Using Anomalies to Forecast High Impact Events

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Overview

R-Climate and meteorologically significant events

- **Historic Events and value of R-Climate**: many large scale and widespread events which affect thousands to tens of millions of people are events with a strong signal in the R-Climate verse the analysis of record and forecasts.
  - Key extreme event type examples→ help in Decision Support Services (DSS)
    - Pattern with anomalies → SIGNIFICANCE
    - Probabilities and Pattern → CONFIDENCE
  - Standardized anomalies
  - Use with forecast guidance→ forecast extreme events

- **Examples Shown in standardized anomaly context**
  - Heavy rainfall / Heavy snowfall
    - **Mid-West/Great Lakes Heavy Rains: 17-19Apr2013**
    - **Western Great Lakes Flood: 17-23July2010**

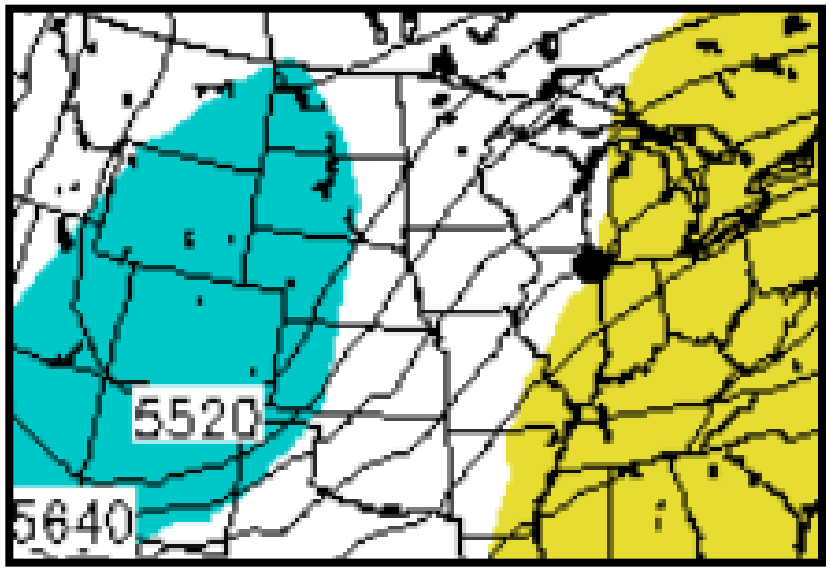
Leveraging Climate Data

- Quickly identify extremes
  - The tails of phase space or PDF
  - We will focus mainly showing standardized anomalies
- Quickly identify when conditions near normal
  - May miss mesoscale phenomena
  - Good to know this for you and decision makers
- The extremes are what feed into significant decisions
  - Need to know patterns with extreme events

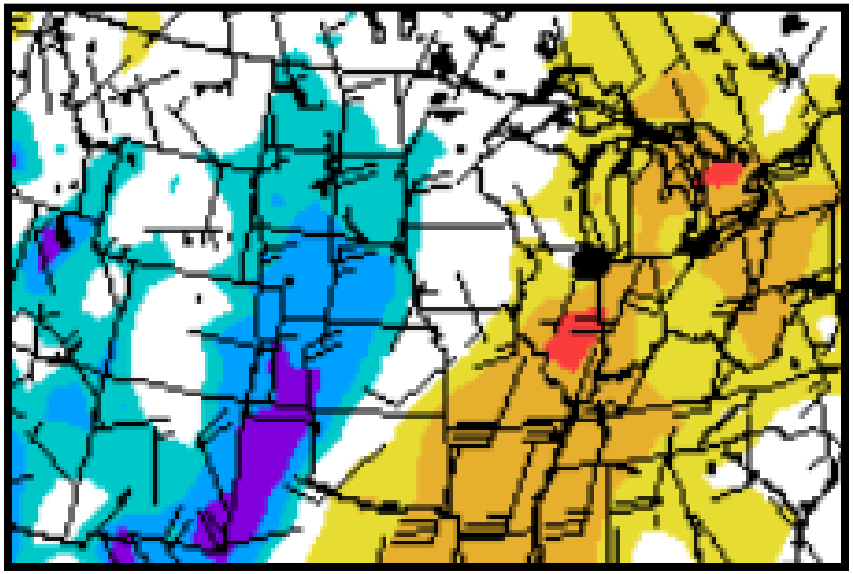
Midwest/Great Lakes Flood: April2013

- Wet conditions first 16 days of April…likely set stage
- Anomalous downstream ridge produced deep moist plume into Mid-Mississippi Valley/Great Lakes
- Several areas received 50-100mm within 12 hrs
  - 75-175mm within 36 hrs
- Pattern and Probs of heavy rainfall = Well Predicted!

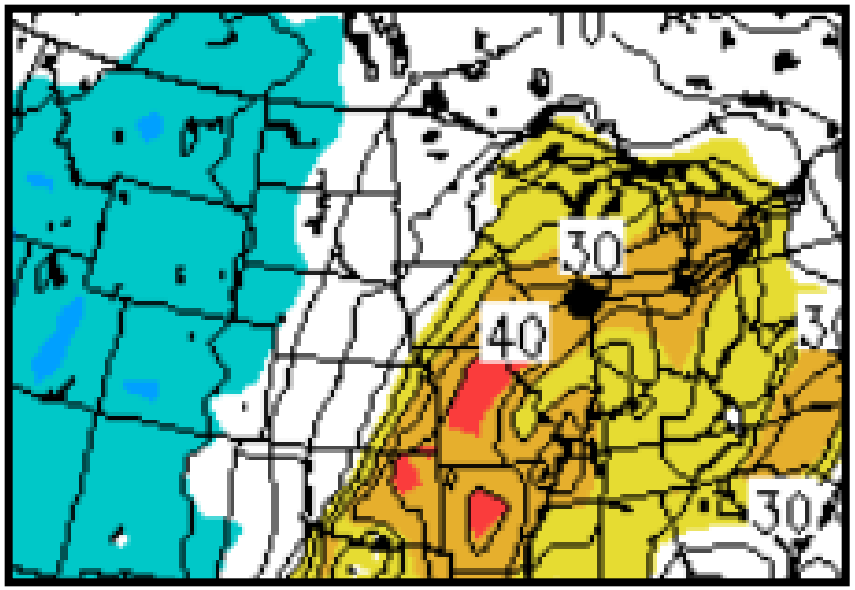
500hPa hts



850hPa V-wind

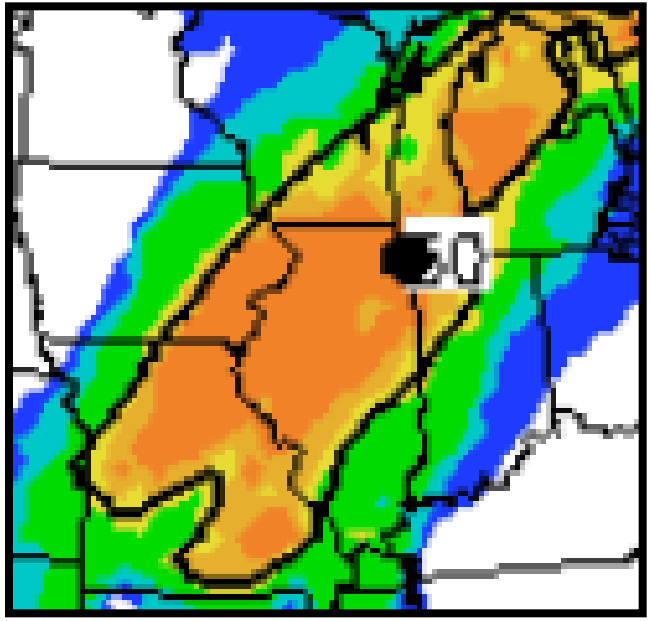


1000hPa PWAT



GEFS

Init: 12Z13Apr2013
Valid: 06Z18Apr2013



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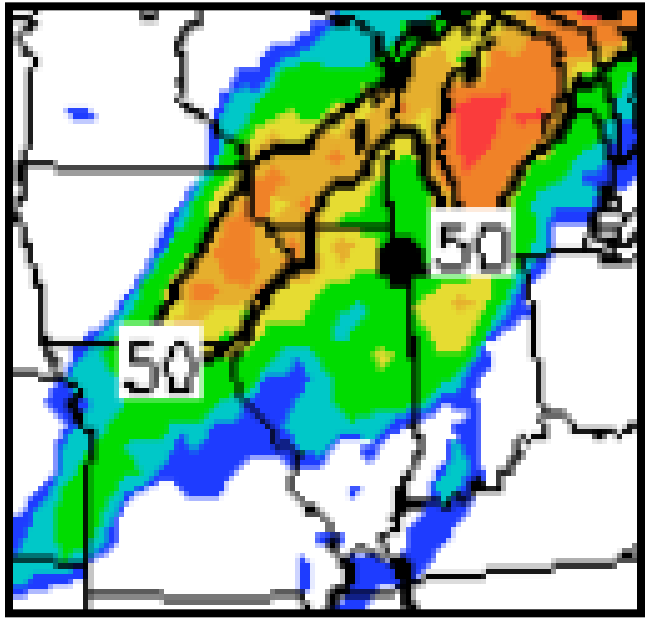

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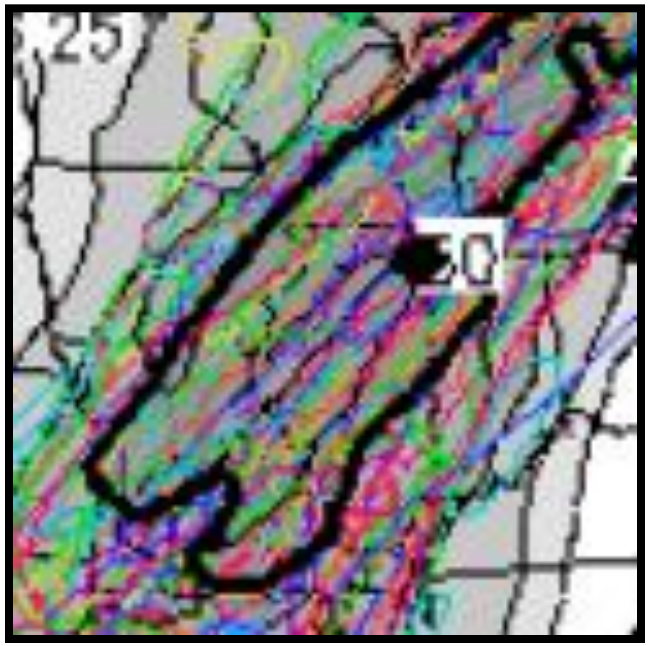
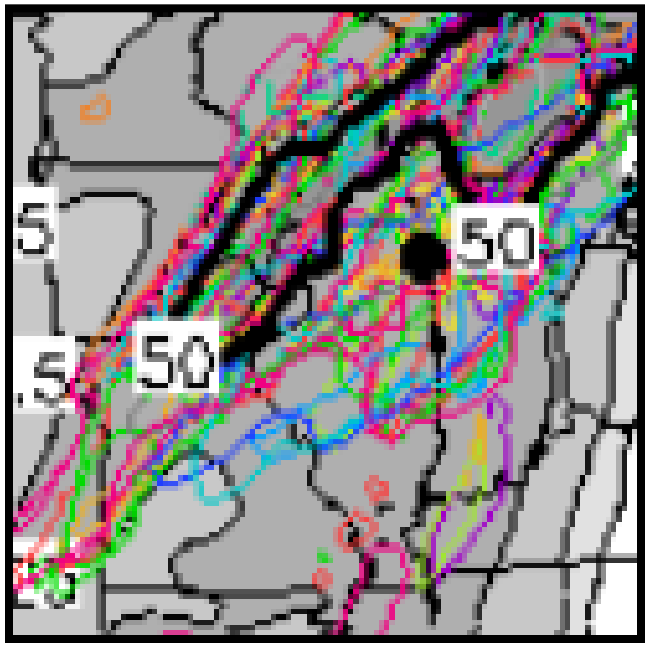
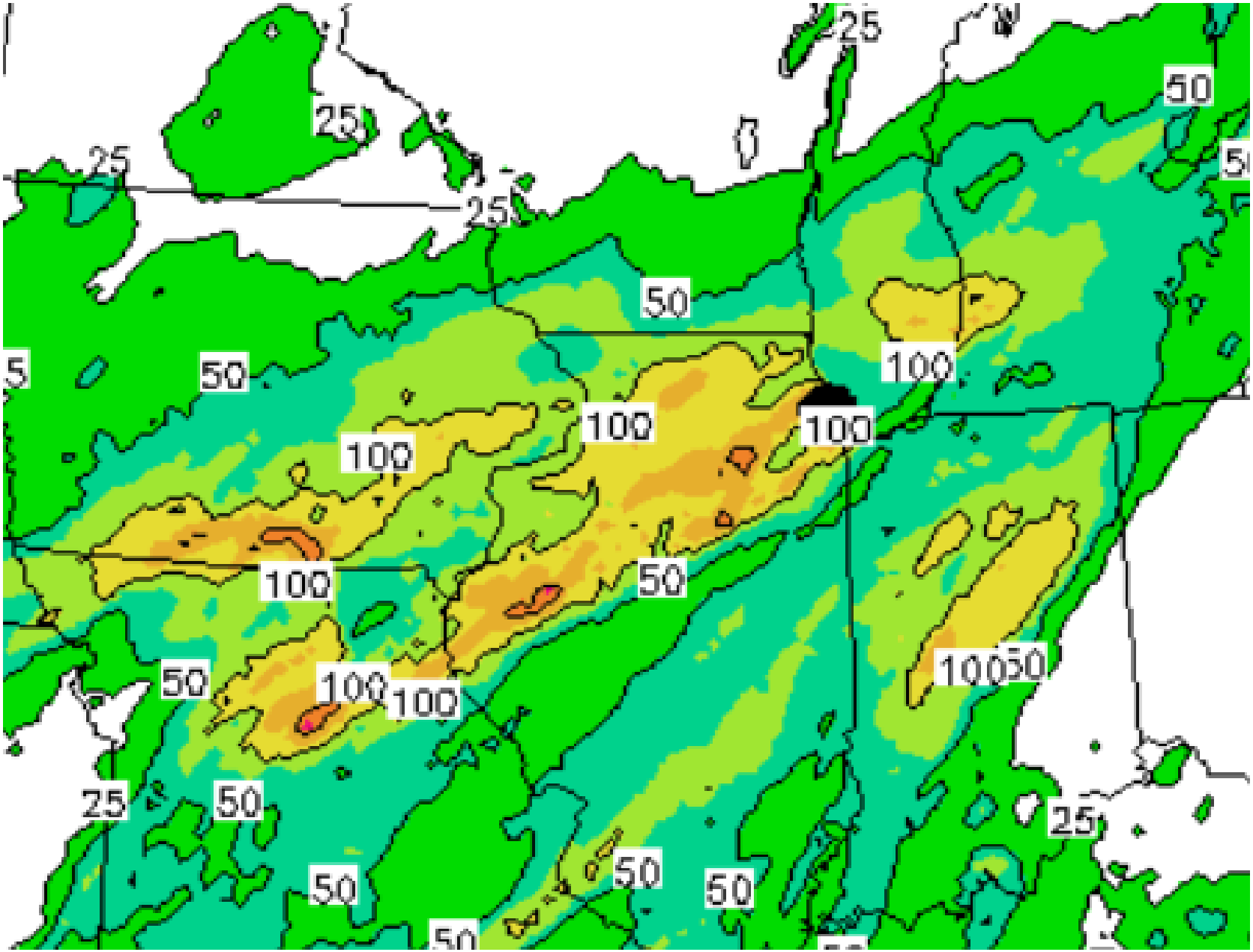




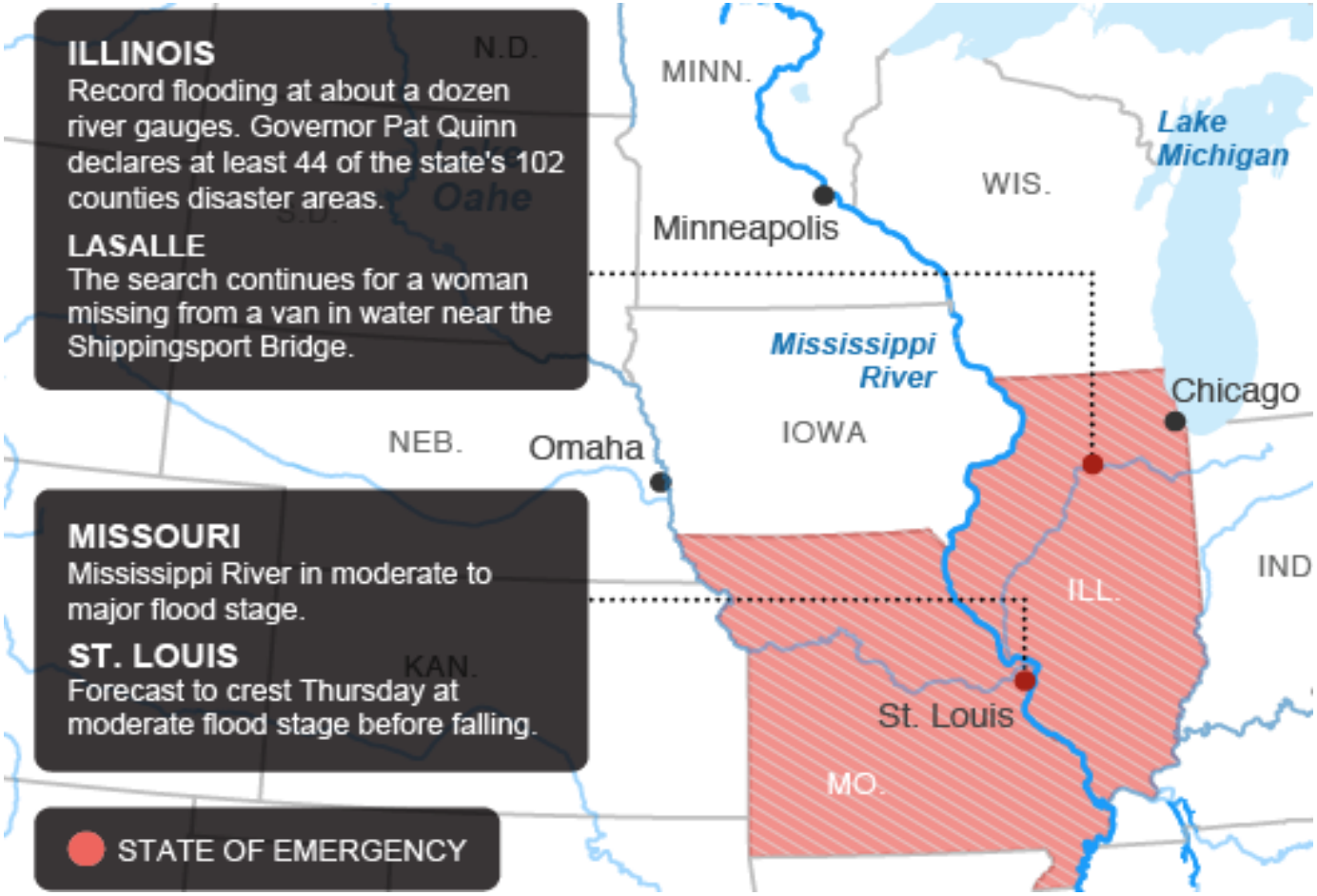
GEFS 36hr Prob 50mm QPF Valid: 00Z-18Apr2013 – 12Z19Apr2013

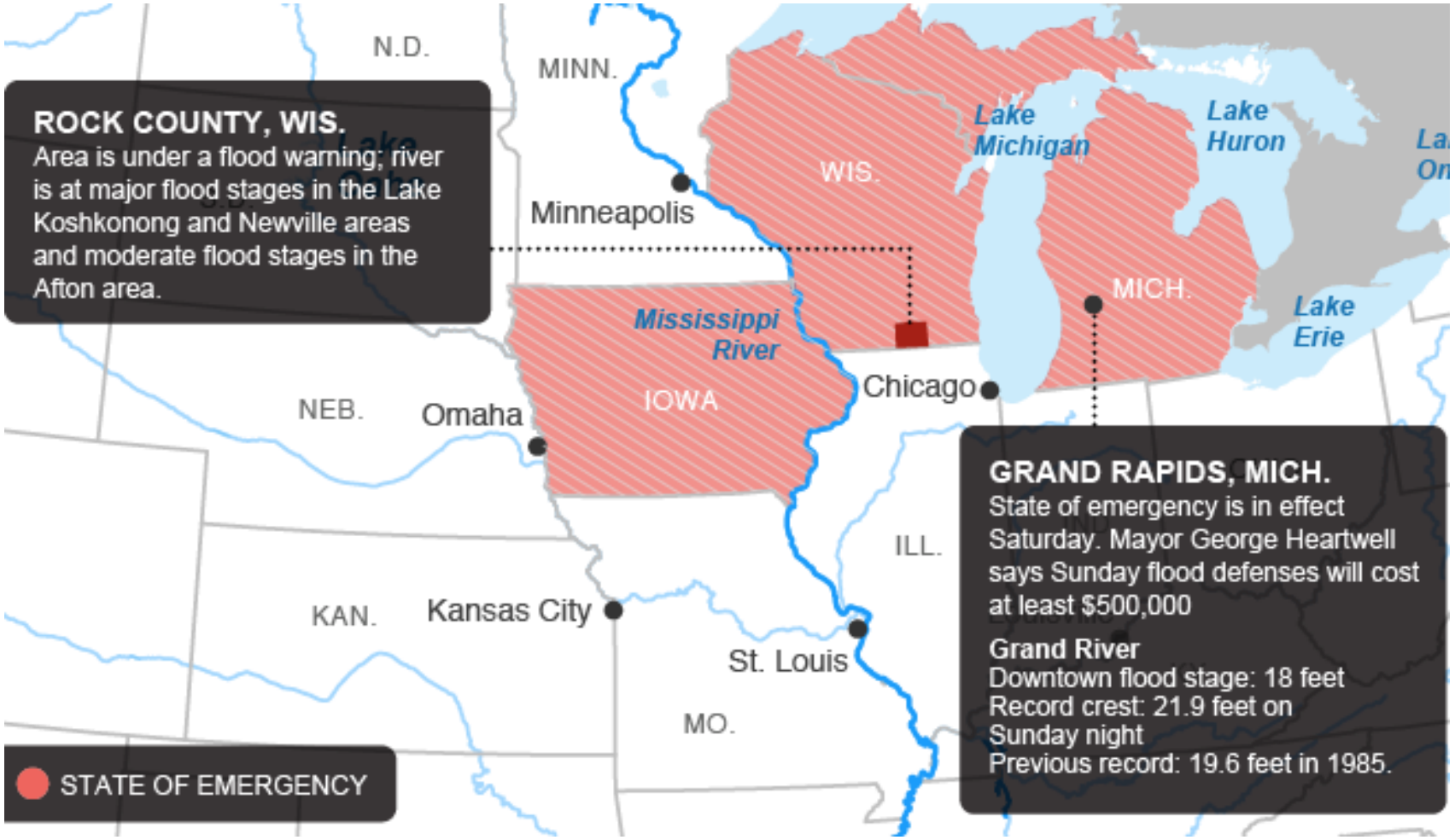


Accumulated Precip (mm) : 12Z17Apr2013-12Z20Apr2013 *Stage-IV Data*

Other Noteworthy Impacts…

- Record flooding on Illinois River caused barges to break free and damage a dam near Marseilles, IL
  - Illinois River peaked at 29.35’ at Peoria (70yr record)



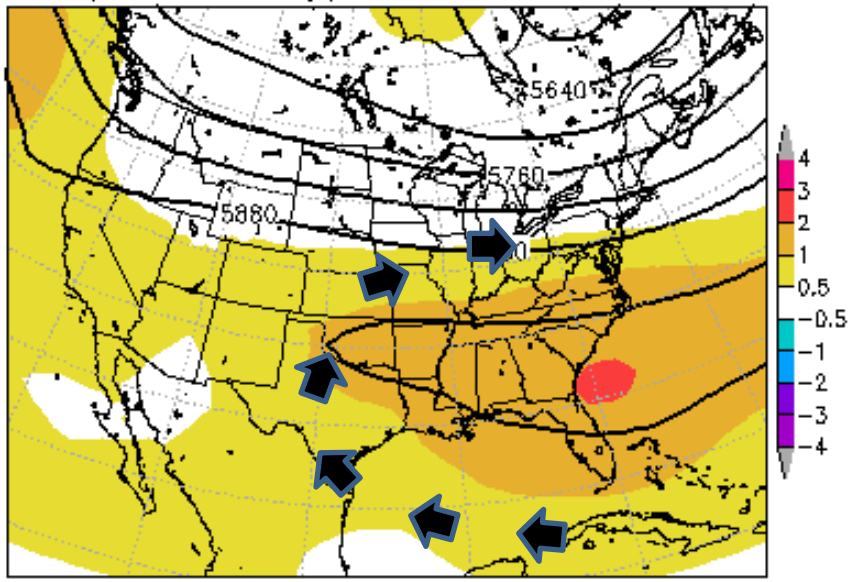

N.D.
MINN.
ROCK COUNTY, WIS.
Area is under a flood warning; river is at major flood stages in the Lake Koshkonong and Newville areas and moderate flood stages in the Afton area.
Lake Michigan
Lake Huron
WIS.
Minneapolis
MICH.
Lake Erie
Mississippi River
IOWA
Chicago
NEB.
Omaha
GRAND RAPIDS, MICH.
State of emergency is in effect Saturday. Mayor George Heartwell says Sunday flood defenses will cost at least $500,000
Grand River
Downtown flood stage: 18 feet
Record crest: 21.9 feet on Sunday night
Previous record: 19.6 feet in 1985.
ILL.
KAN.
Kansas City
St. Louis
MO.
STATE OF EMERGENCY

Western Great Lakes Flood: 21-23July2010

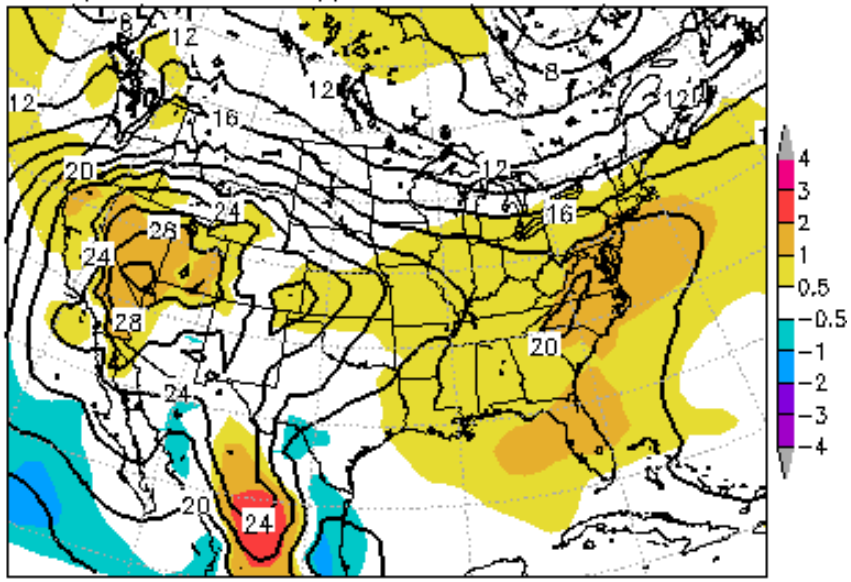
- Dominant Subtropical Ridge
  - Galarneau & Bosart 2006 coined “ridge rollers”
- Flooding aligned with Anomalous PWAT/Ridge
  - 23-24July2010: Heavy Rainfall (flooding) IA > 15”
    - Failure of Lake Delhi Dam (Eastern IA)

Composite: 17-26July2010

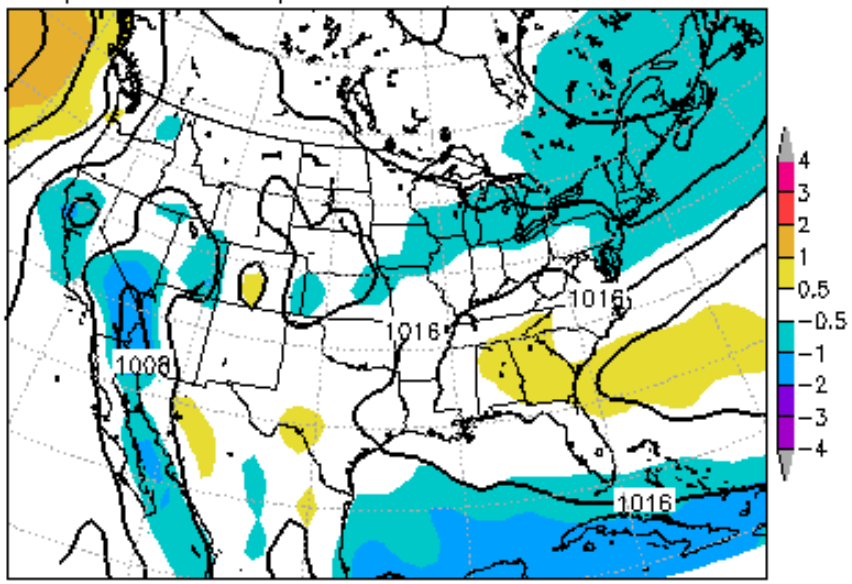
a. Composite 500hPa hgtprs 00Z17JUL2010–00Z26JUL2010



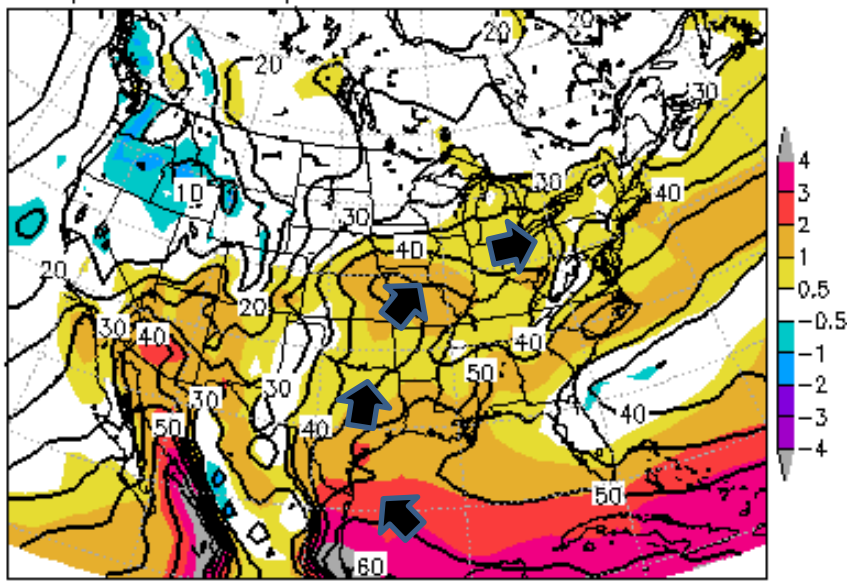
b. Composite 850hPa tmpprs 00Z17JUL2010–00Z26JUL2010



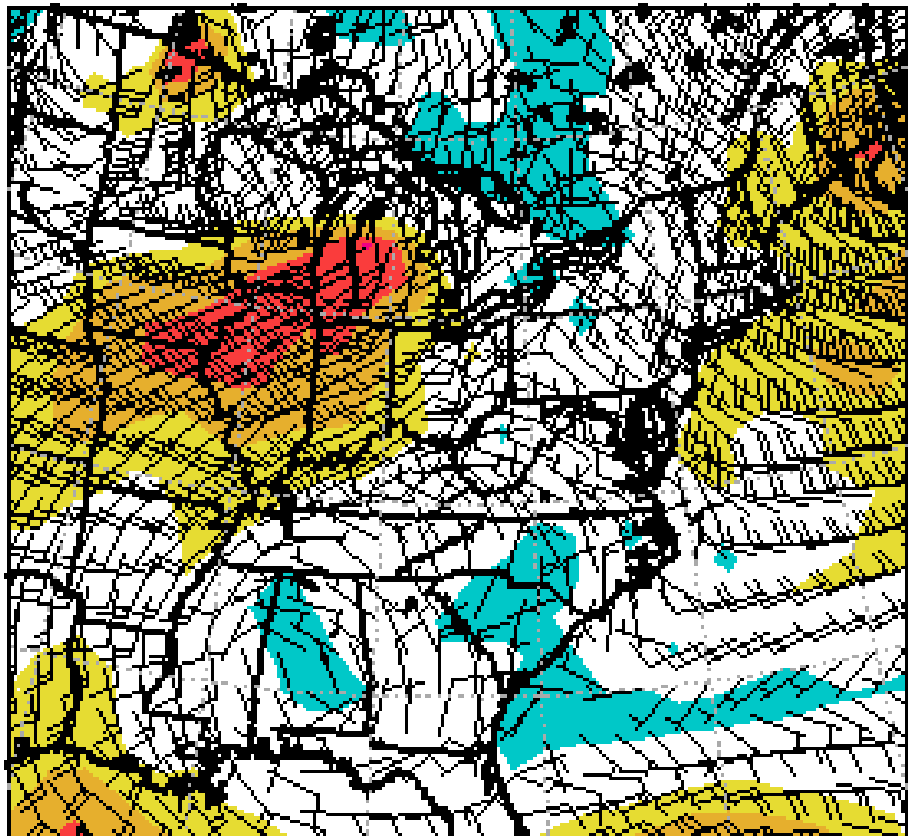
c. Composite 1000hPa prmslmsl 00Z17JUL2010–00Z26JUL2010



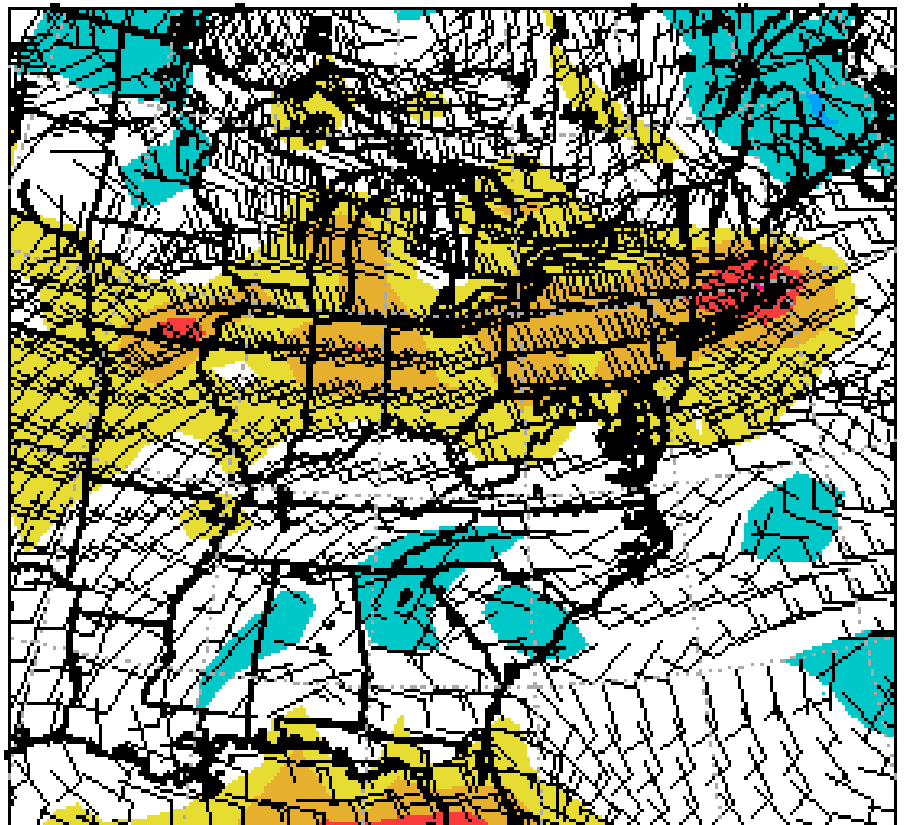
d. Composite 1000hPa pwatclm 00Z17JUL2010–00Z26JUL2010



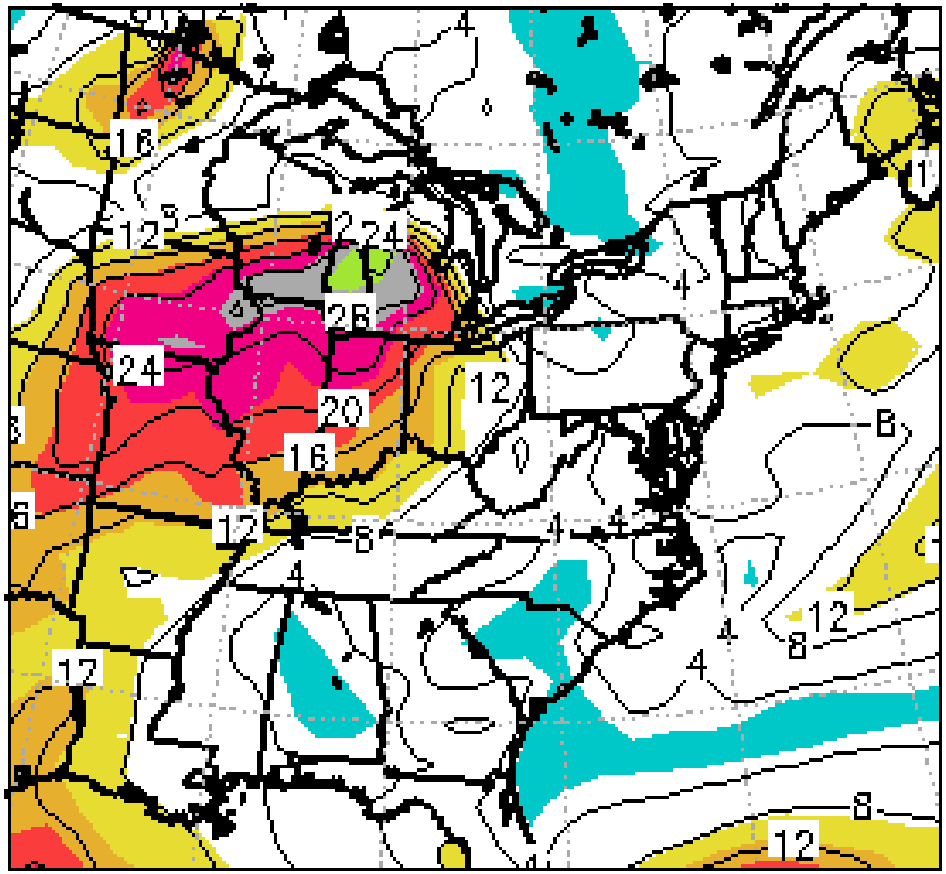
h.GFS 850 wind init:00Z23JUL2010 Valid:00Z23JUL2010



i.GFS 850 wind init:00Z24JUL2010 Valid:00Z24JUL2010



h.GFS 850 mflux init:00Z23JUL2010 Valid:00Z23JUL2010



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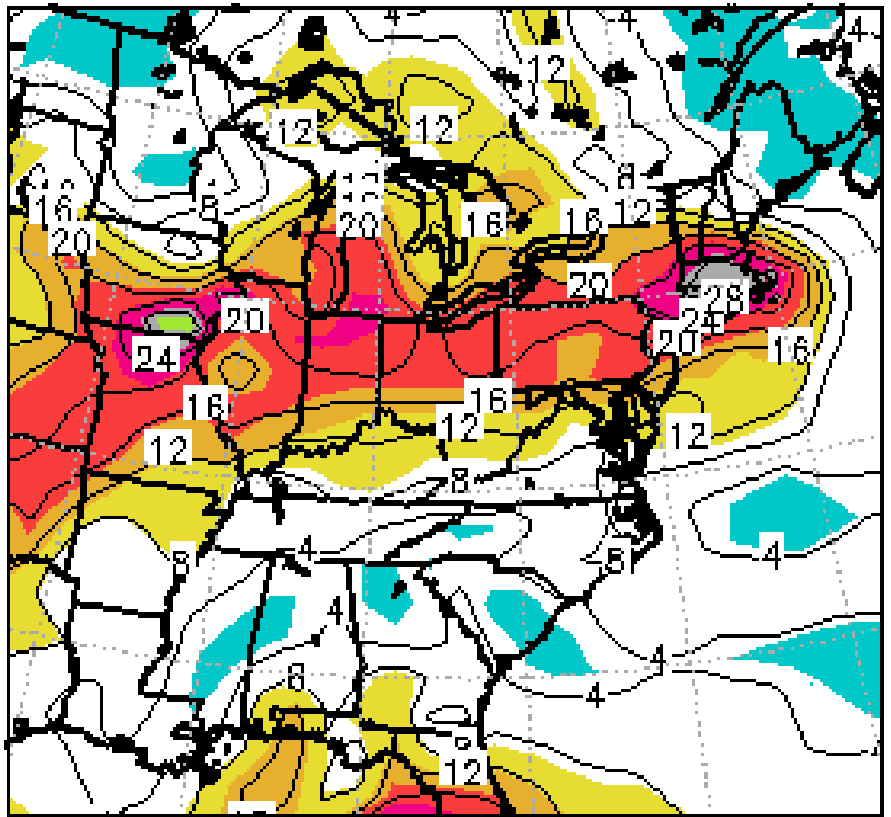

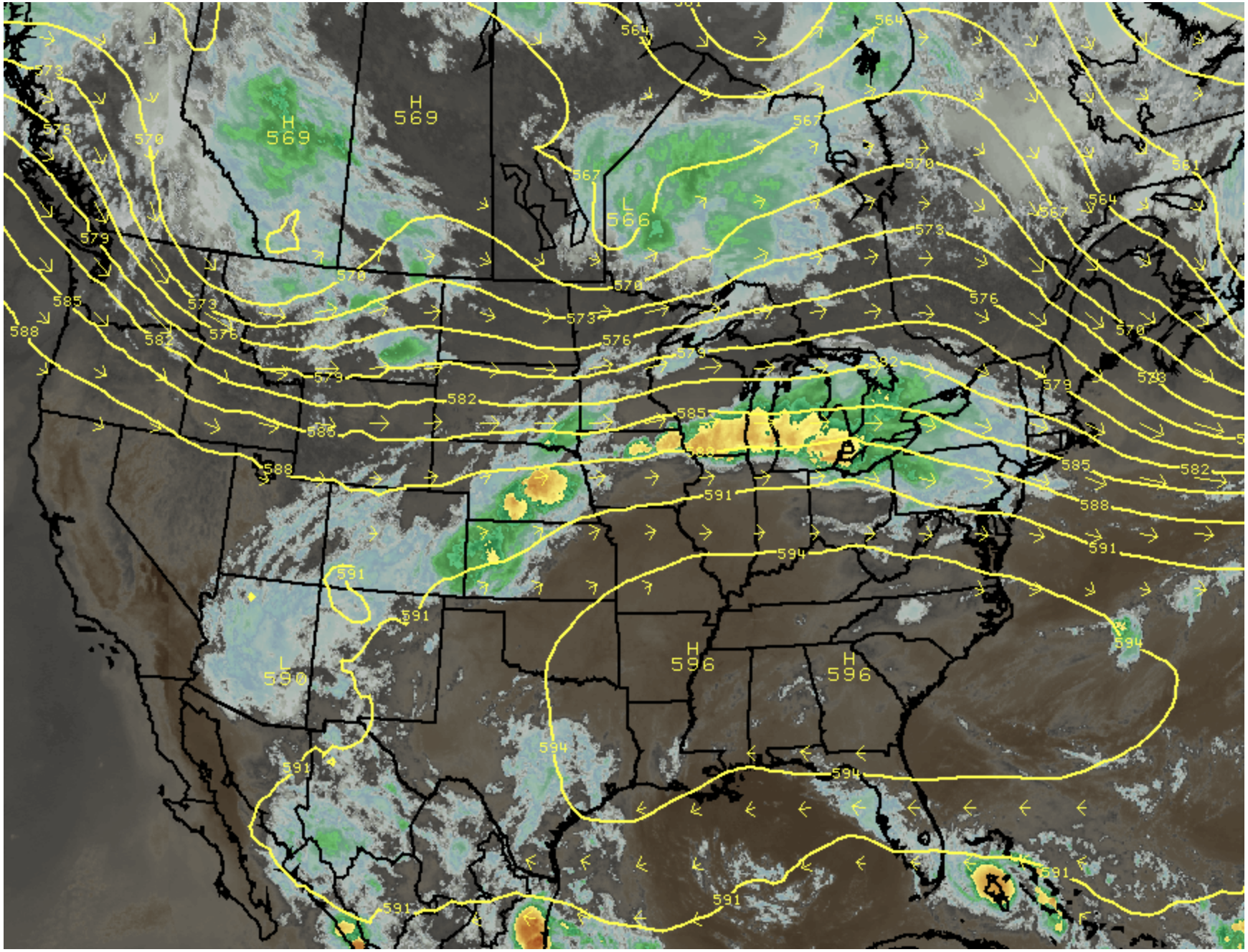
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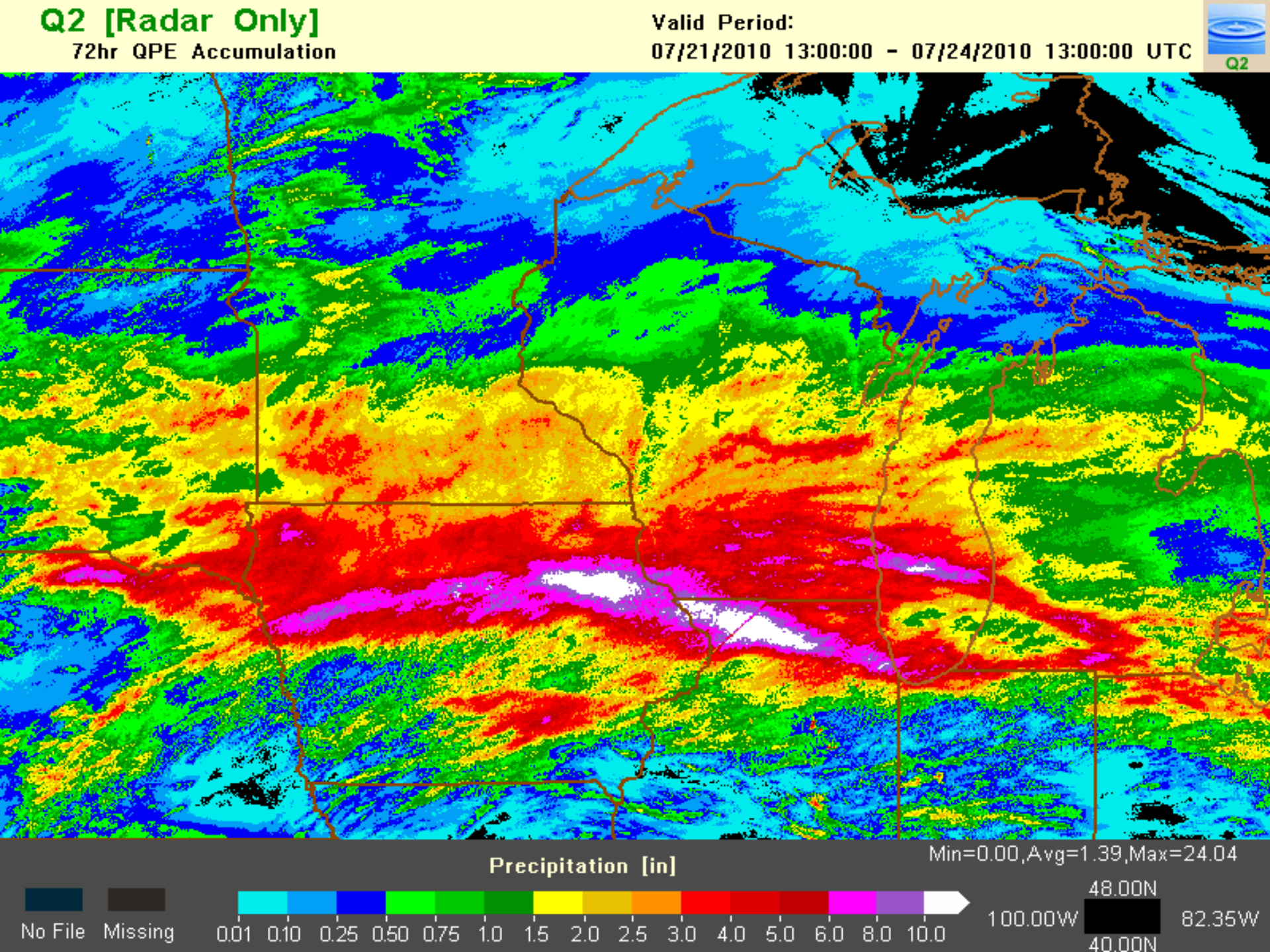
Q2 [Radar Only]
72hr QPE Accumulation
Valid Period:
07/21/2010 13:00:00 - 07/24/2010 13:00:00 UTC
Q2
Min=0.00,Avg=1.39,Max=24.04
Precipitation [in]
No File
Missing
0.01 0.10 0.25 0.50 0.75 1.0 1.5 2.0 2.5 3.0 4.0 5.0 6.0 8.0 10.0
48.00N
100.00W
82.35W
40.00N

A Few Points

- Cherry picked, perhaps. Big signal is there
  - Daily and every 6-hour time step
  - Sometimes over periods of days and months
- But can leverage this
  - Know the patterns
  - ***Using the climate/model phase space to forecast extreme events***.
- **R-Climate and meteorologically significant events** *
  - Focus on standardized anomalies (SA) here
  - Clearly shows signals for synoptic scale extreme events
- **For Pattern people**→ learn the patterns and apply SA and the PDF to identify significant events where you forecast
  - ***Good for Situational Awareness and thus DSS***

References

- **Web resources: http://cms.met.psu.edu/sref/**
  - SREF/GEFS options and Ensemble Threats Page

- Forsythe, J.M., S.Q. Kidder, S.J. Kusselson, A.S. Jones, T.H. Vonder Haar, 2009: Increasing the land coverage of blended multisensory total precipitable water products for weather analysis. 16th Conference on Satellite Meteorology and Oceanography, Phoenix, Arizona. http://ams.confex.com/ams/89annual/techprogram/paper149348.htm
- Hart, R. E., and R. H. Grumm, 2001: Using normalized climatological anomalies to rank synoptic scale events objectively. Mon. Wea. Rev., **129, 2426–2442.**
- Junker, N. W., R. H. Grumm, R. Hart, L. F. Bosart, K. M. Bell, and F. J. Pereira, 2008: Use of standardized anomaly fields to anticipate extreme rainfall in the mountains of northern California. Wea. Forecasting,**23, 336–356.**
- Kusselson, S.J., S.Q. Kidder, J.M. Forsythe, A.J Jones, L. Zhao, 2009: An update on the operational implementation of blended total precipitable water products. 23rd Conference on Hydrology, Phoenix, AZ. http://ams.confex.com/ams/89annual/techprogram/paper_142967.htm

- **http://www.nws.noaa.gov/os/assessments/pdfs/Tenn_Flooding.pdf NWS Service Assessment Tennessee Flood**
- **THE USE OF ENSEMBLE AND ANOMALY DATA TO ANTICIPATE EXTREME FLOOD EVENTS IN THE NORTHEASTERN U.S.**
  - Neil A. Stuart(1), Richard H. Grumm(2), John Cannon(3), and Walt Drag(4)