



Gino Izzi, Matt Wojtowicz and Mark Ratzler
National Weather Service, Chicago/Romeoville, IL

JANUARY 7TH 2008
ILLINOIS TORNADOES

January 7th 2008:

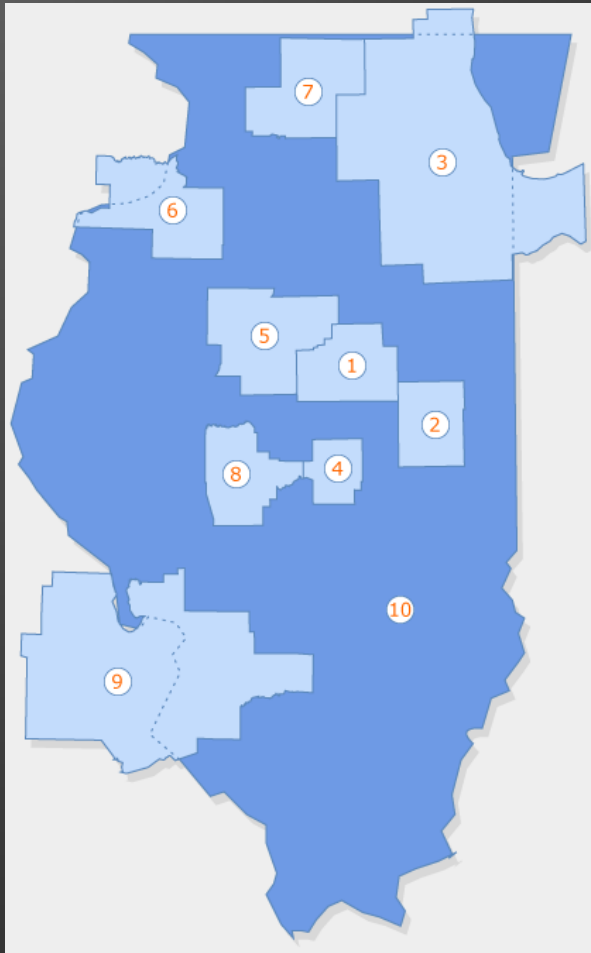
- ⦿ Record shattering warmth advected into northern Illinois and southern Wisconsin
- ⦿ Strong moisture advection fed unseasonably high surface dew point temperatures into the region
- ⦿ Combination of modest instability and strong shear led to favorable environment for supercells
- ⦿ One supercell spawned an EF-3 tornado with a track length of 13.2 miles

Climatology of January Tornadoes in WFO LOT cwa:

- ◉ Jan 2008 Tornado only 2nd on record in WFO LOT cwa in January
- ◉ Only other January tornado was an F2 50 miles south of Chicago on 01/25/1950



Rockford IL Climate:



- Early Jan Average temps: 27°F/11°
- Actual 01/07/08 temps: 63°F/38°F
- Shattered previous record high of 49°F

Forecastability of Jan 7th

Tornadoes

- ⦿ Climatologically extreme event
 - Time of year
 - Intensity of Tornado
- ⦿ Subtle forcing, questions about degree of instability added to degree of forecast difficulty

Forecastability of Jan 7th

Tornadoes

- ⦿ Active weather pattern likely decreased situational awareness
 - Forecast of potential record flooding and +RA event demanded attention
 - Multiple forecast updates for all-time record breaking high temperatures
 -
 - Demand for media interviews very high (~dozen interviews between 8 am-noon)

Forecastability of Jan 7th

Tornadoes

- ⦿ Could the tornado threat have been reasonably detected any earlier?
- ⦿ Just how early could the tornado threat have been reasonably forecast?

Let's Take A Closer Look:



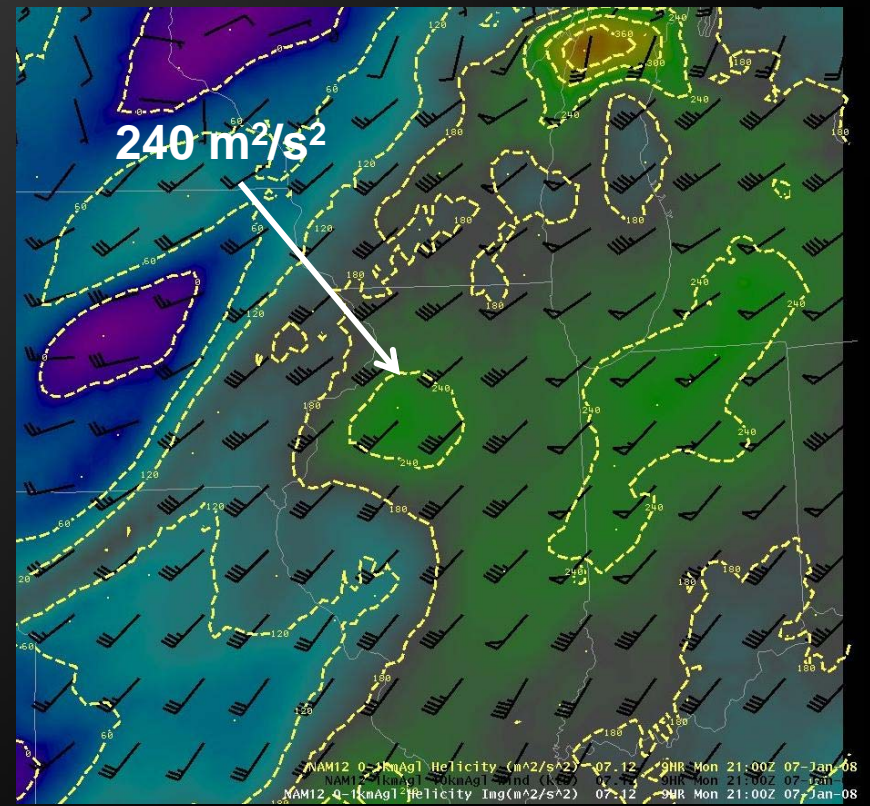
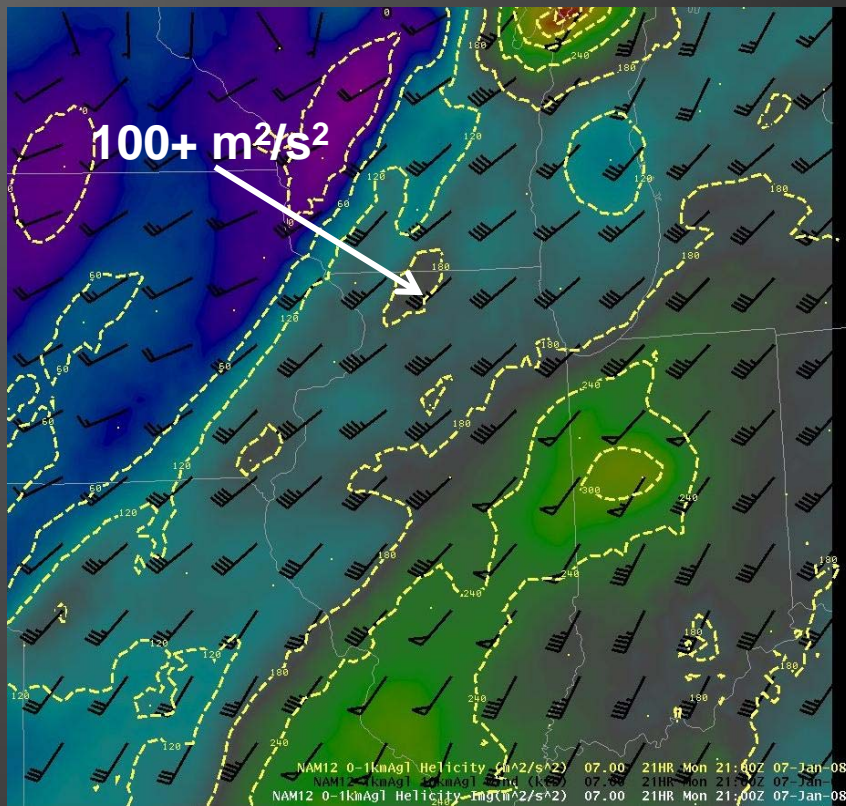
Ingredients Based Approach

- Shear
- Forcing
- Instability (boundary layer for tornadoes)
- Shear + Forcing + Instability = *Bad day for EM's*

Shear

- ⦿ Rarely the “missing link” in winter events
- ⦿ Model trends indicated increasingly strong low level shear
- ⦿ Deep layer shear more than sufficient

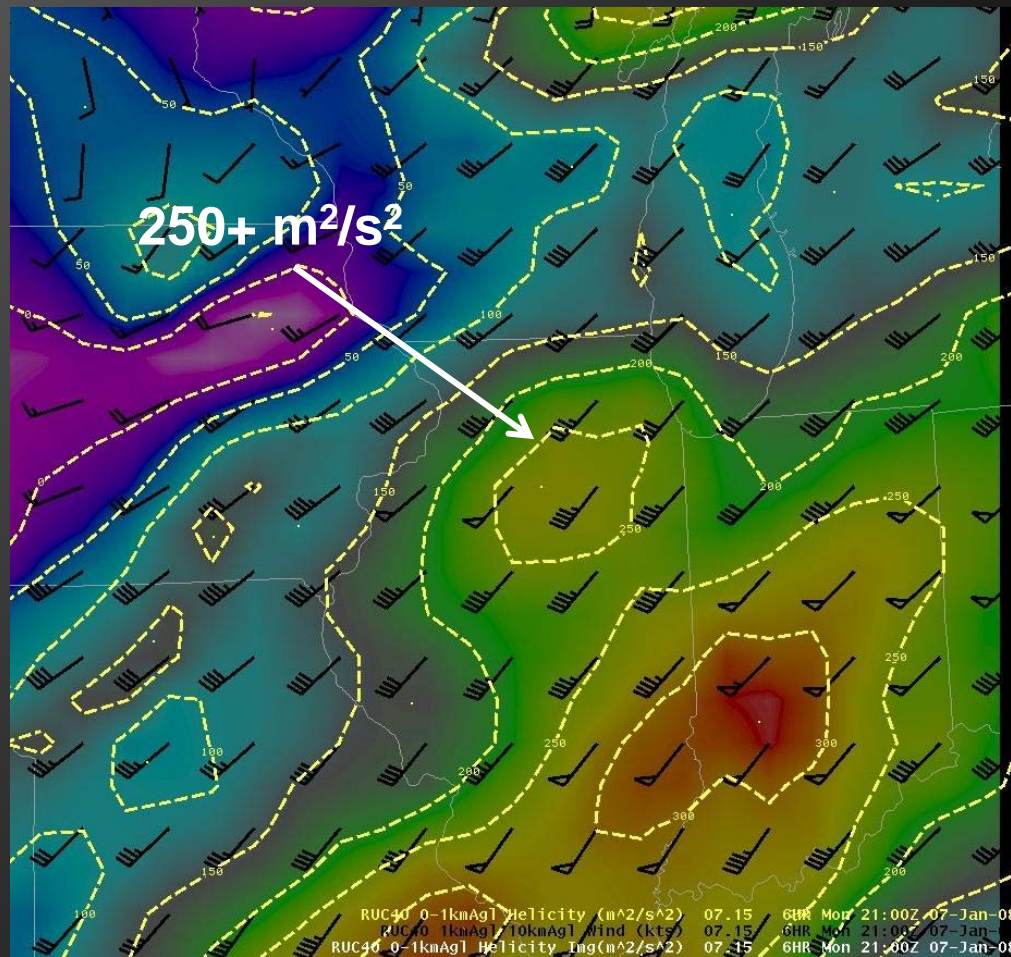
WRF Shear Trends:



**00Z WRF 0-1 km Helicity
Valid 21Z 01/07/08**

**12Z WRF 0-1 km Helicity
Valid 21Z 01/07/08**

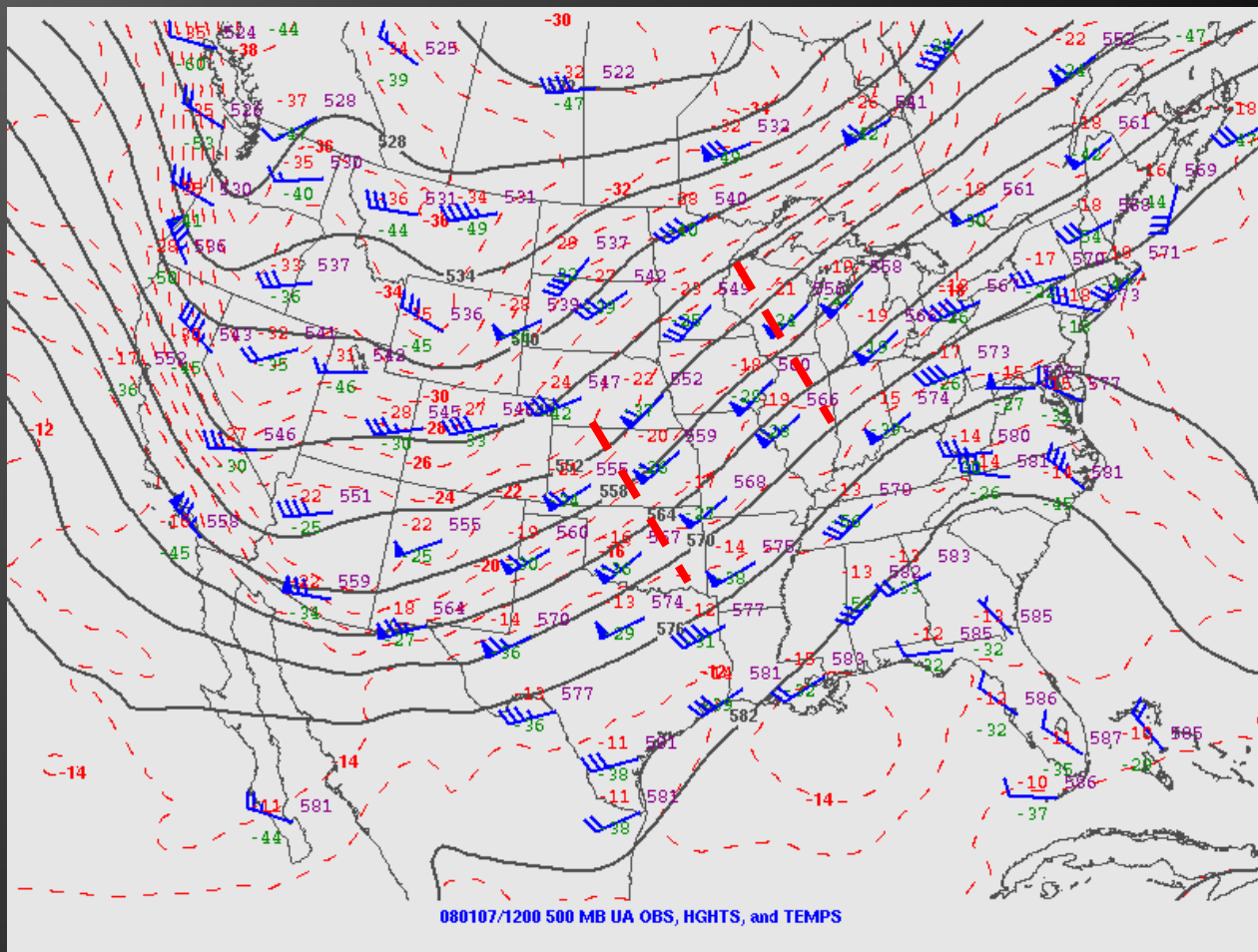
15Z RUC 0-1 km Helicity



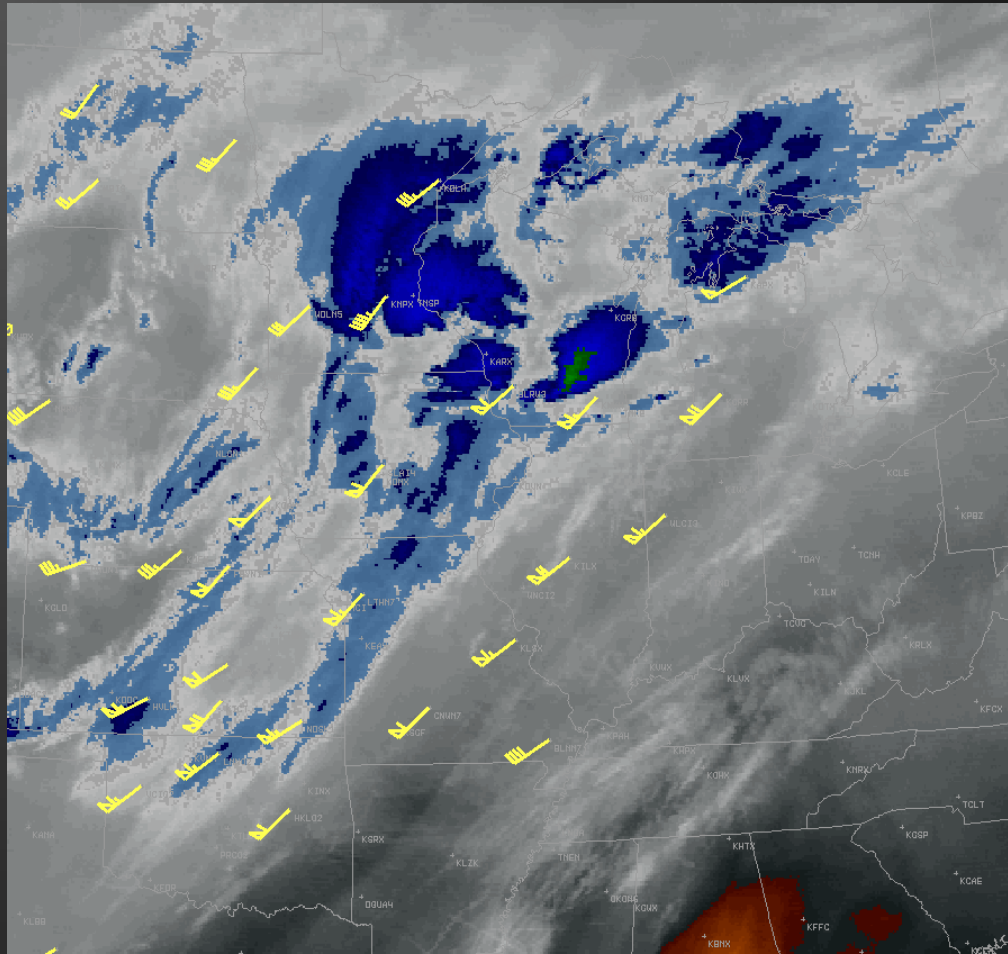
Forcing

- ⦿ Lacking strong well-defined mid level short wave
- ⦿ No strong or rapidly deepening surface wave
- ⦿ Storms formed well east of maximum low level convergence

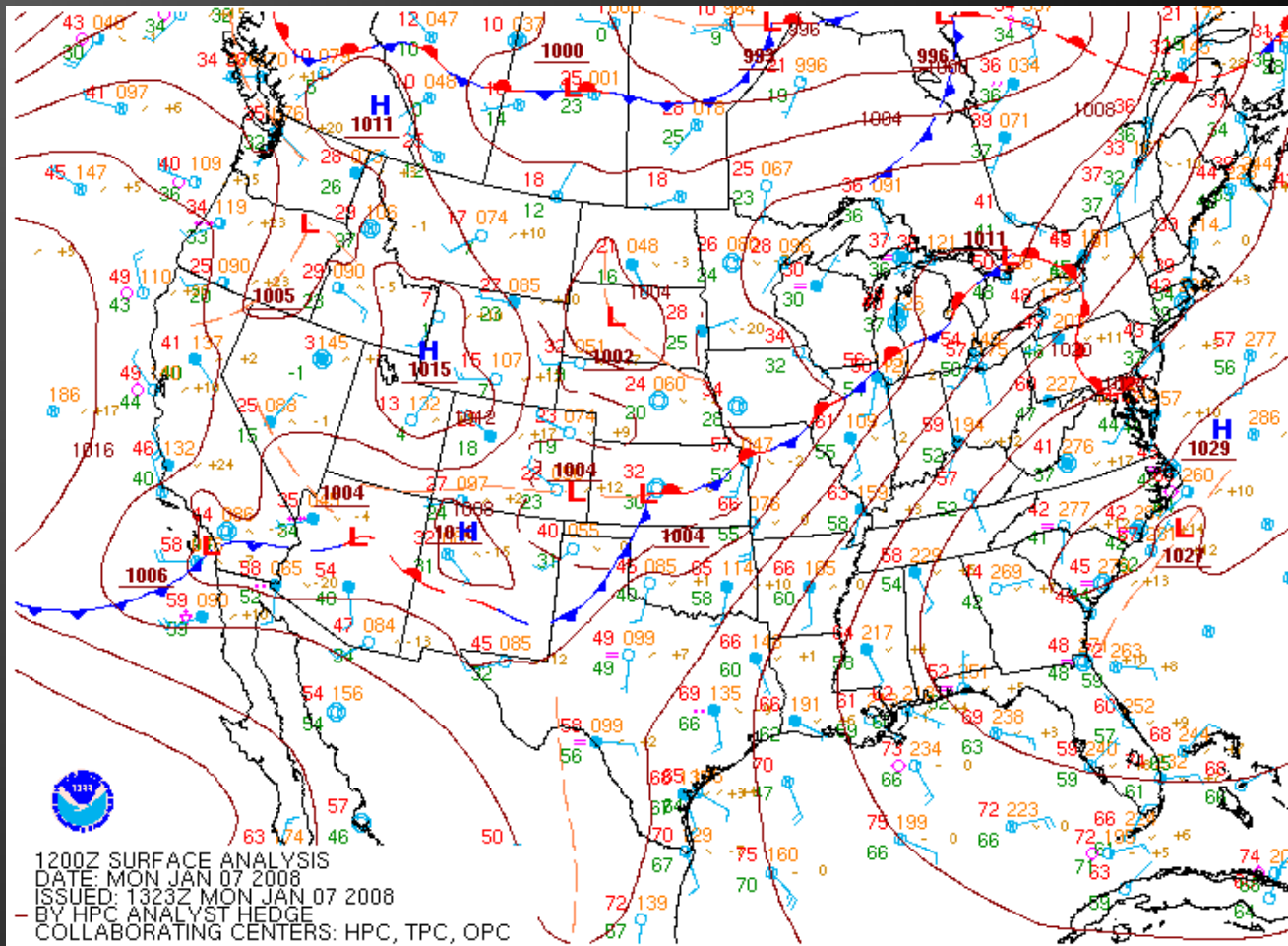
12Z 500 hpa



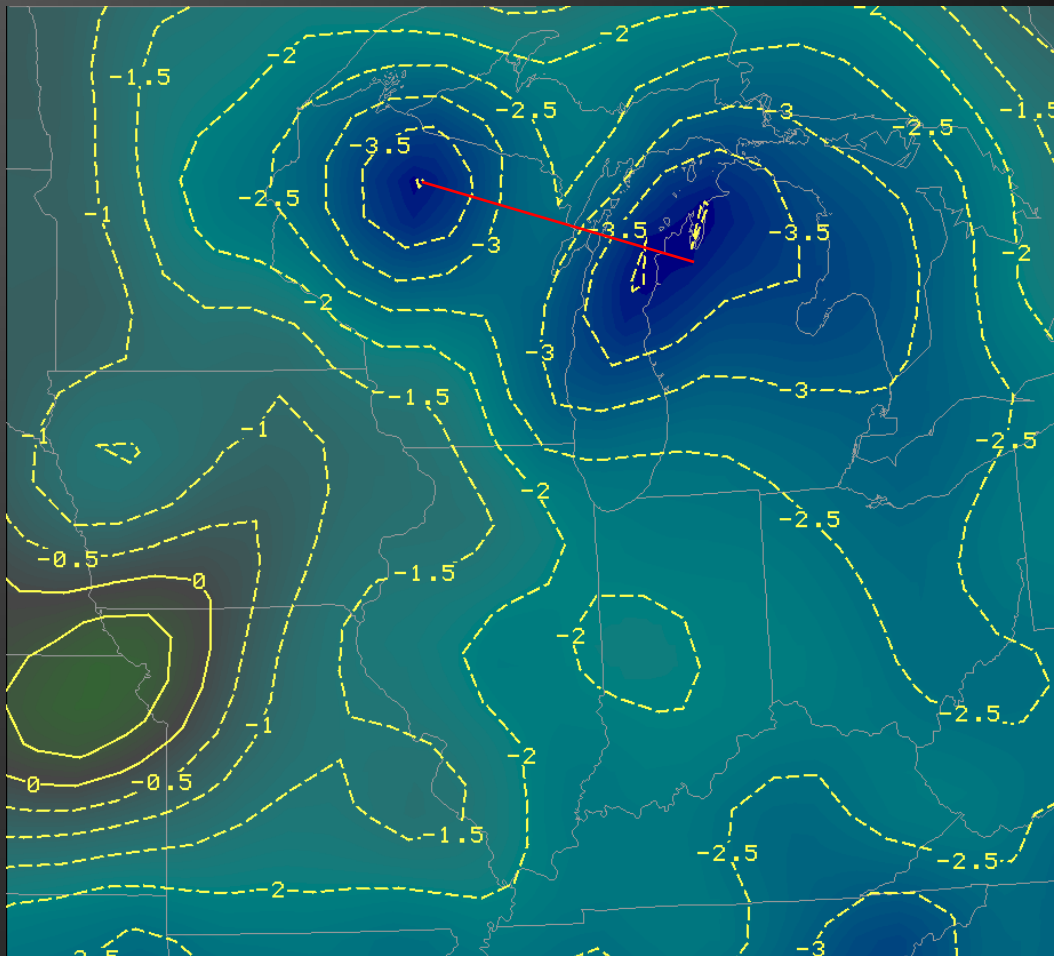
Water Vapor and 500 hpa Profiler



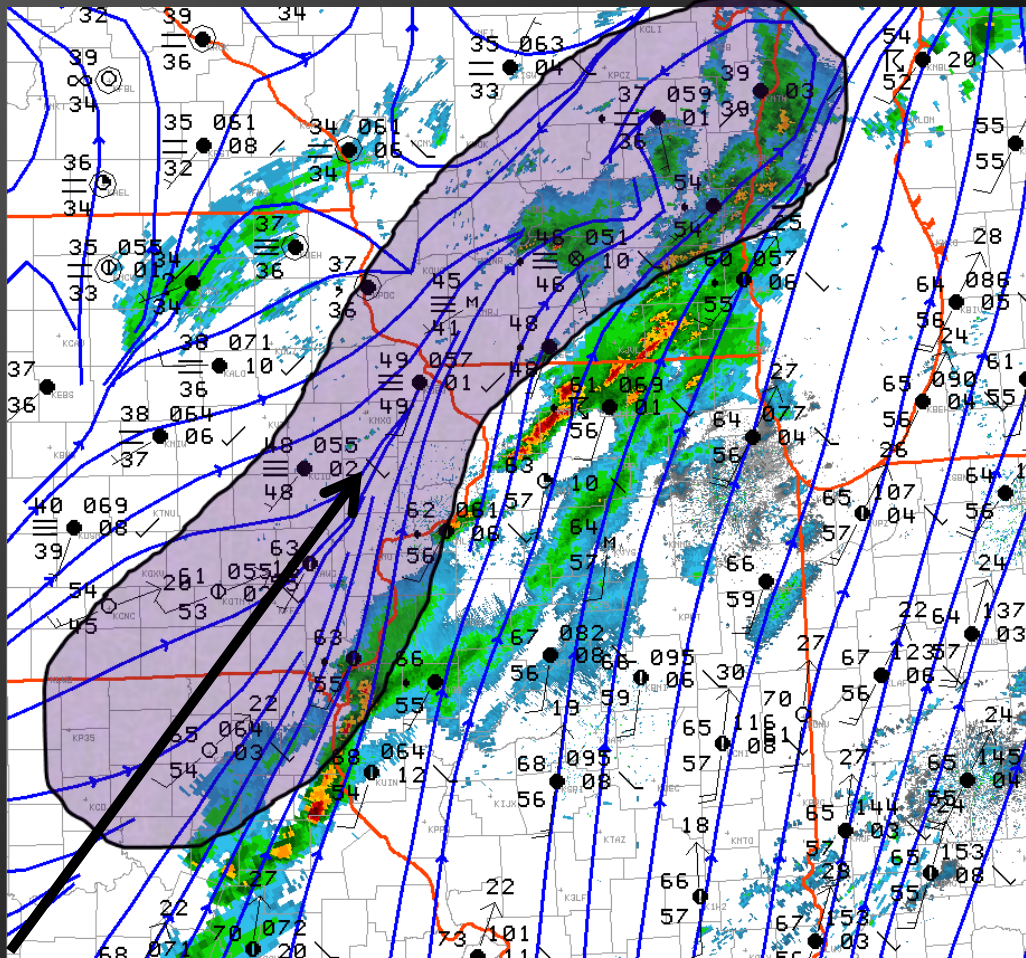
13Z Surface



3 Hr Pressure Falls: 19Z



Radar and Surface Obs

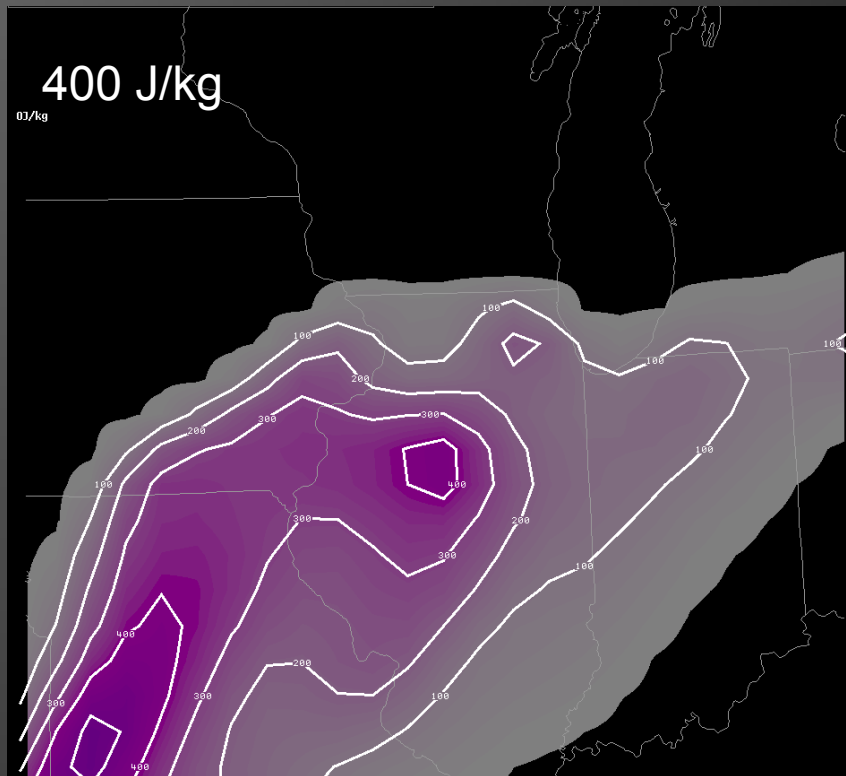


Axis of Maximum convergence

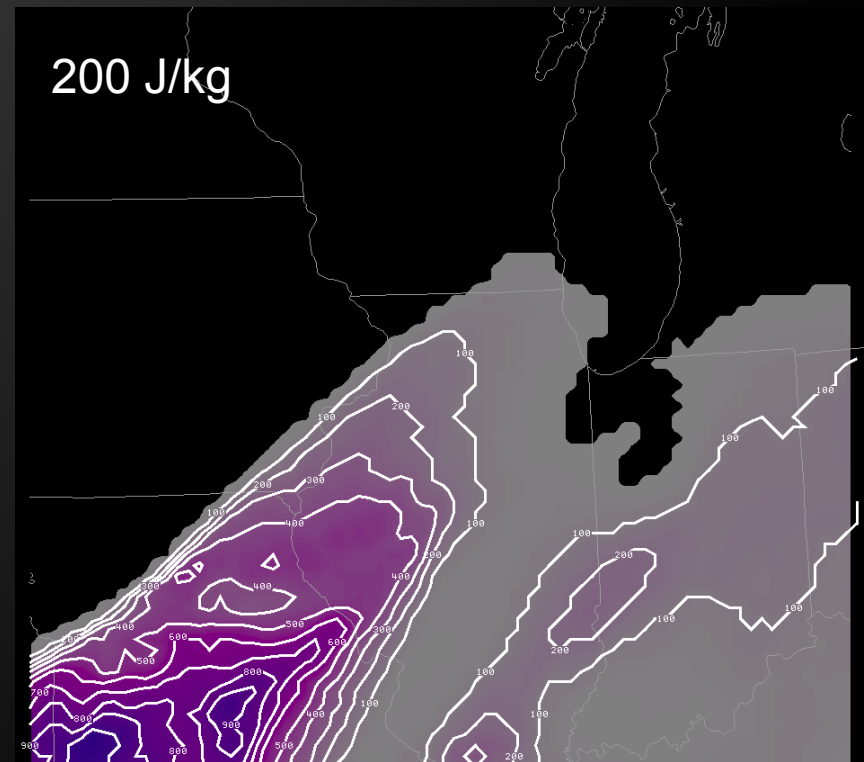
Instability

- Typically is the “missing link” in winter severe events
- Much lower degree of forecast certainty
- Models consistent in forecasting some MUCAPE in this case, but...
- Signal more nebulous for SBCAPE and potential for BL rooted storms

Instability: Forecast SBCAPE

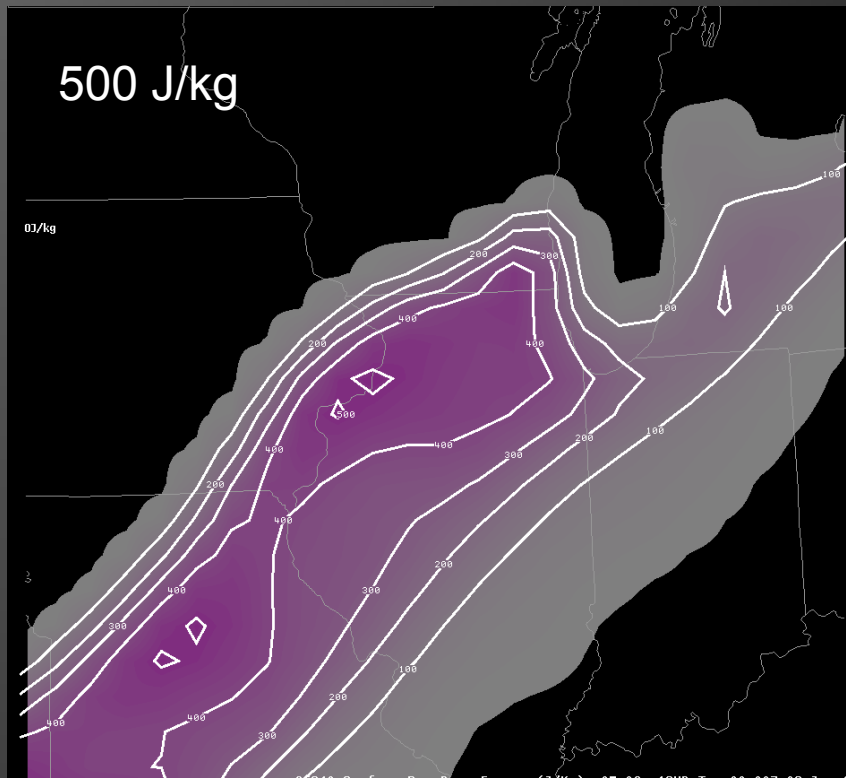


00Z GFS valid 21Z
01/07/08

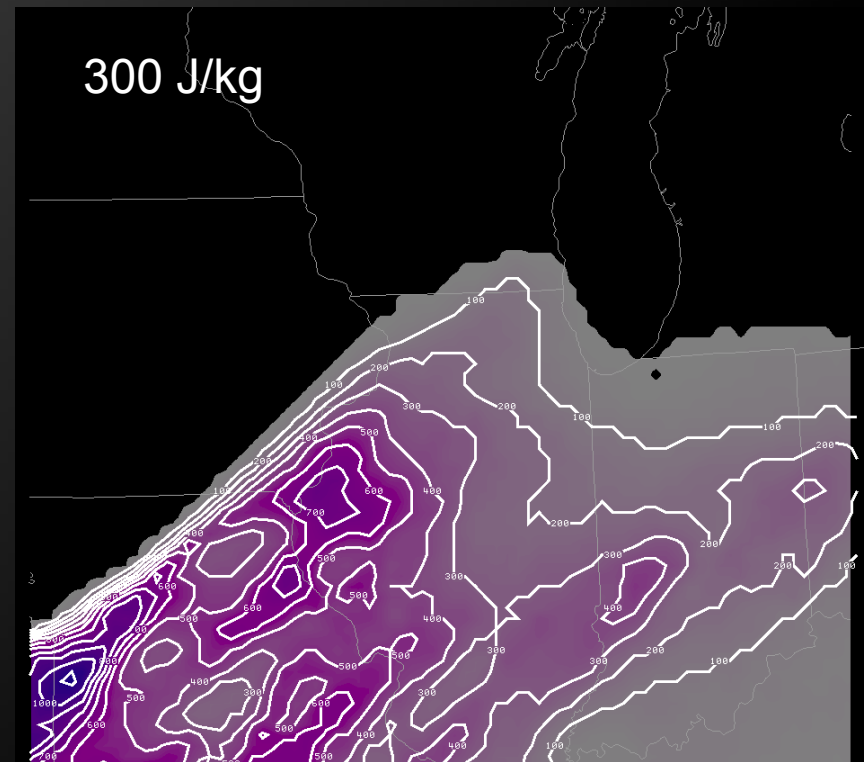


00Z WRF valid 21Z
01/07/08

Instability: Forecast SBCAPE

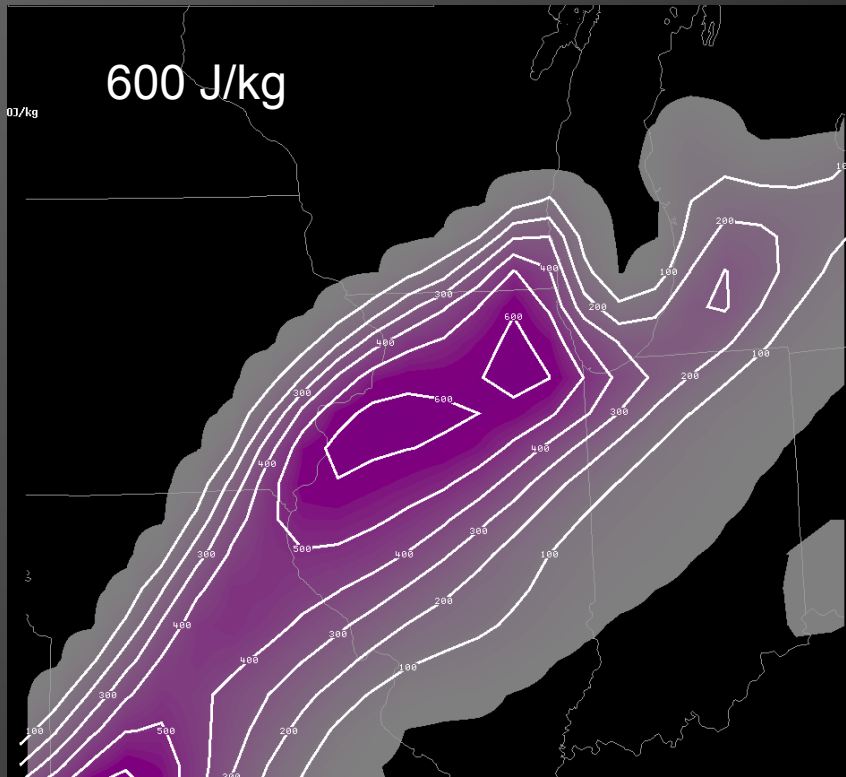


06Z GFS valid 21Z
01/07/08

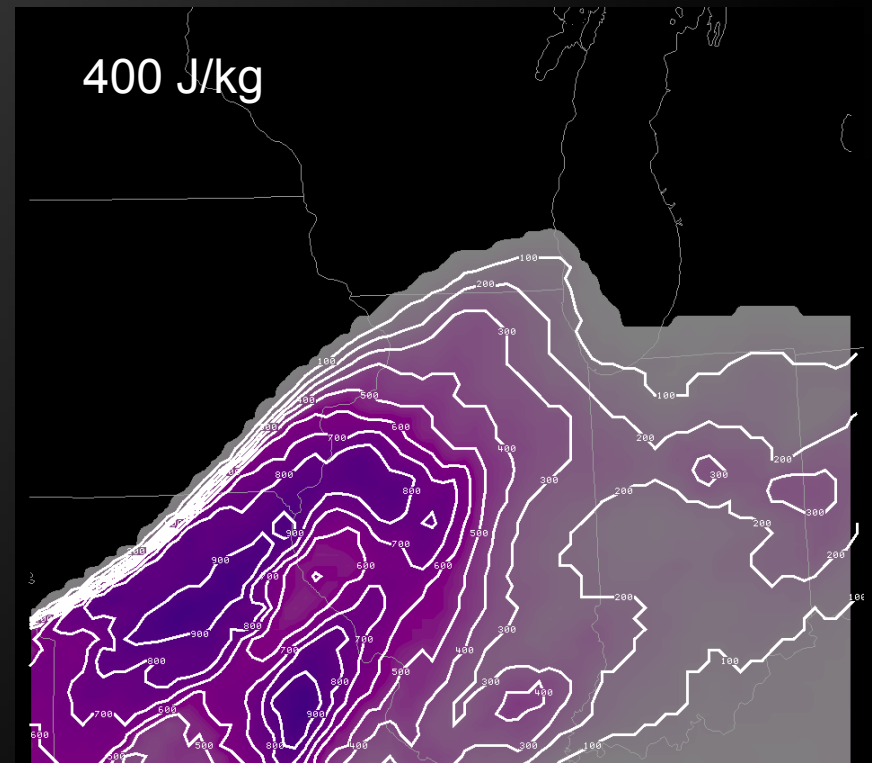


06Z WRF valid 21Z
01/07/08

Instability: Forecast SBCAPE

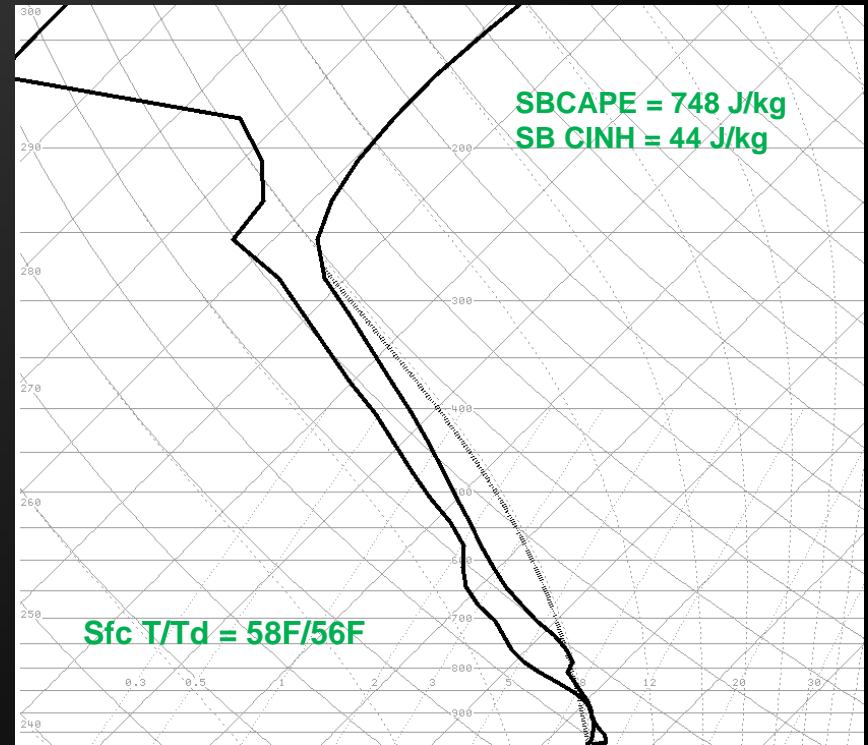
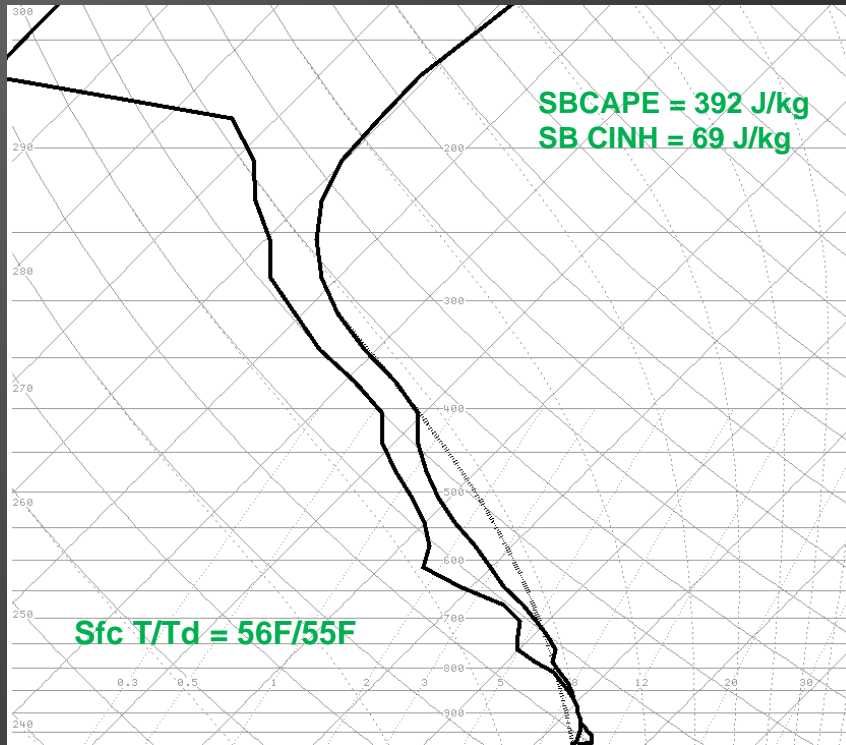


**12Z GFS valid 21Z
01/07/08**



**12Z WRF valid 21Z
01/07/08**

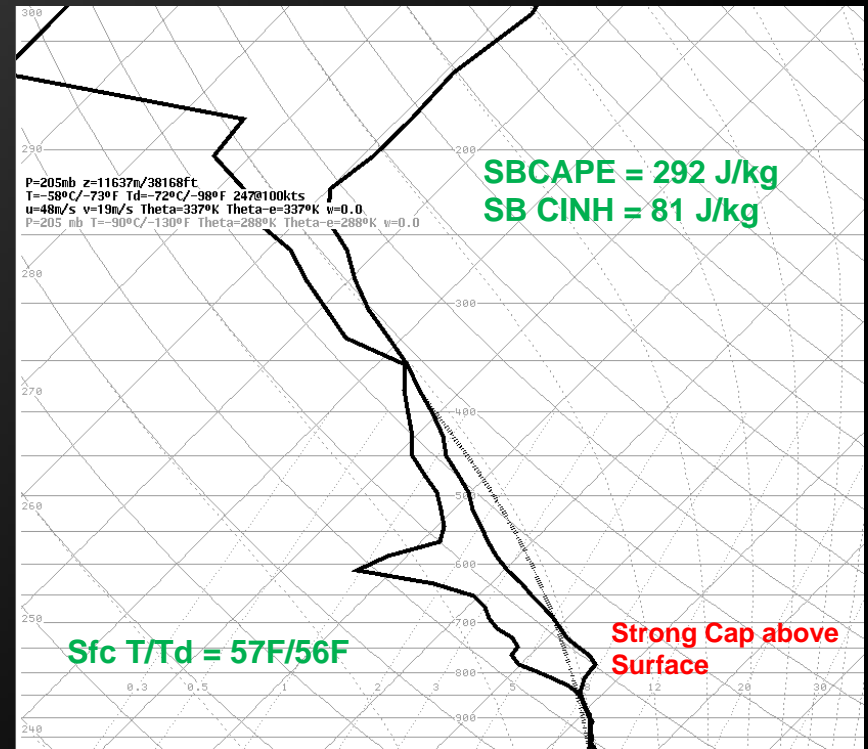
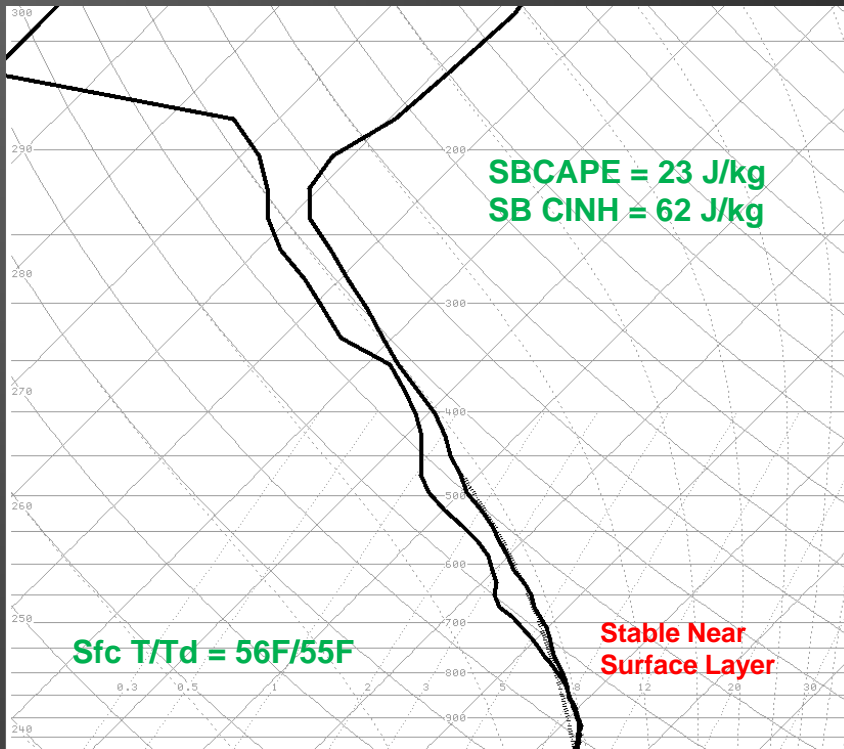
GFS Forecast Soundings



21 hour forecast from 00Z
valid 21Z

9 hour forecast from 12Z
valid 21Z

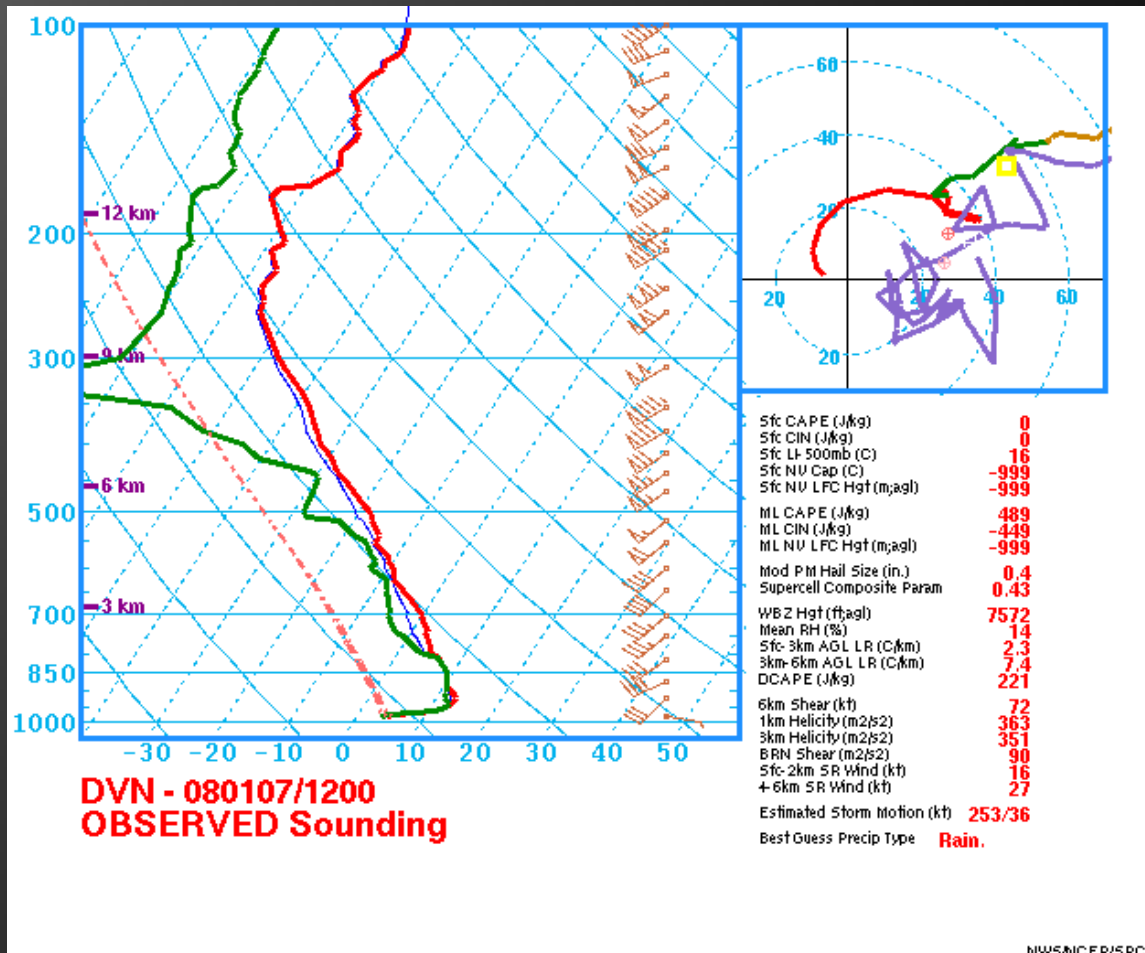
WRF Forecast Soundings



21 hour forecast from 00Z
valid 21Z

9 hour forecast from 12Z
valid 21Z

12Z DVN Observed Sounding



Instability: Model Trends

- Trend from in both models 00Z to 12Z is for stronger instability, farther north
- GFS and WRF both forecast considerable CIN, generally within surface based stable layer
- GFS outperformed WRF SBCAPE and SBCIN forecasts...should the forecaster have expected that?

Instability: In Reality

- Surface temperatures were actually 2-3C warmer than any model forecast
- Resulting boundary layer warmth allowed for stronger SBCAPE and little SBCINH

Was This Event Forecastable?

- ⦿ Subjective question, but...
- ⦿ Highly improbable that midnight shift could have anticipated tornado threat
- ⦿ Despite trends, both 00Z and 06Z runs of WRF and GFS offered little indication of surface based convection

Was This Event Forecastable?

- ◎ By mid-morning on Jan 7th some clues became apparent:
 - Skies were clearing in warm sector
 - Temps warming rapidly, exceeding forecast
 - 12Z GFS/WRF both more foreboding, especially in light of model trends
- ◎ Climatology still carried significant weight in forecasters mind, even into early afternoon

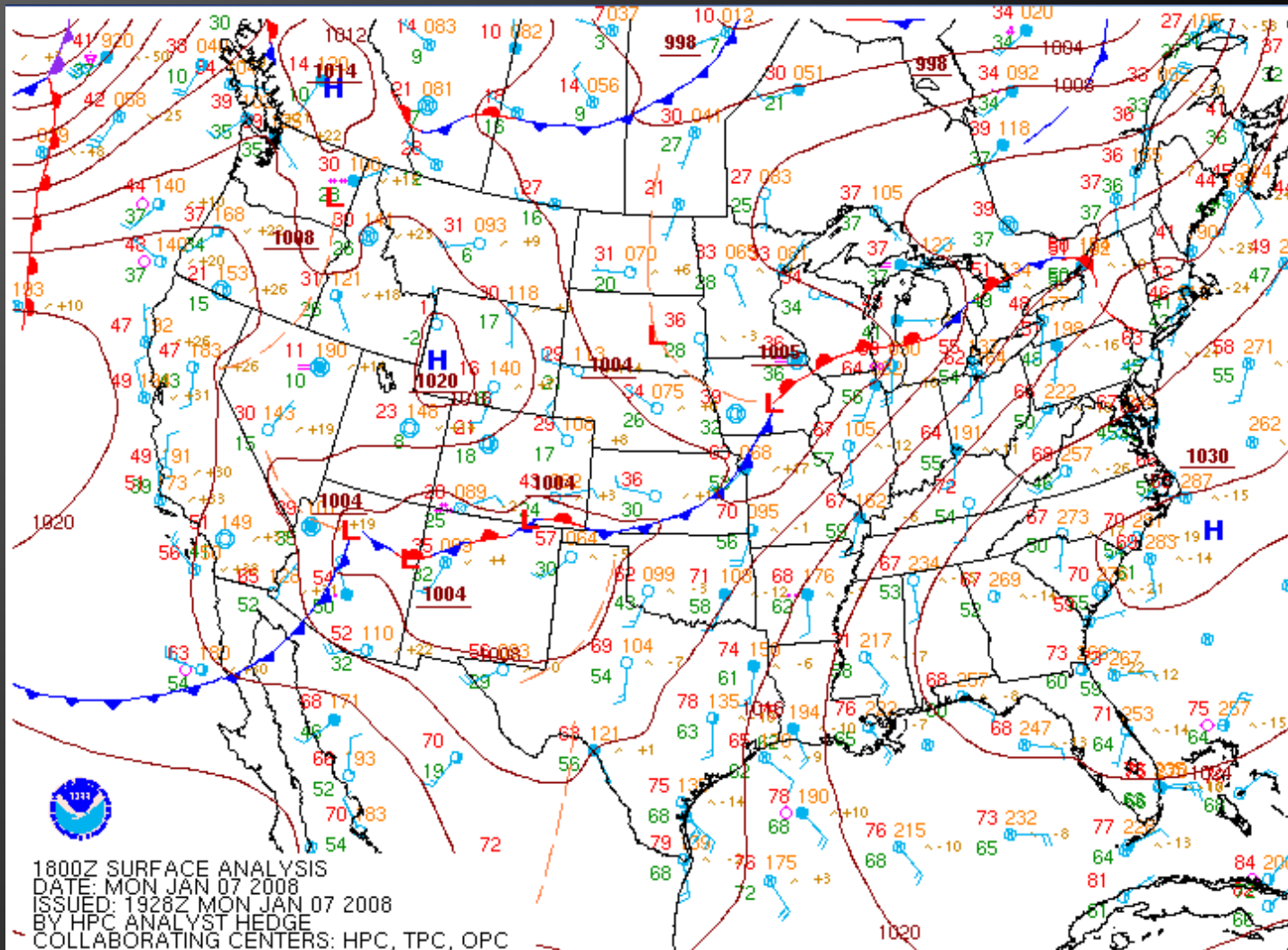
Was This Event Forecastable?

- By 19Z, observed data pointed strongly toward tornado potential, but climatology still weighed heavily on minds of WFO and SPC forecasters
- Following acceptance that an “unlikely” event was becoming “likely”, spin up was quick at WFO and SPC with excellent short term services provided

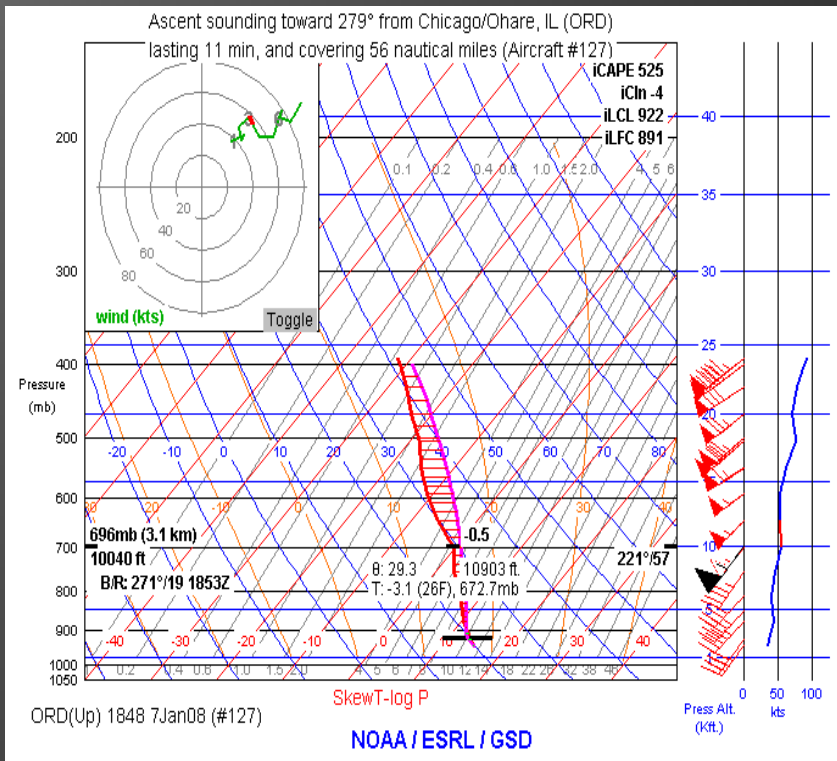
SPC and WFO Products

- 1944Z, HWO updated to include potential of severe thunderstorms
- 1947Z, MCD issued for northern IL and southeast WI
“...Tornado Watch Likely...”
- 2001Z, SWODY1 expands SLGT as far north as extreme southeast WI
- 2015Z, HWO updated again to include tornado potential
- 2035Z, Tornado Watch #2 issued for northern IL
- 2112Z, first tornado warning issued:
 - 100% POD for tornadoes
 - Average lead time >15 minutes
- 2130Z, tornado in Boone County

18Z Surface



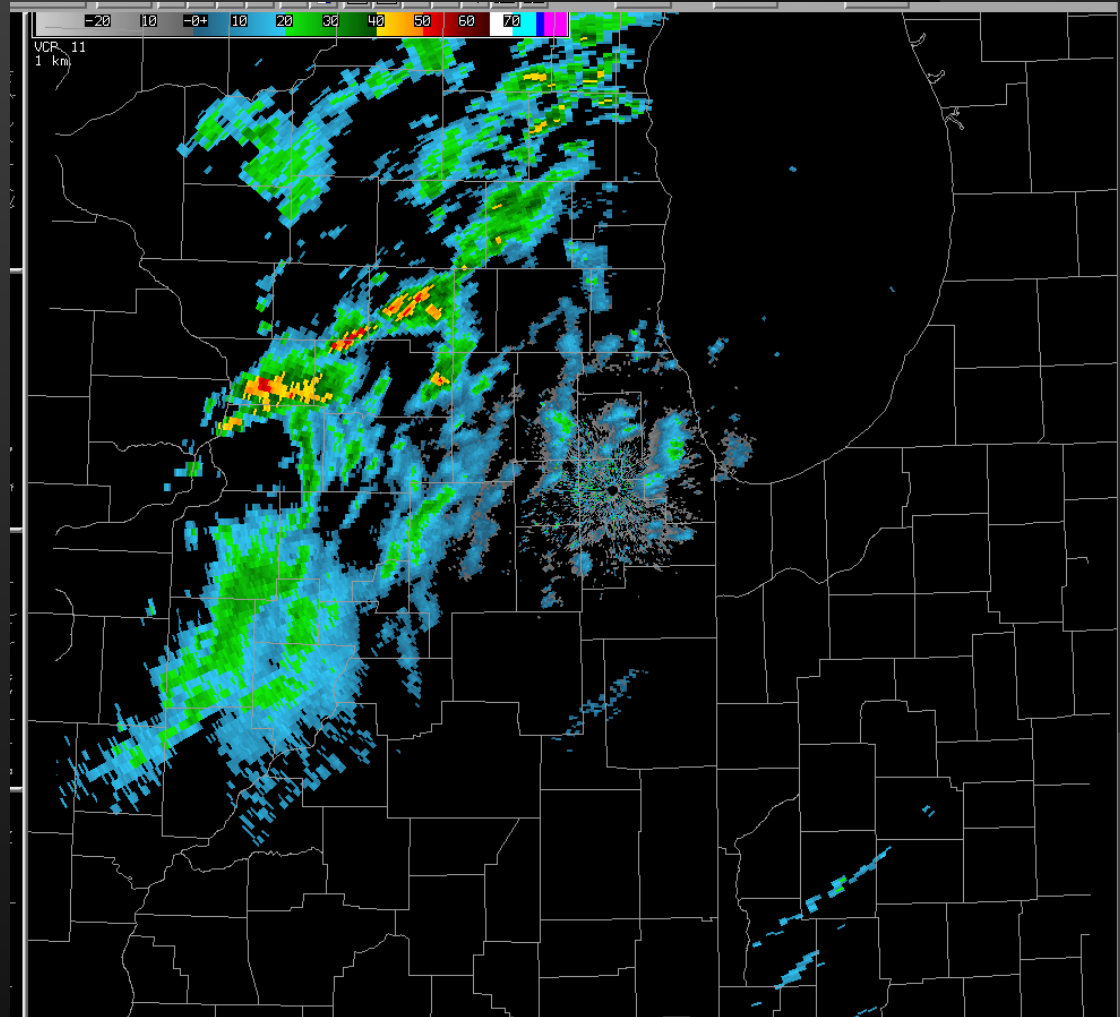
1848Z ORD Modified ACARS Ascent Sounding



- Very strong winds aloft, impressive deep layer and low level shear
- Mid levels cooled slightly from AM sounding
- Modest surface based instability now present...525 J/kg, only 4 J/kg CINH
- Small surface T/Td spreads...low LCL

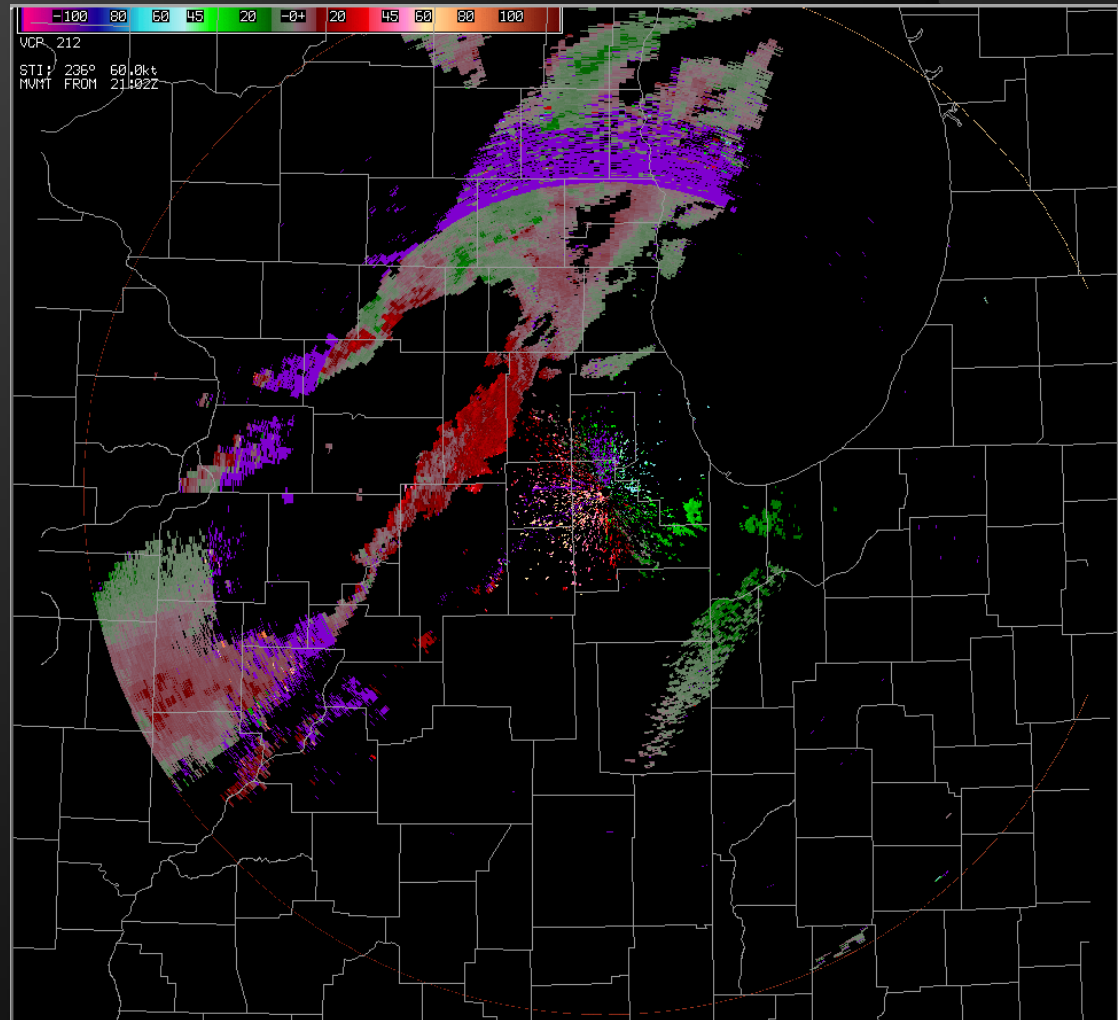
Radar: 2009Z to 2107Z

- Steady increase in intensity & coverage of convection
- Trailing cell in cluster becomes most intense moving into NC IL



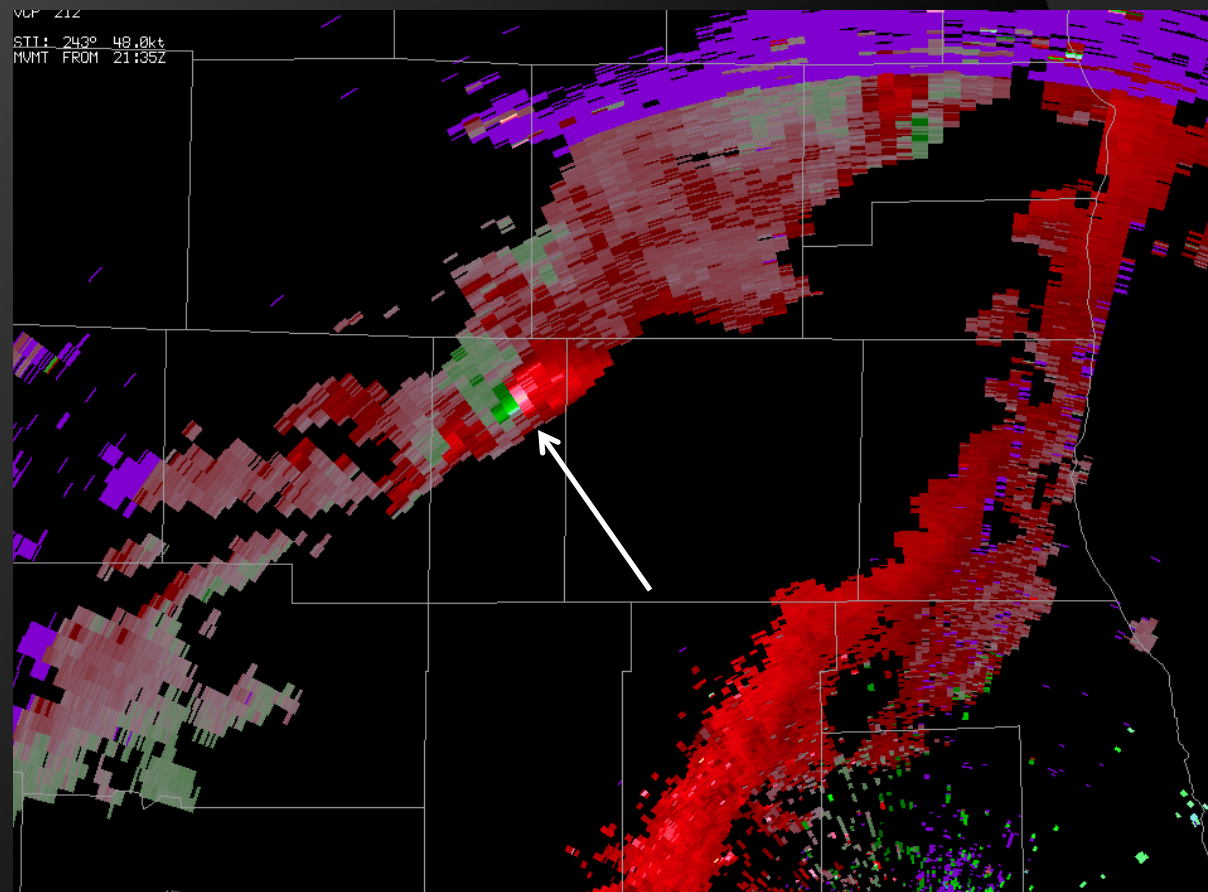
Storm Relative Velocity: 2007Z to 2139Z

- Mesocyclone develops with cell over NC IL
- With time velocity couplet tightens & intensifies
- Tornado occurs at 2130Z

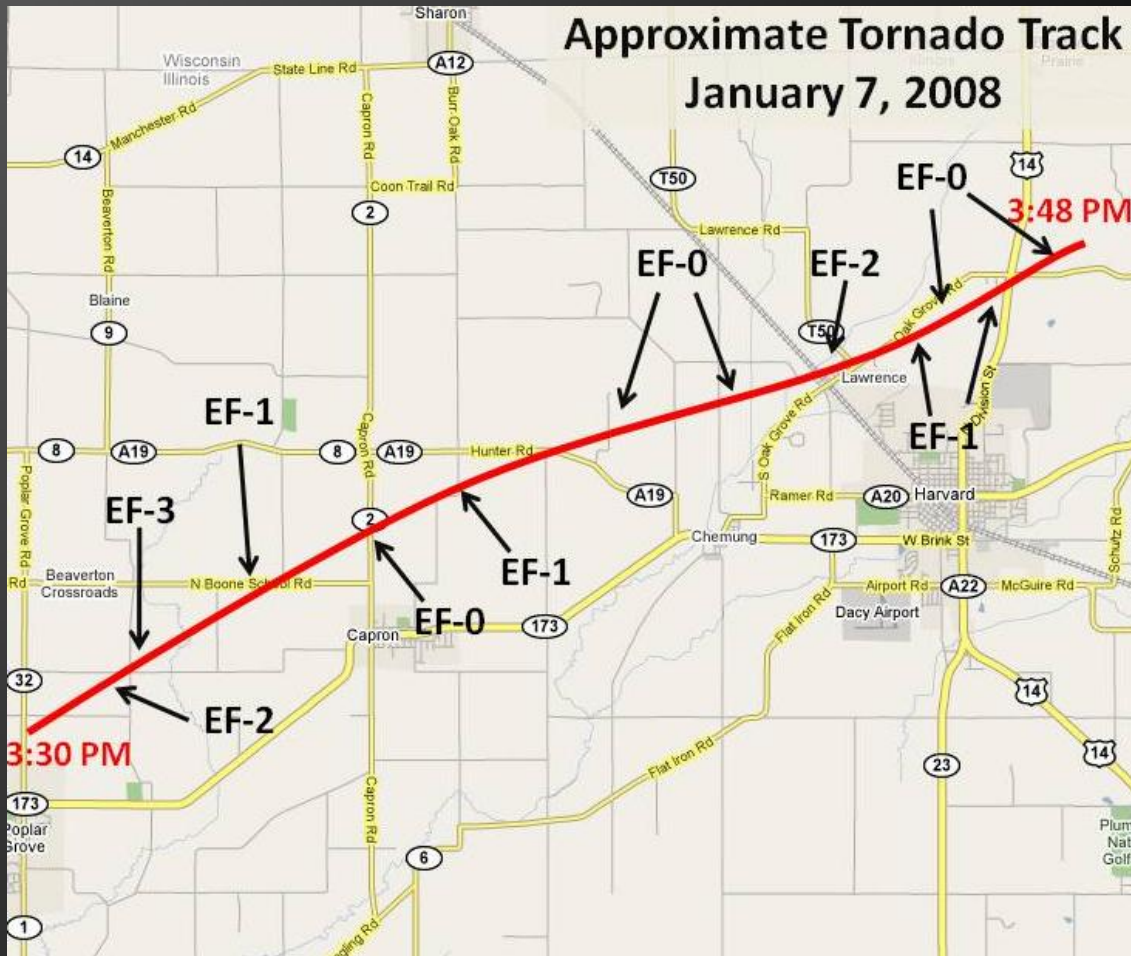


Storm Relative Velocity at 2135Z

- Approximate time strongest tornado damage was occurring
- $\Delta V = 102\text{kt}$, strongest velocity couplet noted with storm
- 58 nm, ~5000 ft agl



Tornado Track: From WFO LOT Damage Survey



The Tornado



Poplar Grove, IL Boone County

Damage Pictures:



Damage Pictures:



Snow pile with debris



Freight train derailed with hazmat cars

Summary

- ⦿ Very challenging event
- ⦿ While model forecasts trended toward greater instability and less inhibition, difficult to assess the potential for surface based convection with ample lead time
- ⦿ Once threat clearly realized, response was swift and likely saved lives