P150

An Examination of Convective Enhancement within Complex Terrain on 5 April 2017 during VORTEX-SE

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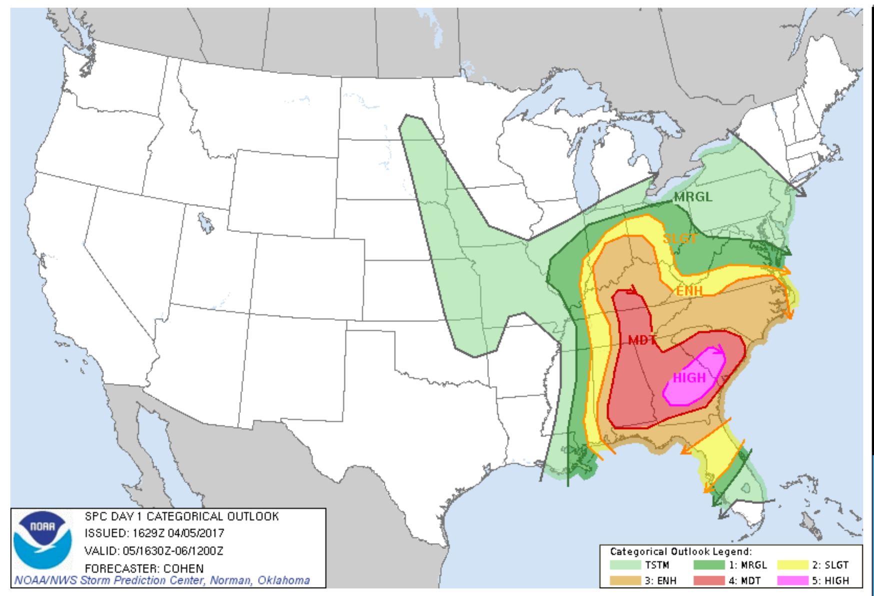
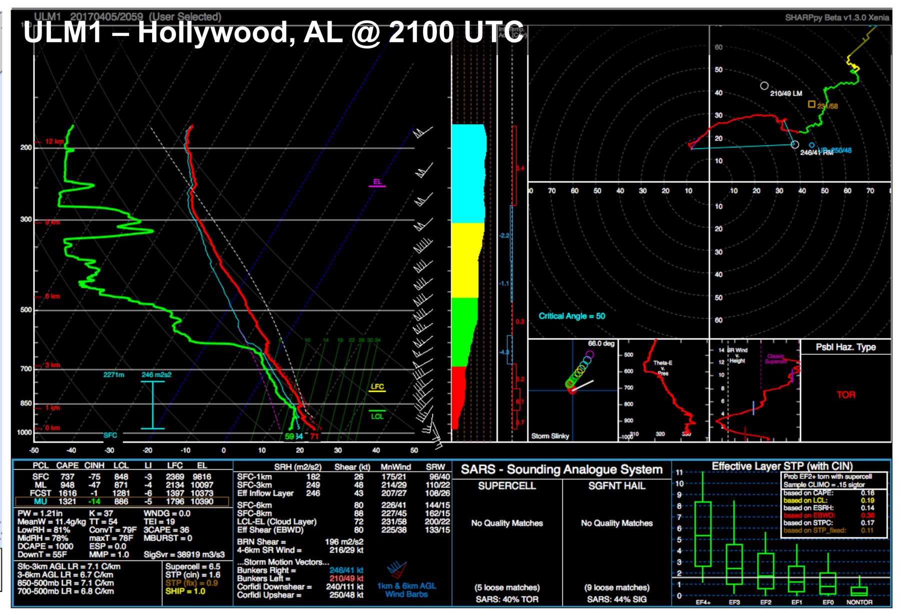
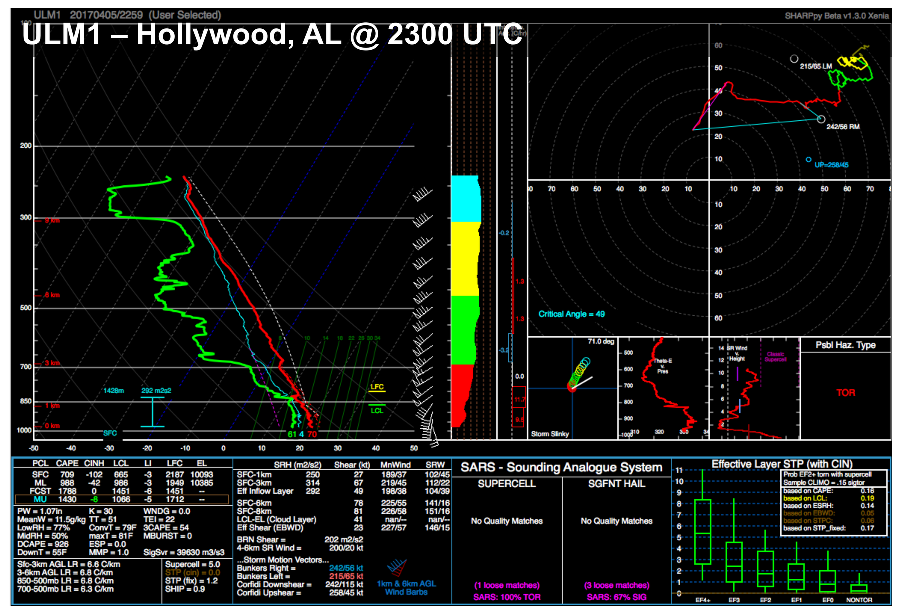
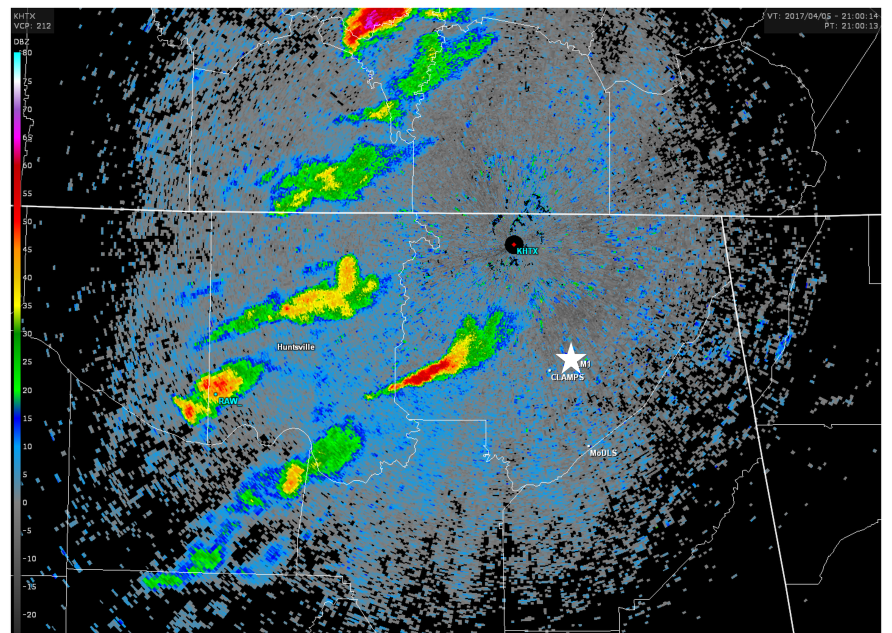
IOP3b (5 April 2017) Summary







- Moderate risk in place across far eastern portions of the VORTEX-SE domain with 15% (hatched) tornado probabilities
- Sfc cold pool from predawn elevated convection kept sfc layer stable for much of the day
- Late afternoon profiles exhibited weak-to-moderate sfc instability but maintained ~100 J kg^{-1} of CIN
- Bulk shear near 80 kts with low-level hodographs that appeared favorable for supercells & tornadoes
- However, wind profiles were similar to the composite VORTEX2 nontornadic sounding (Coffer and Parker 2016)
- A surface boundary combined with slightly unstable profiles lead to, scattered CI during the late afternoon
- Convective cells quickly became elongated as updrafts had difficulty organizing & sustaining under the weak instability and strong shear (KHTX reflectivity @ 2100 UTC)
- Convective coverage and intensity significantly increased near 00 UTC, as the surface boundary moved through the complex terrain of NE Alabama (KHTX reflectivity @ 0000 UTC)


KHTX 0.5° Reflectivity @ 2100 UTC
Star = radiosonde launch location

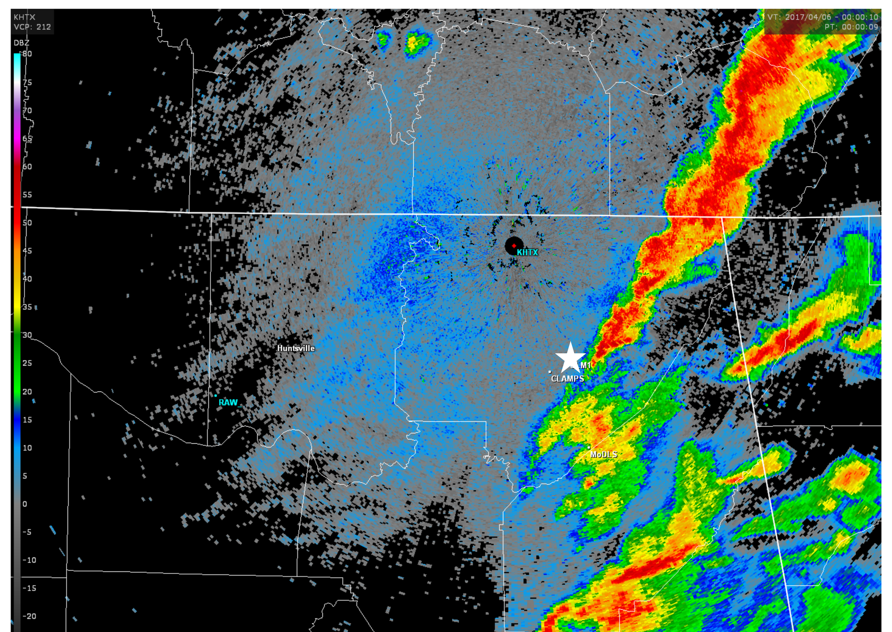
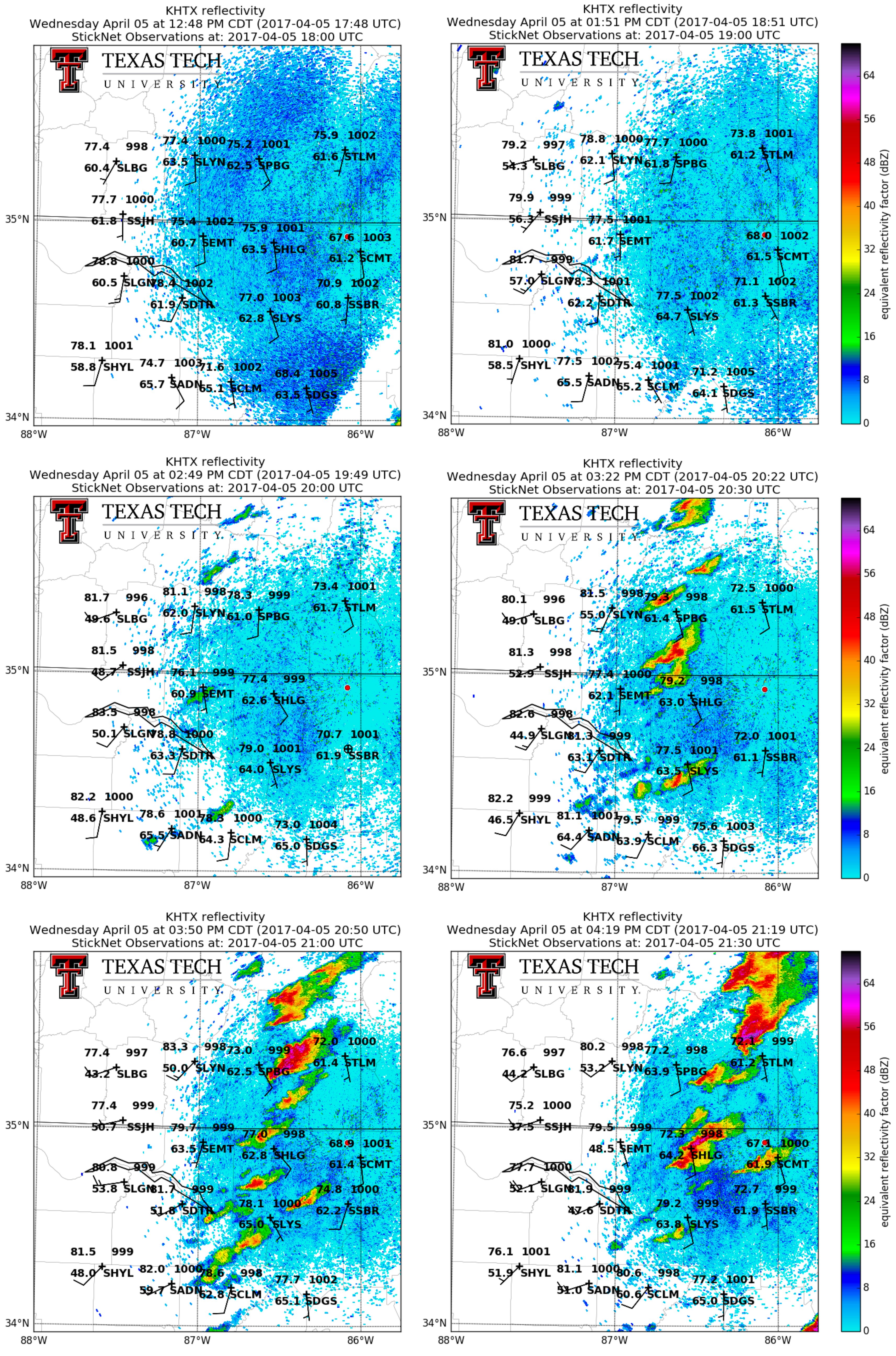

KHTX 0.5° Reflectivity @ 0000 UTC
Star = radiosonde launch location

Table 1: Sounding Data from ULM Team 1 in Hollywood, AL

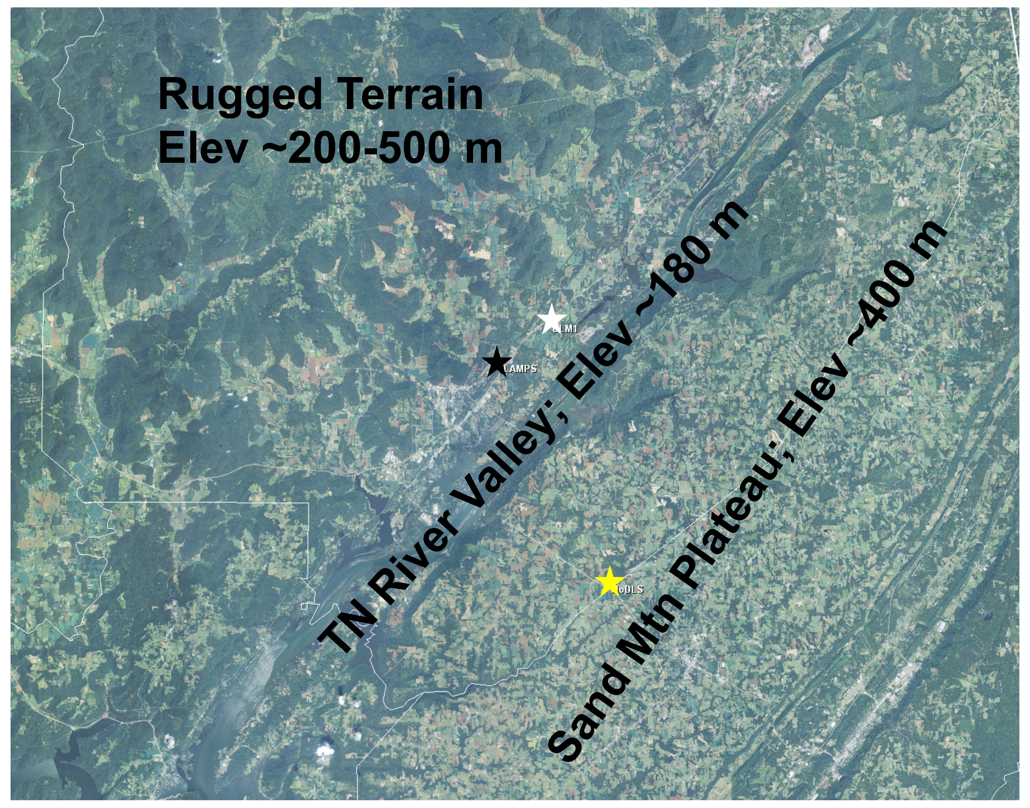
Time (UTC)	SBCAPE (CIN) (J kg^{-1})	MLCAPE (CIN) (J kg^{-1})	0-1 km SRH (m^2 s^{-2})	0-3 km SRH (m^2 s^{-2})	0-6 km Shear (kt)
1115	0 (0)	252 (–89)	237	292	80
1600	0 (0)	26 (–51)	84	203	68
1714	221 (–27)	272 (-18)	4	126	66
2000	153 (–120)	541 (–61)	156	237	75
2100	737 (–75)	948 (–47)	182	249	80
2200	828 (–83)	937 (–55)	185	270	84
2300	709 (–102)	988 (–42)	250	314	78

Dryline in Alabama?

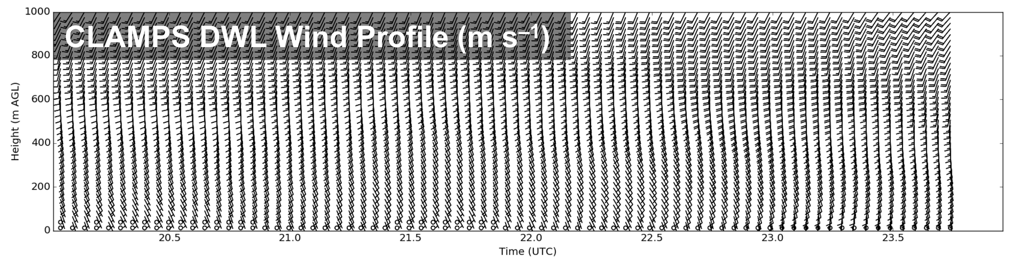
- Observations from the Texas Tech Stesonet suggests a weak dryline propagated through the VORTEX-SE domain ahead of a primary surface cold front
- Beginning near 1930 UTC, ~5-10˚ F of drying and ~3-5˚ F of warming was observed in the western domain along a pressure trough / wind shift line
- By 2030 UTC, ~20˚ F dew point gradient was observed across the domain; temperatures in the western domain remained steady or slightly increased
- Convection was initiated along this surface boundary around 1945 UTC

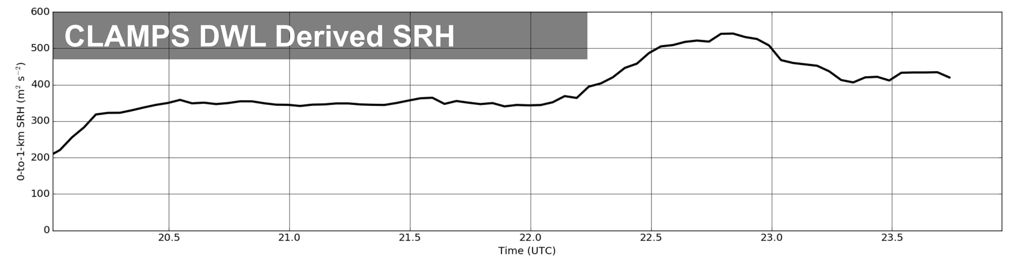


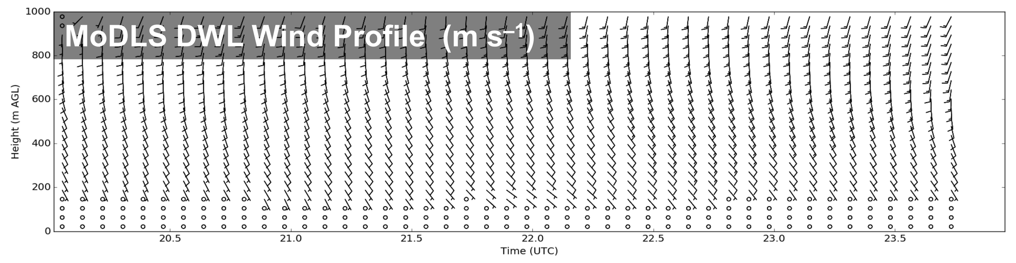
Observations in Complex Terrain

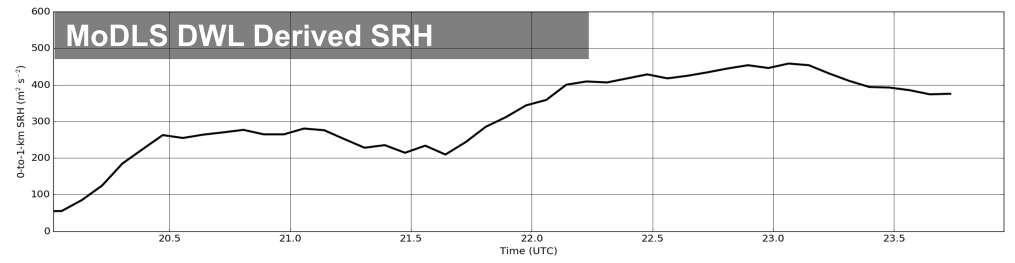


- OU/NSSL CLAMPS (black star) located in TN River Valley
- UAH MoDLS (yellow star) located atop Sand Mountain Plateau
- ~18 km horizontal distance; ~200 m elevation rise
- ULM Sounding Team 1 (white star)
- 0-1 km valley wind profiles 5-10 m s^{-1} stronger than those atop the plateau
- Winds in lowest 200 m noticeably stronger in the valley
- As sfc boundary approached, valley winds veered from SSE to S, while plateau winds remained backed in the lowest 500 m

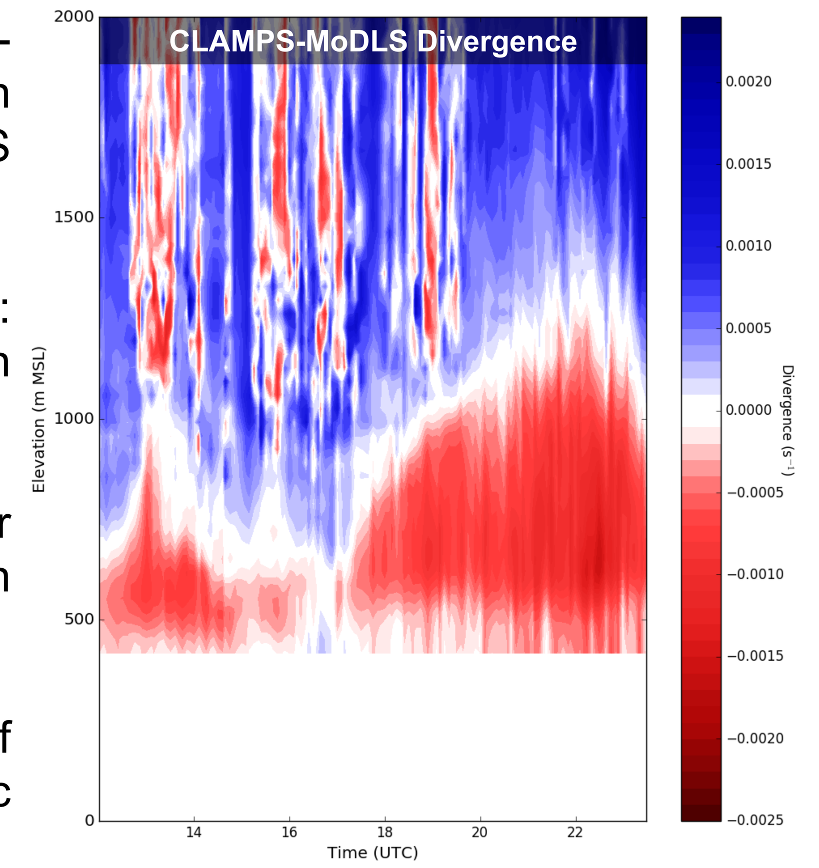








- The contribution of across-terrain flow to divergence can be estimated using MoDLS and CLAMPS data
- Key assumption to analysis: flow changes along the length of the terrain are minimal
- ***Persistent*** boundary layer convergence signature within the terrain
- Magnitude and depth of convergence increases as sfc boundary approaches



Future Work

- Analyses of divergence in western part of domain; compare with terrain analyses
- Multi-Doppler analyses of convection in the terrain
- Further analyses of radiosonde datasets; specifically differences in wind profiles in river valley vs plateau