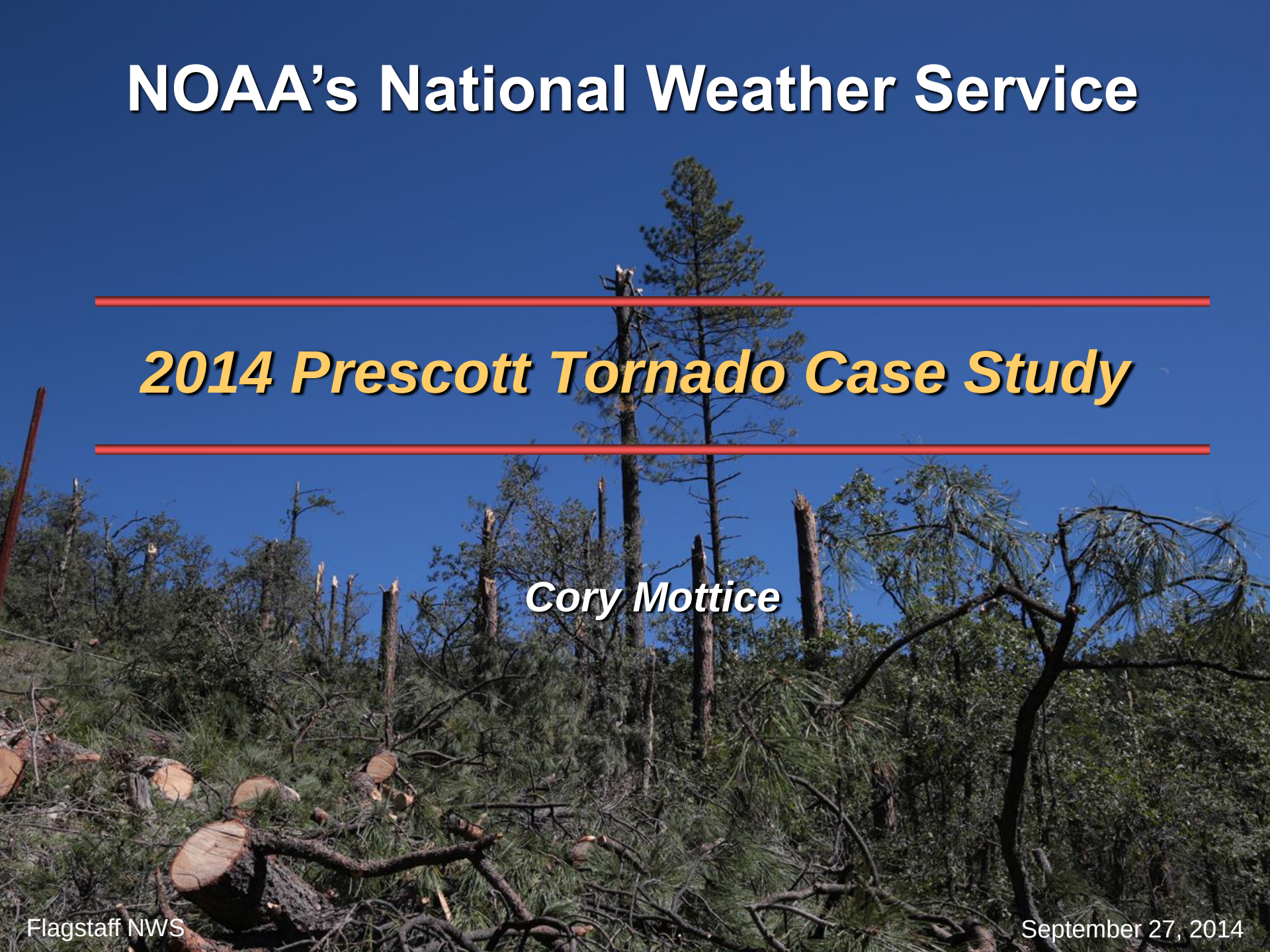
NOAA's National Weather Service

2014 Prescott Tornado Case Study

Cory Mottice



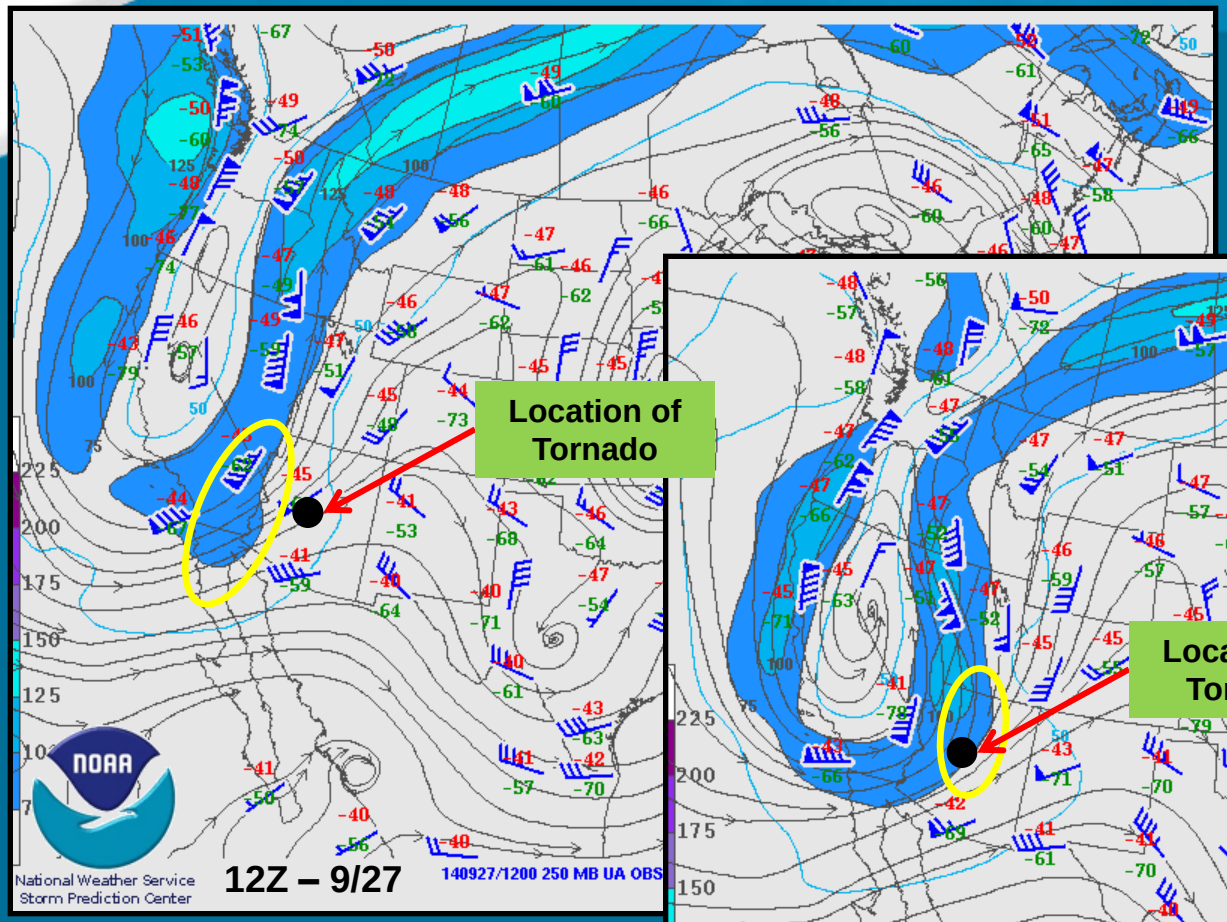
Flagstaff NWS

September 27, 2014

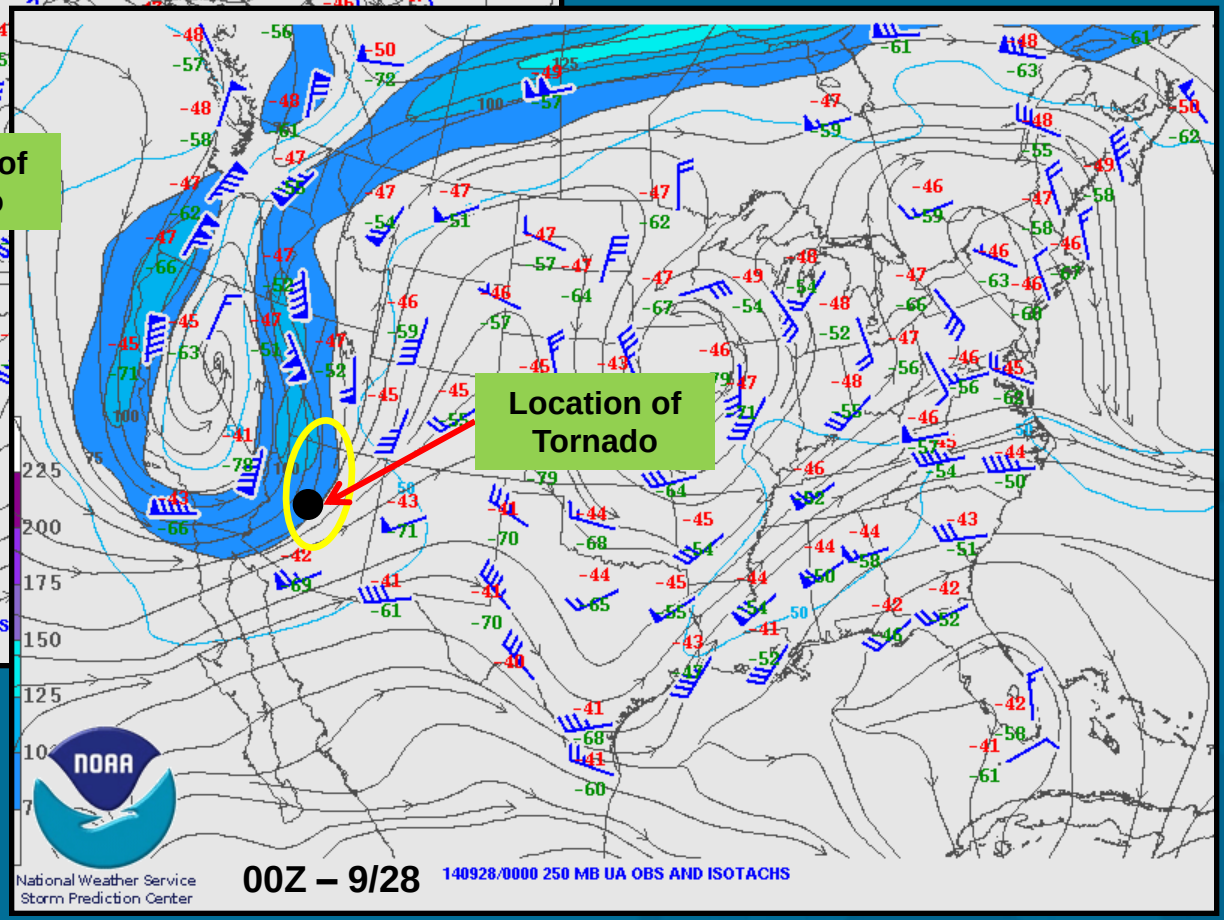
Outline

- ***Synoptic Overview***
  - **Favorable severe/tornadic parameters**
- ***Thermodynamic Overview***
  - **Favorable severe/tornadic parameters**
- ***Radar Analysis***
- ***Conclusions***

250 mb Analysis

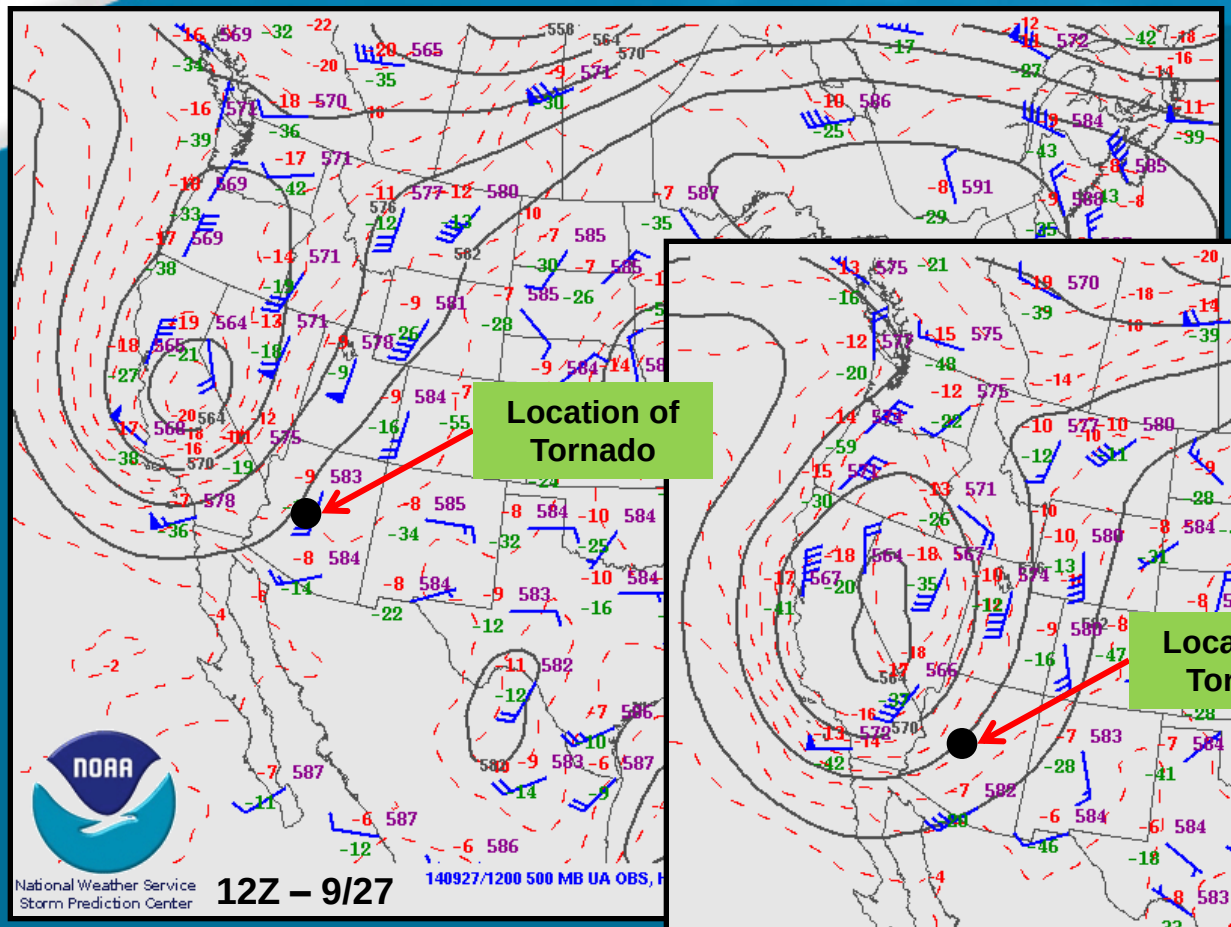


- 90-100 knot jet streak punching into western Arizona by the evening of Sep. 27th.

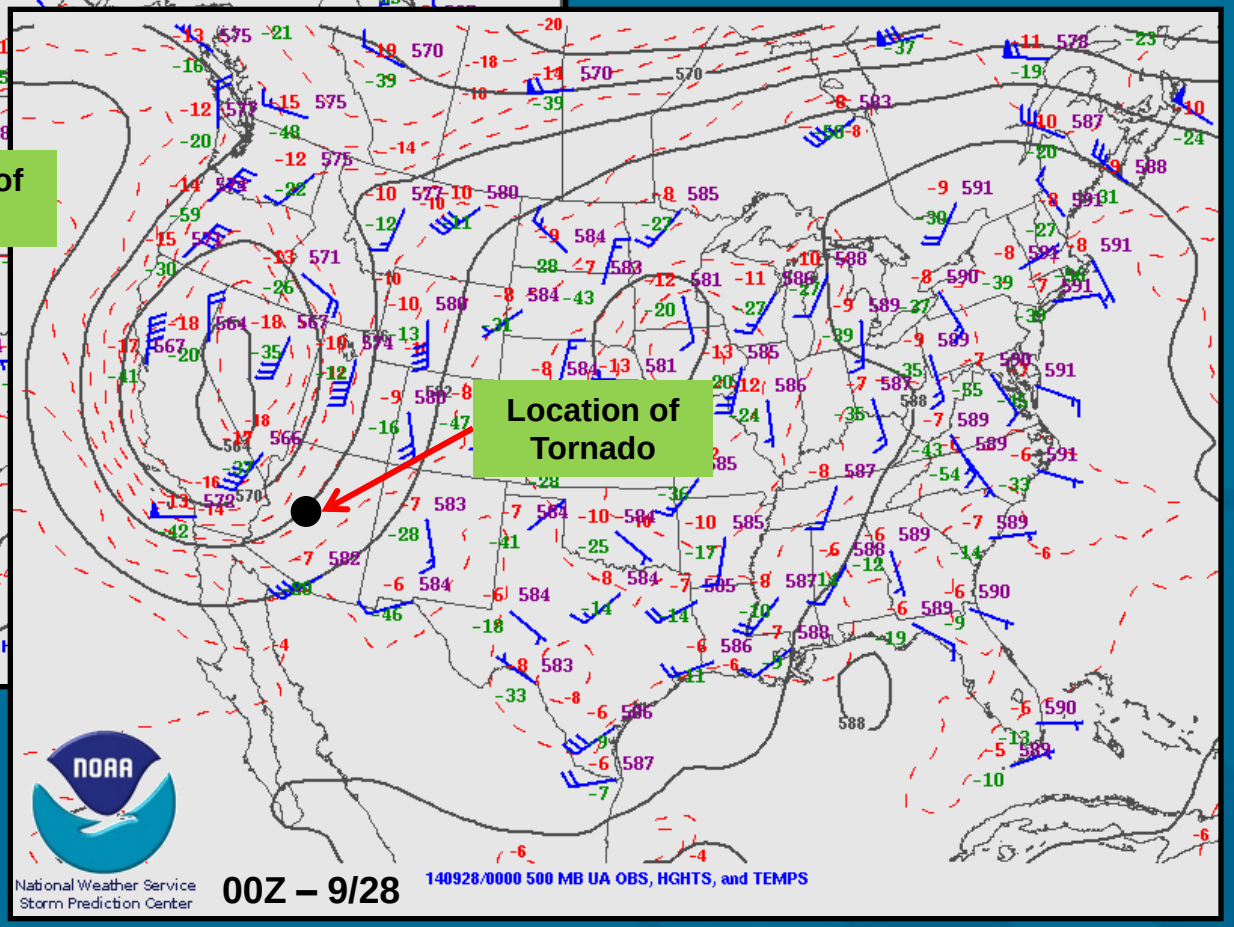


- Significant upper level divergence evident in the upper levels (denoted by the yellow outline).

500 mb Analysis

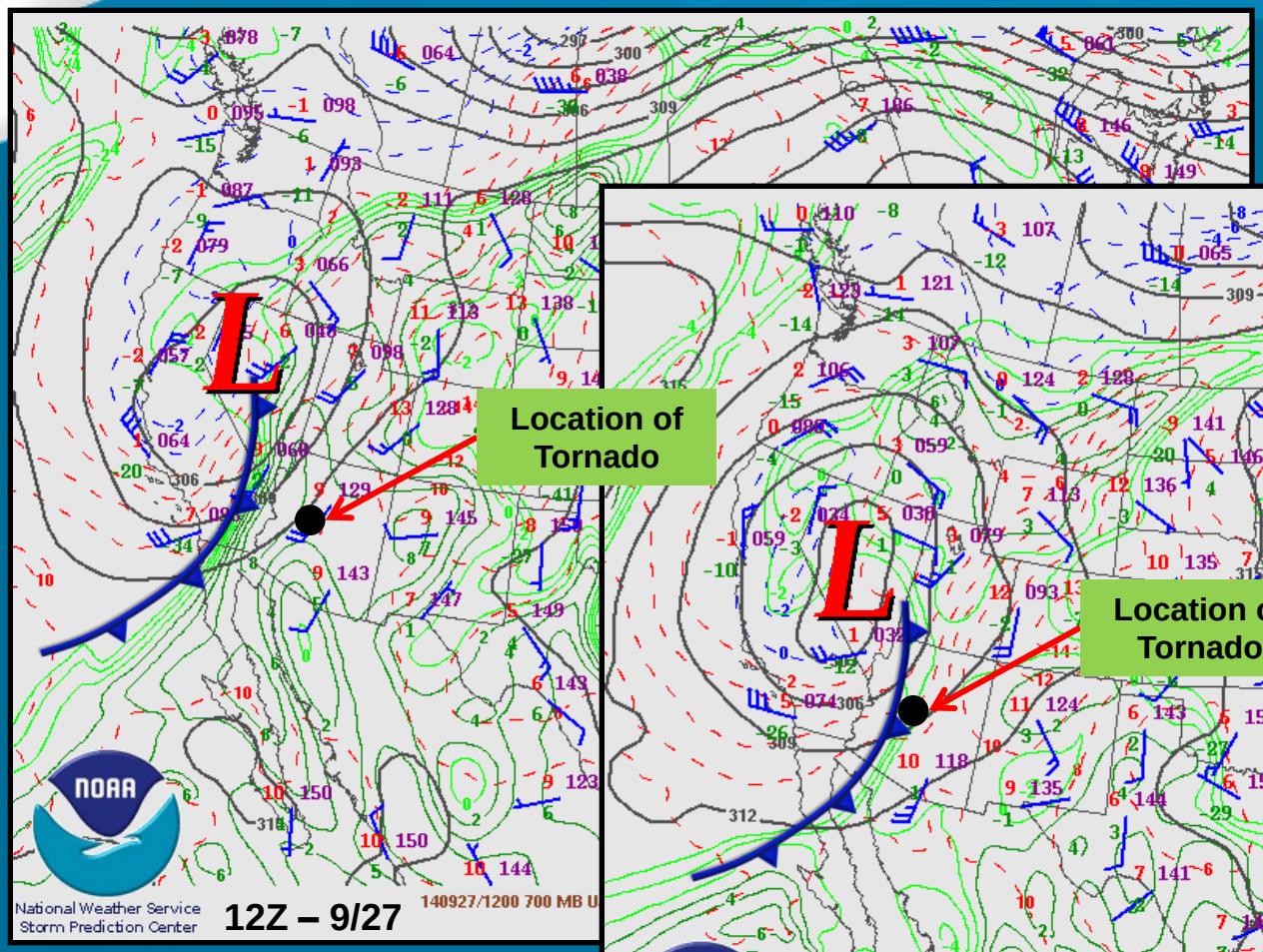


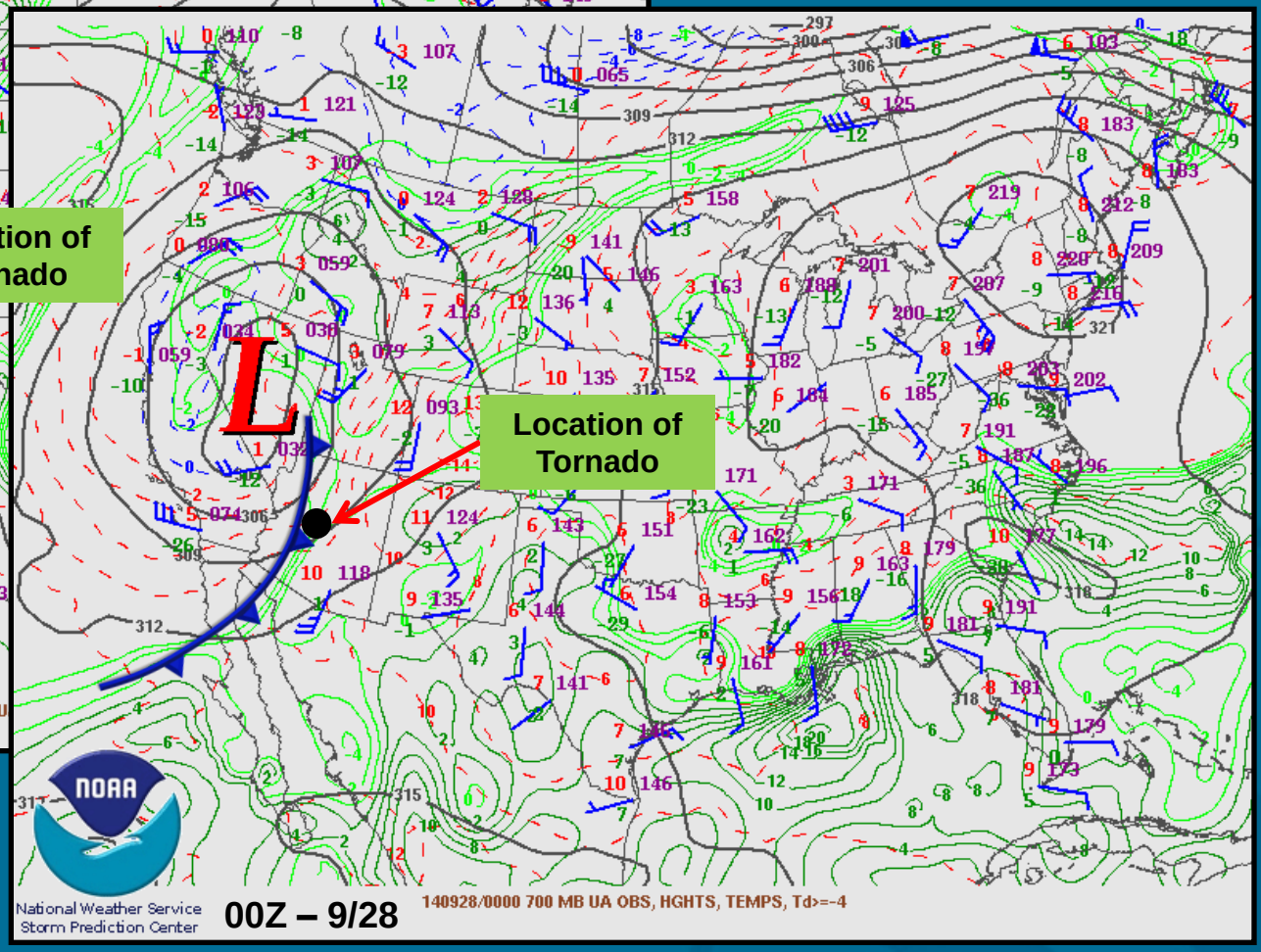
- Closed low centered along the CA/NV border.
- Temps constant around -9C from 12Z/27th – 00Z/28th.



- Height falls in central AZ of around 5-7 dam from 12Z/27th – 00Z/28th.

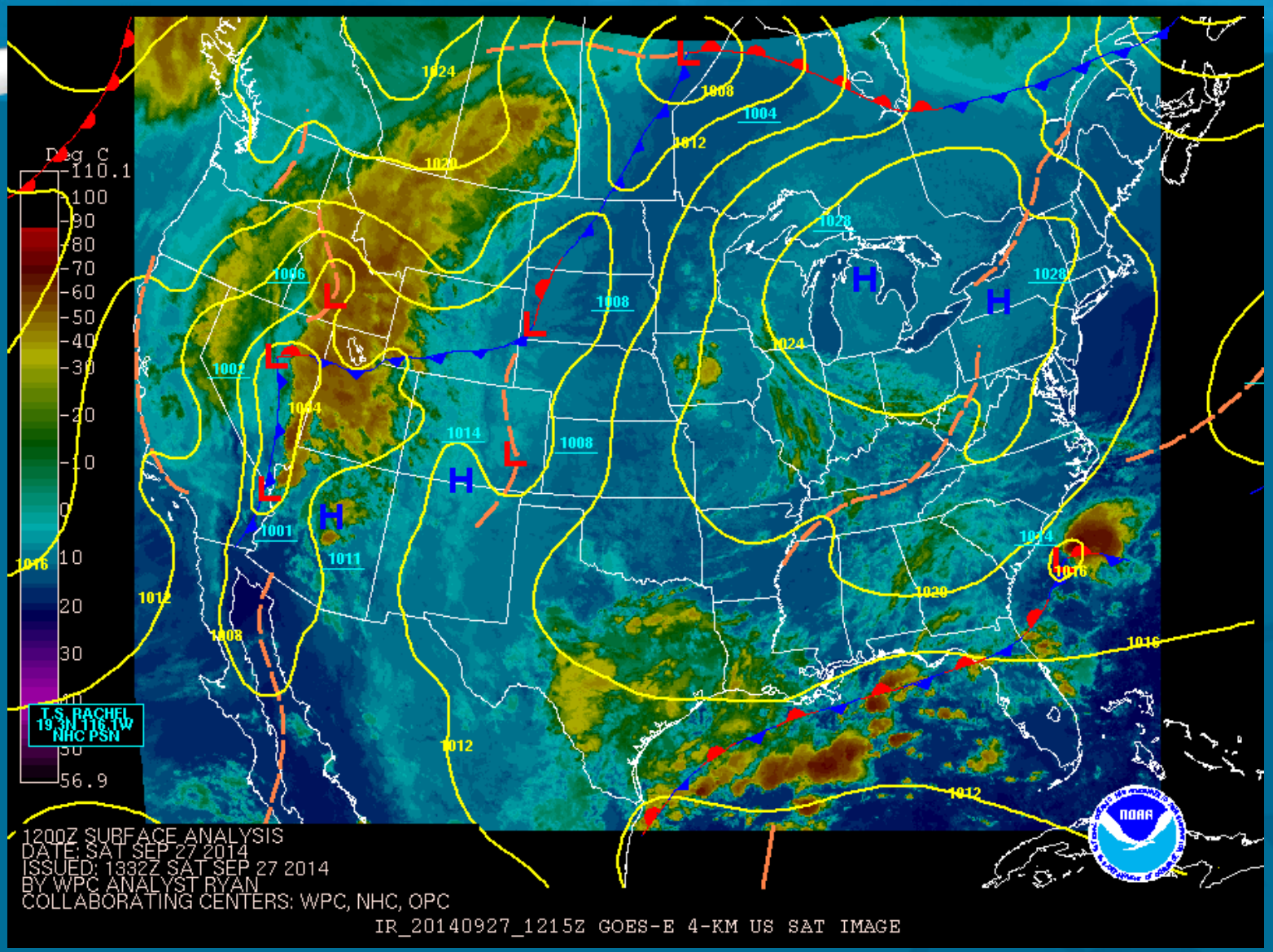
700 mb Analysis



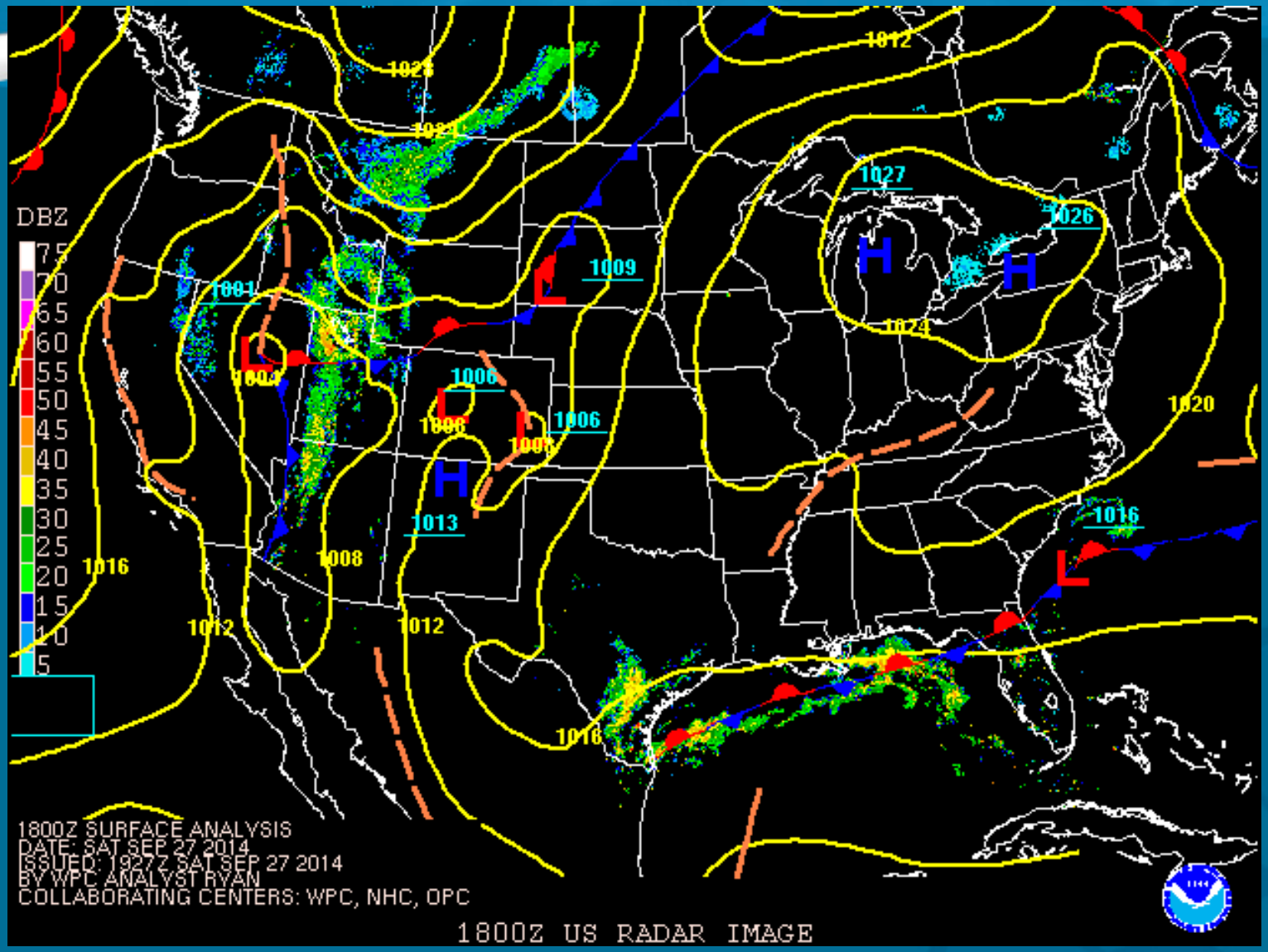


- Dewpoint constant around 5-7C (bad dpt data at 00Z/28 – shown later)

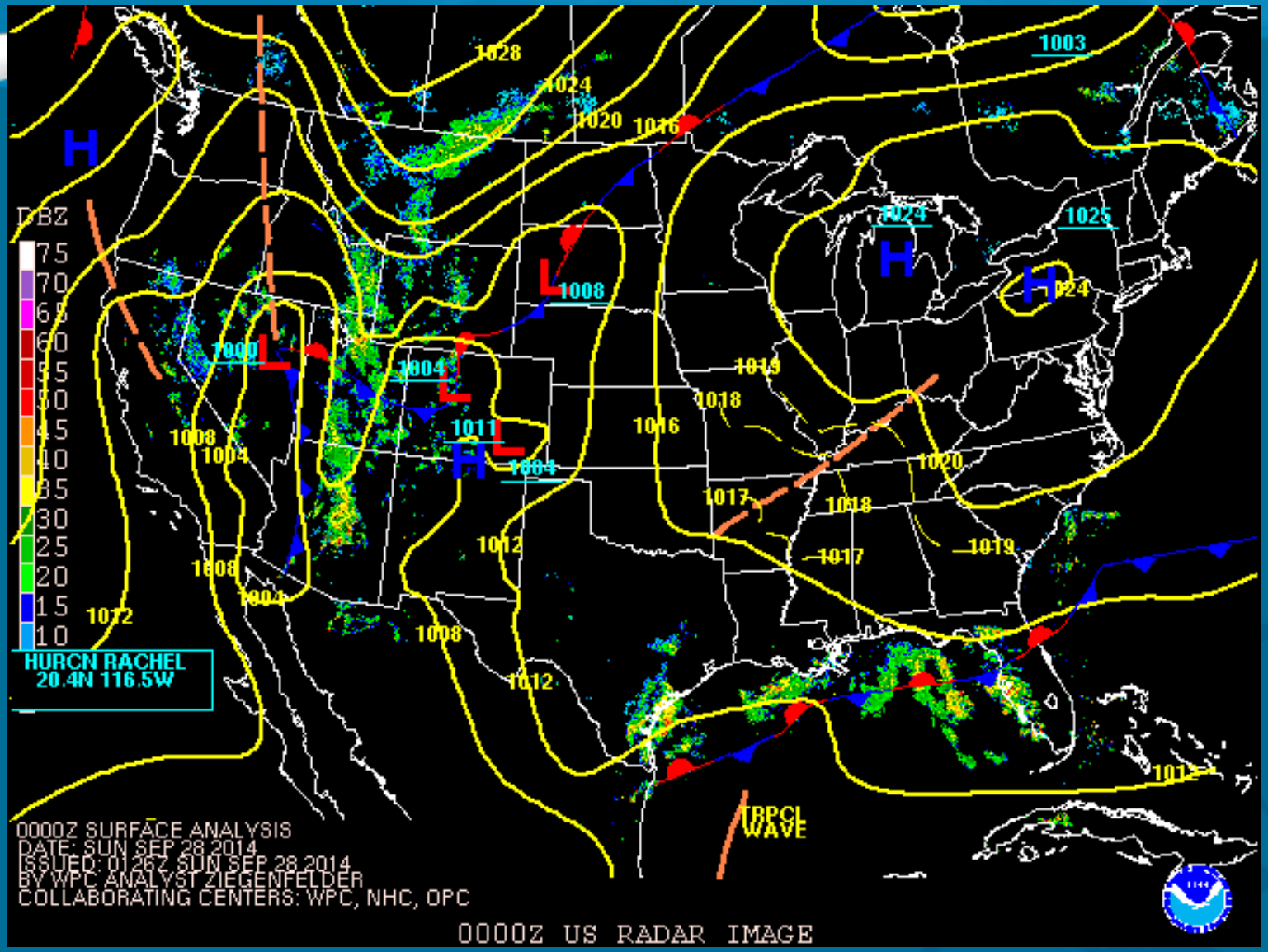
12Z Surface Analysis



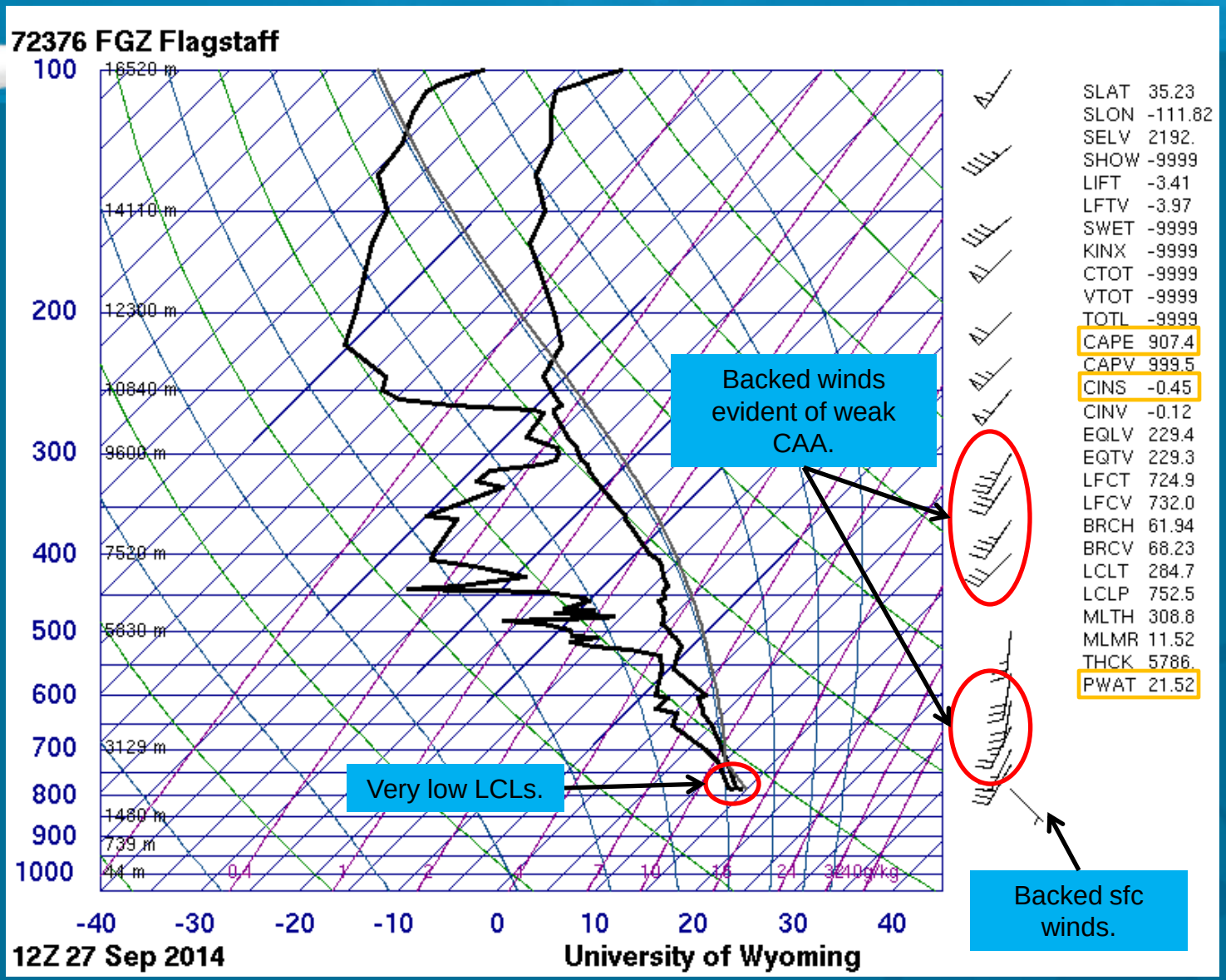
18Z Surface Analysis



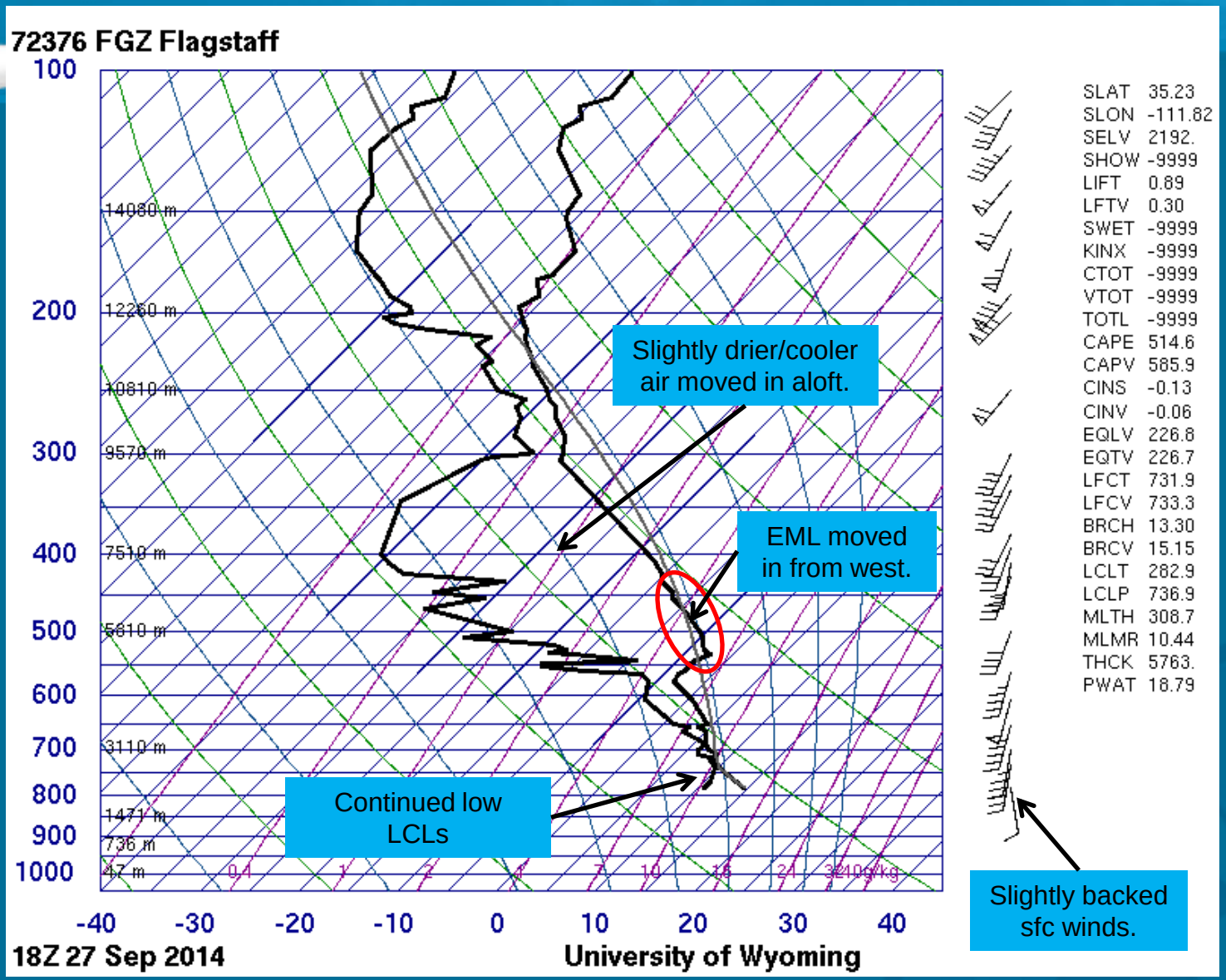
00Z Surface Analysis



12Z/27 FGZ Sounding

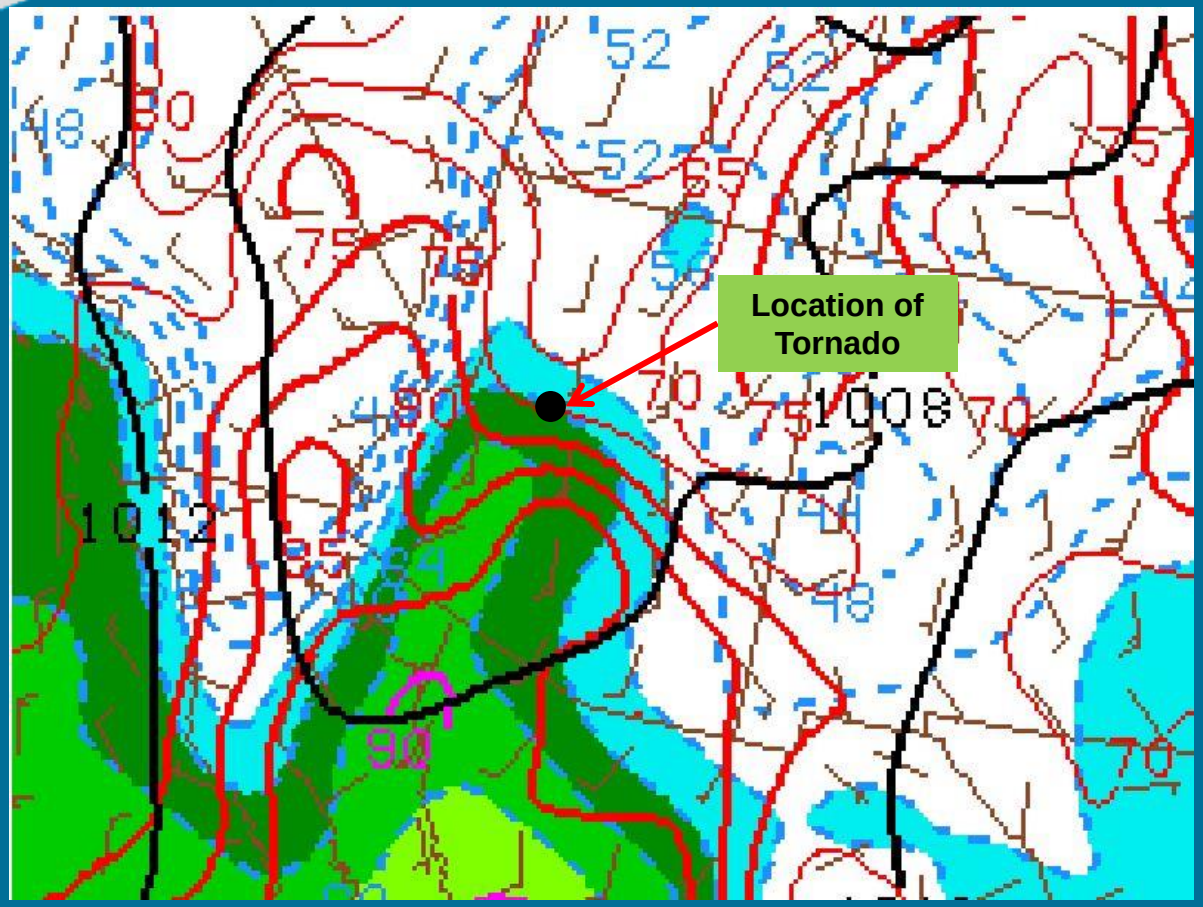


18Z/27 FGZ Sounding



Mesoanalysis

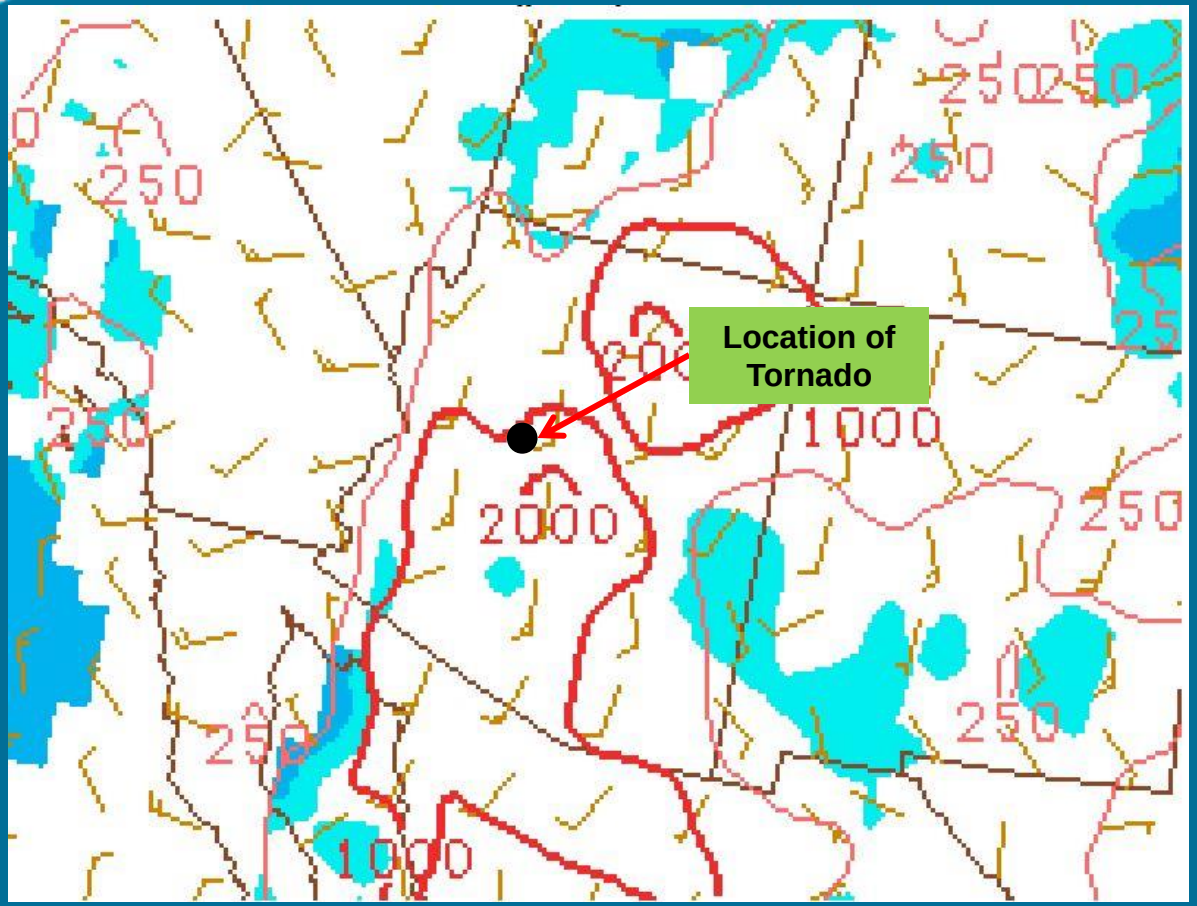
Valid at 19Z on Sept. 27, 2014



- Surface dewpoints in the upper 50s to around 60.
- Temperatures in the lower 70s.
- Prescott area located at the nose of the moisture plume.
- Decent temp/dewpoint gradient near the location of the tornado.

Mesoanalysis

Valid at 19Z on Sept. 27, 2014



- CAPE around 1000 J/Kg
- No CIN

Mesoanalysis – Other Parameters

- ***Effective Bulk Shear – 30-35 knots (marginal for supercells)***
- ***0-3km EHI – Around 1 (suggests supercells possible)***
- ***BRN around 35-40 (suggests supercells possible)***

Thermodynamics Overview

- *Temperatures rose into the low 70s in the Prescott area (low 60s in the FLG area)*
- *Dewpoints were in the upper 50s to low 60s throughout the region (low dewpoint depressions).*
- *CAPE around 1000 J/Kg and no CIN*
- *Most parameters suggested supercells were a possibility*

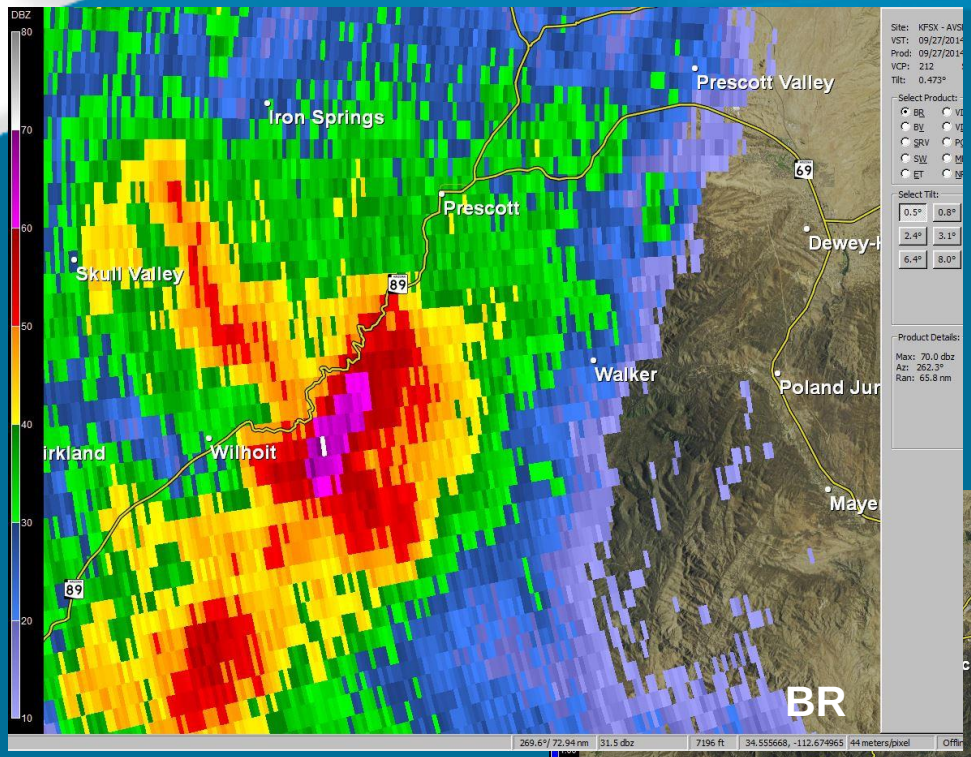
What is NROT?

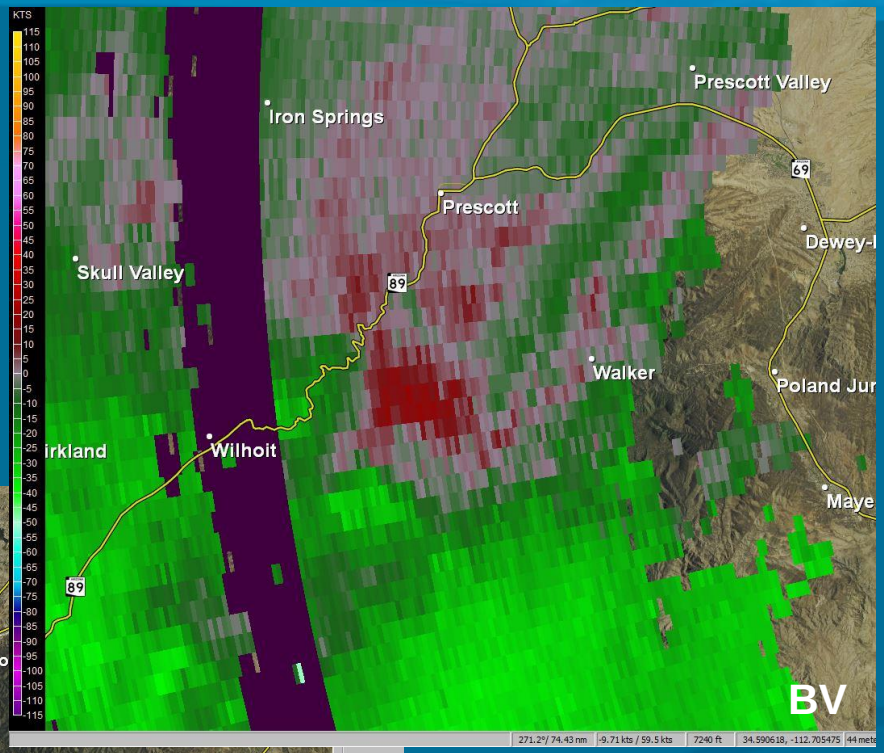
- *NROT is the normalized rotation calculated by using the local, linear, least squares method*
- *Not calculated within 8 miles of radar*
- *Ranges from -5 to 5 (unitless)*
  - **Positive = cyclonic; Negative = anti-cyclonic**
- *>1 considered significant; >2.5 extreme*

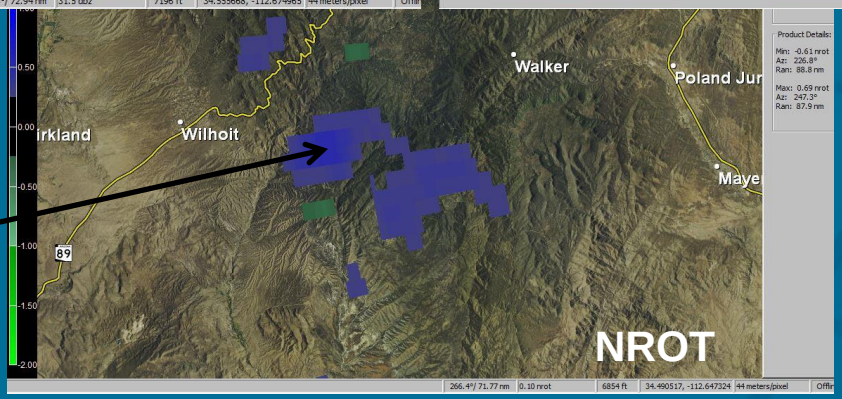
Albany, NY Study

- ***A study from the Albany NWS found that values above 0.8 indicated a possible tornado and values > 1 almost always indicated a tornado.***
- ***No tornado ever occurred with a value < 0.8 with the 35+ cases in their study.***
- ***No study has been done in the southwest that I know of.***
  - *Working on this now.*
  - *Early results indicate the numbers for a likely tornado will be >1 as opposed to 0.8. Research is ongoing…*

Radar Images at 1:51 PM

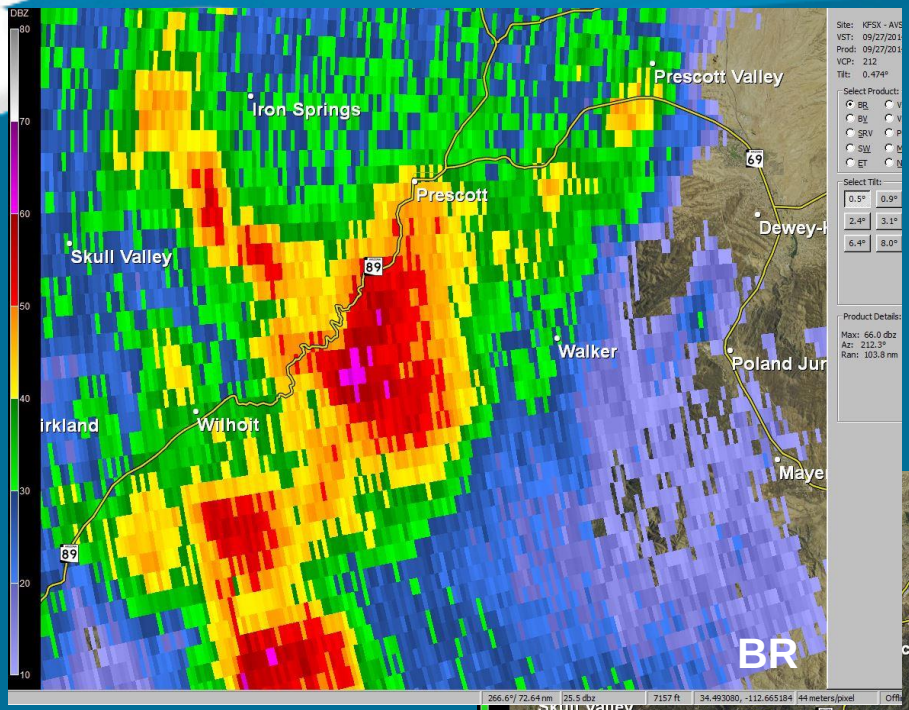


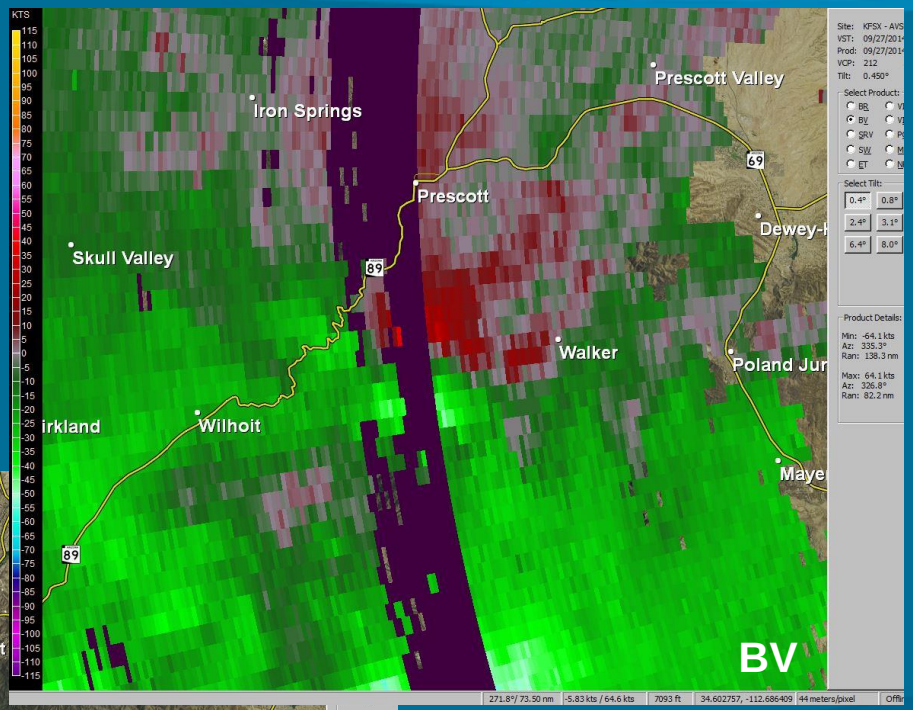




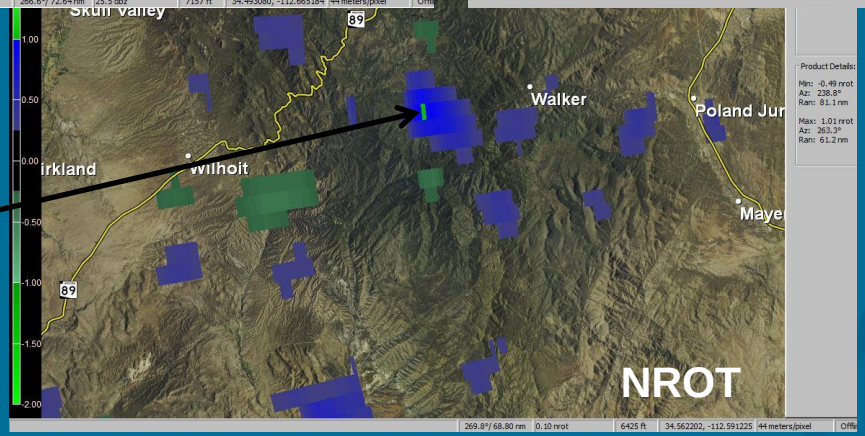
- Max value of 0.49
- Increasing, but still well below 0.8

Radar Images at 1:56 PM





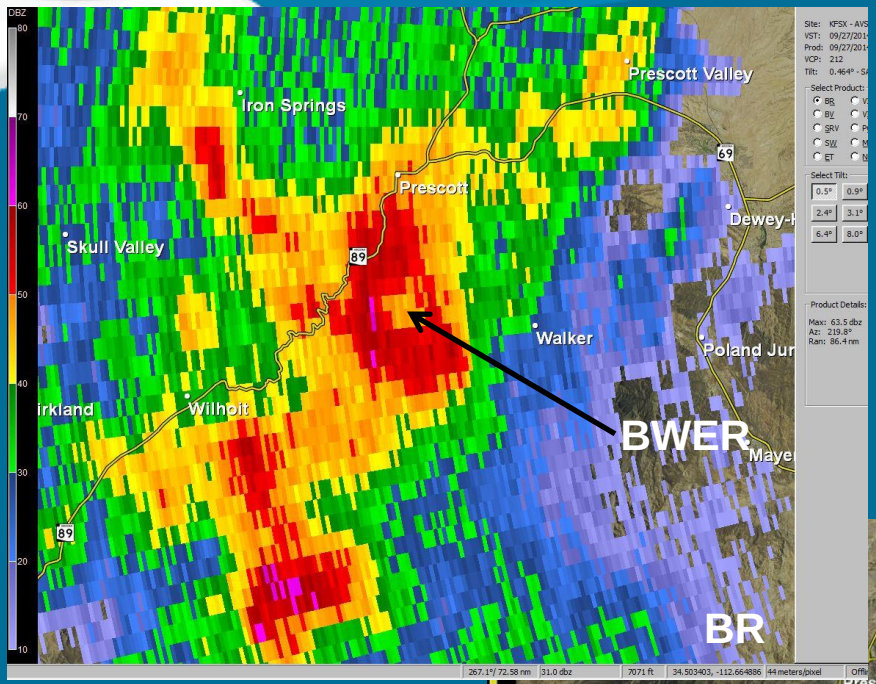
- Max value of 1.01
- Now exceeds significant threshold
- Suggests tornado or developing tornado likely

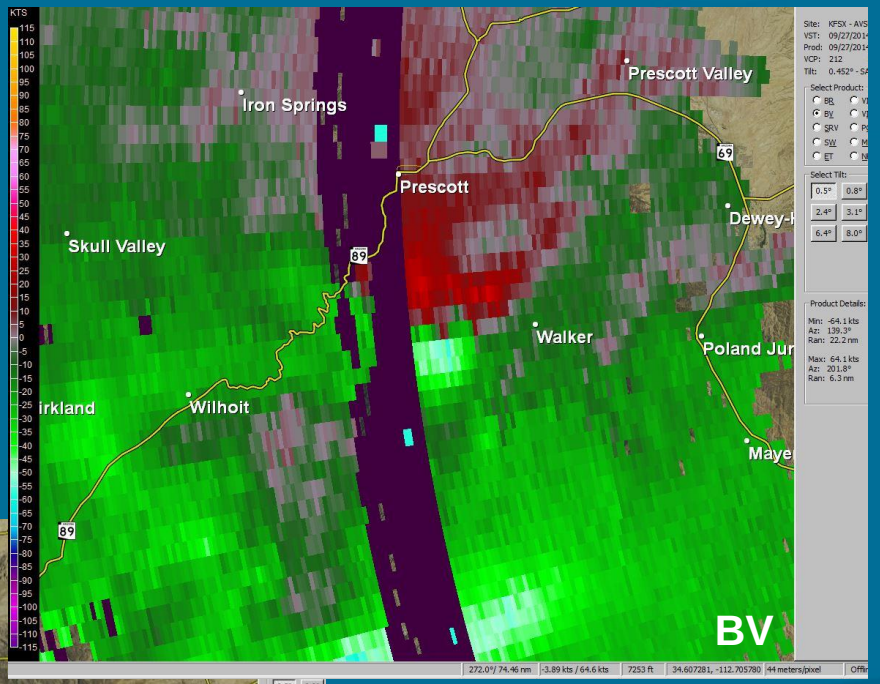


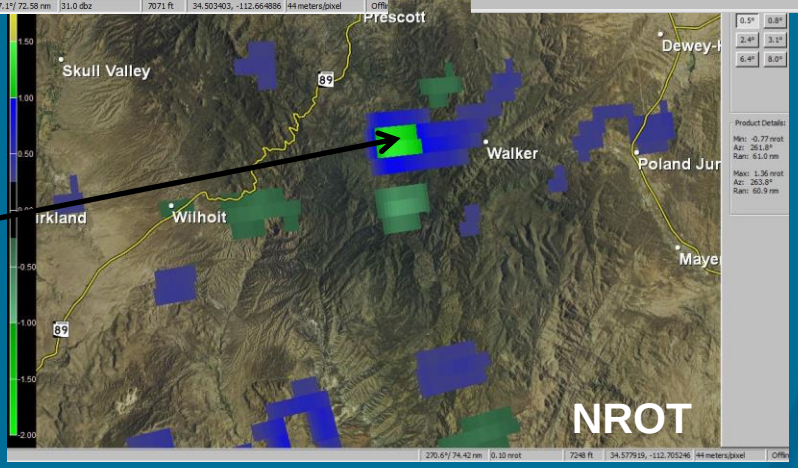
- Mesocyclone is persistent and deep (>5,500 feet)
- Gate to gate shear of around 80 knots

Radar Images at 1:58 PM

Yay SAILS!



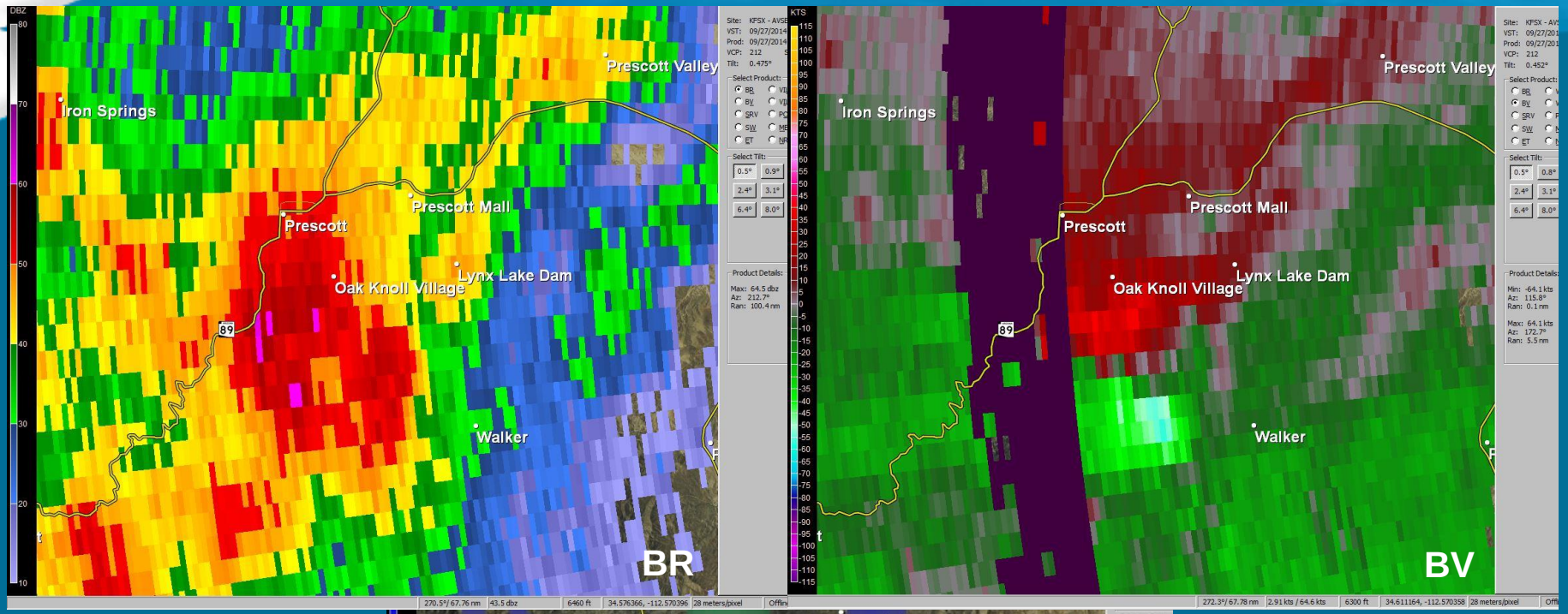




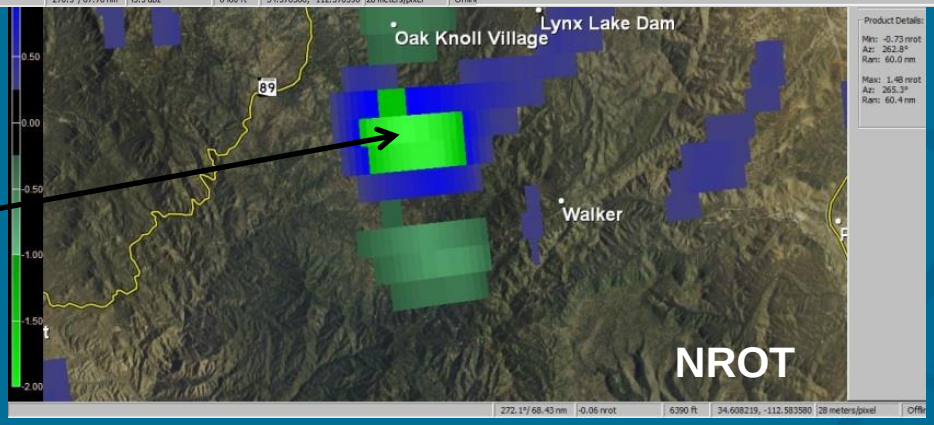
- Max value of 1.36
- Value continues to rapidly increase
- Suggests tornado likely

- Significant rotation correlates well with high NROT values
- Gate to gate shear of around 90 knots

Radar Images at 2:00 PM



- NROT value peaked at 1.48
- This is very high and suggests a tornado is likely occurring



- Strong rotation, high NROT values, and BWER all align
- Gate to gate shear of 96 knots

Radar Analysis Overview

- ***Broad, weak rotation evident by 1:51 PM***
  - **NROT exceeded significant threshold at this time**
- ***Strong rotation from 1:56 PM – 2:02 PM***
  - **NROT value reached 1.48, well in excess of significant threshold of 1.0**
- ***Tornado confirmed from ~1:55 PM – 2:05 PM***
  - **Rated EF1 (86-110 mph)**
  - **3 homes with sig. damage, others with minor damage**
  - **Length of 1-2+ miles and a width of 0.4 miles**

Prescott Tornado Summary

- ***Significant upper-level divergence***
- ***5-7 dam height falls***
- ***Forcing along cold front moving in from west***
- ***Low LCLs, sufficient CAPE, no CIN***
- ***Backed surface winds***
- ***Most parameters suggested supercells were possible***
- ***Tornado signature evident on radar from 1:56PM – 2:00PM***
  - **SAILS scan captured strongest rotation (would not have been observed otherwise)**