Using GOES-R Demonstration Products to "Bridge the Gap" Between Severe Weather Watches and Warnings for the 20 May 2013 Moore, OK Tornado Outbreak

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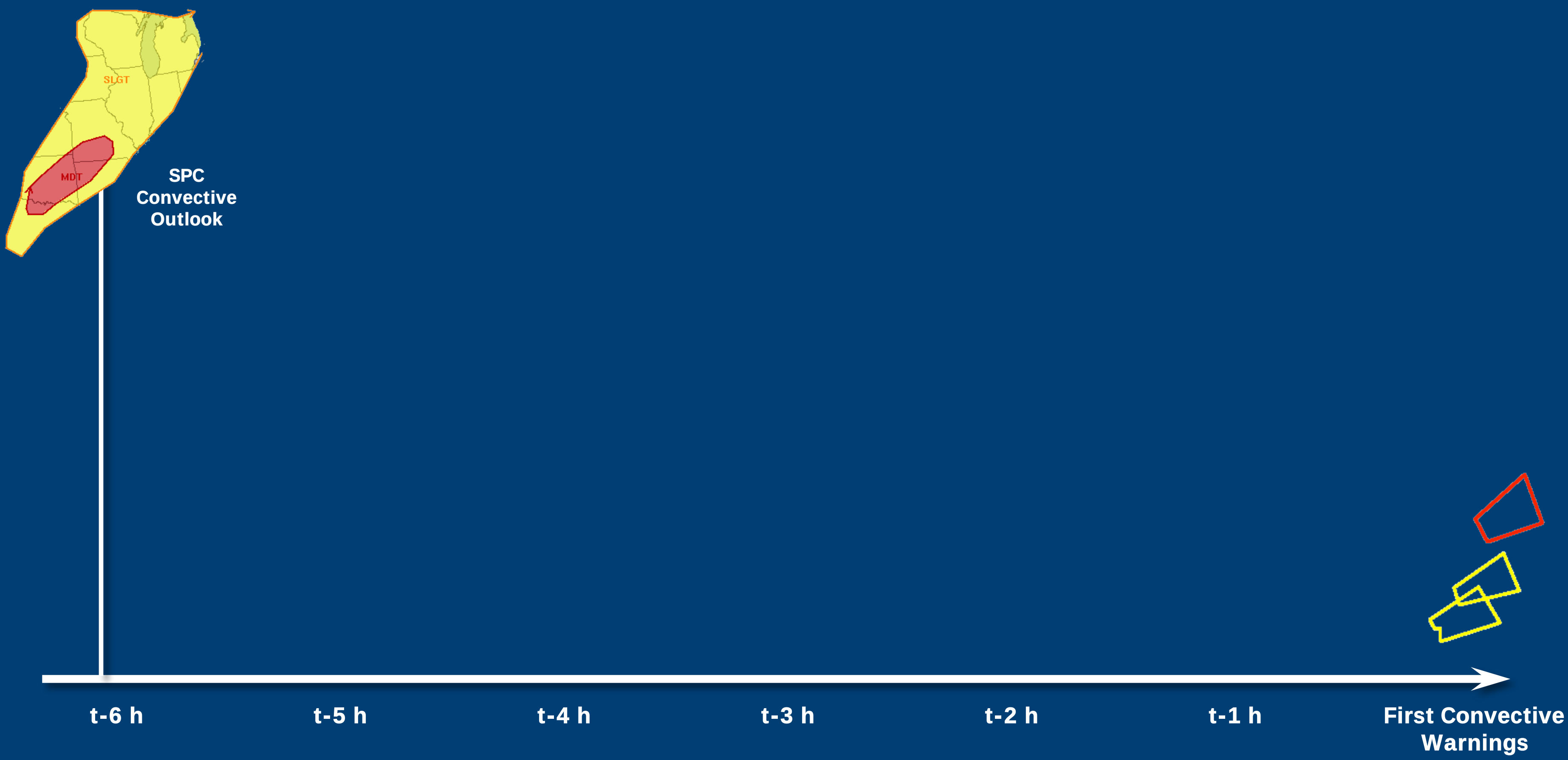
GOES-R Monthly Science Seminar – 24 January 2014

The -6-0 h Convective Forecasting Timeline



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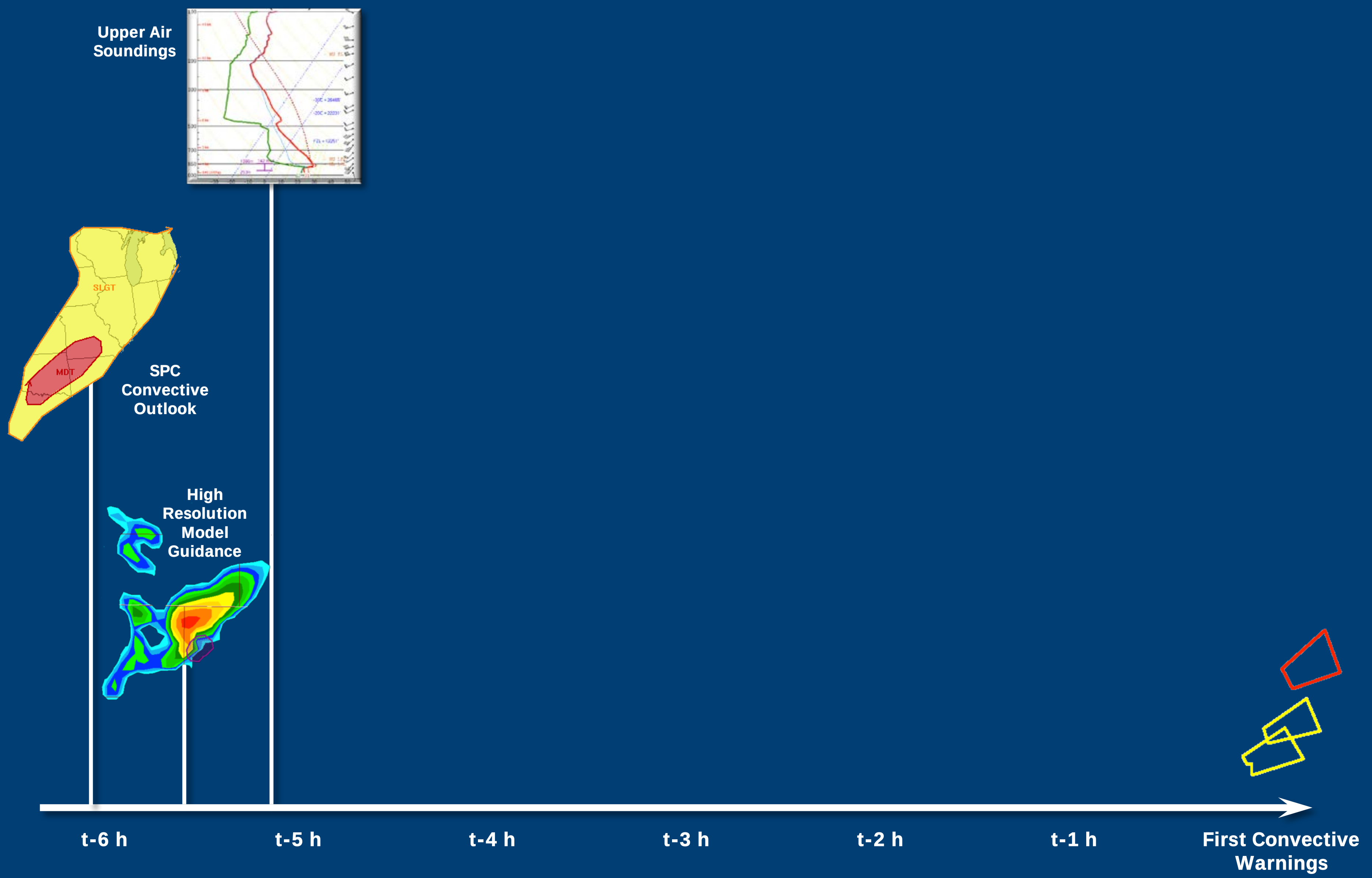

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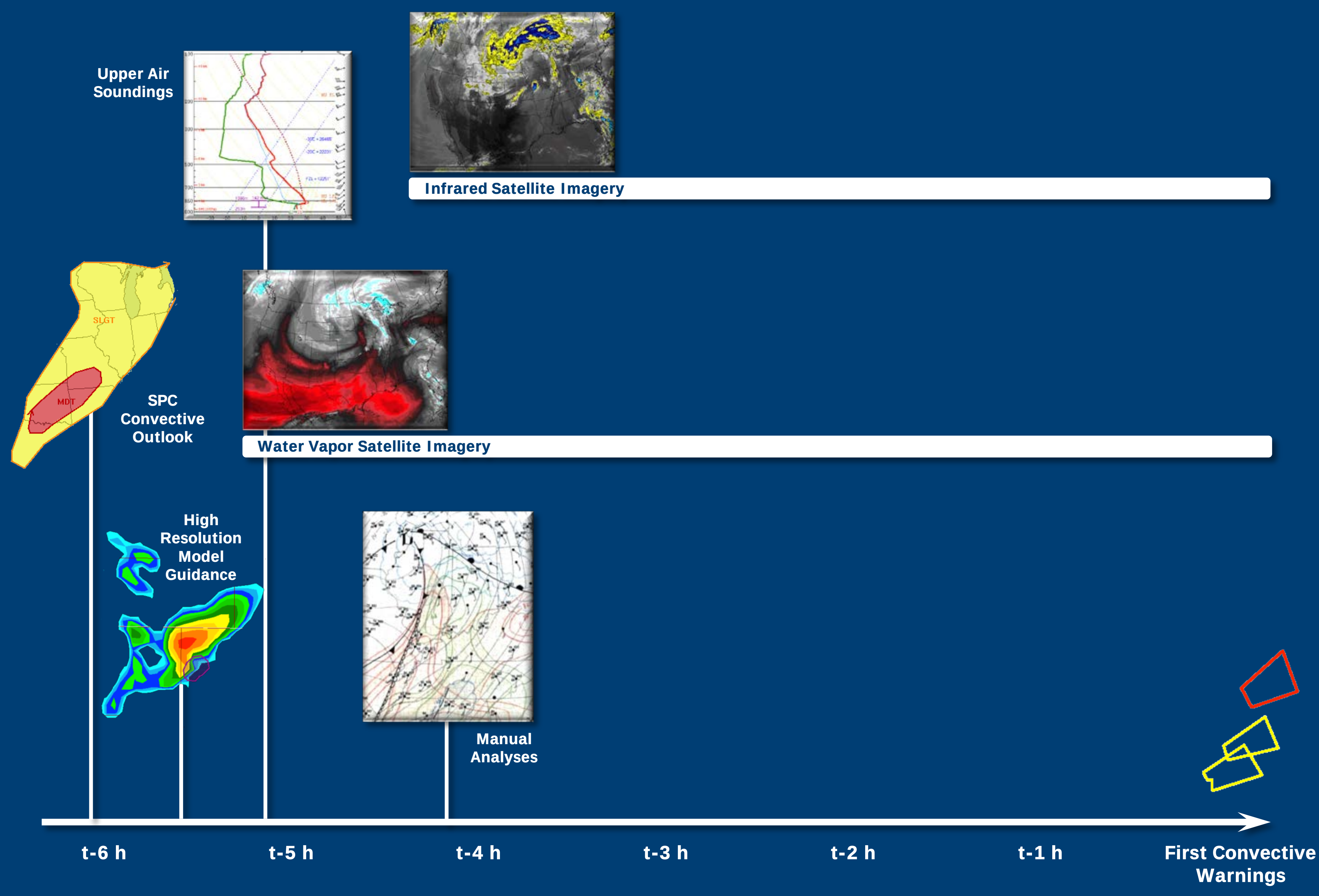

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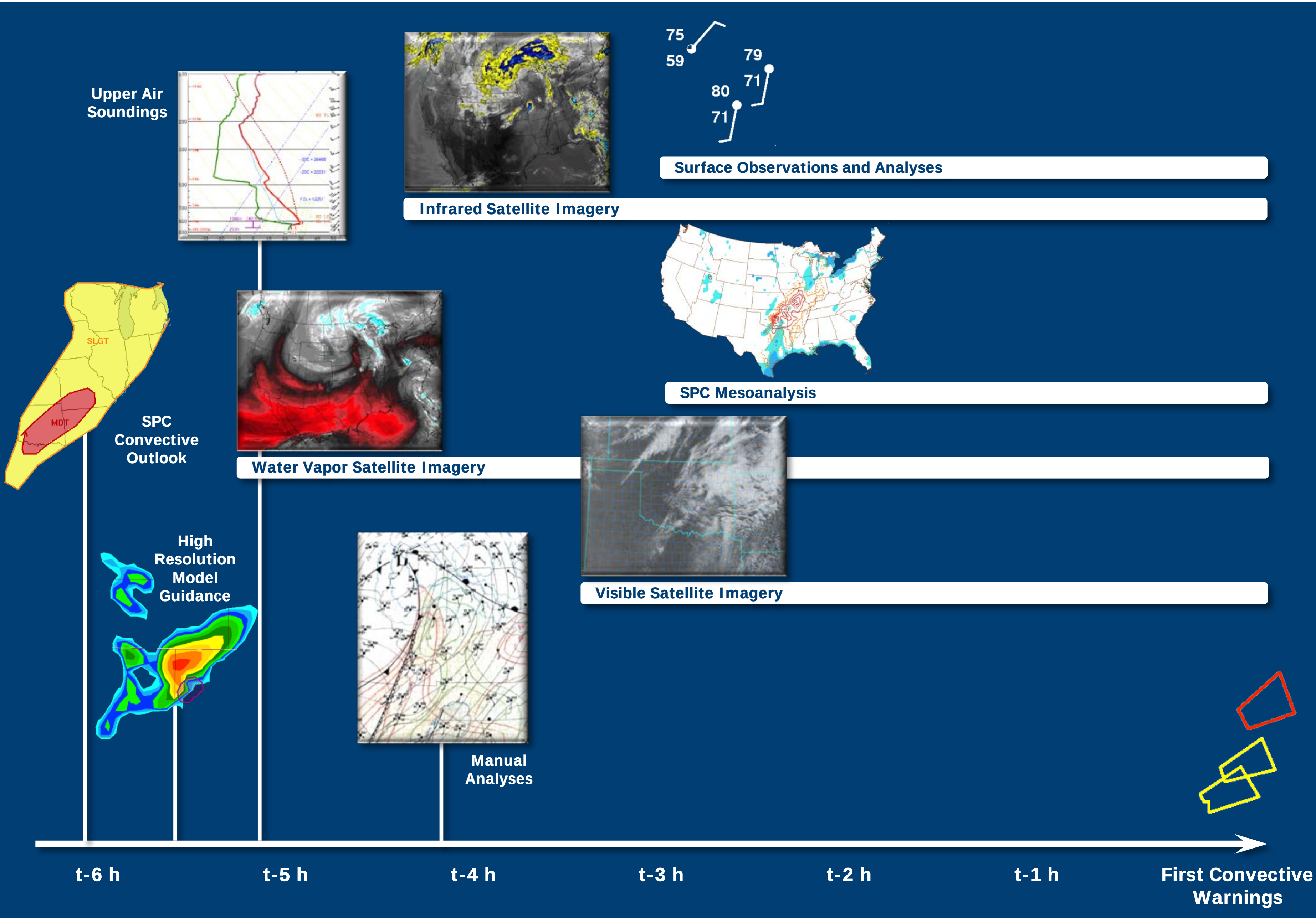

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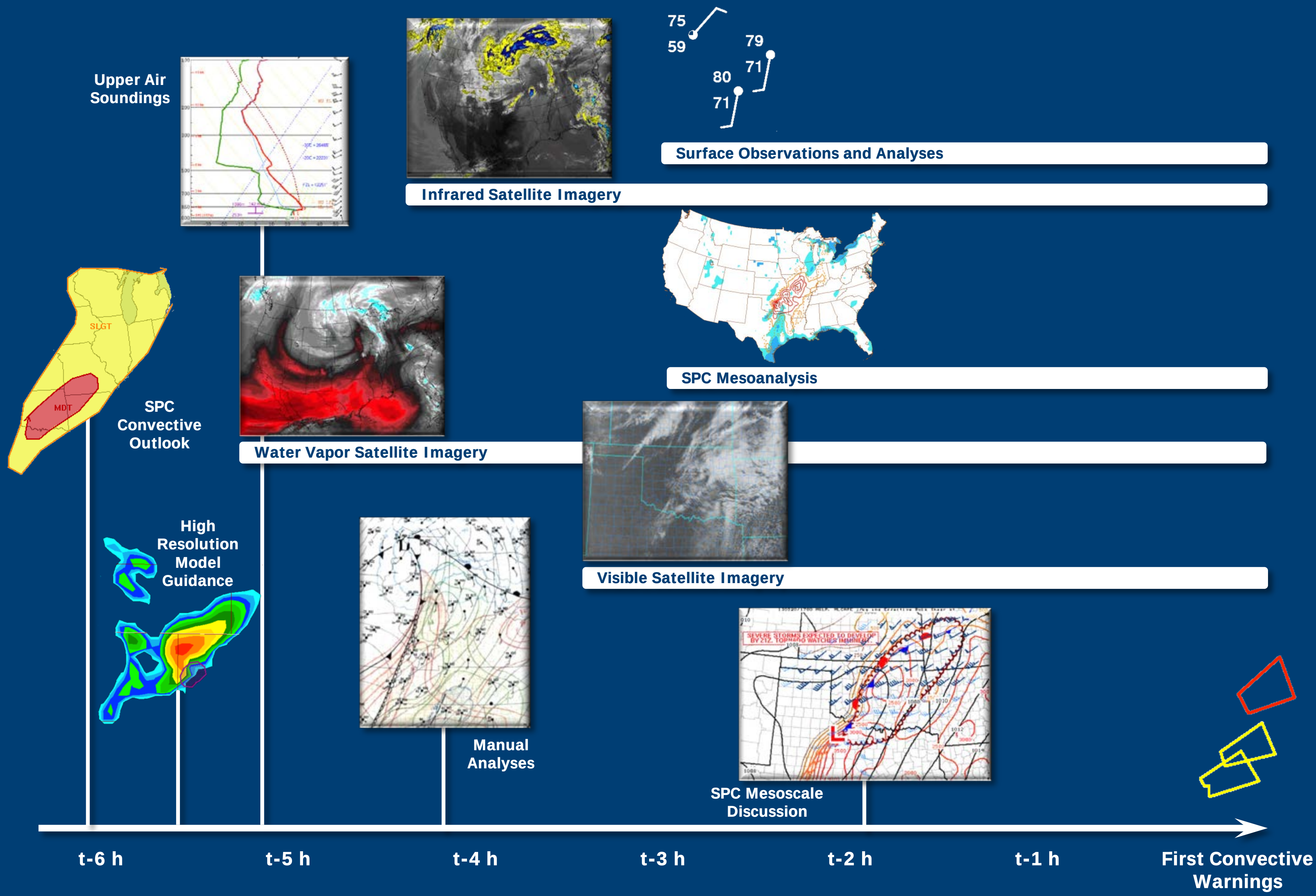

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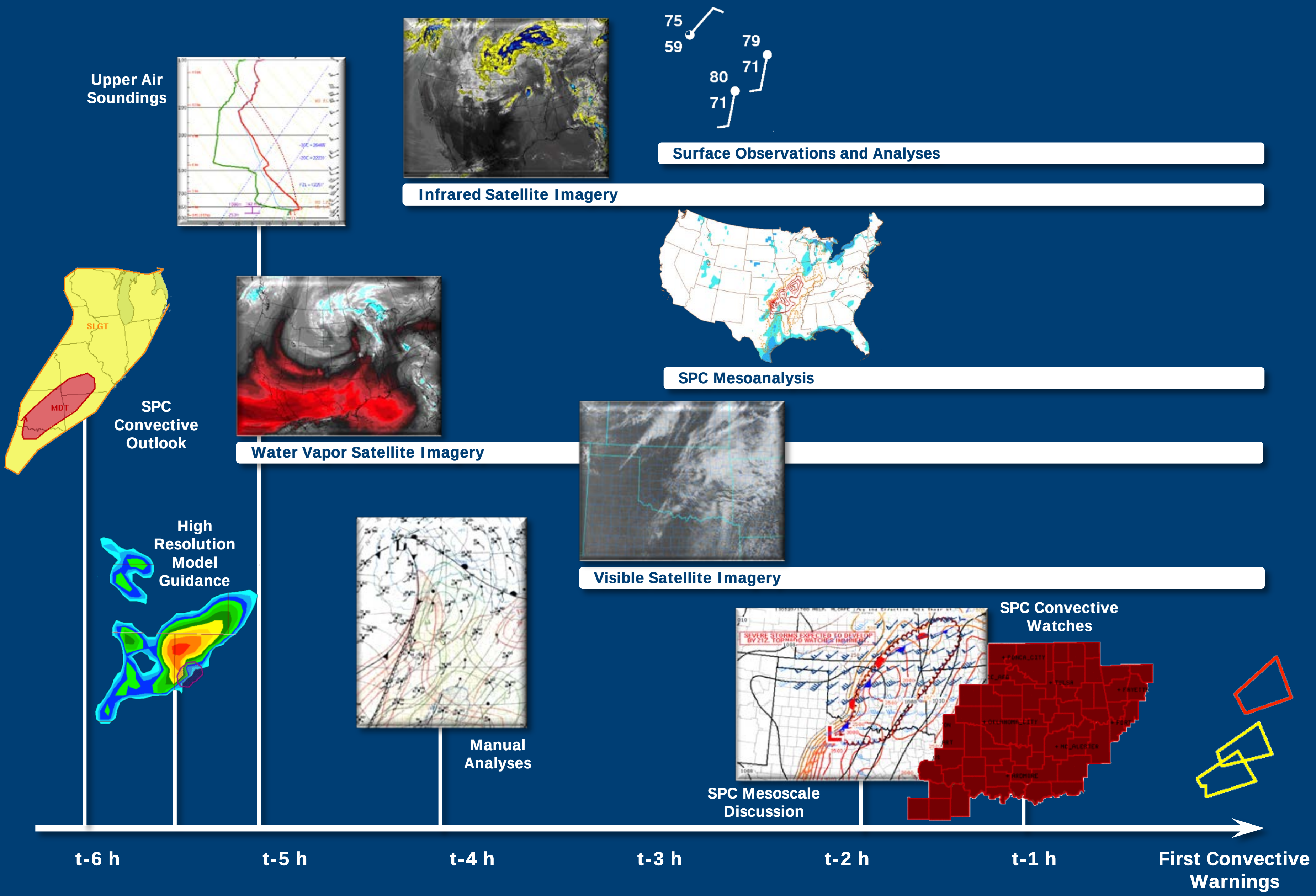

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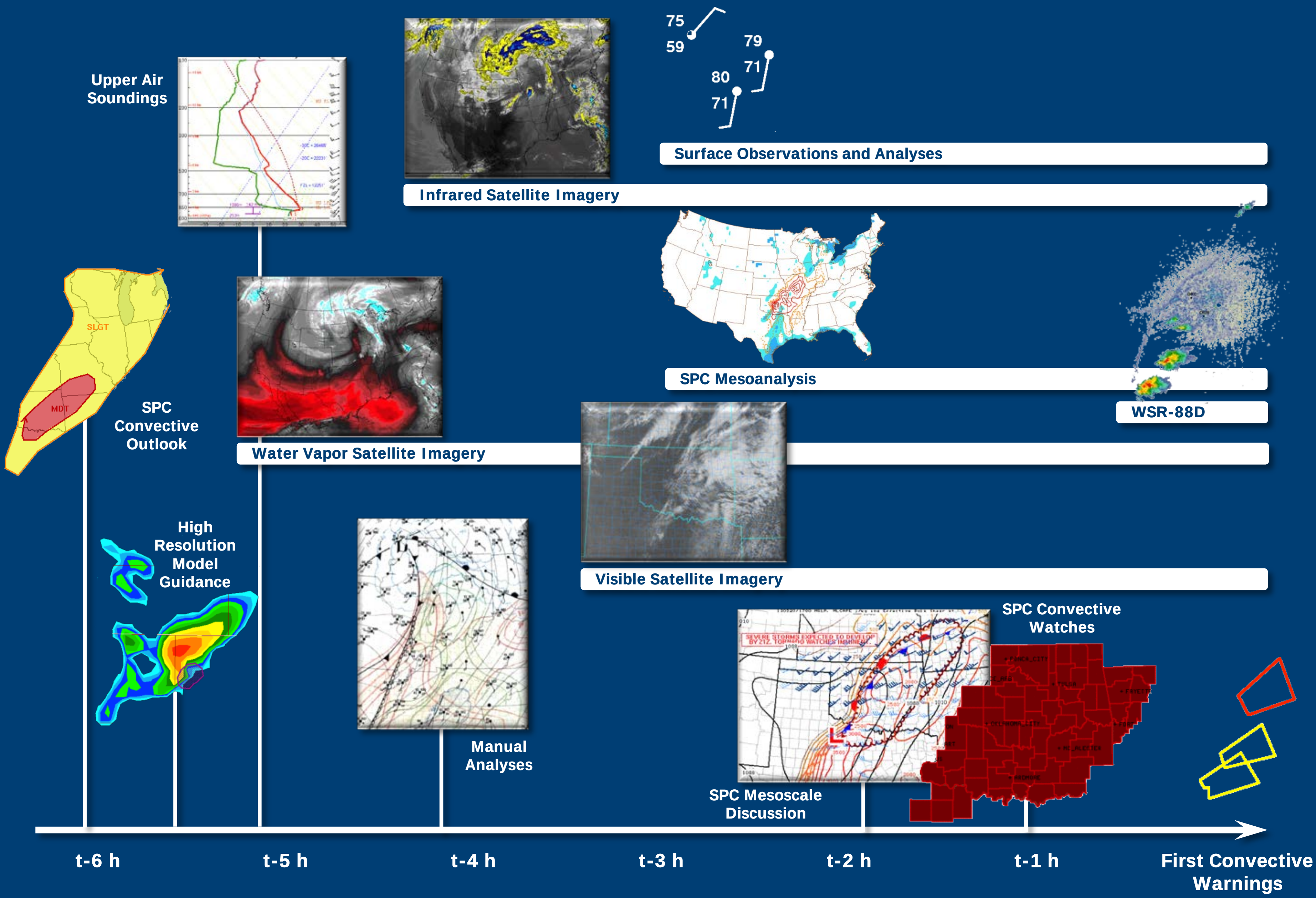

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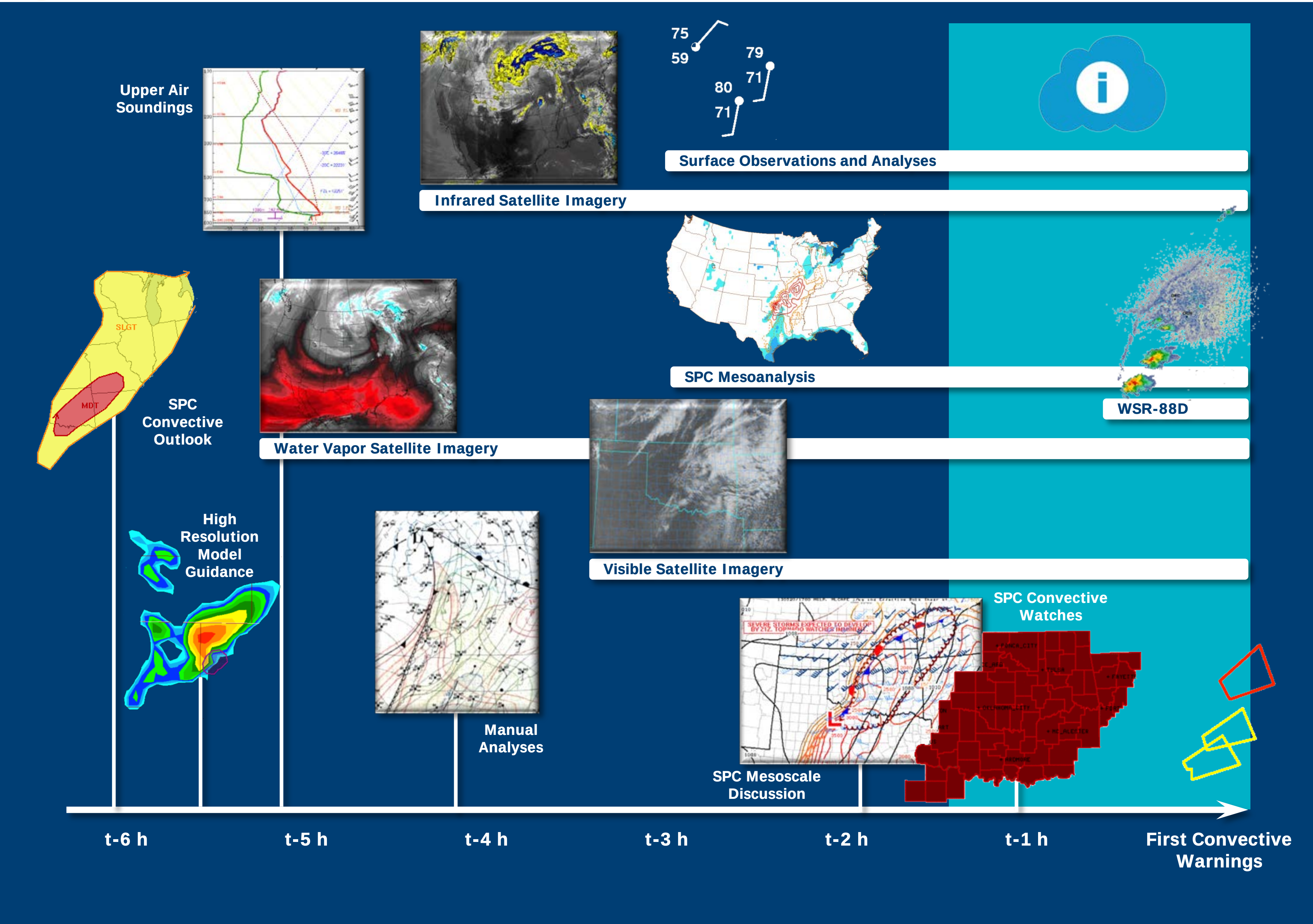

GOES-R Convective Monitoring Demonstration Products

- Day-1 readiness of GOES-R products is accomplished by providing pre-operational products that use the current GOES and/or model data.

- NearCast
  - Ralph Petersen (UW-CIMSS) Bill Line (OU-CIMMS/SPC)
  - Short-term predictions of convective instability
  - Availability: Hourly
  - Latency: ~ 2-3 min
- Convective Initiation
  - John Mecikalski (UAH-ATS)
  - Nowcast (0 to 2 hour) probability of convective initiation
  - Availability: Every GOES Scan
  - Latency: ~ 13-15 min
- Convective Cloud-Top Cooling
  - Justin Sieglaff (UW-CIMSS) Lee Cronce (UW-CIMSS)
  - Assessment of vertical convective cloud-top growth
  - Availability: Every GOES Scan
  - Latency: ~ 5-6 min
- Overshooting Top Detection
  - Kris Bedka (SSAI – NASA Langley)
  - Detection and magnitude of overshooting tops
  - Availability: Every GOES Scan
  - Latency: ~ 5-6 min
- Pseudo Geostationary Lightning Mapper
  - Geoffrey Stano (NASA SPoRT)
  - Total Lighting Flash Extent Density
  - Availability: Every 2 min
  - Latency: ~ 3-4 min

How can these products be used in a data-fusion process prior to convective initiation and during convective warning operations?

What is Data Fusion?

1. Multiple data sources are integrated to generate more meaningful information that can be of greater value than single source data.
   - Fog and Low Stratus
   - Convective Initiation

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1. Multiple data sources are integrated to generate more meaningful information that can be of greater value than single source data.
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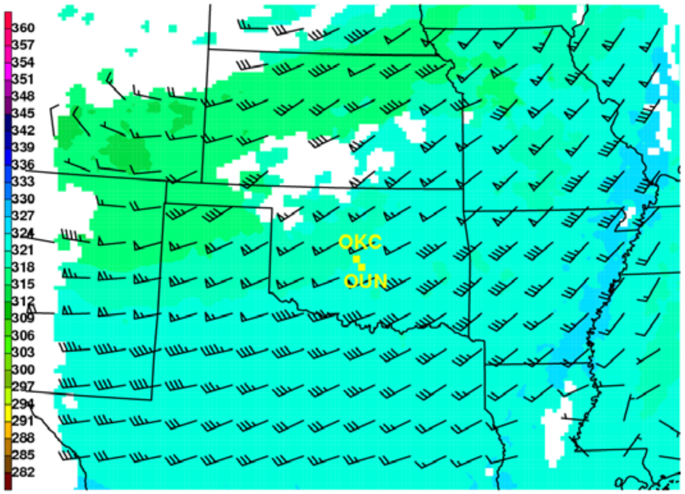
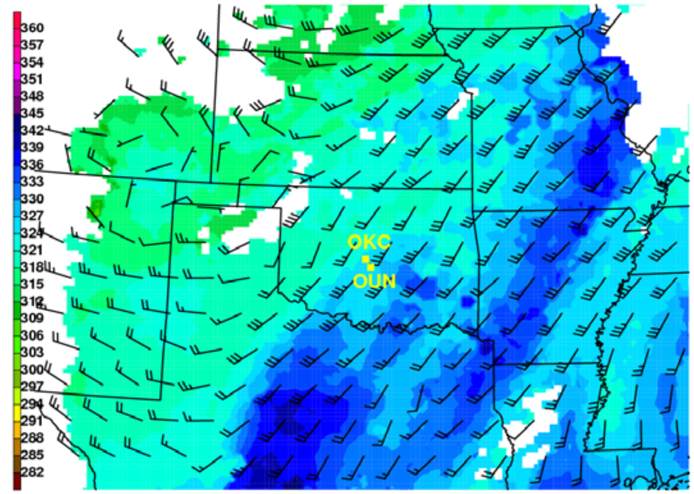
2. Multiple products are integrated in a visualization framework to provide situational awareness for weather hazards.
   - Cohesive group is more than the sum of its parts
   - Product Centric ⟶ NWS Decision Support Services
   - Fusion Process or Synergistic Approach

GOES-R NearCast – 0-6 h Forecasts

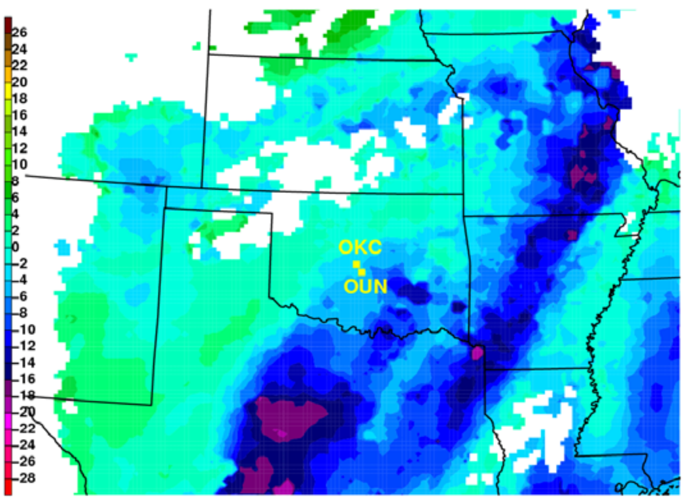
1500 UTC NearCast Forecasts Valid Between 1500-2100 UTC on 20 May 2013



NearCast Upper-Level Theta-E



NearCast Low-Level Theta-E

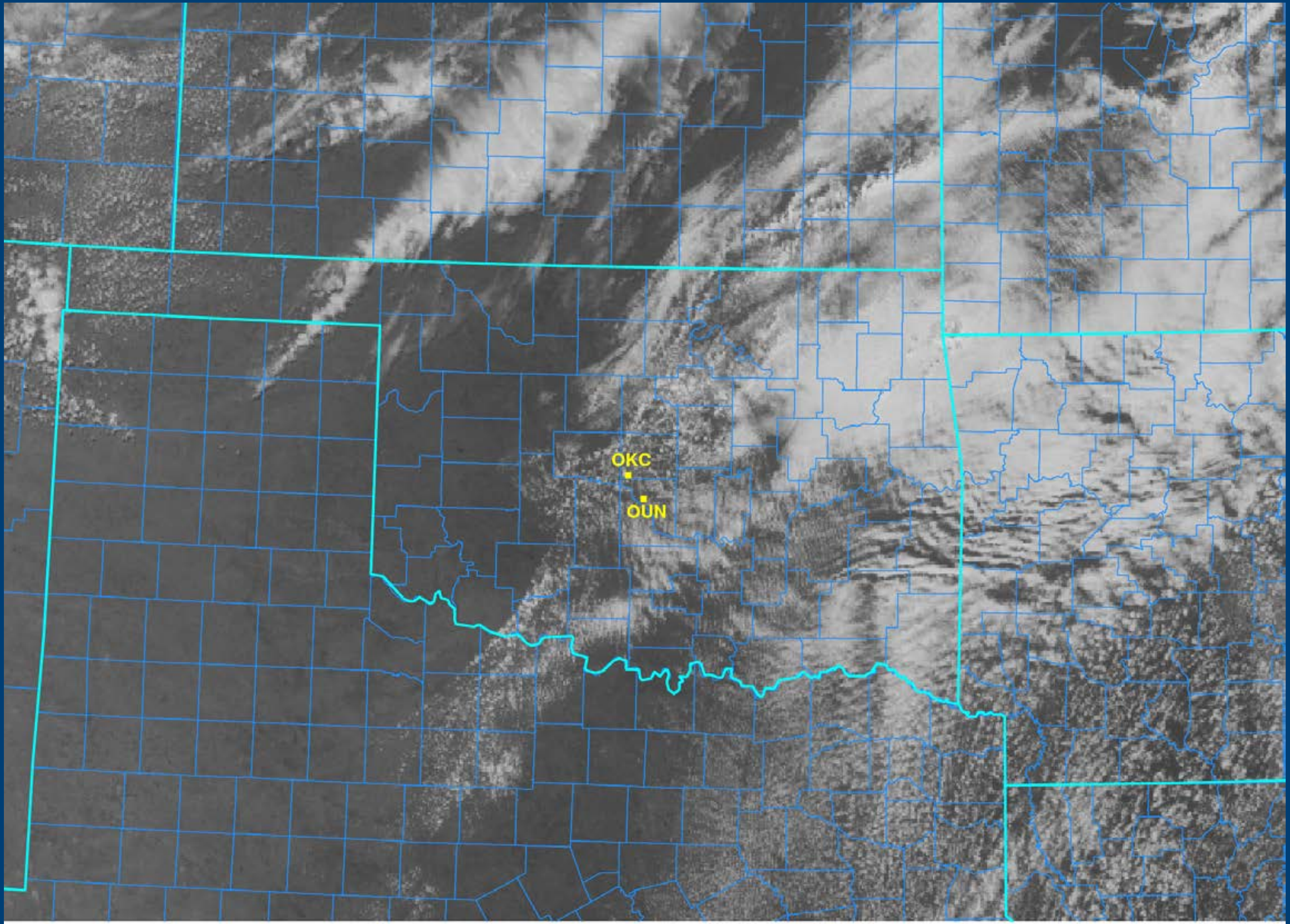


NearCast Mid-Low Theta-E Difference

- **Upper and Low-Level Theta-E Difference → 500-780-hPa Convective Instability**
- **Cool and dry air progressing east above a northward surge of low-level warm and moist air.**
- **This results in a destabilization of the region to the east of the cold front and dryline.**

A Lagrangian transport model of upper and lower-level moisture observations from the GOES Sounder is used to make short-term predictions of convective instability.

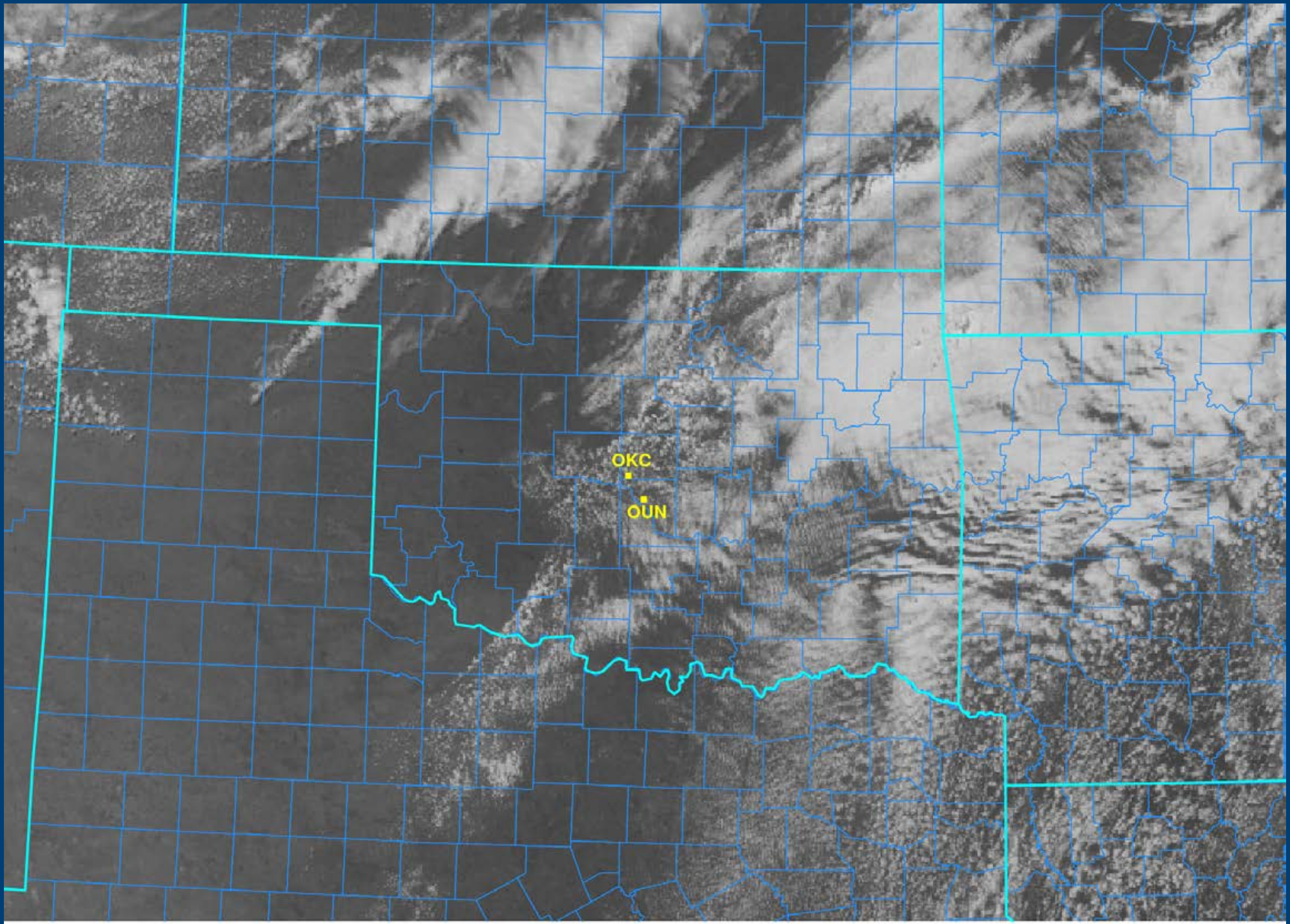
GOES-R CI (Probability Cloud Object Reaching 35 dBZ)



GOES-13 Visible valid 20 May 2013 at 1725 UTC

Determining which portion of a cumulus field will develop convection can be challenging.

GOES-R CI (Probability Cloud Object Reaching 35 dBZ)



GOES-13 Visible valid 20 May 2013 at 1732 UTC

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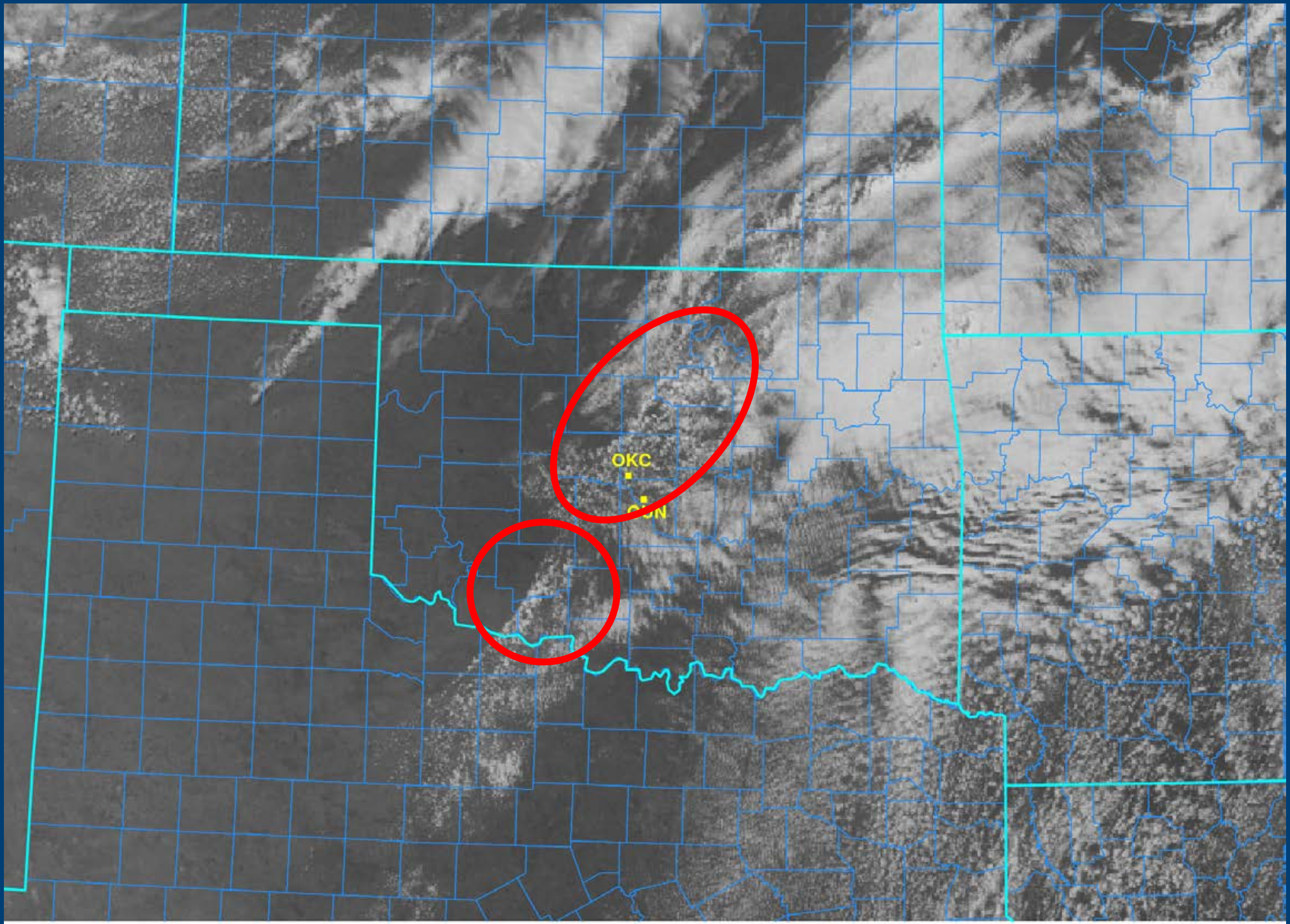

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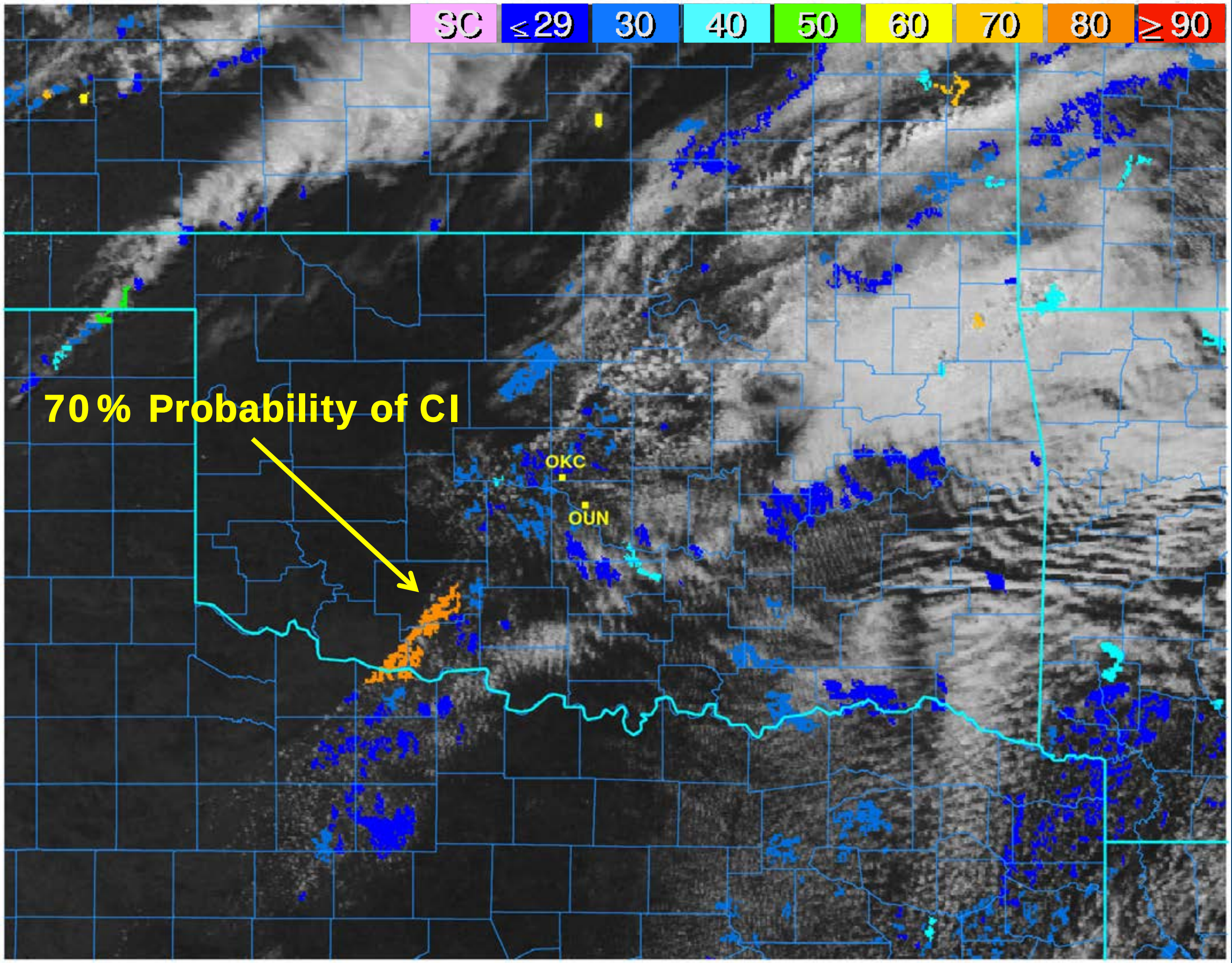
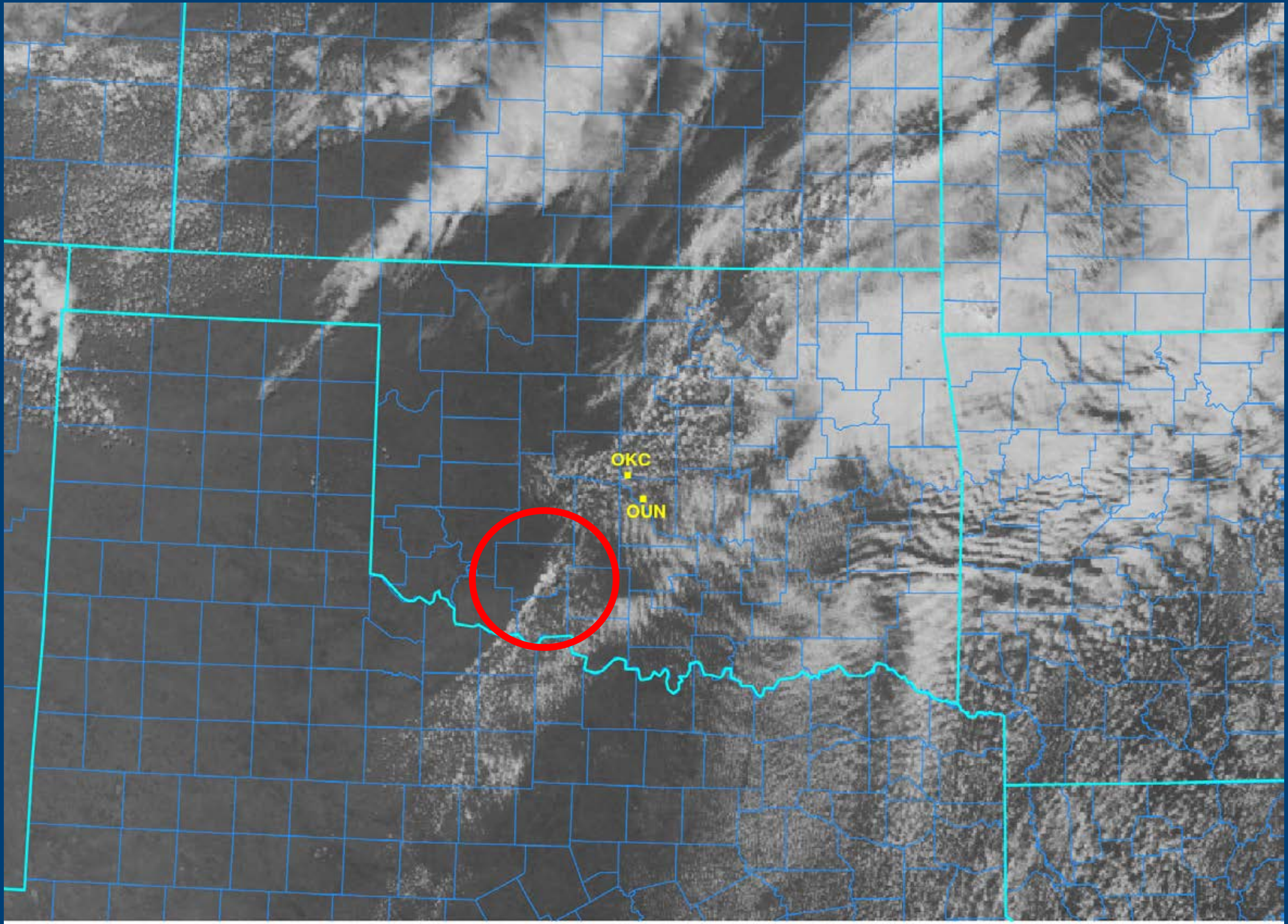


GOES-R CI (%) and GOES-13 Visible valid 20 May 2013 at 1732 UTC

Fused Product: 9 satellite interest fields and 15 NWP RAP fields were used to train the GOES-R CI Probability algorithm.

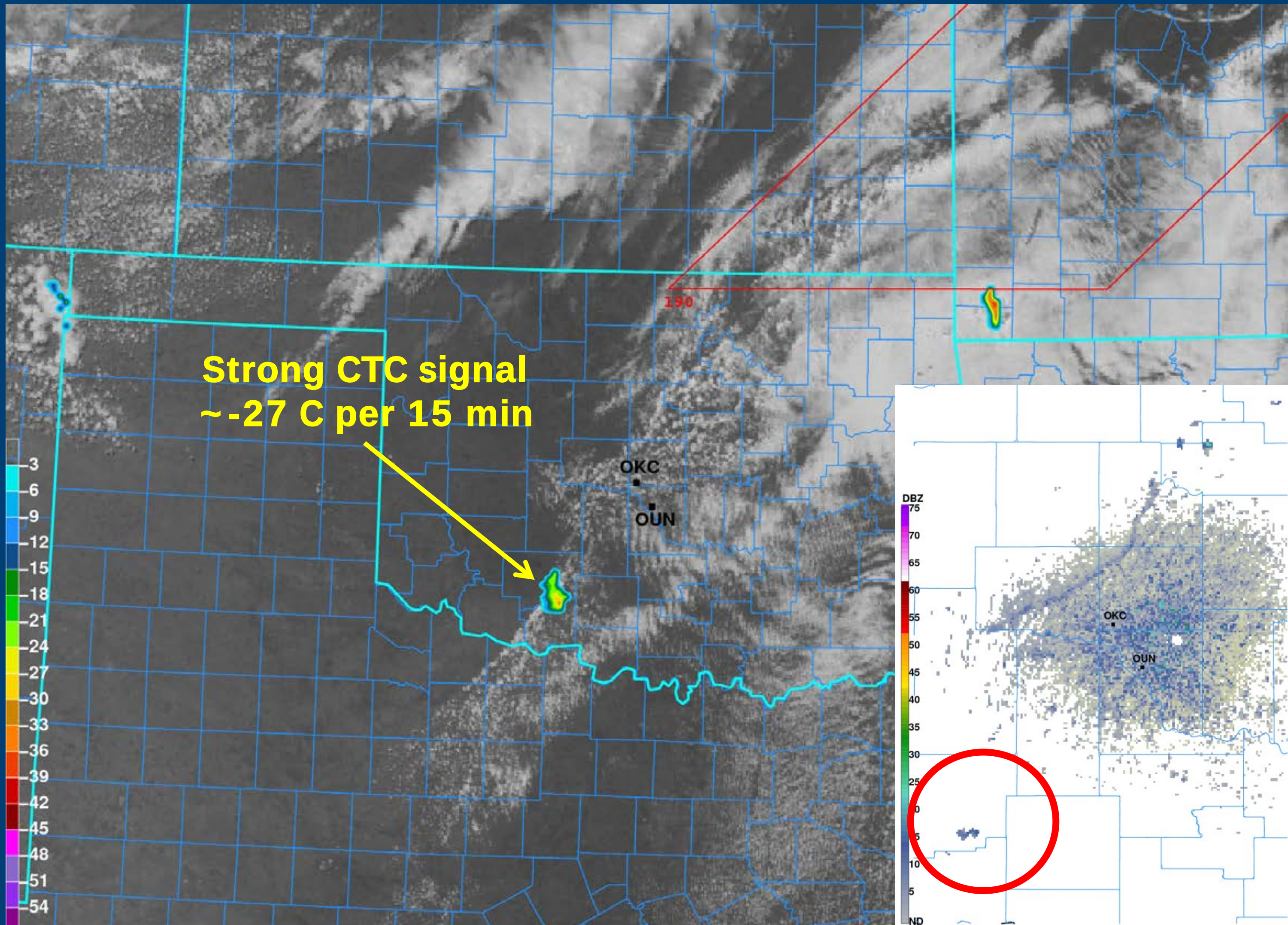
GOES-R Convective Cloud-Top Cooling



GOES-13 Visible valid 20 May 2013 at 1745 UTC

How quickly are agitated cumulus growing? Is there significance to this growth rate?

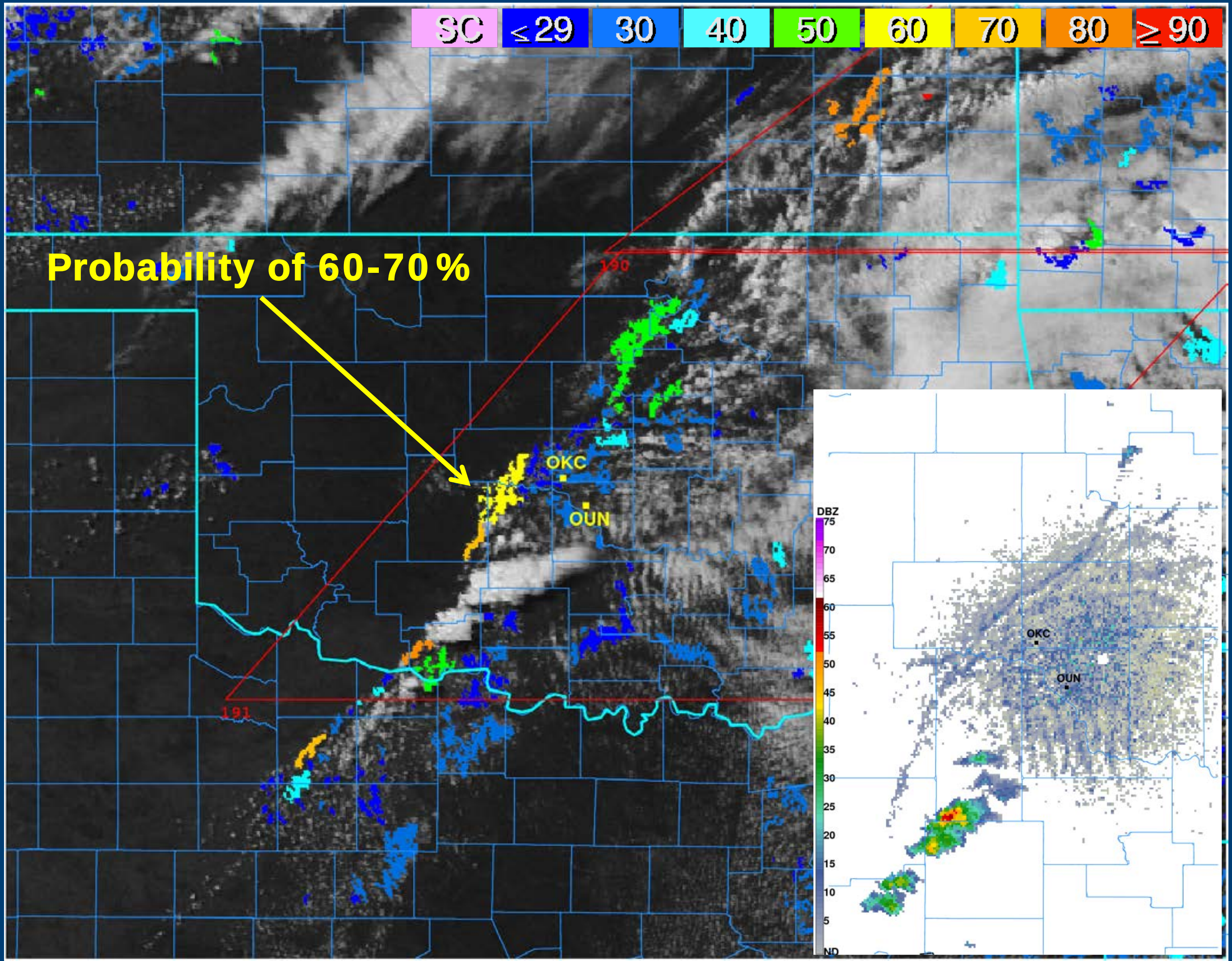
GOES-R Convective Cloud-Top Cooling



GOES-R CTC (°C per 15 min) and GOES-13 Visible valid 20 May 2013 at 1745 UTC
TLX 1km Base Reflectivity valid 20 May 2013 at 1748 UTC

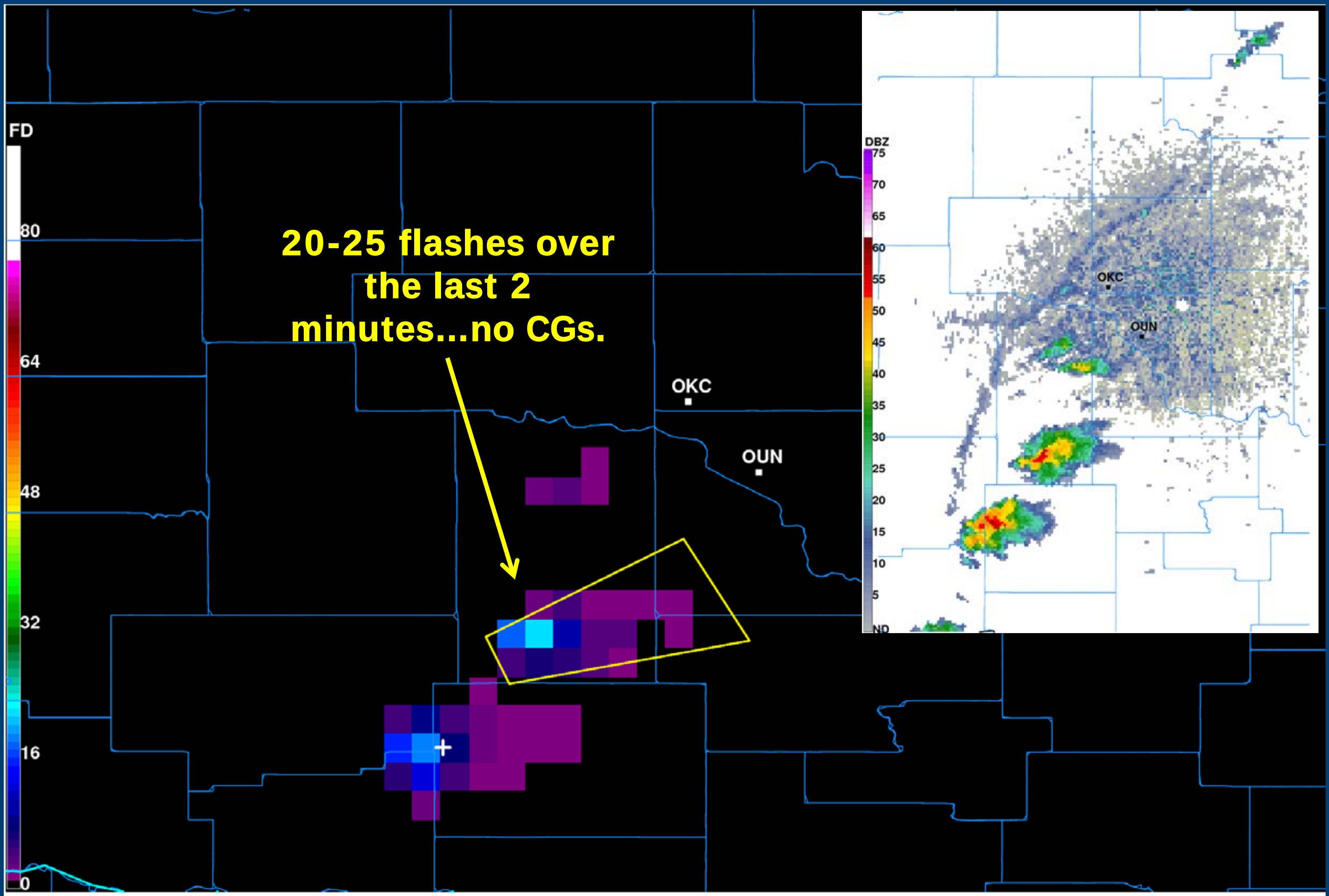
Verification results of CTC in SPC Slight Risk areas have shown that signals stronger than -20 C per 15 min have a POD of 0.83 for severe MESH.

GOES-R CI (Probability Cloud Object Reaching 35 dBZ)



GOES-R CI (%) and GOES-13 Visible valid 20 May 2013 at 1832 UTC
TLX 1km Base Reflectivity valid 20 May 2013 at 1836 UTC

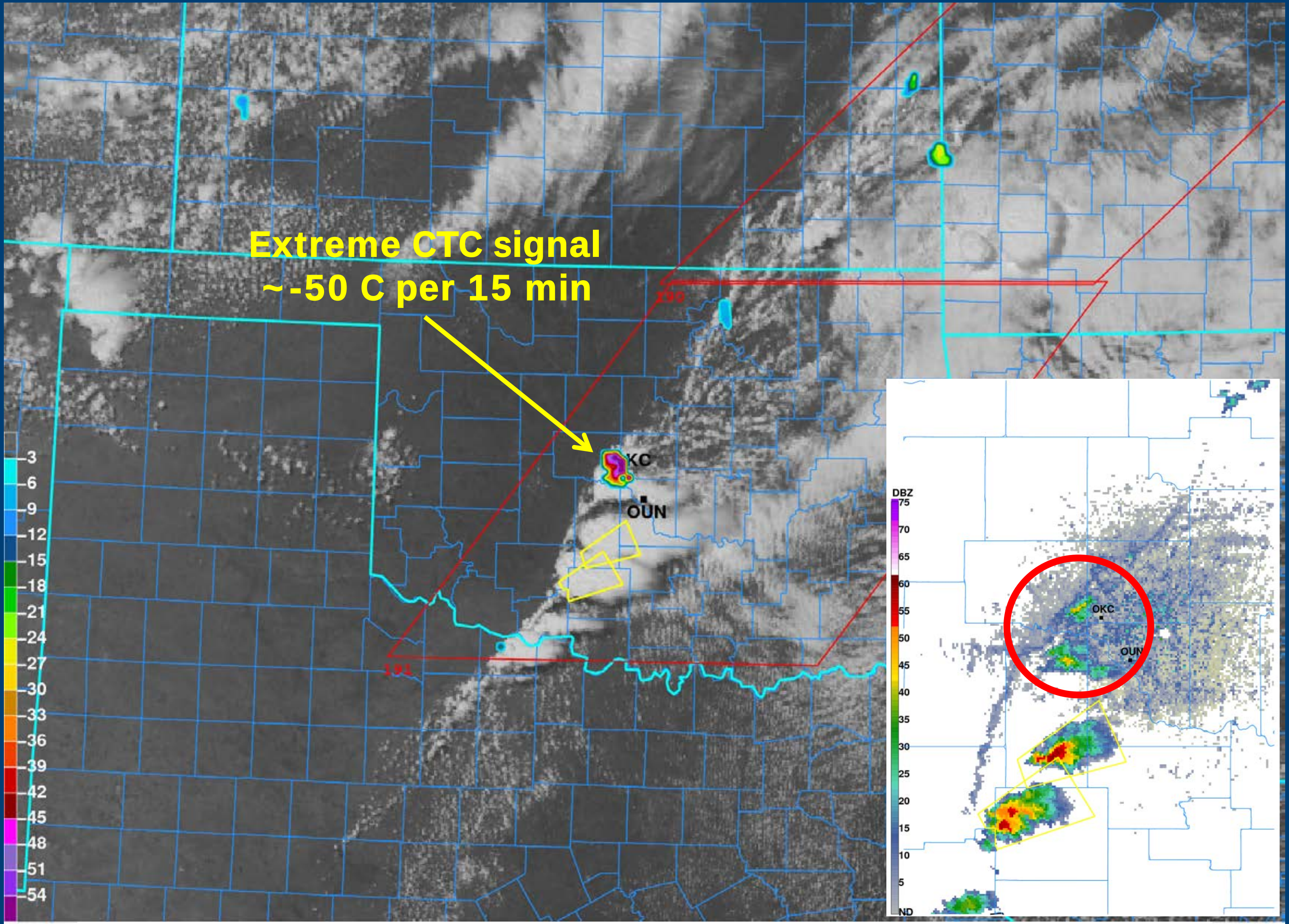
GOES-R Pseudo Geostationary Lightning Mapper



GOES-R Pseudo GLM Flash Extent Density and 2-min NLDN CG valid 20 May 2013 at 1900 UTC
TLX 1km Base Reflectivity valid 20 May 2013 at 1900 UTC

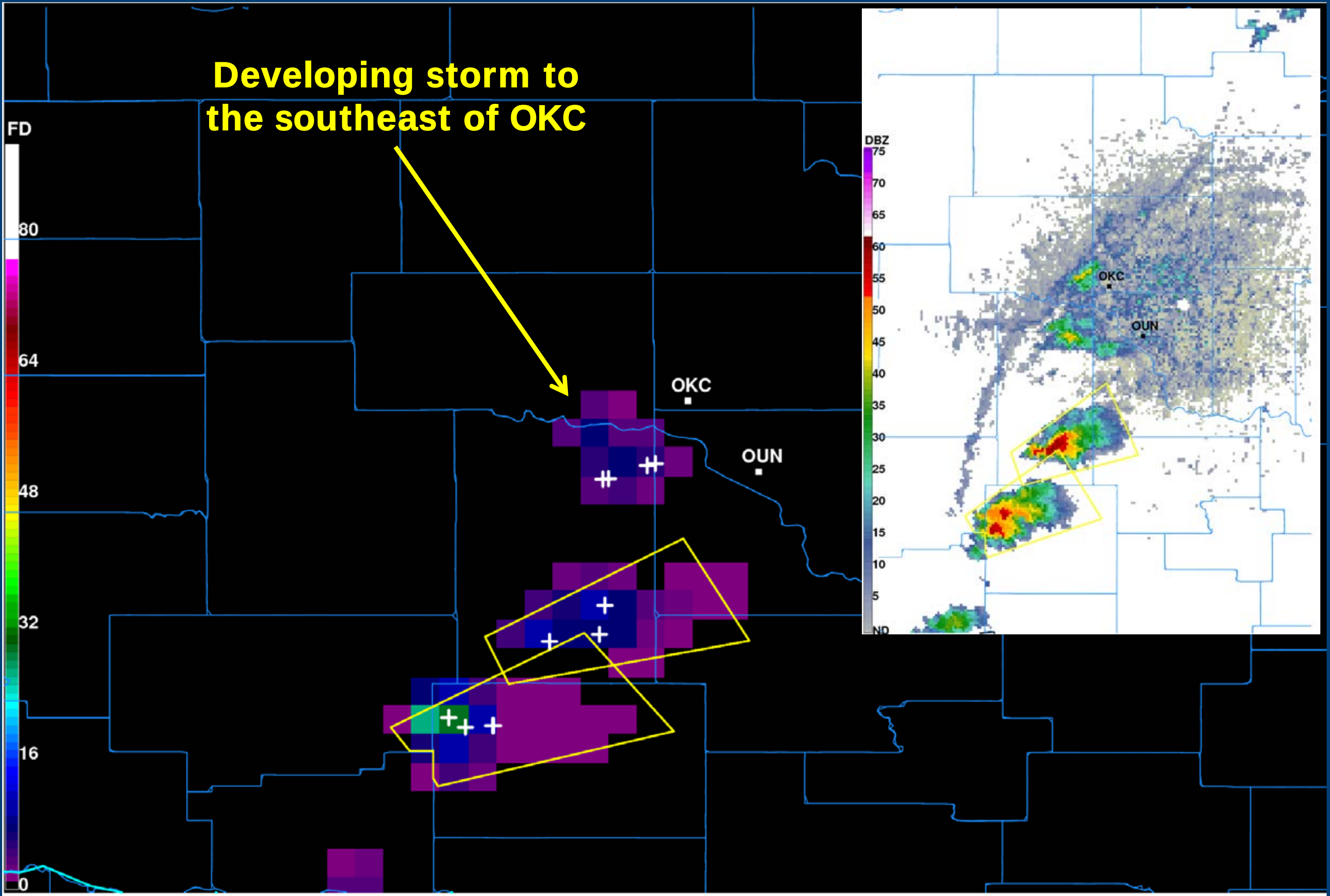
Total lightning (CG, CA, IC, CC) provides a better indication of the electrification of developing convection than CGs alone.

GOES-R Convective Cloud-Top Cooling



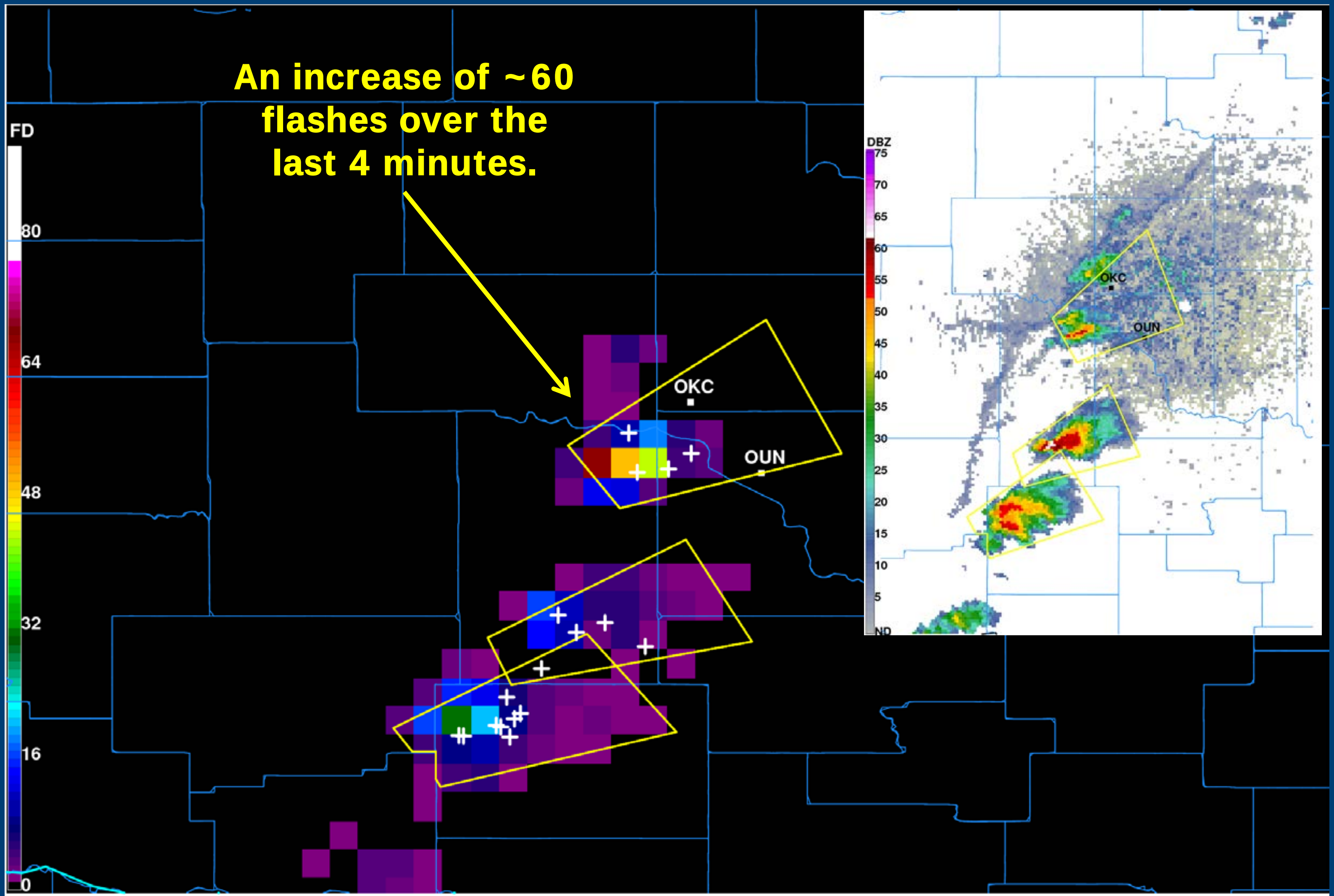
GOES-R CTC (°C per 15 min) and GOES-13 Visible valid 20 May 2013 at 1910 UTC
TLX 1km Base Reflectivity valid 20 May 2013 at 1908 UTC

GOES-R Pseudo Geostationary Lightning Mapper



GOES-R Pseudo GLM Flash Extent Density and 2-min NLDN CG valid 20 May 2013 at 1908 UTC
TLX 1km Base Reflectivity valid 20 May 2013 at 1908 UTC

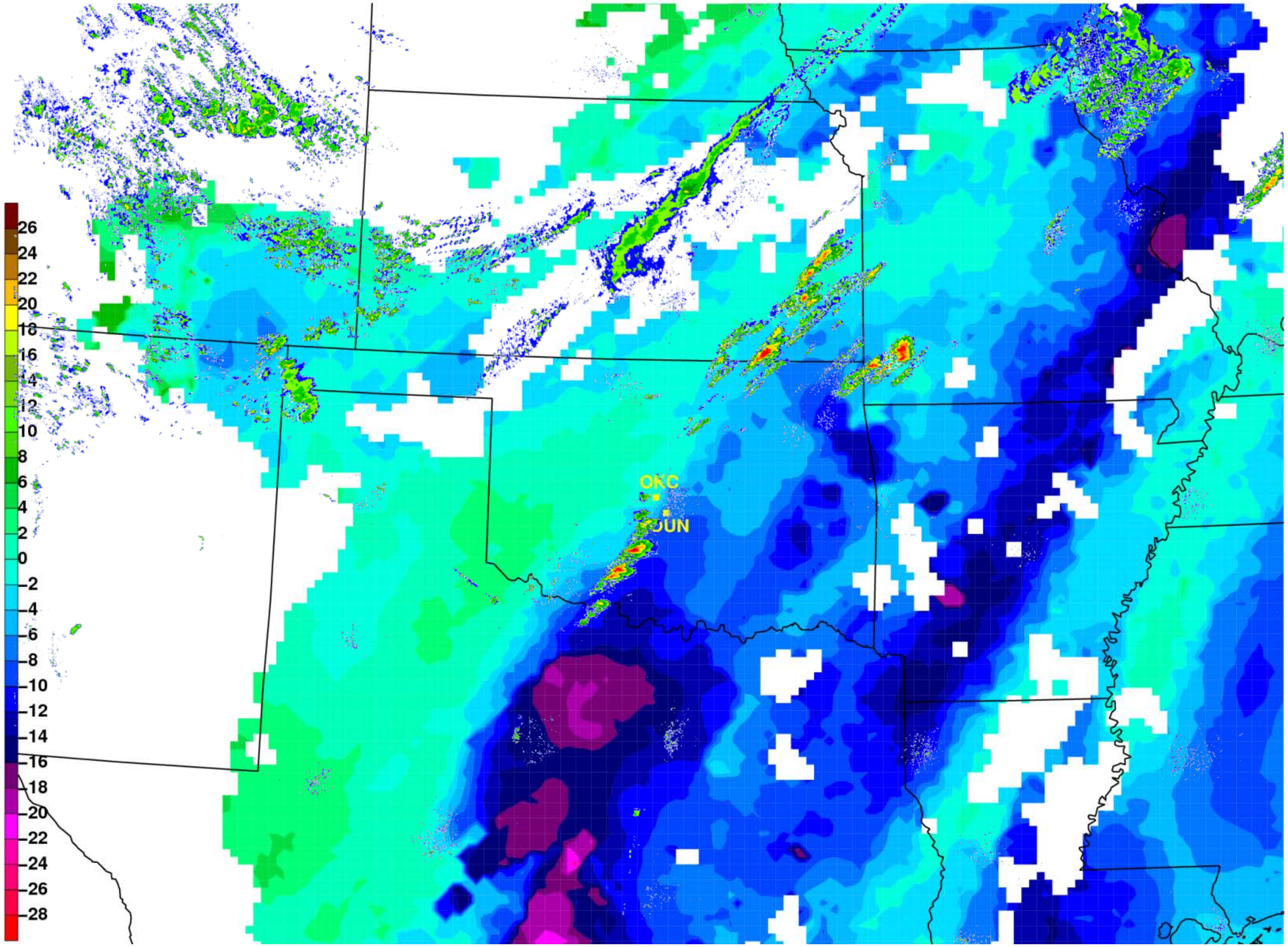
GOES-R Pseudo Geostationary Lightning Mapper



GOES-R Pseudo GLM Flash Extent Density and 2-min NLDN CG valid 20 May 2013 at 1912 UTC
TLX 1km Base Reflectivity valid 20 May 2013 at 1912 UTC

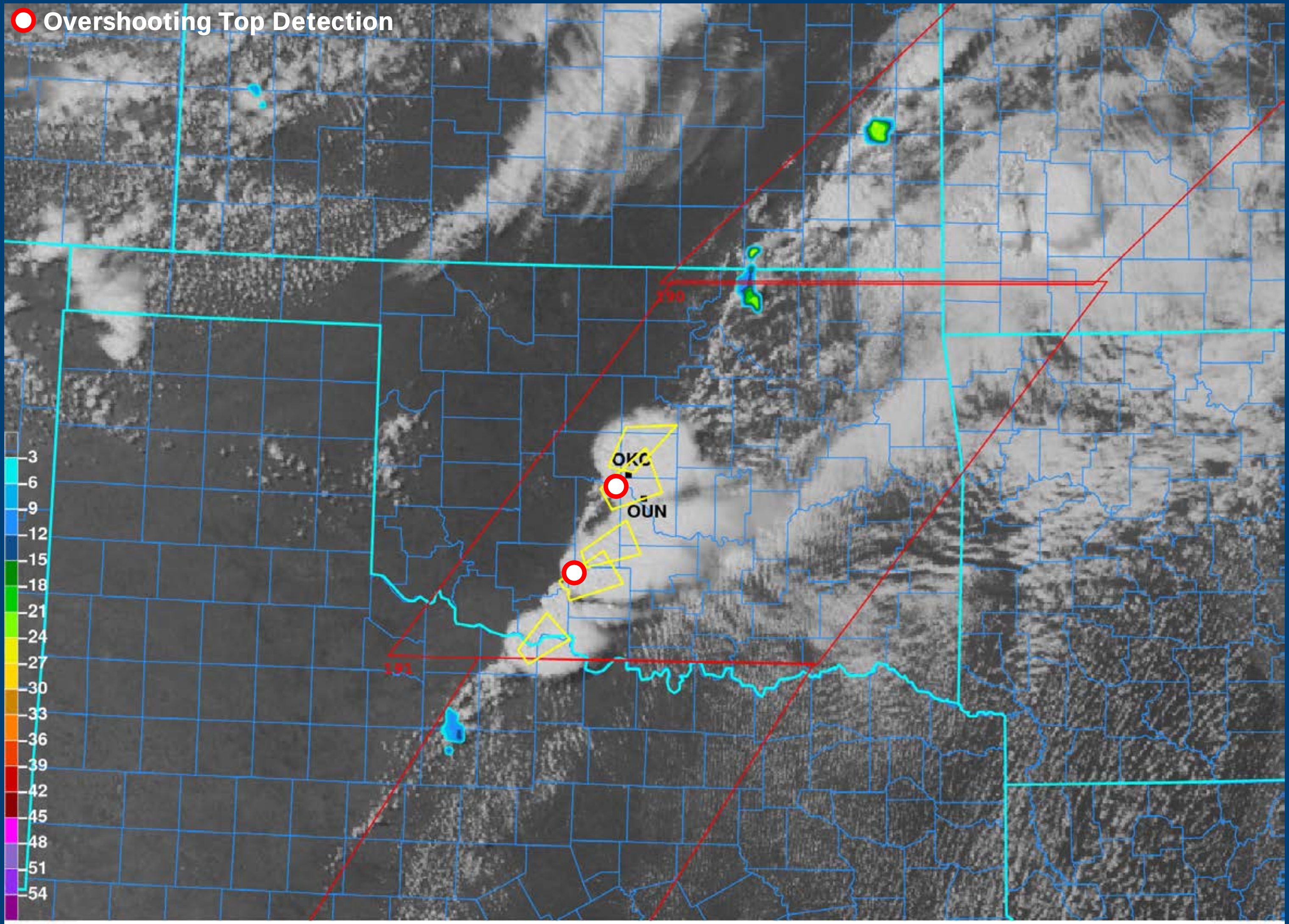
Lightning jumps are indicative of a strengthening updraft and often precede severe weather.

GOES-R NearCast – Mid-Low Level Theta-E Difference (K)



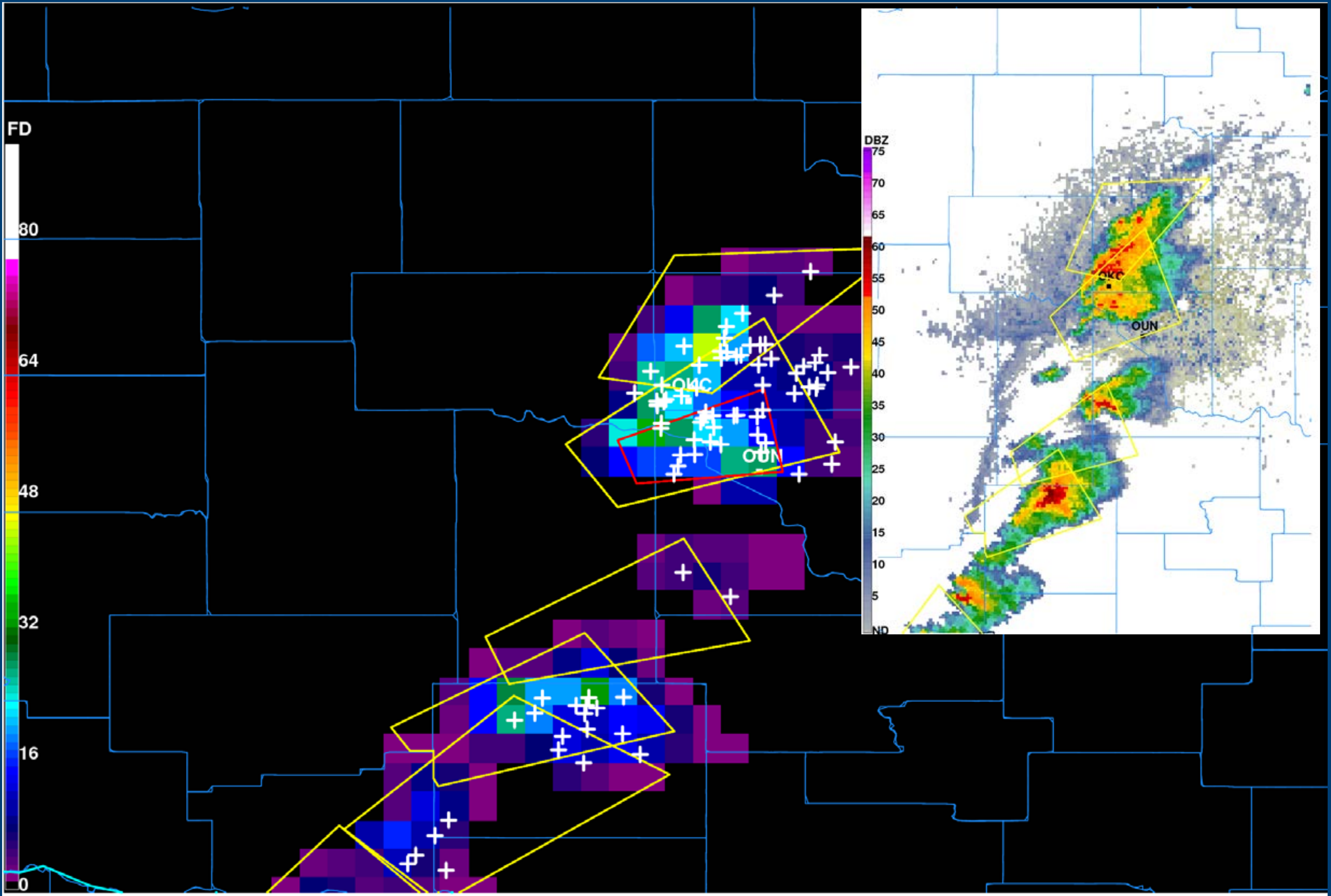
NearCast Mid-Low Theta-E Difference 03-h FCST valid 20 May 2013 at 1800 UTC
WSR-88D 1-h Accumulated Composite Reflectivity valid 20 May 2013 at 1900 UTC

GOES-R Convective Cloud-Top Cooling and Overshooting Tops



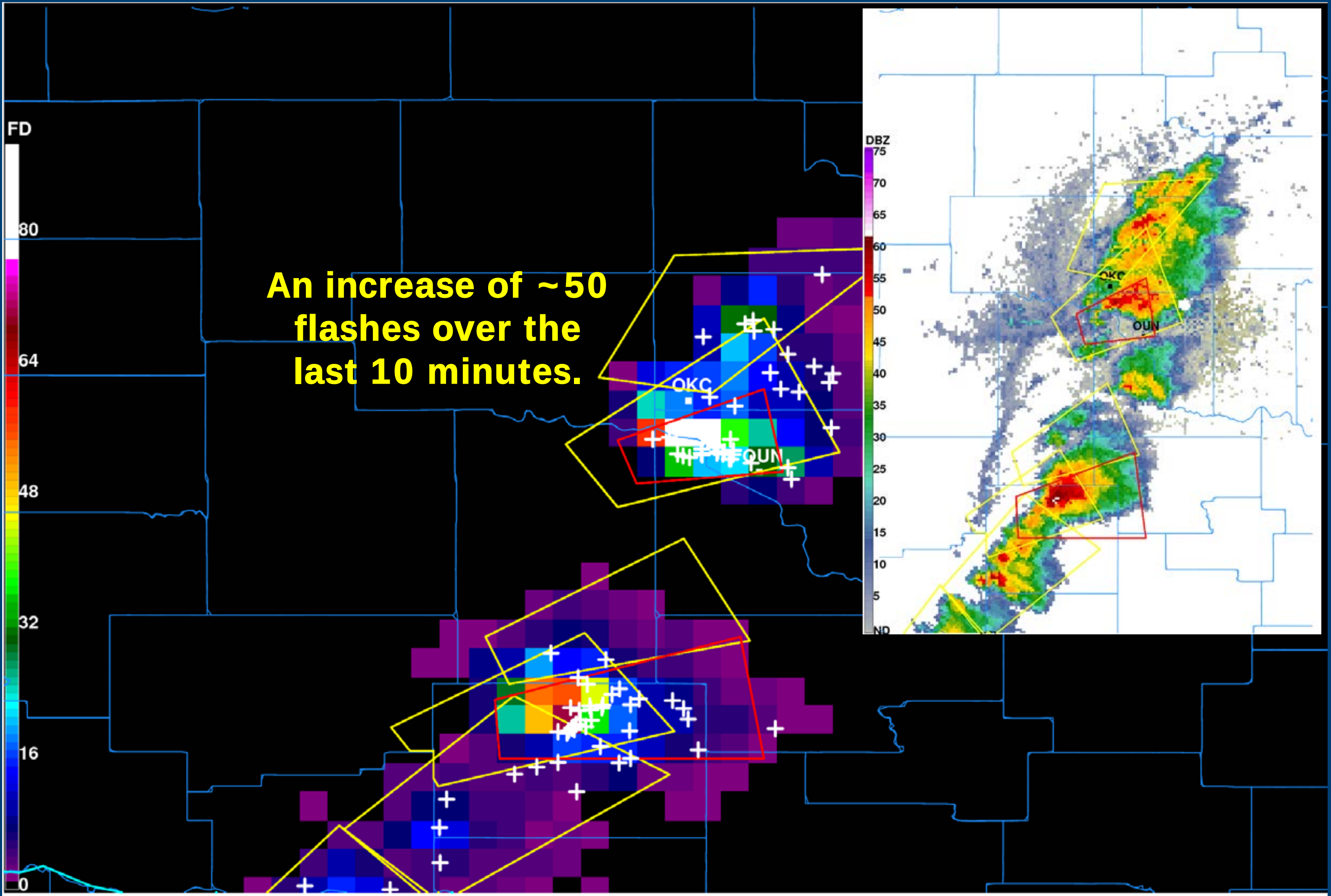
GOES-R CTC (°C per 15 min), Overshooting Top Detection, and GOES-13 Visible valid 20 May 2013 at 1932 UTC

GOES-R Pseudo Geostationary Lightning Mapper



GOES-R Pseudo GLM Flash Extent Density and 2-min NLDN CG valid 20 May 2013 at 1940 UTC
TLX 1km Base Reflectivity valid 20 May 2013 at 1938 UTC

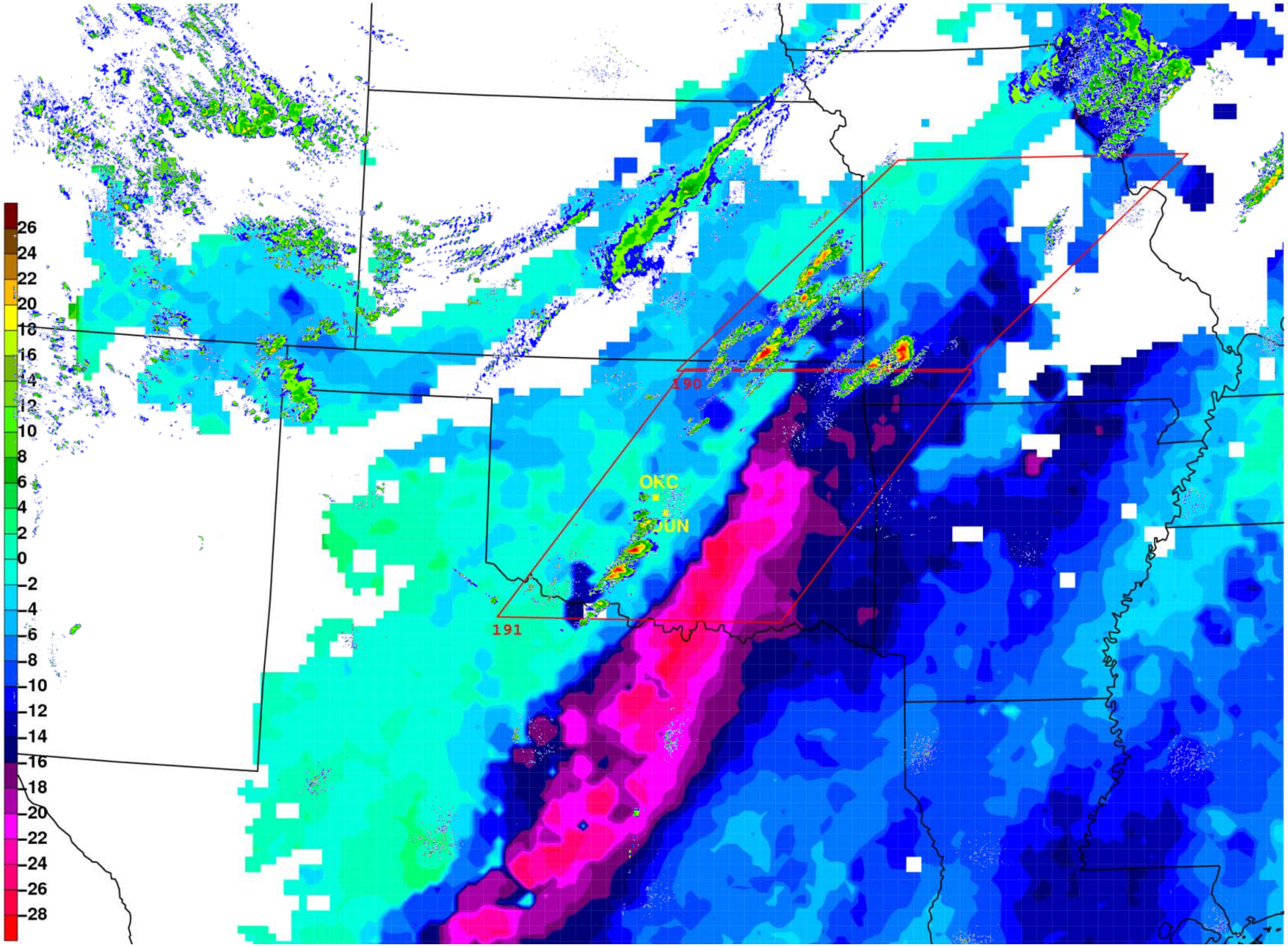
GOES-R Pseudo Geostationary Lightning Mapper



GOES-R Pseudo GLM Flash Extent Density and 2-min NLDN CG valid 20 May 2013 at 1950 UTC
TLX 1km Base Reflectivity valid 20 May 2013 at 1951 UTC

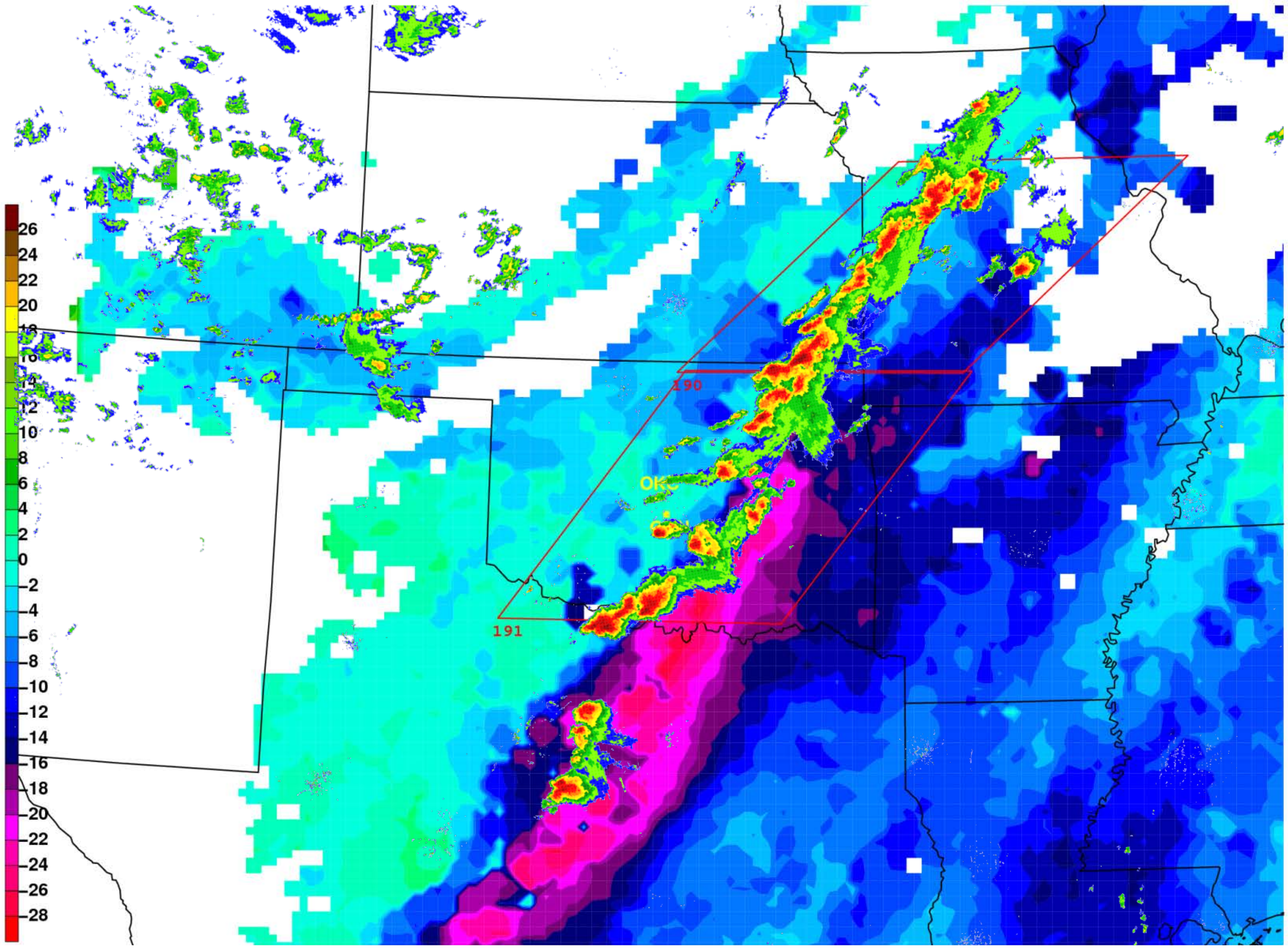
Reinforcing lightning jump emphasizes that the storm continues to intensify…this jump occurred approximately 8 minutes before the tornado spun up.

GOES-R NearCast – Mid-Low Level Theta-E Difference (K)



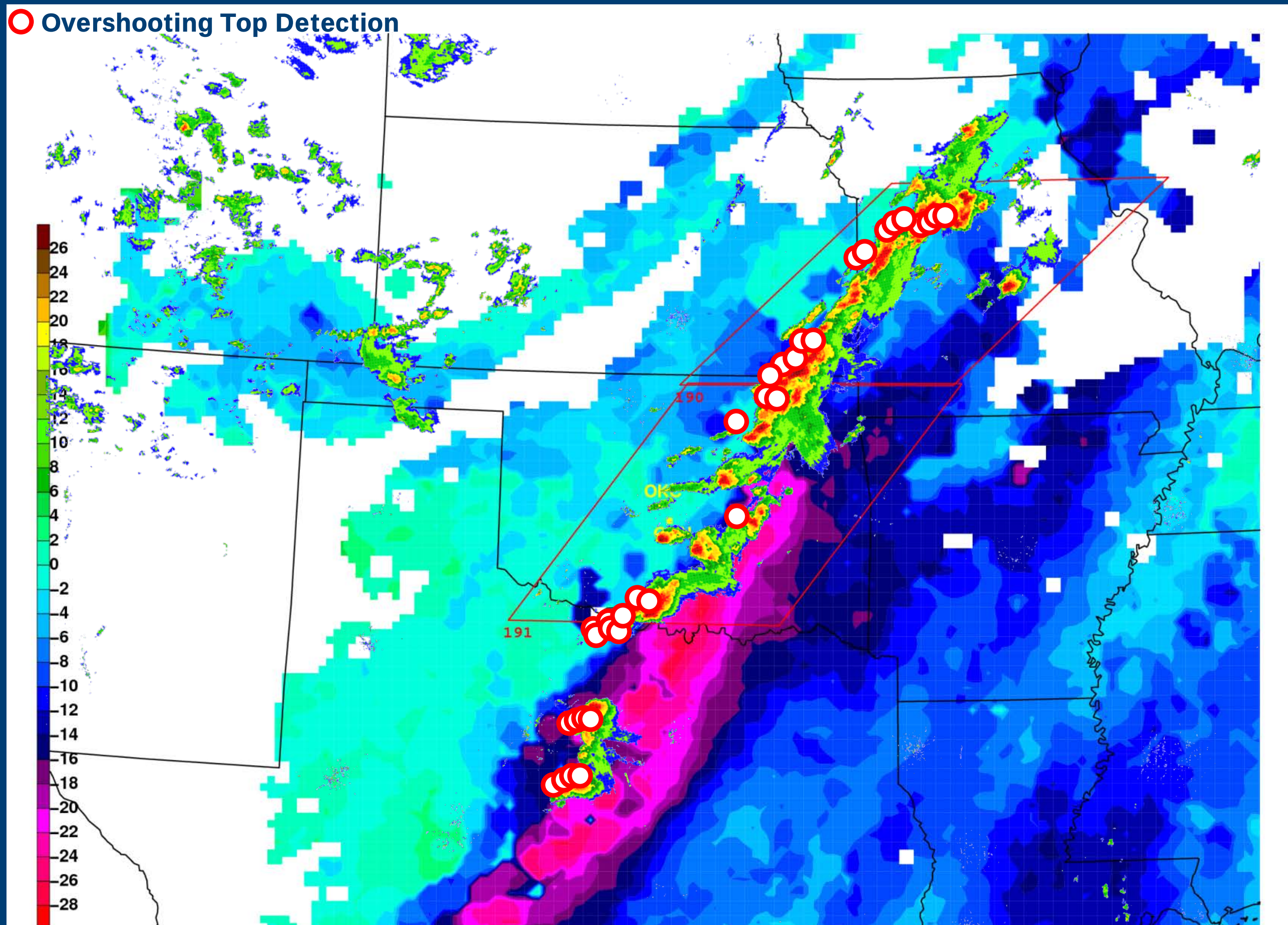
NearCast Mid-Low Theta-E Difference 03-h FCST valid 20 May 2013 at 2200 UTC
WSR-88D 1-h Accumulated Composite Reflectivity valid 20 May 2013 at 1900 UTC

GOES-R NearCast – Mid-Low Level Theta-E Difference (K)



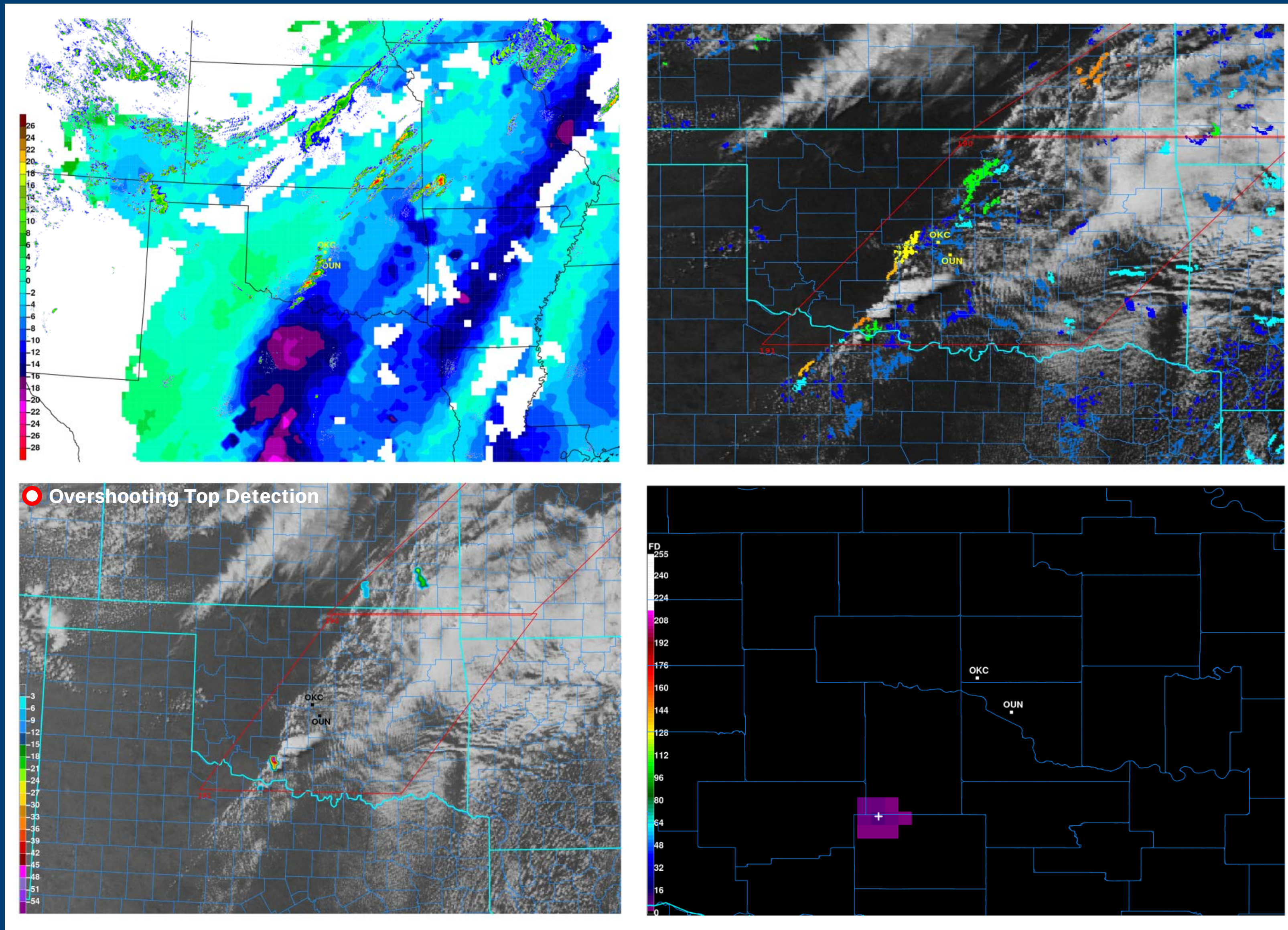
NearCast Mid-Low Theta-E Difference 03-h FCST valid 20 May 2013 at 2200 UTC
WSR-88D Composite Reflectivity valid 20 May 2013 at 2202 UTC

Overshooting Top Detection



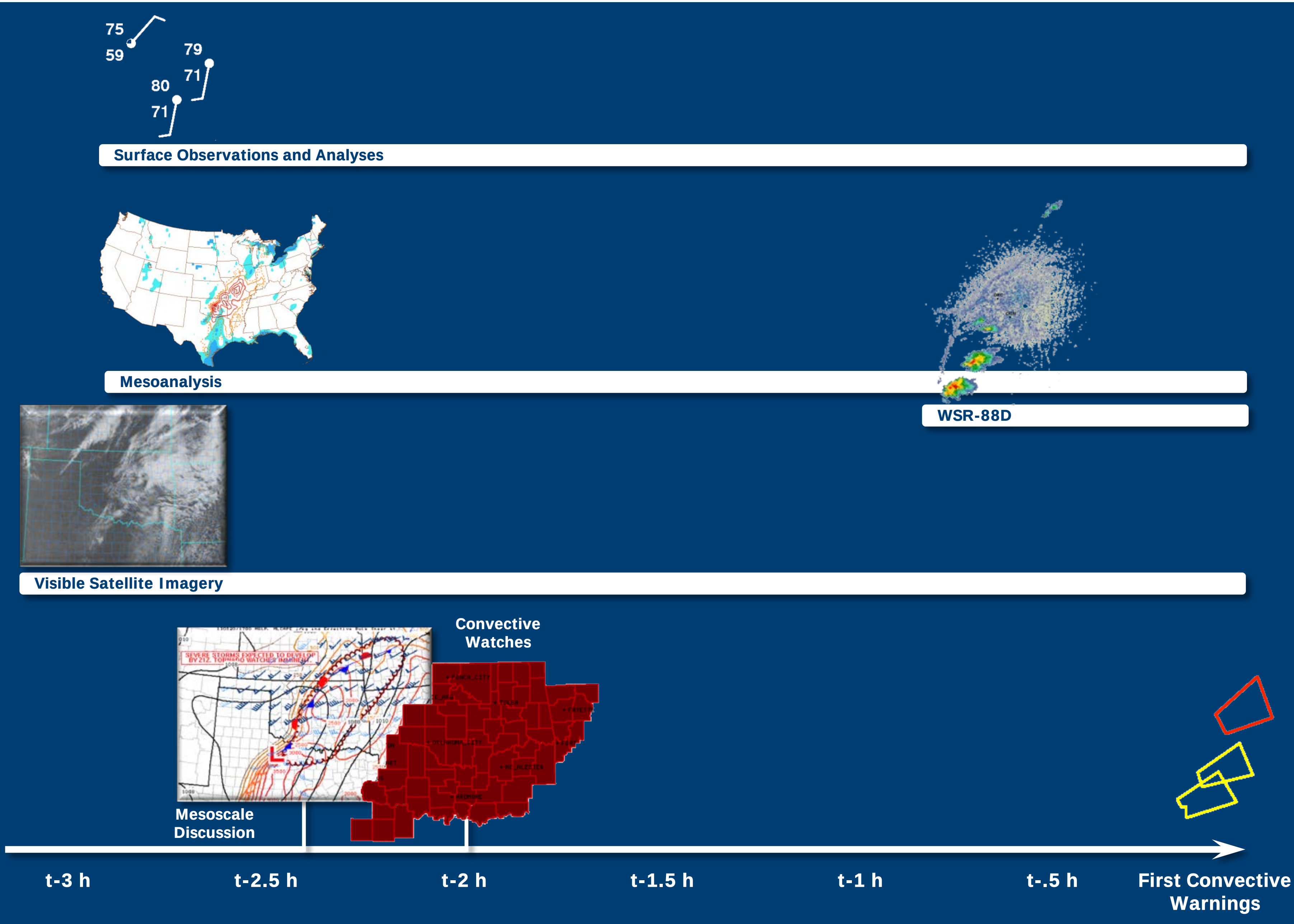
NearCast Mid-Low Theta-E Difference 03-h FCST valid 20 May 2013 at 2200 UTC
30-min Overshooting Top Detection Accumulation valid 20 May 2013 at 2202 UTC
WSR-88D Composite Reflectivity valid 20 May 2013 at 2202 UTC

GOES-R Convective Situational Awareness Display



These five (+) products provide enhanced situational awareness of the convective environment.

The -3-0 h Convective Forecasting Timeline



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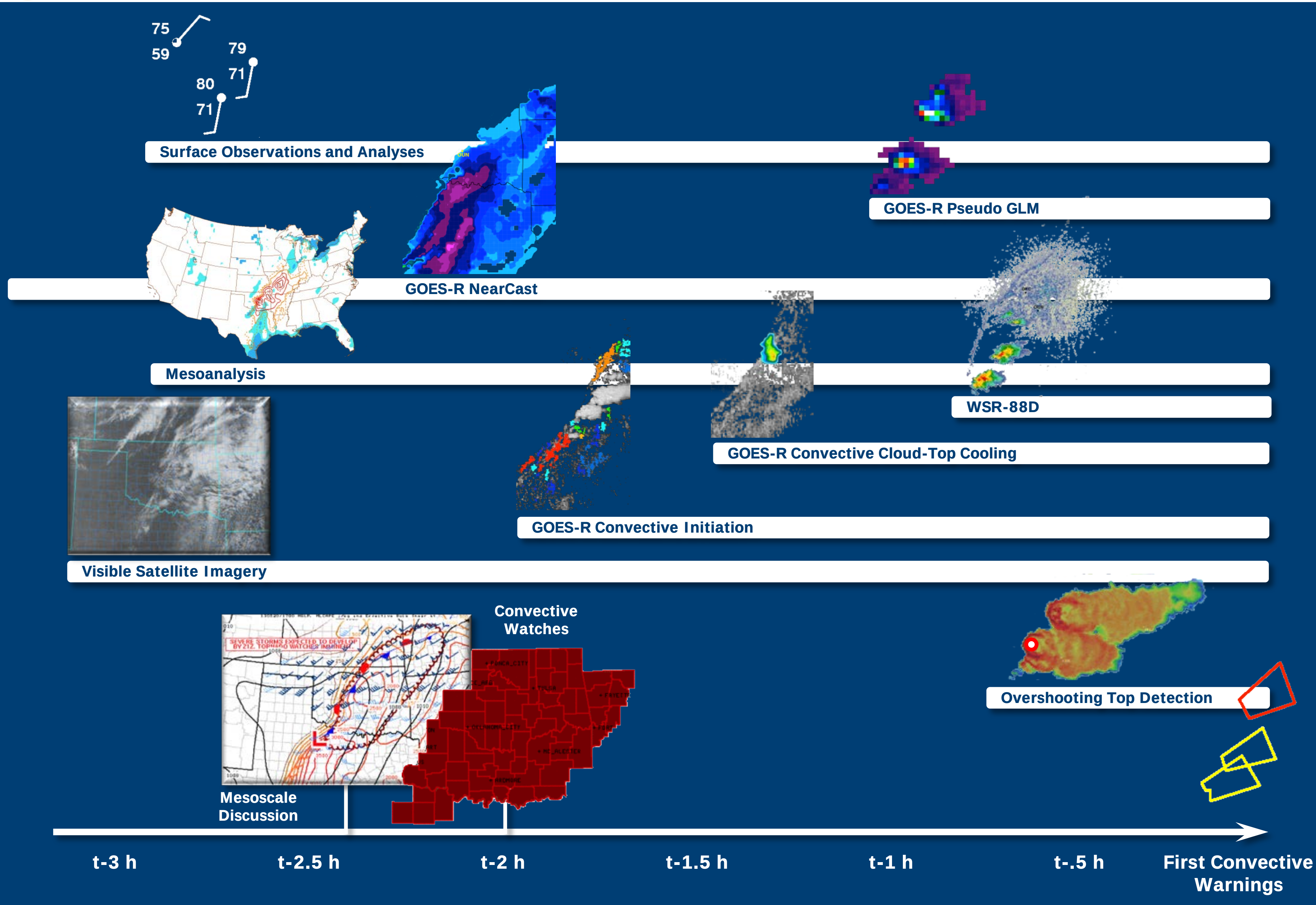

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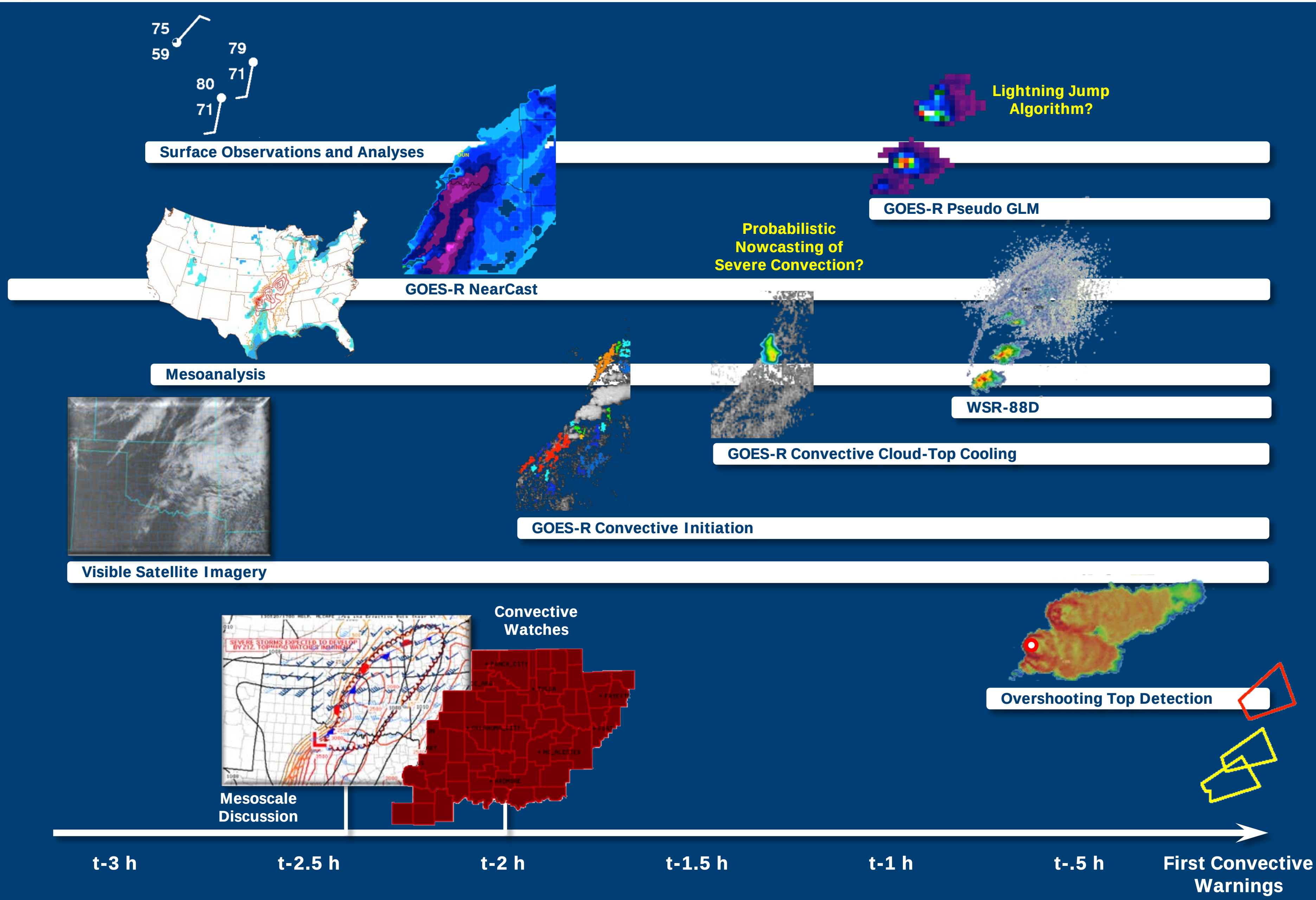

How Does the Transition to a Fused Approach Occur?

- Slowly.
- Evaluate "Data Fusion Process" using GOES-R convective products presented here within the 2014 Experimental Warning Program in the HWT and at a WFO (at the least) within a LMA domain for convective season.
- Answer Questions:
  - Can warning forecasters use this display while issuing warnings?
  - Warning forecaster or mesoscale analyst?
  - Outbreaks Days vs Non Outbreak Days
- Fused Approach at many WFOs using Convective Initiation and Probability of Severe Convection.
  - Products compliment each other

Conclusions

- GOES-R products can be valuable in maintaining and improving situational awareness during the 0-6 h hours prior to CI and during different portions of the convective life cycle.

- Data fusion approach…use with existing observational and model data sets forecasters are familiar using during convective situations.

Special thanks to Steve Weiss for reviewing an earlier version of this presentation.

CIMSS

GOES-R PROVING GROUND

SPORT

Questions or comments?

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