The Influence of the Low-Level Jet on Aviation

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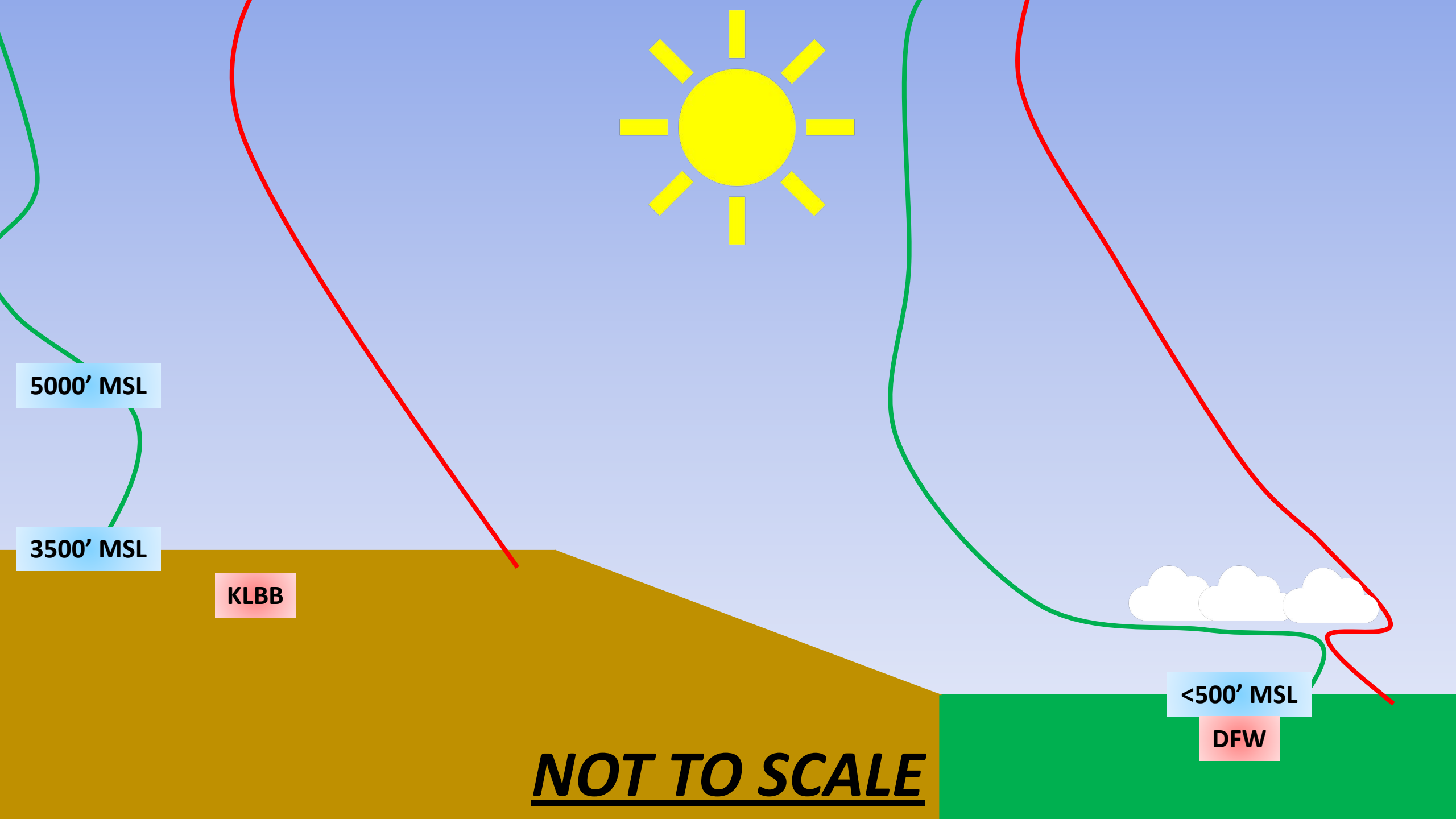
What is the low-level jet?

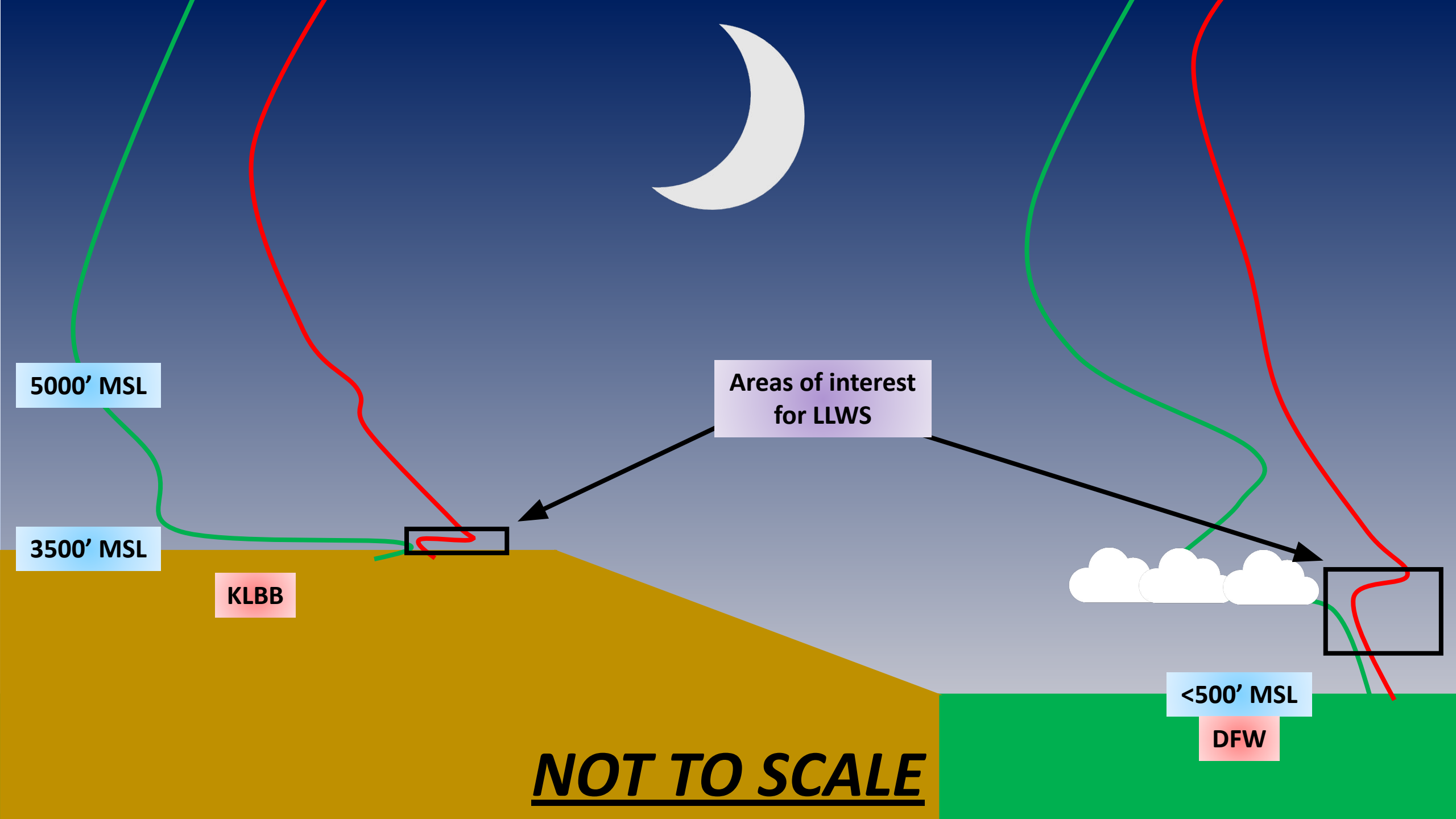
- **NWS definition**: A region of relatively strong winds in the lower part of the atmosphere. Specifically, it often refers to a southerly wind maximum in the boundary-layer *(the lowest few thousand feet of the atmosphere)*, common over the Plains states at night during the warm season *(spring and summer).*

- Physically, the LLJ is formed by two phenomena: 1) a significant change of winds at low altitudes compared to the surface, 2) large-scale *dynamics (an approaching upper-level disturbance and its associated surface low.)*

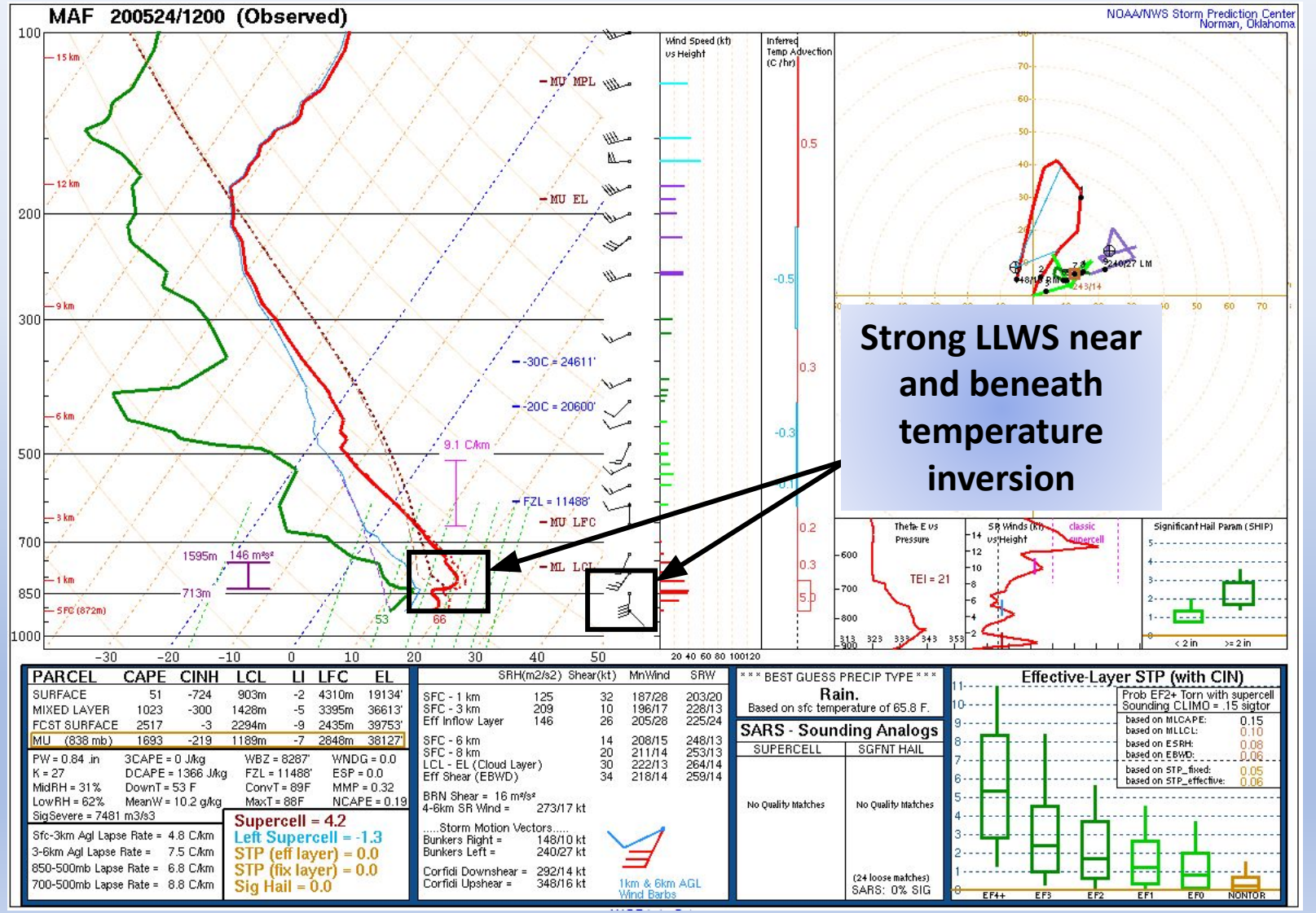
What is the low-level jet (cont'd)?

- During the day, well-mixed low-levels disperse near-surface frictional effects *(think thermal turbulence during departure and approach)*
- At dusk, this mixing "shuts off", and the top portion of the lowest levels become "disconnected" from that at the surface
- When this happens, there is a disruption in multiple balances of forces, reducing friction in the upper part of the lowest levels.
- The result is a vertical discontinuity which leads to a sharp increase in wind speeds and often direction a few hundred feet to a few thousand feet AGL.

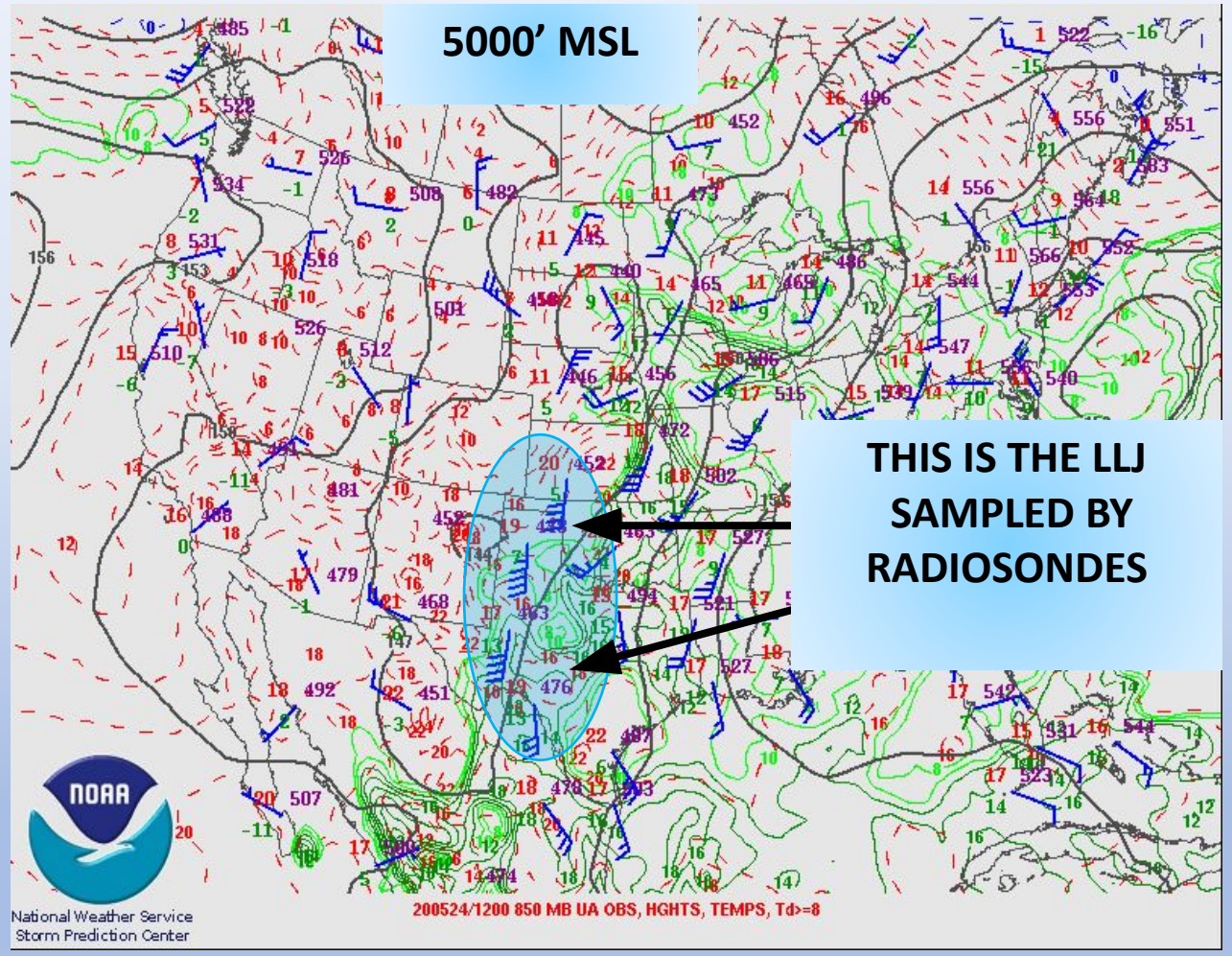

5000’ MSL
3500’ MSL
KLBB
<500’ MSL
DFW
NOT TO SCALE

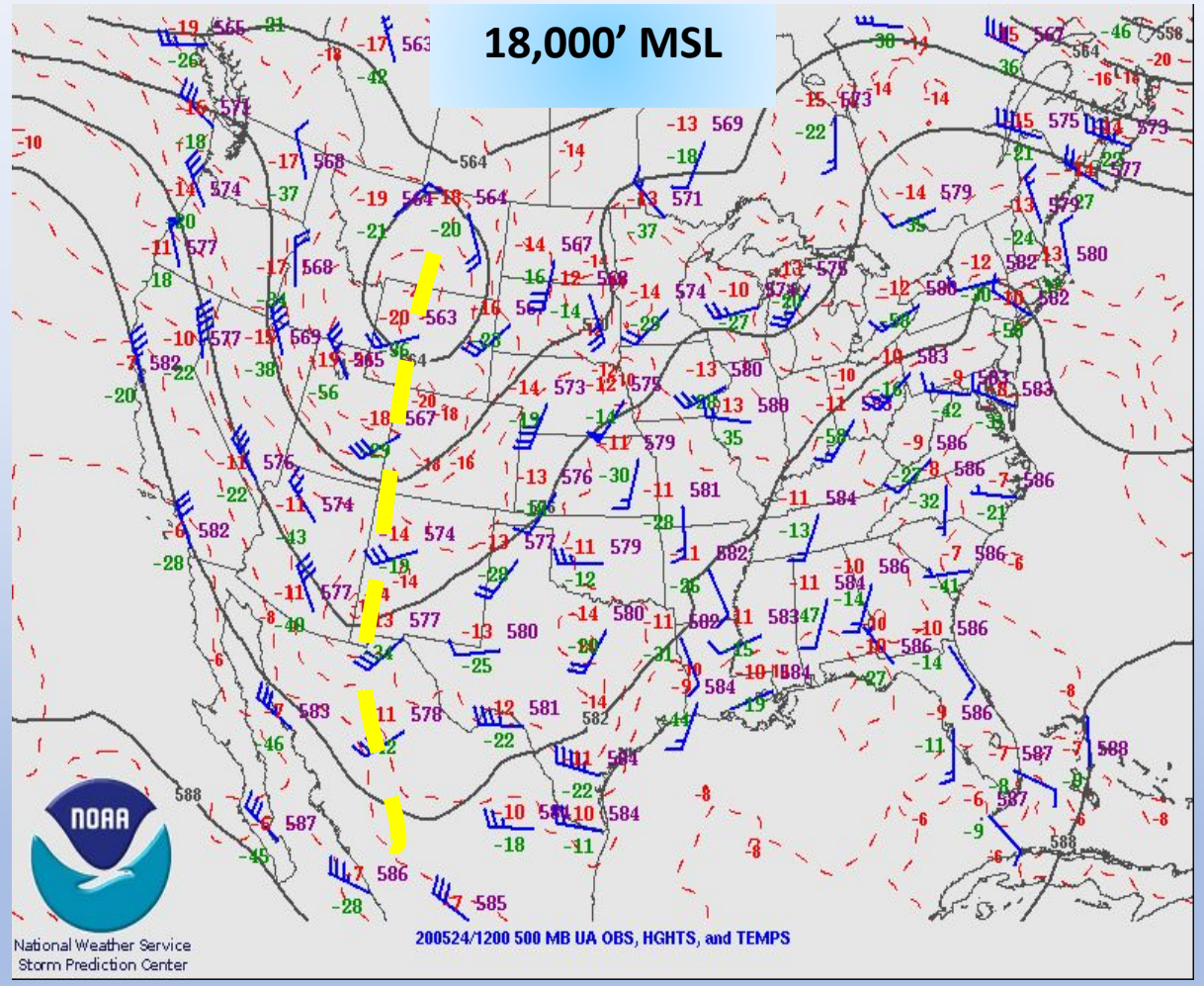

5000’ MSL
3500’ MSL
KLBB
Areas of interest for LLWS
<500’ MSL
DFW
NOT TO SCALE

Observed soundings (RAOBs/ACARs) provide a wealth of information!



Where does the LLJ set up in proximity to an upper-level trough?





Half barb = **5 kt** Full barb = **10 kt** Flag = **50 kt**

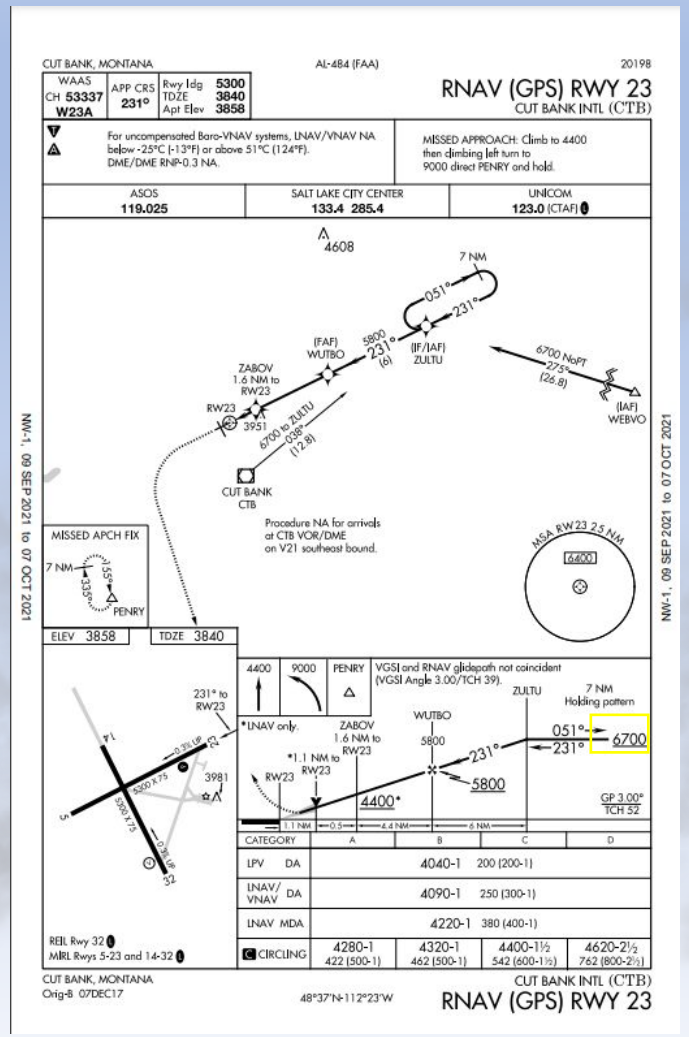
A climatology of the low-level over West Texas

- We conducted a five-year climatology (2016-2020) of the LLJ over West Texas using archived Mesoscale Analysis data obtained from the Storm Prediction Center.
- Data points obtained were in each meteorological spring (March 1st through June 1st) each day between 00-12 UTC (time interval when the oscillation of the LLJ wind maximum is at its greatest).
- Surface to 5000’ MSL winds were obtained.
- Five years of TAFs were also analyzed to gather forecast LLWS height issued by WFO LUB.
- If the wind direction at 5000’ MSL was not within 120-220 degrees, data points were removed **unless** LLWS was issued in the TAF(s).

The findings…

- The **average** height of LLWS was determined to be approximately 800’ AGL at KLBB and KCDS
- The shear zone was far lower than default DAS LLWS heights
- SODAR (Sonic wind detection systems)/Doppler RADAR-derived vertical wind profile data has detected presence of the LLJ approaching 50 knots as low as 300’ above the surface over KLBB in the late spring season

Issues



Always be aware of vertical temperature profiles in wintertime clouds

Hint, the Winds aloft forecast isn't granular enough

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    FT 3000    6000     9000   12000   18000  24000
CTB 9900-26 3411-17 3527-23 3627-30 3536-35 344140
```

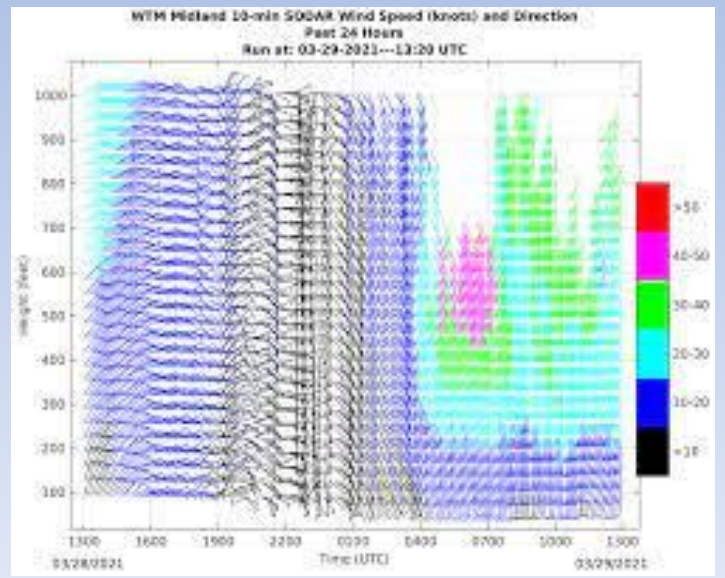
9000’	10°F
8000’	20°F
7000’	30°F
6000’	0°F
5000’	-25°F
4000’	-20°F
AMSL	

Supercooled Liquid (Icing!)

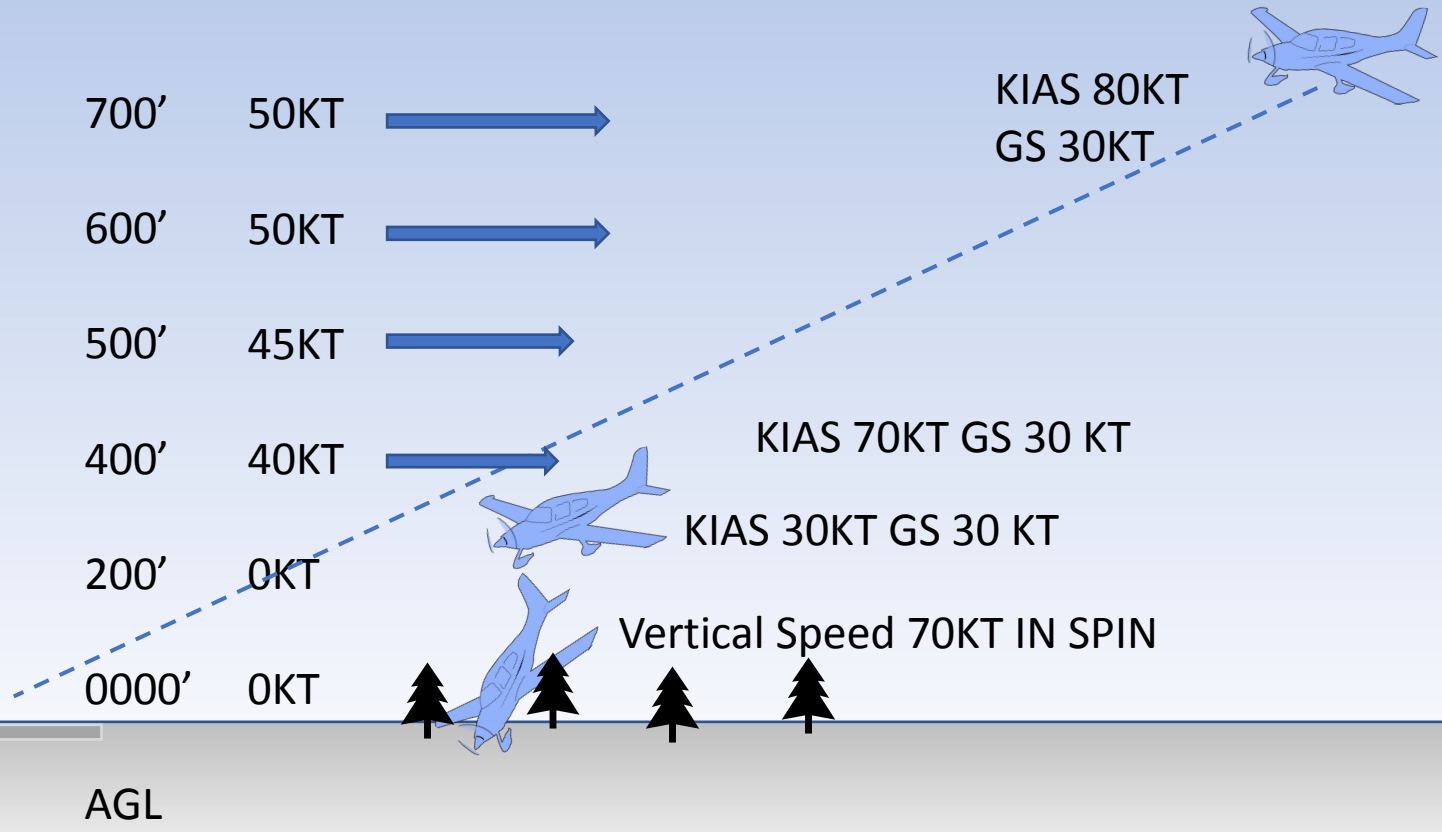
What can you use?
Learn to read SKEW-T model forecasts
Call an NWS Forecast Office and talk to a meteorologist

Low level wind shear hazard (worst case)

If you seem to be really slow on turn to final
and surface winds are near-calm, think LLWS!
NO VISUAL CLUES!



Often a significant overnight hazard
When ground reference clues are at a minimum



Mitigation Strategies

- Watch for mention in TAF

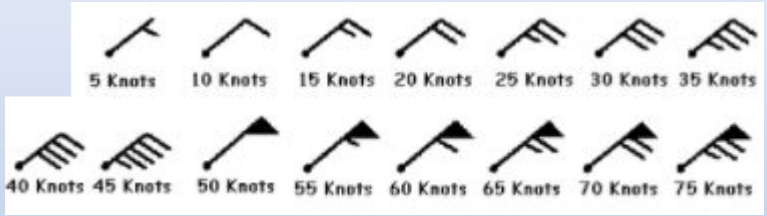
```
TAF
KLBB 042320Z 0500/0524 VRB03KT P6SM SKC
     FM050500 00000KT P6SM SKC  LLWS004/18040KT
     FM051200 18011KT P6SM SKC
```

- Aviation Forecast Discussions (Available in Foreflight)
- G-AIRMETS (LLWS)
- PIREPS (Receive AND Give)
- VAD Wind profiles (from RADAR)
- Model forecasts

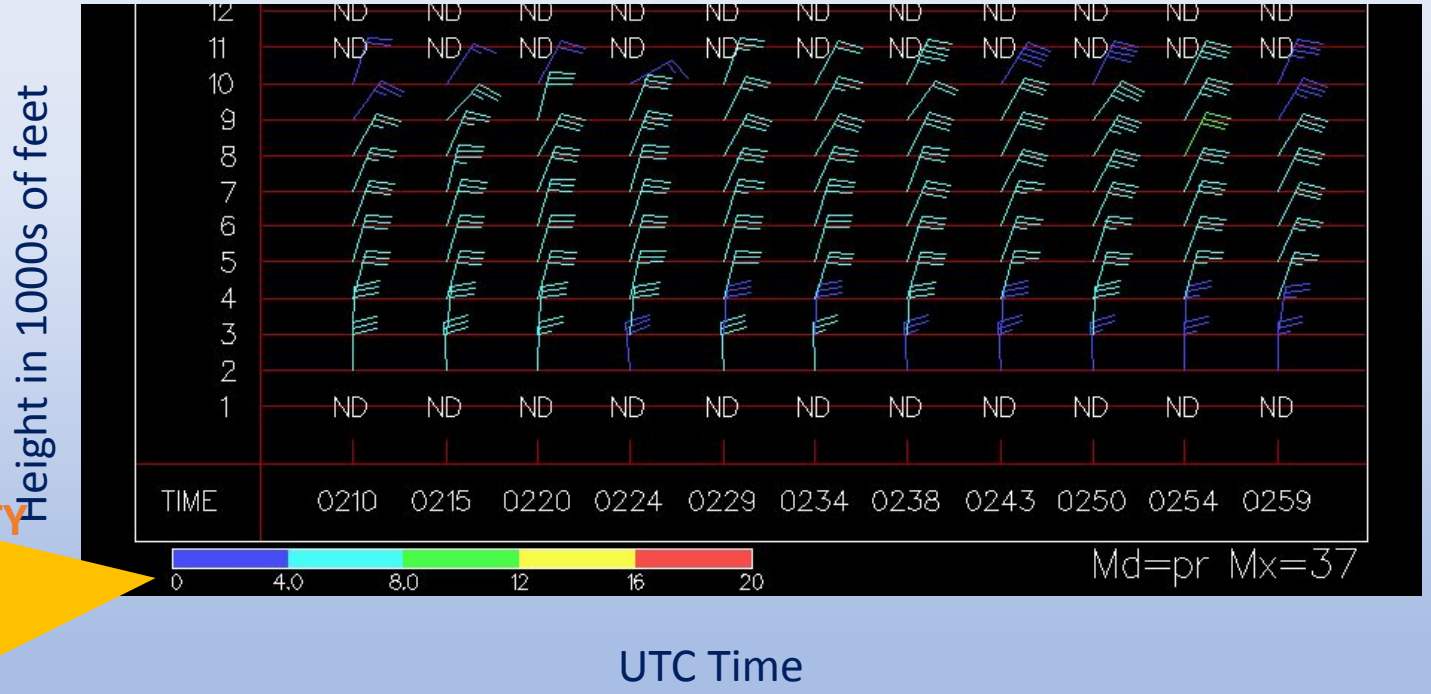
If surface winds are calm and winds are strong aloft, be ready for shear!

Velocity Azimuth Display (VAD)

Vertical granularity isn't optimum, but it is more dense at low altitudes
(and more importantly, an observation)



Color code is **NOT WIND VELOCITY**
Rather, the variance in speed at a given level



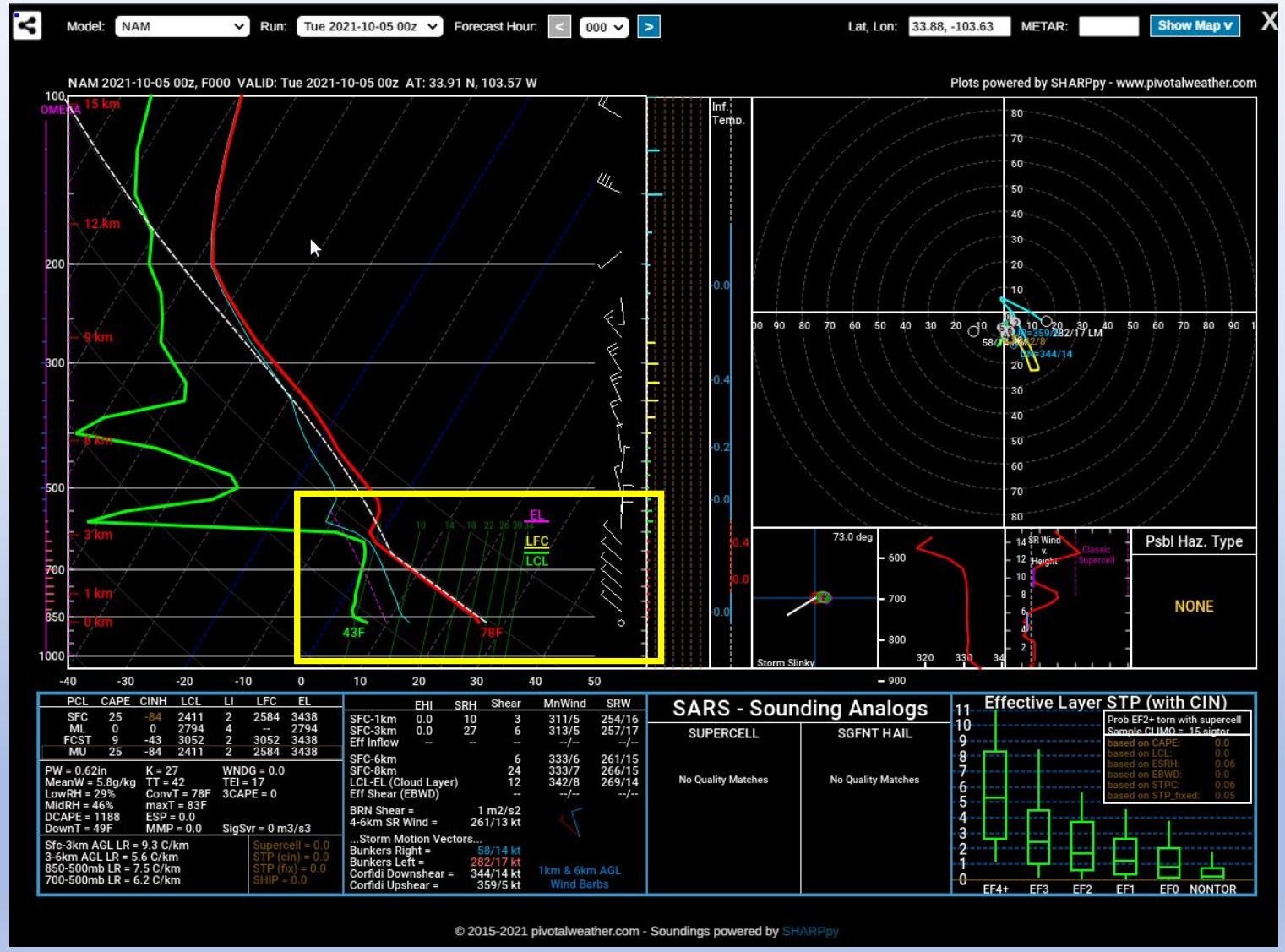
Skew T

This charts provides many invaluable pieces of information. The more you effort YOU put into learning about this fantastic tool, the more you'll be able to make sound aeronautical decisions.

These can help you detect hazards like

- Icing
- Turbulence
- IFR conditions

As well as saving $ by optimizing altitudes for winds.



Handy resources

- Forecast discussions (very informative)
  https://www.aviationweather.gov/fcstdisc
- G-AIRMETS
  https://www.aviationweather.gov/gairmet
- TAF
  https://www.aviationweather.gov/taf
- VAD Profiles
  https://weather.cod.edu/satrad/nexrad/index.php?type=KABX-NVW-0-2
- Your local National Weather Service Office meteorologists

Further learning

- Skew T for pilots
  http://newlangsyne.com/articles/skewt/index.htm
- AOPA Skew-T
  https://www.aopa.org/news-and-media/all-news/2008/july/pilot/wx-watch-skew-t-basics
- Forecast Skew-Ts Nationwide (click map to get a sounding anywhere)
  https://www.pivotalweather.com/model.php?m=nam&p=850td