

NOAA
National
Weather
Service

Inland Northwest High Wind Events

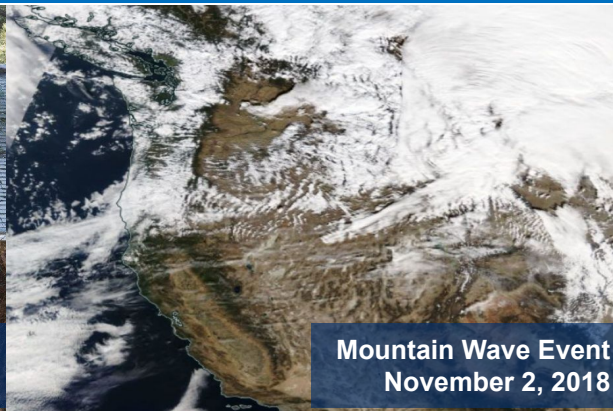
Intermountain West Aviation Weather Safety Workshop

2022 June 10th

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Forecaster
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Historic Windstorm
November 17, 2015



Mountain Wave Event
November 2, 2018



Dust Storm
March 28, 2021



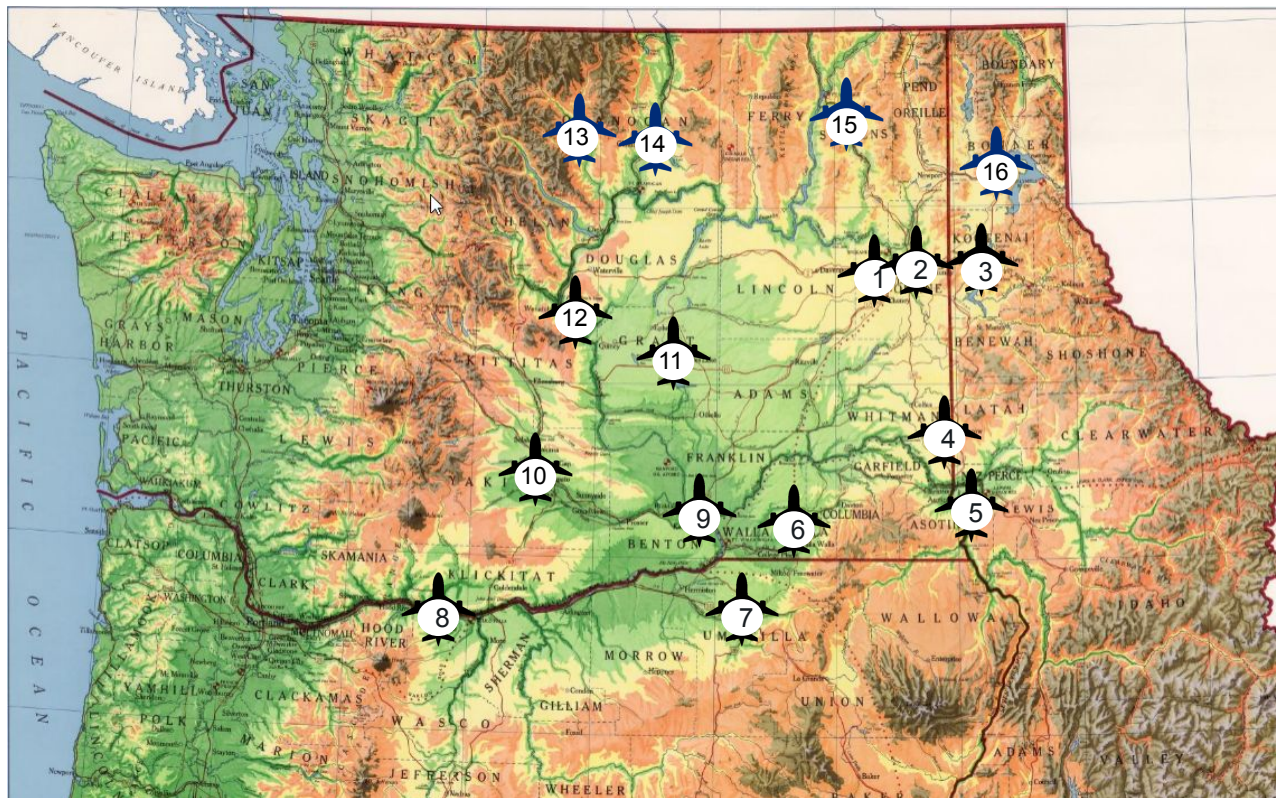
Overview



- Topography of the Inland Northwest (INW)
- Synoptic patterns for high wind events
 - Gradient driven
 - Mountain waves
- Model guidance pertaining to mountain waves



Topography of the INW



Airports with TAFs

1. Spokane International (GEG)
2. Spokane Felts Field (SFF)
3. Coeur d'Alene (COE)
4. Pullman/Moscow (PUW)
5. Lewiston (LWS)
6. Walla Walla (ALW)
7. Pendleton (PDT)
8. The Dalles (DLS)
9. Pasco/Tri Cities (PSC)
10. Yakima (YKM)
11. Moses Lake (MWH)
12. Wenatchee (EAT)

Airports without TAFs

13. Winthrop (S52)
14. Omak (OMK)
15. Colville (CQV)
16. Sandpoint (SZT)



Typical High Wind Pattern



Strong westerly upper level jet off of the eastern Pacific.

Strengthening surface low across southern British Columbia.

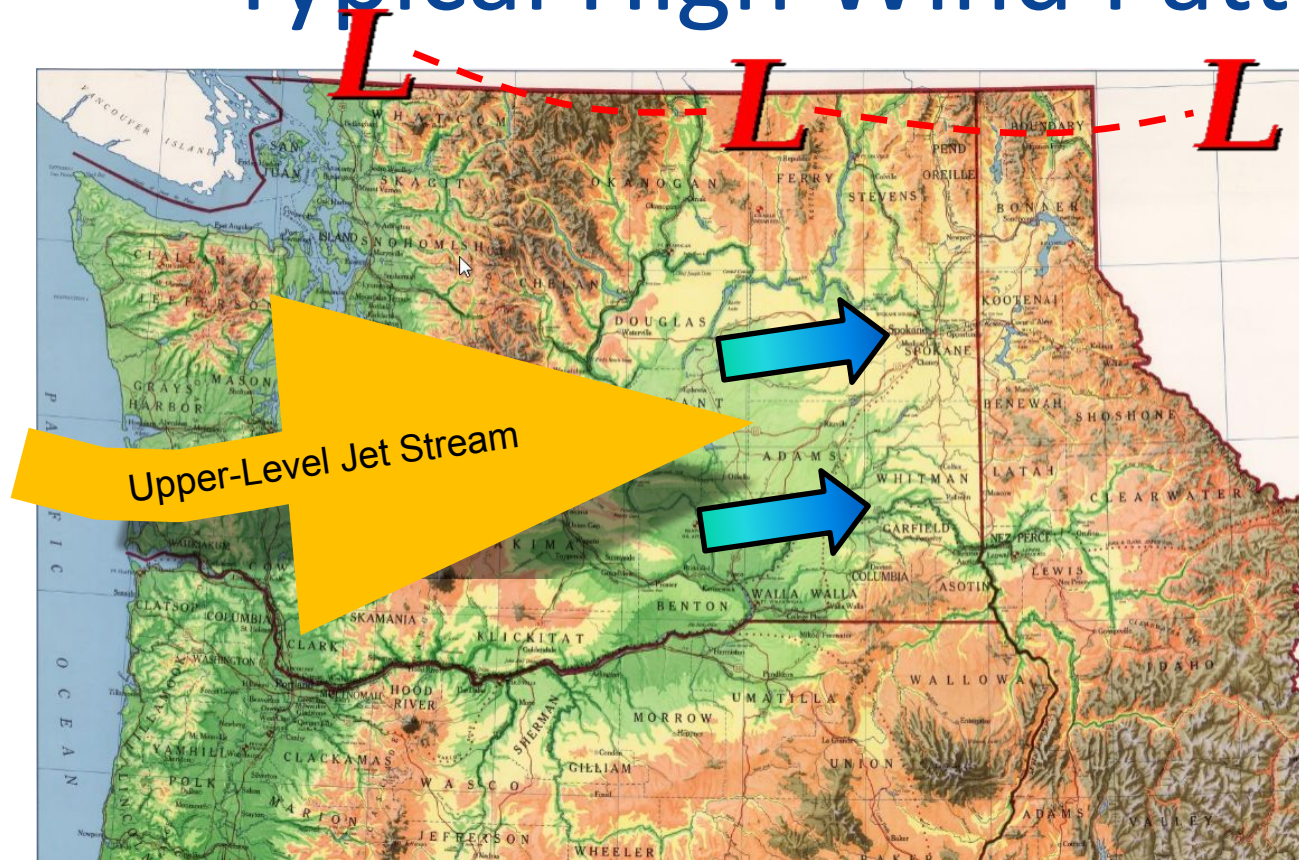
Strong low level jet out of the Columbia Gorge across.

Palouse and Spokane Area

- Winds at 850mb can be as strong as 50-65 kts.



Typical High Wind Pattern



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Palouse and Spokane Area

- Winds at 850mb can be as strong as 50-65 kts.

Cold air advection drives down stronger winds aloft.

- Westerly jet aligned with surface gradient.
- Maximizing wind gust potential.



Past Cases of High Winds at GEG



- February 2nd, 1999 (53 mph)
- November 18th, 2003 (63 mph)
- November 17th, 2015 (71 mph) – record for non-convective gust
- October 13th, 2020 (59 mph)
- January 13th, 2021 (71 mph) – tied the record 6 years later
- March 28th, 2021 (56 mph)
- November 15th, 2021 (62 mph)

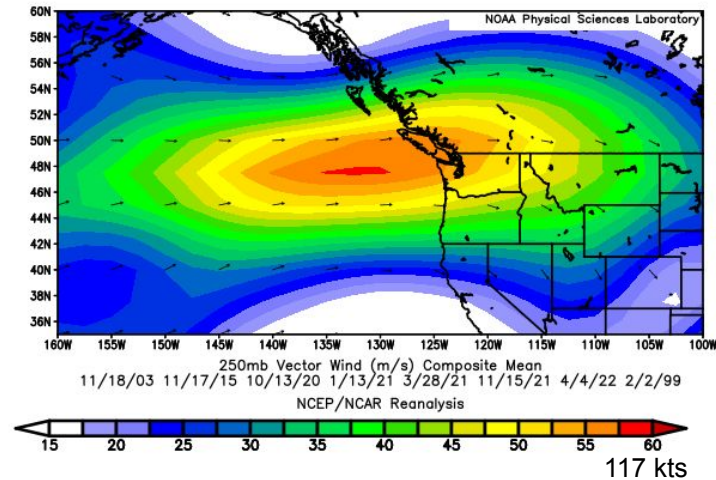




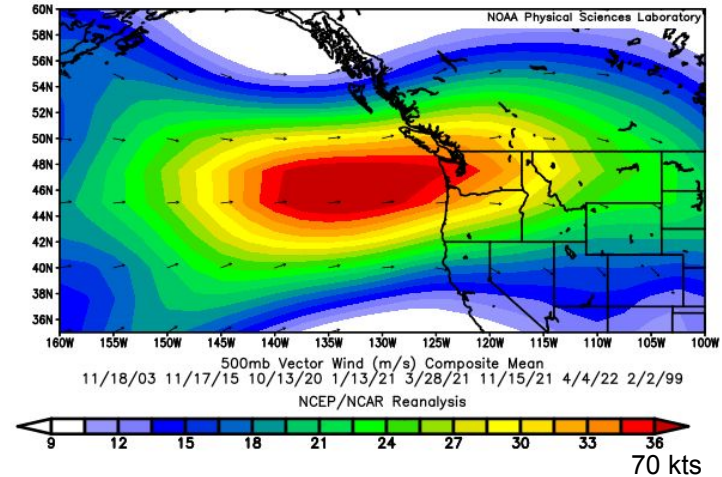
Upper Level Winds Reanalysis Charts



250 mbs



500 mbs



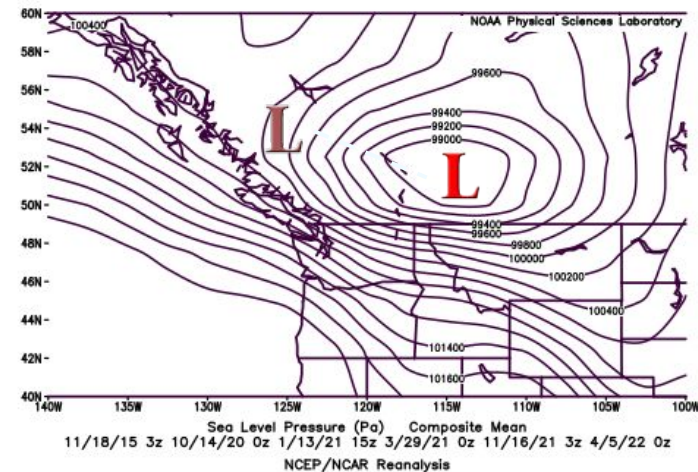
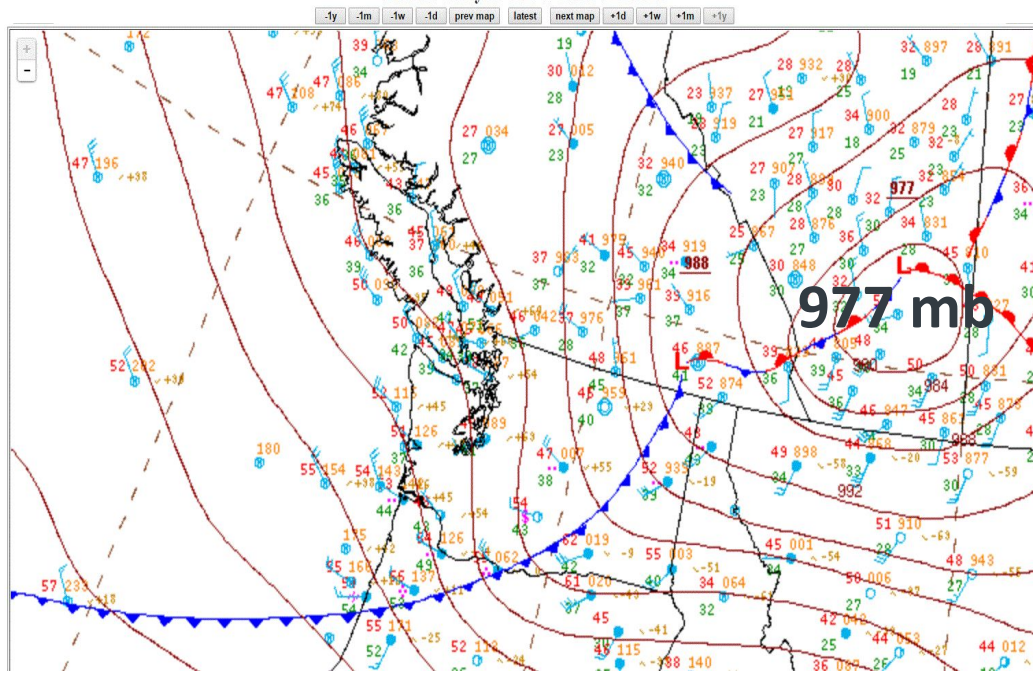
- Strong zonal jet streak into WA
- Southern BC in left exit region of jet



Sea Level Pressure Analysis/Reanalysis

2015 November 17th Windstorm

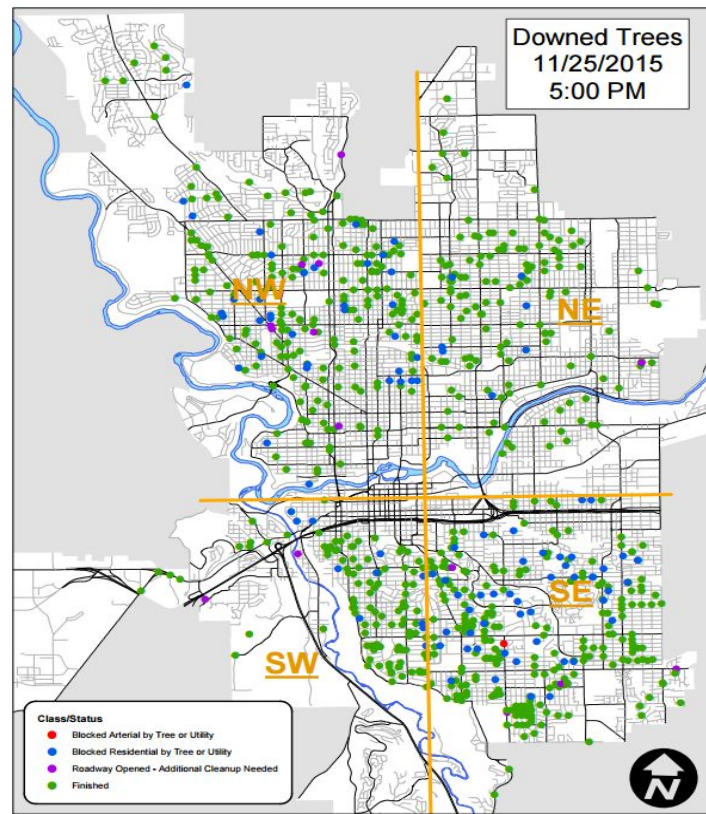
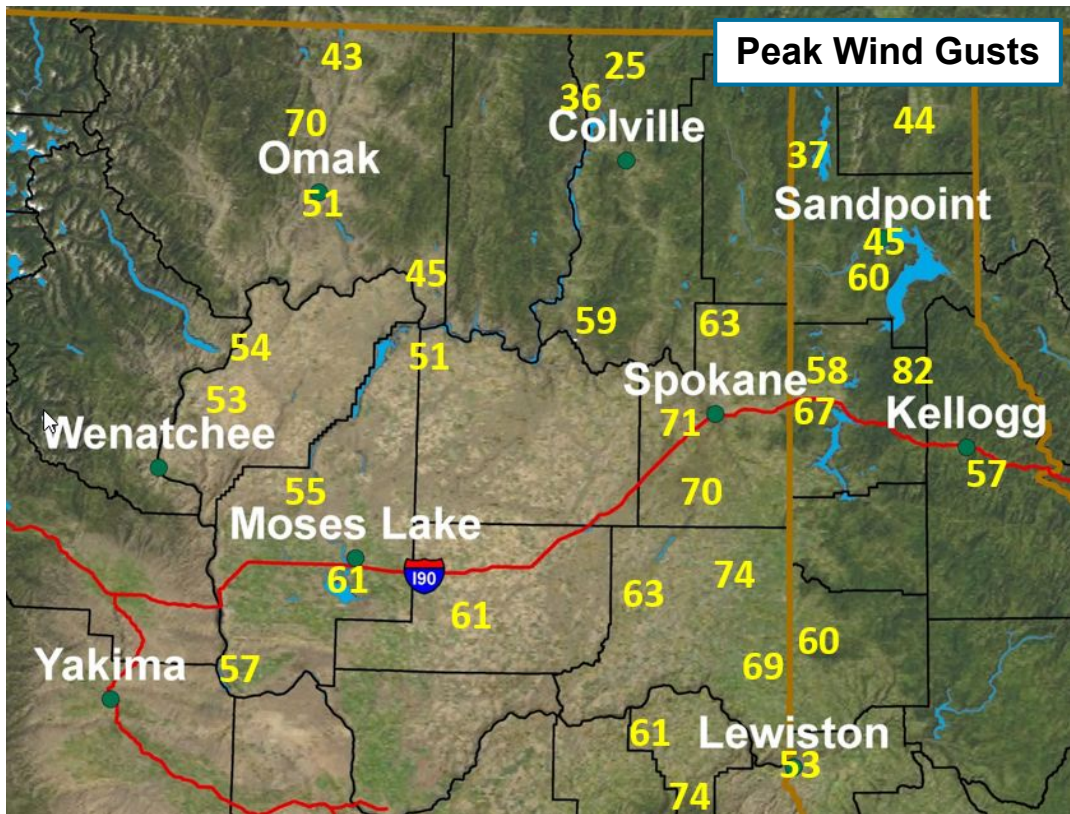
Surface analysis 03Z Wed Nov 18 2015



A deepening surface low tracks across BC, Canada

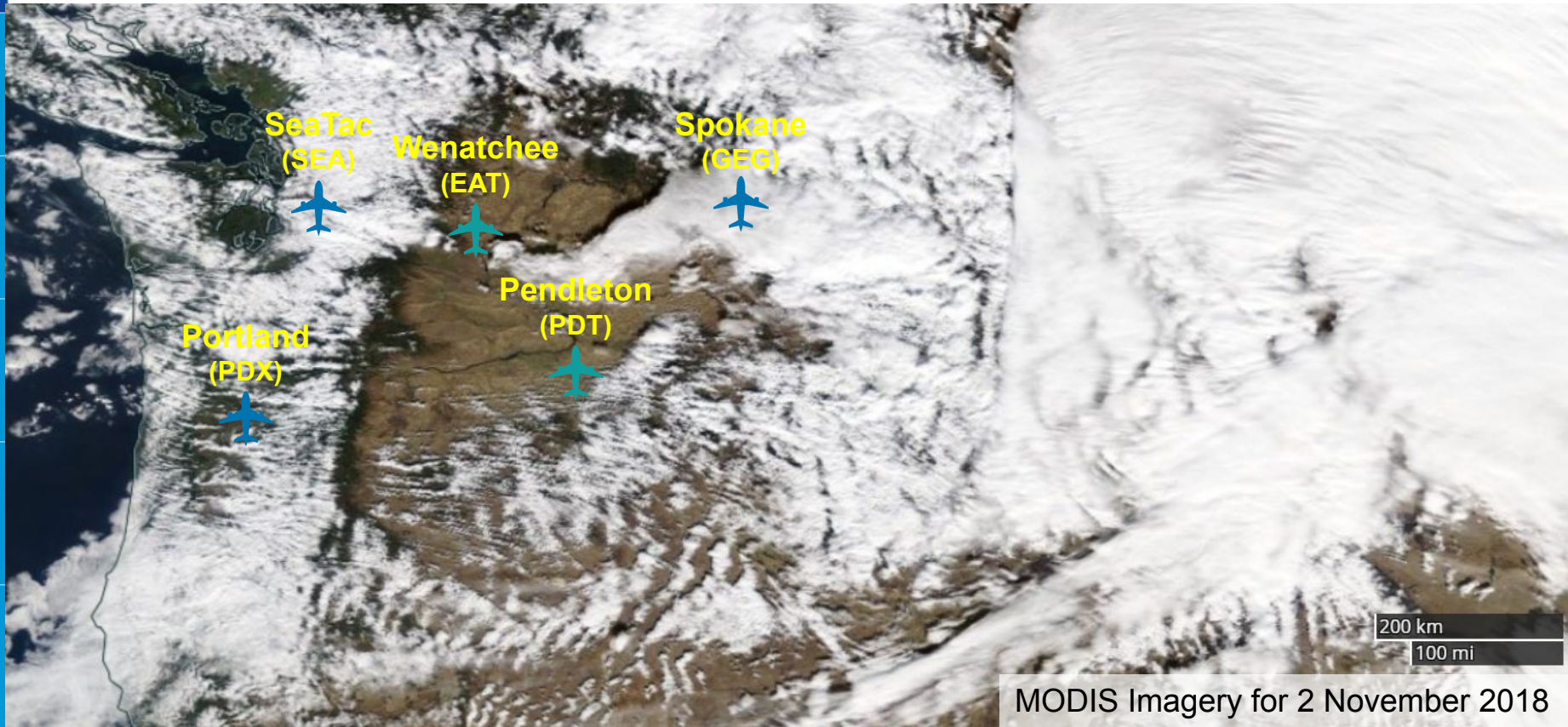


2015 November Windstorm





Cascade Mountain Waves



MODIS Imagery for 2 November 2018





Basic Mountain Wave Theory

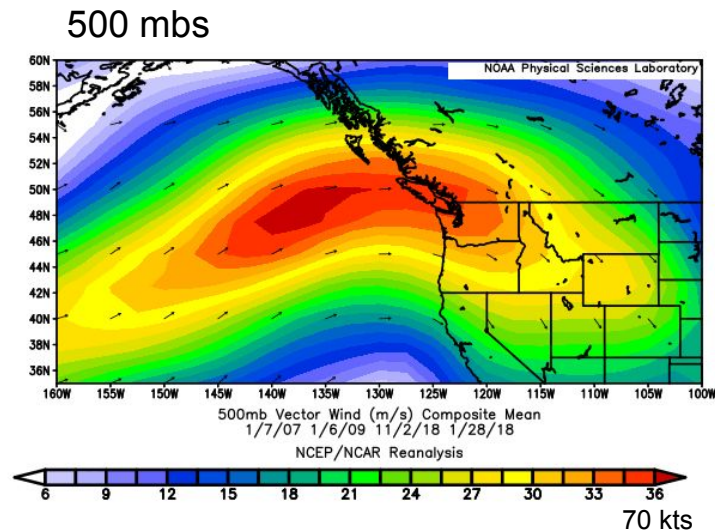
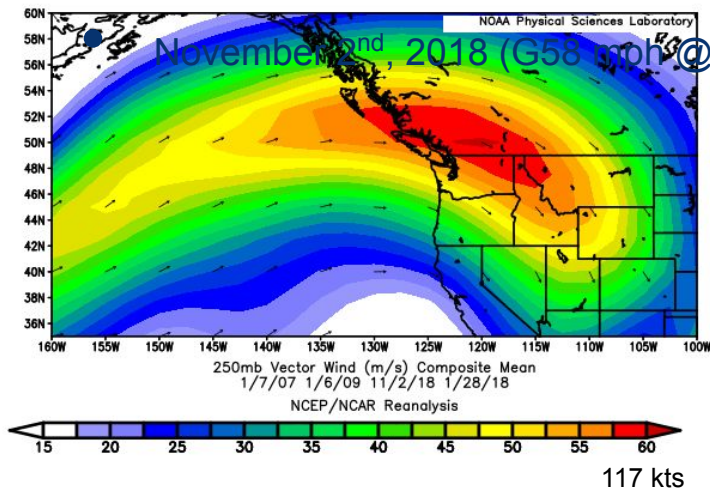
- Froude number (Fr) = $\frac{\text{kinetic energy (wind sp)}}{\text{potential energy (stability x height)}}$
Fr $\sim$ 1 : mountain waves likely





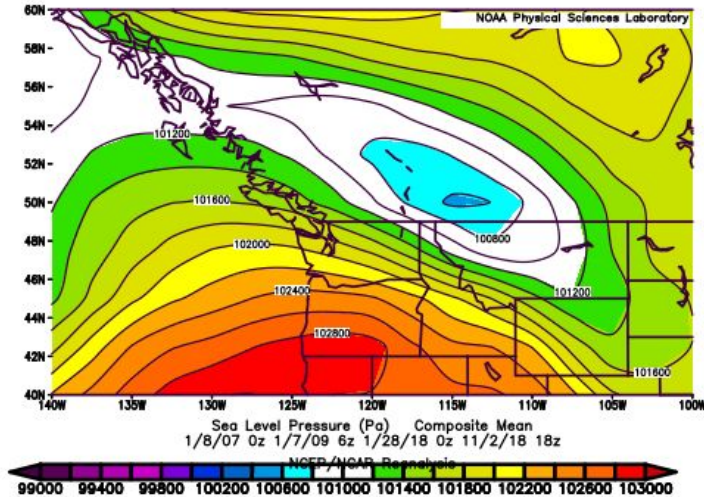
Upper Level Winds Reanalysis Charts

- January 7th, 2007 (G72 mph @ EAT)
 - January 6th, 2009 (G62 mph @EAT)
 - January 27th, 2018 (G44 mph @EAT)
- 250 mbs
- November 2nd, 2018 (G58 mph @EAT)

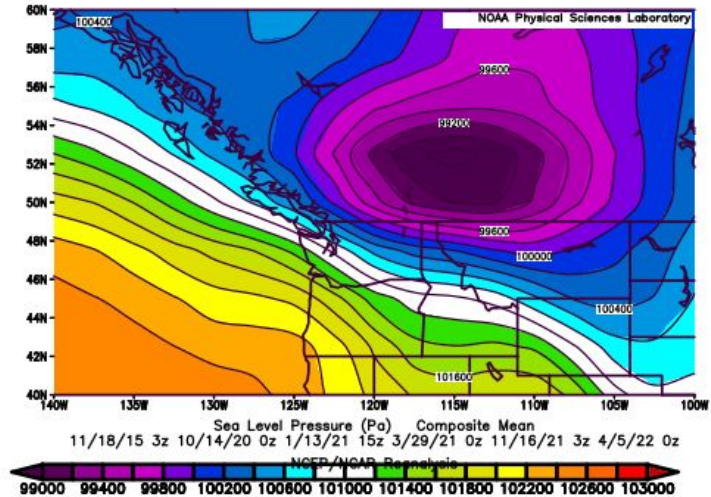




Comparison of MSLP



- Mountain wave cases

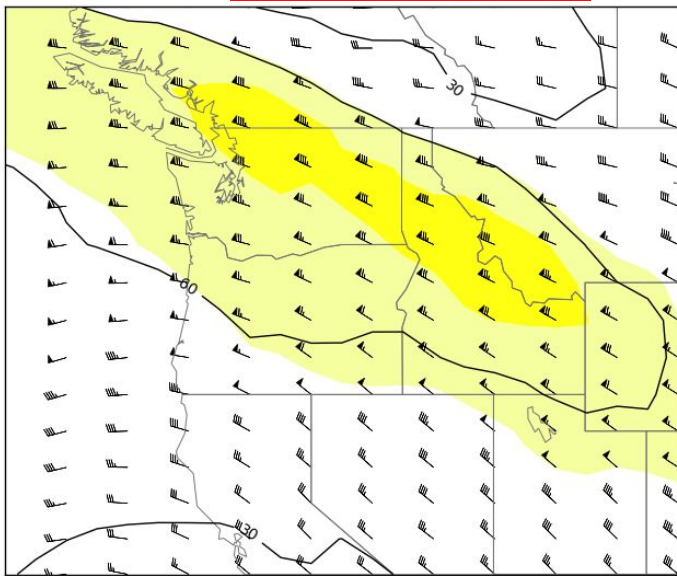


- Gradient high wind cases



Ensemble Guidance: Mountain Waves

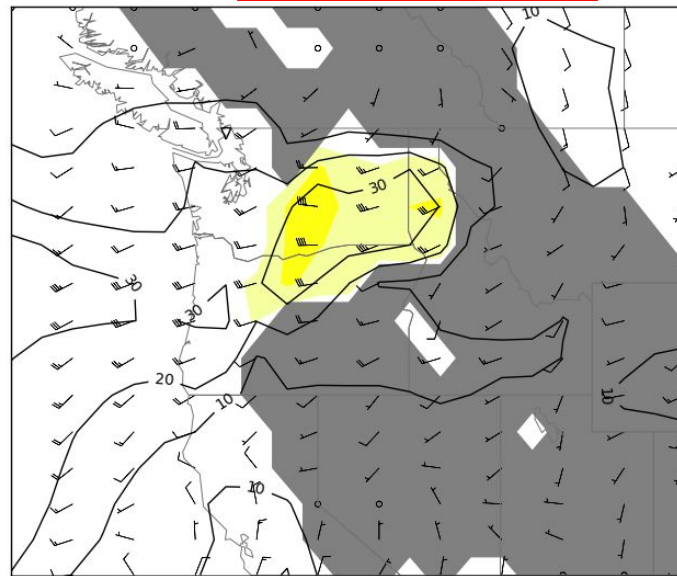
NAEFS Mean 500-hPa Wind Speed (kt) and Standardized Anomaly
HOUR 036 - VALID 00:00 UTC Sun Jan 28 2018



Relative to the 17-Jan to 07-Feb 1979-2009 CFSR climatology



NAEFS Mean 850-hPa Wind Speed (kt) and Standardized Anomaly
HOUR 036 - VALID 00:00 UTC Sun Jan 28 2018



Relative to the 17-Jan to 07-Feb 1979-2009 CFSR climatology
(gray = near or below ground)

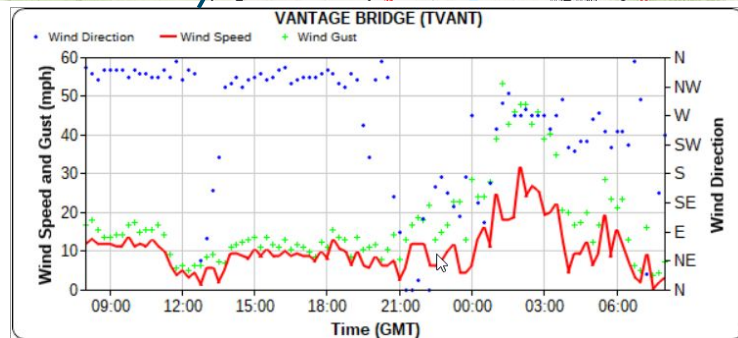
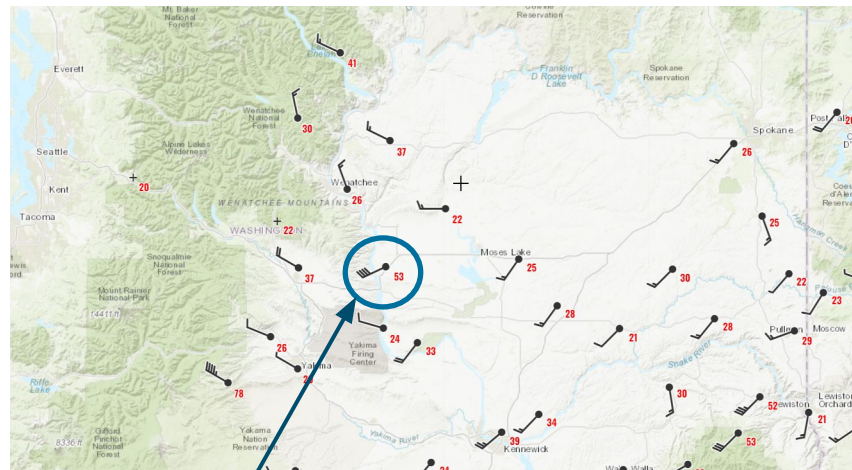
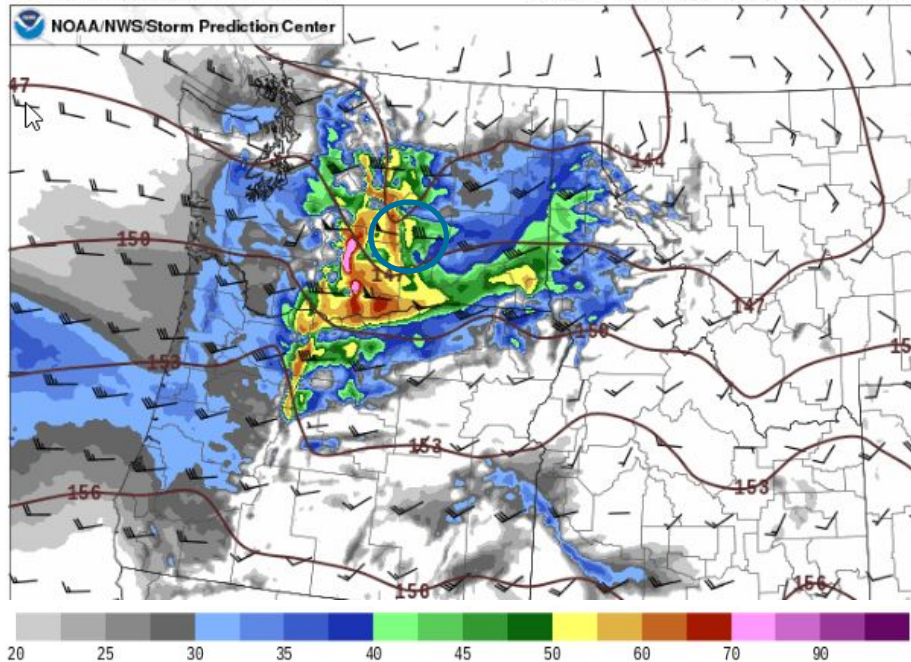




HREF Compared to Observed Gusts



HREF MN[850 mb Z] (dam) Run: Sat 2018-01-27 00:00 UTC
850 mb wind (kts), ensemble mean Valid: Sat 2018-01-27 22:00 UTC





Stable Layers

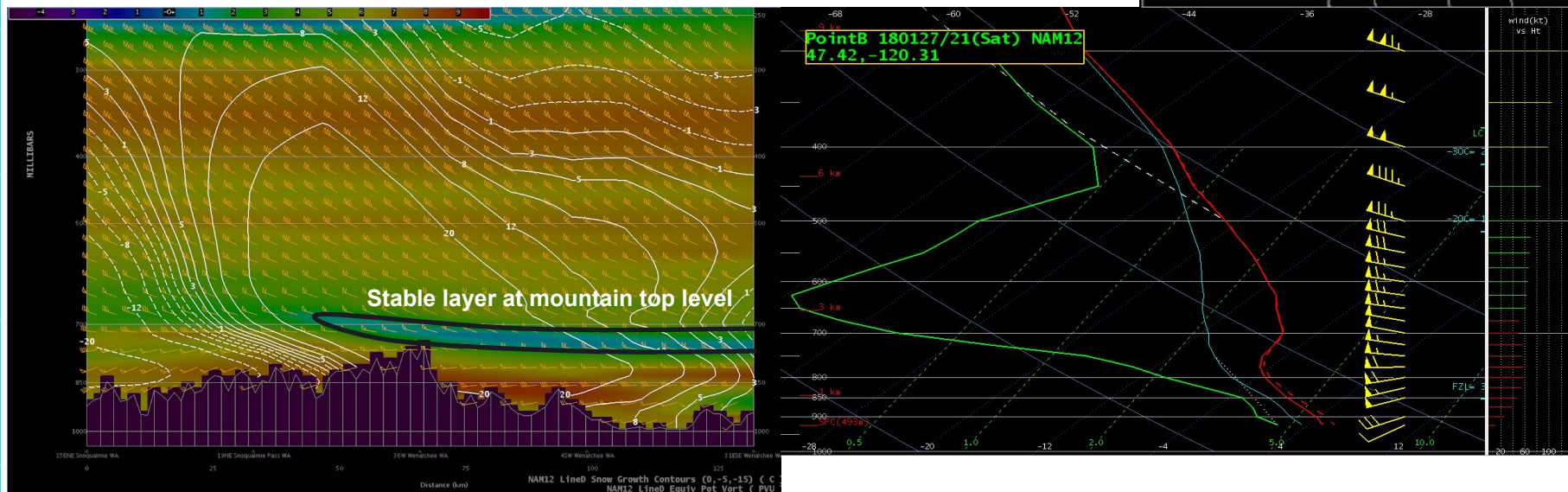


Image: Lapse Rate (blue = negative)
Contours: Omega (positive values = downward motion)

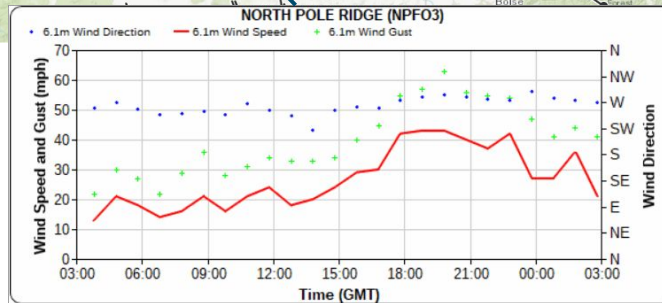
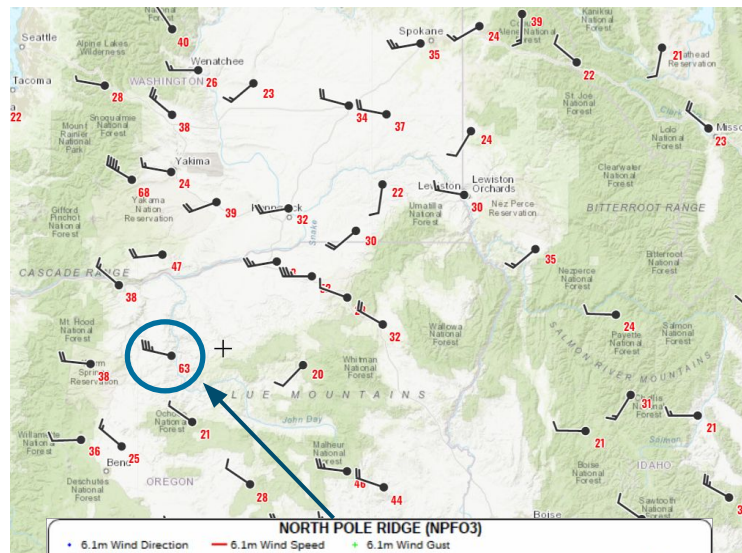
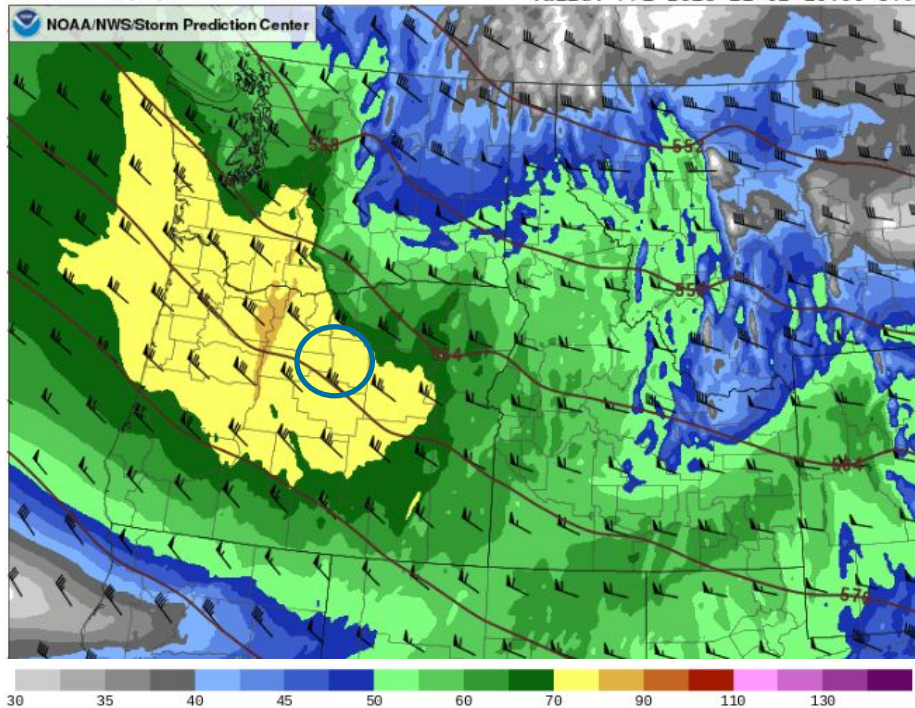




Mountain Wave Enhancement?

HREF MN[500 mb Z] (dam) Run: Fri 2018-11-02 12:00 UTC

500 mb wind (kts), ensemble mean Valid: Fri 2018-11-02 20:00 UTC

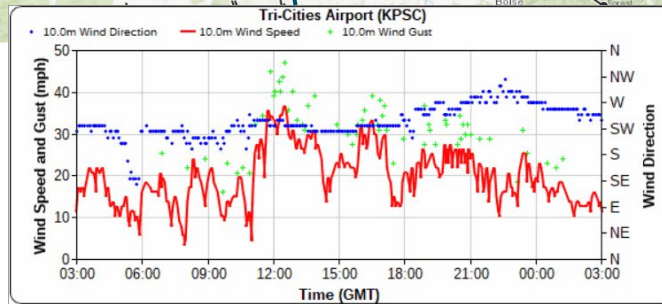
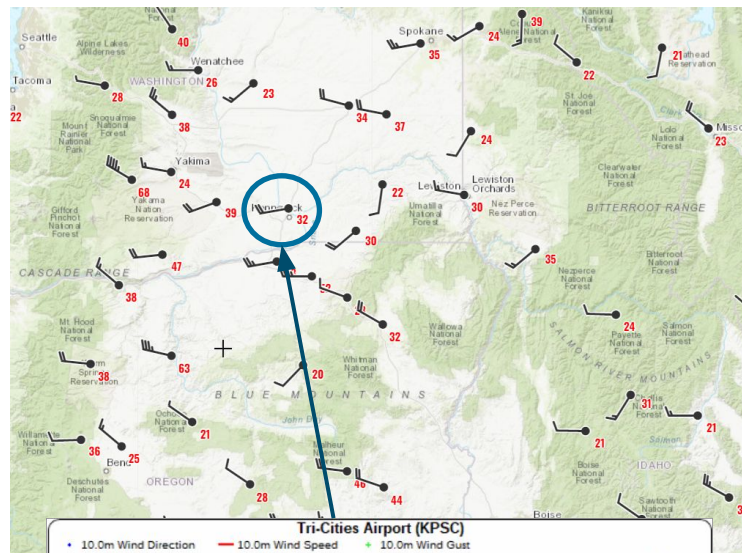
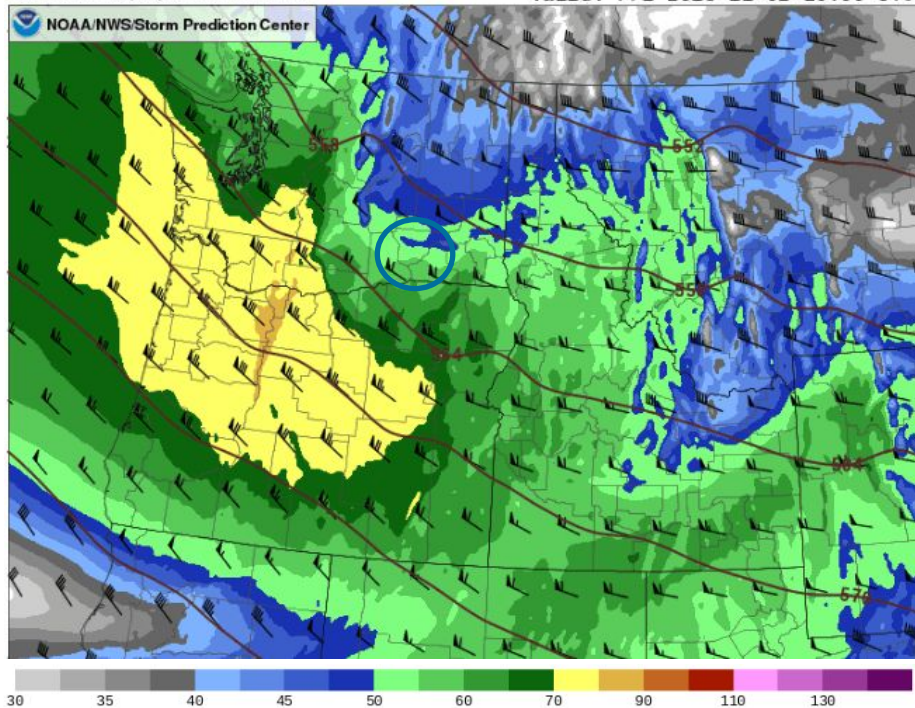




Mountain Wave Enhancement?

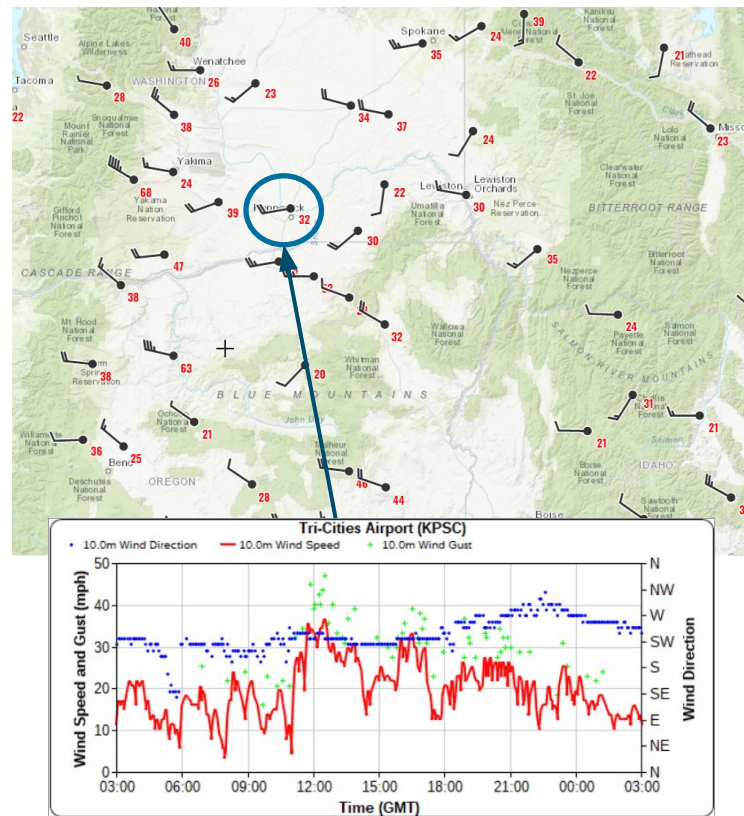
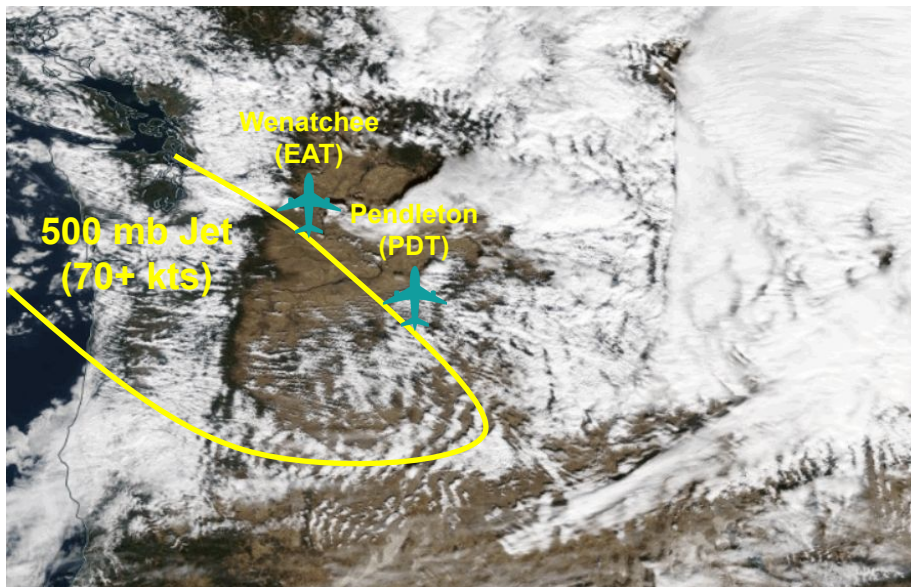
HREF MN[500 mb Z] (dam) Run: Fri 2018-11-02 12:00 UTC

500 mb wind (kts), ensemble mean Valid: Fri 2018-11-02 20:00 UTC





Mountain Wave Enhancement?





Summary



- Increase in high wind patterns over the INW in the last 5-10 years.
 - Low level wind shear concerns in the warm sector.
 - Extensive damage possible, especially where there are trees in NE WA/N ID.
 - Increasing episodes of blowing dust; drought is a factor.
- Mountain wave activity off of the Cascades can produce high winds.
 - Impacts tend to be more localized.
 - Pattern recognition and relying on high resolution model guidance are key.
 - Northwest to southeast oriented upper level jet across mountain chain.
 - Stable layer near mountain top level.



Thank You!

steven.vanhorn@noaa.gov

(EAT)

(GEG)

(PDT)

100 km

50 mi

