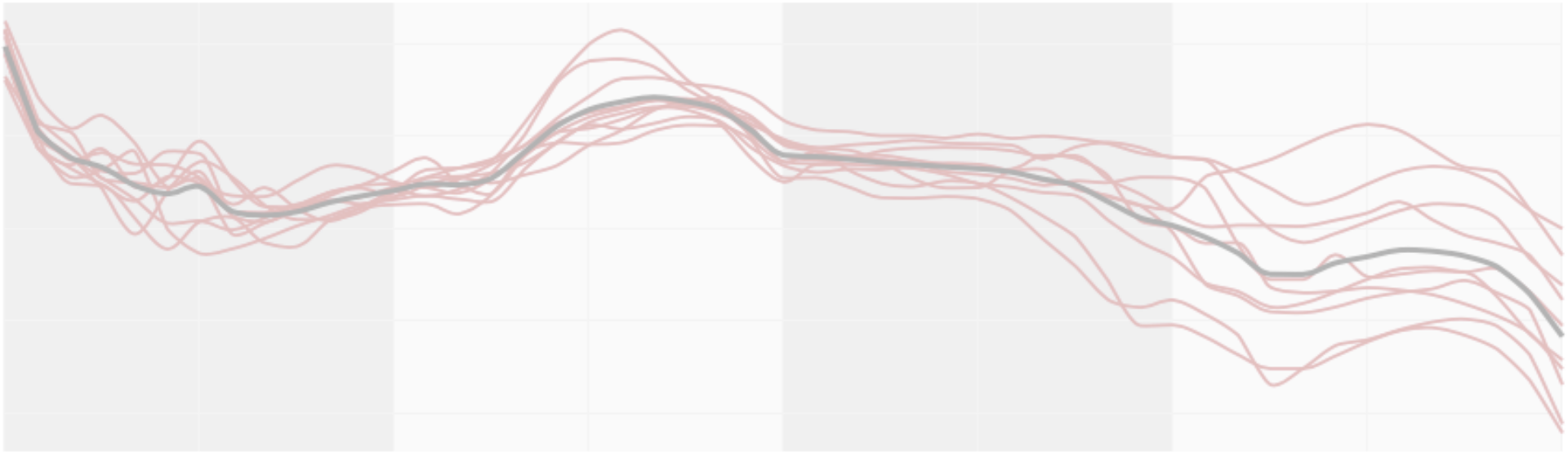
# Visualizing ensemble forecast information

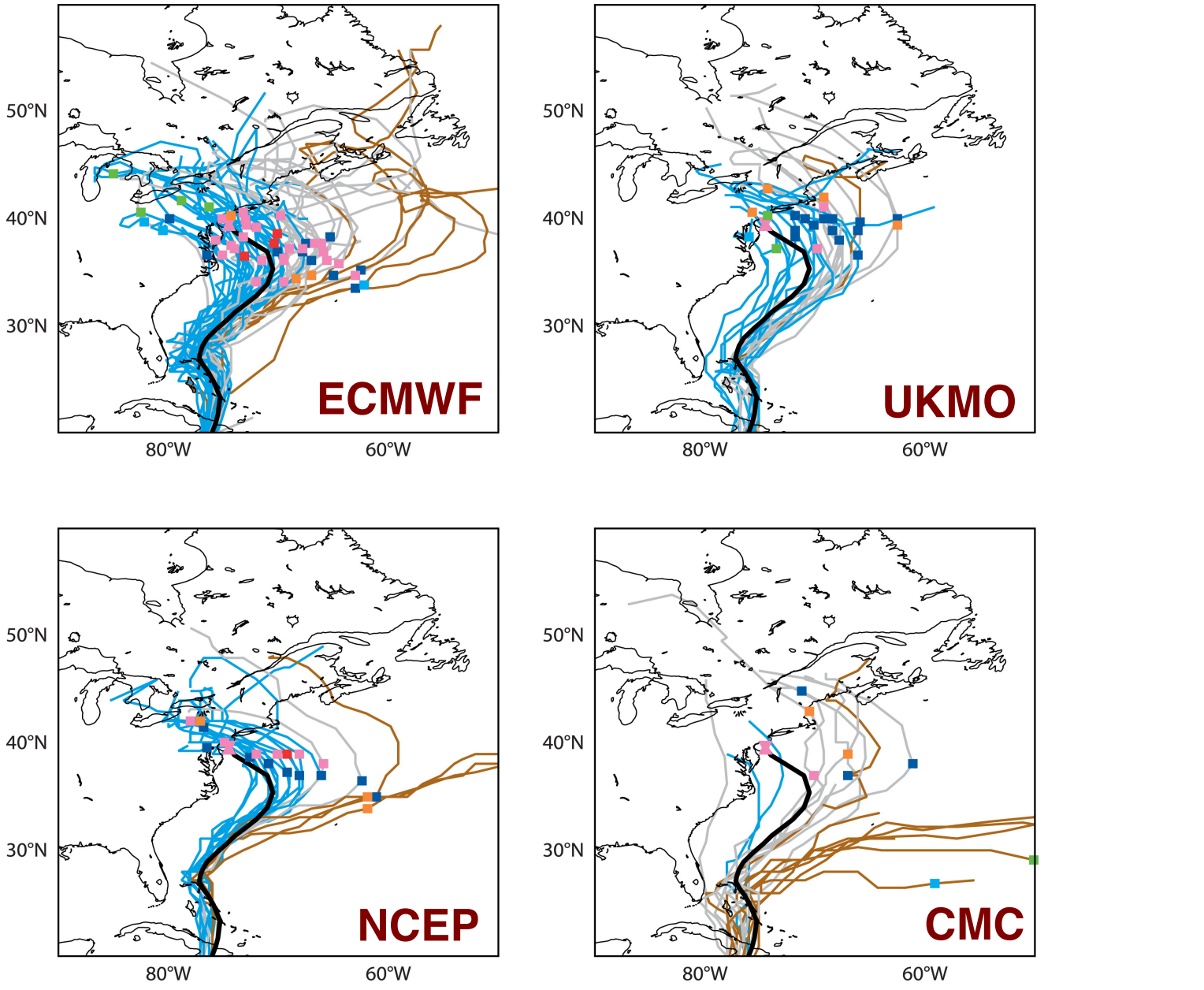
Ryan Sobash



2017 WRF Users' Workshop: Ensemble Forecasting Tutorial

NCAR
NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

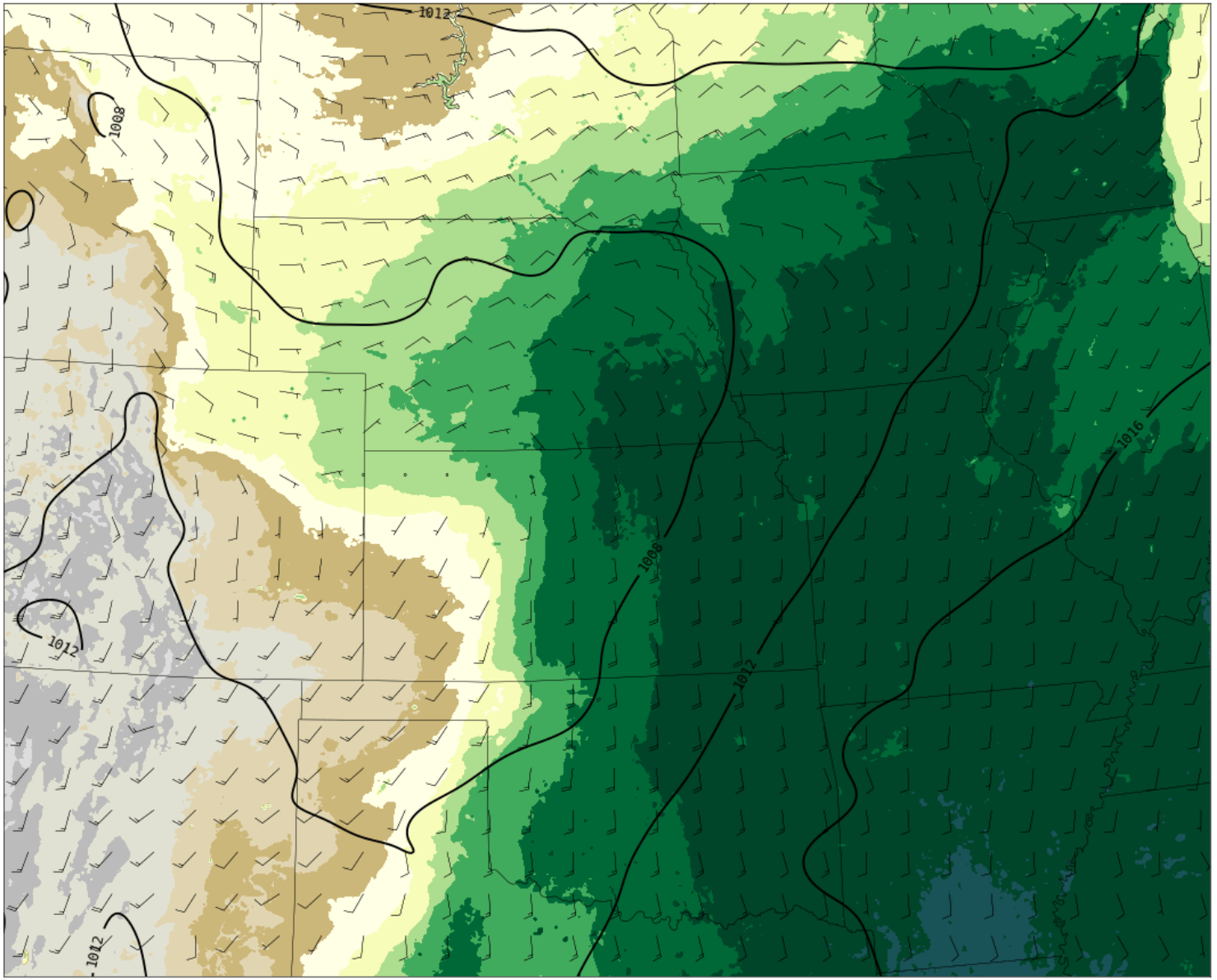
# Hurricane Sandy ensemble forecasts initialized 12 UTC 24 Oct 2012




Adapted from
Magnusson et al. (2014)

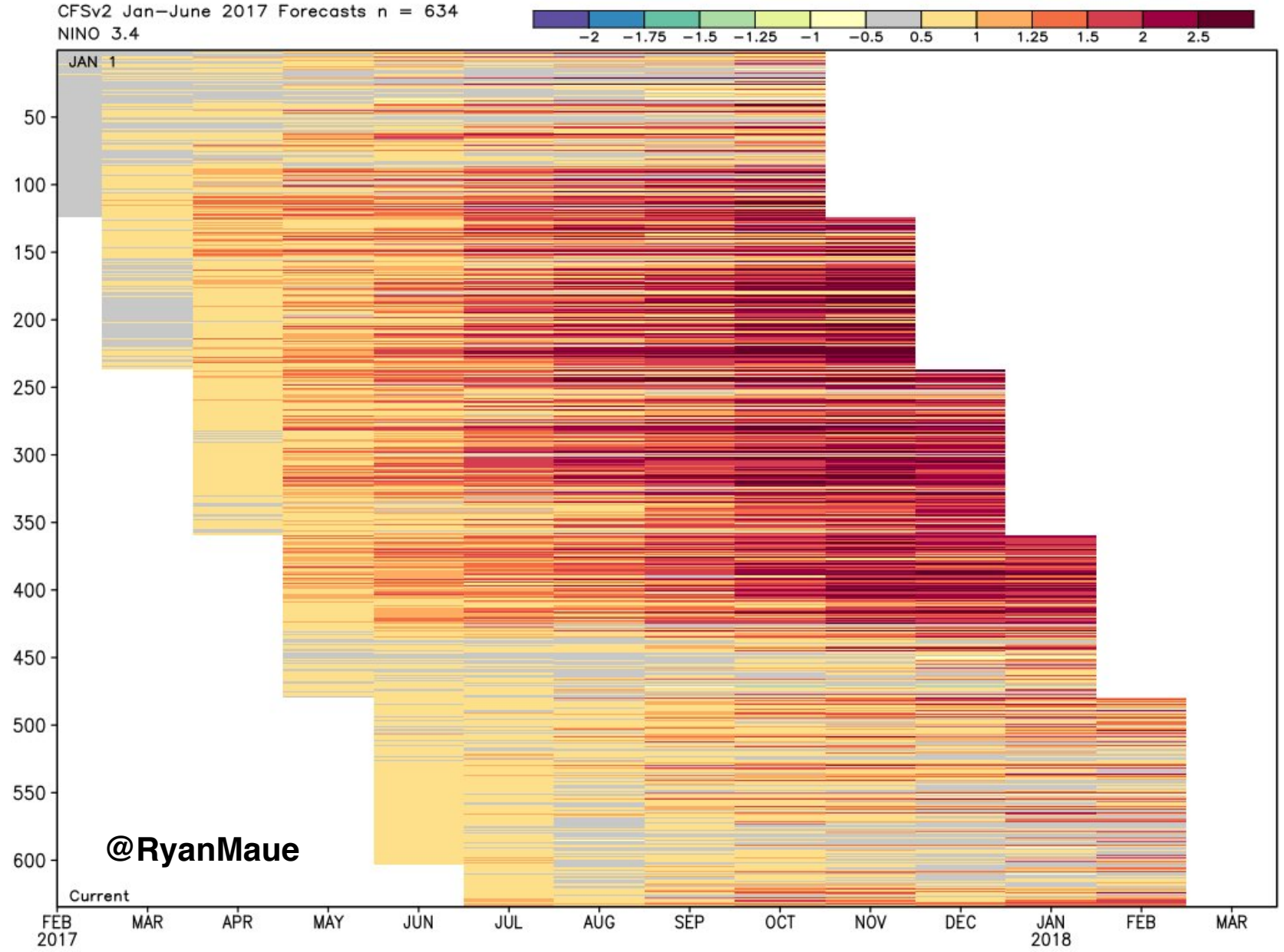
Ensemble mean 2-m dewpoint (fill; F), MSLP (contour; hPa), and 10-m wind (kts)

Init: Sun 2017-06-11 00 UTC
Valid: Mon 2017-06-12 18 UTC




NCAR
ensemble.ucar.edu

−20 −15 −10 −5 0 5 10 15 20 25 30 35 40 45 50 55 60 64 68 72 76 80


CFSv2 Jan–June 2017 Forecasts n = 634
NINO 3.4
−2 −1.75 −1.5 −1.25 −1 −0.5 0.5 1 1.25 1.5 2 2.5
JAN 1
50
100
150
200
250
300
350
400
450
500
550
600
@RyanMaue
Current
FEB 2017
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN 2018
FEB
MAR

# http://**ensemble.ucar.edu**

**NCAR Ensemble Forecasts**
Initialized: **00 UTC Wed 29 Jun 2016**

Surface / Precip | Upper-Air | Severe | Winter | Hourly-Max | Domains

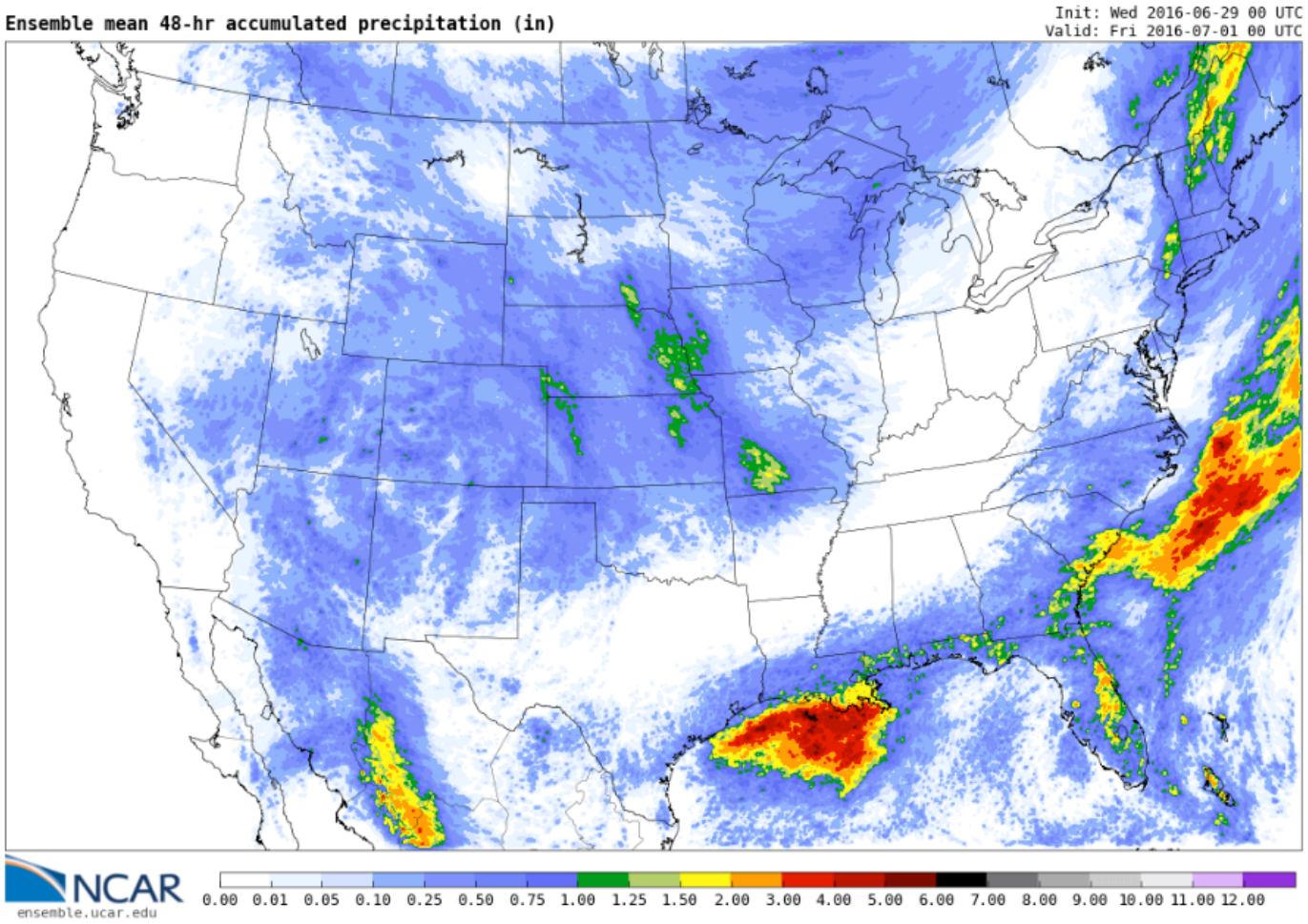
**Ensemble Summary**

- **Ens Mean 48-hr Precip**
- Ens Mean 48-hr Snowfall
- Ens Mean 48-hr Freezing Rain
- Ens Mean 48-hr Sleet
- Ens Max 48-hr Updraft Helicity
- Ens Max 48-hr Updraft Speed
- Ens Max 48-hr Surface Wind

**What's New**

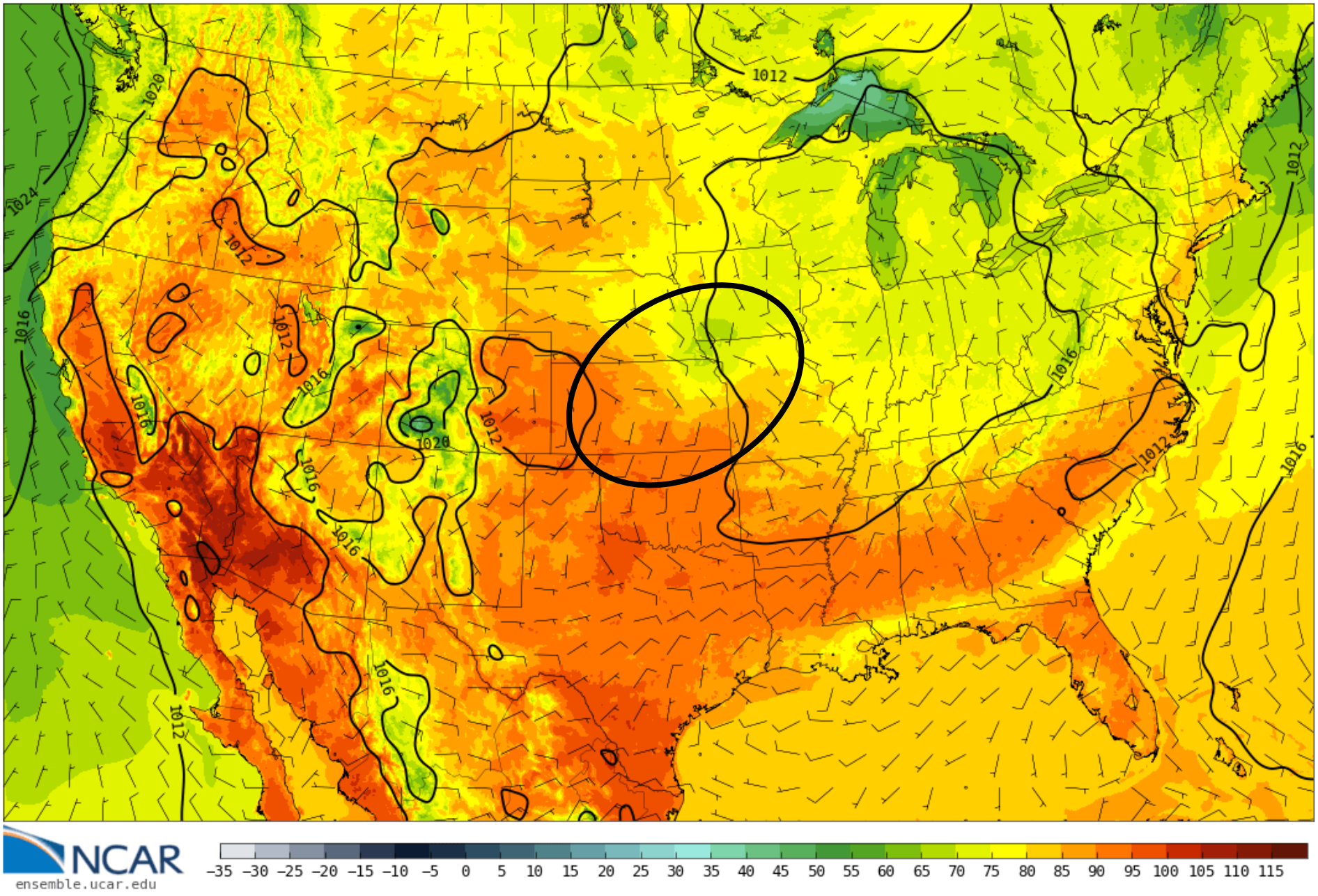
- **NEW**: Member Viewer for CREF/UH
- **NEW**: Ensemble Plumes Page

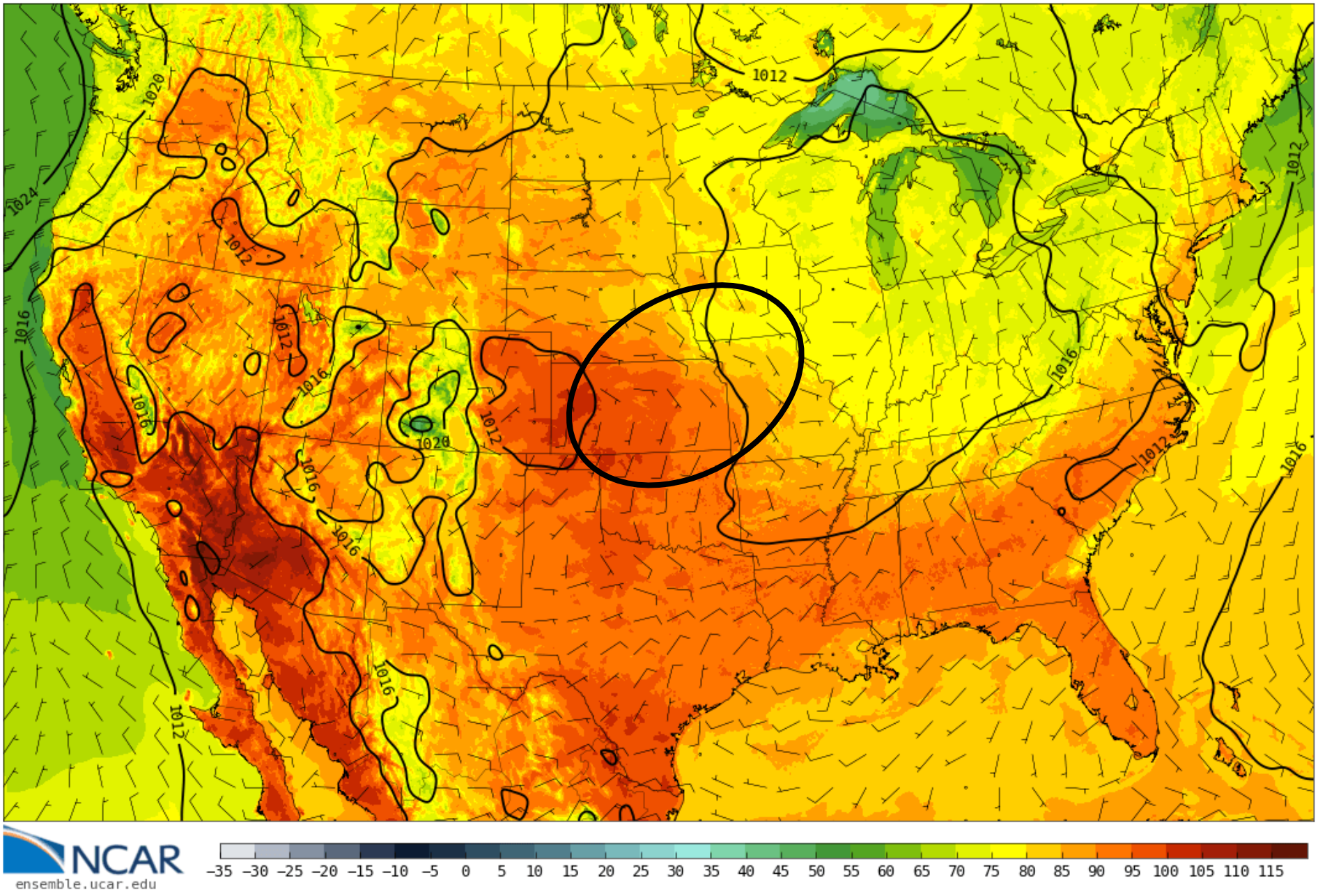
- WAF Article Describing Ensemble System
- Ensemble soundings now available at every 30th grid point
- Addition of Frequently Asked Questions webpage

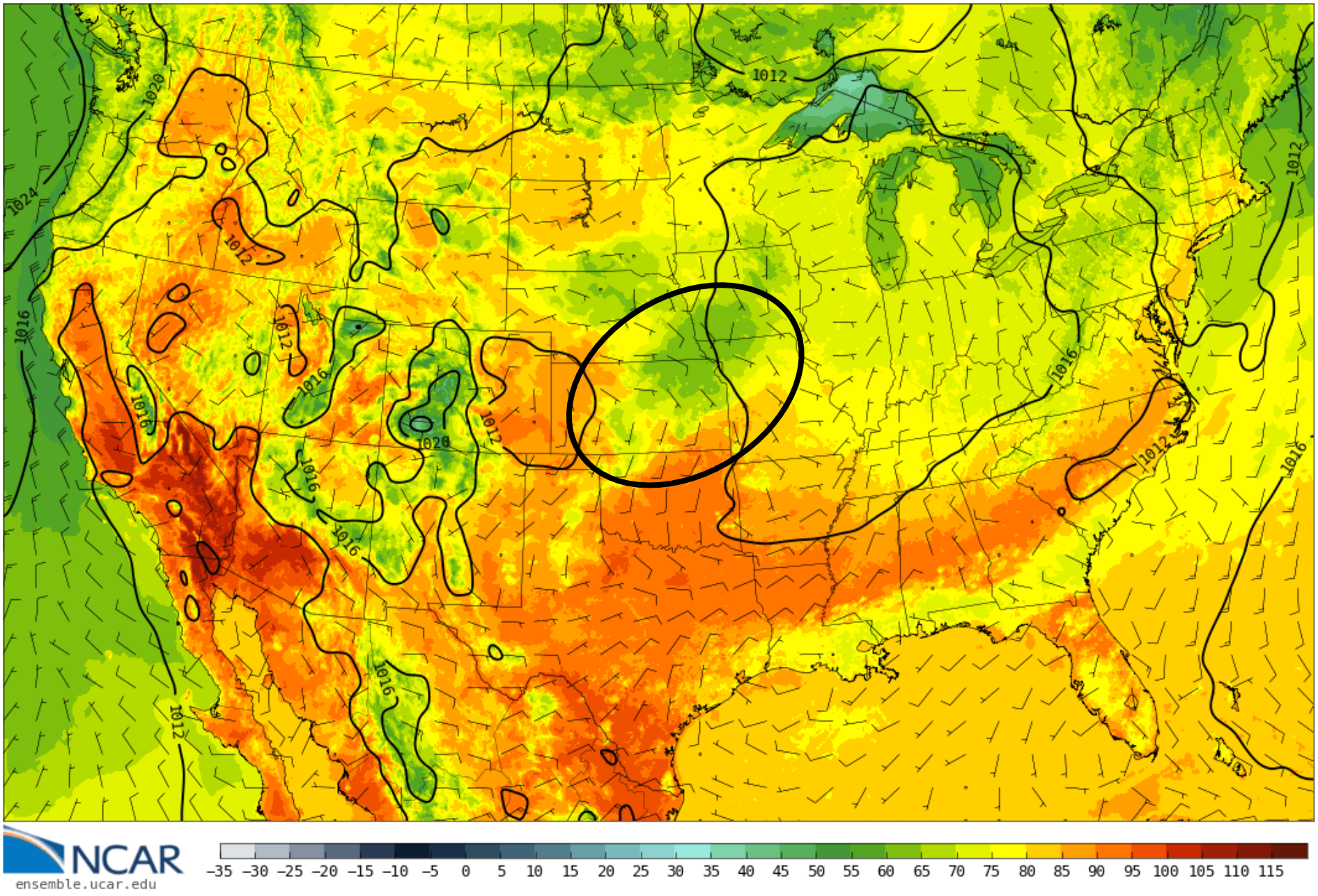


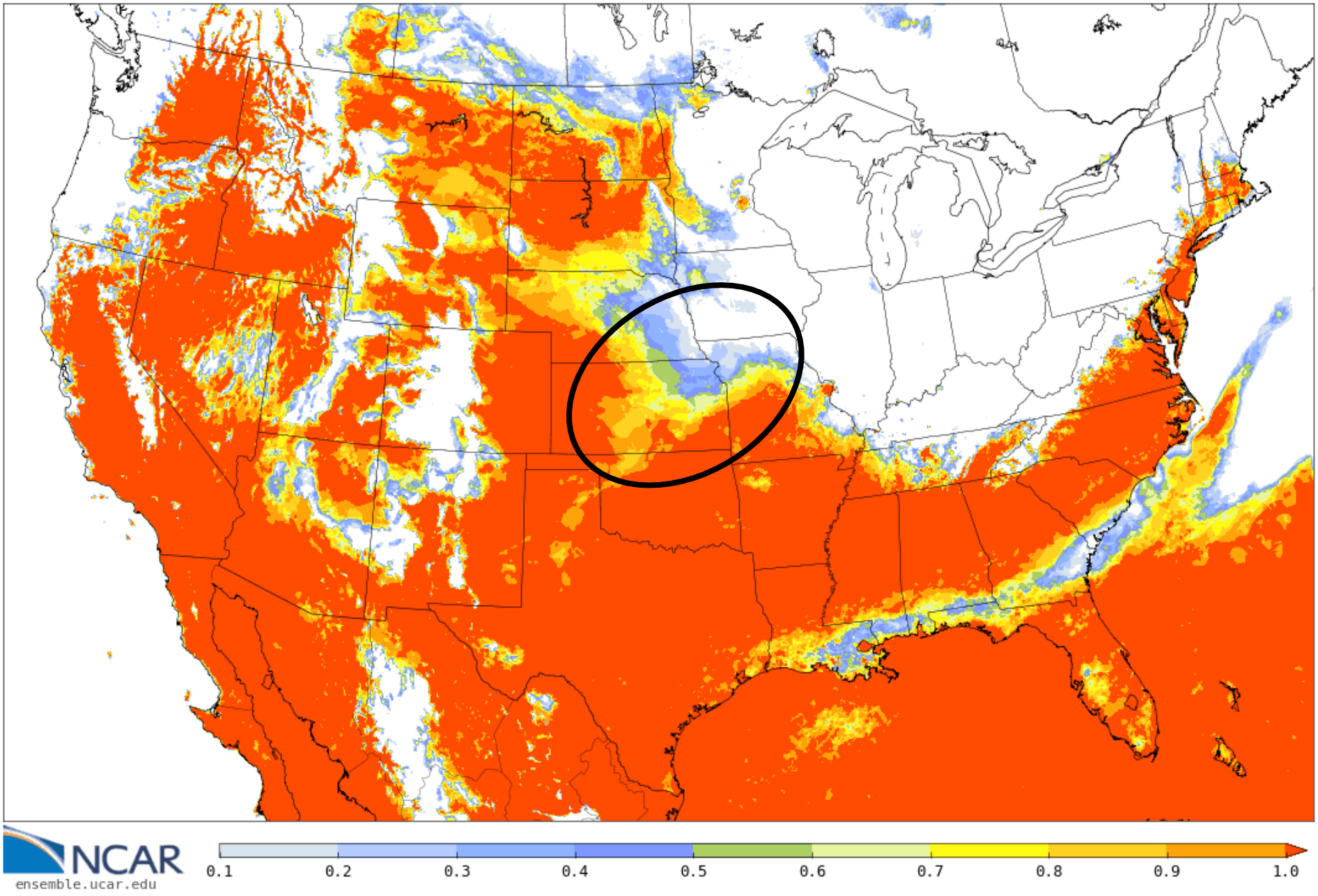

Forecasts sponsored by the National Science Foundation, National Center for Atmospheric Research/Mesoscale and Microscale Meteorology Laboratory, and Computational Information Systems Laboratory
About these Forecasts || Analysis System Statistics || Verification || System Status || FAQ || Contact us: ensemble (at) ucar (dot) edu

Lots of data! (NCAR 10-member 3-km WRF ensemble produces ~4 TB of data/day).


Ensemble mean 2-m temperature (fill; F), MSLP (contour; hPa), and 10-m wind (kts)
Init: Wed 2016-06-29 00 UTC
Valid: Wed 2016-06-29 20 UTC
1012
1020
1024
1016
1012
1016
1012
1016
1020
1012
1016
1012
1016
1016
1012
1016
−35 −30 −25 −20 −15 −10 −5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115
NCAR
ensemble.ucar.edu

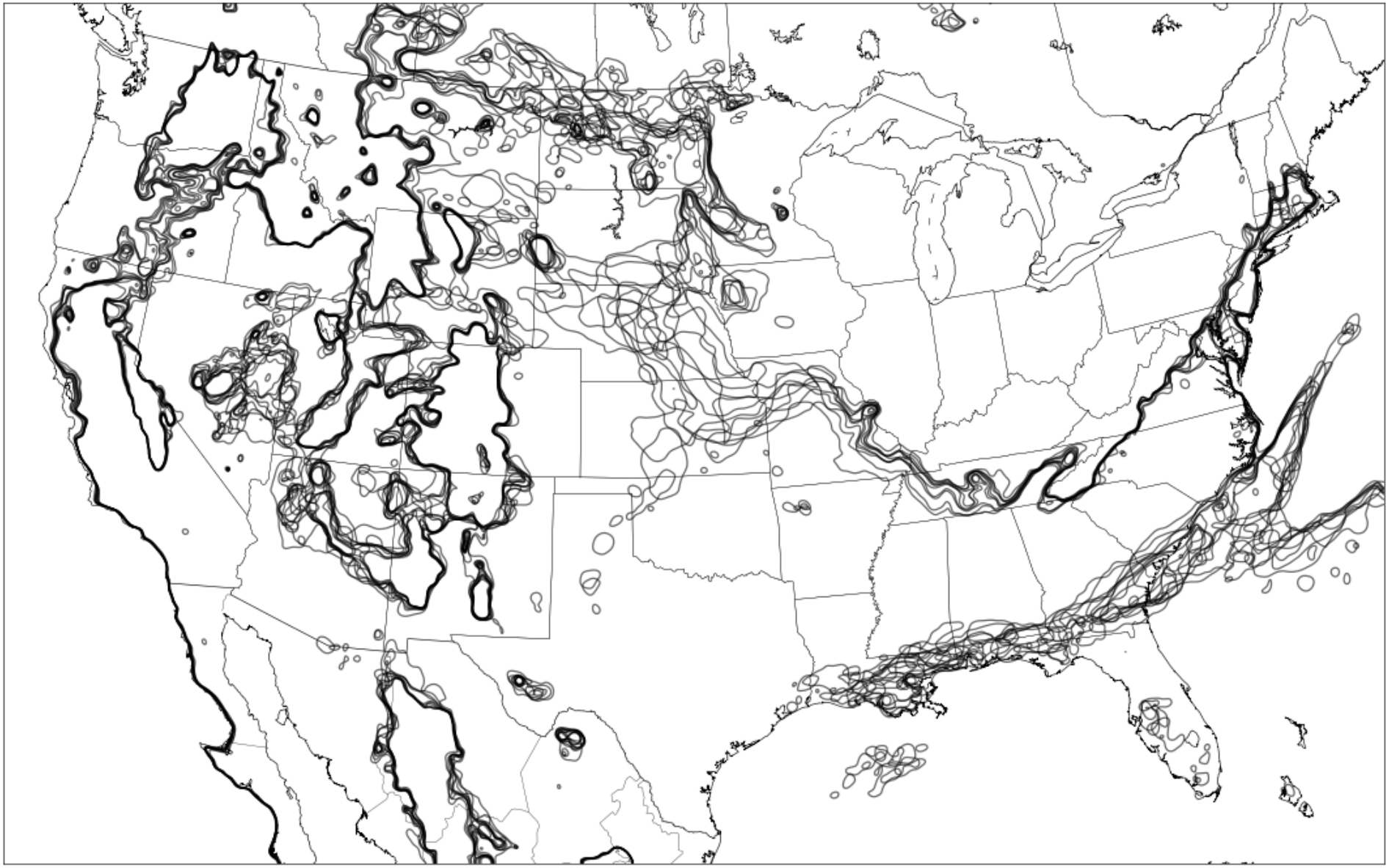

Ensemble max. 2-m temperature (fill; F), mean MSLP (contour; hPa), and mean 10-m wind (kts)
Init: Wed 2016-06-29 00 UTC
Valid: Wed 2016-06-29 20 UTC
1012
1016
1020
1024
−35 −30 −25 −20 −15 −10 −5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115
NCAR
ensemble.ucar.edu


Ensemble min. 2-m temperature (fill; F), mean MSLP (contour; hPa), and mean 10-m wind (kts)
Init: Wed 2016-06-29 00 UTC
Valid: Wed 2016-06-29 20 UTC
1012
1016
1020
1024
NCAR
ensemble.ucar.edu
−35 −30 −25 −20 −15 −10 −5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115


Probability of 2-m temperature > 80F (fill)
Init: Wed 2016-06-29 00 UTC
Valid: Wed 2016-06-29 20 UTC
NCAR
ensemble.ucar.edu
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

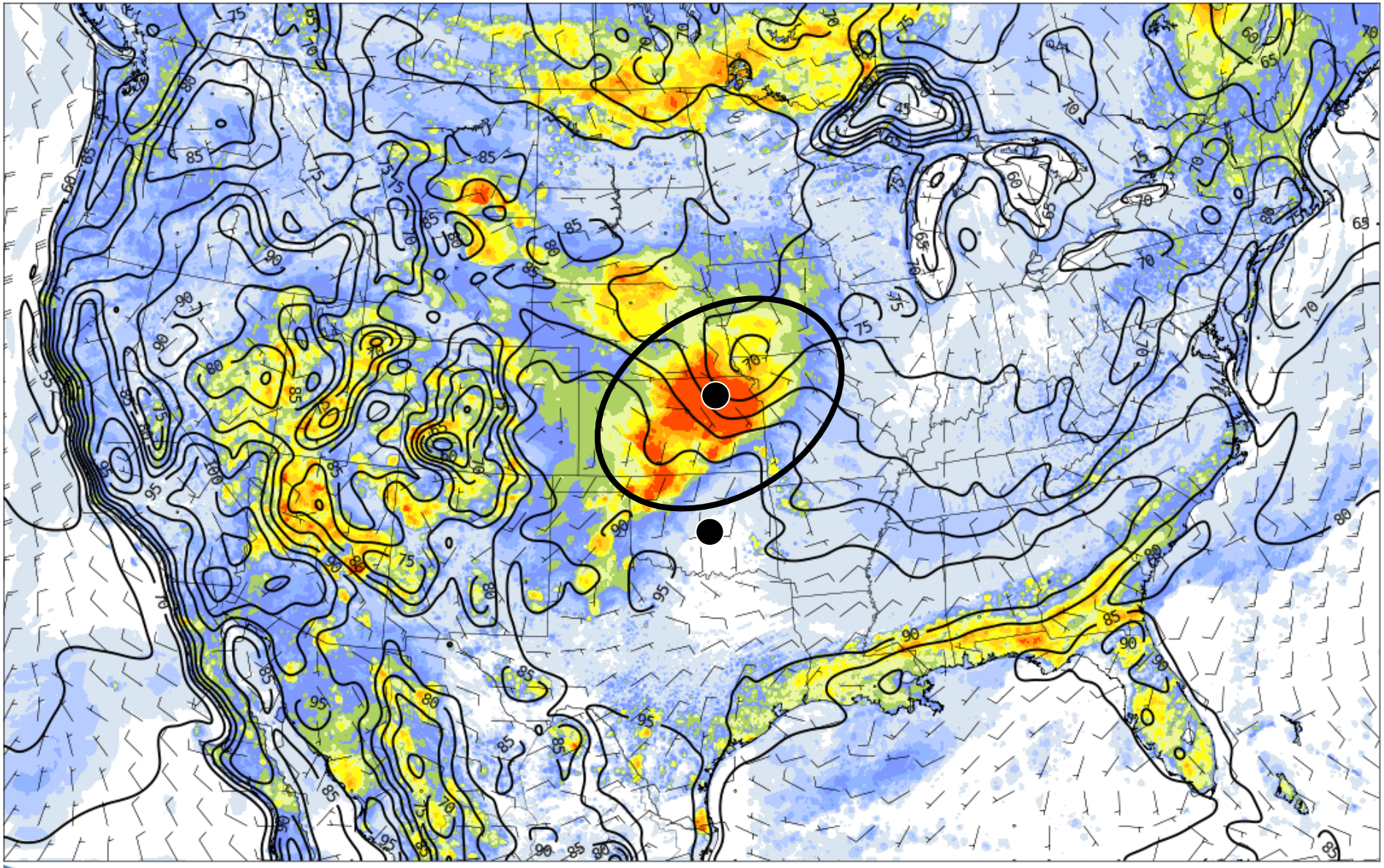
**Ensemble 2-m temperature (80F contours)**

Init: Wed 2016-06-29 00 UTC
Valid: Wed 2016-06-29 20 UTC



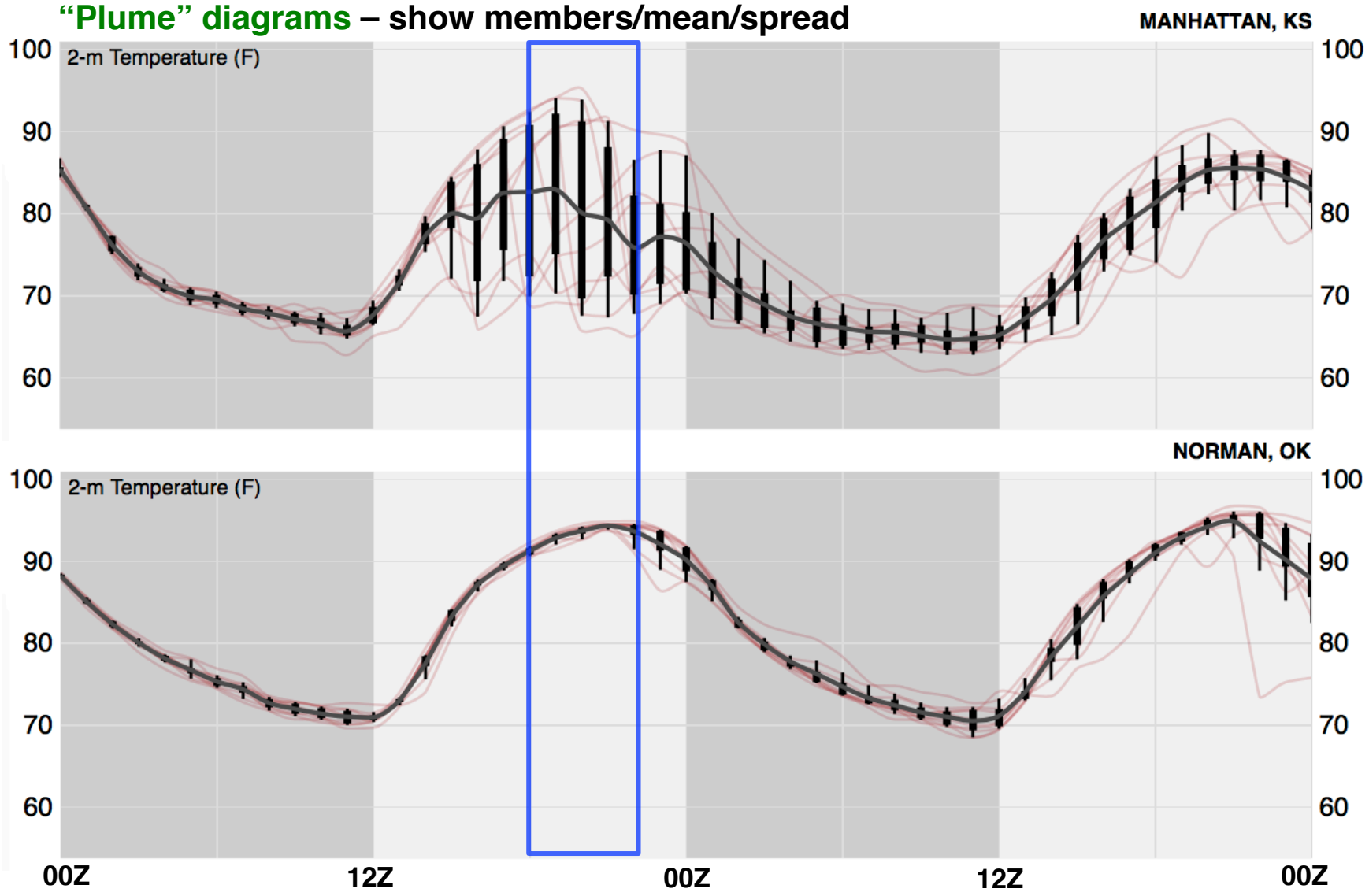
Ensemble mean (contour; F) and spread (fill; F) of 2-m temperature, and mean 10-m wind (kts)

Init: Wed 2016-06-29 00 UTC
Valid: Wed 2016-06-29 20 UTC

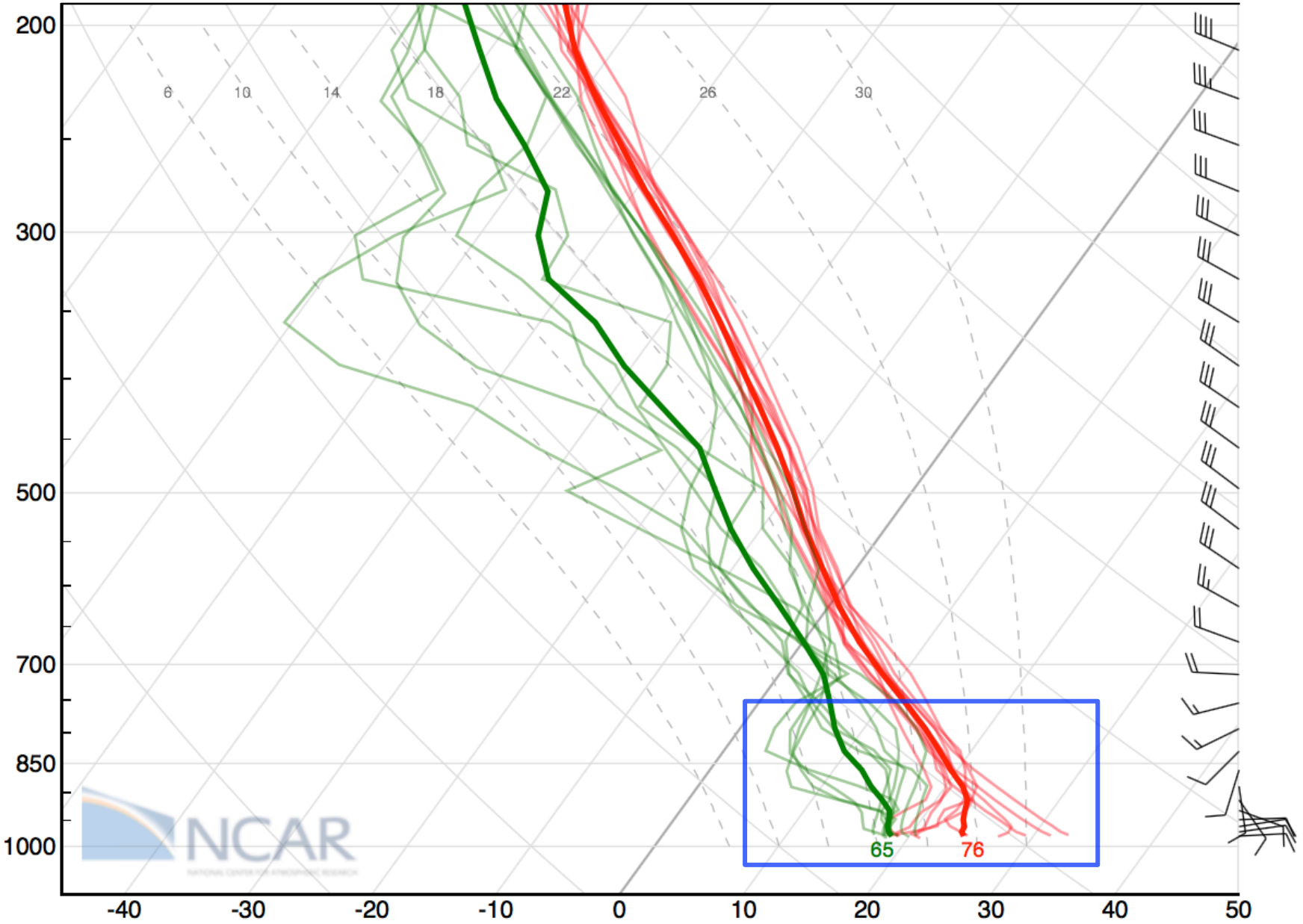


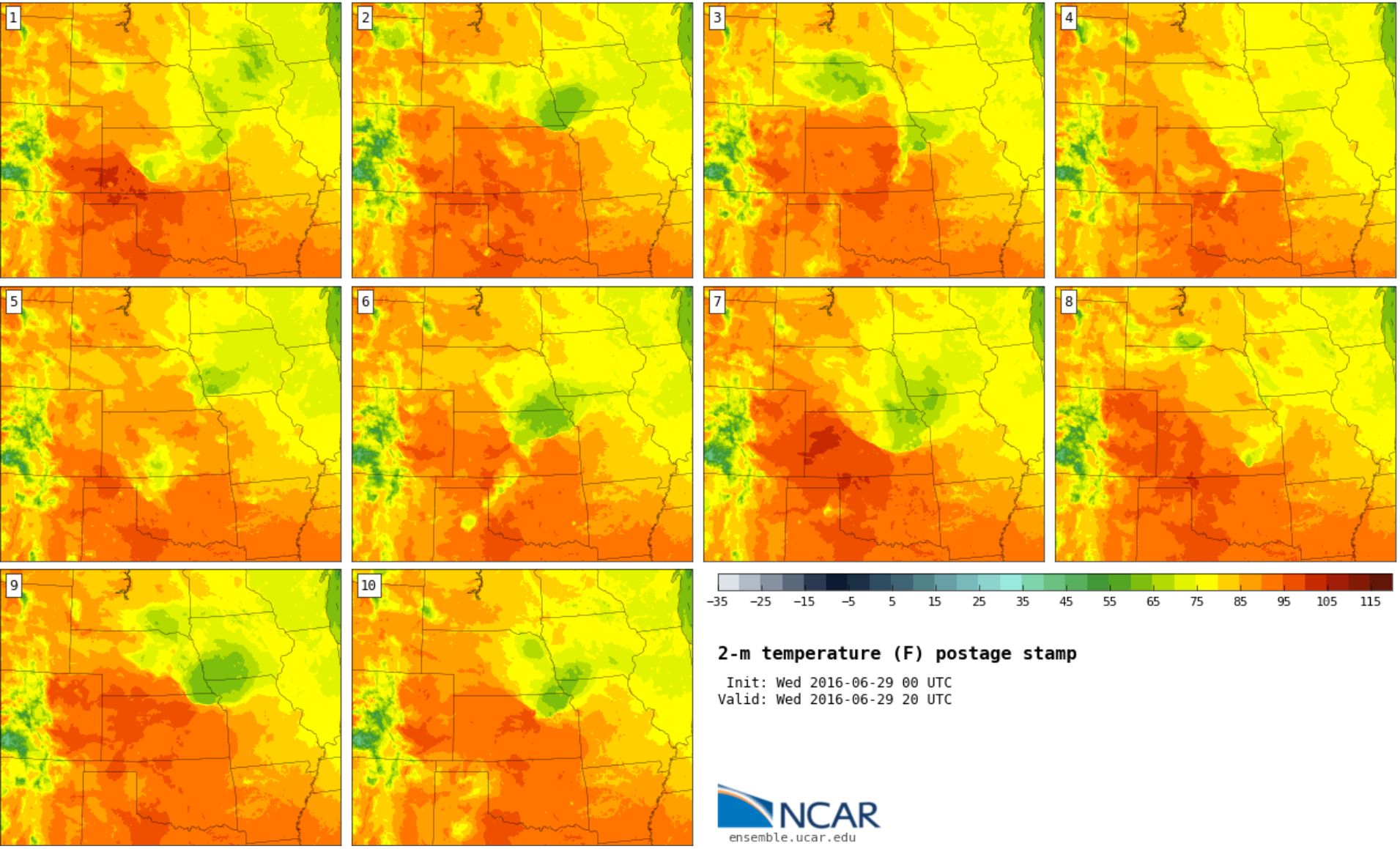
NCAR
ensemble.ucar.edu

0.5 1.0 1.5 2.0 3.0 4.0 5.0 6.0 7.0 8.0


"Plume" diagrams – show members/mean/spread
MANHATTAN, KS
2-m Temperature (F)
100
90
80
70
60
NORMAN, OK
2-m Temperature (F)
00Z
12Z
00Z
12Z
00Z

# Ensemble Skew-T plots






**2-m temperature (F) postage stamp**

Init: Wed 2016-06-29 00 UTC
Valid: Wed 2016-06-29 20 UTC

NCAR
ensemble.ucar.edu

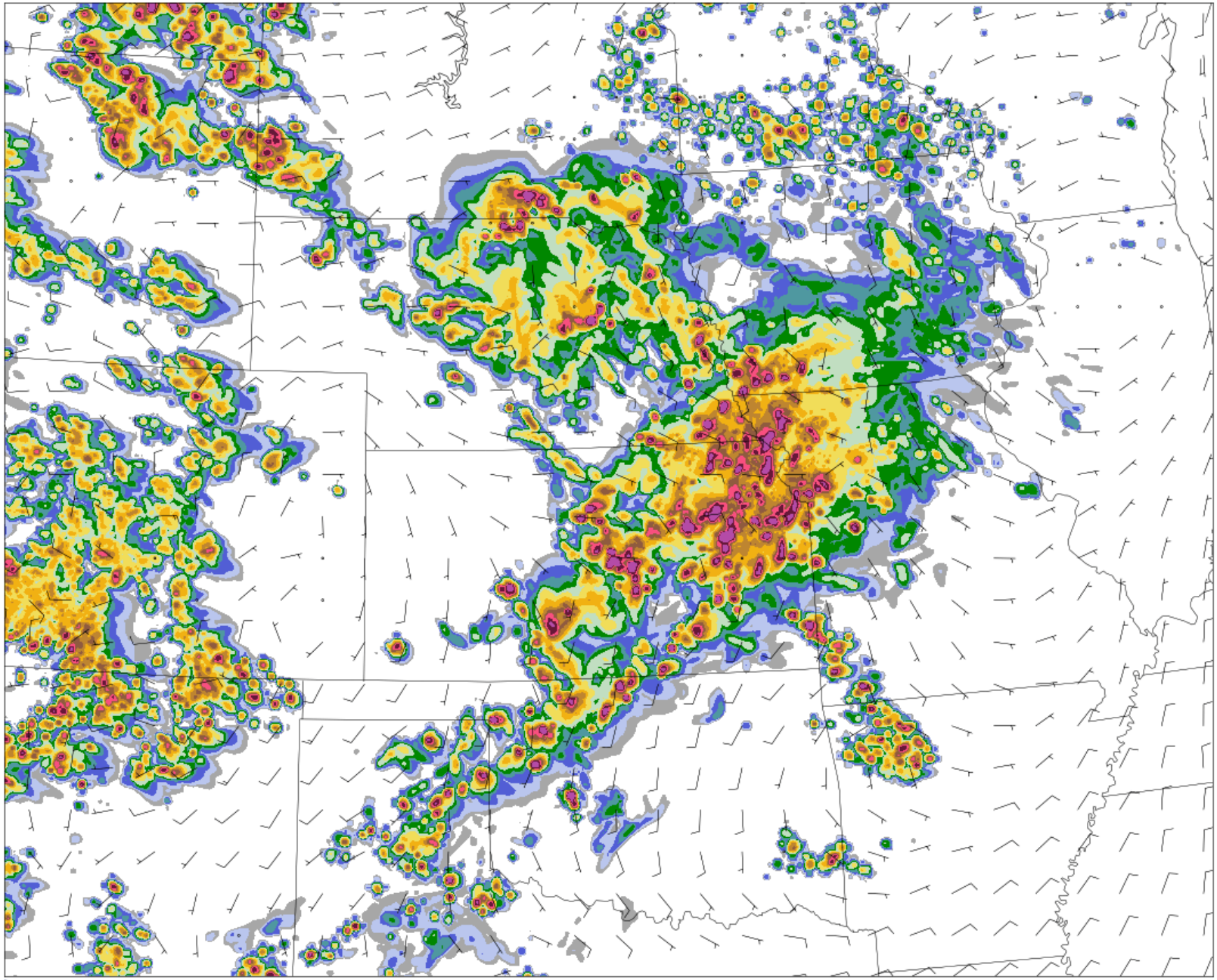
## Unique ensemble fields for small-scale phenomena

Thunderstorms, heavy rain

Ensemble mean not useful for discrete fields containing spatial displacements

**Ensemble max. column reflectivity and ensemble mean 10-m wind (kts)**

Init: Wed 2016-06-29 00 UTC
Valid: Wed 2016-06-29 20 UTC

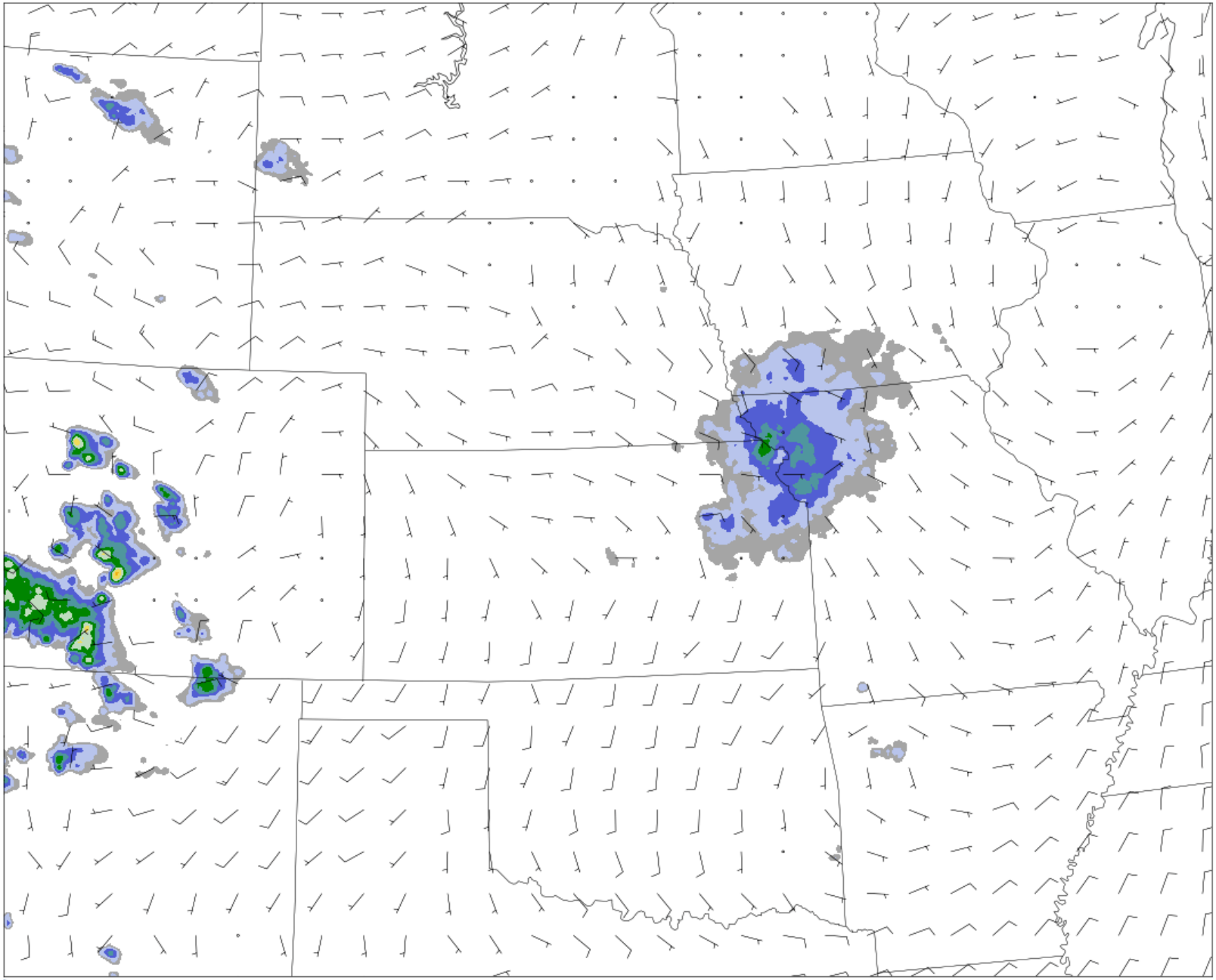


NCAR
ensemble.ucar.edu

5 10 15 20 25 30 35 40 45 50 55 60 65

**Ensemble mean max. column reflectivity and ensemble mean 10-m wind (kts)**

Init: Wed 2016-06-29 00 UTC
Valid: Wed 2016-06-29 20 UTC

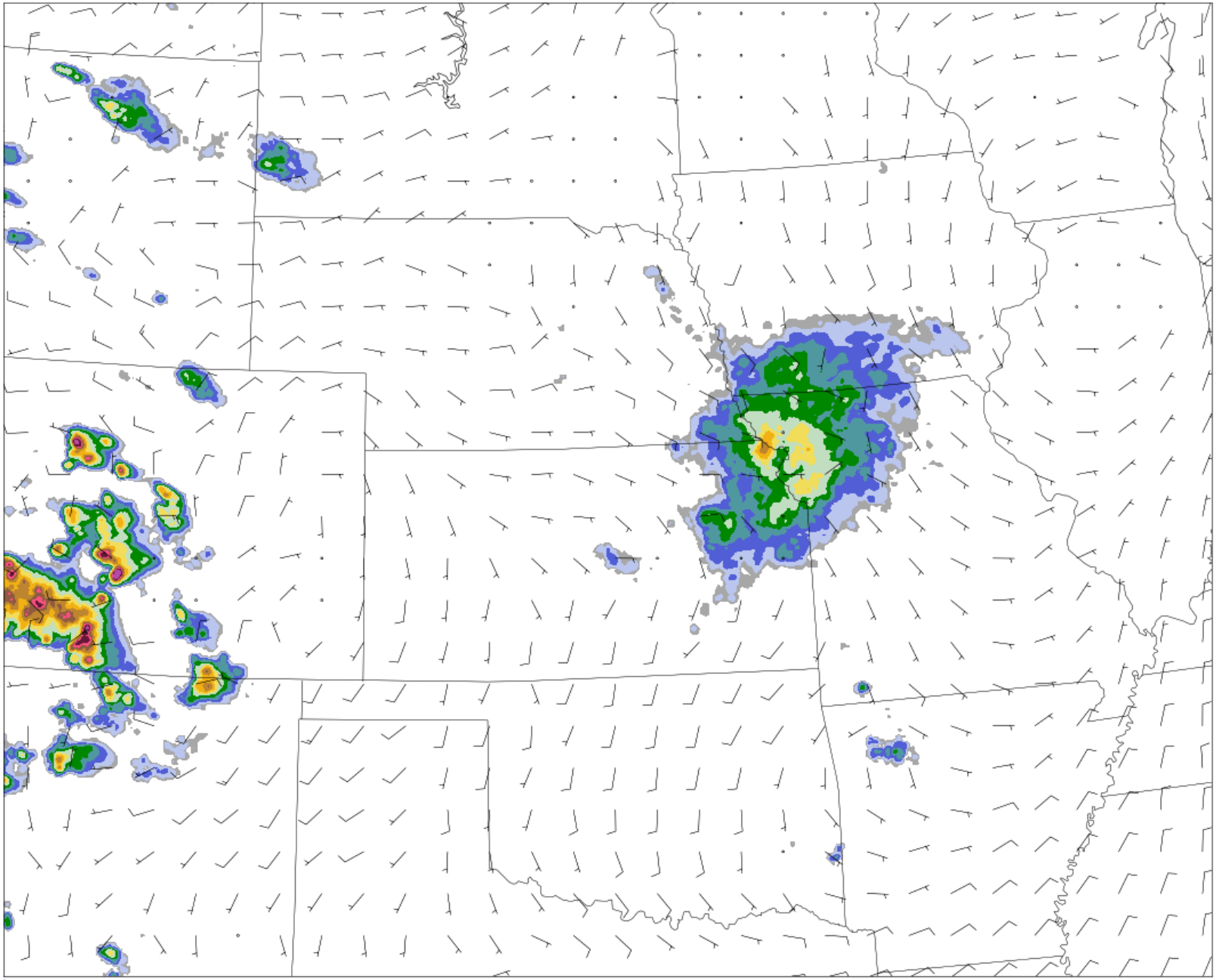


NCAR
ensemble.ucar.edu

5 10 15 20 25 30 35 40 45 50 55 60 65

**Probability matched mean max. column reflectivity and ensemble mean 10-m wind (kts)**

Init: Wed 2016-06-29 00 UTC
Valid: Wed 2016-06-29 20 UTC

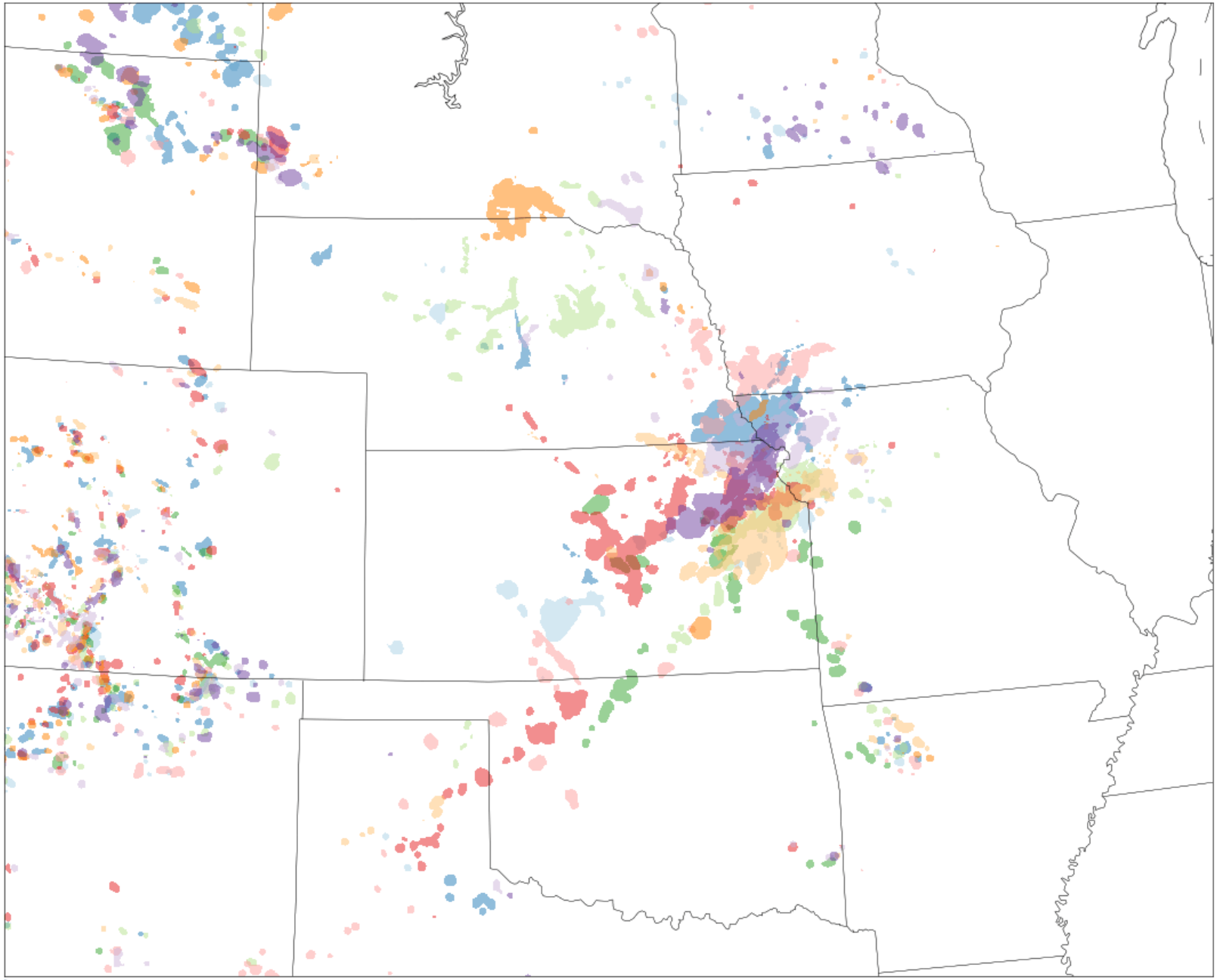


NCAR
ensemble.ucar.edu

5 10 15 20 25 30 35 40 45 50 55 60 65

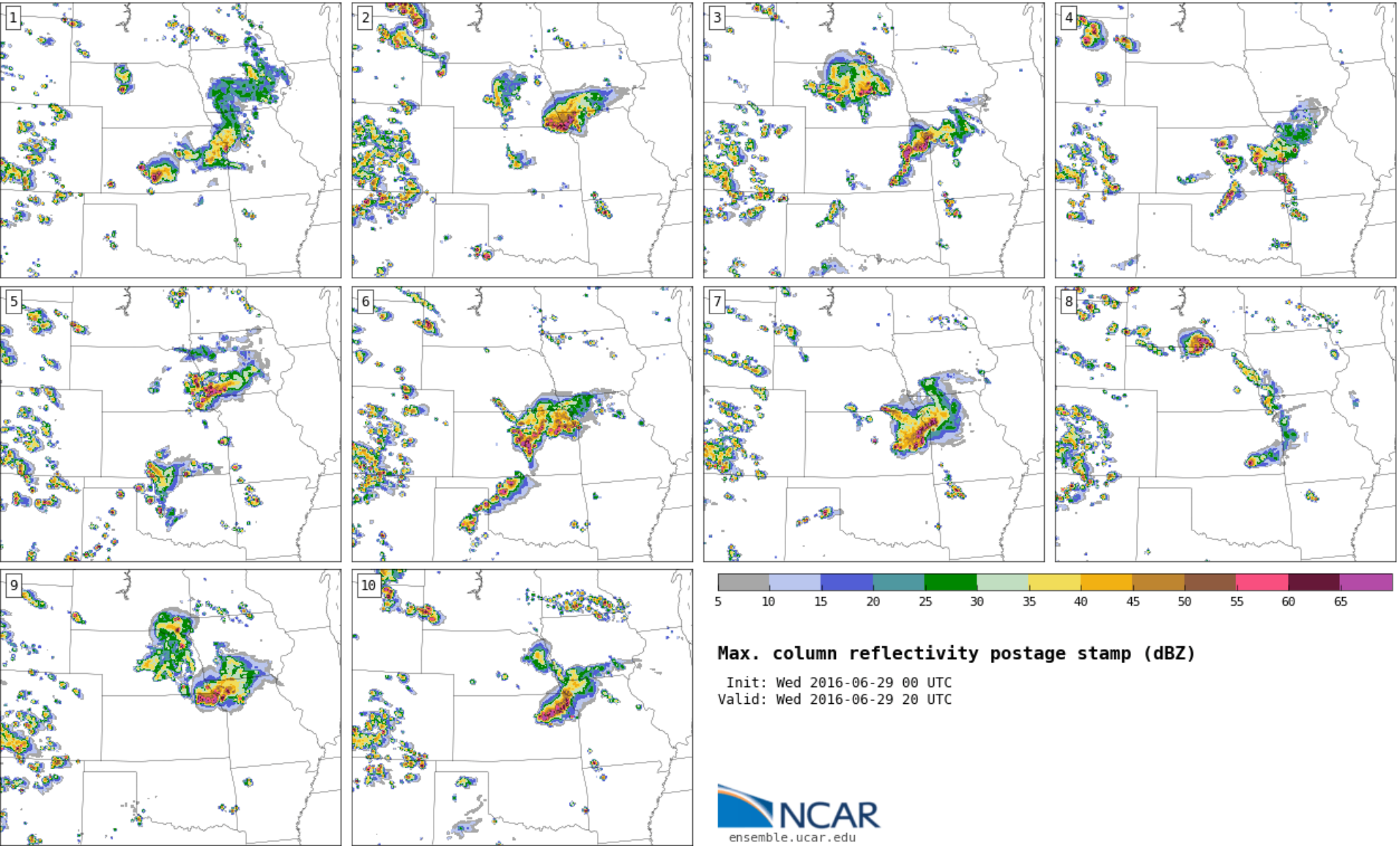
Max. column reflectivity > 40 dBZ from each member

Init: Wed 2016-06-29 00 UTC
Valid: Wed 2016-06-29 20 UTC



NCAR
ensemble.ucar.edu

member 1 member 2 member 3 member 4 member 5 member 6 member 7 member 8 member 9 member 10

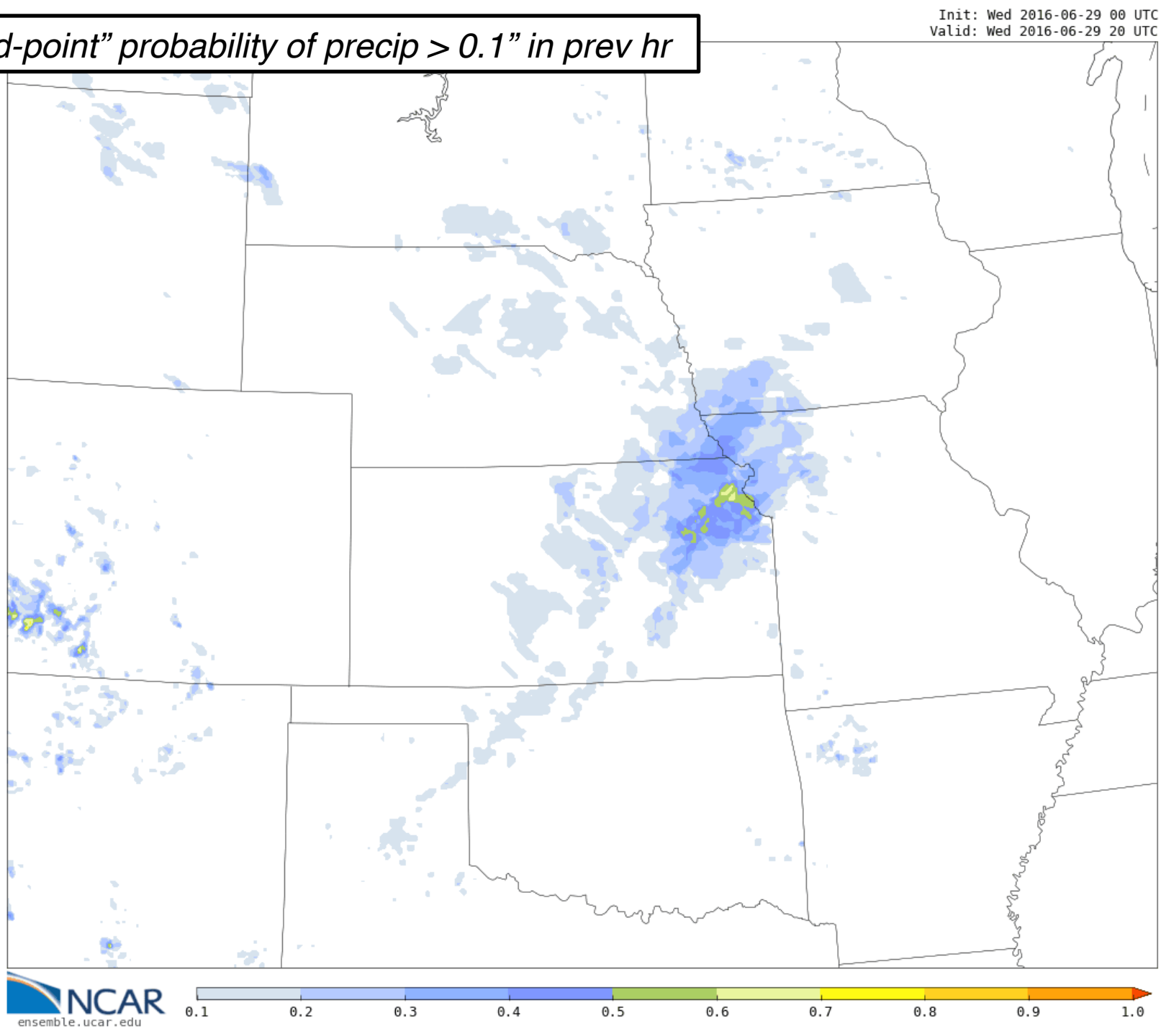



**Max. column reflectivity postage stamp (dBZ)**

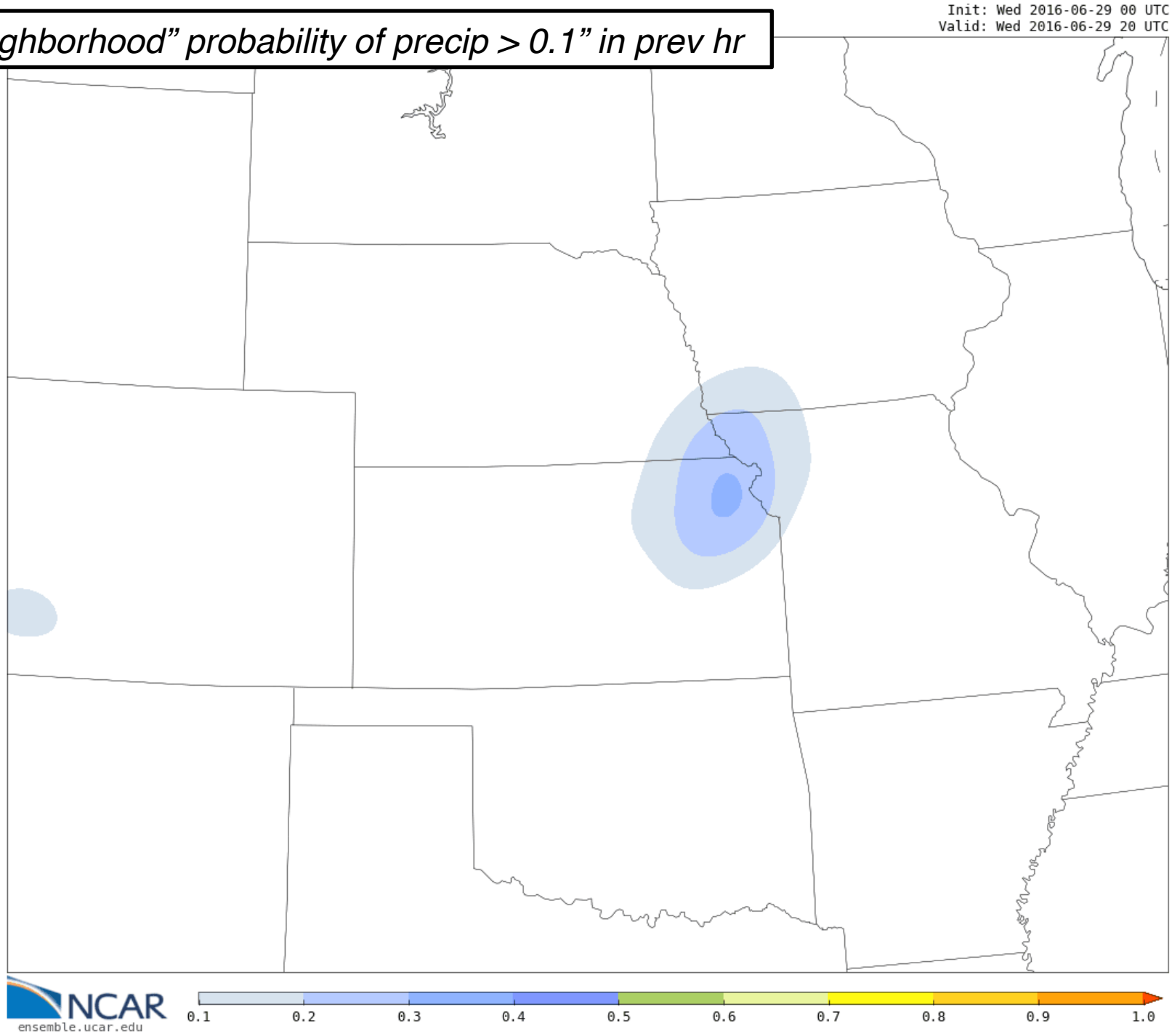
Init: Wed 2016-06-29 00 UTC
Valid: Wed 2016-06-29 20 UTC

NCAR
ensemble.ucar.edu

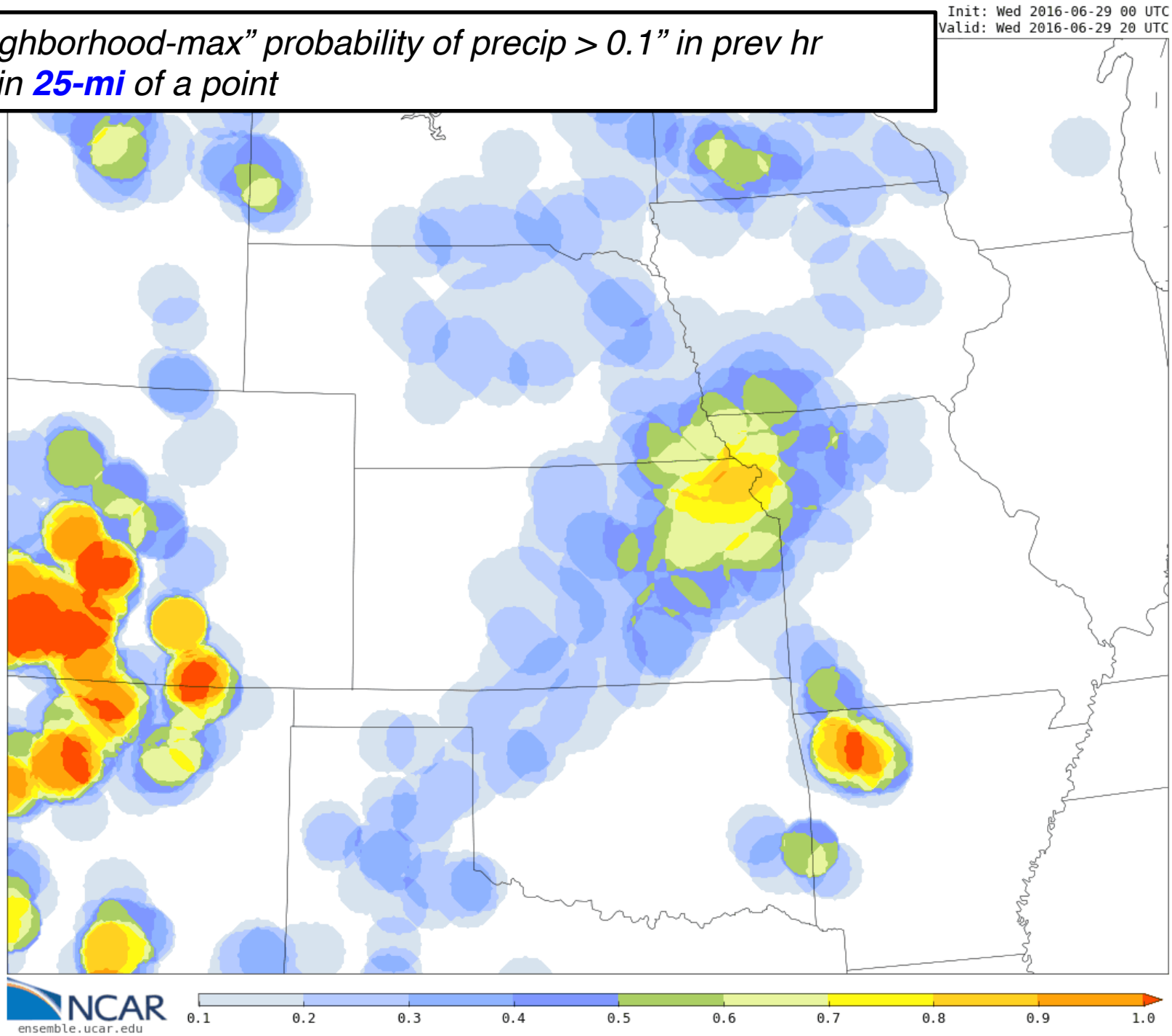
*"Grid-point" probability of precip > 0.1" in prev hr*



*“Neighborhood” probability of precip > 0.1” in prev hr*



*"Neighborhood-max" probability of precip > 0.1" in prev hr within **25-mi** of a point*



**Useful software packages:**

e.g., NCL/Python/Grads

**Web-based visualization libraries:**

e.g., javascript/d3

**NCAR Ensemble Forecasts**

Initialized: 00 UTC Wed 29 Jun 2016

Surface / Precip | Upper-Air | Severe | Winter | Hourly-Max | Domains

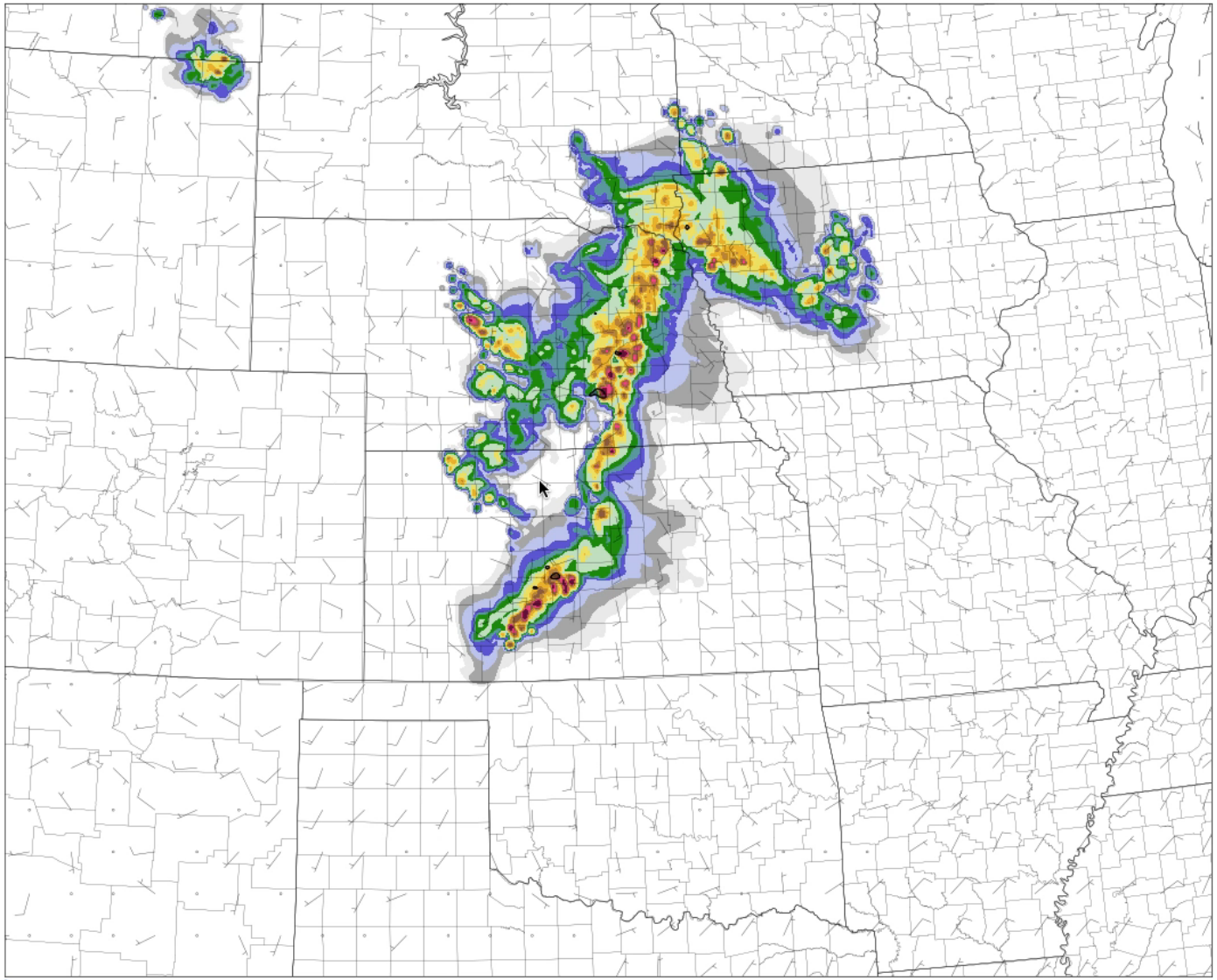
13 14 15 16 17 18 19 20 21 22 23 24

Mem 1
Mem 2
Mem 3
Mem 4
Mem 5
Mem 6
Mem 7
Mem 8
Mem 9
Mem 10

D1: 01 - 12 UTC
D1: 13 - 00 UTC
D2: 01 - 12 UTC
D2: 13 - 00 UTC
Full 48-hour

Member 1 column maximum reflectivity, 10-m wind speed, and hourly-max 2-5 km UH > 50 m2/s2

Init: Wed 2016-06-29 00 UTC
Valid: Wed 2016-06-29 13 UTC



NCAR
ensemble.ucar.edu

5 10 15 20 25 30 35 40 45 50 55 60 65

Forecasts sponsored by the National Science Foundation, National Center for Atmospheric Research/Mesoscale and Microscale Meteorology Laboratory, and Computational Information Systems Laboratory

**Thanks!**

**sobash@ucar.edu**