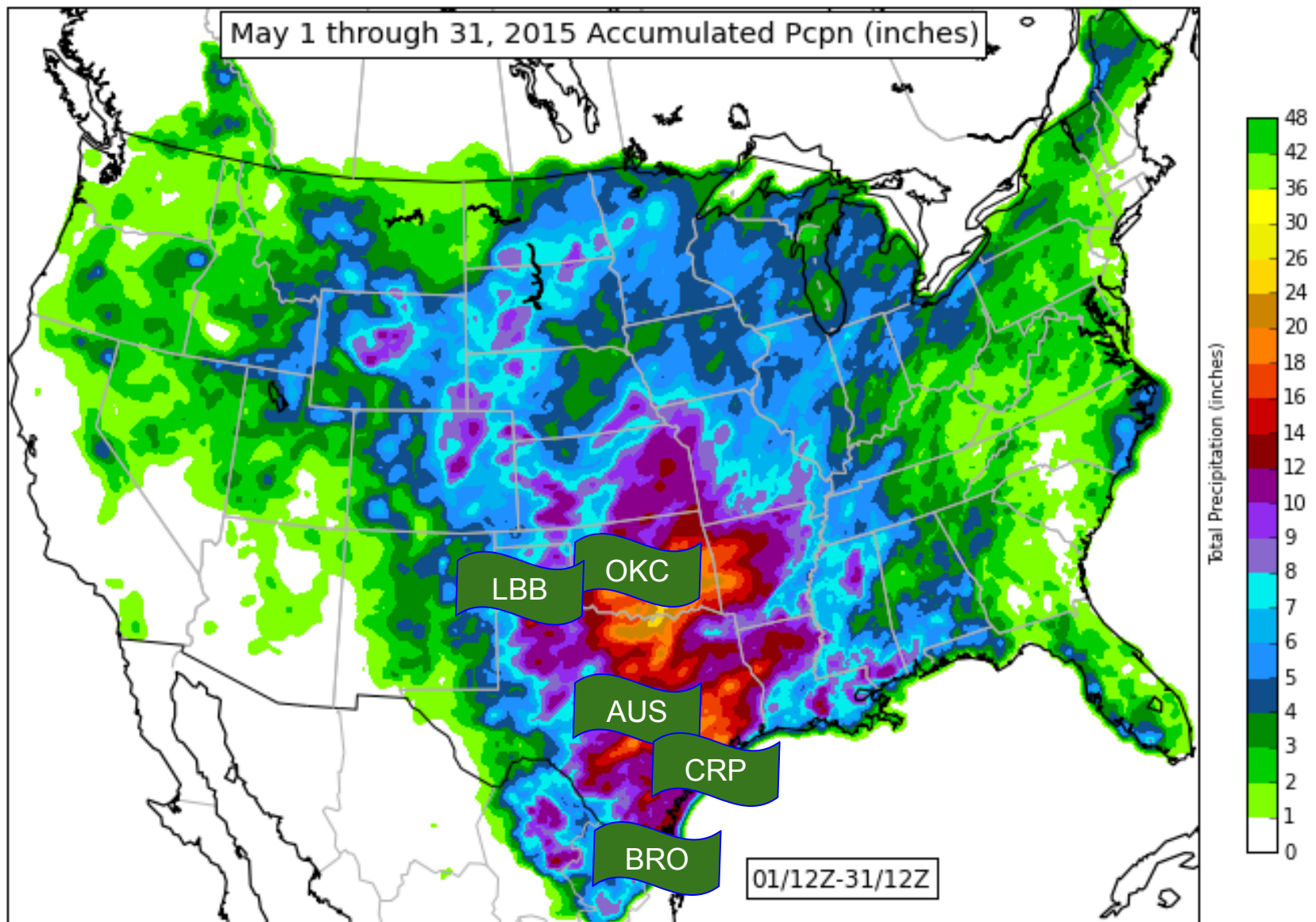
NOAA/ESRL PSD and CIRES-CU



May U.S. Rainfall Accumulation Loop

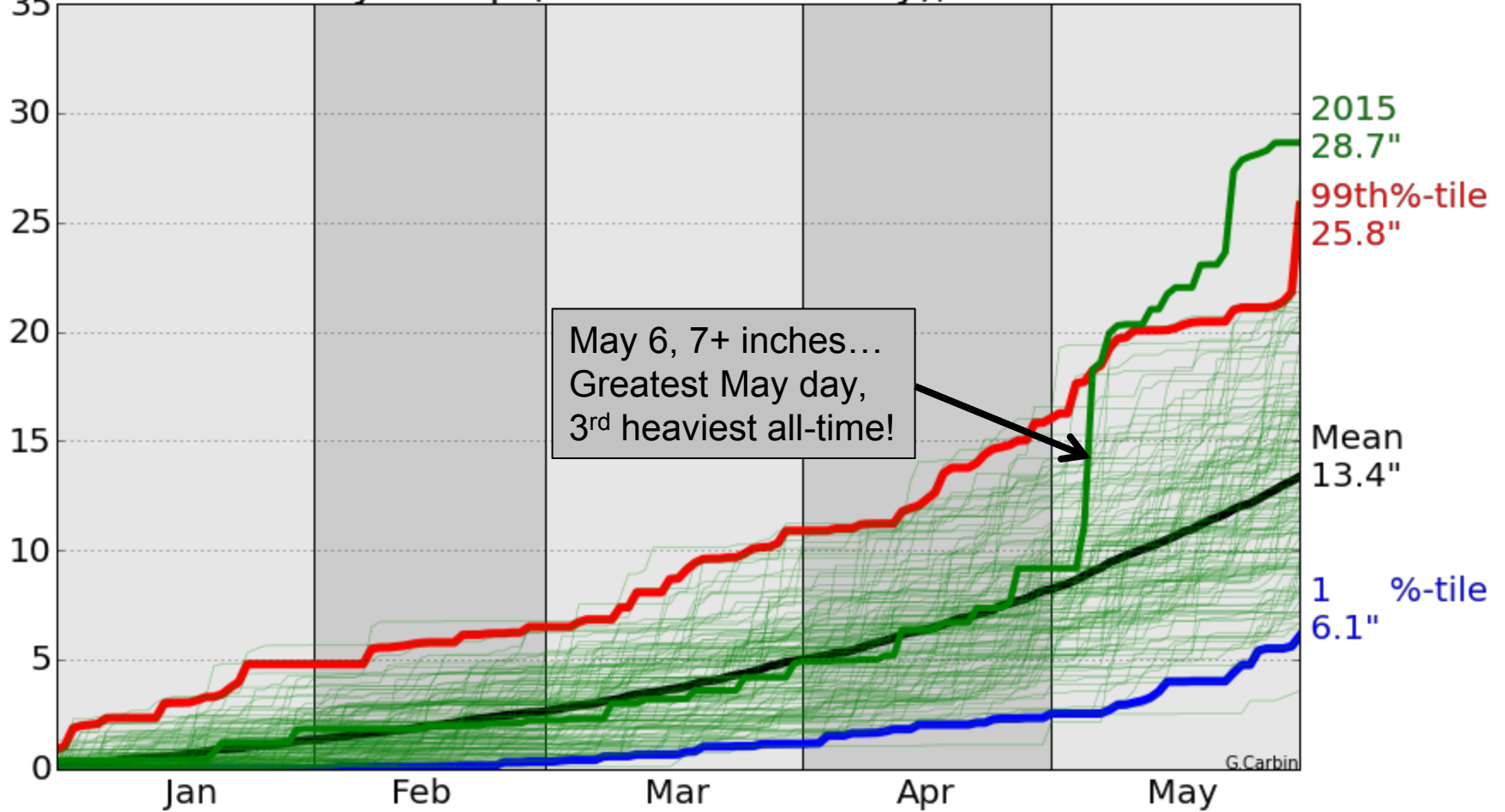


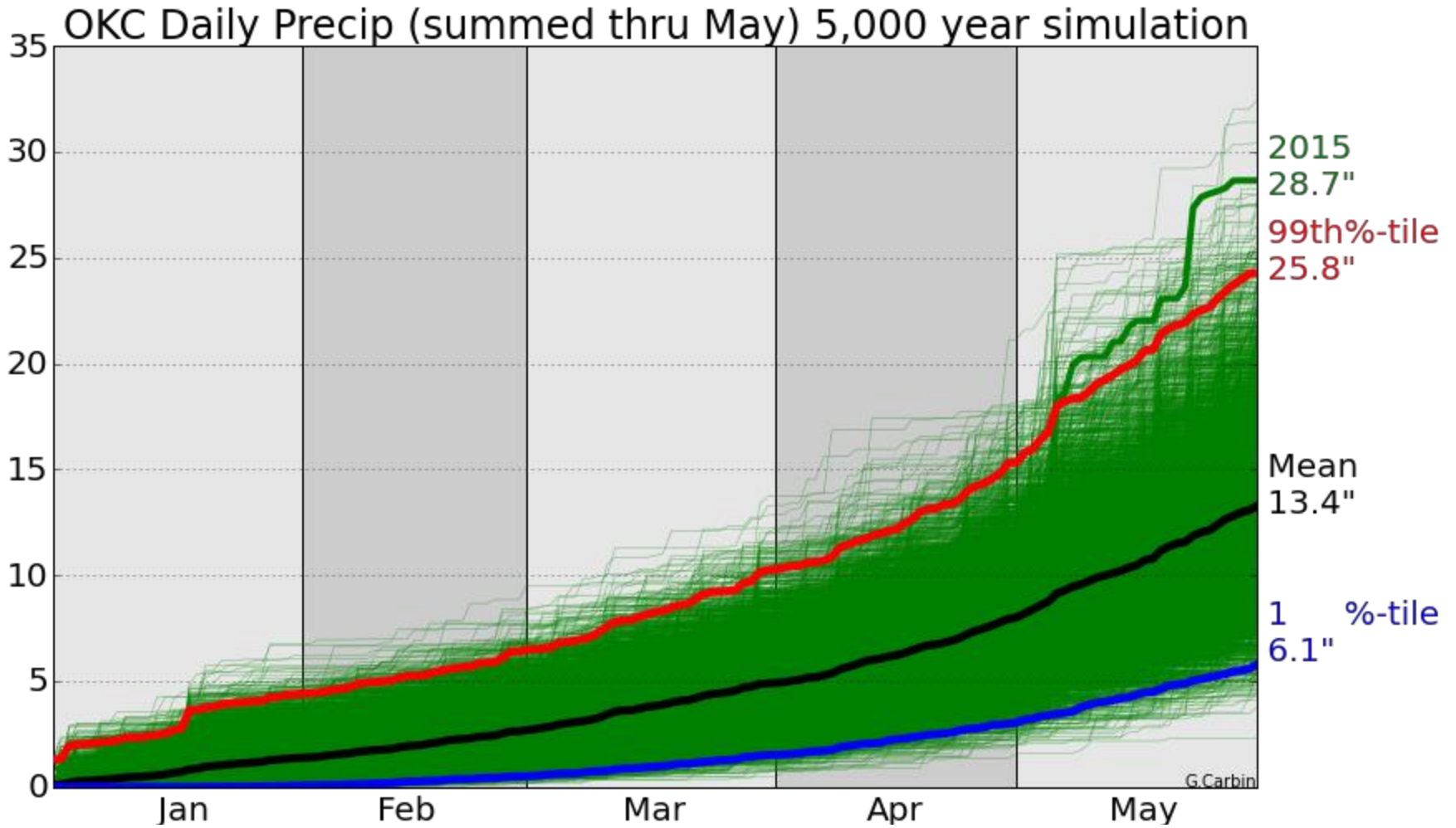
Jan-May All-time Wettest in 70-90 Years of Records





OKC Daily Precip (summed thru May), 1891-2015





Estimated return frequency of about 500-1000 years!



Marie D. De Jesus, Houston Chronicle



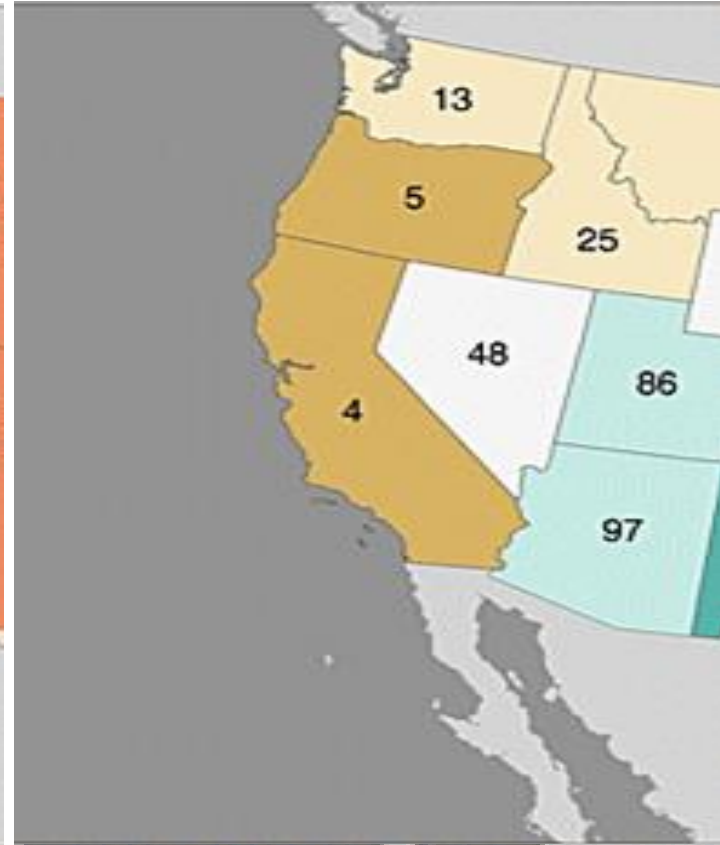
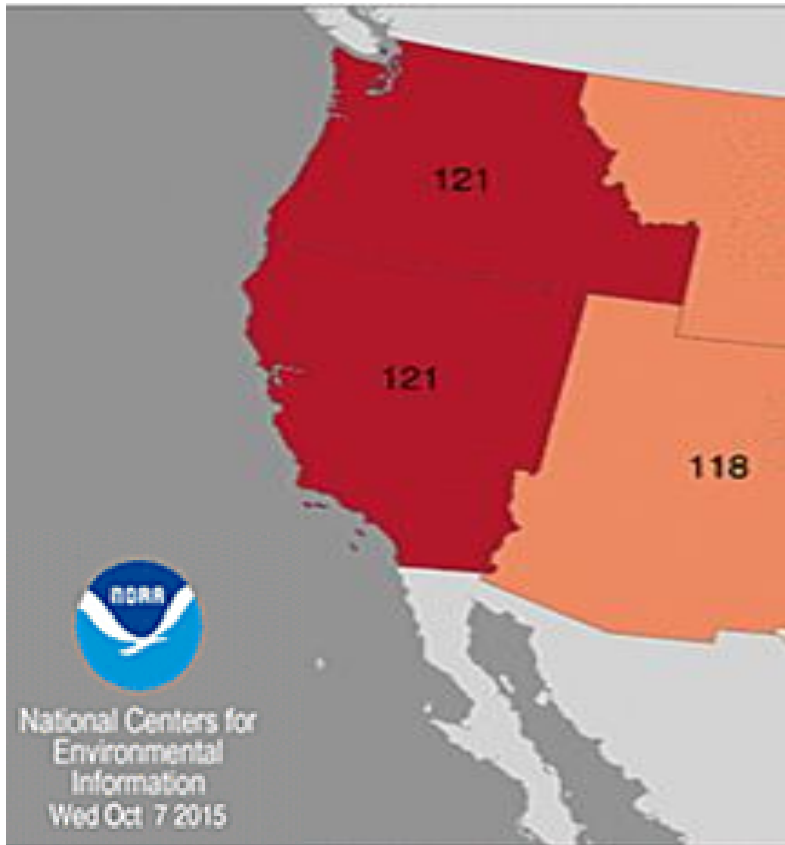
#5

Wettest Month on Record (CONUS)

- **Incredibly Wet Spring in the Plains**
- **Annual Rainfall in 1 Month, Some Areas**
- **Many All-time Precipitation Records Set**

#6 Western U.S. Heat, Drought and...

West: 2015 record warmest Jan-Sep period in 121y. CA/OR 4th and 5th driest Jan-Sep.



Much Above Average

Record Warmest (121)

Record Driest (1)

Much Below Average

#7

...Fire!

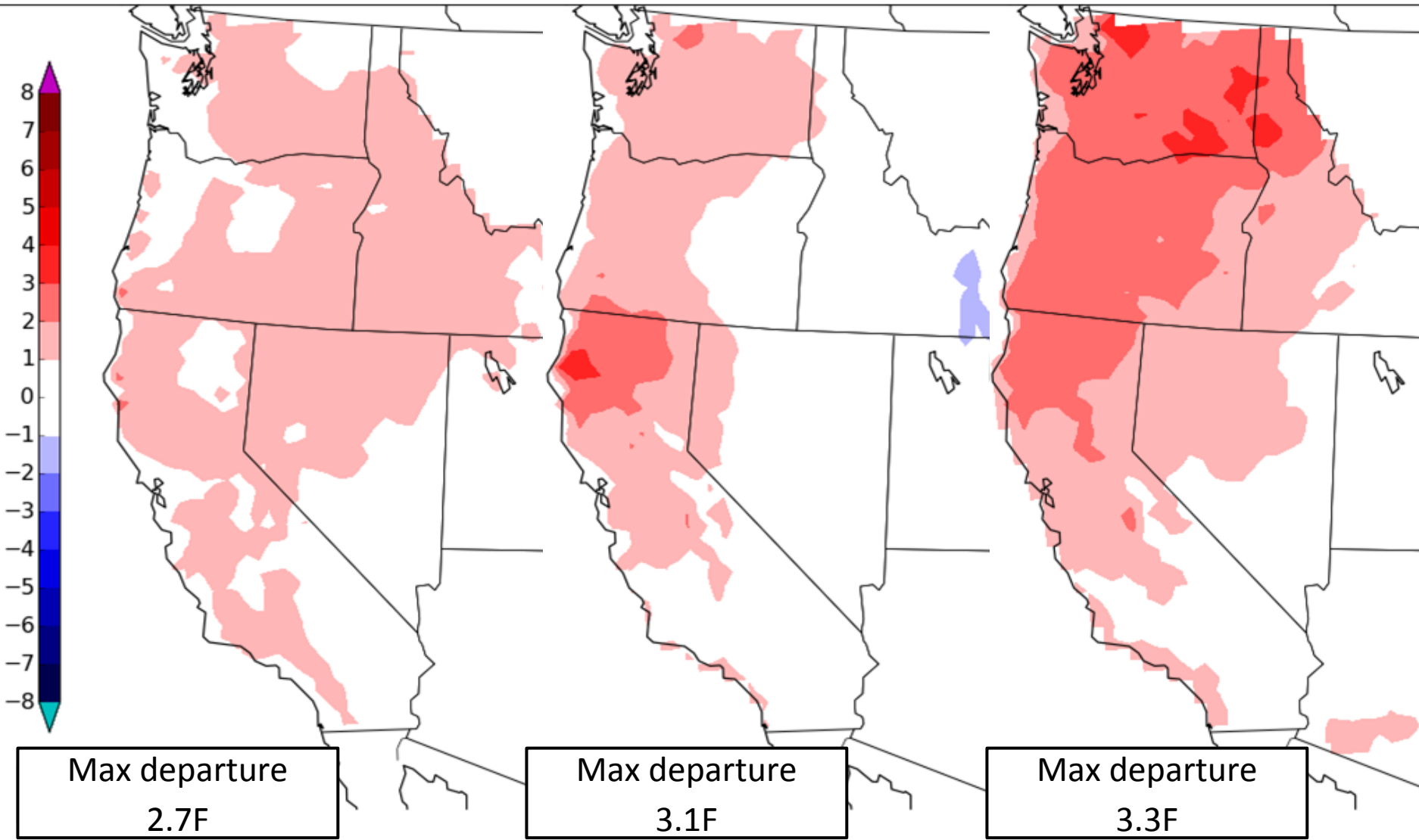


June, July, August Temperature Anomalies

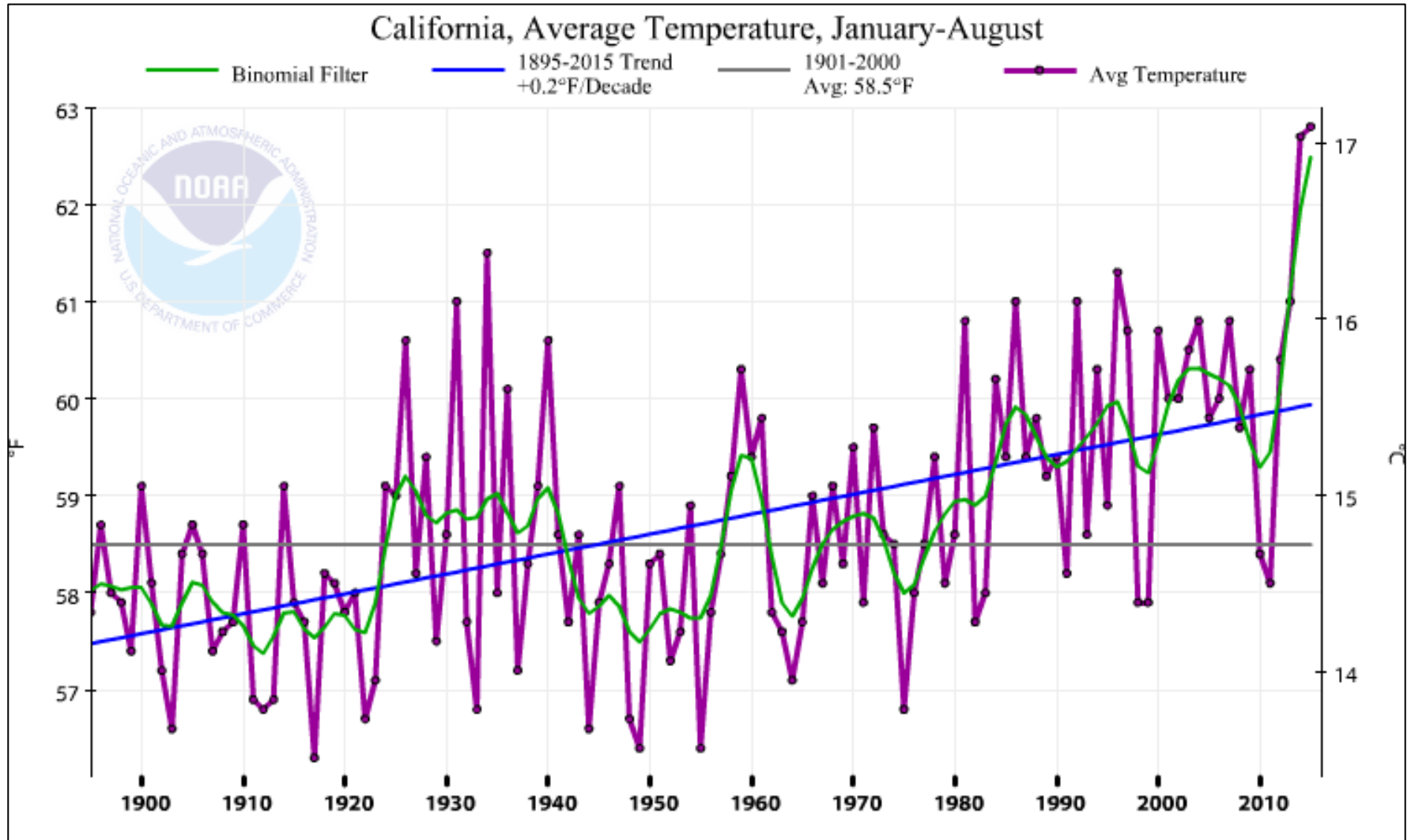
2013

2014

2015

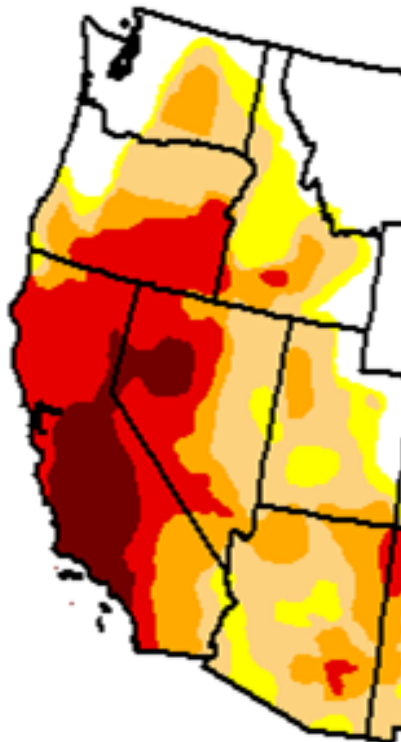


Toasty California Temperatures in Uncharted Territory

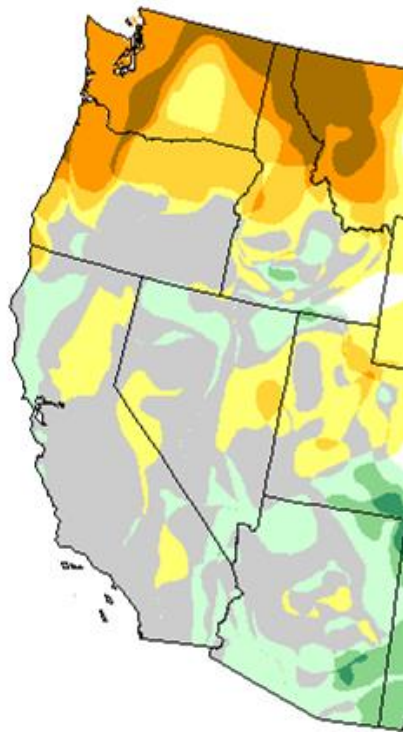


Expansion of Western Drought in 2015

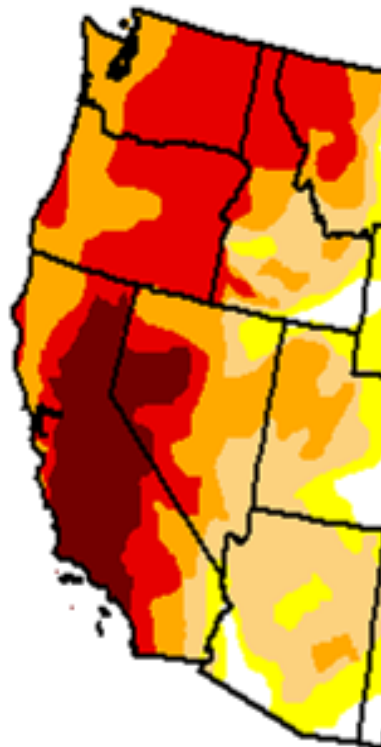
December 2014



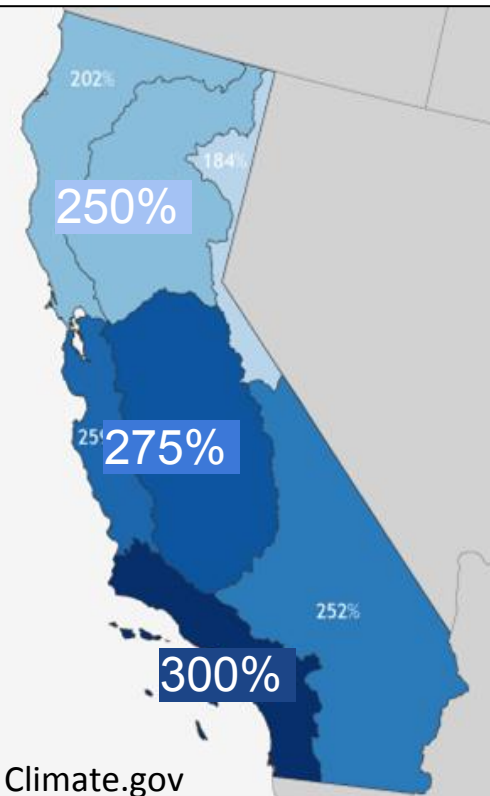
change since then



Current (Oct. 2015)

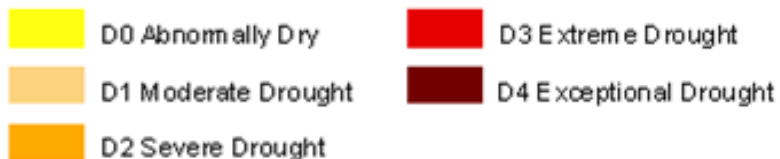


Percent of normal precip thru Sep. '16 to reach median 5y accum.



Climate.gov

Intensity:

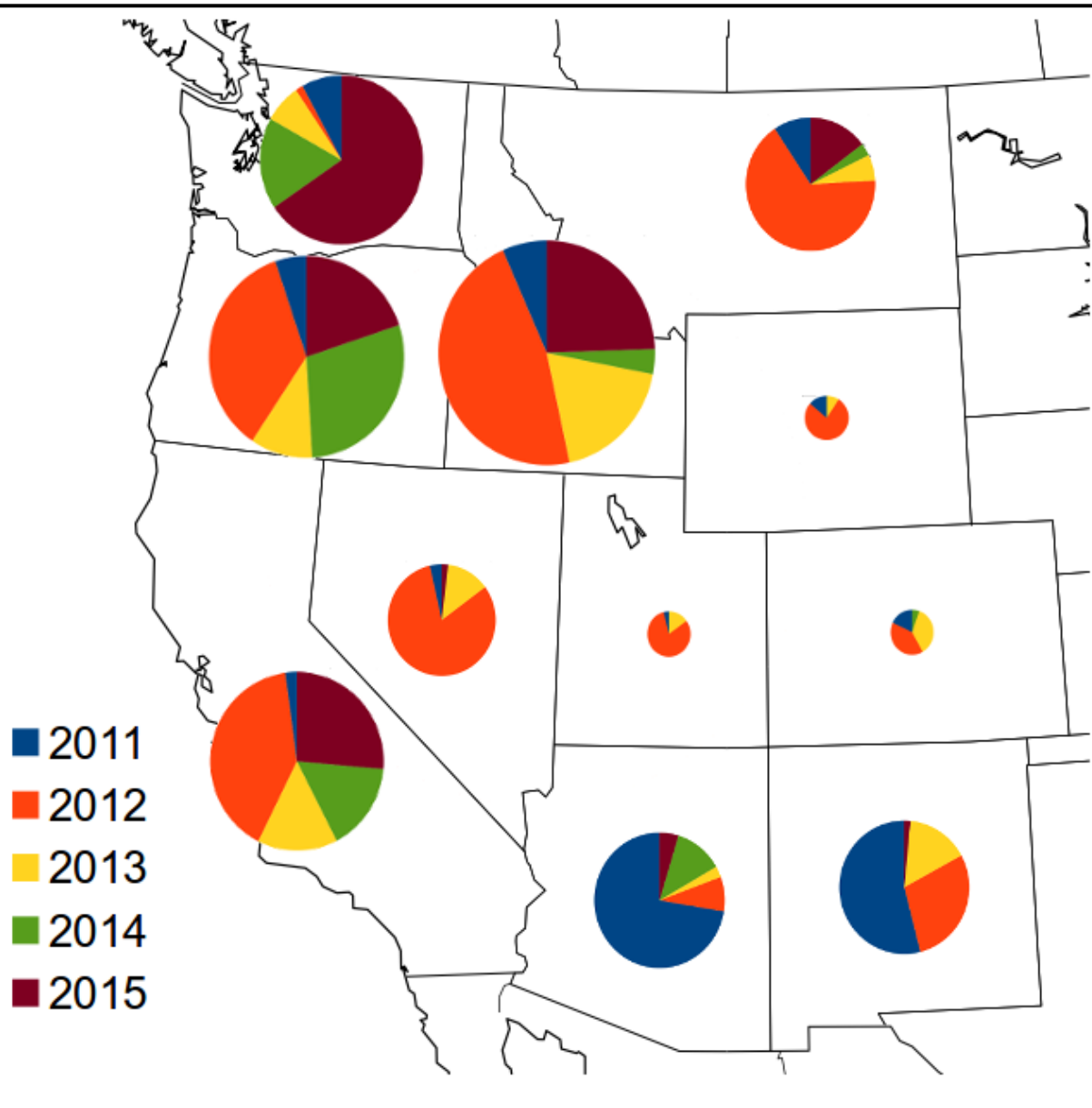


Author(s):
David Miskus
NOAA/NWS/NCEP/CPC



<http://droughtmonitor.unl.edu/>

Western Megafires (10,000 acres and larger) 2011-2015



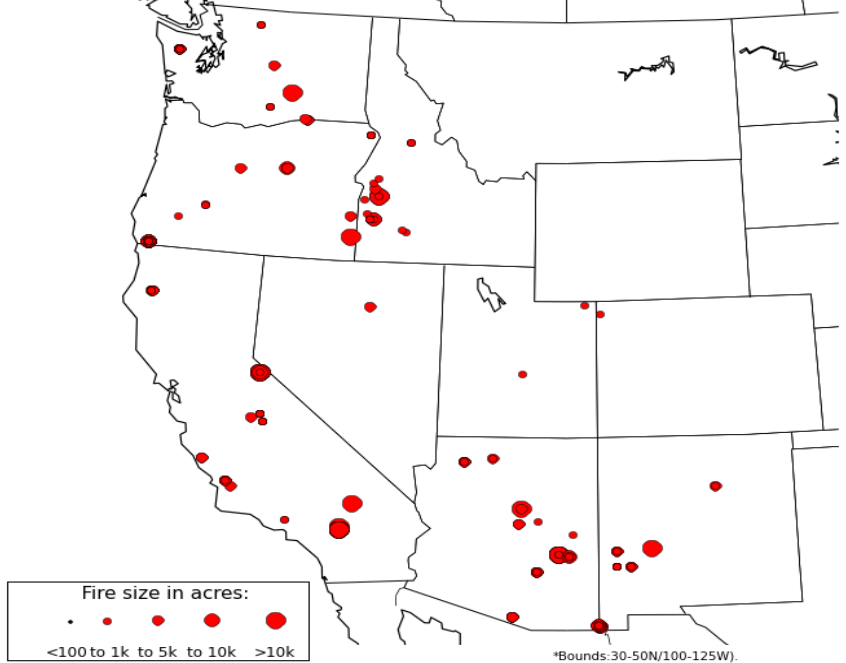
Idaho total of 3.25 million acres burned in 10k+ acre fires since 2011. ~50% in 2012 and 25% in 2015.

Oregon #2 w/ ~3 million acres in 10k+ acre fires since 2011. 20% of the total in 2015.

CA and WA have seen just under 2 million total acres burned by megafires since 2011. 2012 worst year in CA with 700k acres burned. 2015, 2nd worst for CA, about 500k acres.

Megafires in Washington this year burned 1 million acres. 2015 was Washington's worst year since at least 2011.

June 2015 NIFC Large Fires*



*Bounds: 30-50N/100-125W).
Data: NIFC/USFS. Mapping by G. Carbin



Fernanda Santos, NYT/Twitter



2011 2012 2013 2014 2015



Almaden Res., San Jose, Calif. (Justin Sullivan/Getty)

#6-7

Western U.S. Heat, Drought, Fire

- **Warmest Year on Record, Western U.S.**
- **Drought Recovery Not in Sight**
- **Wildfire Activity Extreme and Extensive**

#8 Deadly Flash Flooding, Southern Utah



September 14, 2015

7 adult explorers killed
in Zion NP canyon flash
flood.

12 dead, 1 missing
when 2 vehicles swept
away in flash flood.

Hildale

BRYC
CANYO
NATIONA
PAR

ARIZONA

GRAND CANYON
NATIONAL PARK

20
20

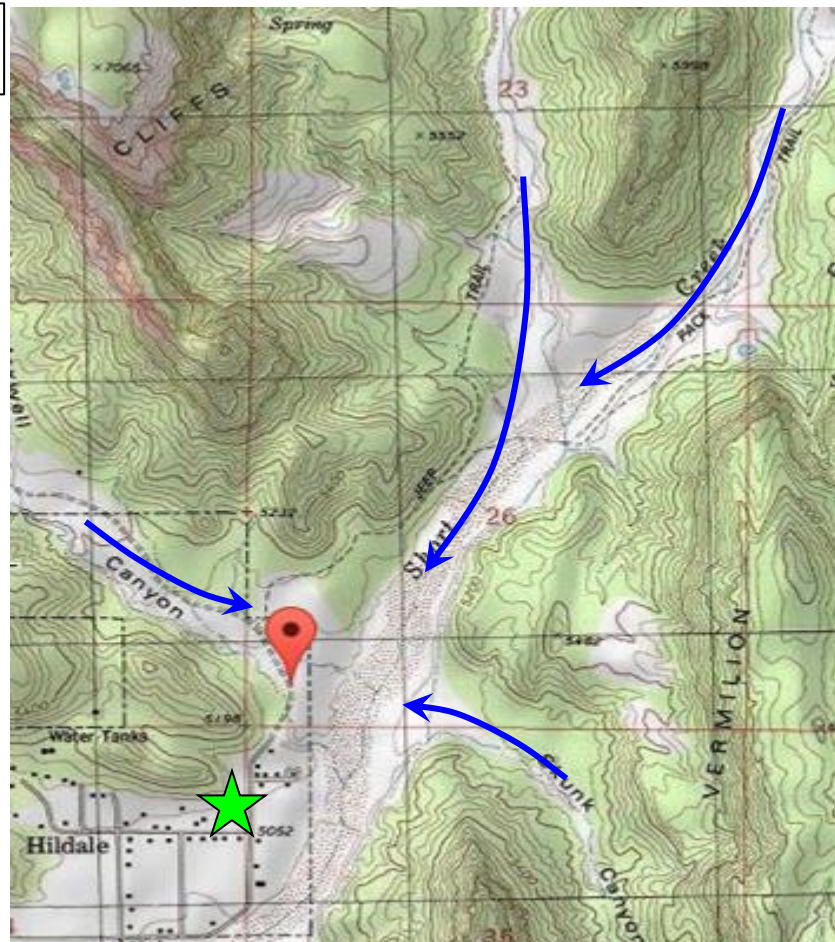
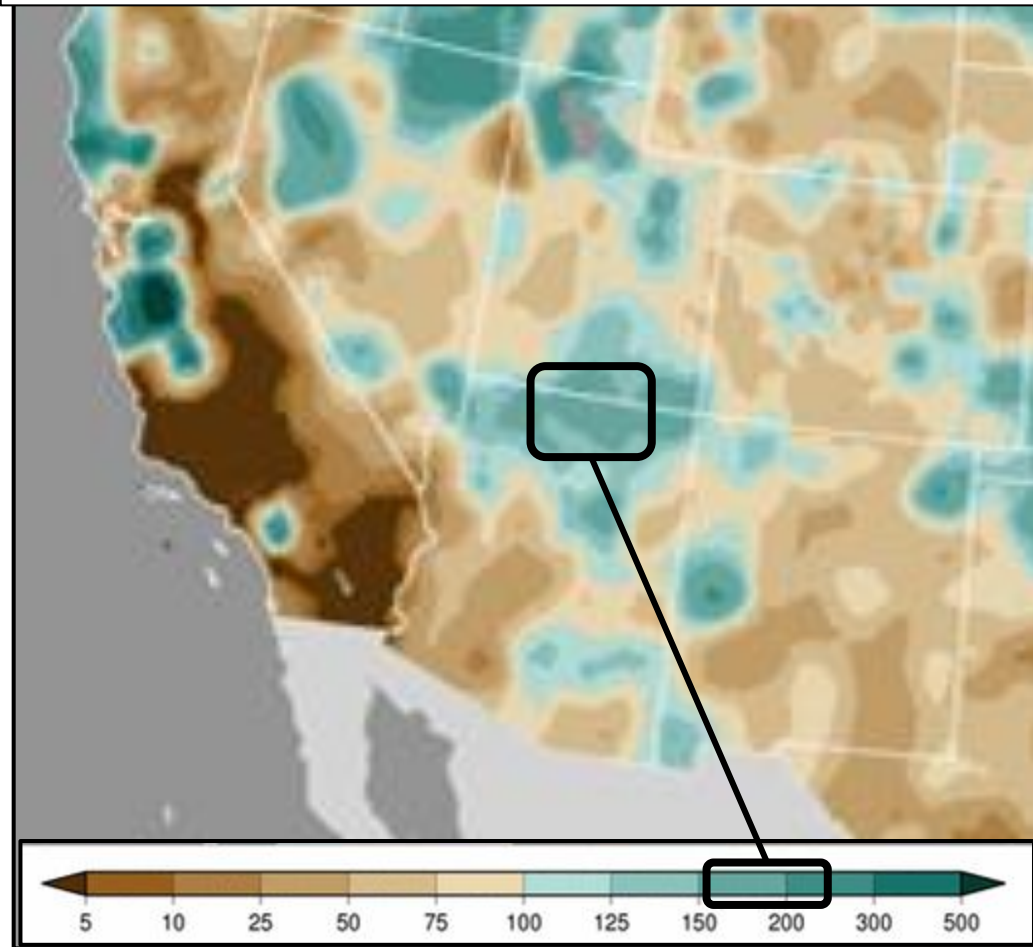


SOURCE: maps4news.com

Flash Flood Equation

Saturated Ground + Terrain +

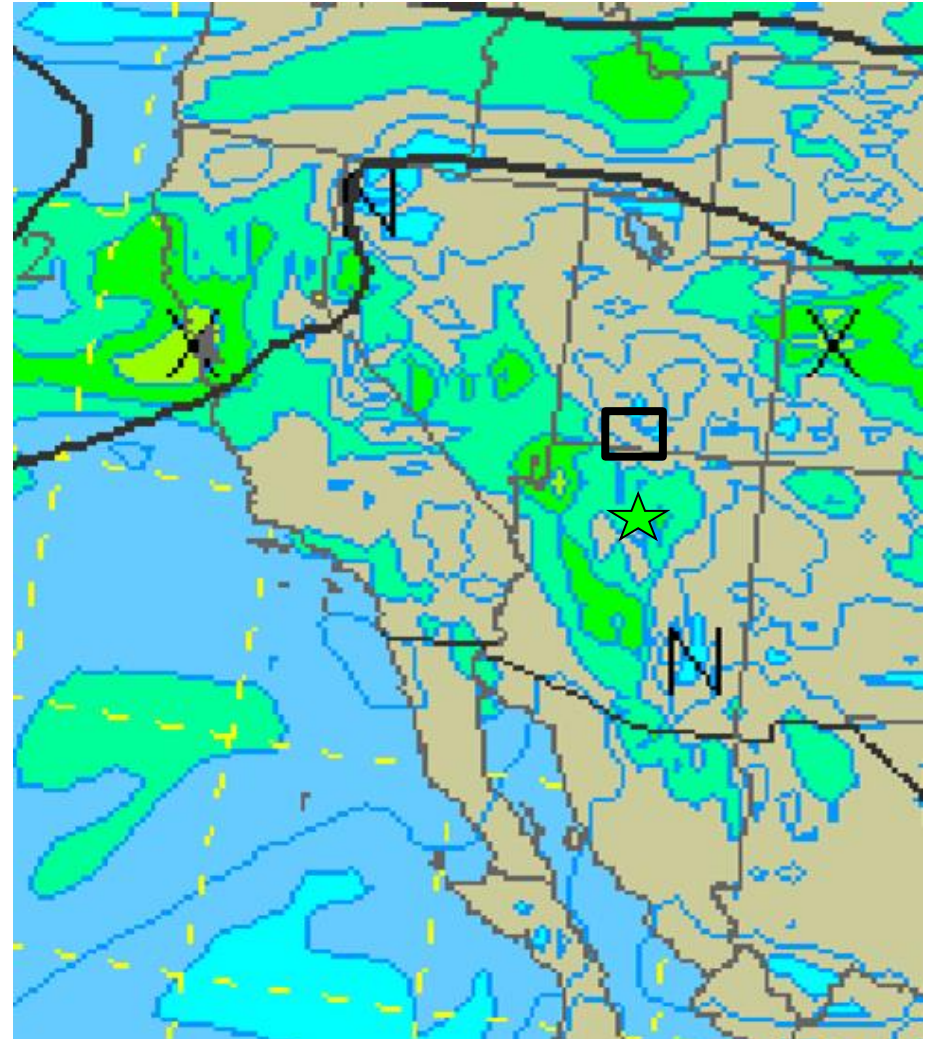
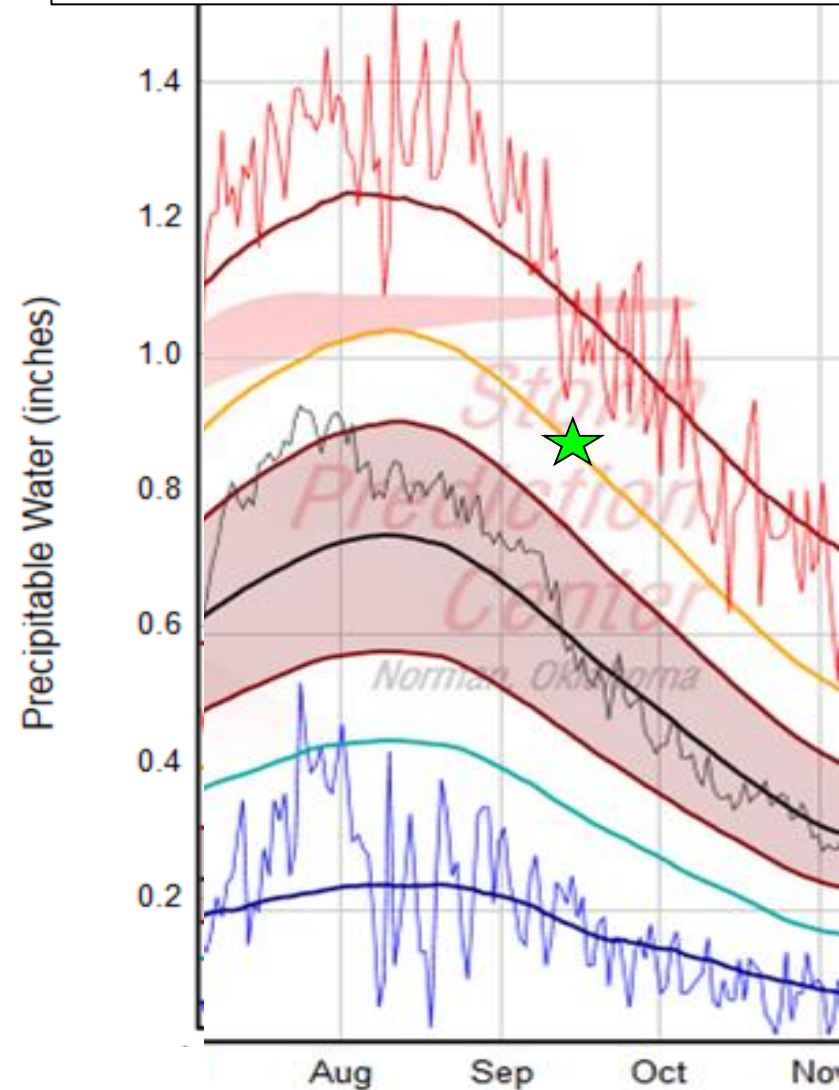
Aug. 2015 rainfall was well above normal



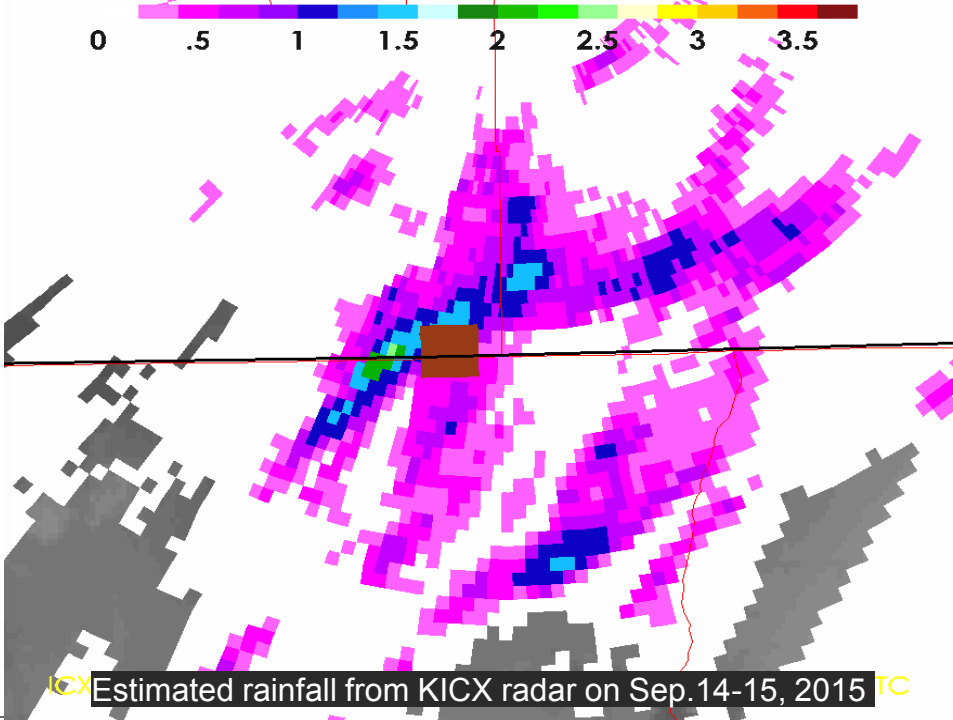
Hildale at mouth of four canyons

Anomalous Moisture + Shortwave Troughs

★ Flagstaff, AZ Sep. 14, 2015 PW



500mb heights/vort Sep 14-15, 2015



Michael Chow/The Arizona Republic

#8

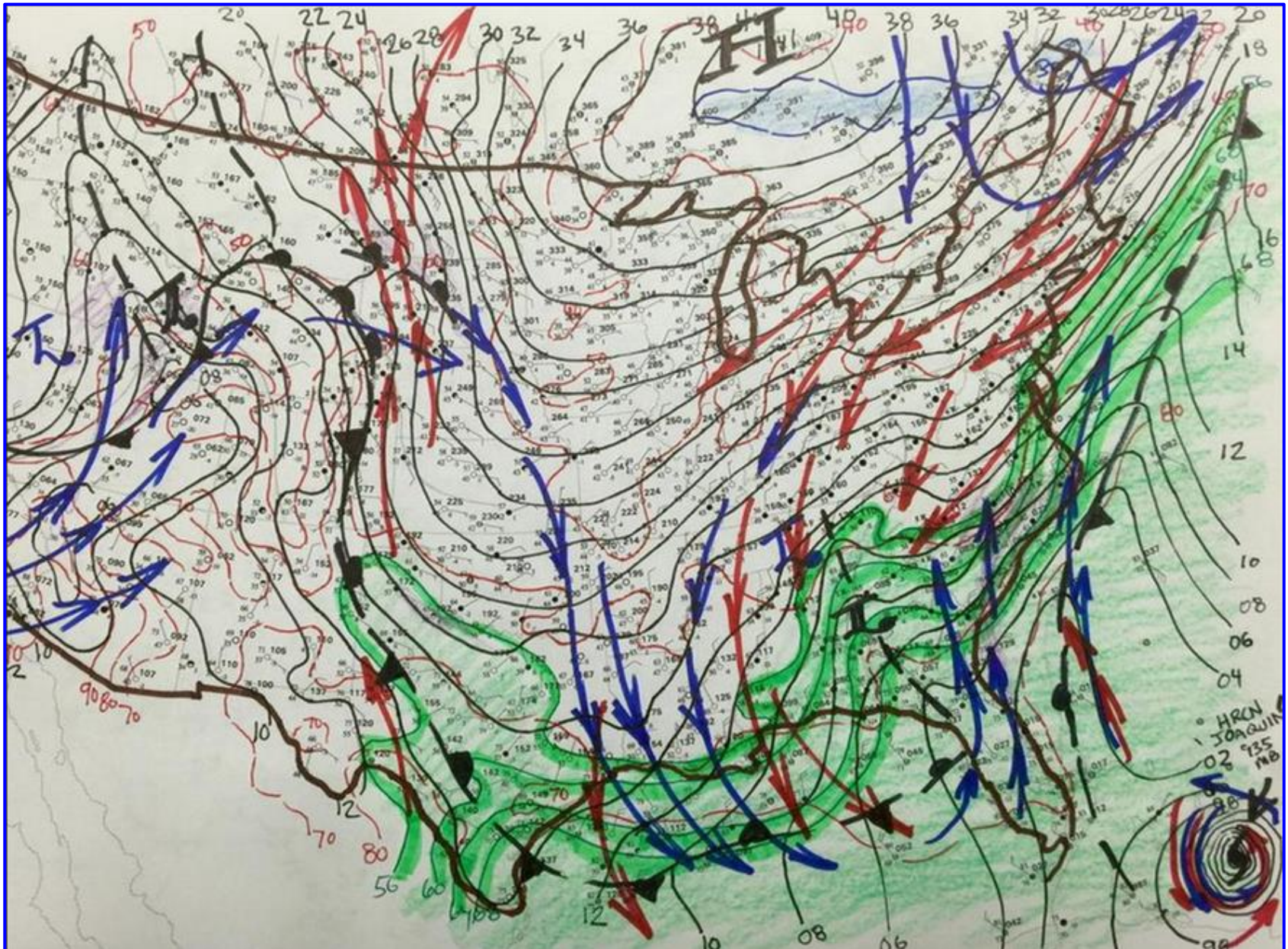
Deadly Flash Flooding, Southern Utah

- **20 Fatalities (2x '15 tornado deaths)**
- **Deadliest Flash Flood Event of 2015**
- **Zion NP Reconsidering Permit Process**

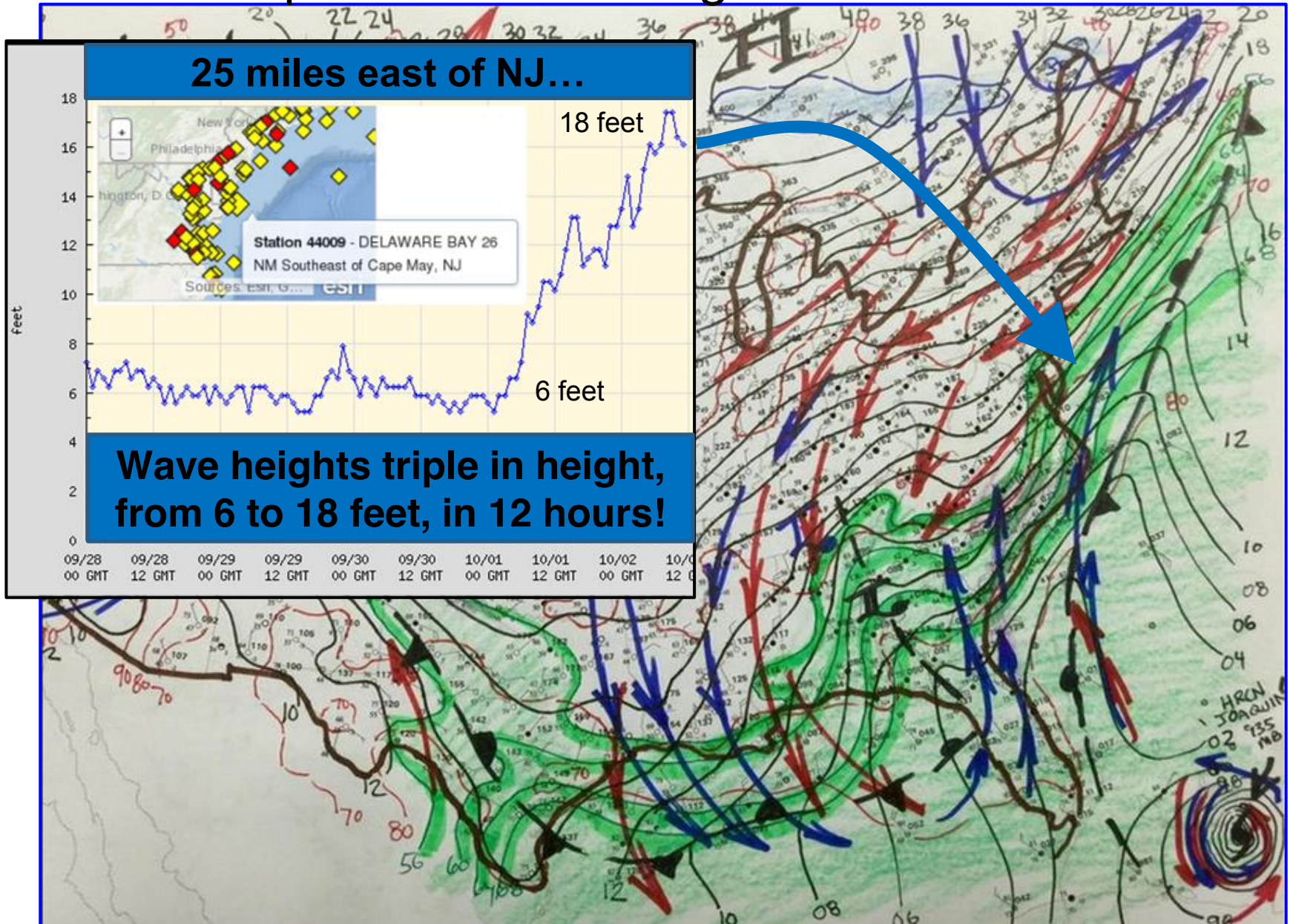
#9 Joaquin and South Carolina Rain



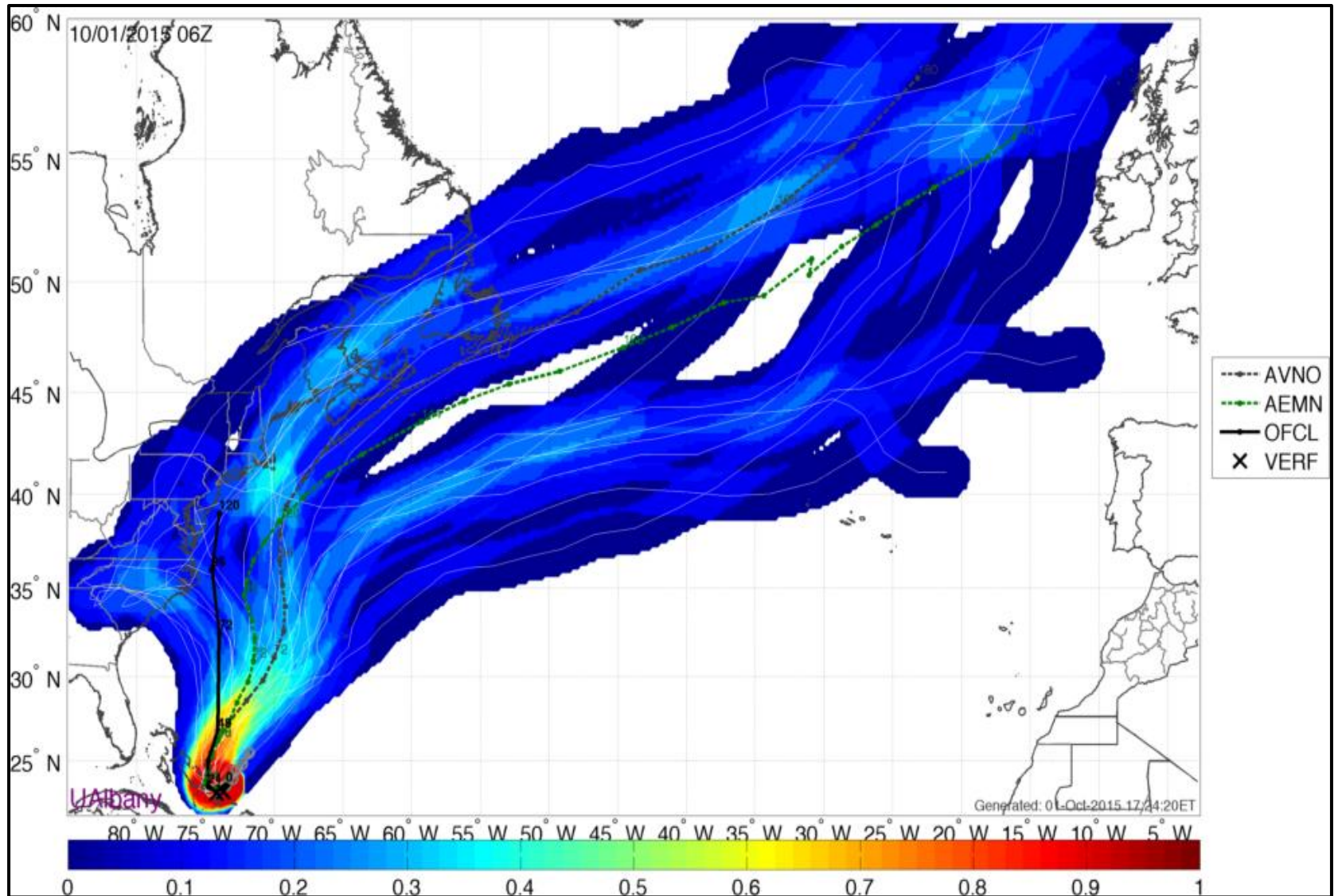
The Coalescence of Chaotic Coincidence



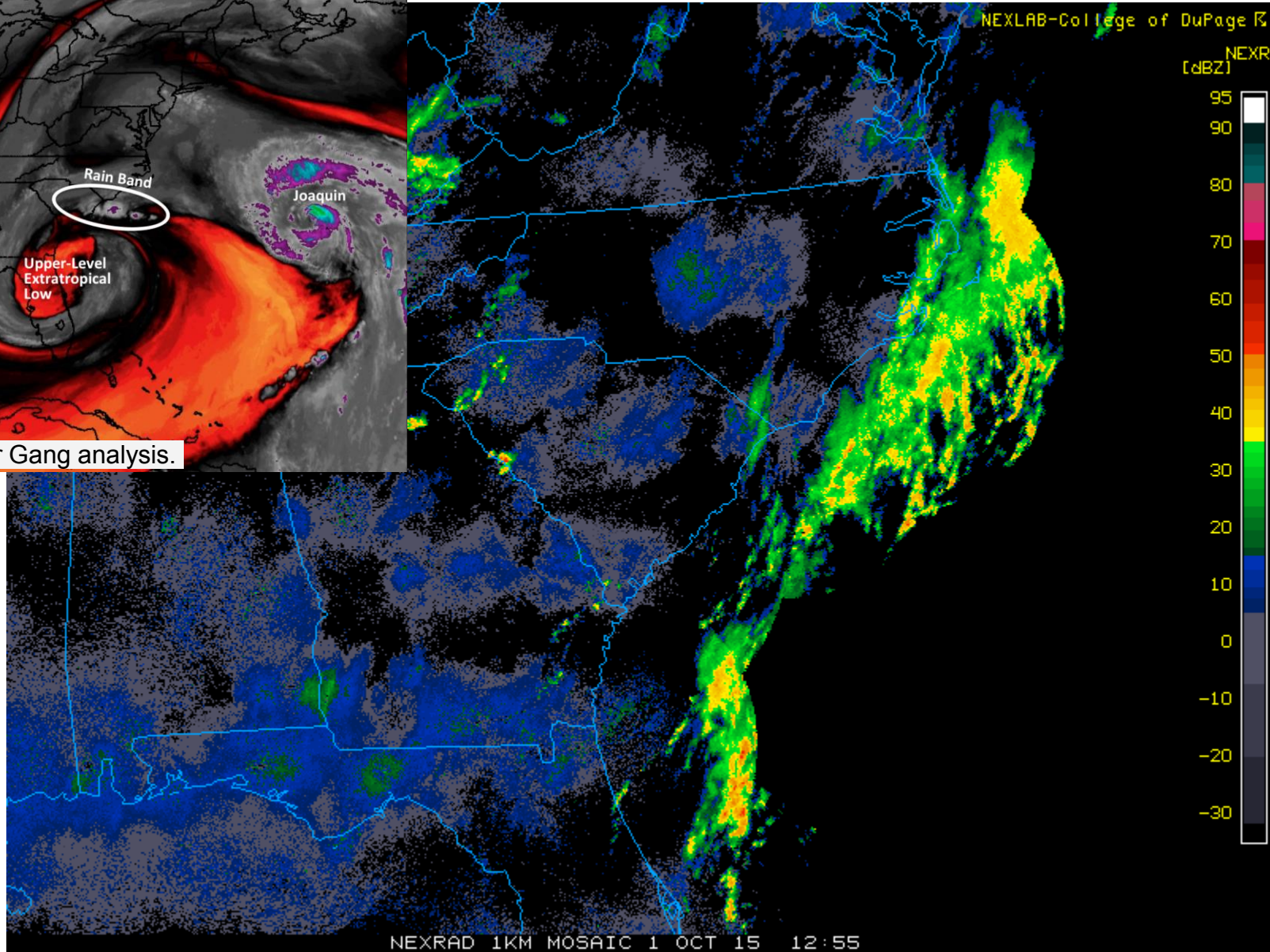
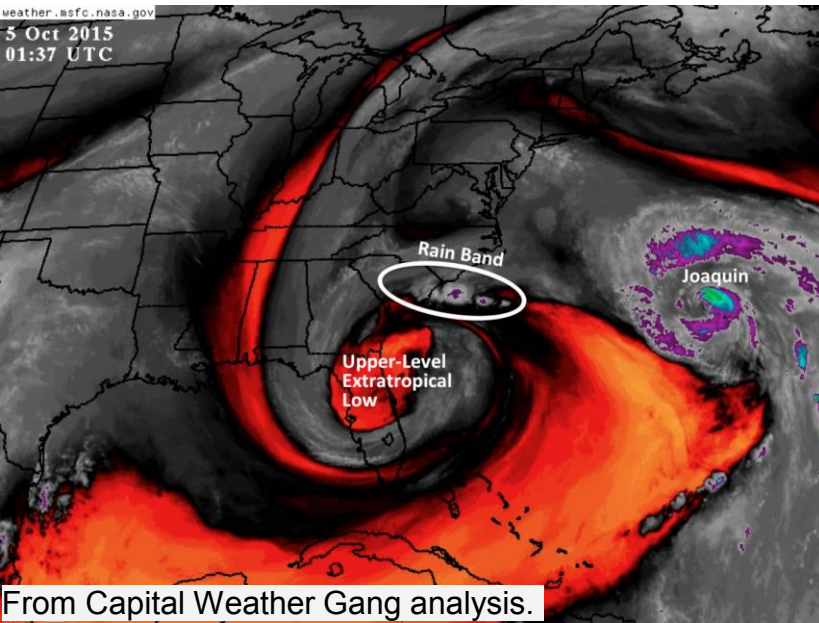
The Atmosphere Was Moving A LOT of Water Around



Other Things Were Moving Around Too!

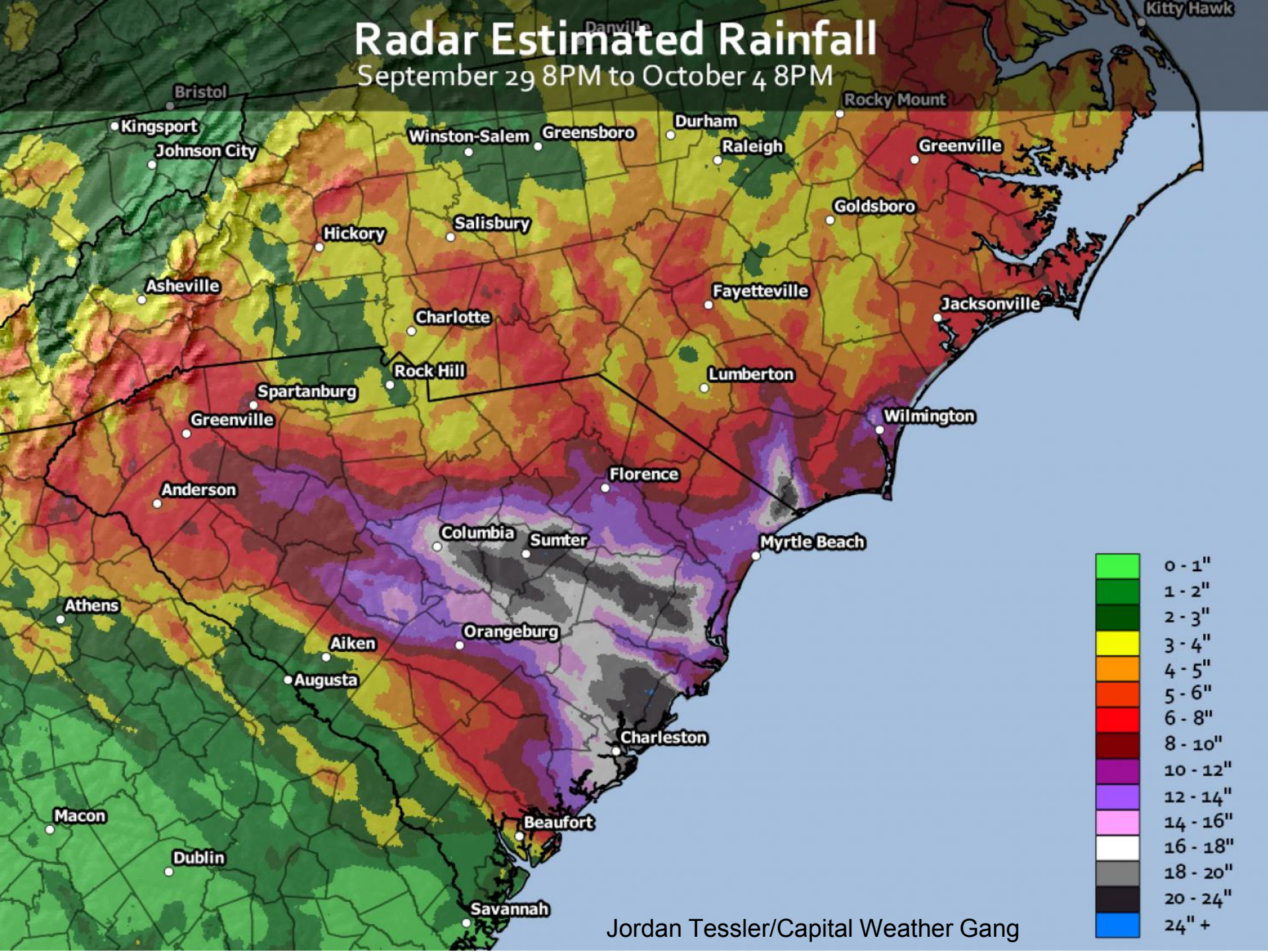


Oct. 1-5, 2015 Radar Loop and Oct. 5 "Big Picture"

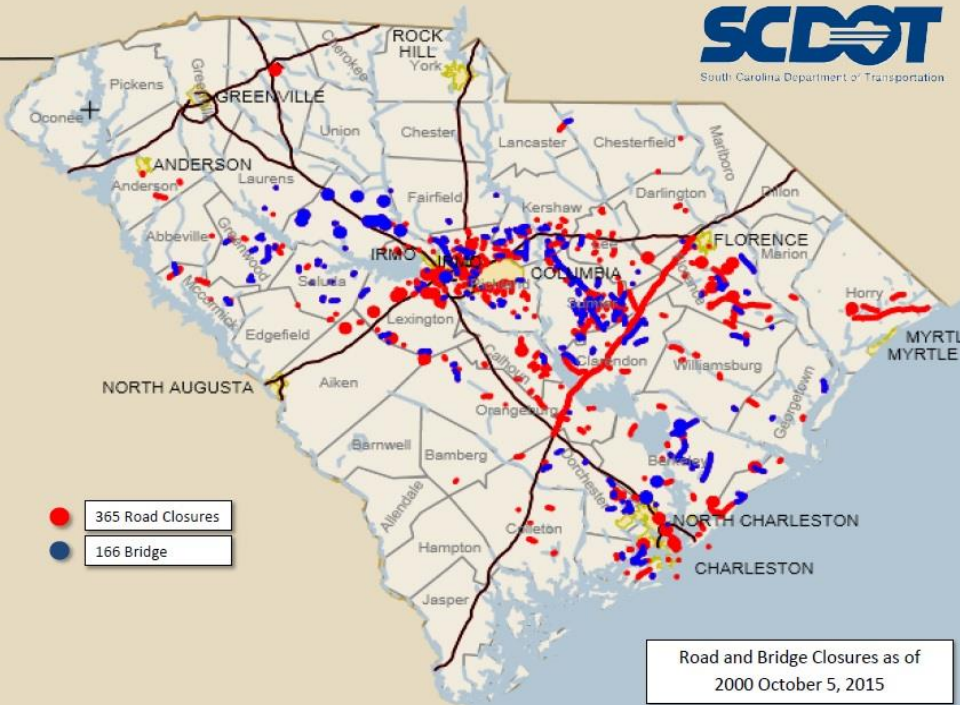


Radar Estimated Rainfall

September 29 8PM to October 4 8PM



Jordan Tessler/Capital Weather Gang



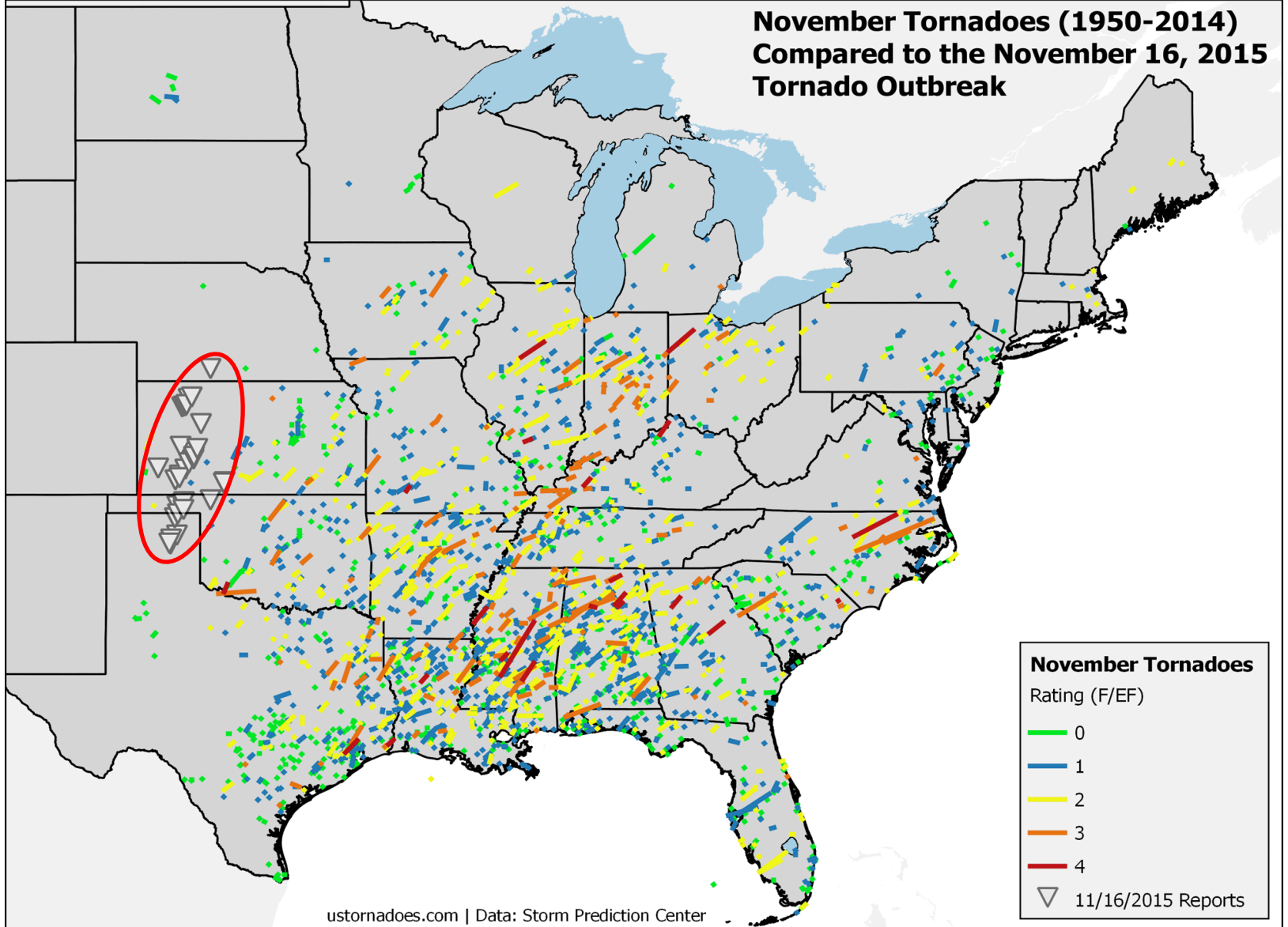
#9

Joaquin and South Carolina Rain

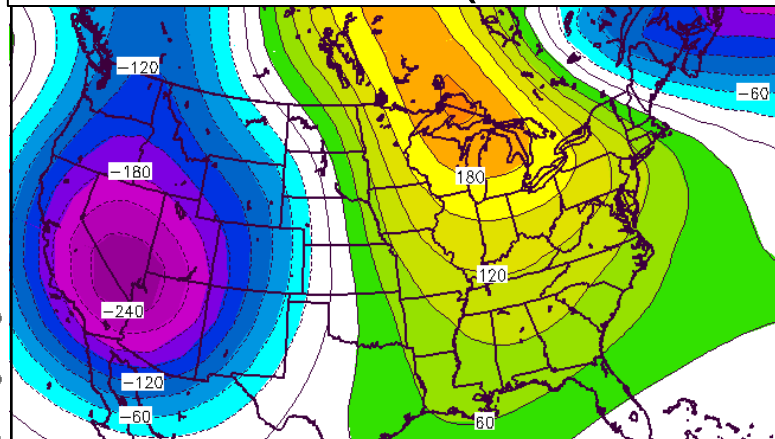
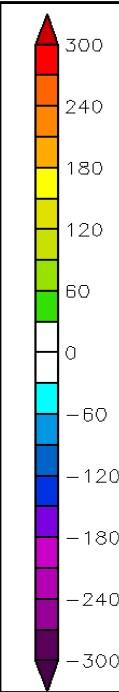
- Tropics + Jet + Topography = 1000y Rainfall
- 21 Deaths NC/SC (as of Oct. 11)
- Hundreds of Dam Failures/Major Road Dmg.

#10

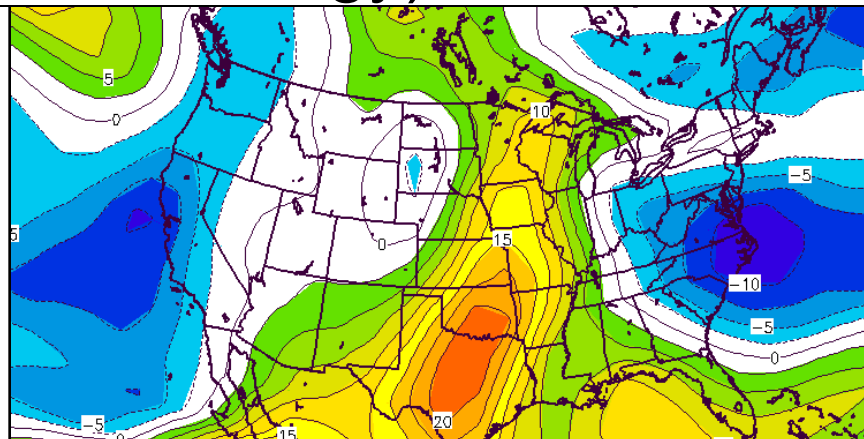
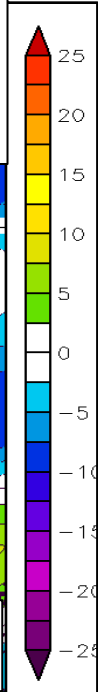
High Plains Tornadoes... in November!



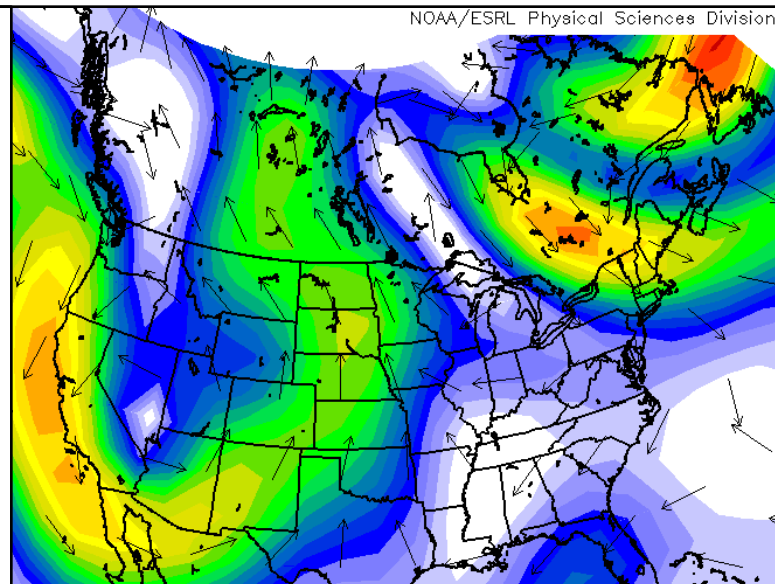
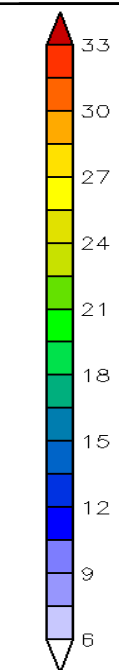
NOAA/ESRL PSD NCEP/NCAR Reanalysis (1981-2010 climatology)



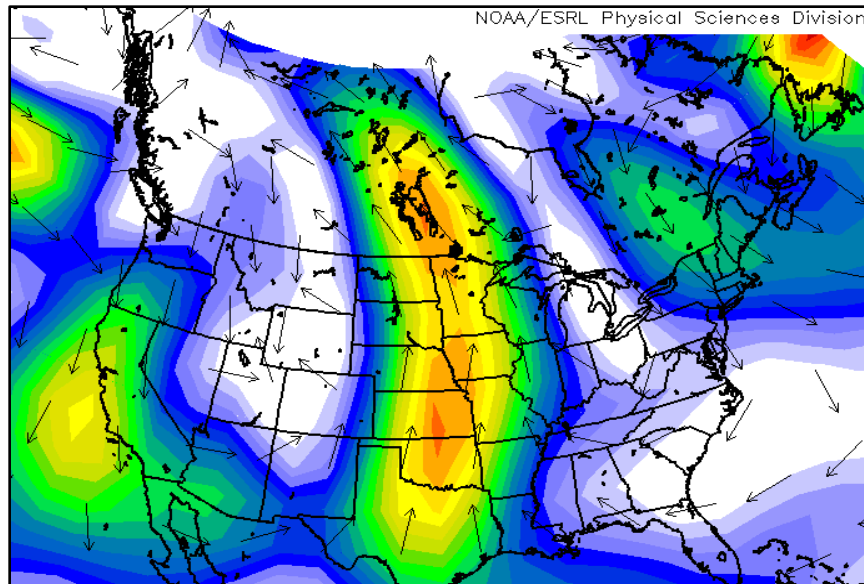
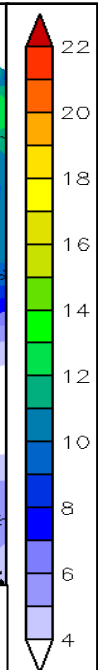
16-Nov 2015 500mb anomaly



16-Nov 2015 PW anomaly (mm)

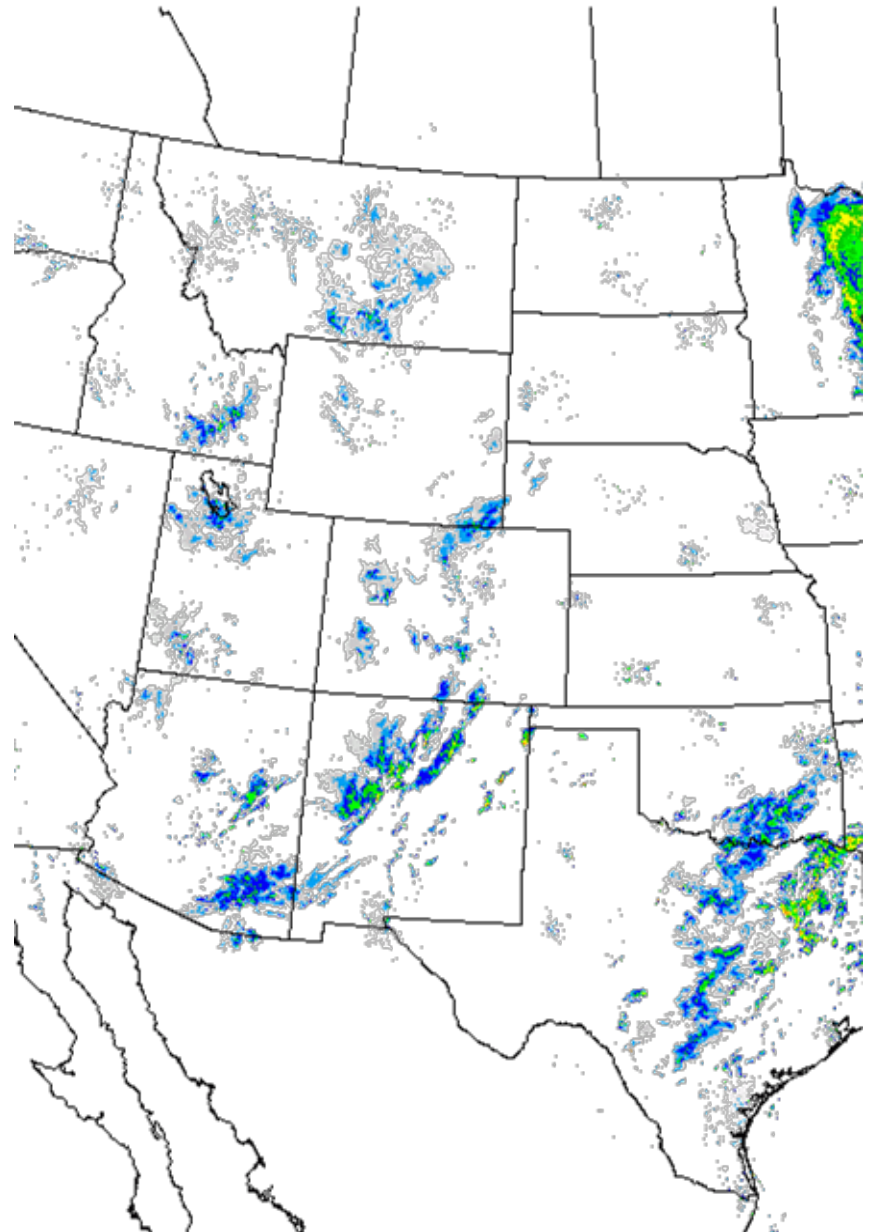
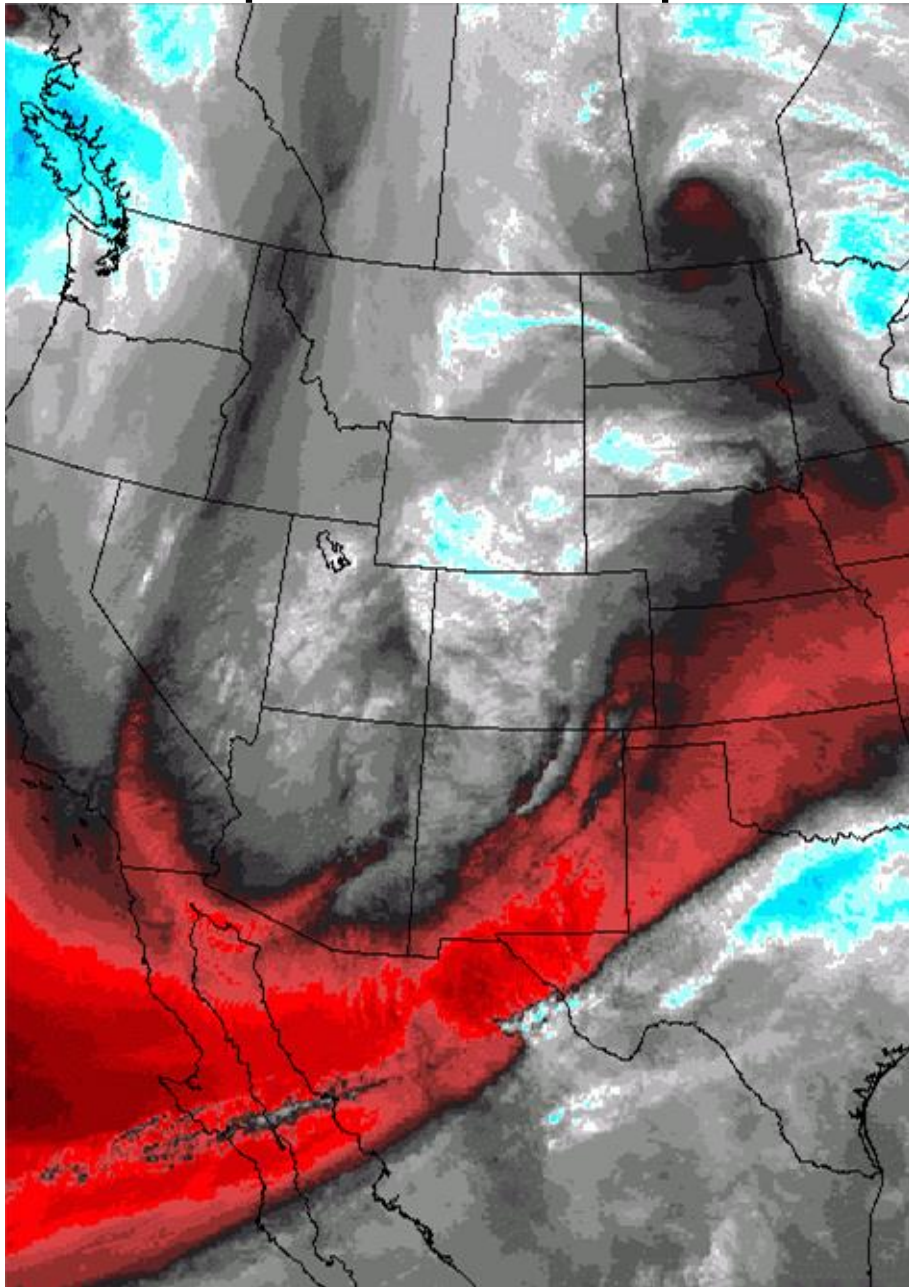


16-Nov 2015 H5 wind anomaly

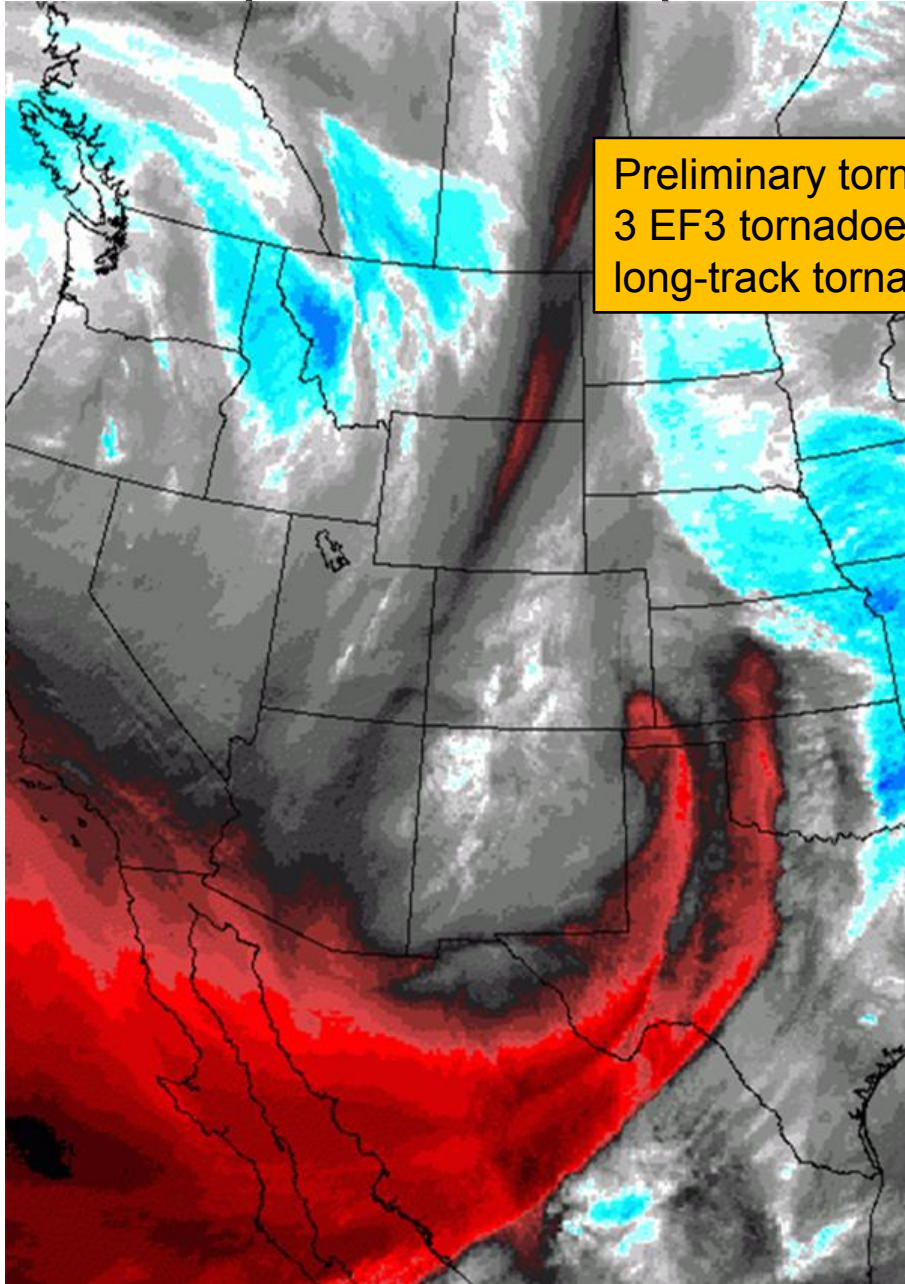


16-Nov 2015 H85 wind anomaly

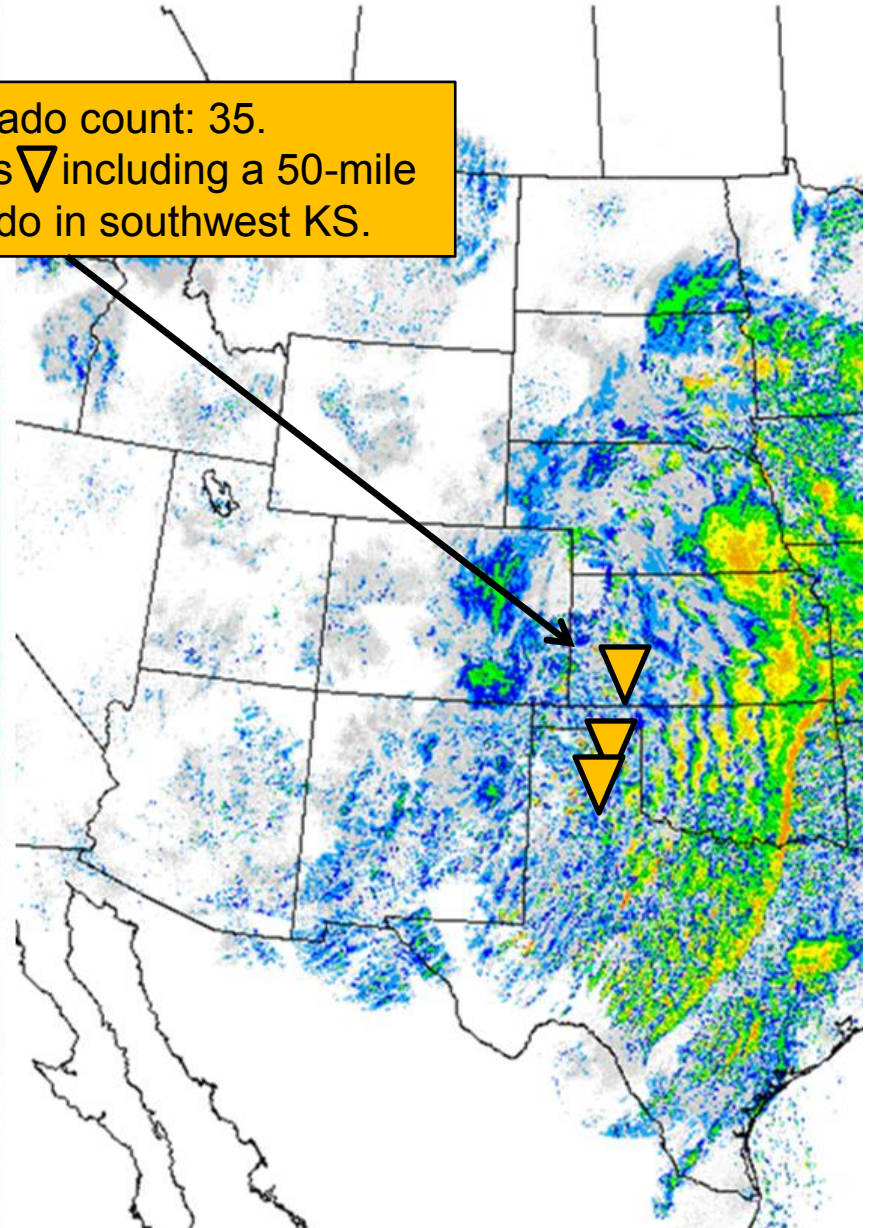
Water Vapor and Composite Radar 18-12 UTC 16/17 Nov.



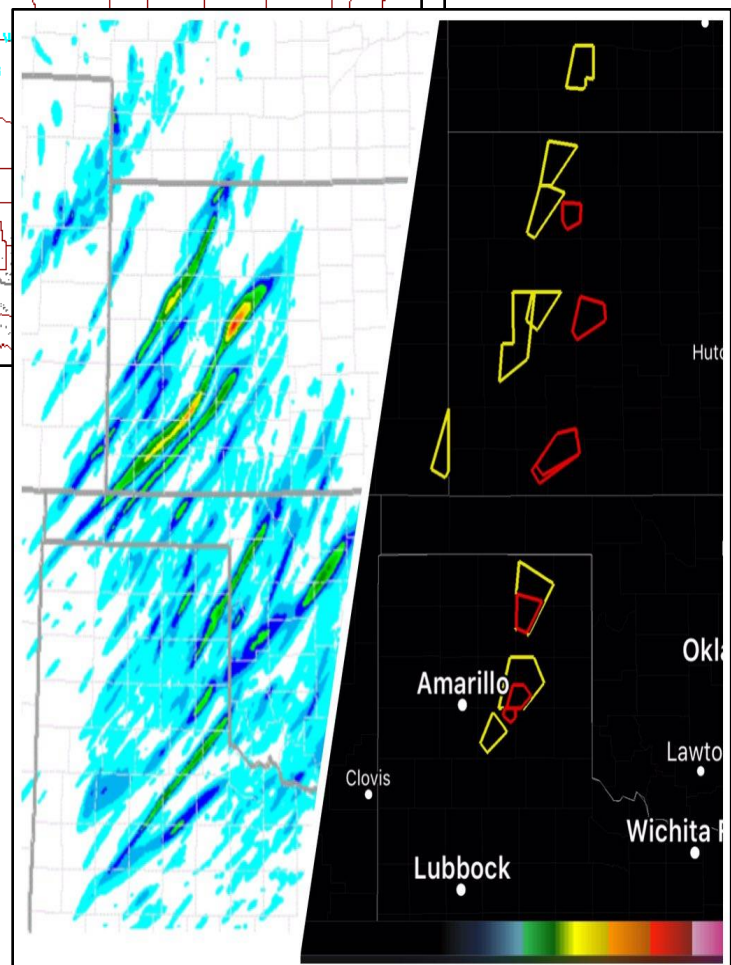
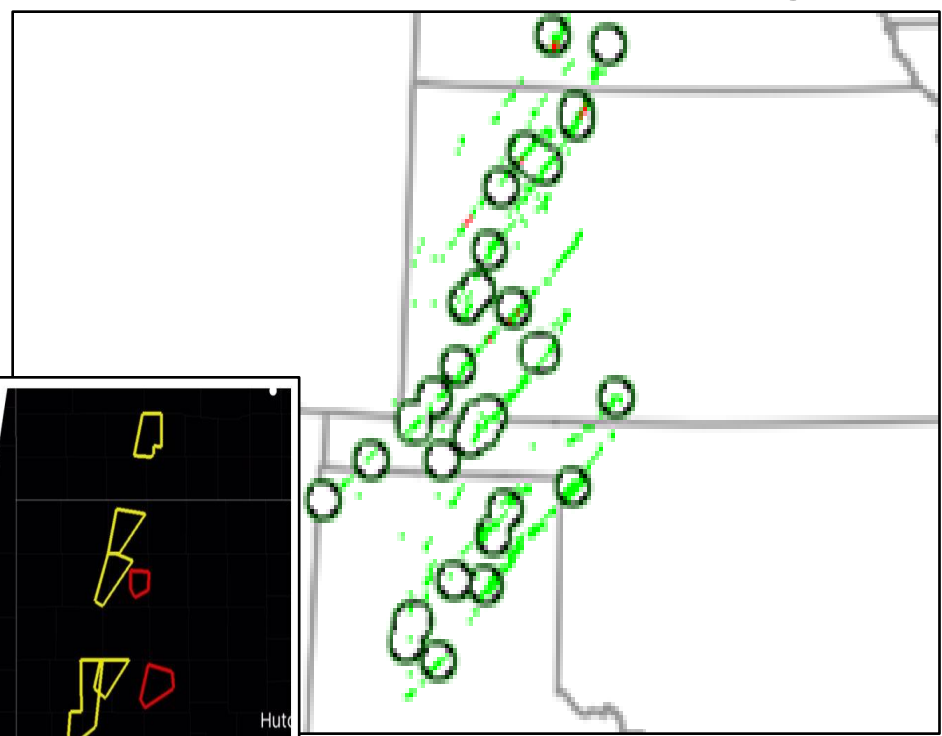
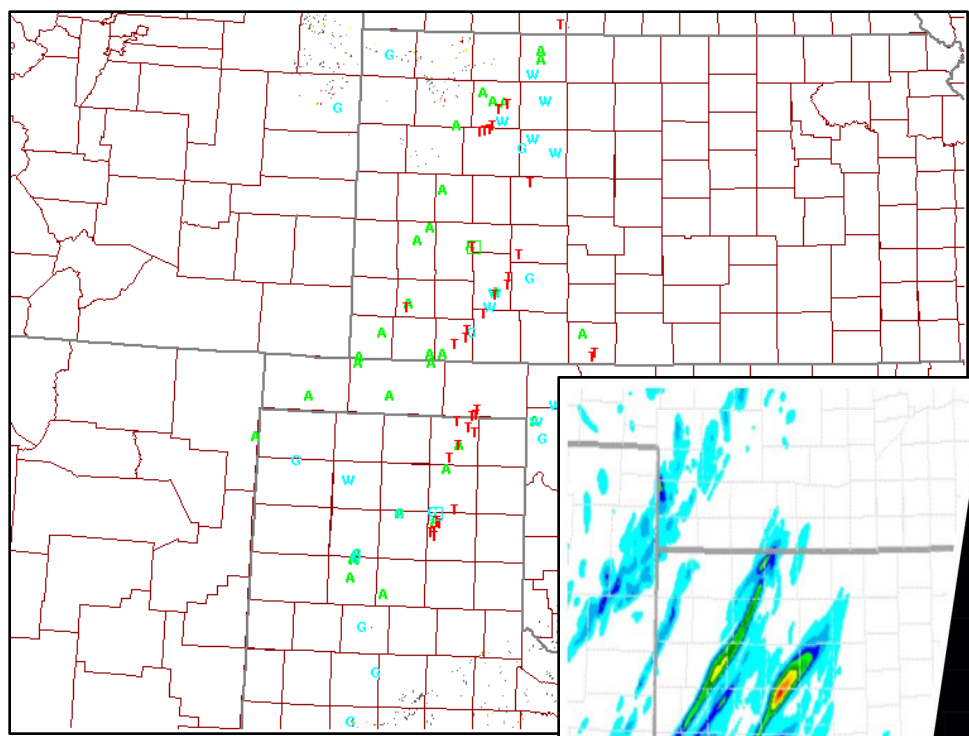
Water Vapor and Composite Radar 18-12 UTC 16/17 Nov.



Preliminary tornado count: 35.
3 EF3 tornadoes ▽ including a 50-mile
long-track tornado in southwest KS.



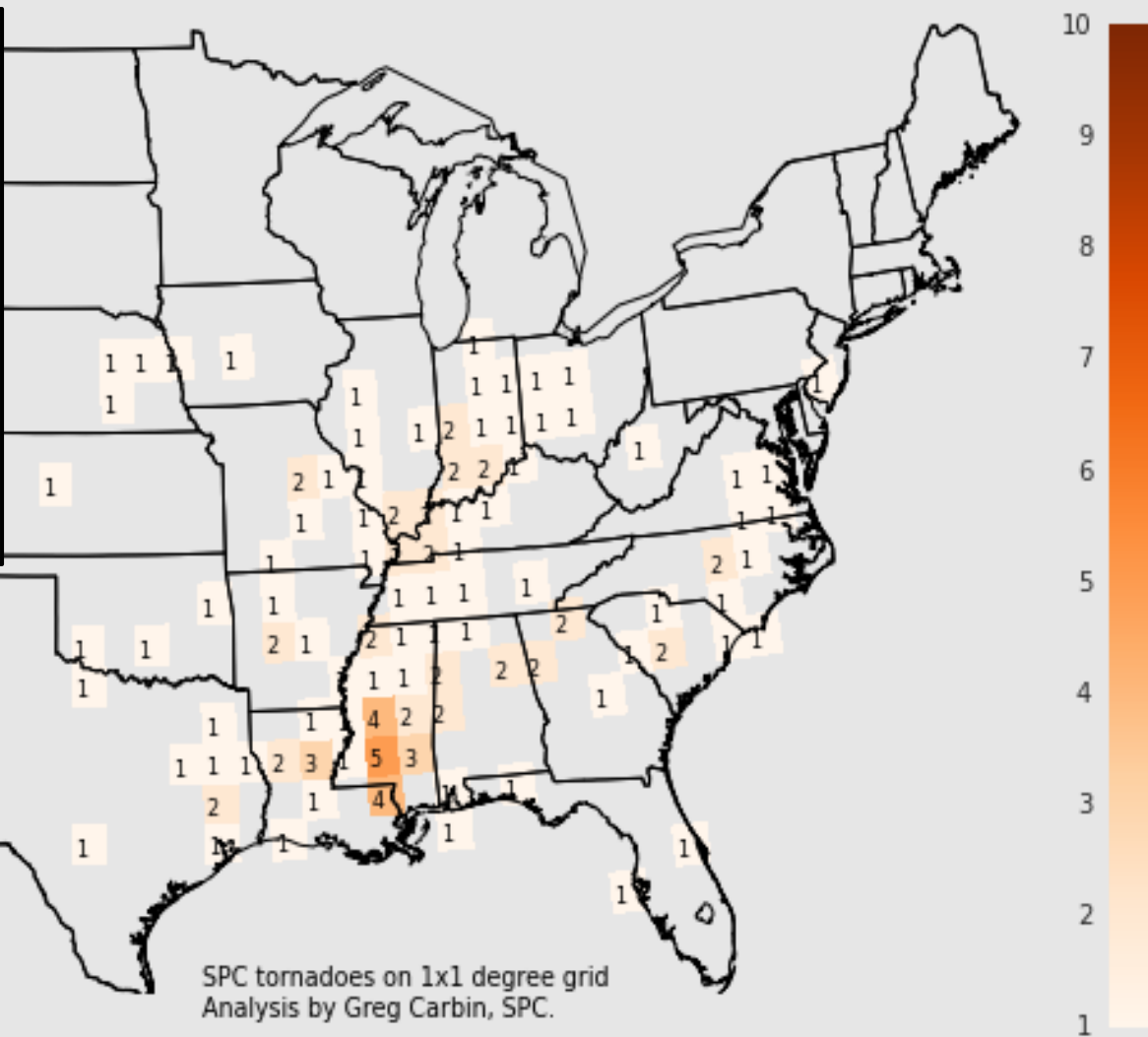
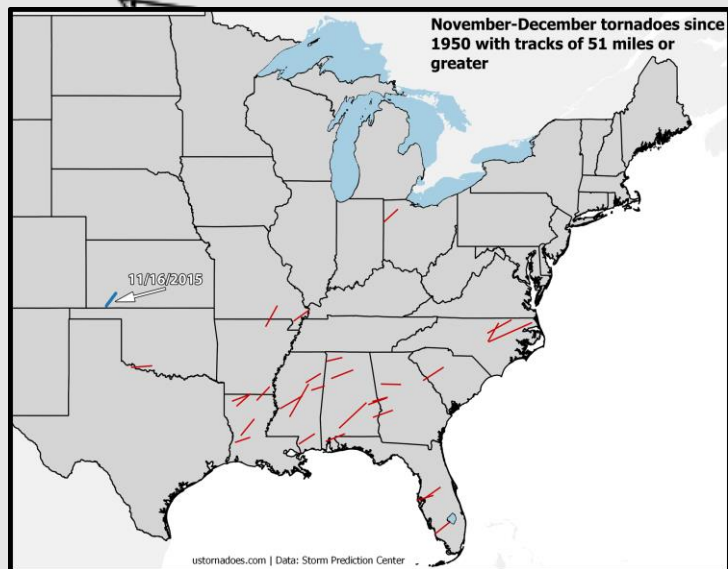
Reports, LLRT, MESH/LSR and Forecast Tracks & Warnings



(E)F3+ Tornadoes Occurring in Oct/Nov/Dec Since 1985

Nov-Dec Long-track Tornadoes Since 1950 (inset)

OND F3+ Tornadoes, 1985-2014 (total: 157, grid sum: 133)



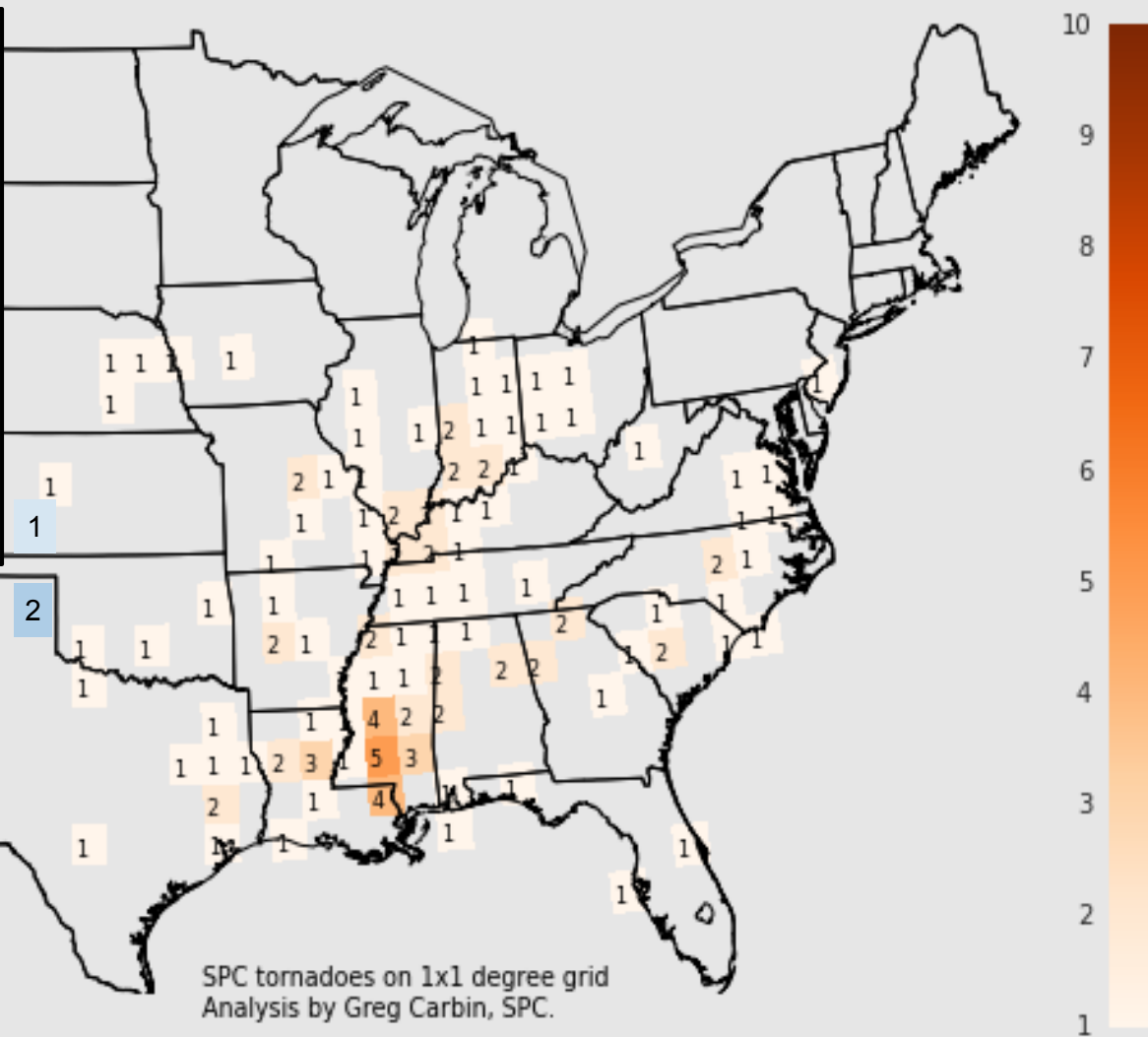
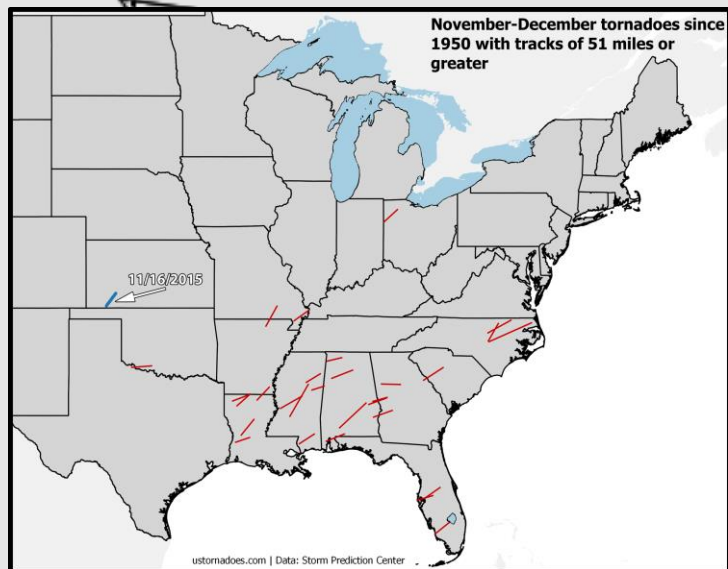
NOAA
National Weather Service
Storm Prediction Center



(E)F3+ Tornadoes Occurring in Oct/Nov/Dec Since 1985

Nov-Dec Long-track Tornadoes Since 1950 (inset)

OND F3+ Tornadoes, 1985-2014 (total: 157, grid sum: 133)



NOAA
National Weather Service
Storm Prediction Center





#10

High Plains Tornadoes in November

- **Unprecedented Event KS & TX Panhandle**
- **Powerful Storms through the Night in OK**
- **Longest November Tornado Track in KS**

Meteorological Memories of 2015

Meteorological Memories of 2015

Greg Carbin
NOAA/NWS Storm Prediction Center

1

#1 Boston Snowfall Records Buried

Stan Grossfeld Boston Globe

2



3



4

#4 April 9 Fairdale, IL EF4 Tornado

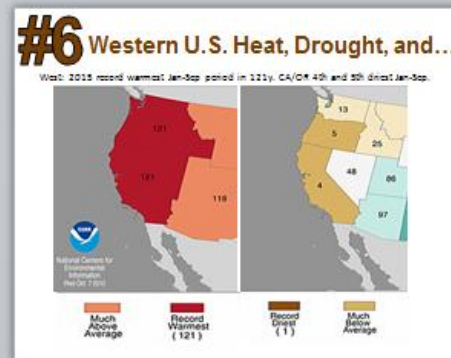
April 9, 2015 U.S. Storm Reports

Fairdale, IL 60146

5



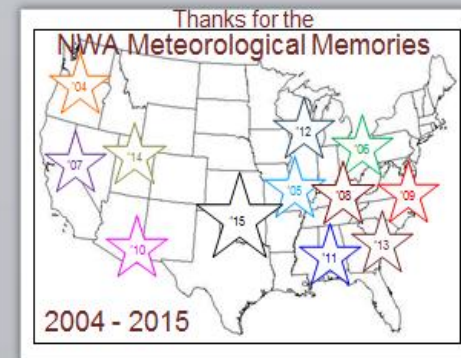
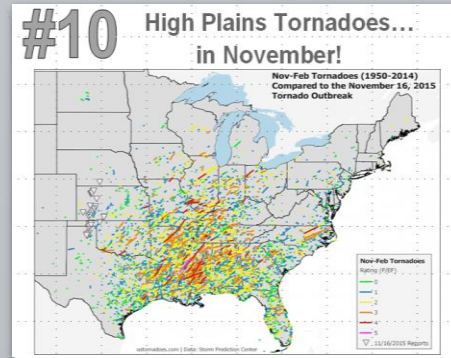
6



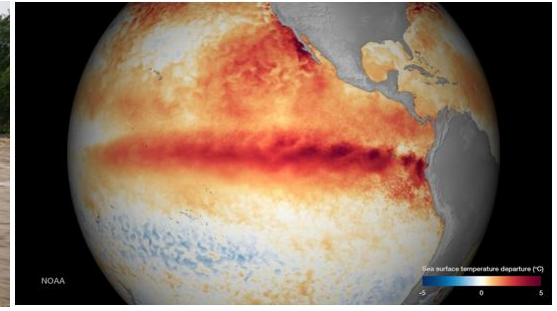
7



8



Meteorological Memories of 2015



Greg Carbin

NOAA/NWS Storm Prediction Center

