

# NOAA's National Weather Service



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## *2014 Prescott Tornado Case Study*

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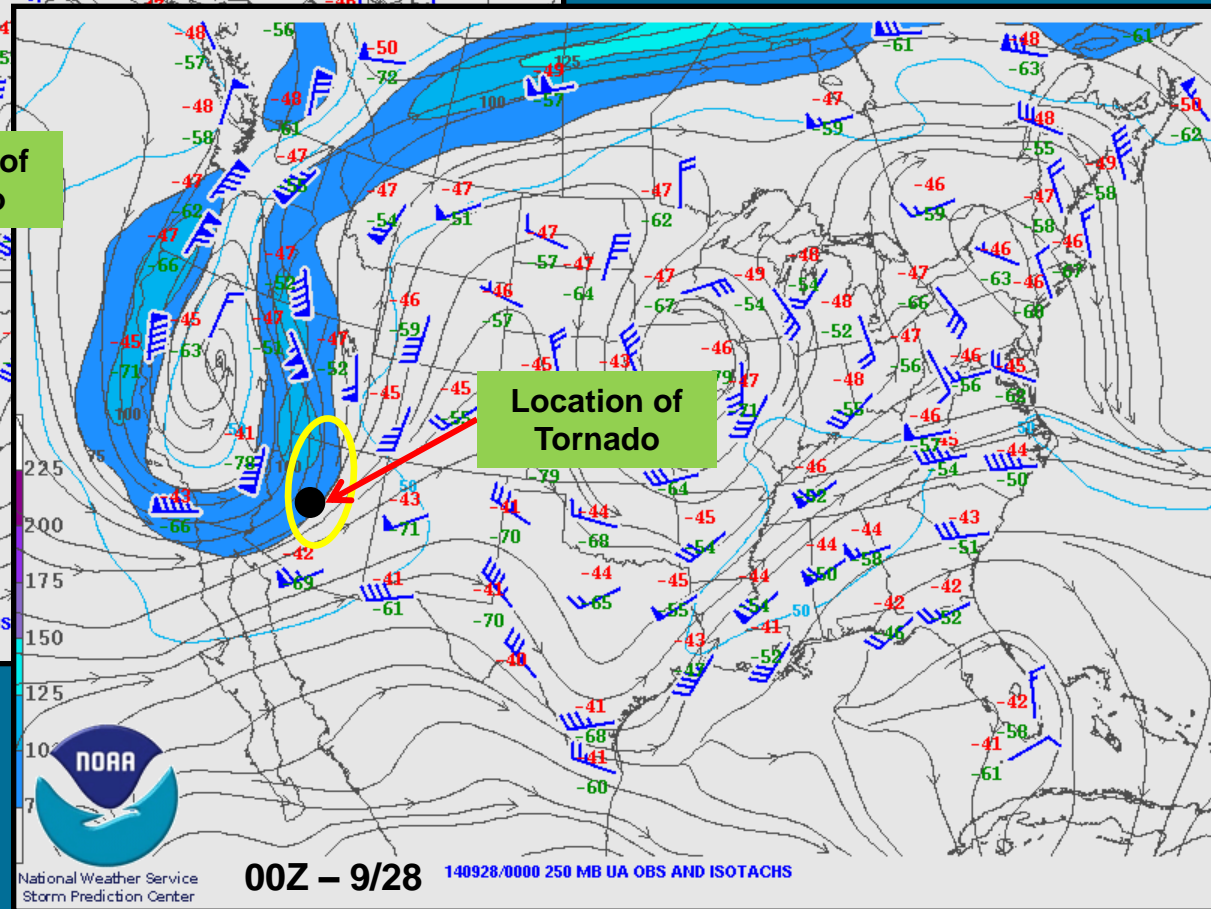
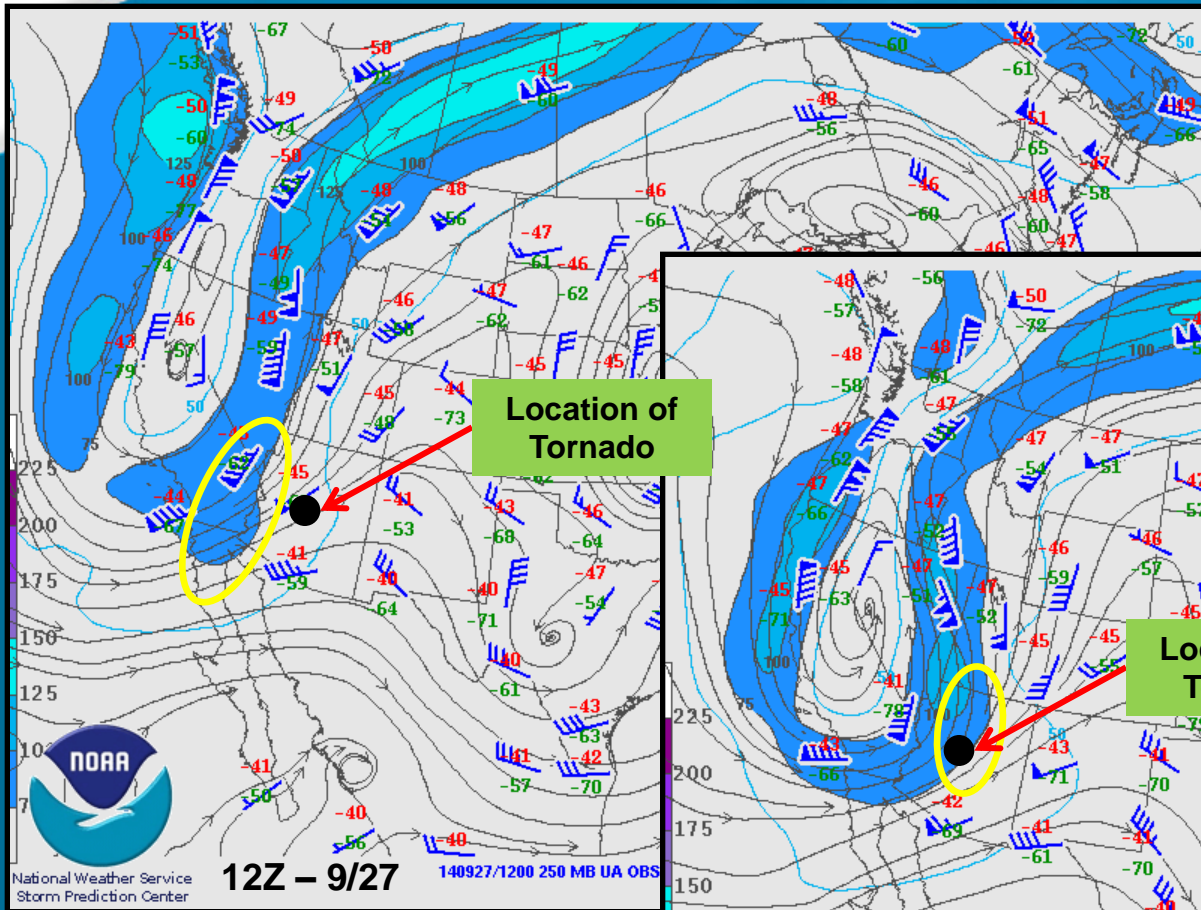
*Cory Mottice*

# Outline

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

# 250 mb Analysis

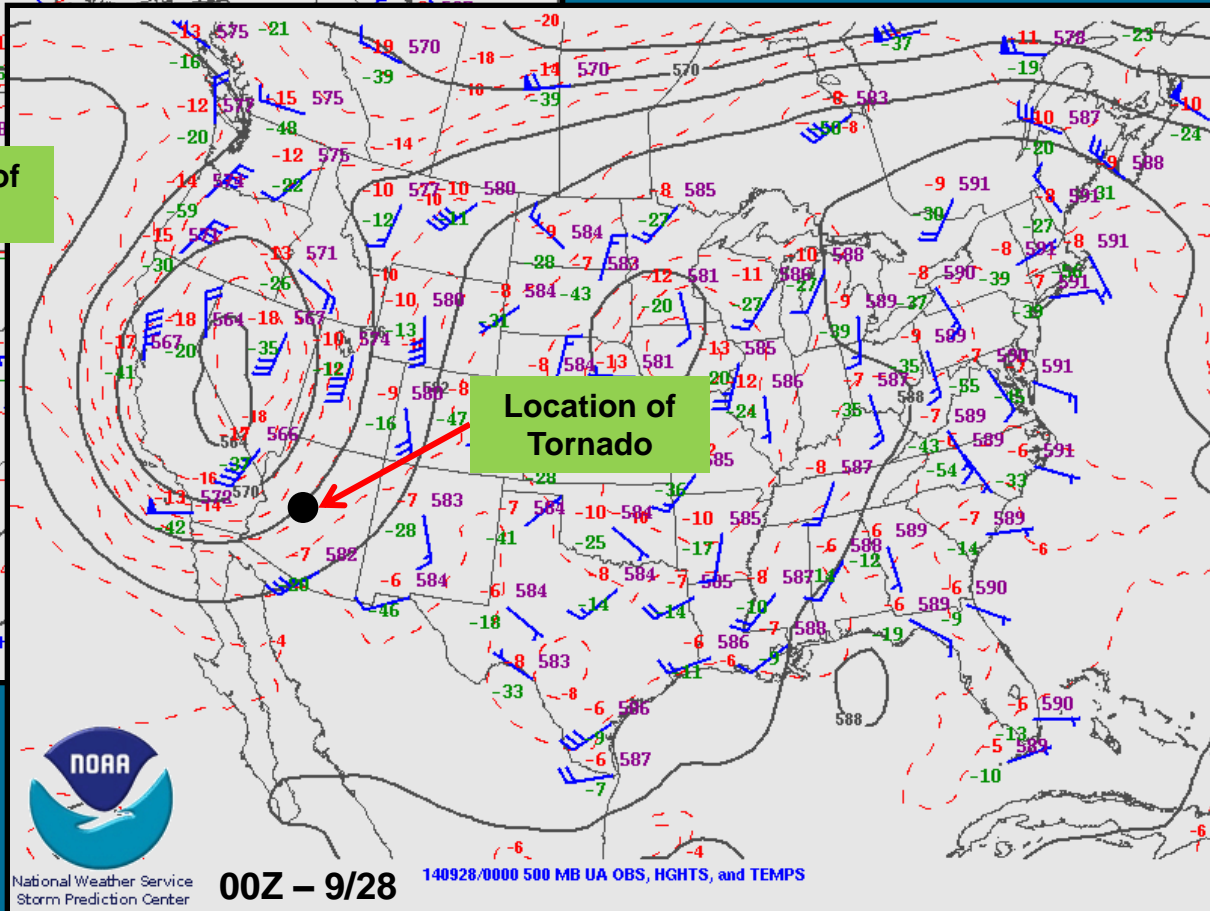
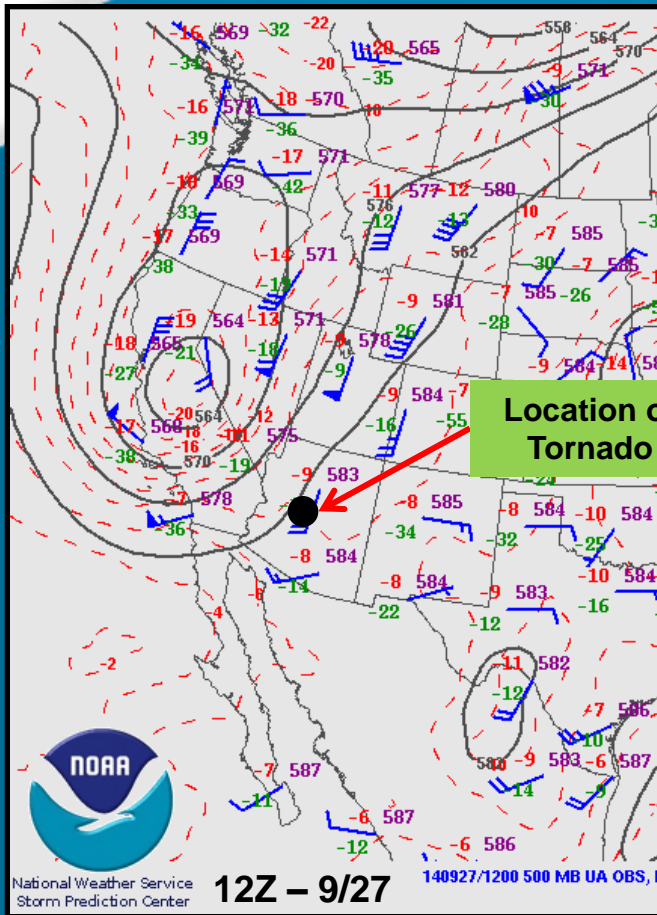
- 90-100 knot jet streak punching into western Arizona by the evening of Sep. 27<sup>th</sup>.



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

# 500 mb Analysis

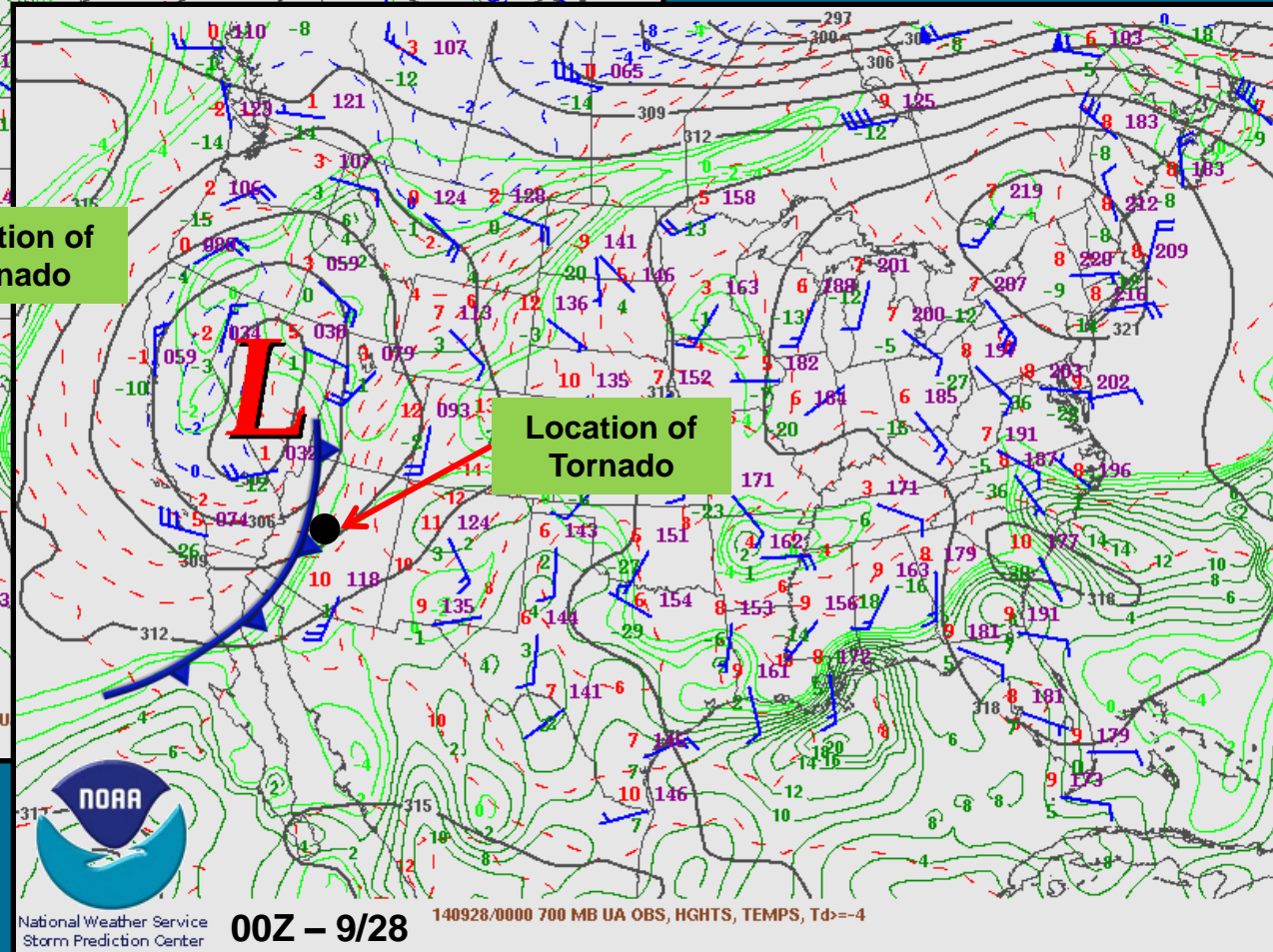
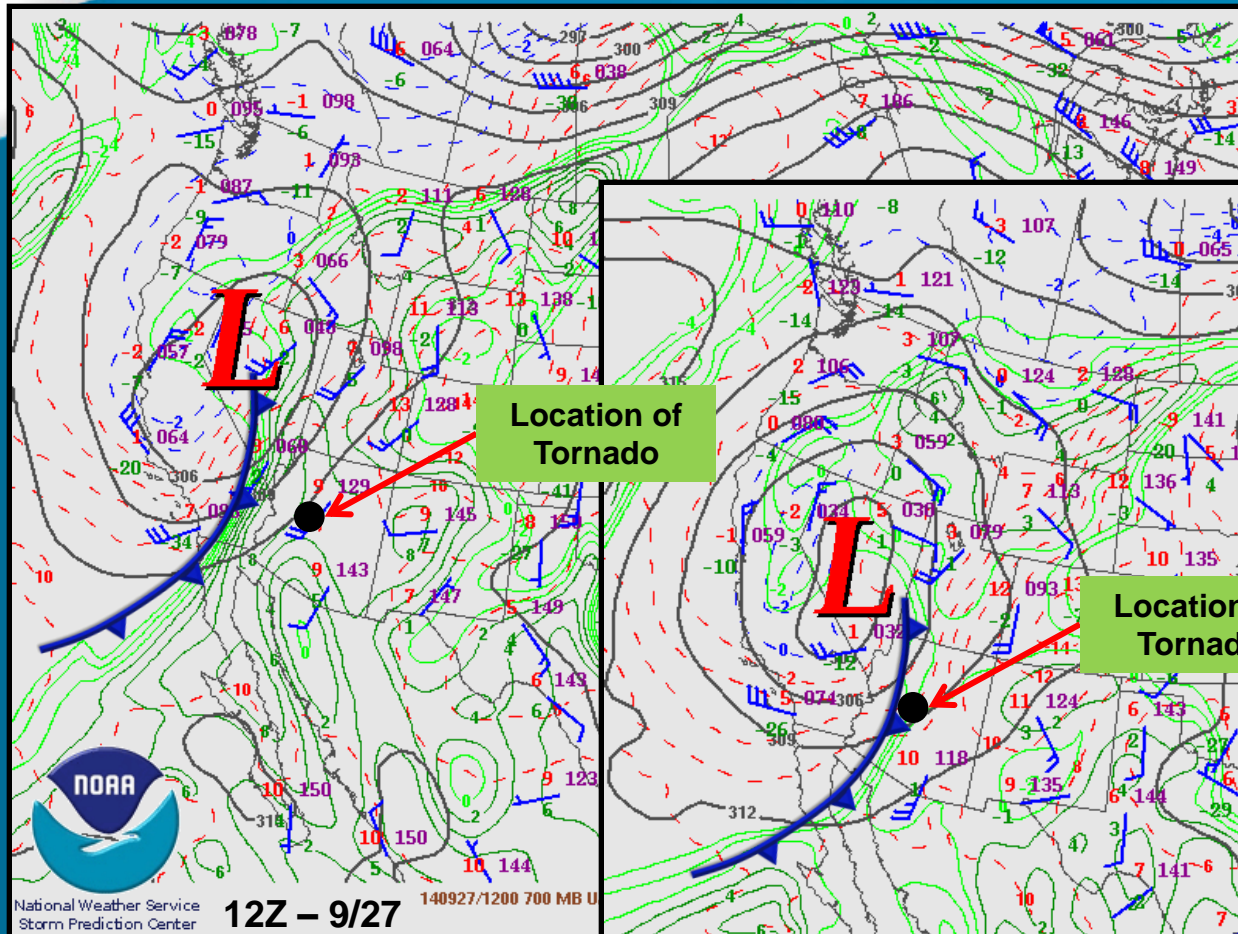
- Closed low centered along the CA/NV border.
- Temps constant around -9C from 12Z/27<sup>th</sup> – 00Z/28<sup>th</sup>.



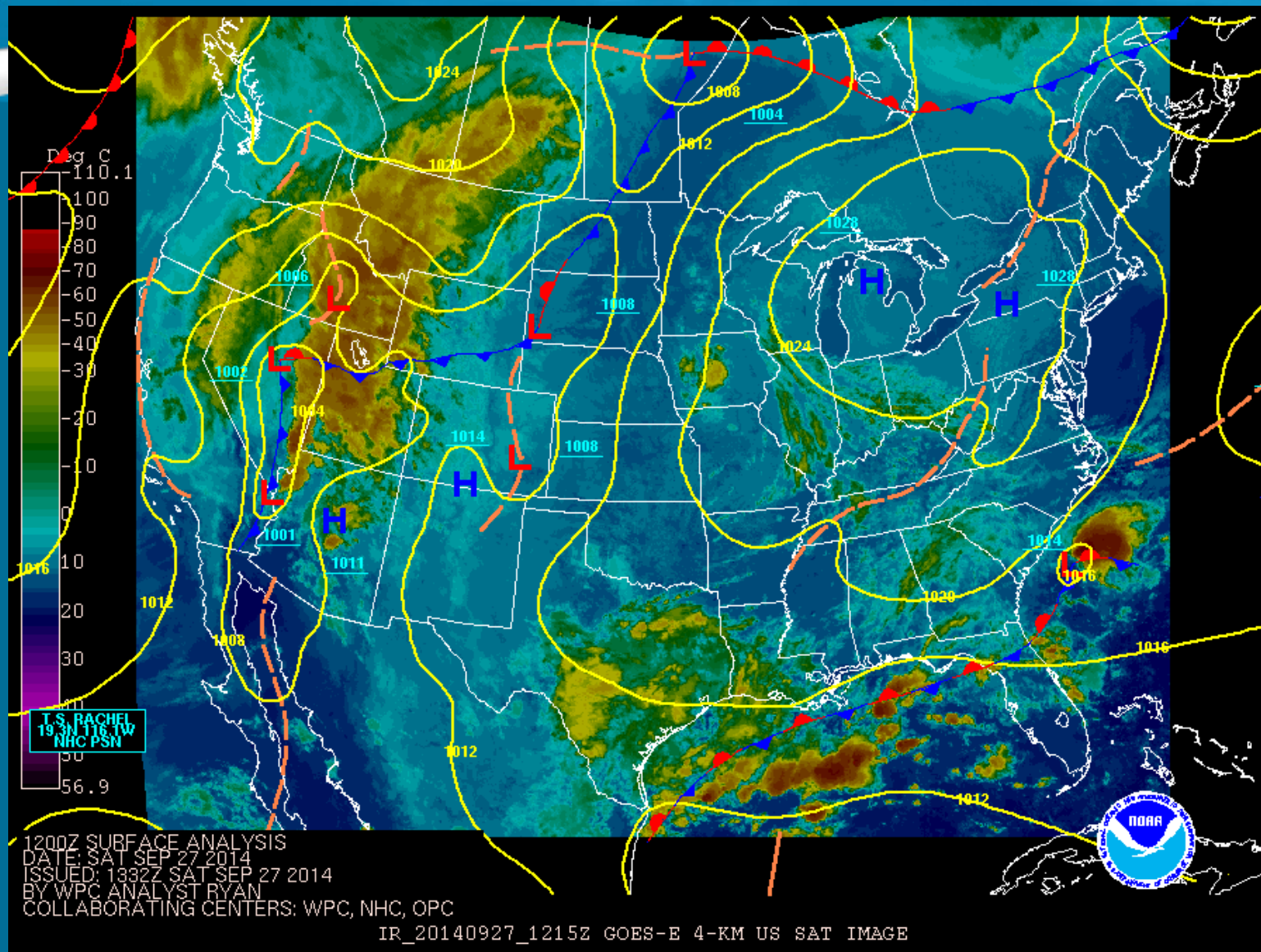
- Height falls in central AZ of around 5-7 dam from 12Z/27<sup>th</sup> – 00Z/28<sup>th</sup>.

# 700 mb Analysis

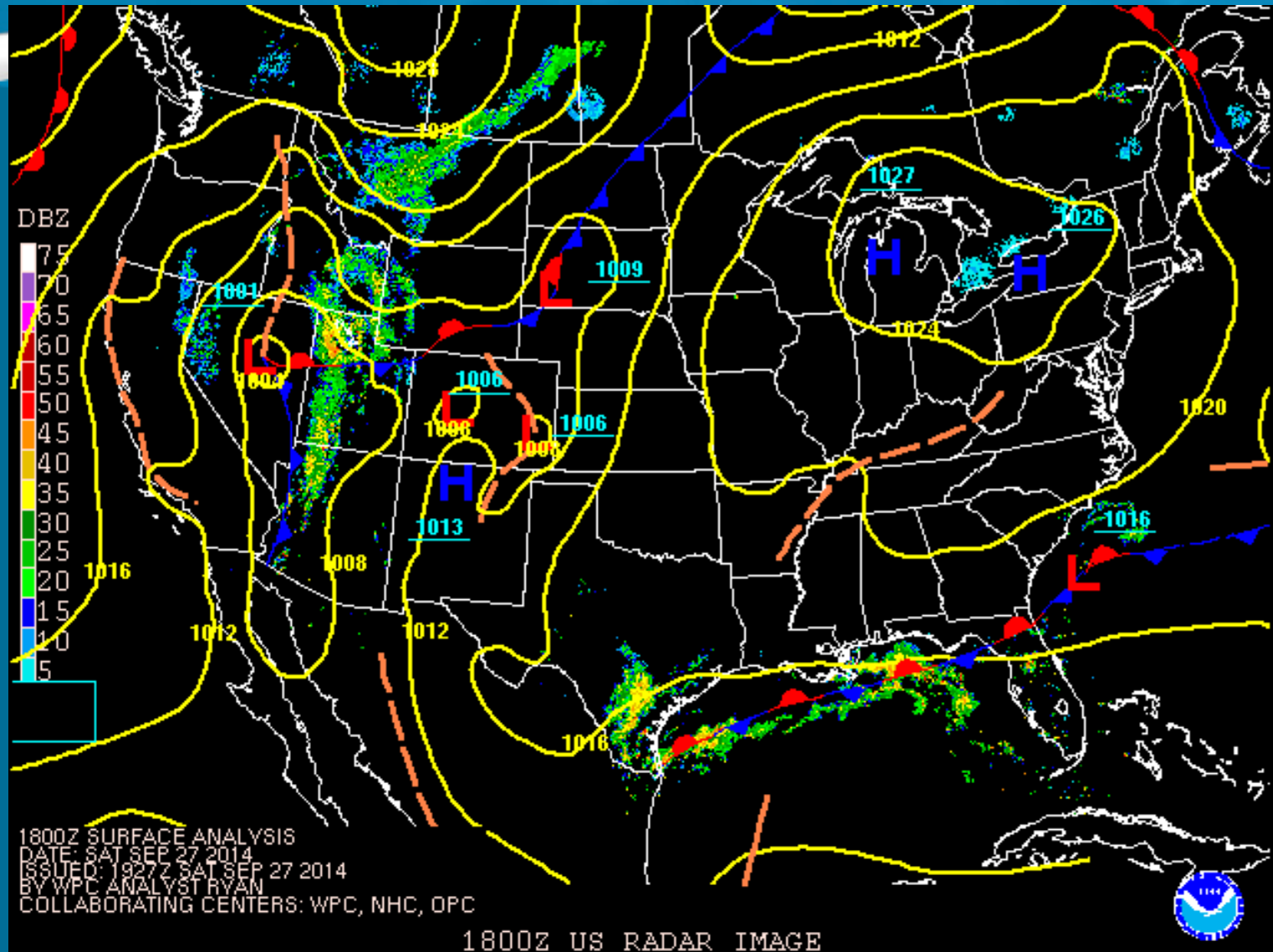
- Dewpoint constant around 5-7C (bad dpt data at 00Z/28 – shown later)



# 12Z Surface Analysis

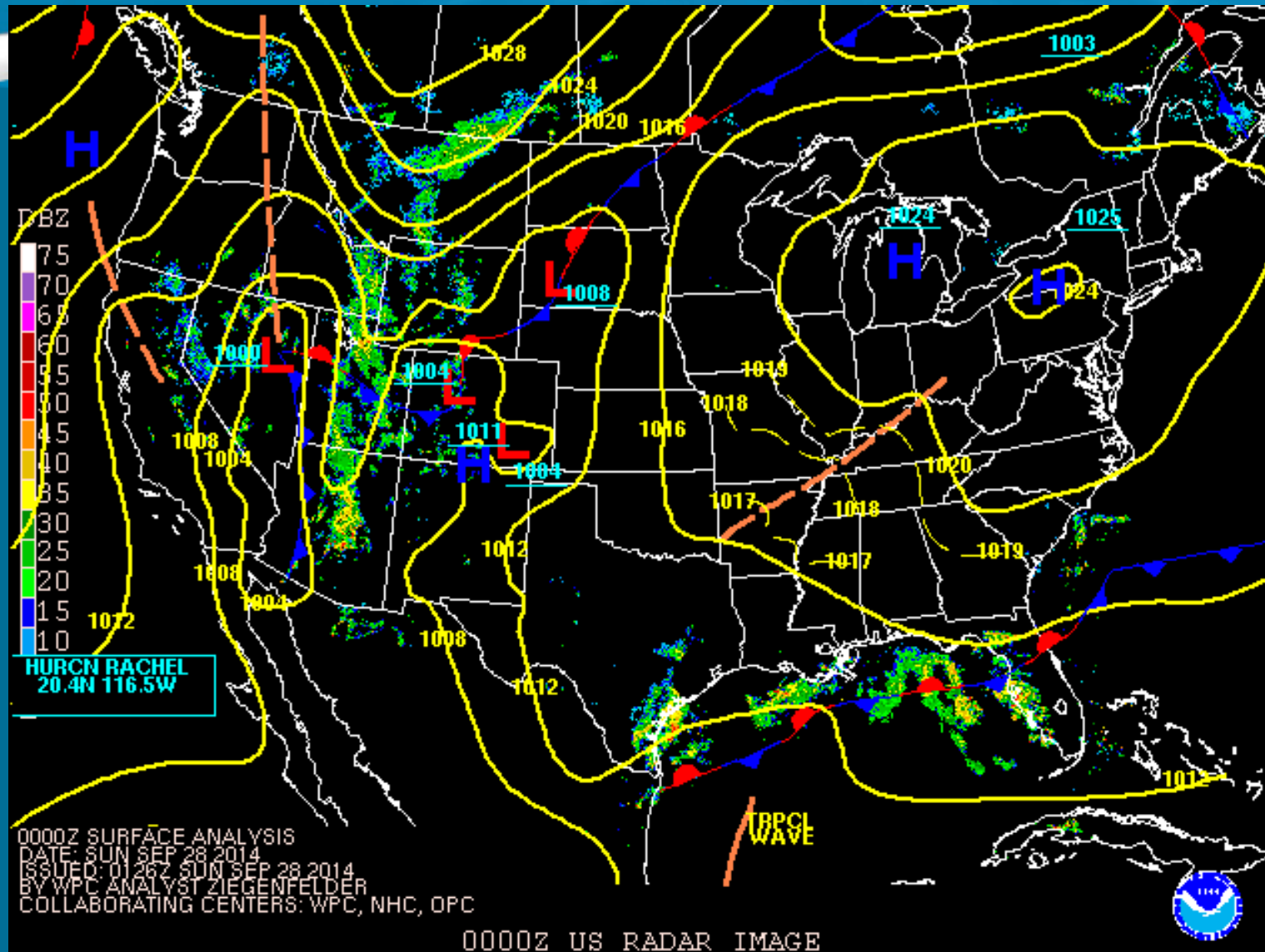


# 18Z Surface Analysis



1800Z US RADAR IMAGE

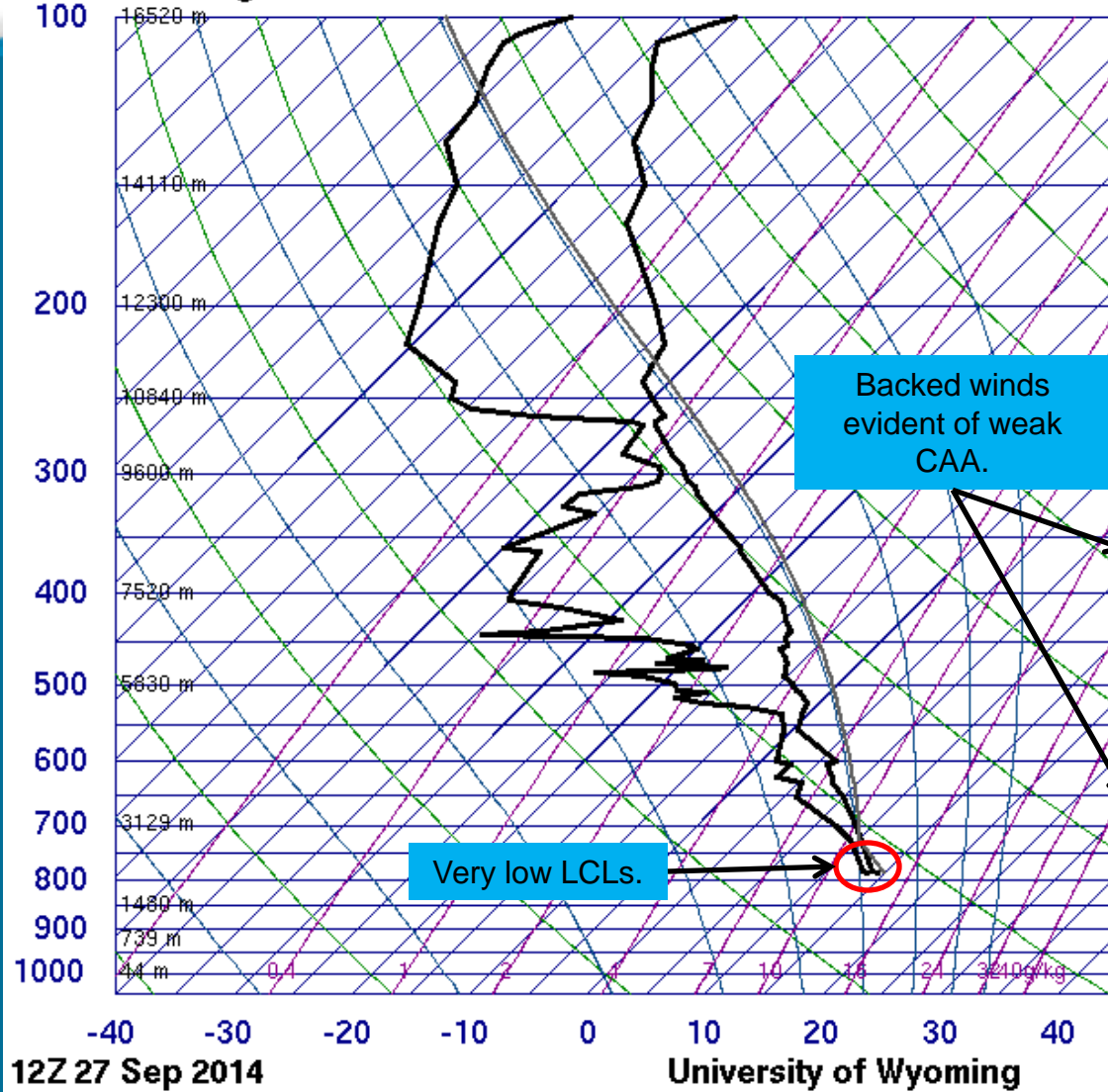
# 00Z Surface Analysis





# 12Z/27 FGZ Sounding

72376 FGZ Flagstaff



SLAT	35.23
SLON	-111.82
SELV	2192.
SHOW	-9999
LIFT	-3.41
LFTV	-3.97
SWET	-9999
KINX	-9999
CTOT	-9999
VTOT	-9999
TOTL	-9999
CAPE	907.4
CAPV	999.5
CINS	-0.45
CINV	-0.12
EQLV	229.4
EQTV	229.3
LFCT	724.9
LFCV	732.0
BRCH	61.94
BRCV	68.23
LCLT	284.7
LCLP	752.5
MLTH	308.8
MLMR	11.52
THCK	5786
PWAT	21.52

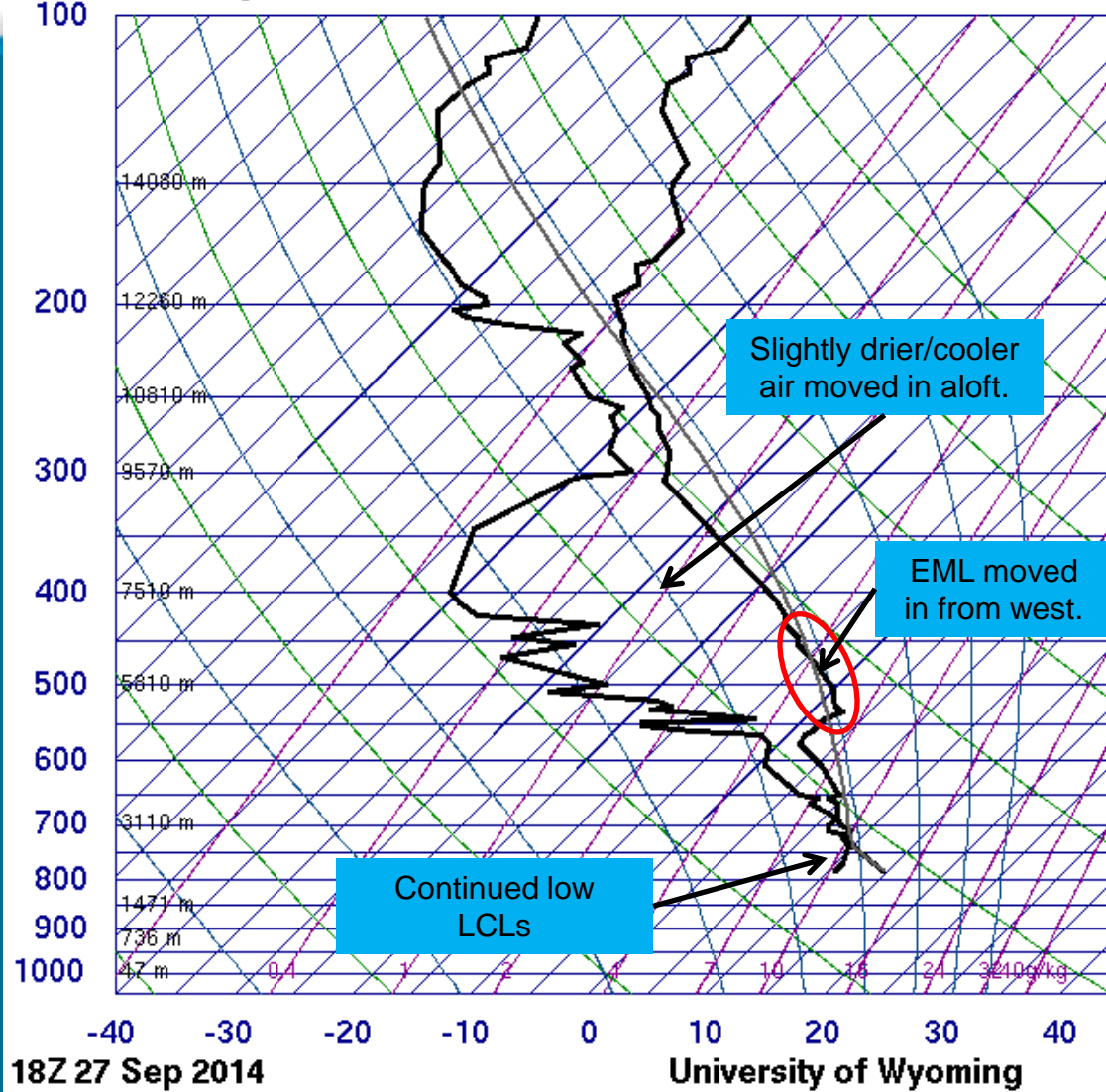
Backed winds evident of weak CAA.

Very low LCLs.

Backed sfc winds.

# 18Z/27 FGZ Sounding

72376 FGZ Flagstaff

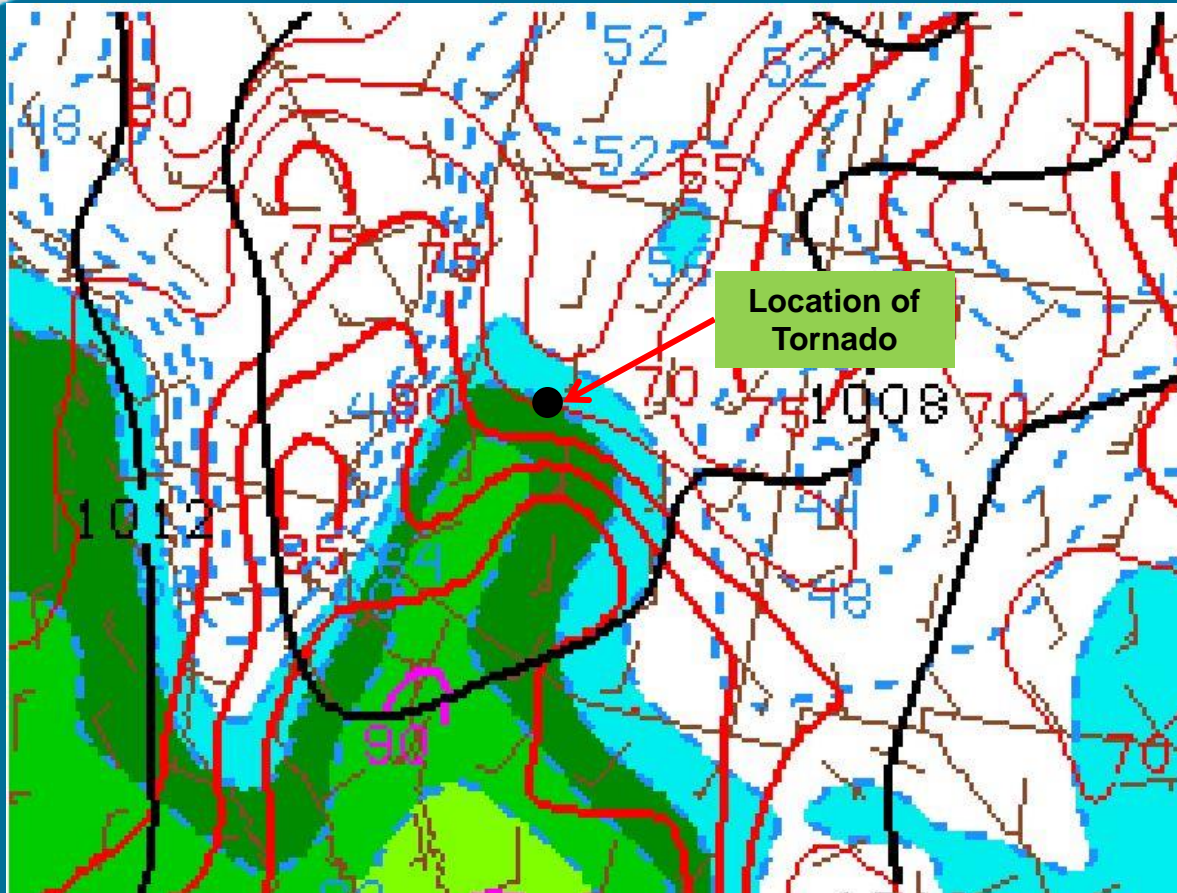


SLAT	35.23
SLON	-111.82
SELV	2192.
SHOW	-9999
LIFT	0.89
LFTV	0.30
SWET	-9999
KINX	-9999
CTOT	-9999
VTOT	-9999
TOTL	-9999
CAPE	514.6
CAPV	585.9
CINS	-0.13
CINV	-0.06
EQLV	226.8
EQTV	226.7
LFCT	731.9
LFCV	733.3
BRCH	13.30
BRCV	15.15
LCLT	282.9
LCLP	736.9
MLTH	308.7
MLMR	10.44
THCK	5763.
PWAT	18.79

Slightly backed sfc winds.

# Mesoanalysis

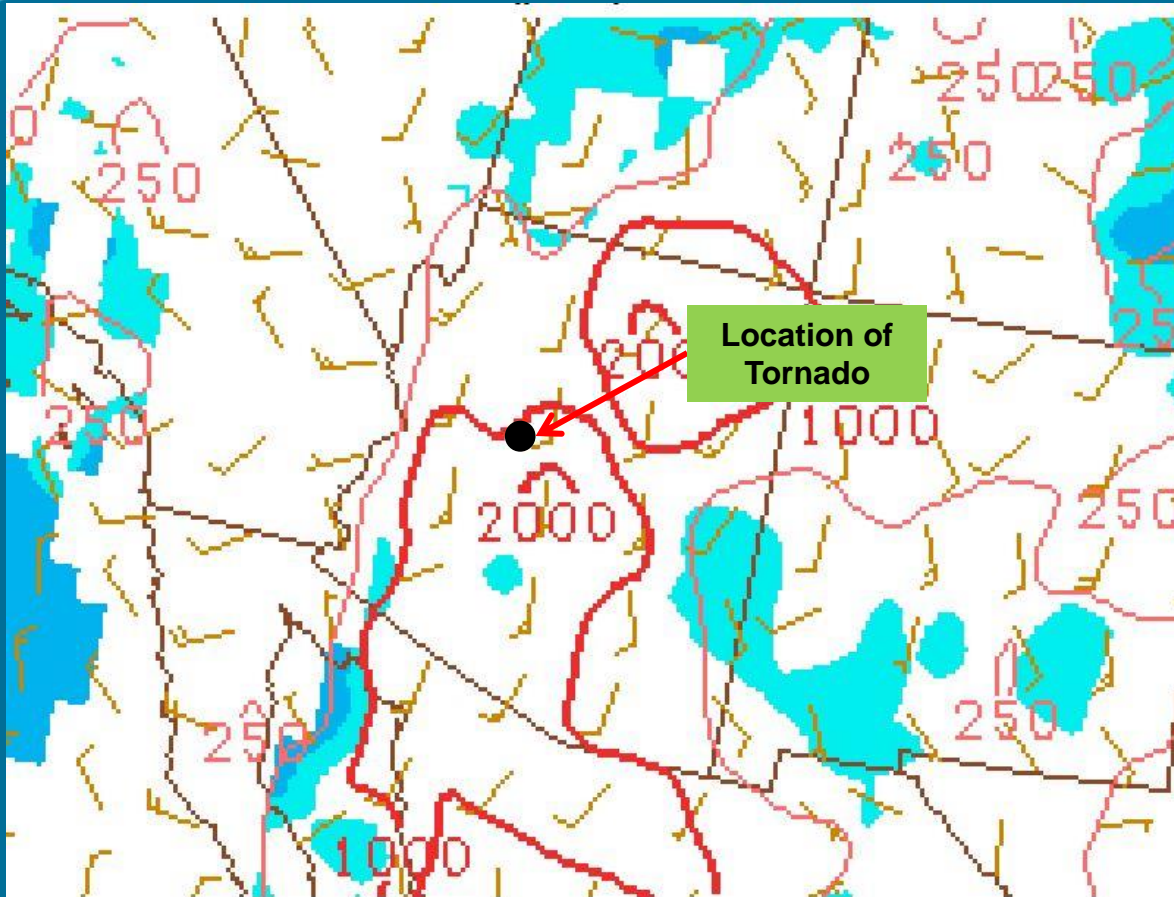
Valid at 19Z on Sept. 27, 2014



- 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?

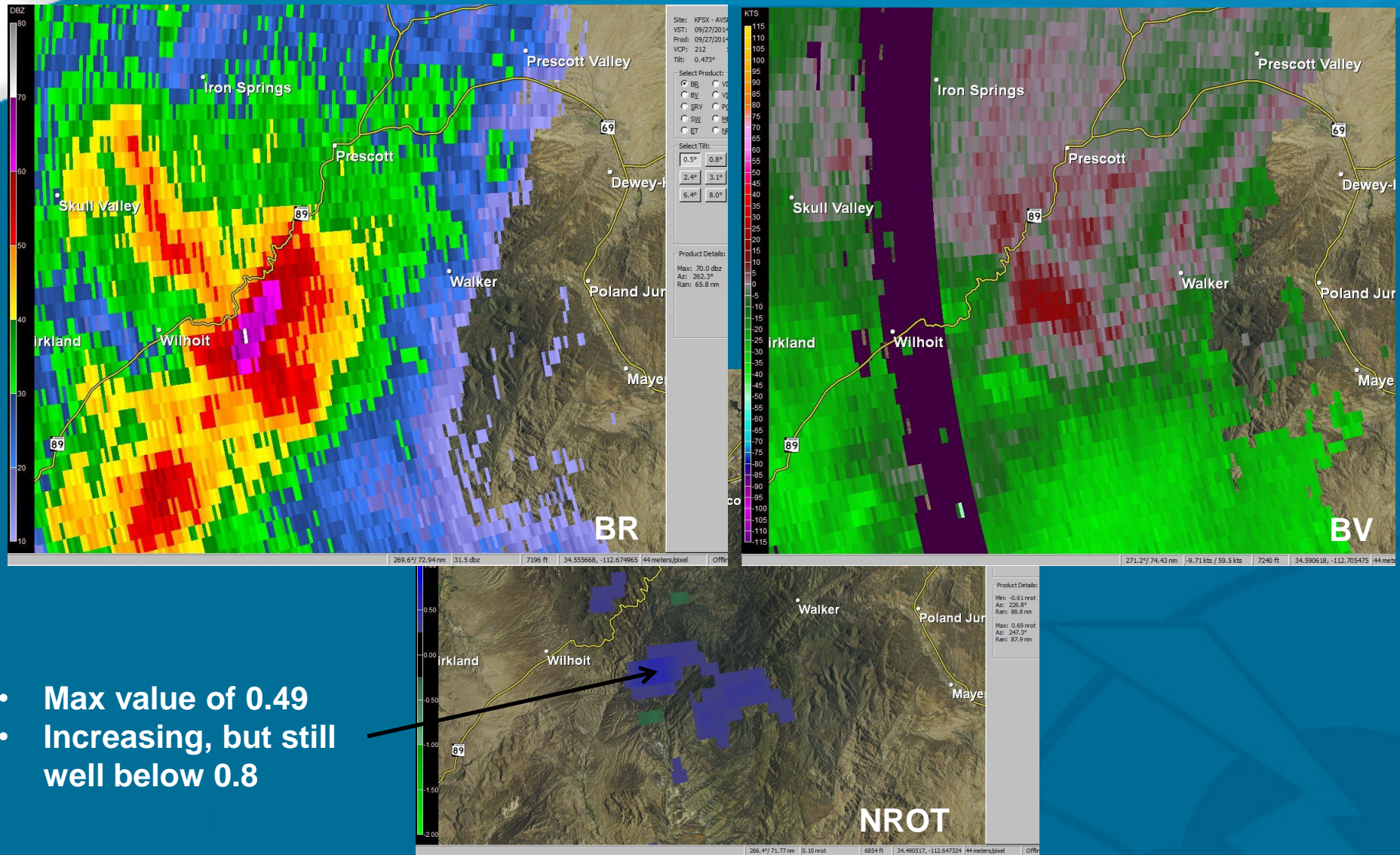
- *NROT is the normalized rotation calculated by using the local, linear, least squares method*
- *Not calculated within 8 miles of radar*
- *Ranges from -5 to 5 (unitless)*
  - **Positive = cyclonic; Negative = anti-cyclonic**
- *>1 considered significant; >2.5 extreme*

# Albany, NY Study

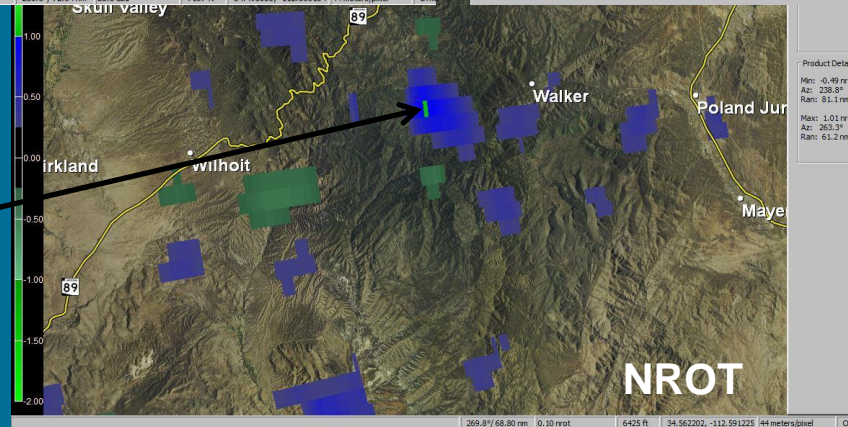
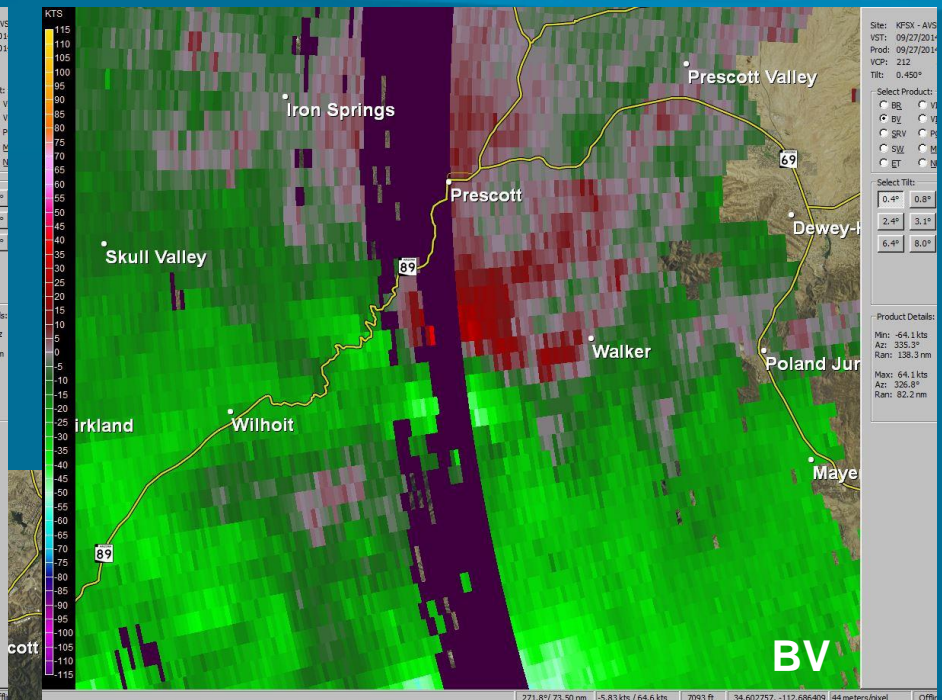
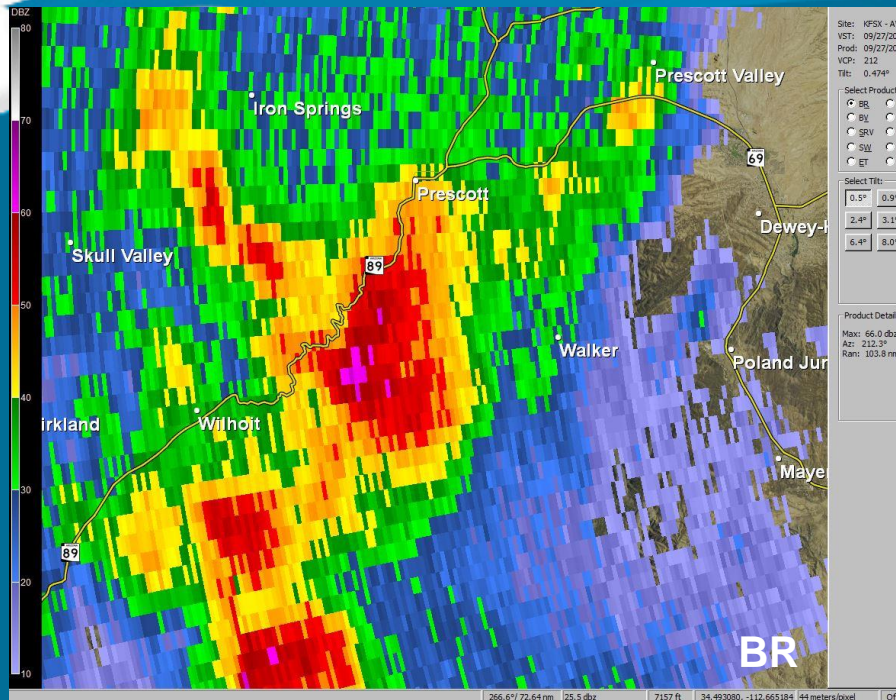
- *A study from the Albany NWS found that values above 0.8 indicated a possible tornado and values  $> 1$  almost always indicated a tornado.*
- *No tornado ever occurred with a value  $< 0.8$  with the 35+ cases in their study.*
- *No study has been done in the southwest that I know of.*
  - *Working 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



# Radar Images at 1:56 PM

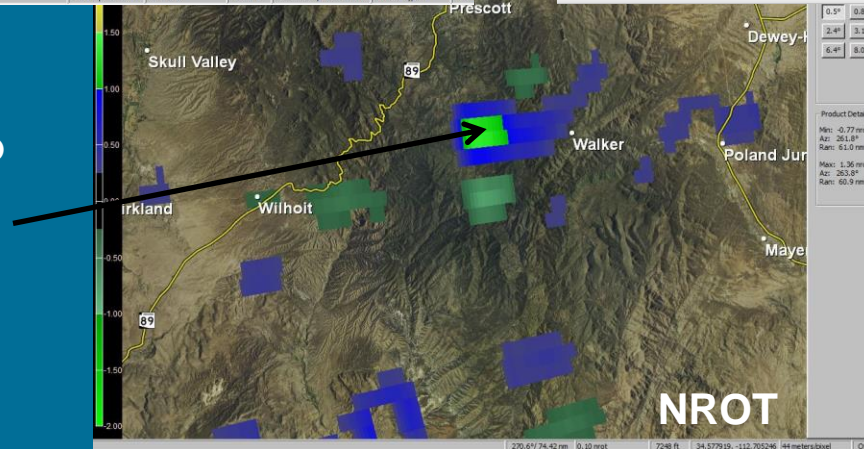
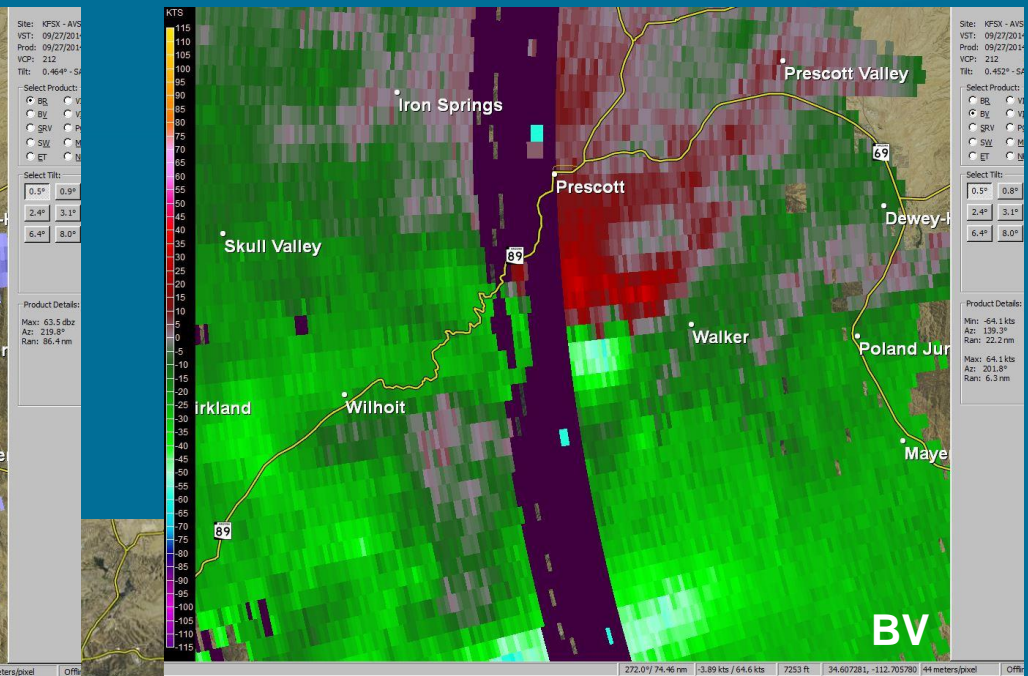
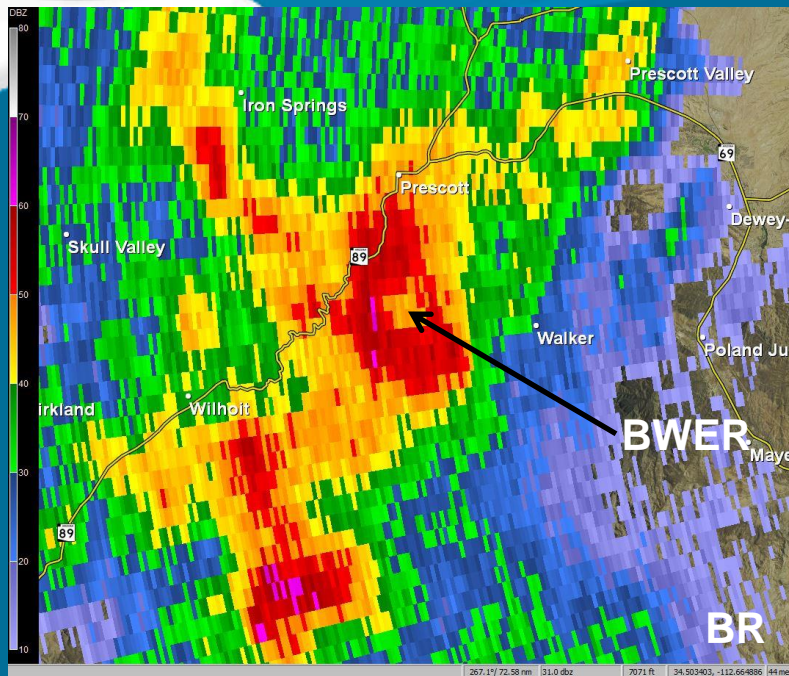


- Max value of 1.01
- Now exceeds significant threshold
- Suggests tornado or developing tornado likely

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

# Radar Images at 1:58 PM

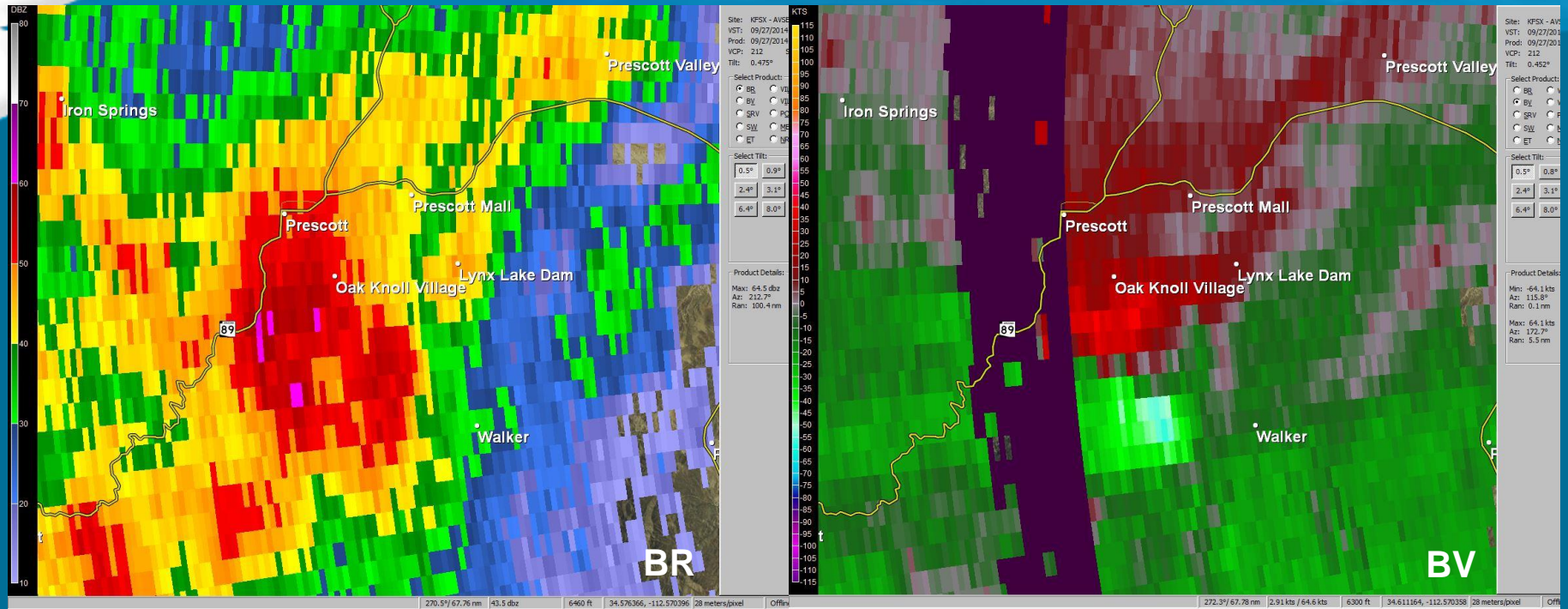
Yay SAILS!



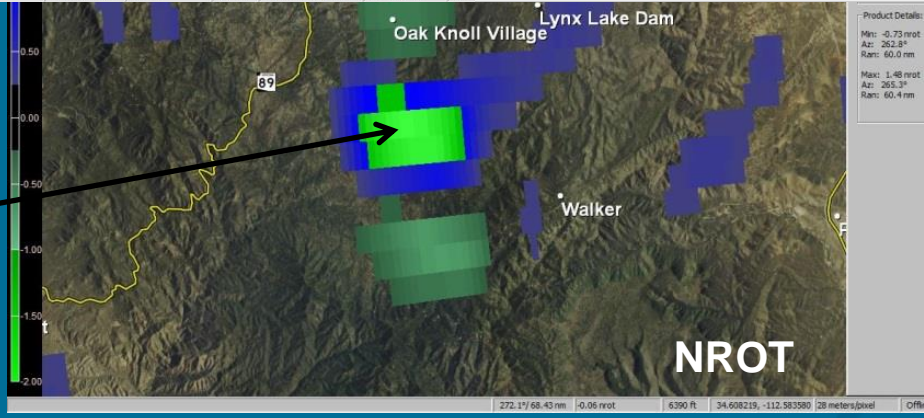
- Max value of 1.36
- Value continues to rapidly increase
- Suggests tornado likely

- 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)*