Low Level Wind Shear at KRNO (Reno, NV)

How to better forecast and detect

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Photo: Scott McGuire, NWS Reno

Why…

- LLWS is a huge impact to aviation at KRNO
- Misunderstood forecasting
- Original idea: High wind days brought shear

- *Goal: To see if there are any patterns that would generate LLWS at KRNO → Ultimately forecast it better*

Actual PIREPs from 12/15/16

RNO UUA /OV RNO 5NW/TM 1855/FL085/TP DH8D/RM LLWS +/- 10KTS ON SHORT FINAL 085-SFC DURD. ROTOR ACTION. AIRCRAFT ALMOST ROLLED AT 085

RNO UA /OV RNO001001/TM 1737/FL010/TP DH8D/RM WINDSHEAR +/- 30-40KTS UP DRAFT 1500-2000 FEET

RNO UUA /OV RNO/TM 1556/FL110/TP B737/TB MOD BLO 110/RM LLWS +/- 30-40KTS. MANY DIVERTS AND GO AROUNDS. ZOA CWSU

Left: 737, Right: Dash 8

Impacts at KRNO

A sample of the number of flights cancelled or diverted* due to wind and LLWS:

10/14/16: 16 flights, 15%**

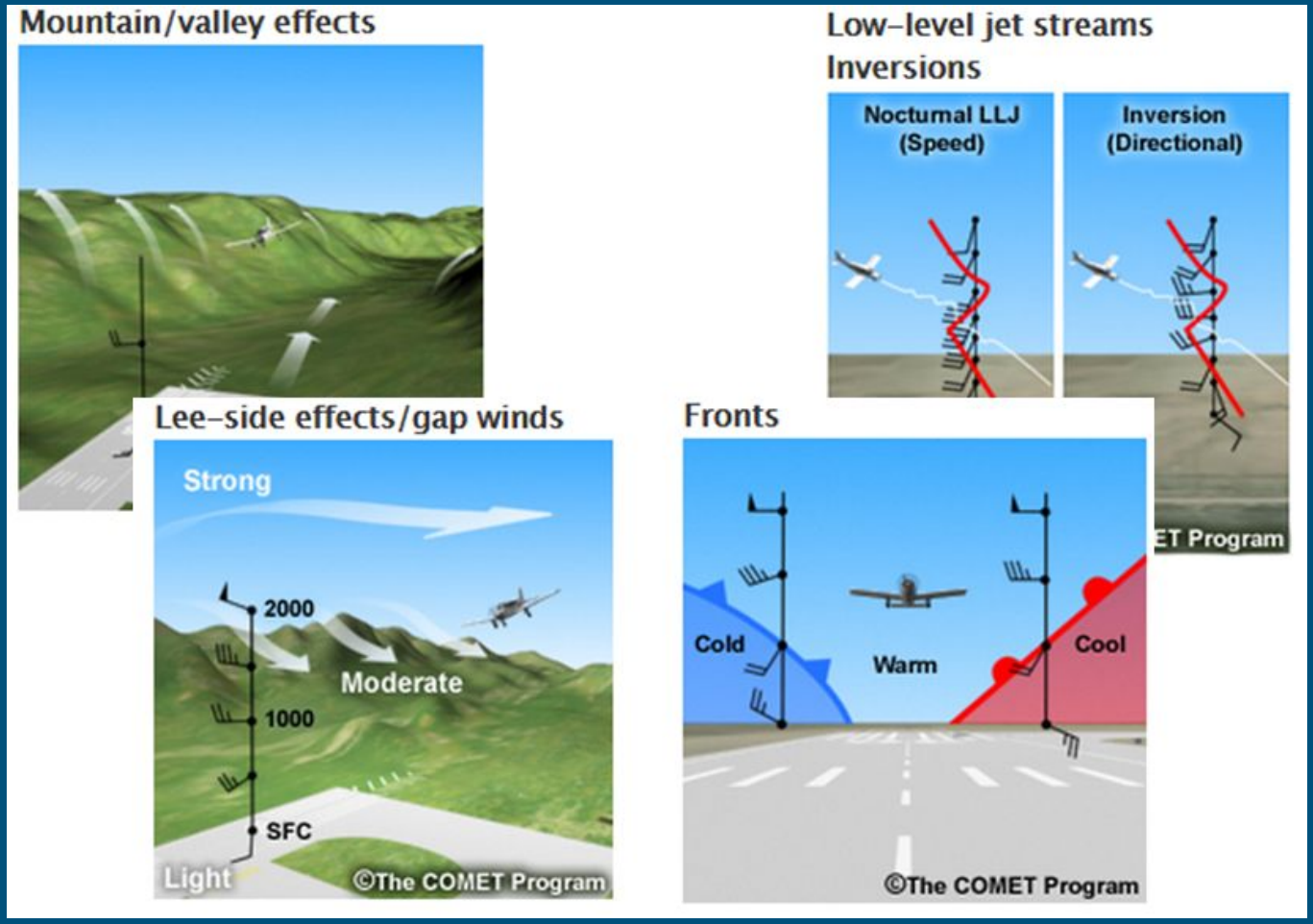
10/15/15: 22 flights, 20%**

12/15/16: 25 flights, 23%**

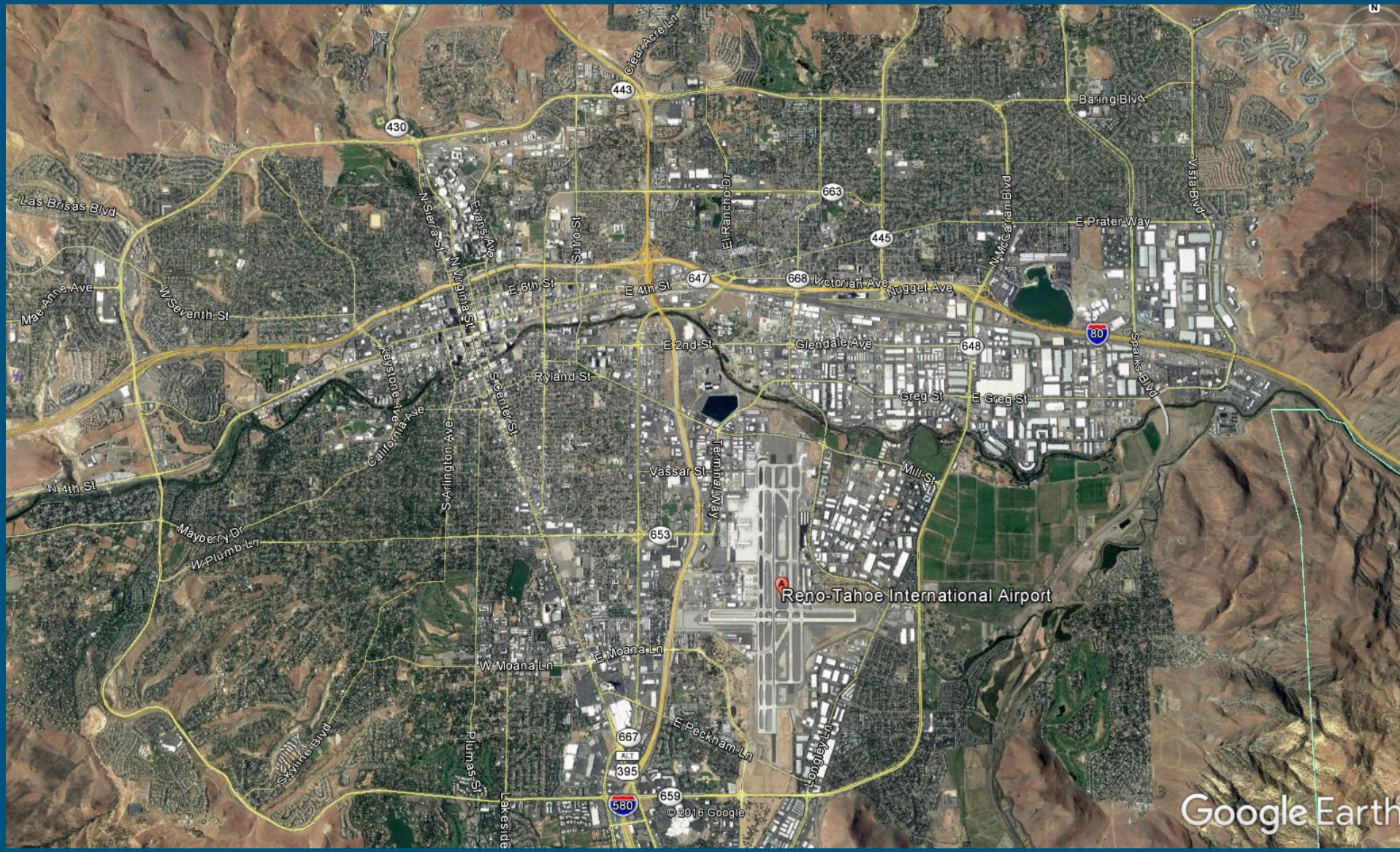
*does not include GA

** % is an estimate based on 110 commercial flights per day

Common Causes of LLWS

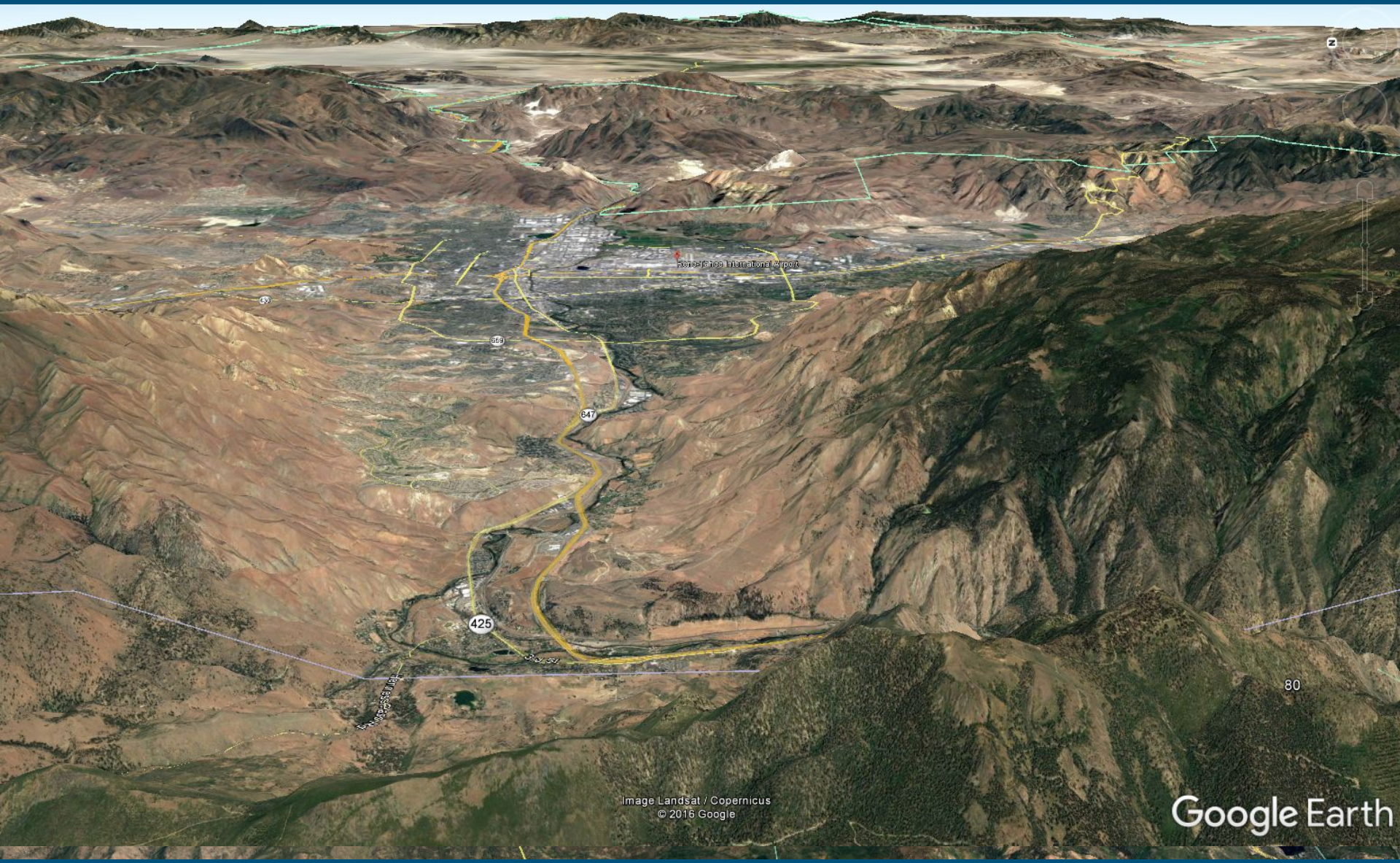


The Reno Airport

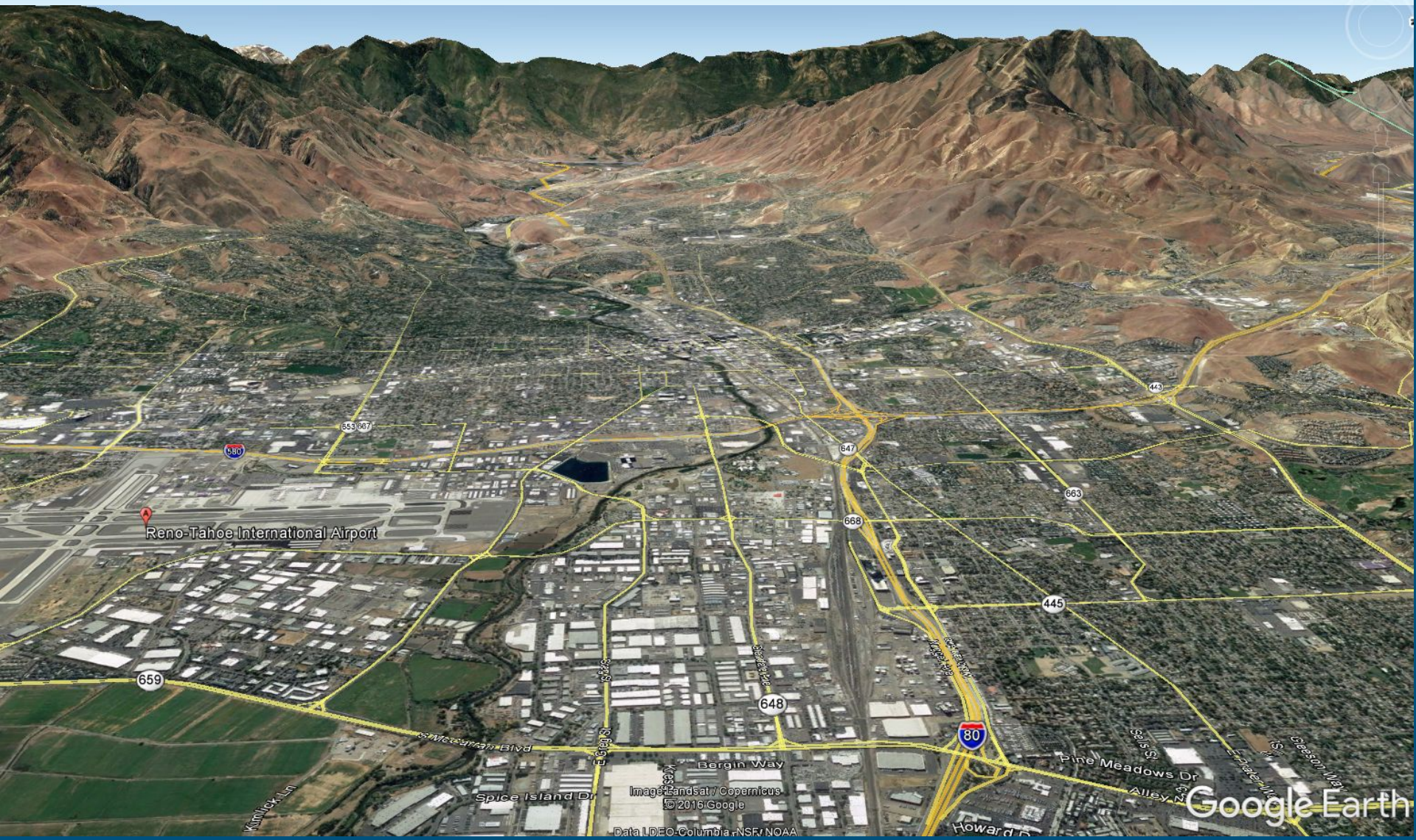


Terrain Viewed From the South

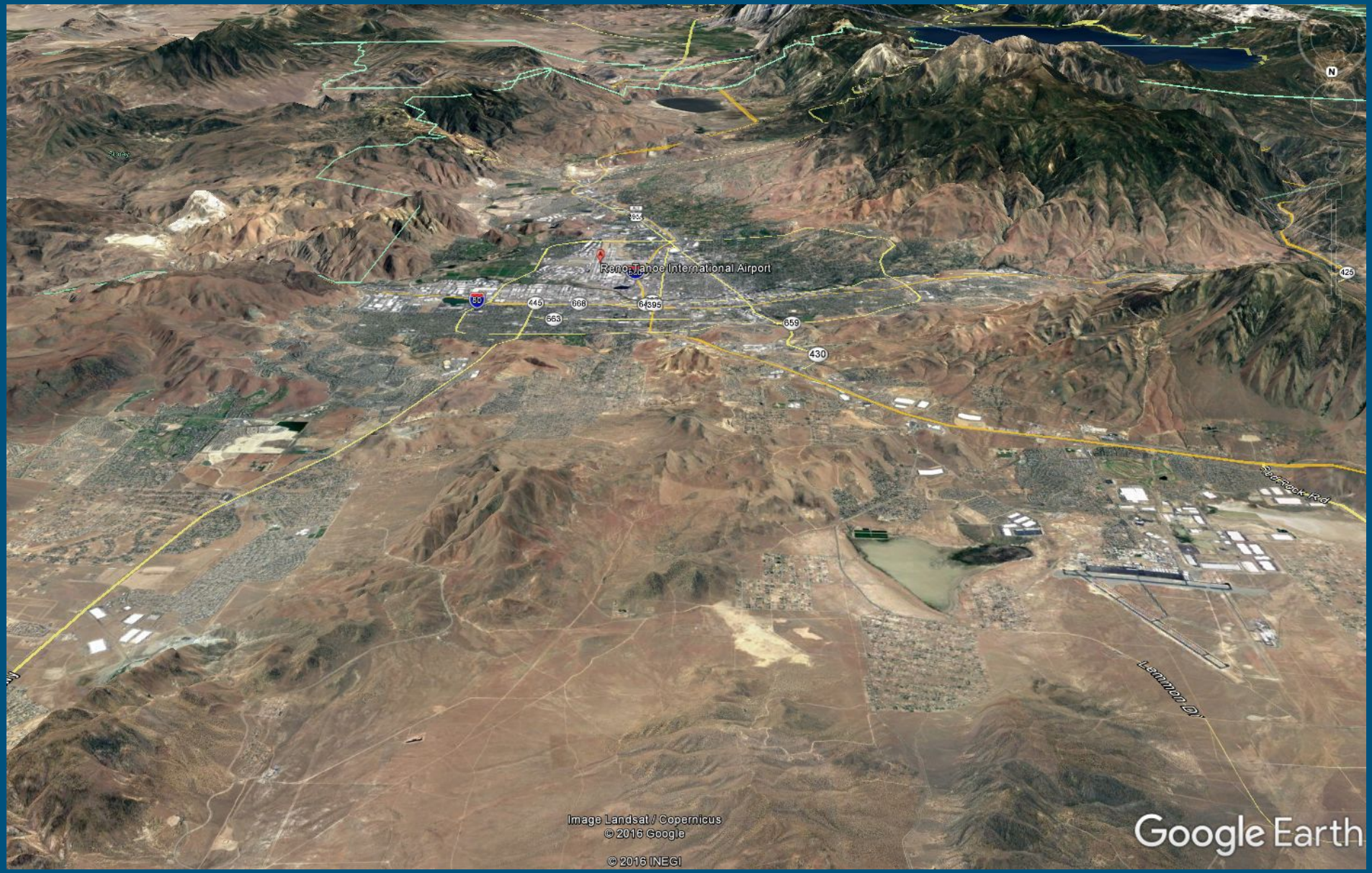
Terrain Viewed From the West



Terrain Viewed From the East



Terrain Viewed From the North



Methodology - The beginning

Finding archived PIREPs - Iowa State started Jan 20, 2015

Complications:

- ➔ PIREPs do not need to fit a strict format specification, so reports may be unparsable and therefore the data set is possibly incomplete.
- ➔ Limited to actual reports
- ➔ You can't search for a particular airport within the data set

Only interested in LLWS outside of summer months -- didn't want convective LLWS

After All That

- Ended up with 48 days there was at least one LLWS PIREP report at KRNO from Jan 20, 2015-Dec 15, 2016 (excluding the months of June/July/August to avoid tstorms)

- Wanted to focus on “big” days since the terrain and localized flow can easily cause LLWS at random times.

- Decided to use days that had 3 or more LLWS reports
  - This took it down to 19 days

Areas That Were Explored

- Observations at KRNO for the days of the study focused +/- 3 hours of the LLWS report timing
- Mesowest data - to explore lower level obs within the valley
- Ridge level wind data - winds aloft (approx 700 mb)
- Archived surface analysis (fronts, etc), soundings for KREV
- Winds (zonal and meridional components)
  - Jet position and anomalies
  - 700 mb anomalies
  - 850 anomalies (translates to near surface)
- 500 mb height anomalies - approaching systems, frontal boundaries

Speed Isn't What You Think

- There was no direct correlation between higher averaged sustained wind speeds and greater number of LLWS reports
- The difference between sustained speeds and the speed/gust spread also had no correlation

Peak Gust Stats

– 58% - 50 mph or greater

** Note this leaves 42% of cases below advisory criteria!**

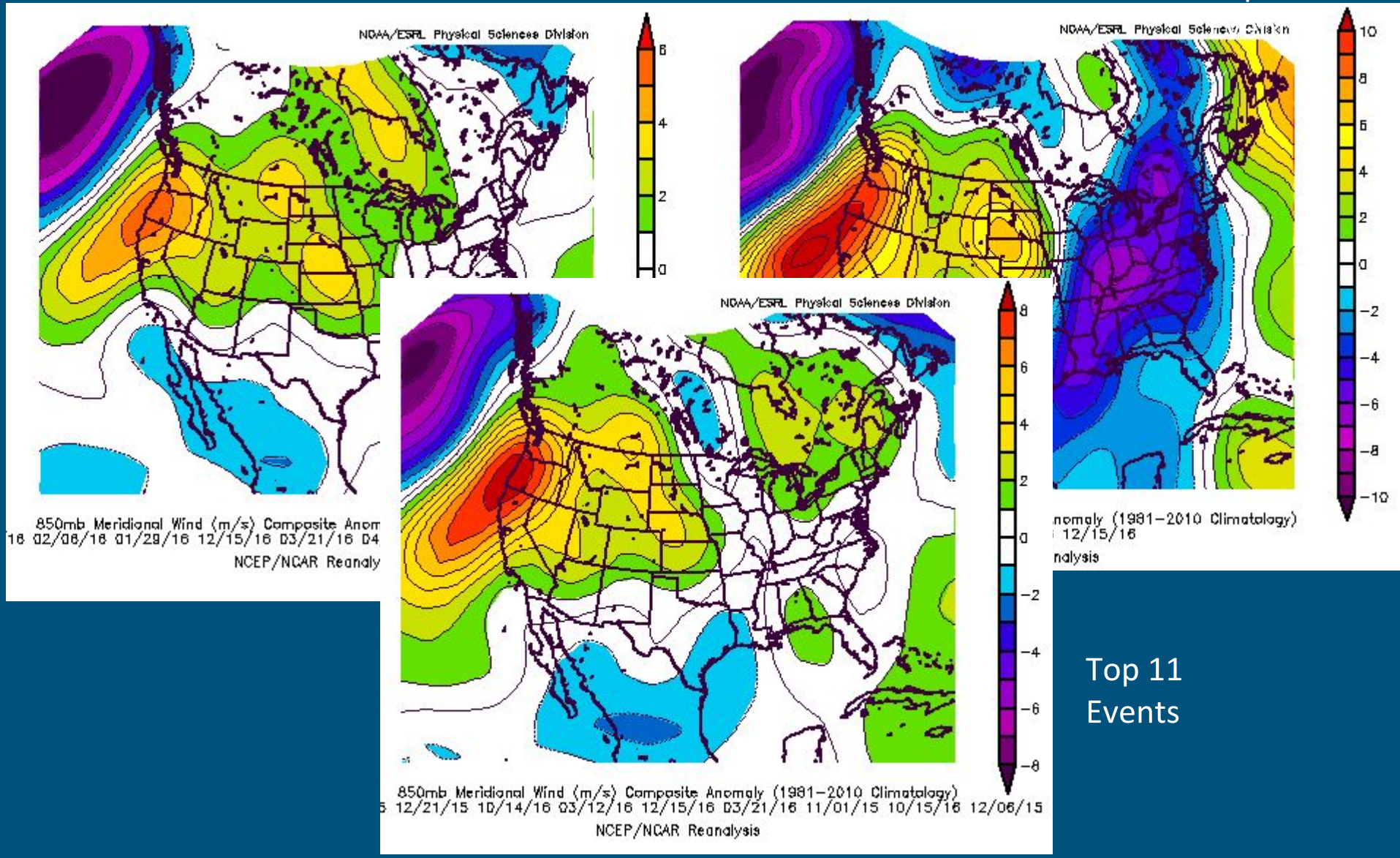
– 26% - 55 mph or greater, 0.05% - 60 mph or greater

All west wind events had peak gusts less than 40 mph

850 mb Meridional Anomalies

All Events

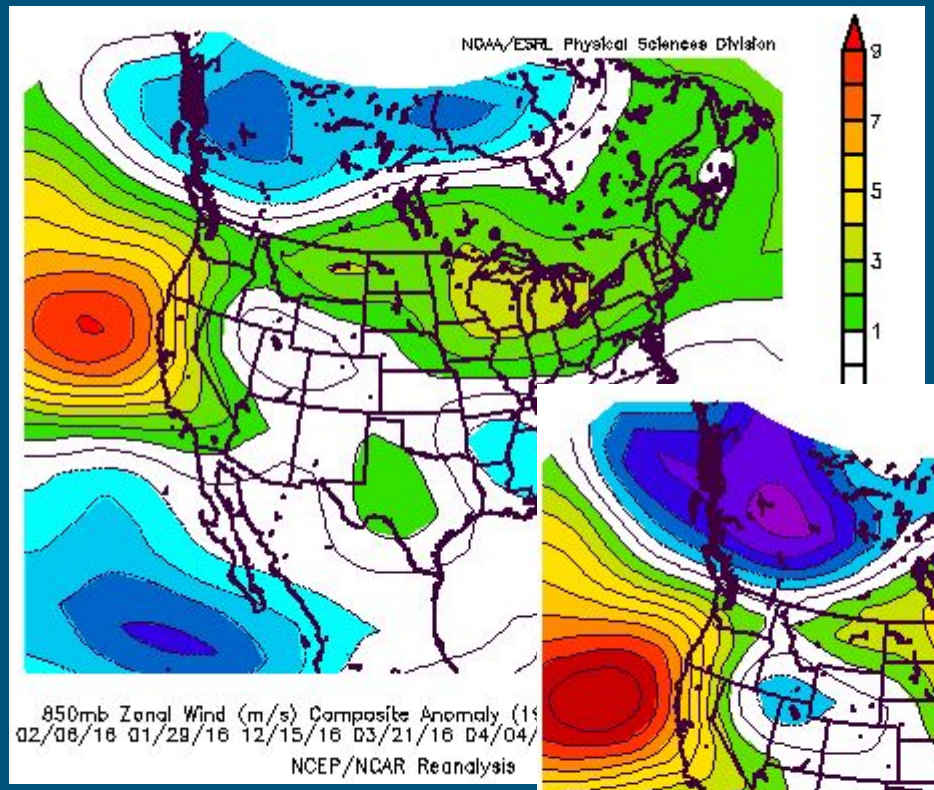
Top 3



Top 11 Events

850 mb Zonal Anomalies

All Events



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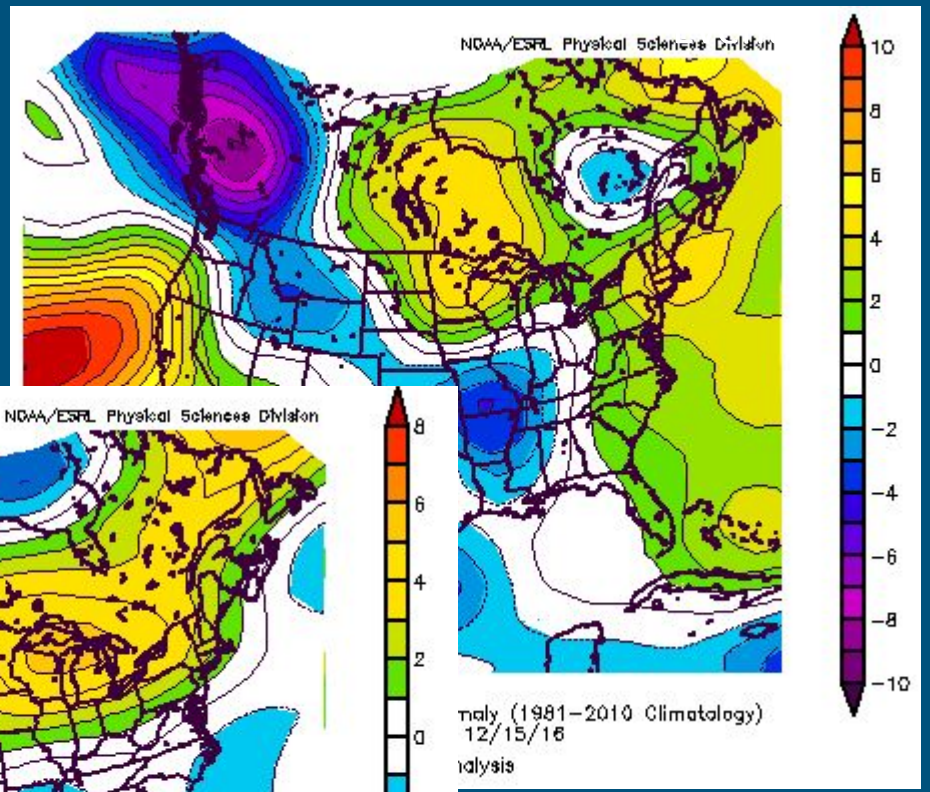
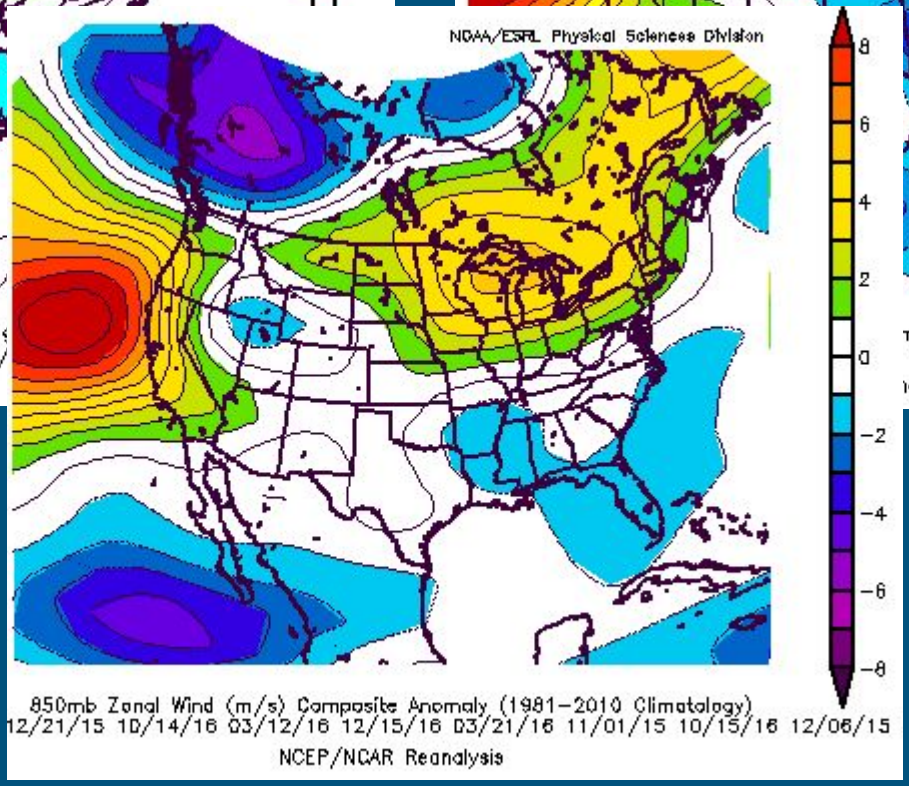
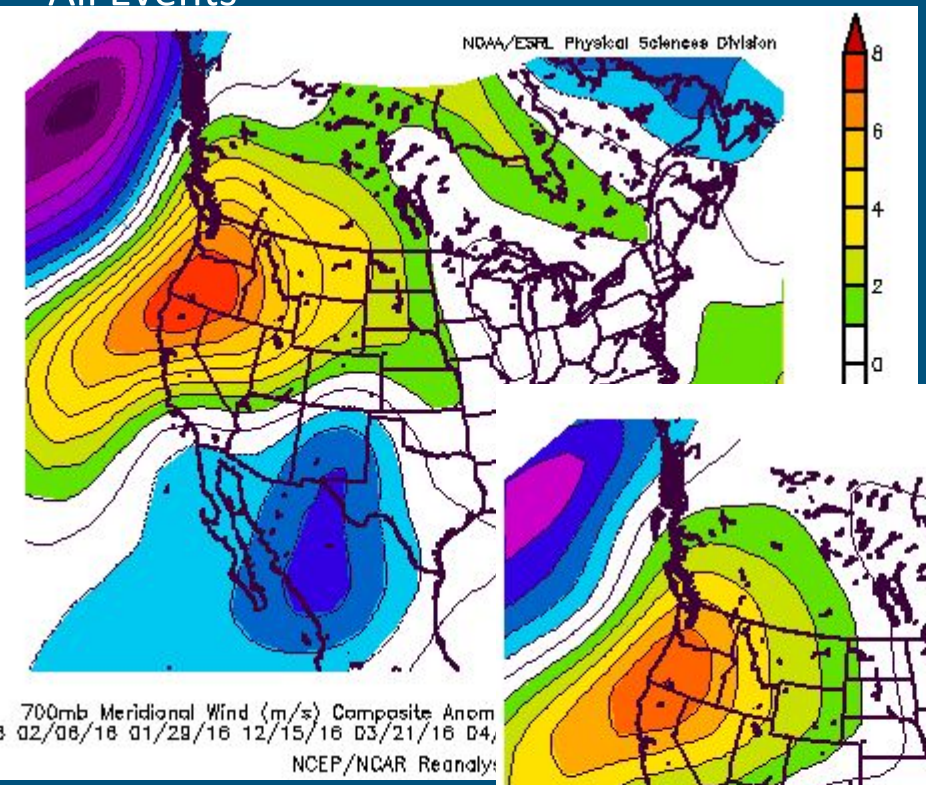




Top 11 Events

700 mb Meridional Anomalies

All Events



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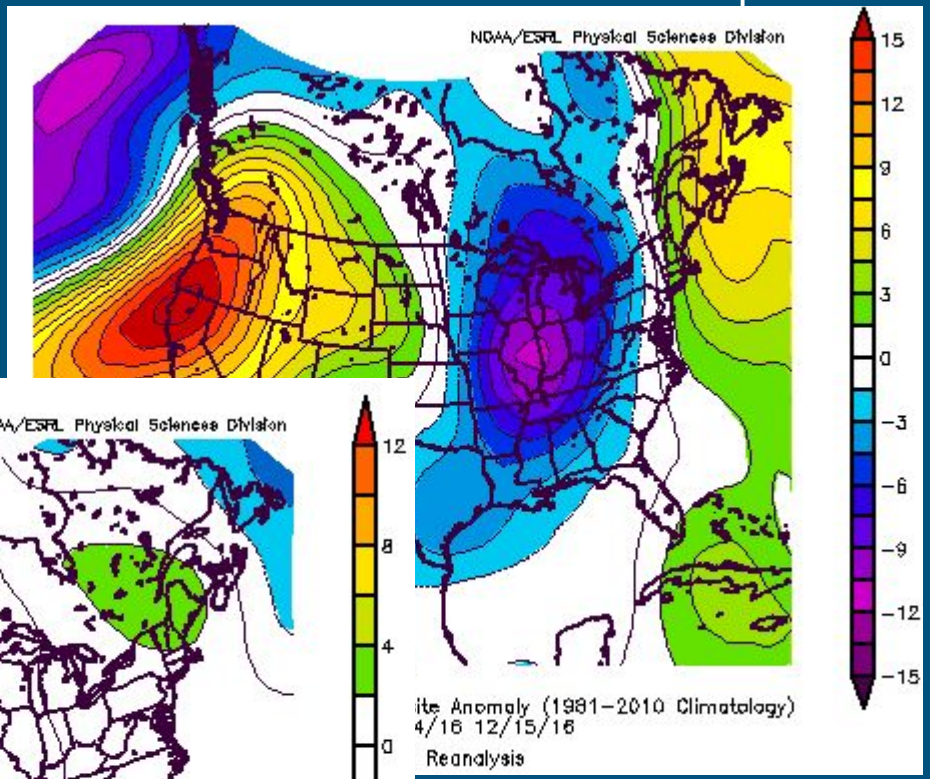

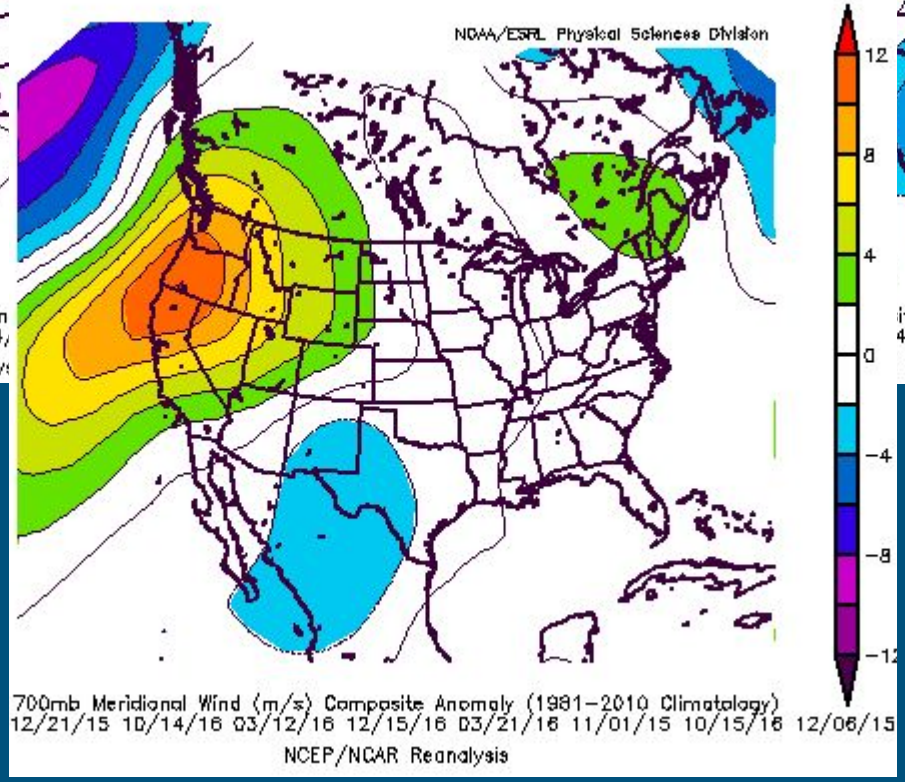

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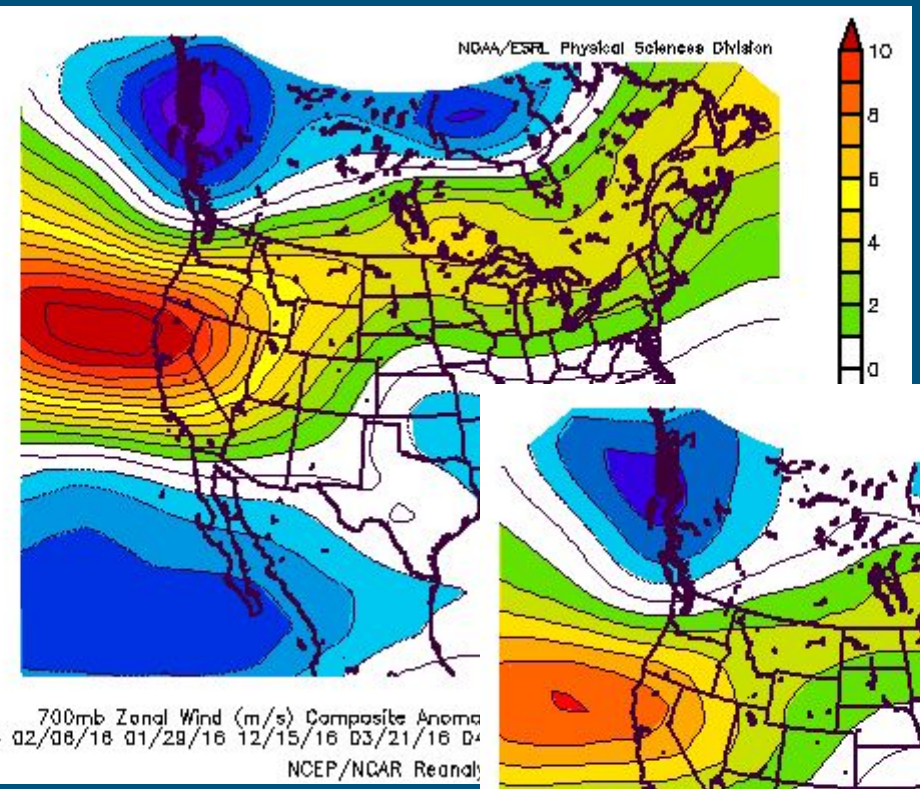
All Events



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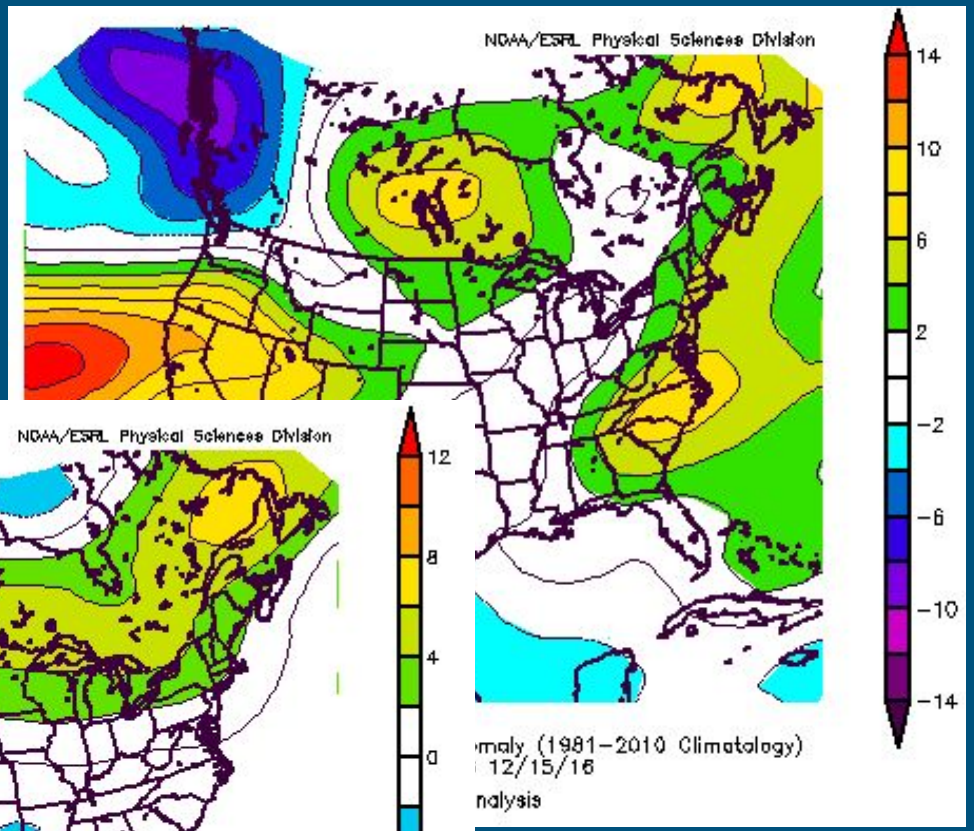
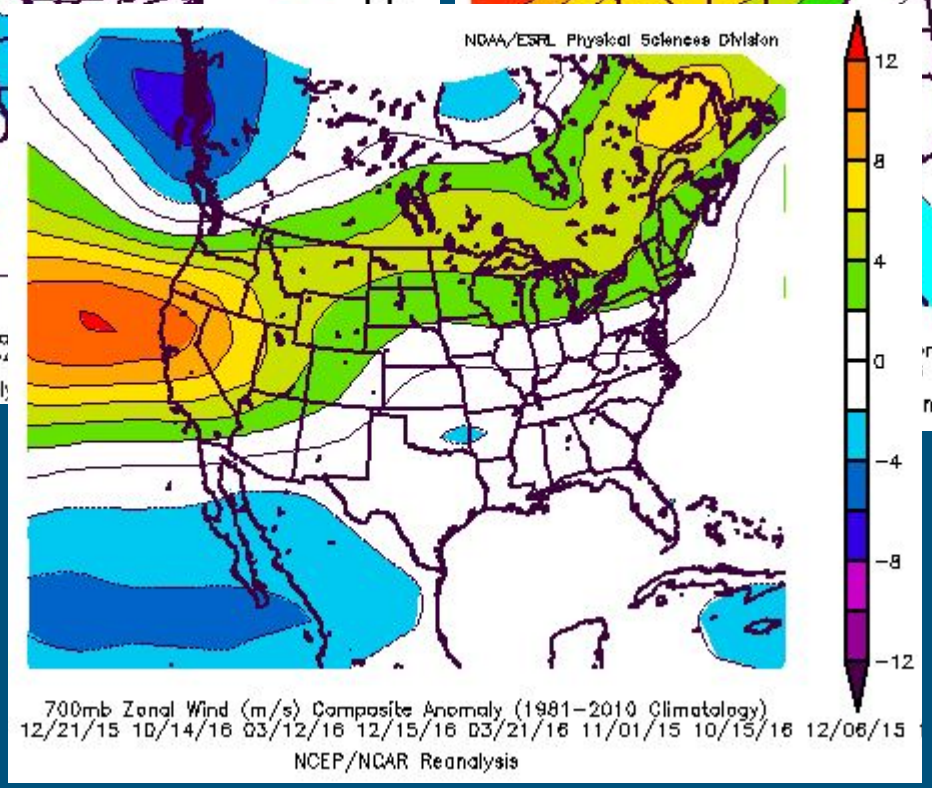
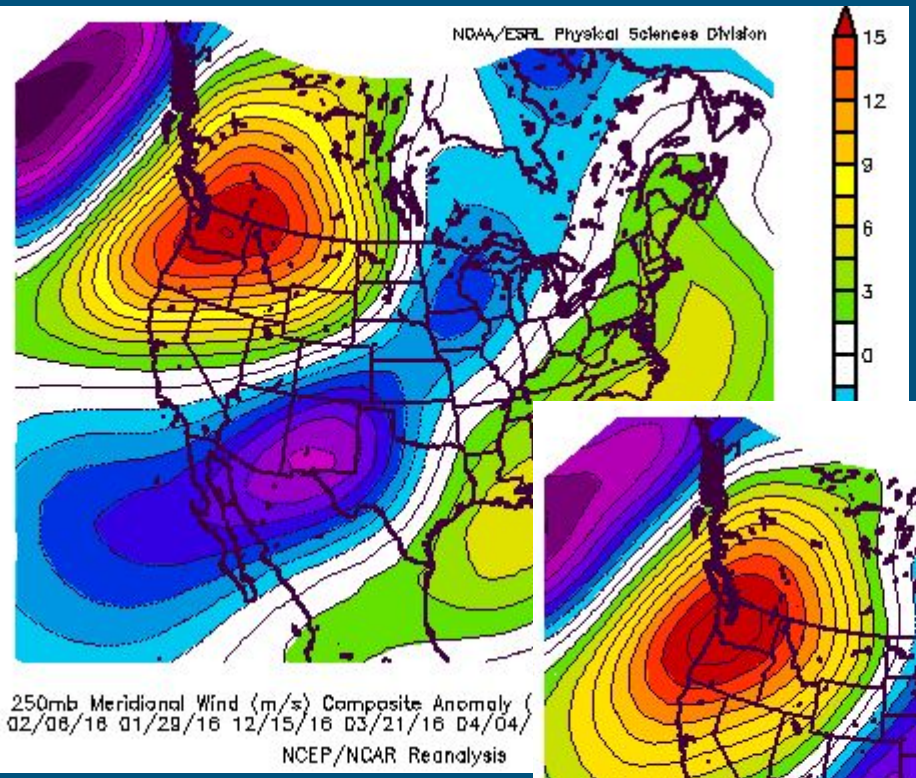




Top 11 Events

250 mb Meridional Anomalies

All Events



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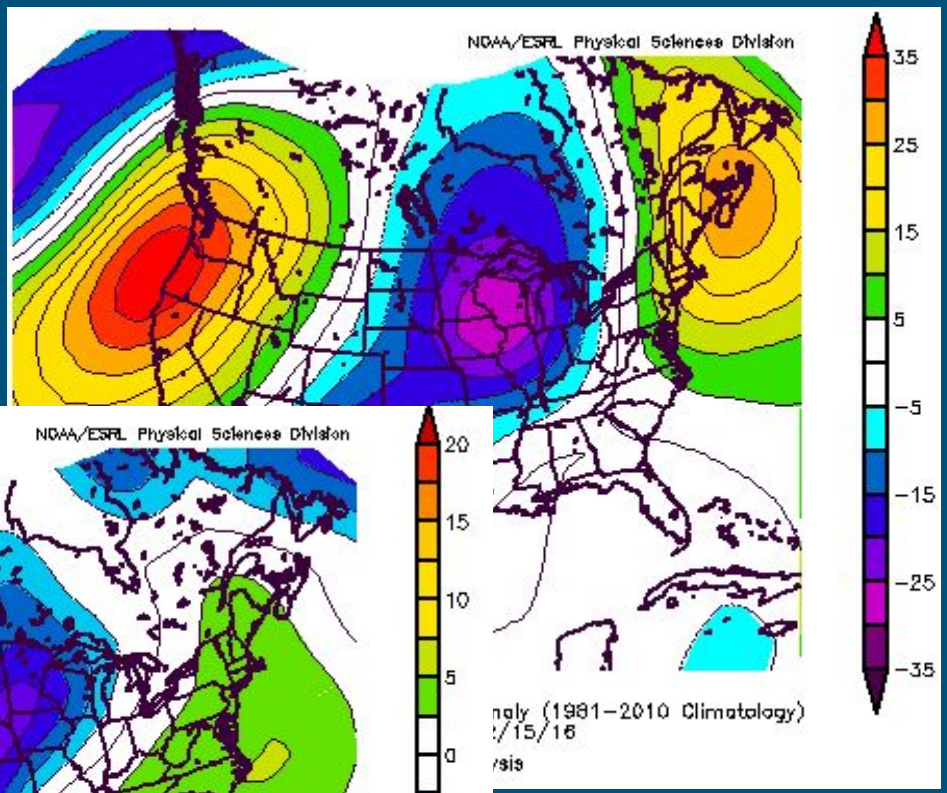
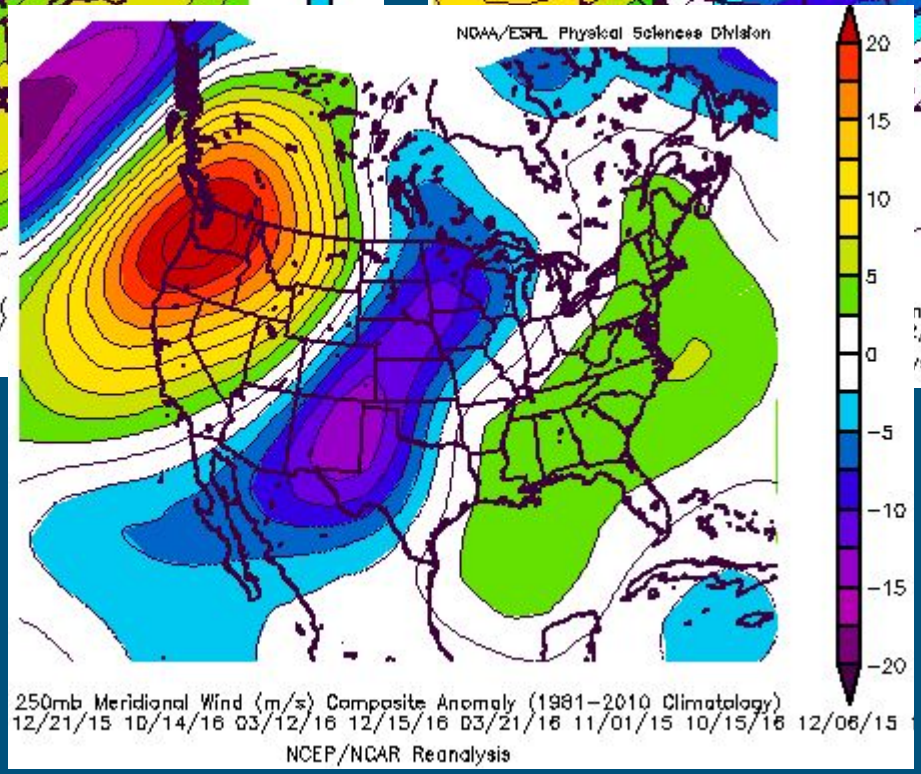
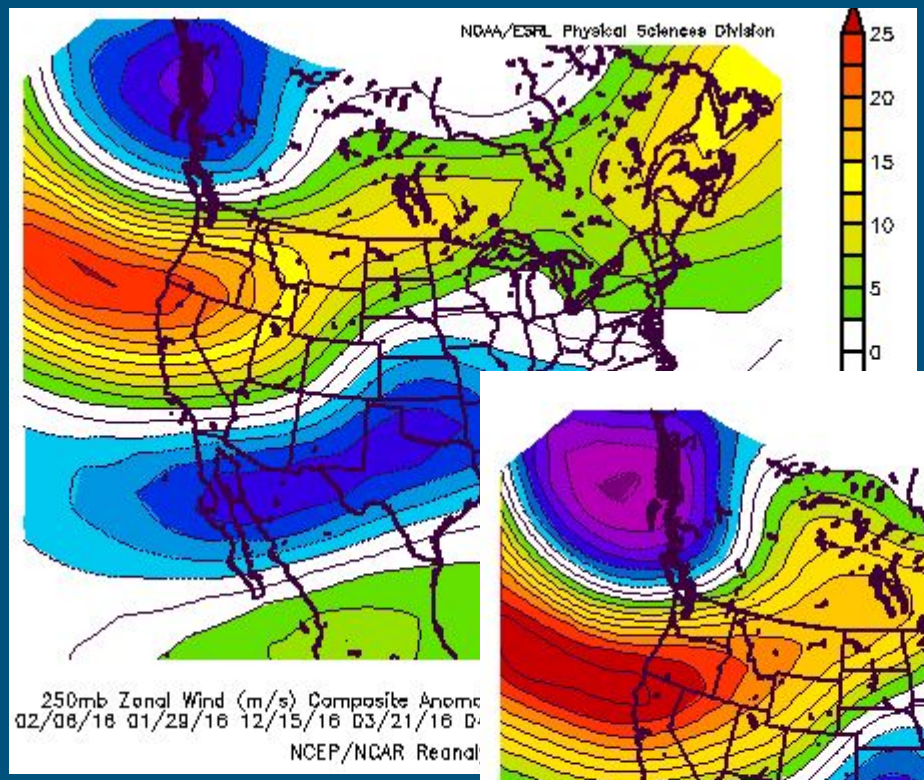




Top 11 Events

250 mb Zonal Anomalies

All Events



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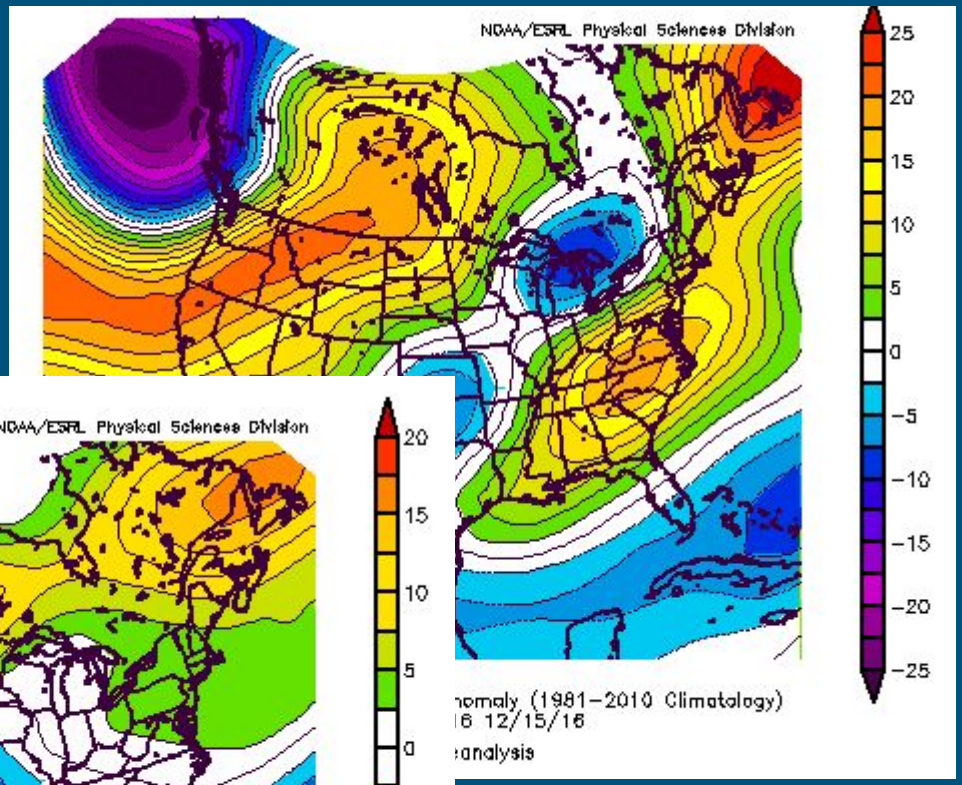
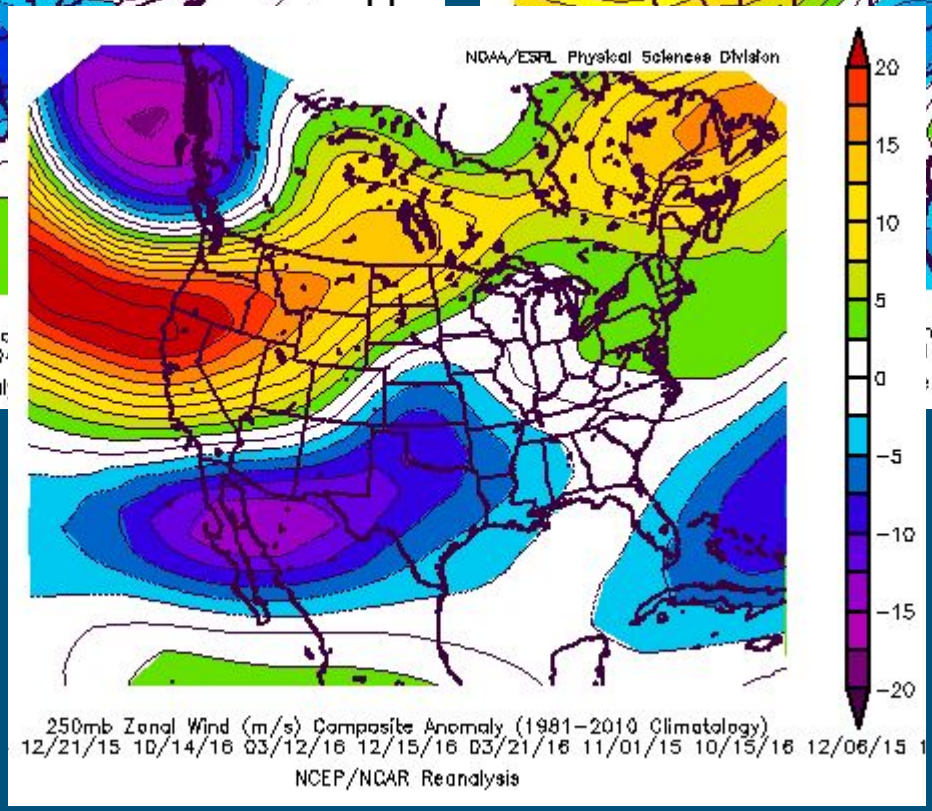




Top 11 Events

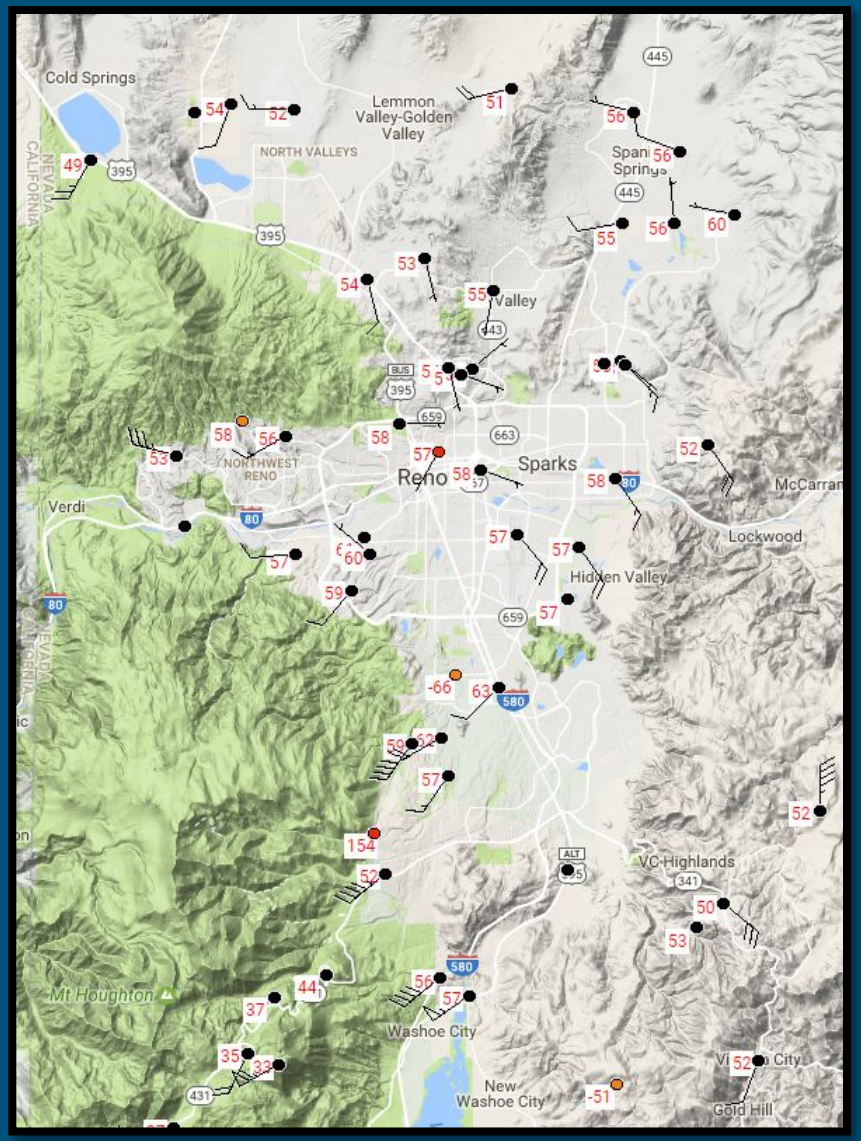
Other Findings

- Southerly winds at KRNO accounted for 84% of the events
- 52% of the events had clear cases of rotors present
- 42% of the events the winds went from calm or nearly calm to howling quickly (sudden inversion break)
- Only 2 events had a clear wind shift from south to west
- Only 1 event featured west winds
  - Also a day with a clear wind shift from a cold frontal passage

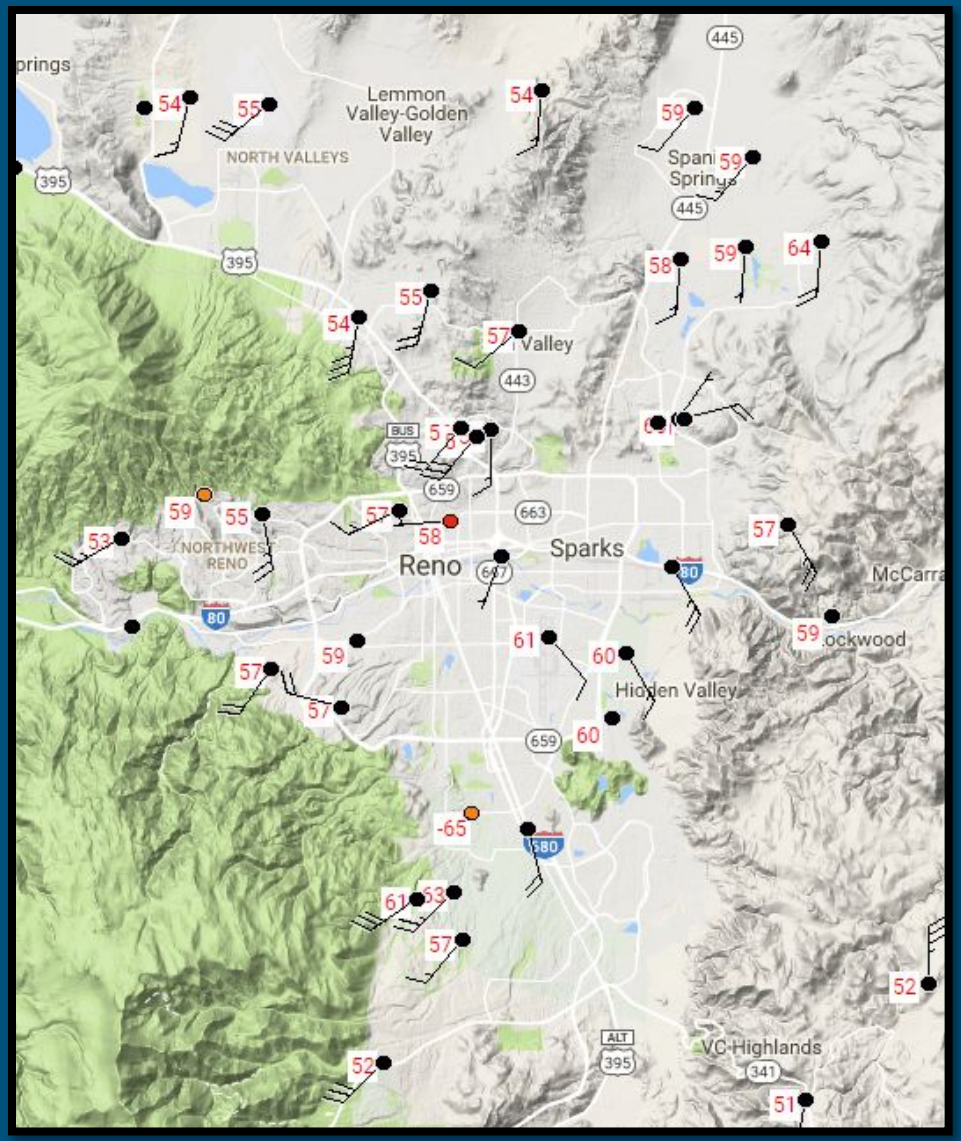
Rotors Ahead!

https://business.facebook.com/NWSReno/videos/534104630570154/

It’s All About Direction

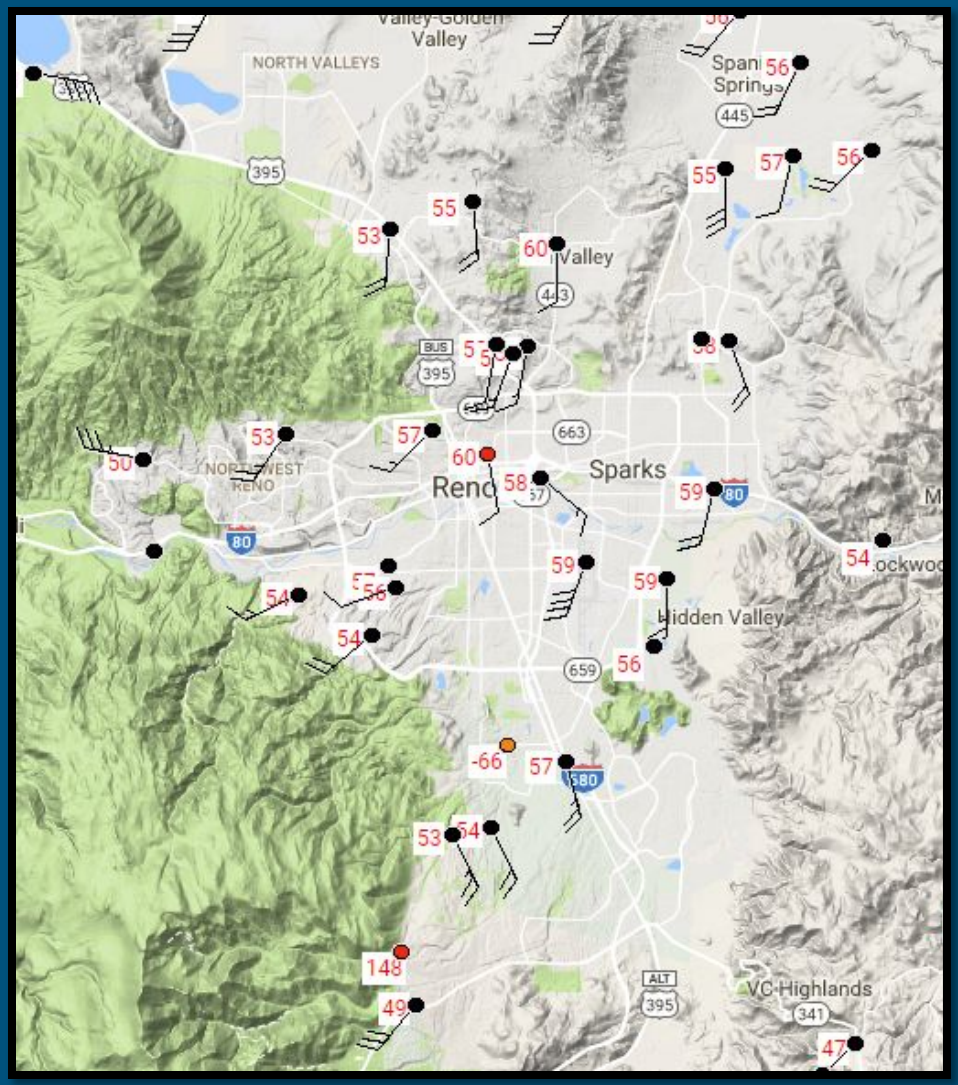


Dec 15, 2016 - 20z

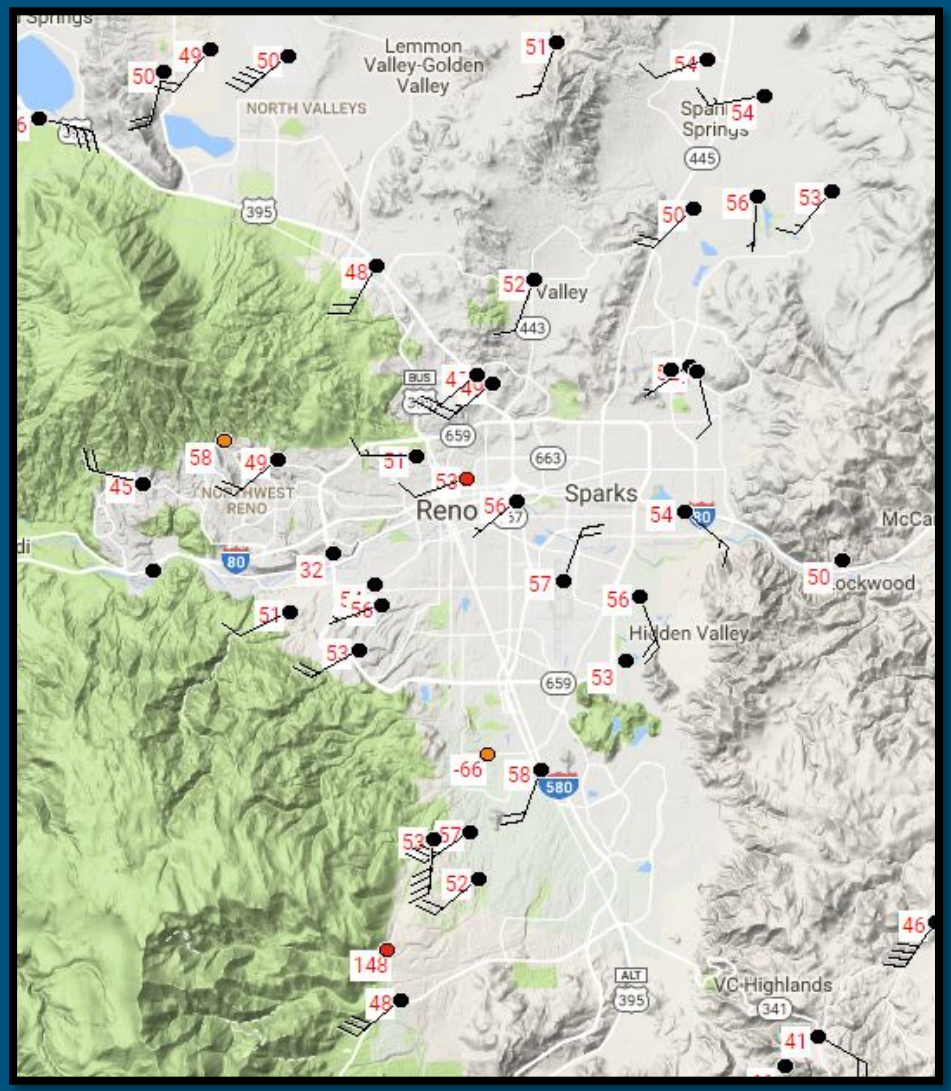


Oct 14, 2016 – 13z

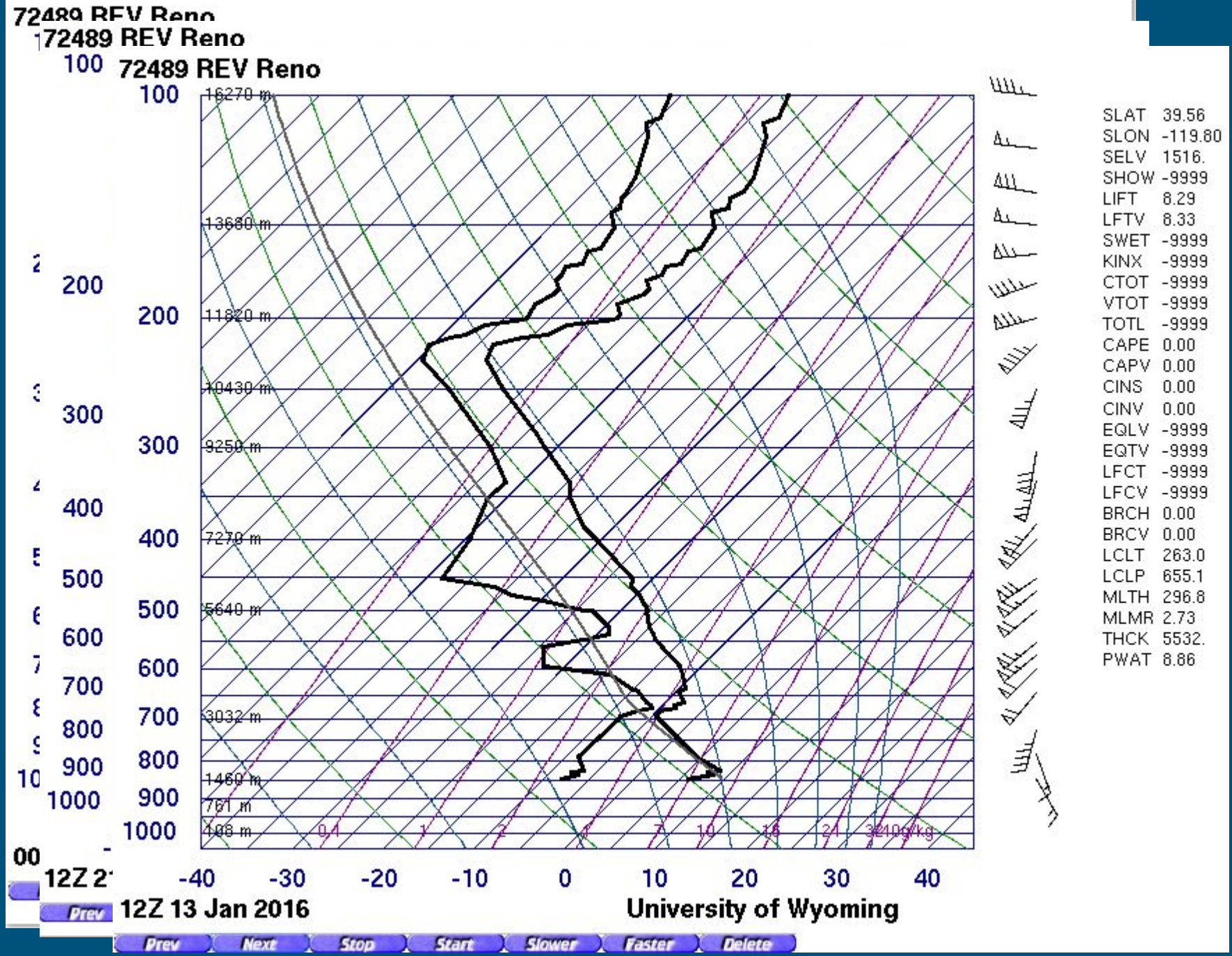
It’s All About Direction



Dec 3, 2015 – 22z



Mar 21, 2016 – 19z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72489 REV Reno
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40
12Z 13 Jan 2016
University of Wyoming
SLAT 39.56
SLON -119.80
SELV 1516.
SHOW -9999
LIFT 8.29
LFTV 8.33
SWET -9999
KINX -9999
CTOT -9999
VTOT -9999
TOTL -9999
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CAPV 0.00
CINS 0.00
CINV 0.00
EQLV -9999
EQTV -9999
LFCT -9999
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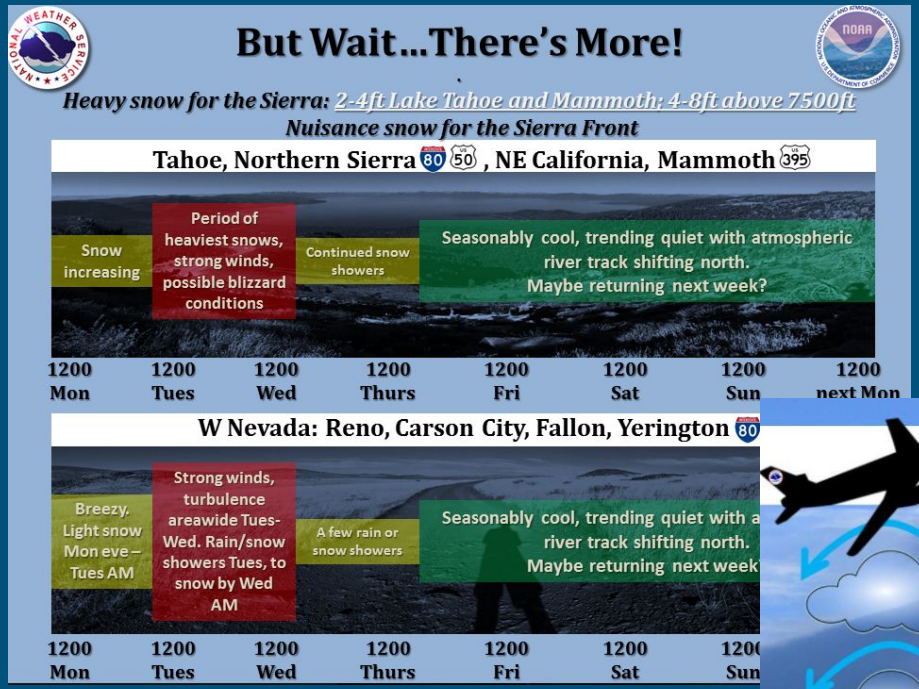
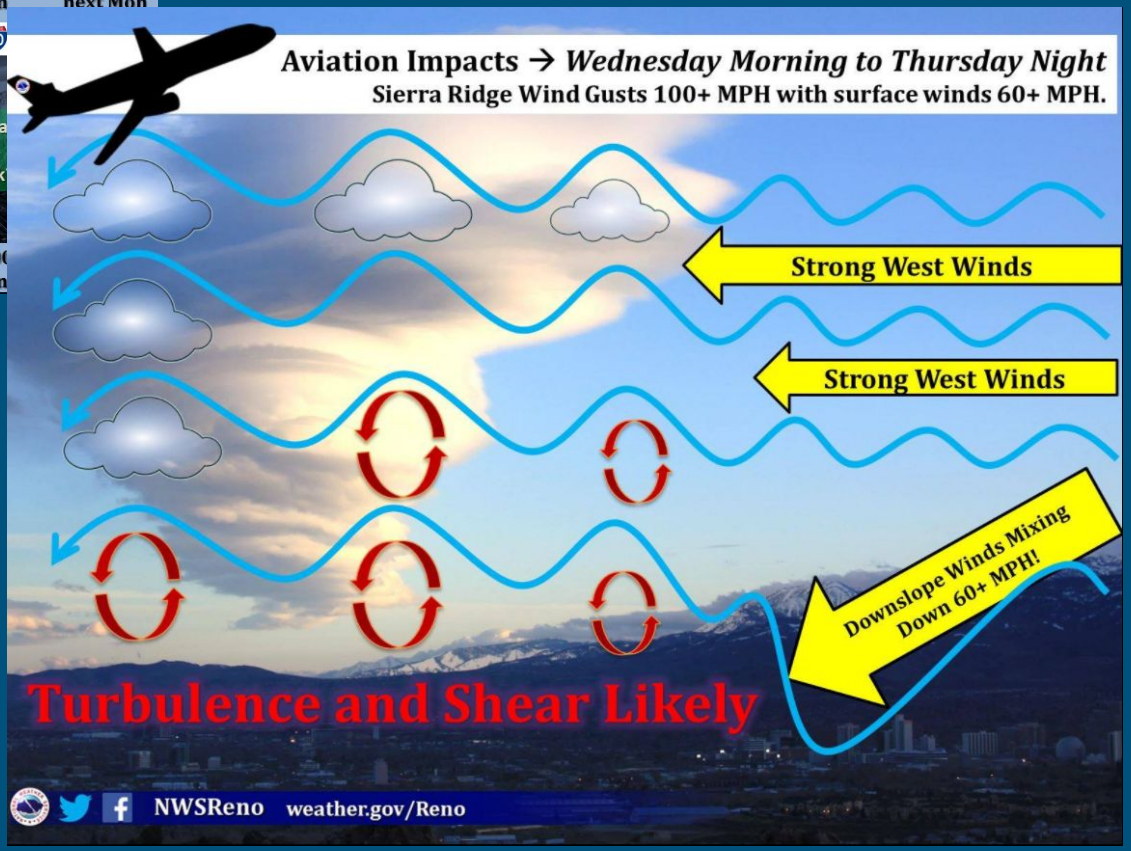
LCLT 263.0
LCLP 655.1
MLTH 296.8
MLMR 2.73
THCK 5532.
PWAT 8.86
Prev
Next
Stop
Start
Slower
Faster
Delete

Best Practices

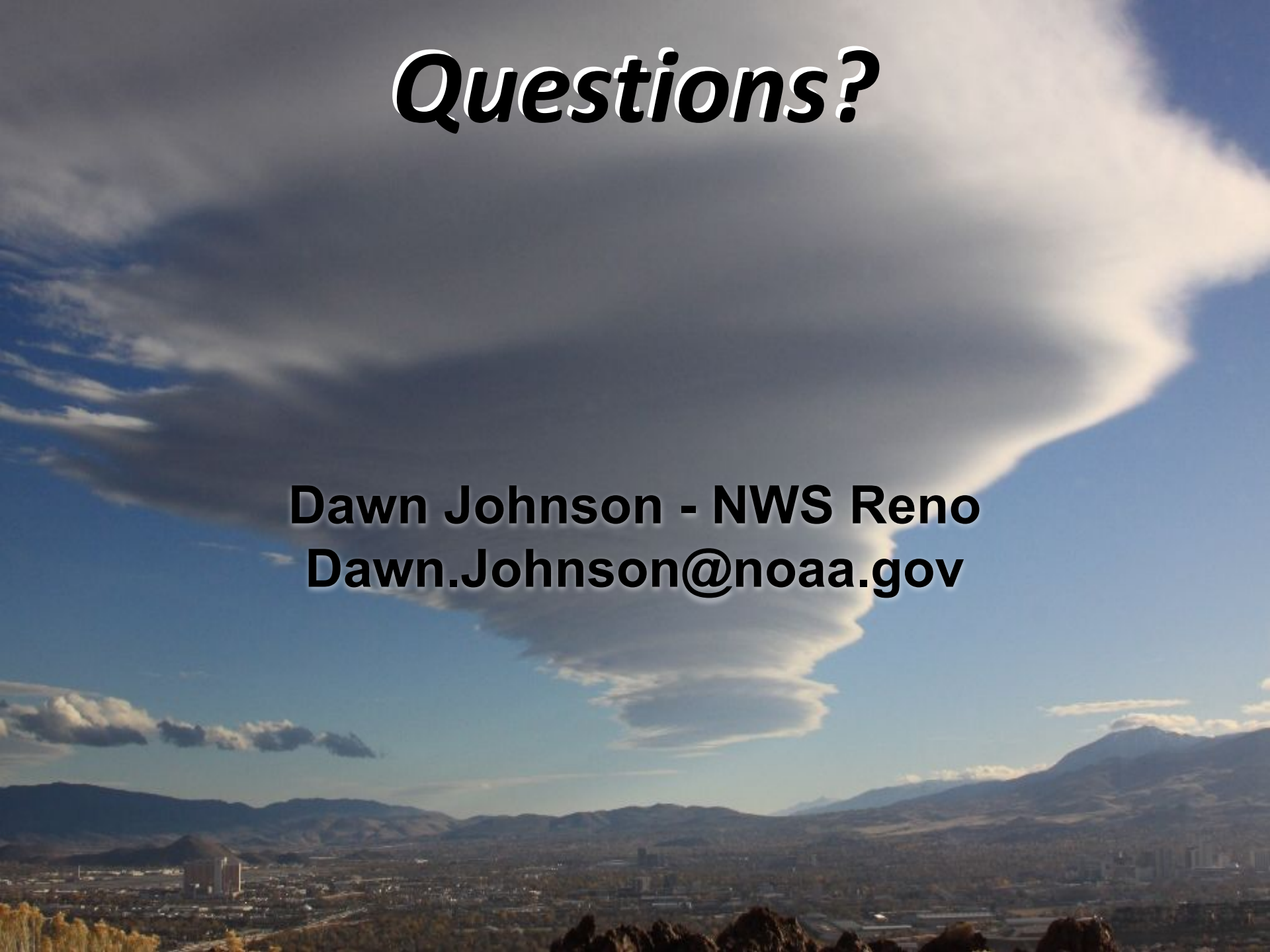
- **Key in on south wind events**
- Look at the anomalies and how they might line up compared to the previous events
- Focus in on the flow through the valley (West, South southwest, South or SE variations, rotors, etc)
- If rotors are present, so is LLWS!
- Be aware of frontal passages – often LLWS along the front

Messaging and Future Work...





NWS Reno -- Briefing on Winds, Warm Up with Snowmelt Increases Next Week


Questions?
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