

Model Updraft Helicity

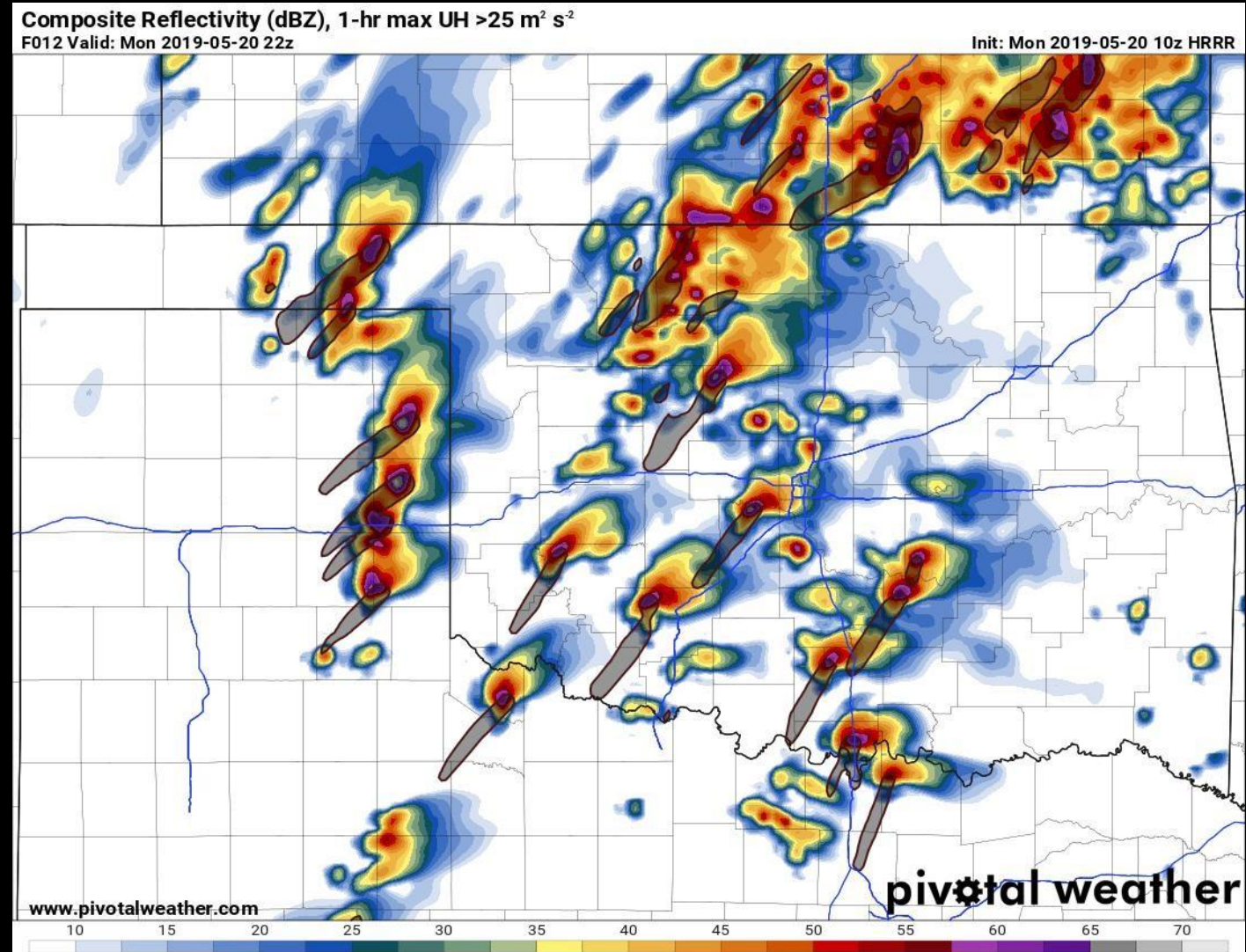
What is it. How to use it. Is it a cheat code?



Updraft Helicity (UH) is a way to evaluate updraft strength through rotation and vertical motion.

$$UH = \int_{z_1}^{z_2} w * \zeta dz$$

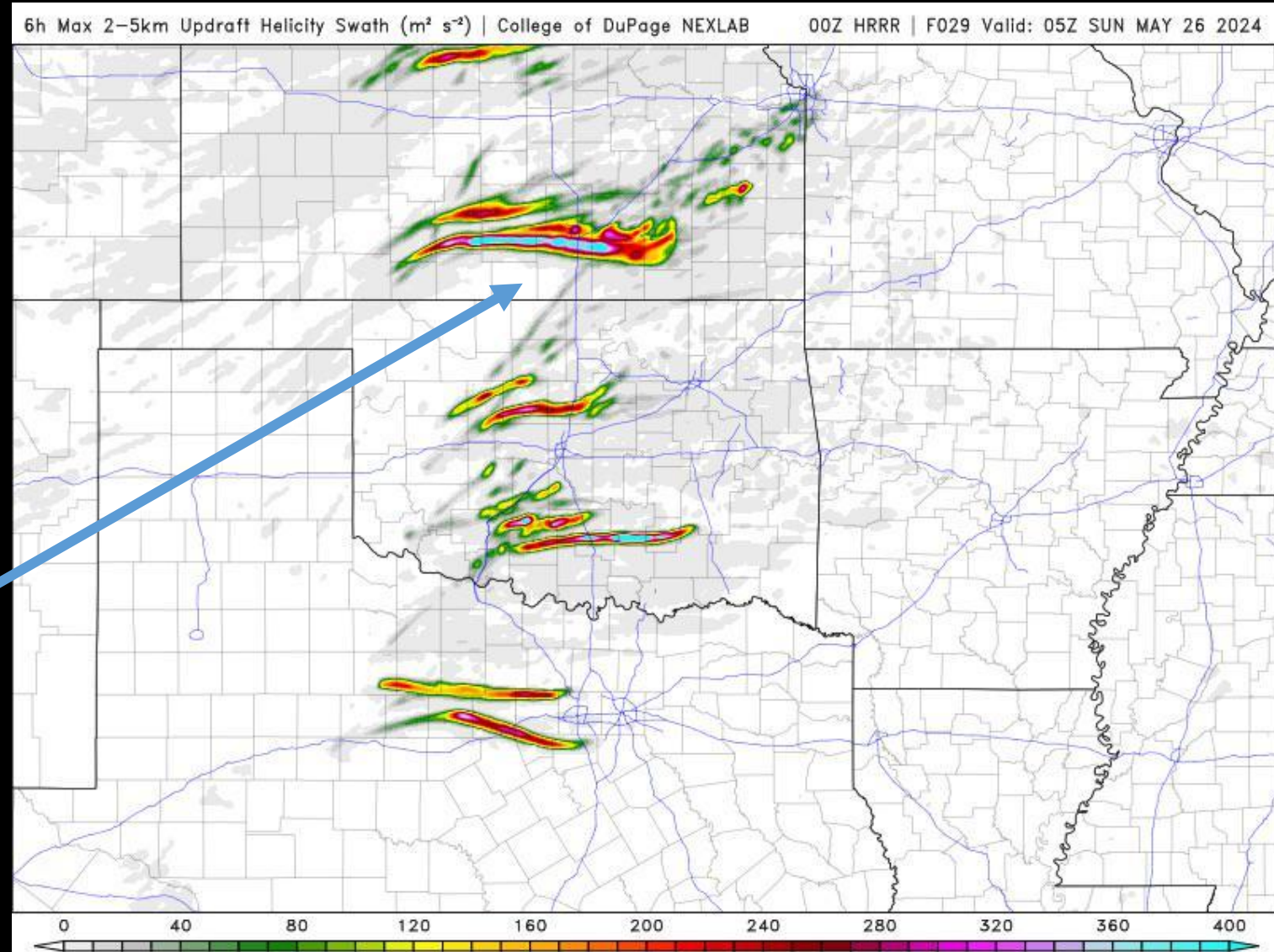
UH = Vertical Motion x Vertical Spin
between two levels.



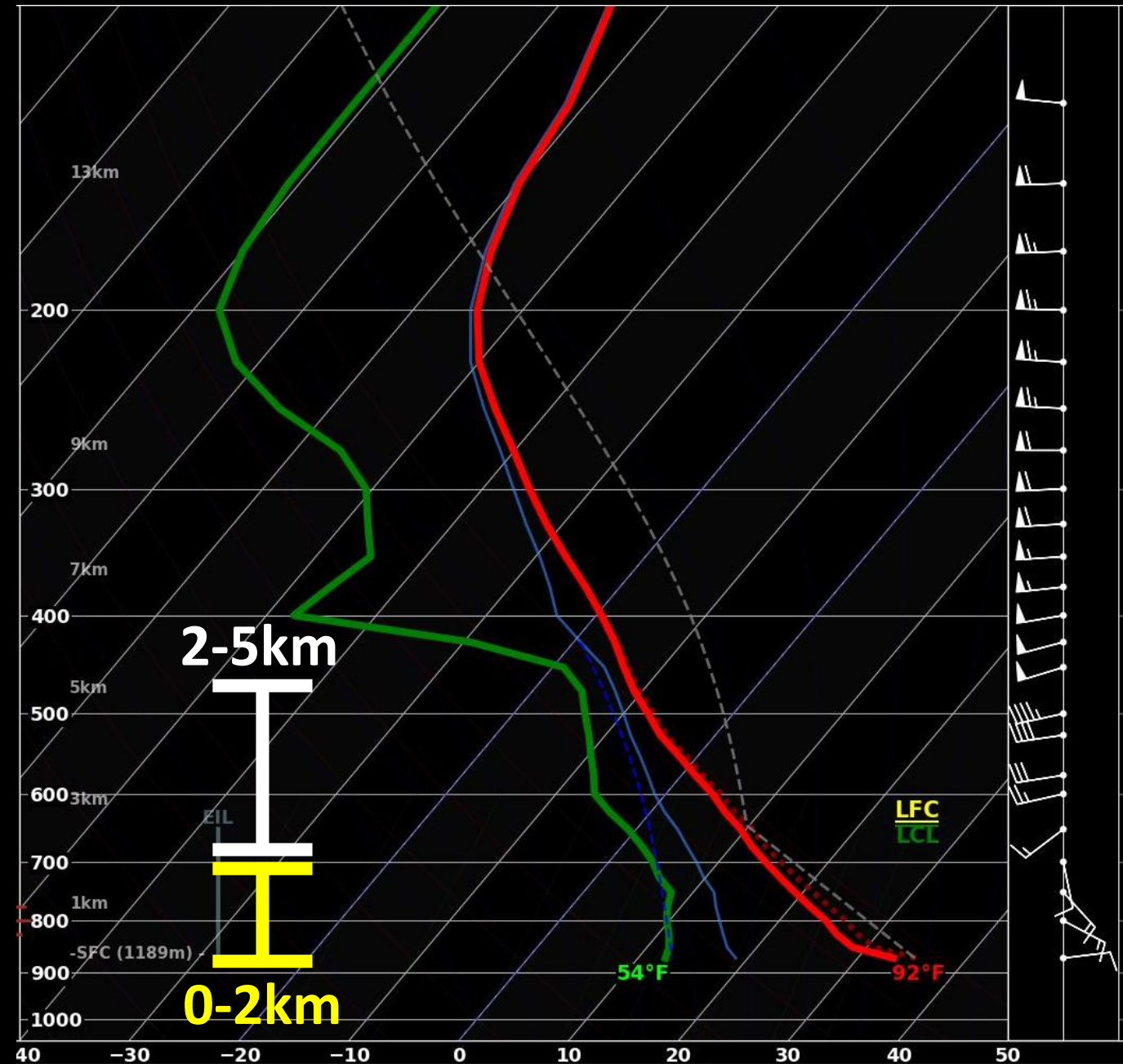
UH becomes large when updraft rotation and/or updraft speed are large.

Theoretically, significant supercells have *deep, persistent mesocyclones*. UH is trying to show this.

UH-tracks are useful for identifying where long-track supercells are possible.



UH on most model sites is computed and depicted **between 2-5km** to represent mid-level mesocyclones.



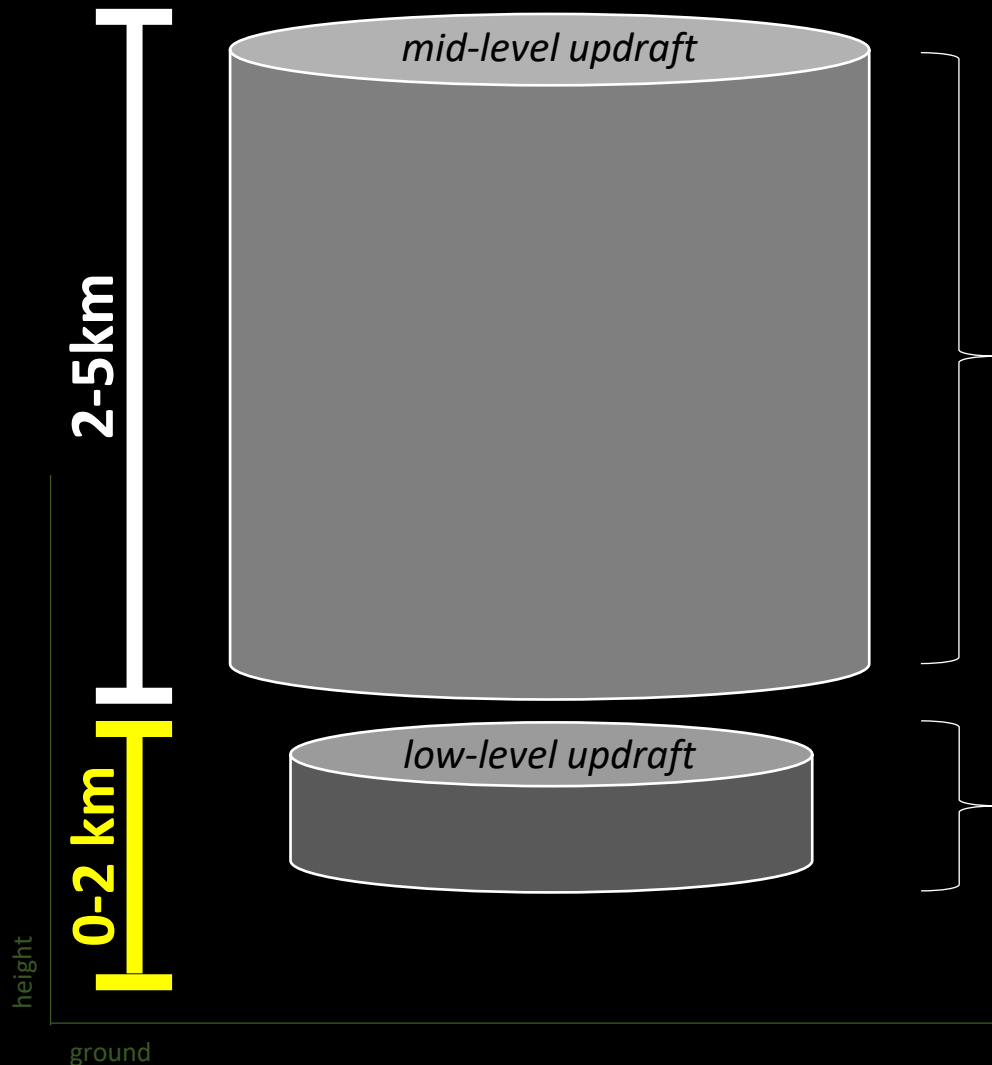
Recall from a previous coaching session (Origins of Updraft Rotation)...

Mesocyclonic rotation is obtained through ingestion of mid-level streamwise vorticity

and

Tornadic rotation requires near-surface rotation, which is obtained through different processes.

So, UH should not be used to assess tornado potential!



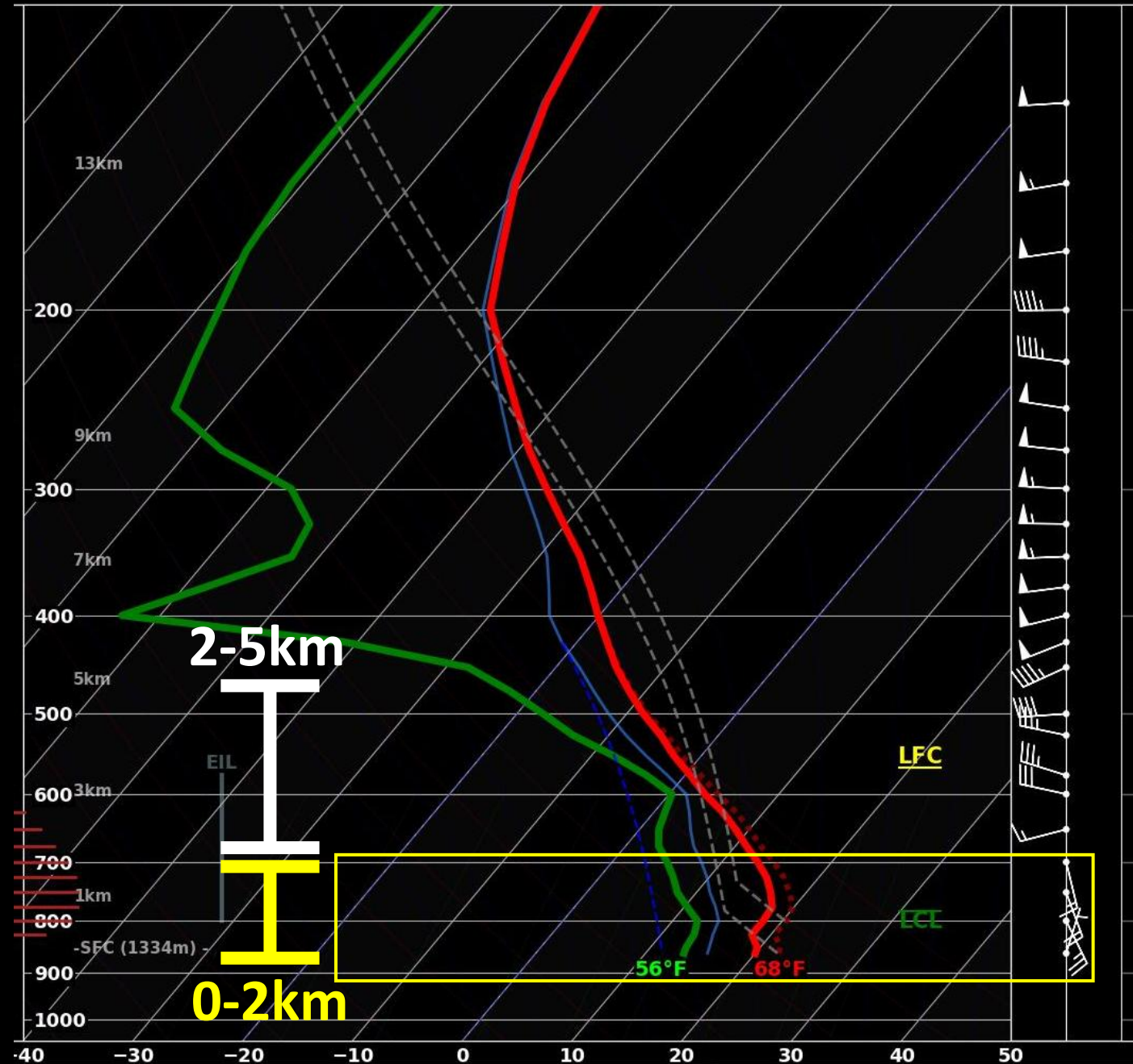
Mid-level rotation requires at least some elevated instability and cyclonic shear

Low-level rotation requires buoyant low-level air, oftentimes downdrafts, and a source of near-surface vorticity

Why this matters...

In a case like this, a model may depict a supercell with a UH track, but given the inversion & low-level stability, that supercell would be elevated.

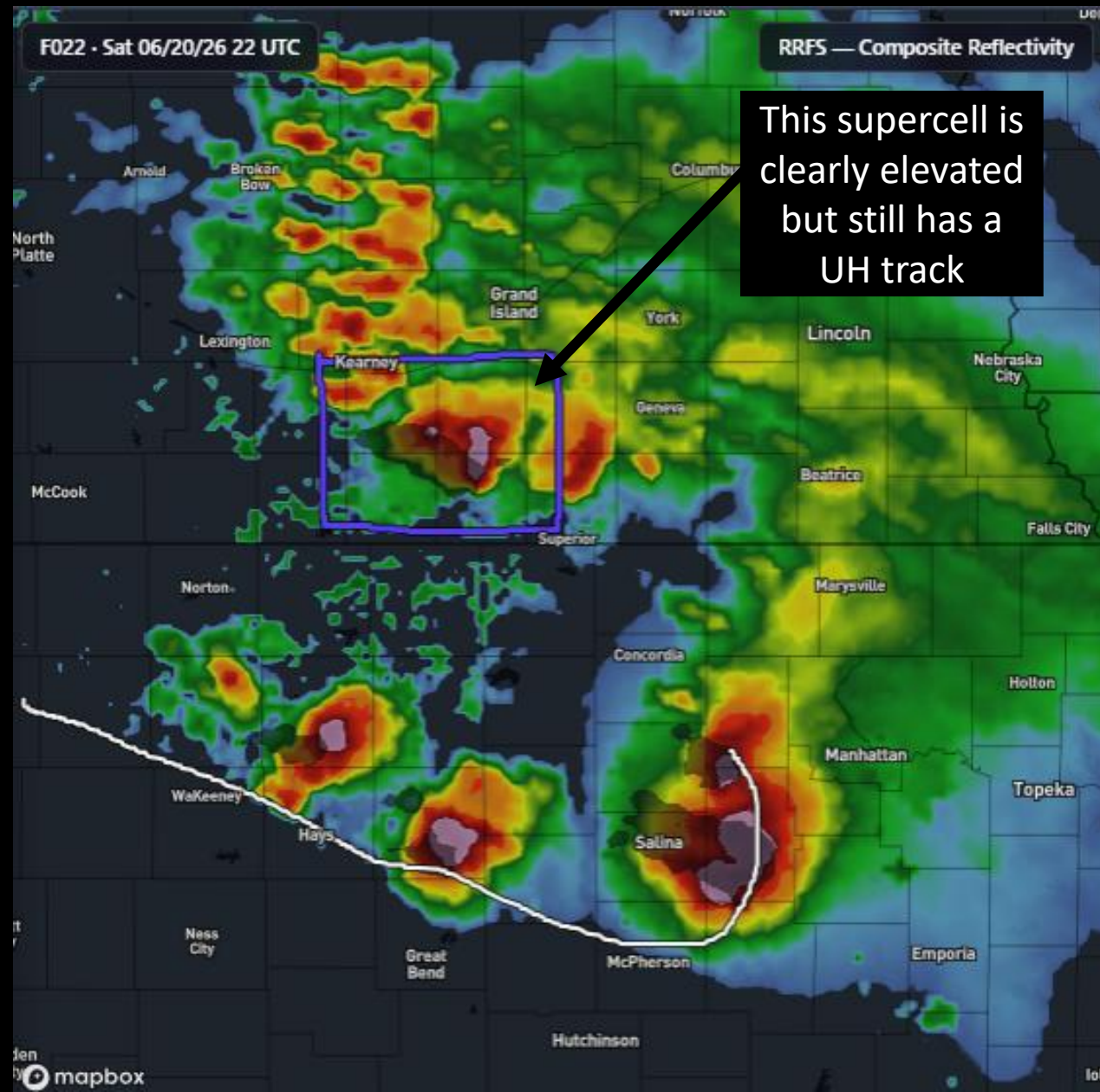
Elevated supercells typically do not produce tornadoes.



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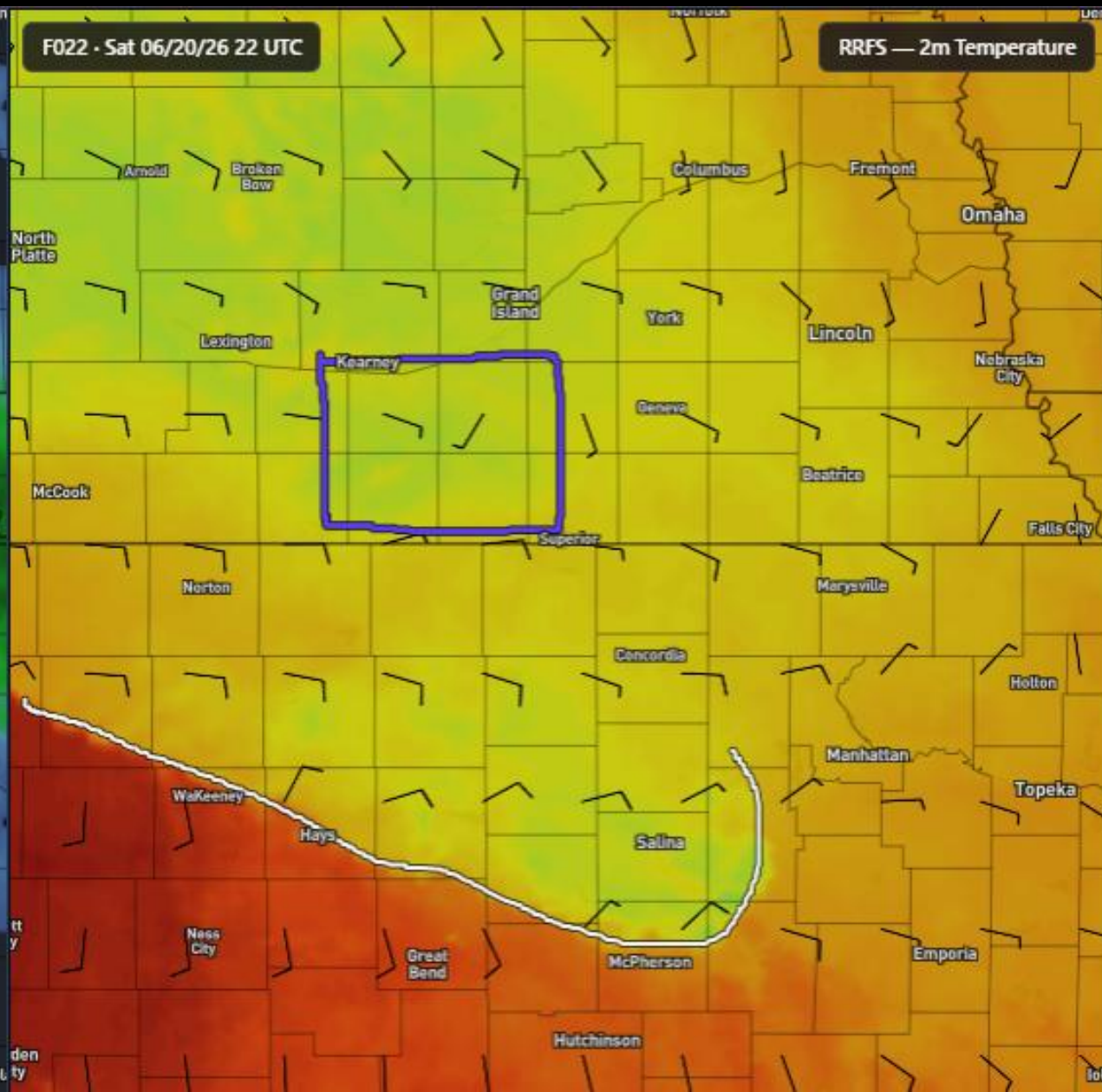
RRFS — Composite Reflectivity

This supercell is clearly elevated but still has a UH track



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RRFS — 2m Temperature

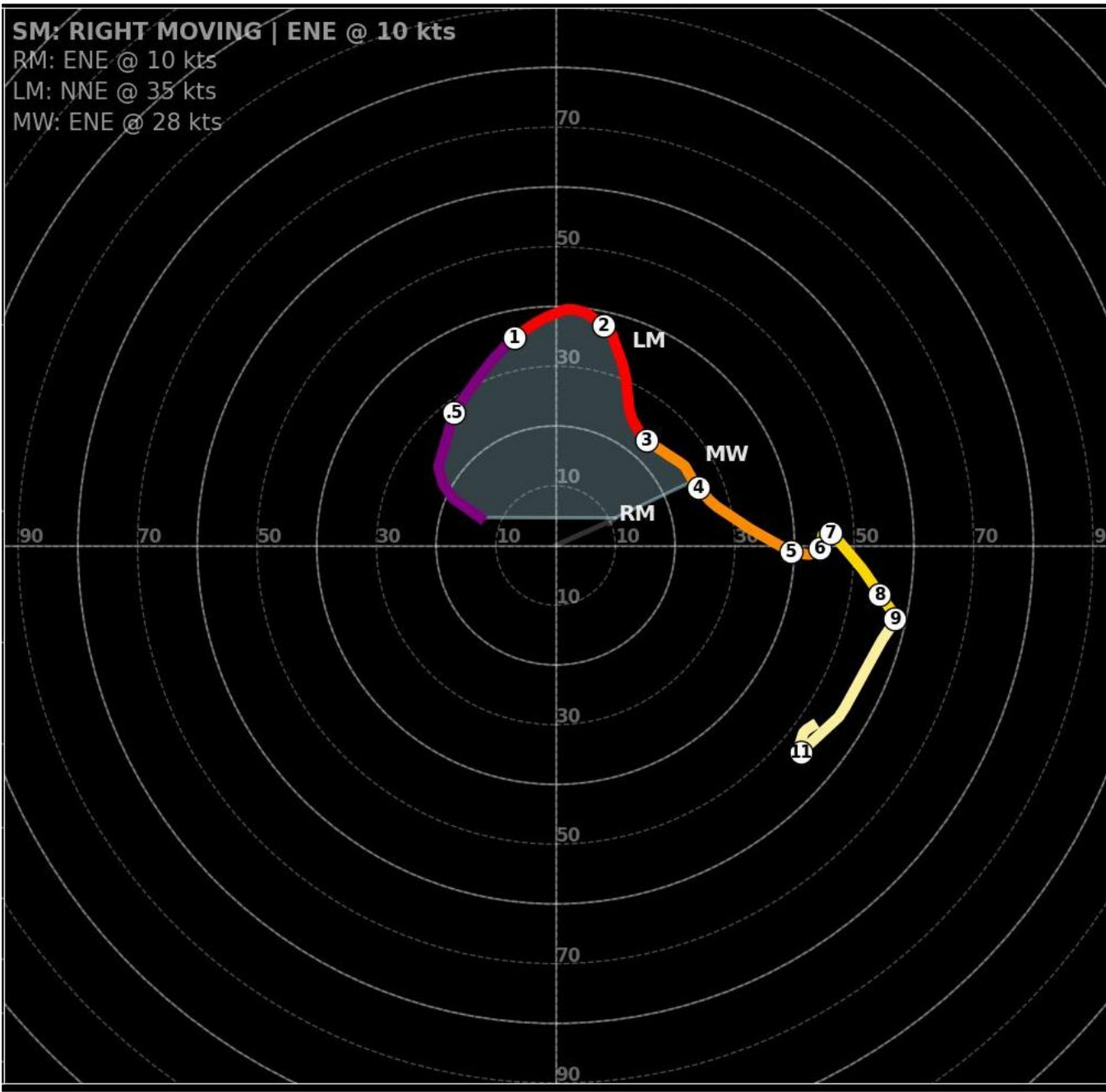


SM: RIGHT MOVING | ENE @ 10 kts

RM: ENE @ 10 kts

LM: NNE @ 35 kts

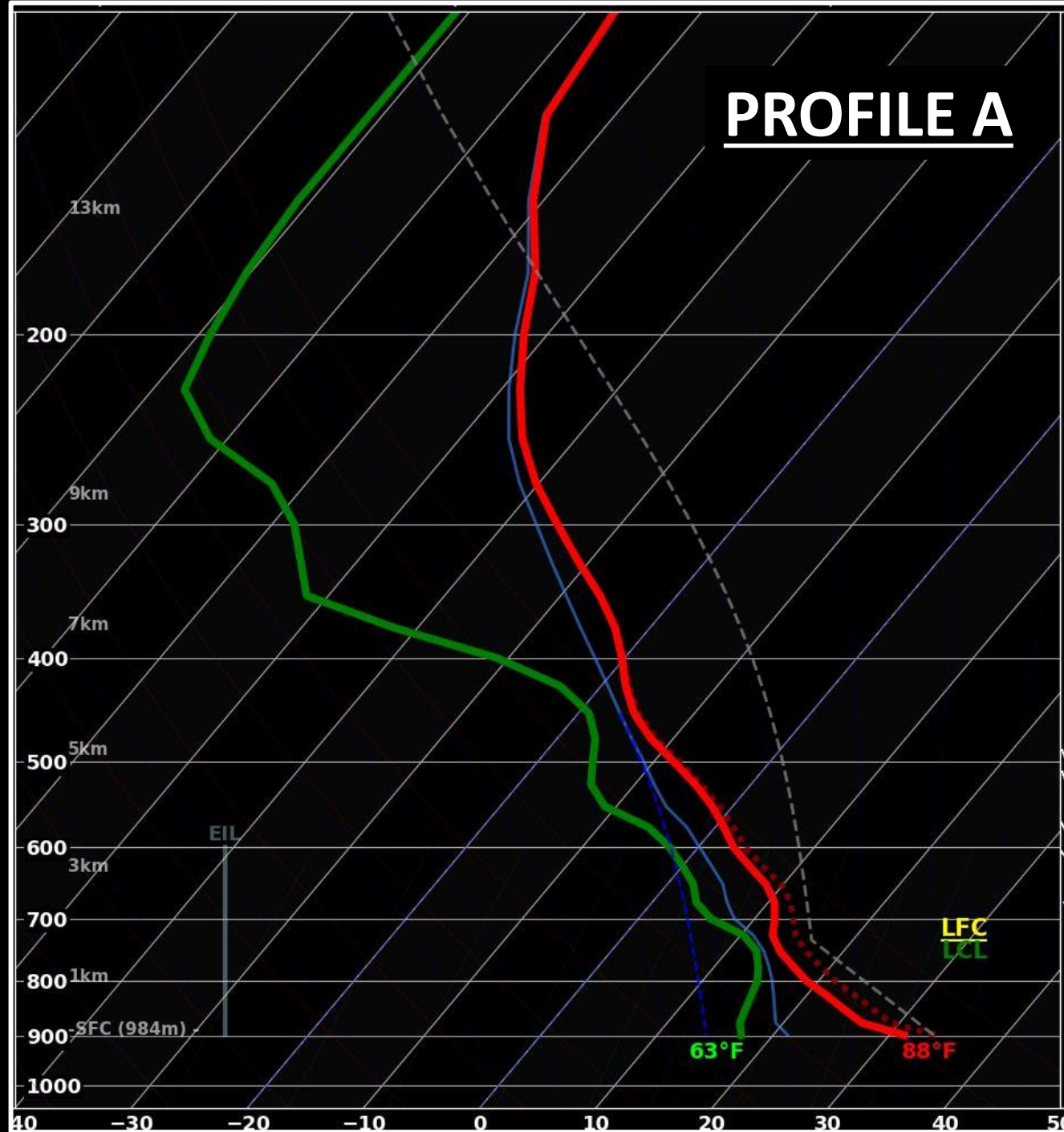
MW: ENE @ 28 kts



Imagine an environment with this hodograph.

- Large low-level shear
- Large deep-layer shear

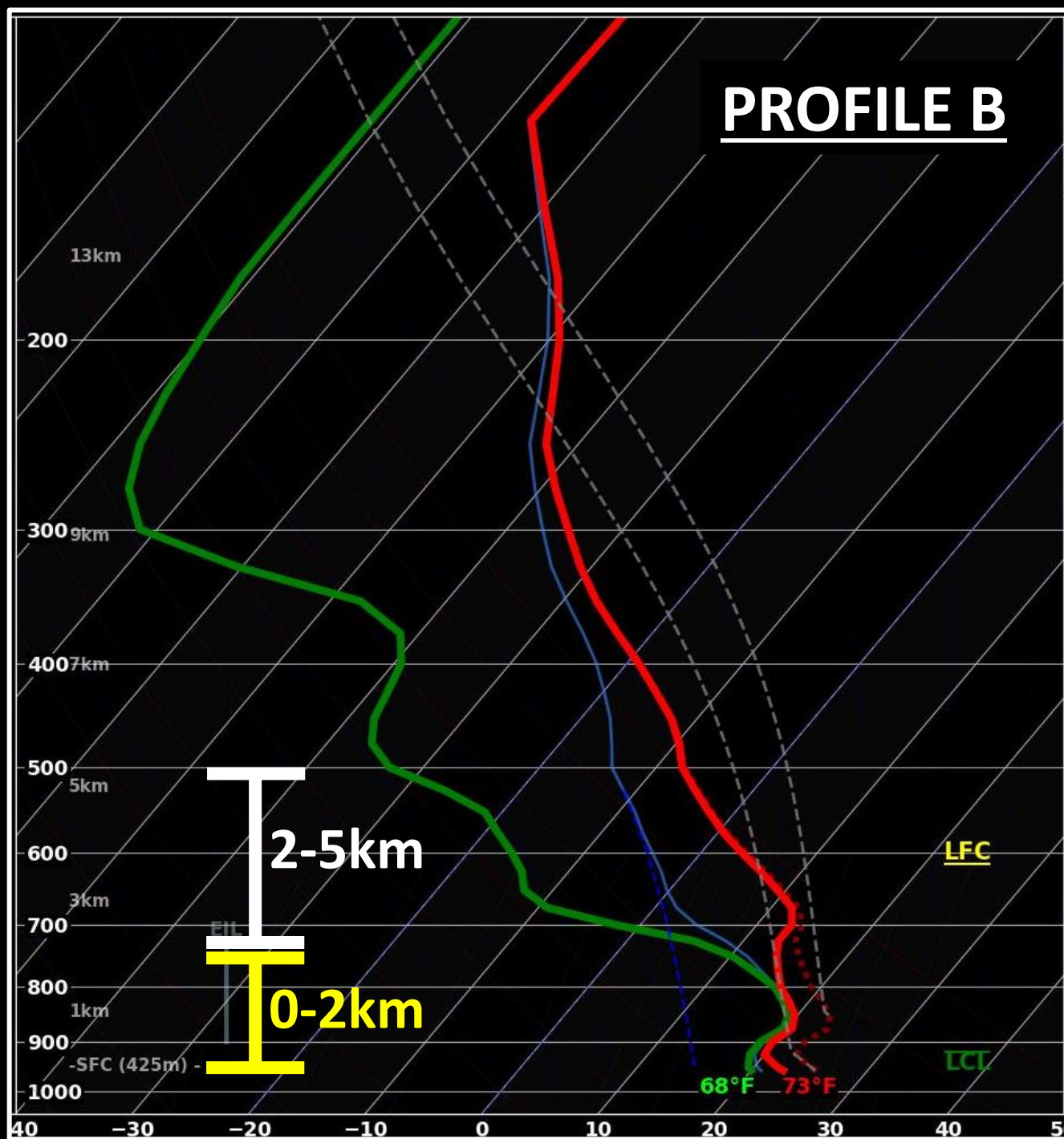
This wind profile supports supercells and perhaps tornadoes.



Now imagine that hodograph with this Skew-T.

- Large low-level instability
- Large deep-layer instability
- No major inversions or cap

This thermodynamic profile would support supercells and perhaps tornadoes (in conjunction with the hodograph)



Now imagine the same hodograph with this Skew-T.....

- No low-level instability
- Moderate deep-layer instability
- Large low-level inversion

This thermodynamic profile would **support elevated supercells** (in conjunction with the hodograph)

But a modeled supercell in this environment could still have a UH track!

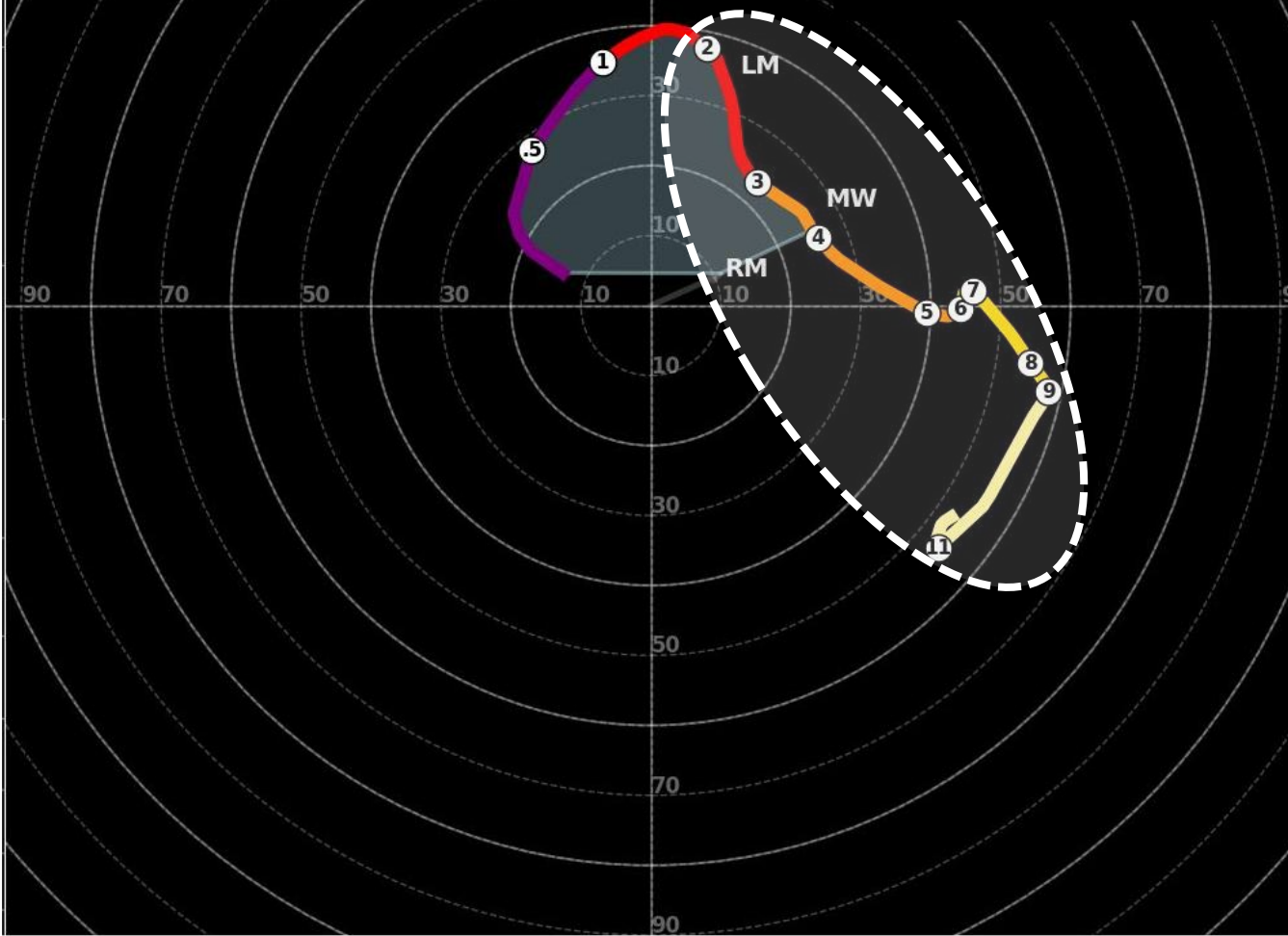
SM: RIGHT MOVING | ENE @ 10 kts

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A supercell would
NOT be able to 'feel'
or 'use' the low-level
shear in this
hodograph!



Back to the hodograph...

- For **PROFILE B**

Only the hodograph above the
inversion will be 'felt' by a supercell!

This hodograph supports...

- Large (straight) deep-layer shear
- No curvature, very little SRH

But a modeled supercell in this
environment could still have a UH
track!

Summary

Takeaway points:

1. Updraft Helicity (UH) is designed to identify *mesocyclones*, signifying the existence of supercell thunderstorms.
2. Updraft Helicity Swaths are useful for identifying regions where long-tracked supercells are possible.
3. Updraft Helicity (2-5km UH) should not be used to predict the likelihood of tornadic storms
 - *2-5km UH represents mid-level mesocyclones, which can exist without ever producing tornadoes! Low-level mesocyclones (or conditions favorable for tilting and stretching of near-ground vorticity) is a better way to diagnose tornado potential.*

A parting idea:

Updraft Helicity (UH) should be displayed on model sites in both **2-5km** and **0-2km** to visualize both low- and mid-level updrafts.

Questions?

