National Weather Service
Seattle ARTCC Center Weather Service Unit

Fall 2016
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ZSE Weather Watch

Are You Weather Ready?

By Alex Dodd, Aviation Meteorologist

September was National Preparedness Month, October saw the 2016 Great ShakeOut earthquake drill (part of America's PrepareAthon), and November welcomes Pacific Northwest Winter Awareness Week. So much is happening this fall reminding us to take action and prepare NOW for the types of emergencies that could affect us where we live, work, and visit.

Weather accounts for over 20 percent of all aviation accidents in the United States, the vast majority of those caused by adverse winds and poor ceiling or visibility conditions, and roughly 80 to 90 percent of these accidents are in the general aviation community. Make sure you are fully aware of the weather you will encounter on your next flight, and that you and your aircraft are prepared for whatever conditions you may encounter!

The CWSU has taken steps to prepare for emergencies that would compromise our ability to provide weather support to FAA air traffic managers and controllers. We have a communication plan which allows our to coordinate with each other when regular communication networks are stretched thin or disrupted. We also have an emergency 'bug-out bag' which enables us to fulfill our mission and commitment to the FAA at an alternate location.

Do you know what you would do if you were in an aviation emergency? Will you be able to communicate with your family and let them know you are okay? Are you familiar with aviation-related weather alerts & notifications, and do you have a way to receive them? Take this opportunity to create emergency plans and supplies. You will be better prepared to either avoid being involved in an emergency, or be able to make it through safely. Don't wait. Communicate!

Traffic Management

Advisory Service

- Sea-Tac operations increased for the third year in a row this Summer, with an 8.1 % increase in 2016. Traffic volume is up 9.7% year-to-date.
- The Aviation Weather Center's 2016 CAWS demonstration closed October 28th. The Experimental CCFPg will continue to run through the winter.
- Daylight Saving Time ends at 2am Sunday, November 6th. Don't forget to "fall back" an hour before bed.

Local Procedures

We've tailored our mountain wave turbulence CWAs to meet the unique needs of our customers in the Pacific Northwest. The following criteria will be used for issuing CWAs and MISs in 2016-2017:

Moderate Mountain Wave

- UDDDS 350-599 ft/min
- Speed change +/- 15-24 Kts
- Net alt change 500-999 ft

Severe Mountain Wave

- UDDDS > 600 ft/min
- Speed change > +/- 25 Kts
- Net alt change 500-999 ft

The Aviation Weather Center's Graphical Turbulence Guidance provides an 18-hour forecast for both clear air and mountain wave turbulence. You can find that, as well as other turbulence products, by visiting our website www.weather.gov/zse and choosing "turbulence" from the "forecasts" tab at the top of the page.

Seasonal Center Weather Advisories

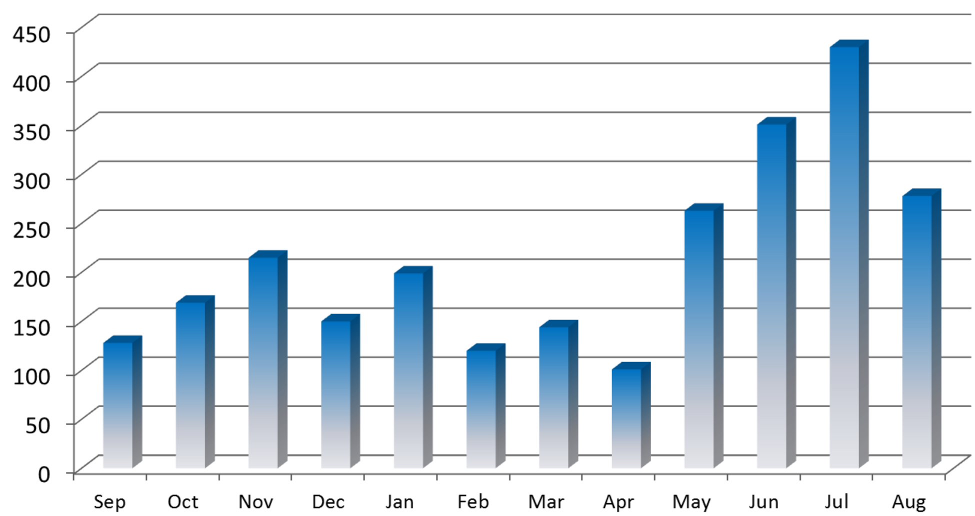
By David Bieger, Meteorologist in Charge

What exactly is a Center Weather Advisory? Well, by definition it's a hazardous weather advisory issued when no existing Aviation Weather Center advisory, such as an AIRMET or SIGMET, is in effect. CWAs may also be issued to supplement, or add value to, an existing advisory, and we issue them for many types of aviation hazards. With the convective season coming to a close, you're probably very familiar with CWAs issued for thunderstorms, so now's a good time to highlight the types of CWAs you'll see as we move into the Fall and Winter months.

CWAs are issued when each of the following occurs:

- Moderate, or greater, icing
- Moderate, or greater, turbulence
- Heavy, or extreme, precipitation
- Freezing precipitation
- Conditions at, or approaching, low IFR
- Surface wind gusts at, or above, 30 knots
- Low level wind Shear

We also issue CWAs for moderate, or greater, mountain wave turbulence. You'll learn a little more about mountain waves (and other types of turbulence) from Jim a little later in the newsletter.



The chart above shows the total number of Center Weather Advisories (and Meteorological Impact Statements) the ZSE CWSU has issued going all the way back to January 1996. You'll notice a pretty obvious spike during the Summer months, when thunderstorms frequent the airspace, but there is also a seasonal spike from mid-Fall to early-Winter that's just getting started. So far, in the month of October, we've issued CWAs for thunderstorms, heavy precipitation, and mountain waves. And with the potential for even greater impacts from La Nina this winter, which Steve will discuss on the next page, don't be surprised to see a freezing precipitation CWA added to that list!

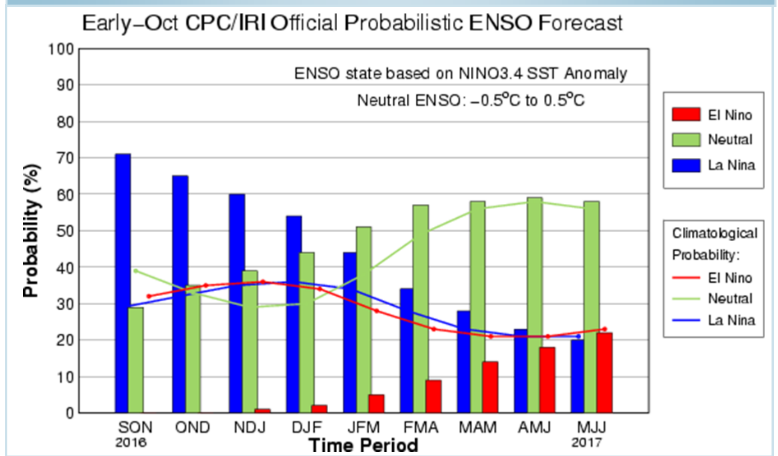
La Niña Winter Outlook

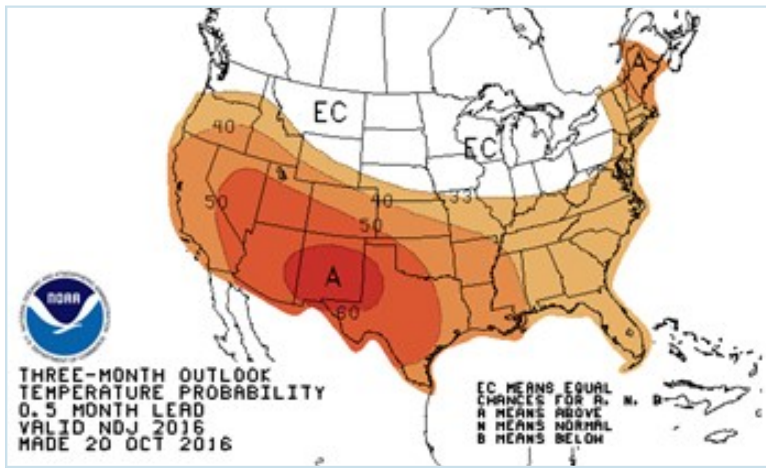
By Steve Adams, Aviation Meteorologist

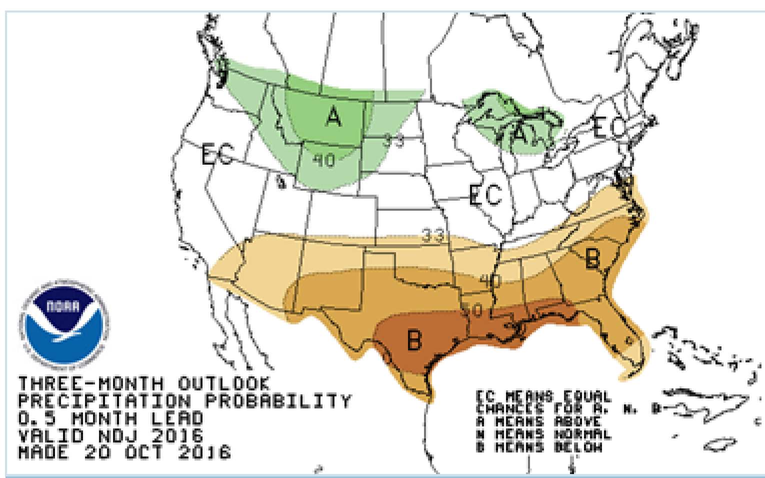
During the strong El Niño of 2015-2016 we experienced warmer than normal and (surprisingly) wetter than normal conditions across much of the Pacific Northwest last Winter. Over the Spring and Summer sea surface temperatures in the Equatorial Pacific returned to normal, but heading into Fall the Climate Prediction Center began to forecast the development of a weak La Niña as near to below average temperatures persisted and expanded Westward. While conditions are currently neutral, a La Niña watch is in effect, and is slightly favored to persist into early Winter 2016-2017. Forecast model indications are confident in the return to neutral conditions as the winter season progresses, however.

So what do experts expect for Fall and Winter? A weaker pattern brings more uncertainty to the winter weather outlook over the Pacific Northwest. The current seasonal outlook for late Fall into early Winter favors above normal temperatures throughout the Pacific Northwest, but generally does not favor one extreme over the other in terms of precipitation (though there has been continued confidence in a wetter than normal forecast for the Northern Rockies including Eastern portions of the airspace). That does change a bit as we move into late Winter, with a cooler and wetter forecast favored for much of the Northwest by January and February. That's certainly a combination that supports freezing rain and snowfall events which can be particularly hazardous to airfield operations.

Looking at past Winters in the Pacific Northwest, where there was little to no influence from La Nina, no clear bias or trend emerges. Some local weather experts have indicated that a greater number of extreme weather events (heavy precipitation, windstorms, heavy snow) have occurred during "neutral" Winters then during those heavily influence by either El Niño or La Niña conditions. With so much uncertainty in the long-term forecast now is the time to prepare for the unexpected. Stay tuned!



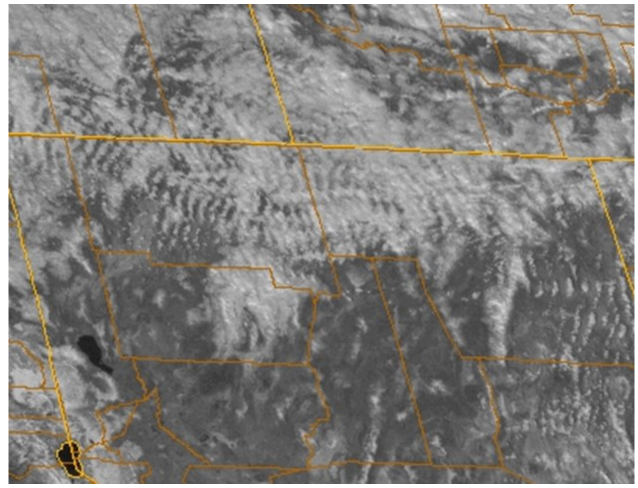




A Primer on Turbulence

By Jim Vasilj, Aviation Meteorologist

As we move into the fall and winter, turbulence becomes more common in the Pacific Northwest. Turbulence can be defined as irregular motion of an aircraft in flight including pitch, yaw, and roll. Types of turbulence include mechanical, wind shear, and convective. Two different planes can go through the same area and receive different levels of turbulence. Factors include size of the aircraft (felt less in large aircraft), aircraft speed (felt less in slower aircraft), altitude, and wing loading.



Visible Satellite Image of Mountain Waves

"Be sure to monitor AIRMETs, SIGMETs, and CWAs, as well as PIREPs and turbulence forecasts, at www.aviationweather.gov and www.weather.gov/zse. "

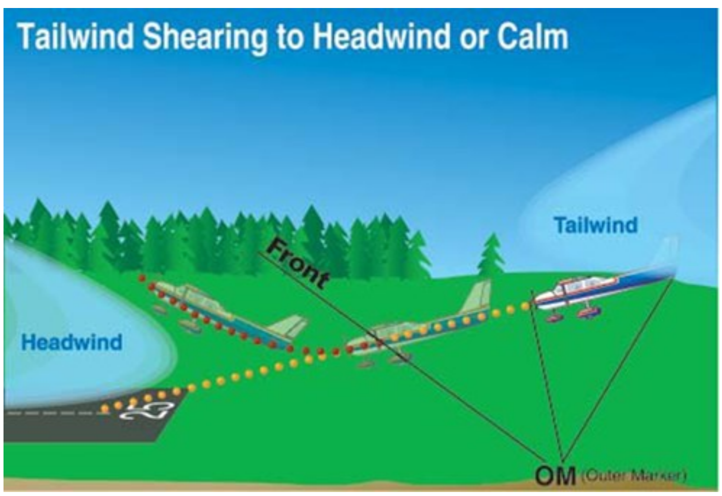


Figure 1: Tailwind to Headwind/Calm

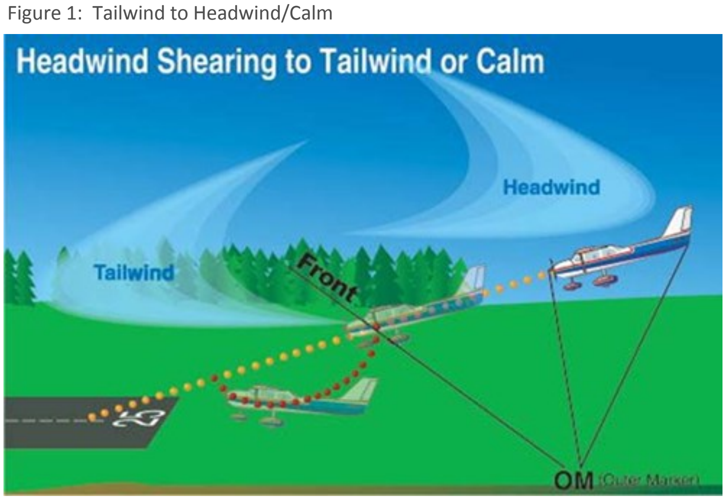


Figure 2: Headwind to Tailwind/Calm

Wind shear generates turbulence between two wind currents of differing velocities (wind speed and/or direction change). Two types of wind shear include 1) at a temperature inversion and 2) clear air turbulence (CAT).

Temperature inversions can occur in the lowest few thousand feet above the ground due to nighttime radiational cooling, along frontal zones, and within cold air trapped in a valley.

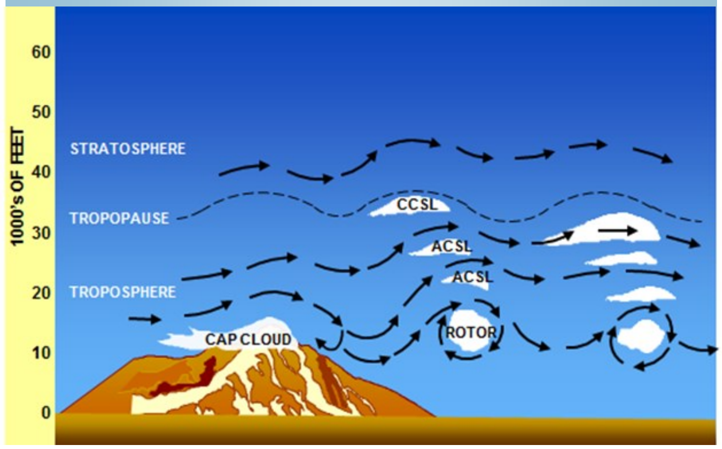
CAT is directly related to wind shear, and the intensity is maximized during winter when jet streams are the strongest. CAT frequently occurs around sharply curved jet streams associated with rapidly intensifying pressure systems, and is usually confined to relatively thin, transient layers where changing altitude is a good way to escape the turbulence.

Low-level wind shear (LLWS) is a shear of 10 knots (or more) per 100ft in a layer more than 200ft thick, within the lowest 2000ft above the surface. When landing, shear related to a tailwind changing to a headwind (Figure 1) could result in the aircraft airspeed increasing, the nose pitching up, and landing long of the runway (ballooning above the glide slope). Shear due to a headwind changing to a tailwind (Figure 2) could result in the aircraft airspeed decreasing, the nose pitching down, leading to a short, or hard, landing, and potentially making recovery impossible.

Turbulence (continued)

Mechanical turbulence is the result of obstructions that disrupt the smooth flow of air. The turbulence intensity is directly related to wind speed and roughness of the obstructions.

One type of mechanical turbulence is mountain waves, which develop above and downwind of mountains. These waves remain stationary in the flow, may extend over 600 miles downwind, and can produce severe to extreme turbulence. If there is sufficient moisture present, clouds may form. Cloud types that would indicate mountain waves are cap clouds near/downstream of mountain top, standing lenticular (CCSL, ACSL), and rotor clouds.



Types and Altitudes of Clouds Associated With Mountain Waves

Finally, convective turbulence is the result of vertical motion, which can be associated with thunderstorms. Known areas for convectively induced turbulence near thunderstorms include above the thunderstorm and downstream from the thunderstorm. Another potential for convective turbulence is due to dry convection (no clouds) or "thermals" associated with uneven heating of the surface that result in turbulent air above.

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