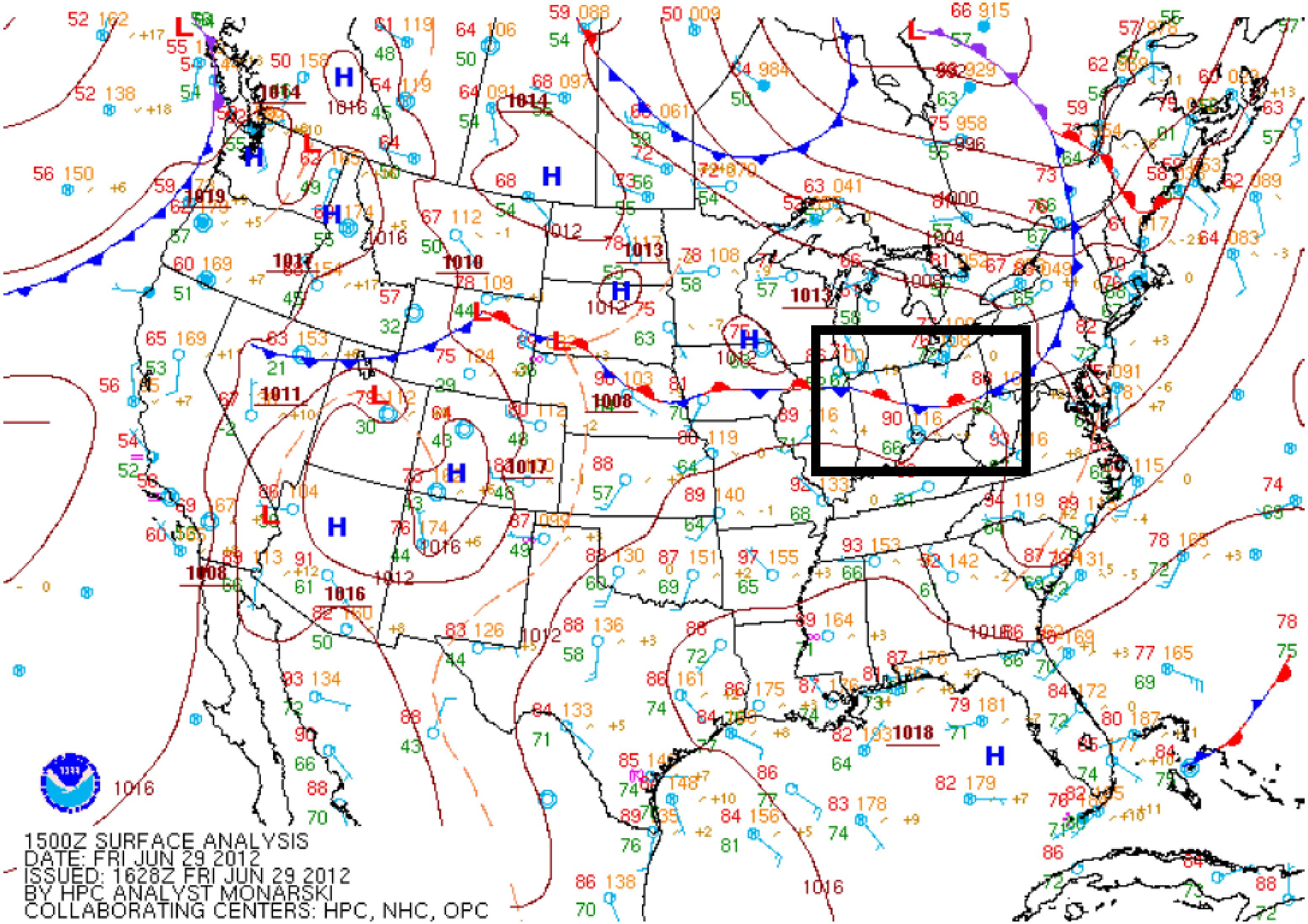
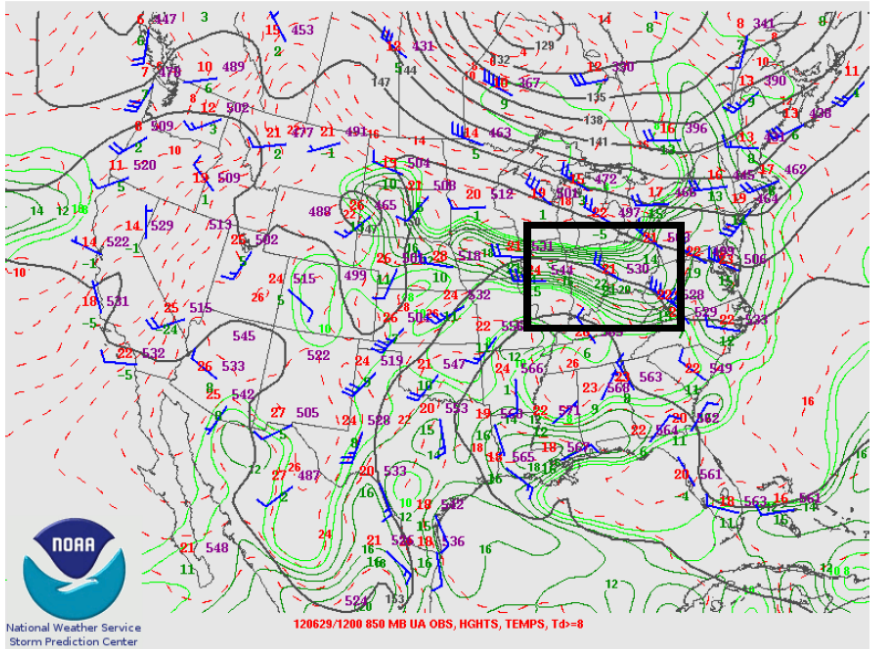
Homework 3 Key

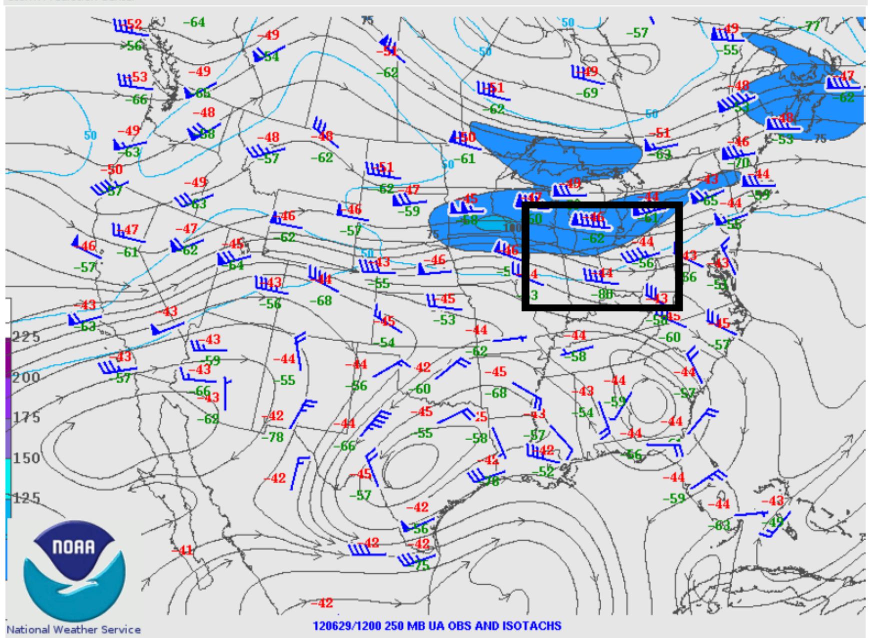
Synoptic discussions: 20 points

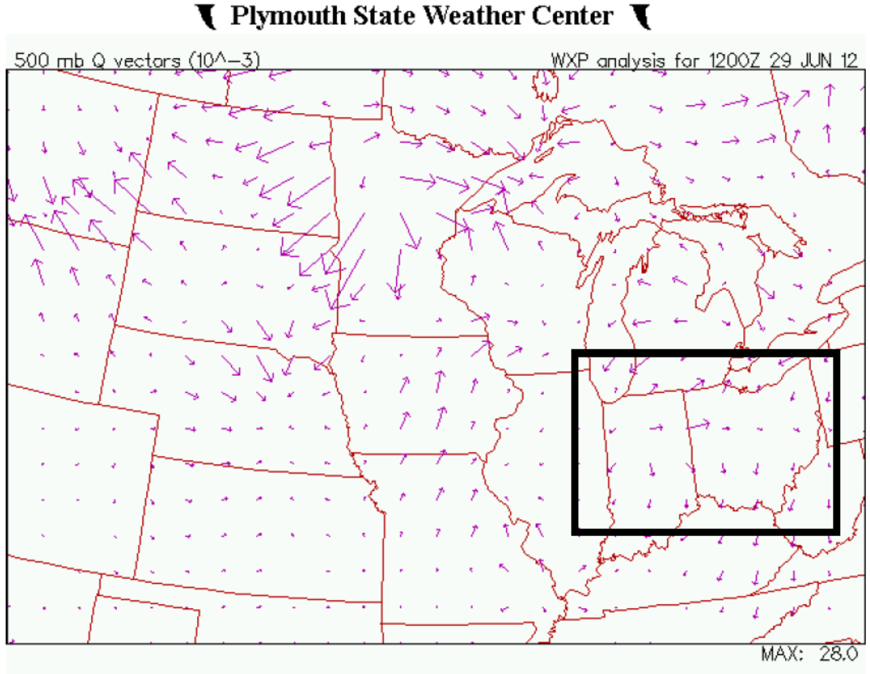
Helicity computations: 30 points

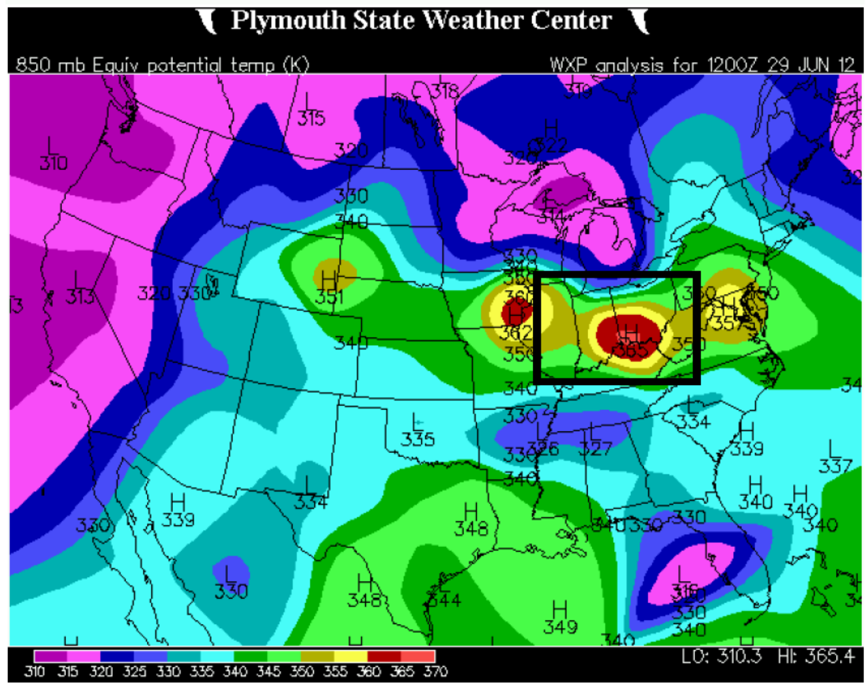
Sample of best synoptic discussions by the class…


1500Z SURFACE ANALYSIS
DATE: FRI JUN 29 2012
ISSUED: 1628Z FRI JUN 29 2012
BY HPC ANALYST MONARSKI
COLLABORATING CENTERS: HPC, NHC, OPC

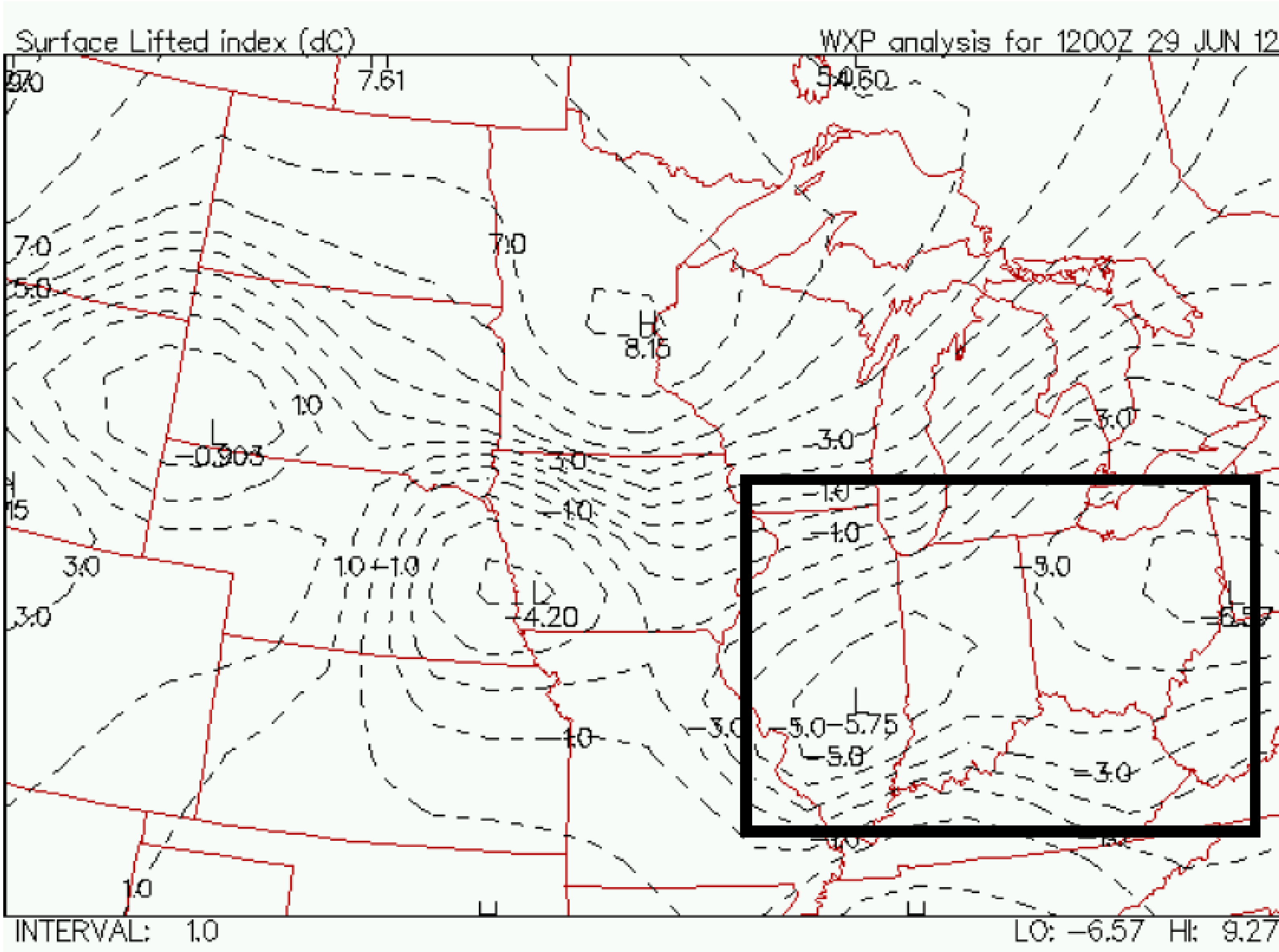

National Weather Service
Storm Prediction Center
120629/1200 850 MB UA OBS, HGHTS, TEMPS, Td>=8


National Weather Service
Storm Prediction Center
120629/1200 250 MB UA OBS AND ISOTACHS


Plymouth State Weather Center
500 mb Q vectors (10^-3)
WXP analysis for 1200Z 29 JUN 12
MAX: 28.0


Plymouth State Weather Center
850 mb Equiv potential temp (K)
WXP analysis for 1200Z 29 JUN 12
310 315 320 325 330 335 340 345 350 355 360 365 370
LO: 310.3 HI: 365.4

Plymouth State Weather Center



The development of a derecho and its propagation across Ohio on June 29th 2012 was due to an incredibly moist and unstable environment. The presence of a high in the Southeast has allowed a weak surface boundary to drop south. Convection developed across northern Illinois/Indiana, due to a remnant MCV along a stationary boundary. This convection organized into an MCS that propagated toward southeastern Ohio where boundary layer CAPE values were around 3500 J/kg and LI values were around -4.5 degrees C. This allowed the system to have a constant supply of high theta-e air, which was near the bullseye of 365 K theta-e and high Td values near a sharp Td gradient. There was also moderate speed shear with upper-level winds being around 15 m/s greater than surface winds, directional shear was nearly nonexistent as indicated by the quasi-linear hodograph. These are all precursor conditions for the development of a derecho. The overall synoptic influence was weak, due to it being summertime the jet streak present was rather weak, however, near the time of the event, the MCS creeped into the jet streaks' right entrance region. This region happened to coincide with a weak area of Q-vector convergence, both of these led to synoptic vertical motion. To summarize, high gulf moisture, moderate-to-high instability and unidirectional shear along a stationary front allowed the formation of the derecho. This type of event is indicative of a Miller type 4, although there was low level moisture, it's the only Miller type that accurately represents the event. RH increased with height, as it was a clash of tropical air advection by the high to the southeast and cool dry continental polar air to the north. Along with being dry adiabatic throughout the sounding in areas where an inversion isn't present. This type of even is also a characteristic of the "ring of fire" in which MCS's pop up along the subtropical high pressure periphery during the summer season.

Only correction here I made is that should read a <u>Miller Type 1</u>, the loaded gun type sounding, but in an environment of fairly unidirectional shear.

Station #2 Phoenix AZ, 6 July 2011

synoptic discussion 1200 UTC 5 July 2011 to 0000 UTC 6 July 2011

An area of persistent surface high pressure system is situated around the Four Corner (Fig. 5) and southern Colorado creating a large area of ridge over the Southwest US as shown in the 500 hPa analysis map at 21 UTC (Fig. 6). Over central California, a low pressure system is located. This two system enhances southerly flow (as shown in the 925 hPa analysis map) the bringing warm moist air to central Arizona (Fig. 7). With surface temperature around 100 degrees Fahrenheit across the Southwest and especially central Arizona, the lower atmosphere has high capacity to hold moisture and thus increase the instability in the region. A typical easterly monsoon flow is noticeable in the 500 hPa analysis map just south of the high pressure system. An inverted trough is moving slowly from the Big Bend (western Texas) westward, and it is likely to help develop the convection downwind (probably south Arizona). The synoptic condition is a very typical summer pattern in which we can see the “ring of fire”. There is at least a thunderstorm event over Minnesota as a cold front propagates southeastward (Fig. 8).

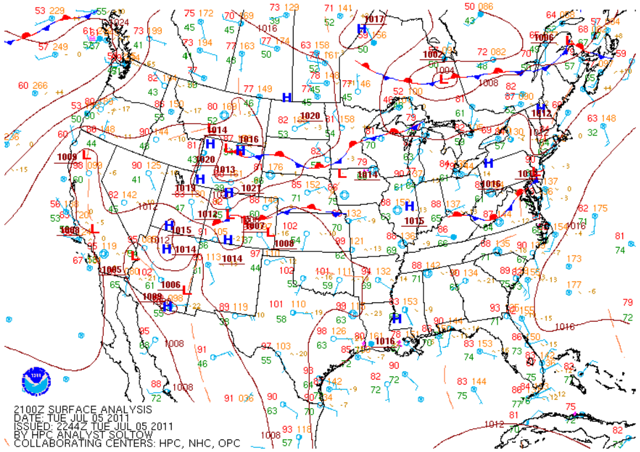


Fig. 5. Surface analysis at 2100 UTC

The atmospheric instability over central Arizona (north of Phoenix) increases as the surface temperature and moisture increases throughout the day, making the air more buoyant. Also the satellite products from July 5 1200 UTC shows the remnant of convective system over the eastern part of Arizona. Thus the lower atmosphere still holds moisture from the previous day. The convection in central Arizona and north of Phoenix area begins at around 2000 UTC.

The sounding resembles the Miller type 2. It has a signature of deep moist layer to at least 425 hPa, close to the moist adiabatic contour. Capping inversion is very small. CAPE is narrow and long.

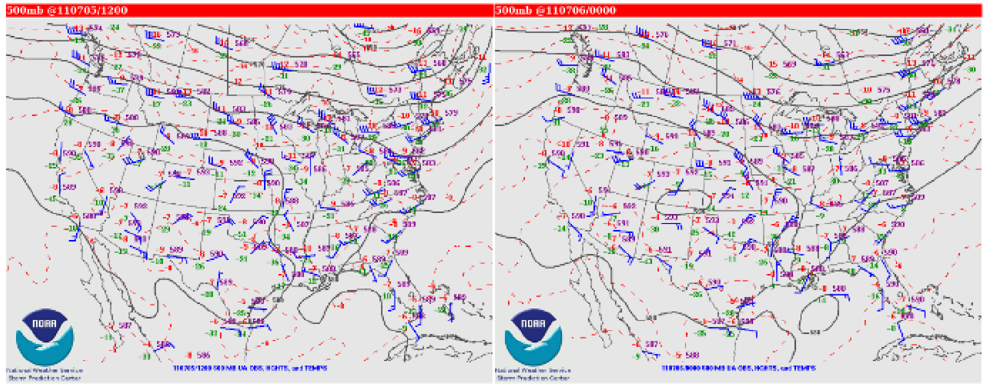


Fig. 6. 500 hPa analysis

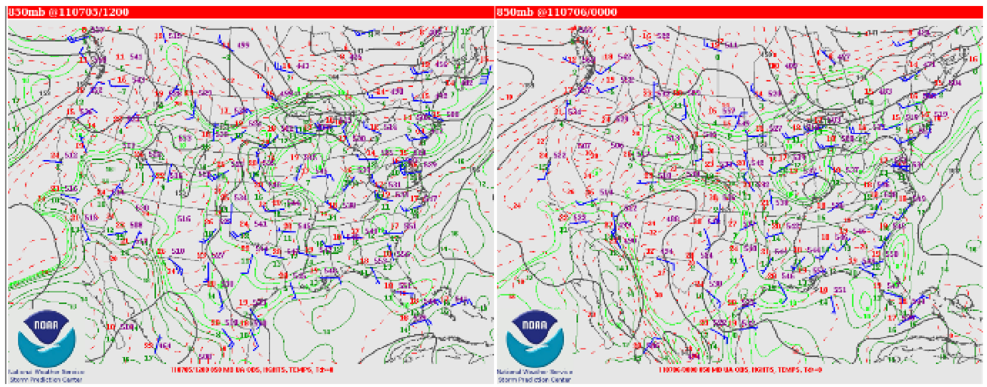


Fig. 7. 850 hPa analysis. Moisture development.

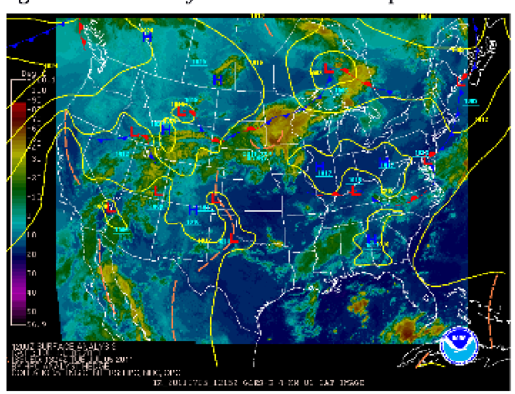
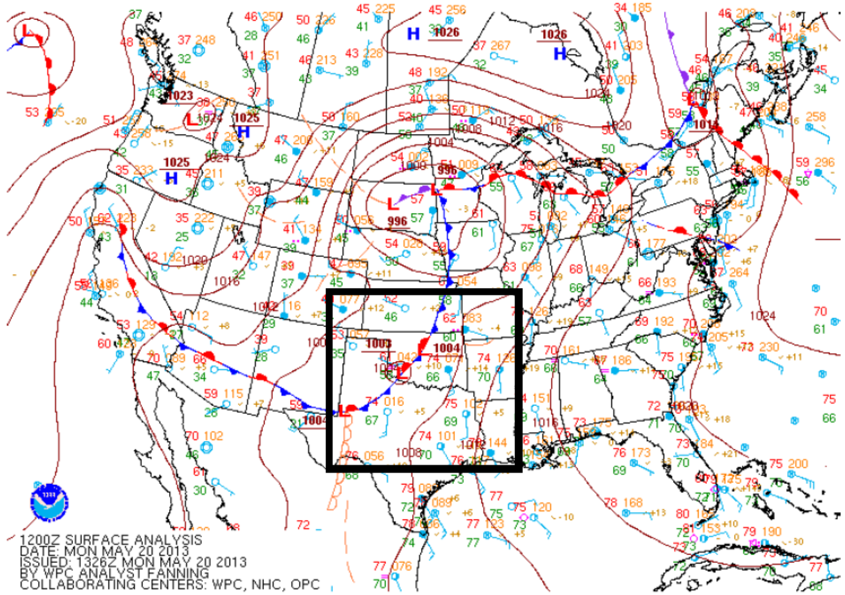
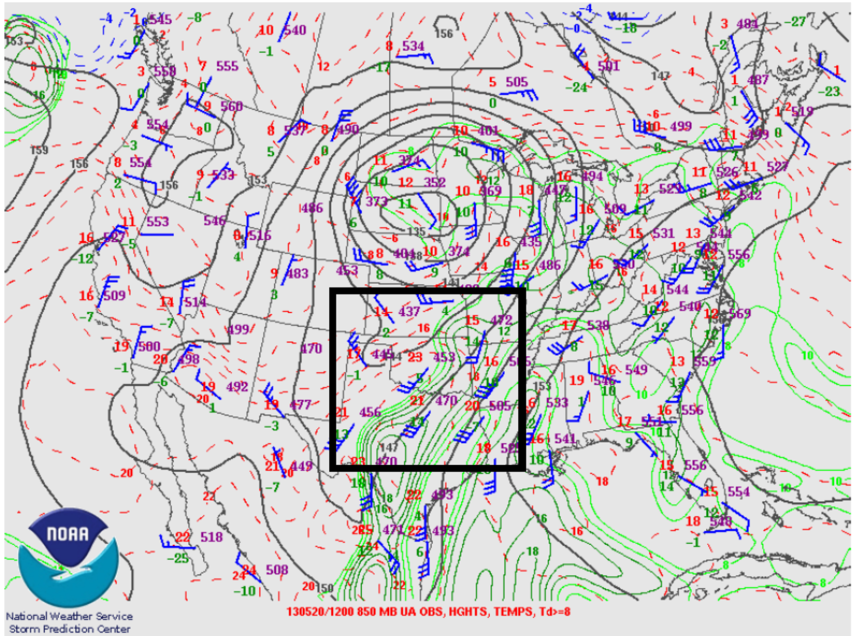
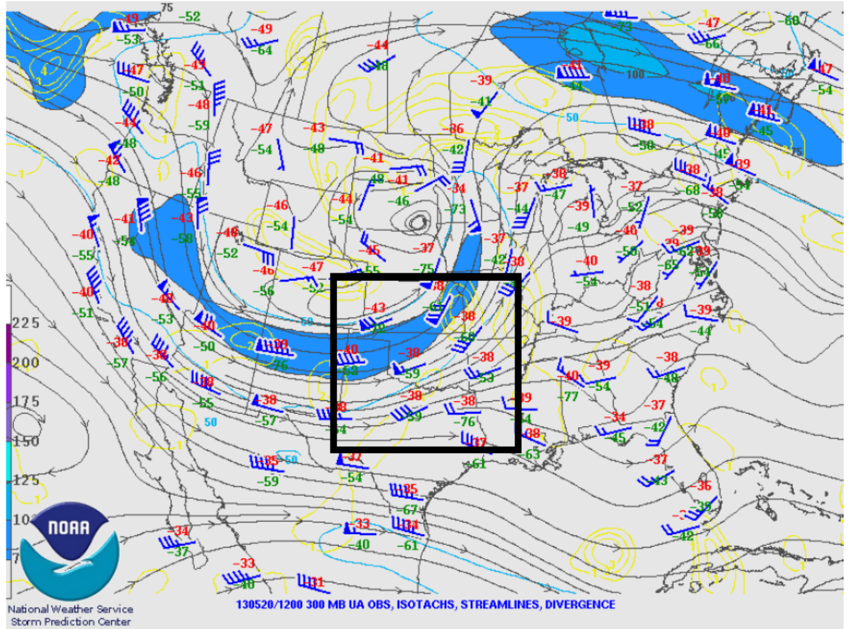


Fig. 8. IR imagery from 12 UTC.

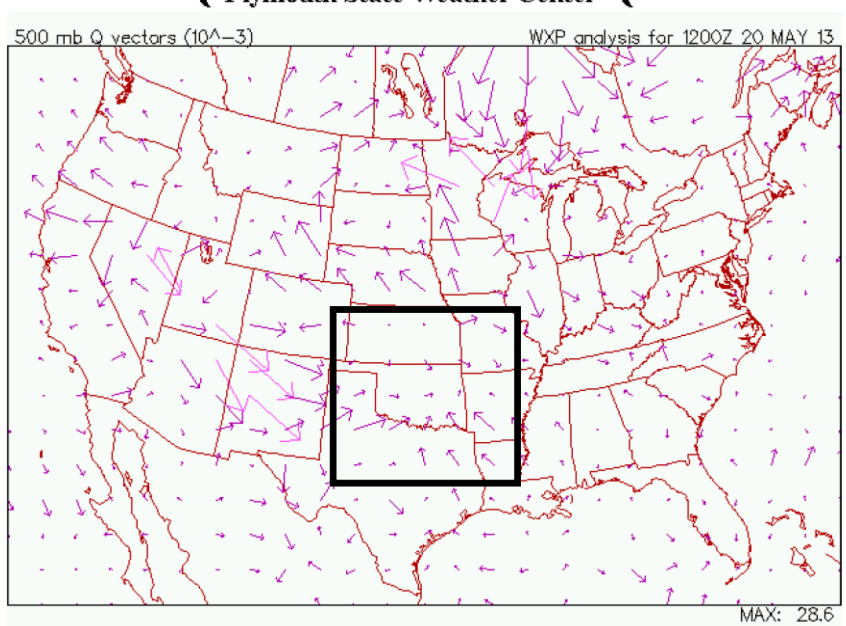
Station Three: Norman, OK

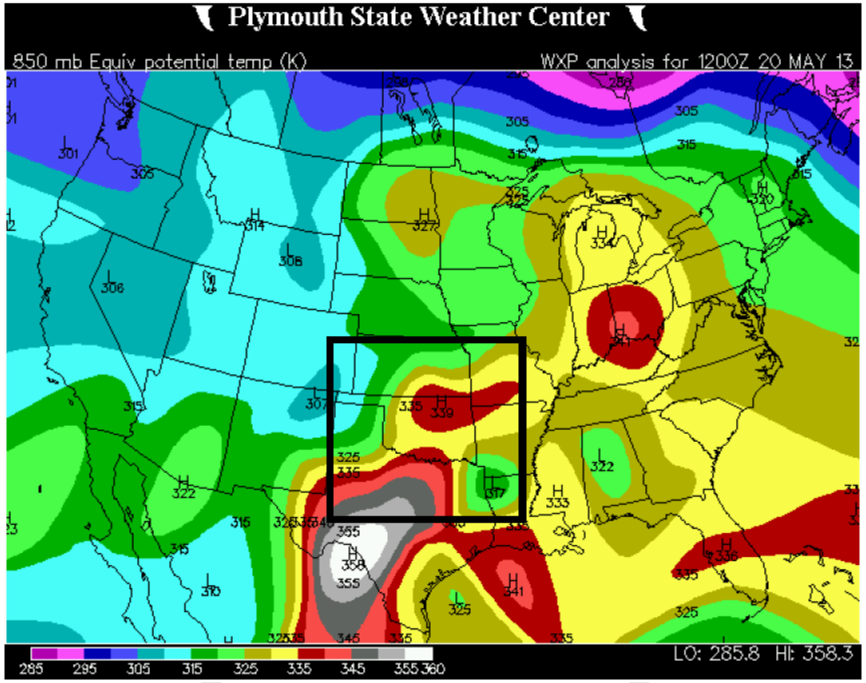


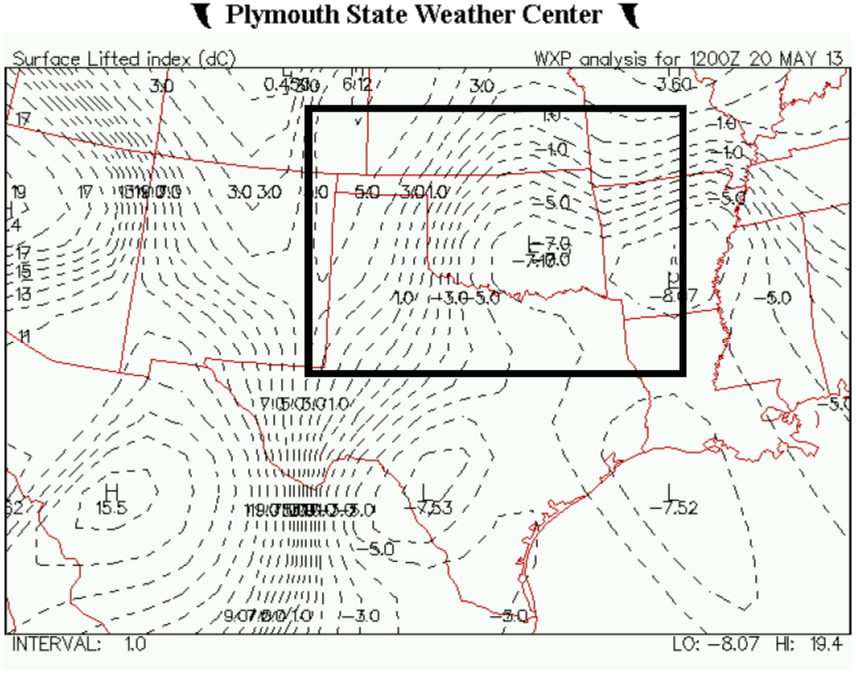




Plymouth State Weather Center



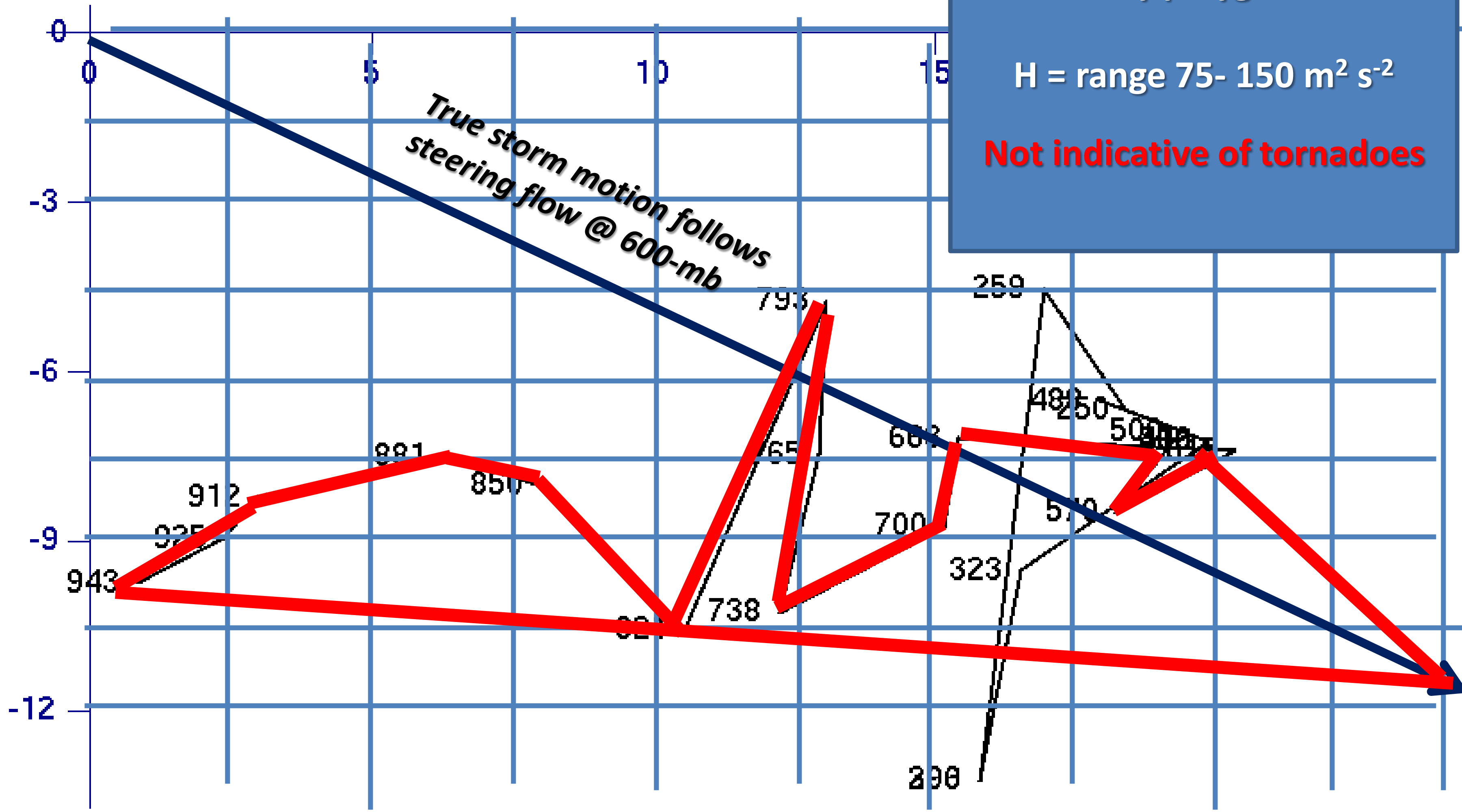

Plymouth State Weather Center
850 mb Equiv potential temp (K)
WXP analysis for 1200Z 20 MAY 13
LO: 285.8 HI: 358.3


Plymouth State Weather Center
Surface Lifted index (dC)
WXP analysis for 1200Z 20 MAY 13
INTERVAL: 1.0
LO: −8.07 HI: 19.4

The development supercells and their associated tornadoes propagated across Oklahoma on May 21st 2013 was due to an incredibly moist and unstable, synoptically-driven, environment. It was the combination of a stationary during the morning hours which then transitioned to a cold front in the afternoon which then clashed with a dryline moving into Oklahoma throughout the afternoon. The air was rich in moisture from the Gulf of Mexico, attributed to the push by both the high in the southeast and low in the northern central plains. This push of high theta-e air into a highly unstable environment characterized by LI values less than -7 degrees C, along with high directional and speed shear allowed for the development of supercells in central Oklahoma. Oklahoma was also under a cyclonically curved jet streak, with differential PV advection providing additional forcing for rising motion. As the dryline creeped into Oklahoma and interacted with the abundant low-level moisture, it instantly caused thunderstorms to blow up, as indicated in the visible imagery, these coincided with the area of Q-vector convergence. The presence of a 25 kt – 45 kt low-level jet also aided in providing rising motion and moisture transport. To summarize, synoptic scale flow allowed for the transport of warm moist air in the central plains which destabilized the environment. When this air collided with the dryline, along with high directional and speed shear the development of supercells was inevitable. This event is best represented by a Miller type 1, which is the loaded gun sounding. This is backed by the well mixed, moist boundary layer, with a stable, dry inversion above the moist layer. Which also includes a cold and very unstable layer above the inversion and directional shear.

Sample hodograph analyses

72426 ILN Wilmington



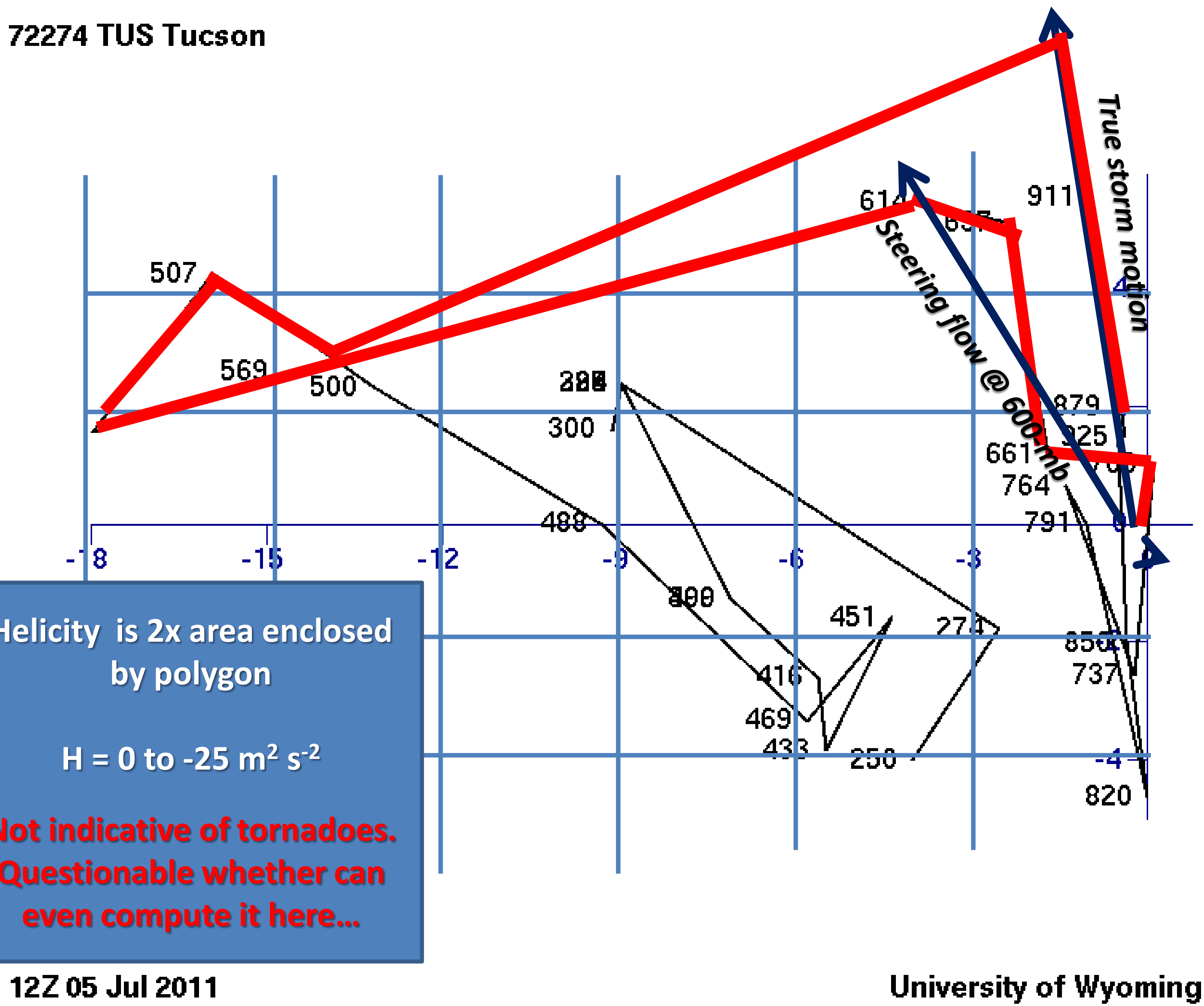
Helicity is 2x area enclosed by polygon

H = range 75- 150 m^2 s^{-2}

Not indicative of tornadoes

12Z 29 Jun 2012

University of Wyoming

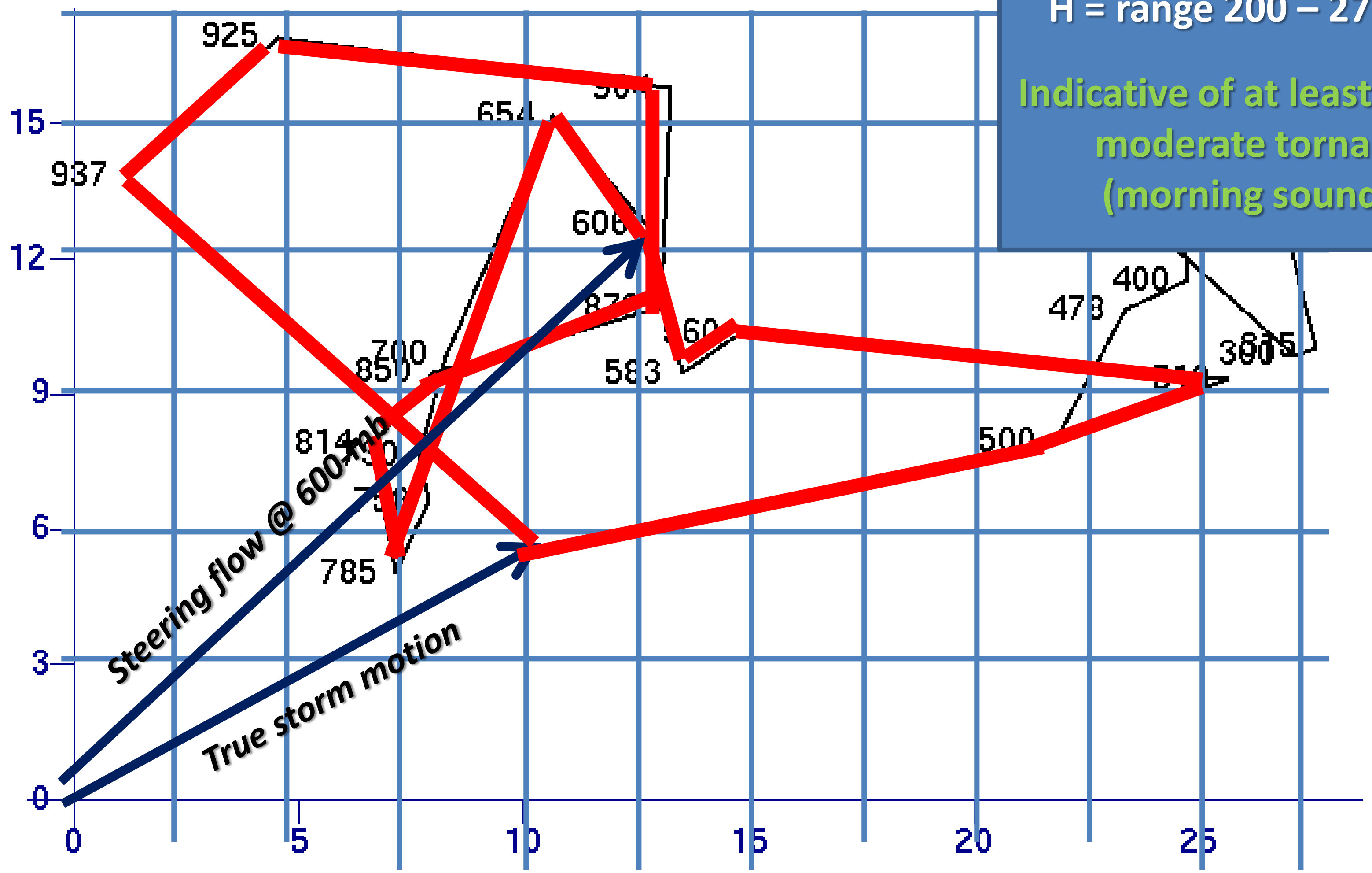


Helicity is 2x area enclosed by polygon

$H = 0$ to $-25\ m^2\ s^{-2}$

Not indicative of tornadoes. Questionable whether can even compute it here…

72357 OUN Norman



Helicity is 2x area enclosed by polygon

H = range 200 – 270 $m^2 s^{-2}$

Indicative of at least weak to moderate tornadoes (morning sounding)

12Z 20 May 2013

University of Wyoming