Low Level Wind Shear at KRNO (Reno, NV)

How to better forecast and detect

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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
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

Top 3

Top 11 Events
700 mb Meridional Anomalies

All Events

Top 3

Top 11 Events
700 mb Zonal Anomalies

Top 3

Top 11 Events
250 mb Meridional Anomalies

Top 3

All Events

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!

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
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
But Wait...There's More!

Heavy snow for the Sierra: 2.4ft Lake Tahoe and Mammoth: 4-8ft above 7500ft
Nuisance snow for the Sierra Front
Tahoe, Northern Sierra (50°), NE California, Mammoth

- Snow increasing
- Period of heaviest snows, strong winds, possible blizzard conditions
- Continued snow showers
- Seasonably cool, trending quiet with atmospheric river track shifting north. Maybe returning next week?

W Nevada: Reno, Carson City, Fallon, Yerington

- Breezy. Light snow Mon AM, Tues AM
- Strong wind, turbulence widespread Tues-Wed. Rain/snow showers Tues, to snow by Wed AM
- Seasonably cool, trending quiet with atmospheric river track shifting north. Maybe returning next week?

Dangerously strong winds likely to affect travel for high profile vehicles and to impact aviation today.

Aviation Impacts → Wednesday Morning to Thursday Night
Sierra Ridge Wind Gusts 100+ MPH with surface winds 60+ MPH.

- Strong West Winds
- Downslope Winds Mixing Down 60+ MPH!

Turbulence and Shear Likely

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

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