Volume 2, Issue 3
Winter 2008-2009
December 21, 2008

THE BRIEF
Winter 2008-2009

FAA-ARTCC, Center Weather Service Unit, 8000 Louisiana Blvd. NE, Albuquerque, NM 87109
Web: http://www.srh.noaa.gov/zab/
Design: Gregory Harris Editors: Gregory Harris, Matt Lorentson

Jet Stream Winds

Gregory Harris and Neil Haley, CWSU Albuquerque

Winter is here and the jet stream is back in the Southwest. The seasonal change occurs because of the earth's tilted axis. The southern hemisphere tilts toward the sun and the northern hemisphere experiences lower sun angles, and thus lower temperatures. At the same time, the polar jet stream shifts south.

The jet stream's push to the south brings stronger winds aloft, in general, and also helps pull cooler air masses from the North Pacific and Canada into the US.

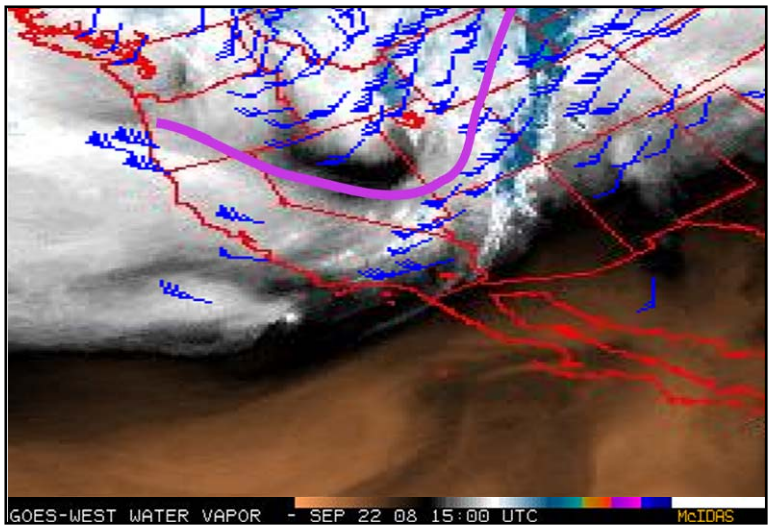

Figure 1. Water Vapor Satellite Image (jet stream shown in purple)

The Jet Stream is a "river" of relatively strong winds in the upper atmosphere. ZAB's Jet Stream map is prepared by the CWSU and distributed throughout the facility via WARP briefing terminals. The CWSU disseminates updated Jet Stream maps as early as 10 am, and again around 8 pm for the 12Z and 00Z forecasts, respectively. The maps show the forecast winds for FL340. When winds are greater than 60 knots, the meteorologist will draw a green line to indicate the general location of the Jet Stream. **Figure 2** to the left is an example of the Jet Stream map.

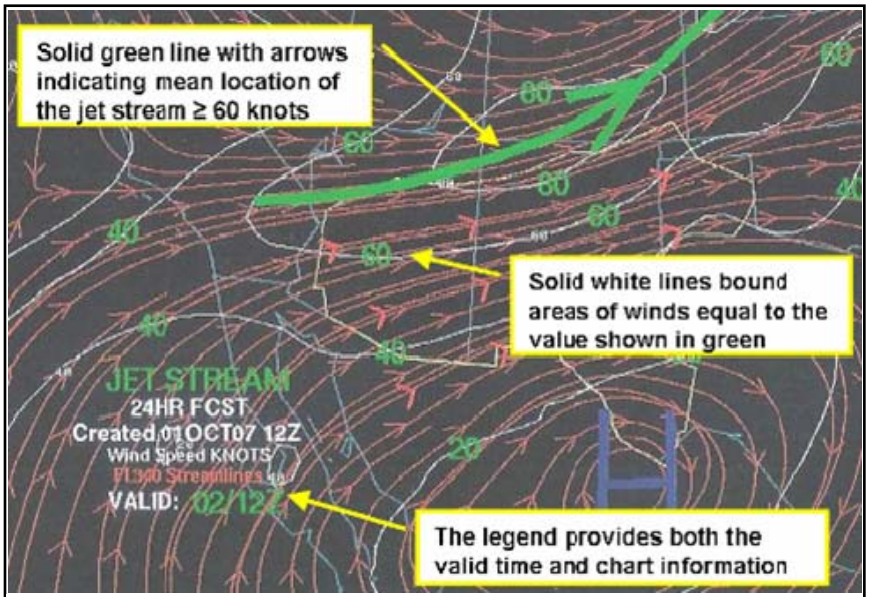

Figure 2. ZAB CWSU Jet Stream Map

"What's the impact for me?" you may ask?

Winds over ZAB at FL340 average around 30-40 knots during the summer. Yet, FL340 winds during the winter are often westerly at 60 to 120 knots, occasionally reaching speeds in excess of 180 knots. The stronger wind flow has a significant impact on air traffic control and may render quick decisions ineffective or dangerous if not taken into account. Compression and turbulence on arrival streams are also associated with the jet stream and will be discussed later in this edition of *The Brief*. For now, here is a quick summary of jet stream impacts:

- NRP Routes - jet stream & turbulence avoidance
- Increased miles-in-trail
- Increased controller stress
- Terminal approach compression
- Vectoring issues and sloppy turns
- Overtakes
- Decreased AAR due to cross winds and or LLWS

"The winds make a huge difference on how you approach vectoring aircraft or whether you end up using altitude versus vectoring." -Chris Prince, former East Specialty Supervisor

"Bad rides and multiple requests for altitude changes congest the frequency which in turn increases the complexity of managing the airspace." -Rick Boatman, Southeast Specialty Supervisor

The strengthening jet stream helps us by scouring thunderstorm-producing monsoon moisture out of the Southwest. On the other hand, especially when first encountered in the fall, strong winds and turbulence can present just as many problems as thunderstorms. **Figure 3** shows an example of strong winds moving over Arizona during the afternoon and evening of March 27, 2007. This pattern forced 40 knot southwest winds at FL340 over PHX to increase to 80 knots, and generated 100 knot winds along the ARLIN/GEELA stream by 00Z. To stay informed about quickly changing winter weather patterns, remember that pilots are a great source for upper level wind, turbulence, and low-level wind shear information. Another source for upper level wind data is the User Request Evaluation Tool (URET), which graphically depicts wind speed and direction for any altitude. To ensure that URET winds are accurate, consult with the CWSU.

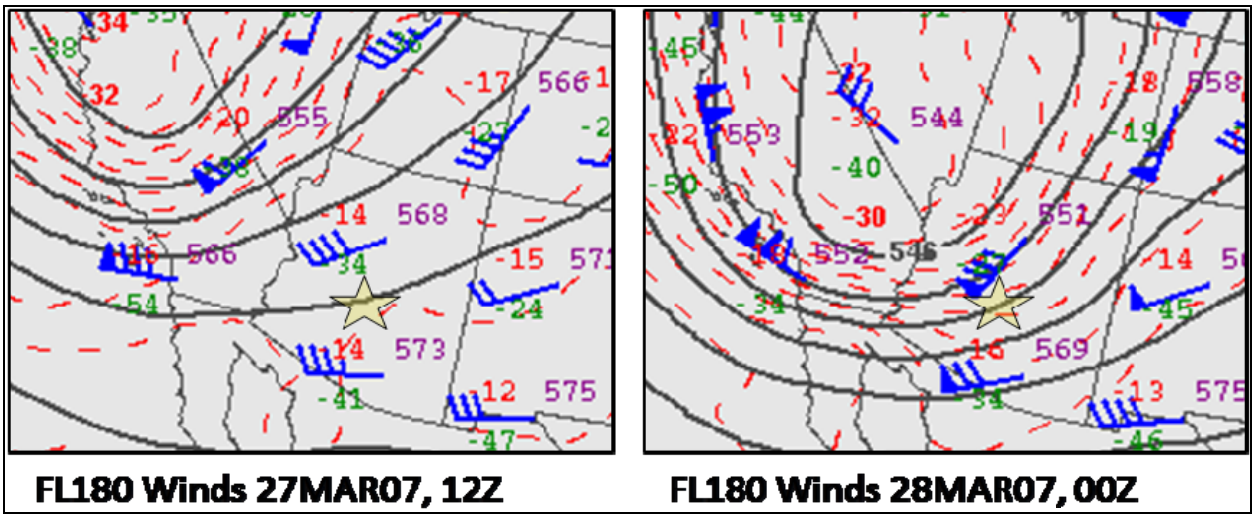

Figure 3. 500mb (~FL180) Pressure-Heights and Wind

Traffic Compression

Gregory Harris, CWSU Albuquerque

As mentioned in the previous article, arrival compression is a problem during the winter. Jet stream winds are generally from the west, but can vary considerably as storms move through the Southwest U.S. Strong west winds create compression on west and northwest approach streams ARLIN/GEELA and COYOT/MAIER (**Figure 4)**, but as a system moves through, strong north winds, or even east winds, can create compression on BUNTR/EAGUL, and SUNNS/KOOLY.

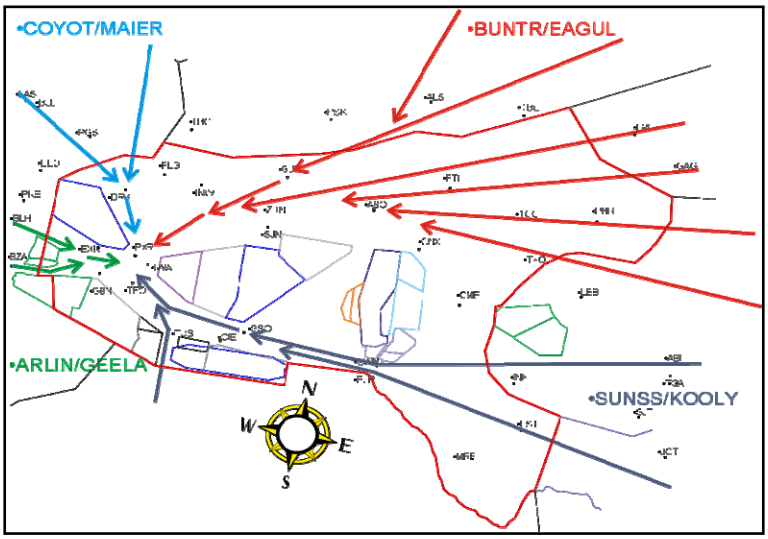

Figure 4. Phoenix Approach Streams

Significant compression issues arise when there is ~50 knots or more of wind difference between FL250 and 100 on the Phoenix approach streams.

The first two examples in **Figure 5** show Tail wind and Tail-to-Head wind compression. Knowing the current, and forecast, magnitude and direction of wind differences is very important.

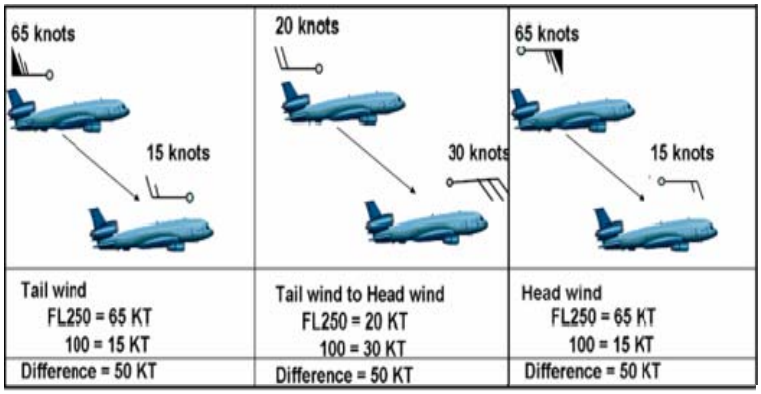

Figure 5. Compression/Decompression

"Compression on approaches creates problematic turns and possibly results in overshooting turns. Additionally if PHX is on an east flow with a strong tail wind, miles in trail becomes an issue for handing off aircraft; but, there are some possible advantages when using the winds to slow aircraft by turning them into the wind."

-Steve Wright, Supervisor
Southwest Specialty

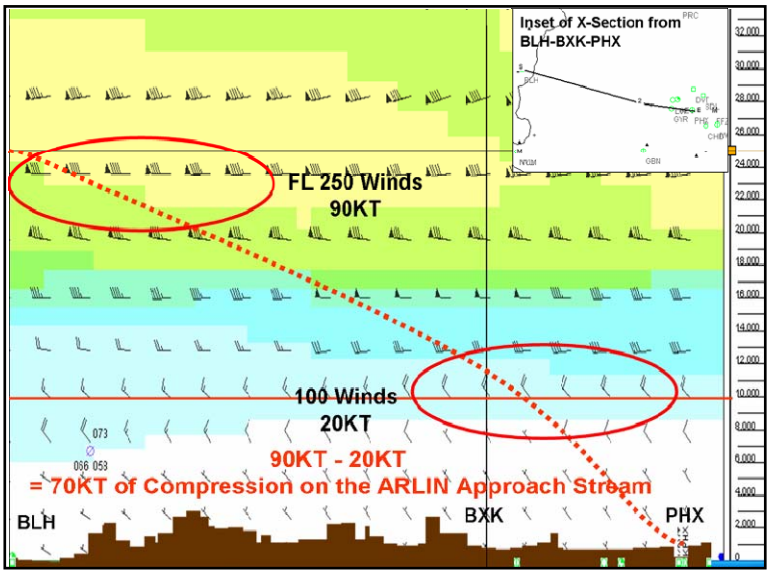

Figure 6. ARLIN Compression

Turbulence

Gregory Harris, CWSU Albuquerque

Wind flow across a relatively smooth surface will produce turbulent eddies. A basic vertical cross section for such an eddy can be seen to the right, **Figure 7**. Turbulent eddies allow stronger winds aloft to mix downward toward the surface and produce speed fluctuations. In METAR surface observations, speed fluctuations are recorded as gusts.

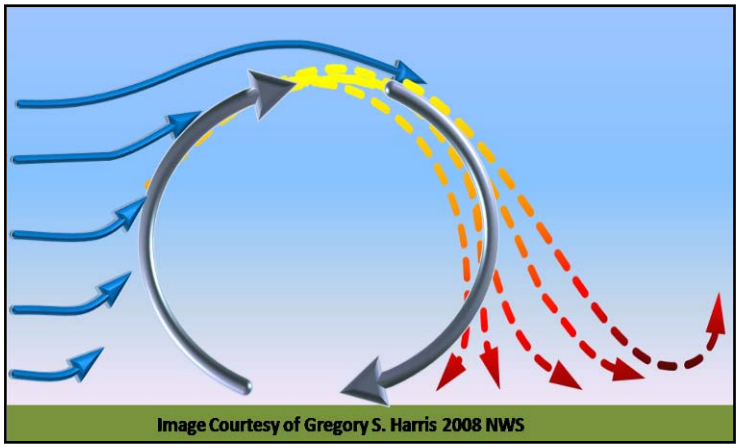

Figure 7. Turbulent eddy. The blue arrows depict winds (increasing with altitude). The grey arrows indicate a turbulent eddy caused by wind shear and surface friction. The yellow-red arrows show how the eddy mixes stronger winds down toward the earth's surface.

Speed fluctuations due to turbulent mixing are important. A sustained surface wind of 20 knots can result in 10-20 knot airspeed fluctuations for aircraft on approach. A plus-or-minus 10 knot fluctuation meets urgent pilot report (PIREP) criteria for wind shear. In addition, sustained winds of 30 knots or greater, even over relatively flat ground, can produce moderate turbulence. Most of the terrain in ZAB's airspace is very complex with hills, valleys, canyons, and mountains, where the likelihood of turbulence is even greater.

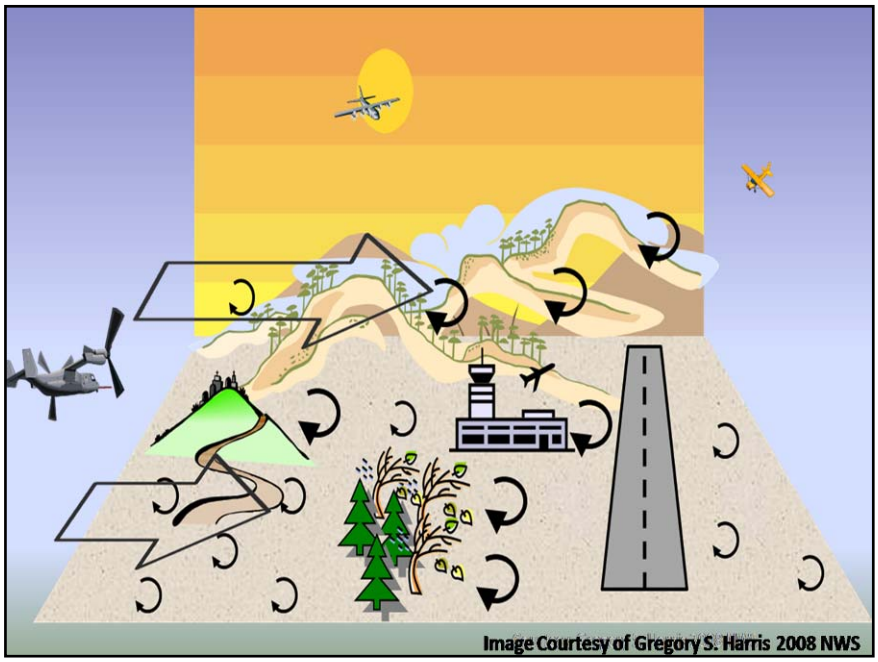

Figure 8. Broad clear arrows indicate general wind flow. The curved arrows illustrate turbulent eddies produced by terrain and/or obstructions.

High, mid, and low level turbulence is a frequent hazard in ZAB airspace due to rugged terrain and strong winter winds.

Figure 8 illustrates horizontal wind flow and the resultant turbulent eddies produced by flat ground, hills, trees, buildings, and other obstructions. Note that aircraft hangars, airport facilities, and towers can generate turbulent eddies in strong low level winds.

Aircraft Icing

Gregory Harris, CWSU Albuquerque

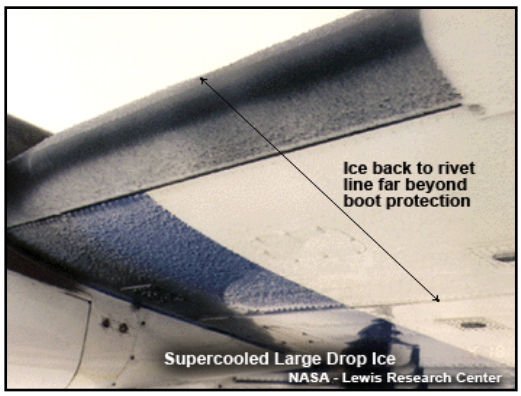

Figure 9. Supercooled Droplet Icing

You may have thought that stronger winds, turbulence, low level wind shear, and compression were enough to deal with during the winter season; however, with the lower sun elevation and the dipping jet stream pattern, we also see lower freezing levels region-wide and more Pacific Low pressure systems move through the Southwest. As these lows move east into the High Plains and tap into Gulf moisture, low-level cold air pushes south along the base of the Rockies on the back side of the low, undercutting the warm moist Gulf air. The moisture is forced aloft, high enough to become supercooled below freezing. Supercooled water vapor will adhere to exposed portions of airframes and accrete rapidly.

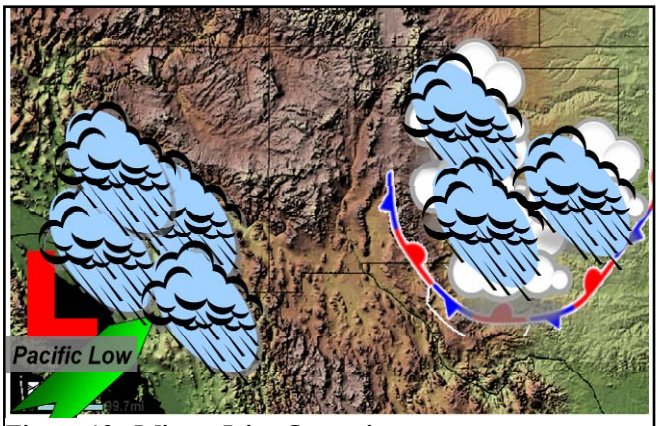

Figure 10. Winter Icing Scenario

Figure 10 depicts both the Pacific Low and cold front scenarios. As the Pacific Low moves east, it will produce a variety of possible icing conditions across the region. Eastern portions of ZAB can experience ongoing severe icing conditions if the pacific low stalls over east New Mexico and produces heavy rain over a shallow sub-freezing layer

Figure 11 depicts freezing rain climatology. Note that the ZAB maximum of ~35 hours per year is located over the Texas Panhandle, with decreasing frequencies across eastern NM. Unlike these flat, two-dimensional figures used to show icing hazard areas, aircraft icing occurs in a three-dimensional realm, at different levels of the atmosphere. This is another reason why pilot reports are so important to meteorologists, controllers, and pilots. When receiving icing PIREPS, remember to include the outside air temperature when possible; this information will help meteorologists determine the depth and nature of icing layers.

Prolonged icing is life-threatening. As it accretes on the aircraft skin, it decreases lift, increases drag, and can ice-over sensitive flight data instruments. For this reason, expediency in handling reports of moderate or greater icing is highly encouraged. When a robust combination of pilot reports, upper air observations, radar, and satellite observations is available, the CWSU meteorologists can best assist you in directing aircraft out of harm's way.

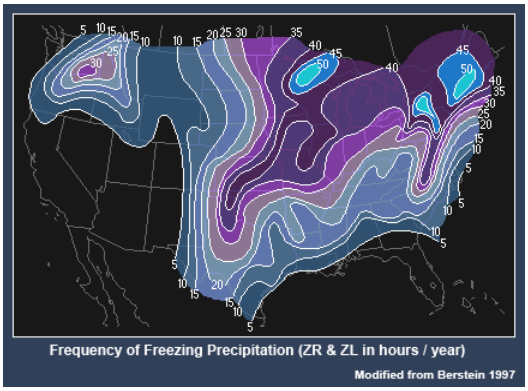

Figure 11. Hours/Year Freezing Rain/Drizzle