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THE BRIEF

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Center Weather Service Unit
8000 Louisiana Blvd. NE
Albuquerque, NM 87109
Editor: Gregory S. Harris; email gregory.harris@noaa.gov; Web: http://www.srh.noaa.gov/zab/

In this third full issue of "*The Brief*" we will look at Post season overview of PHX Gust fronts, The Jet stream, Aircraft Icing, and AIRMET SIGMET review.

Post Season Review - Phoenix Gust Fronts

Thomas Hall, Meteorologist, CWSU Albuquerque, NM

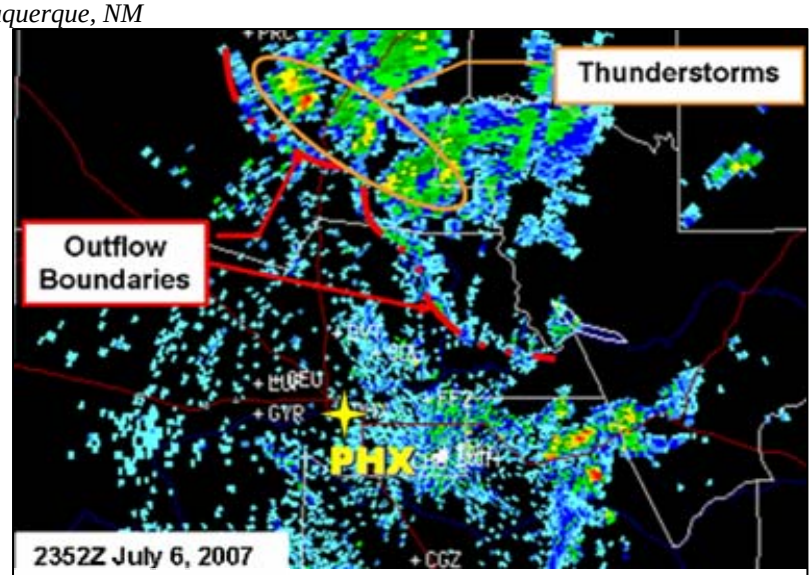


Figure 1

During this past summer it was not uncommon for Phoenix to experience thunderstorm-related delays without a thunderstorm occurring at or near the terminal. Commonly, storms formed over the Mogollon Rim Mountains to the north and east of Phoenix, but dissipated before moving south and west into the Salt River Valley. The remnants of collapsing storms rushed toward the ground as a burst of cold air and moisture. Such "downbursts" on the desert floor were often strong enough to generate outflows capable of traveling hundreds of miles. The leading edge of an outflow is called a "gust front," or "outflow boundary." **Figure 1** shows thunderstorms dissipating--and their associated gust fronts. If strong enough the gust fronts can lift surface dust and sand up to 1500 feet above the ground, producing reduced visibilities through the layer and hindering air travel.

Figure 2

Several gust fronts that swept across Phoenix during the past few months generated sustained winds of 20 knots with gusts to 30 knots. Gust fronts approaching from the north or south produced significant crosswinds over the east-west configured runways at PHX. Gust fronts ≥ 25 knots often caused a 30 minute closure. East or west approaching gust fronts often caused a runway change since they incurred a wind shift (a change in wind direction ≥ 45 degrees in less than 15 minutes with sustained winds ≥ 10 knots). These wind shifts often required PHX to close ~15 minutes to reconfigure for new arrival/departure directions.

Determining the strength and impact of a gust front is a major forecasting challenge. Typically, gust fronts that contain more dust/moisture will exhibit higher reflectivity values on NWS radar. Where available, web cameras provide excellent verification of visibility in the wake of outflows (see **Figures 2 and 3** from the Arizona Department of Environmental Quality web cam, showing the White Tank Mountains before and after a gust front). Other major forecast challenges associated with gust fronts include travel distance and intensity degradation. **Figure 1 and Figure 4** show NWS radar images of the July 6th gust front, which traveled well over 50 miles from its origin over the Mogollon Rim Mountains. The majority of thunderstorm outflows in this region only move 5-10 miles and dissipate before reaching the airport.

Figure 3

The amount of dust contained in an outflow is affected by the:

- parent thunderstorm strength
- direction the thunderstorm was moving when it collapsed
- direction the gust front is moving
- topsoil condition/characteristics along the path of the outflow

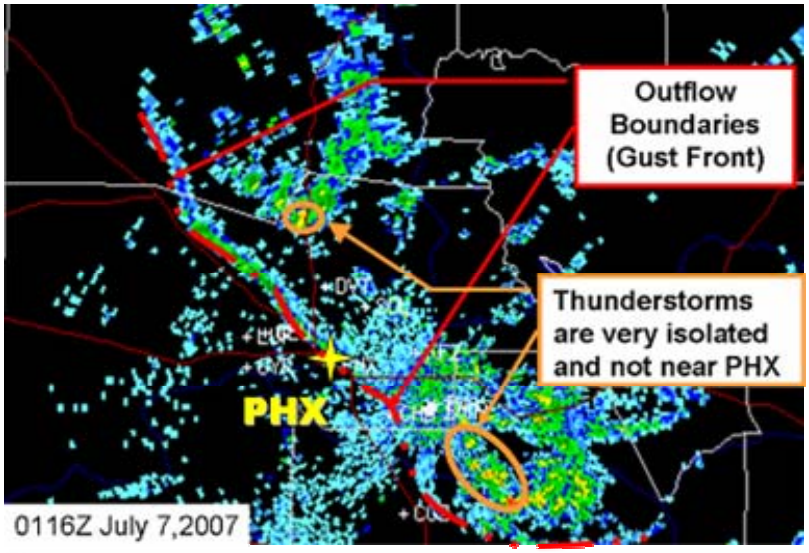


Figure 4

Whether the gust fronts reduce visibility or result in a wind shift, the result is an ATC delay. In general, southbound gust fronts are associated with little dust. Gust fronts from the east or west might reduce the visibility to 2-3 miles, while gust fronts from the south of Phoenix may reduce visibility to zero. These northbound gust fronts are commonly capable of containing more dust due to the open desert topography of South Arizona.

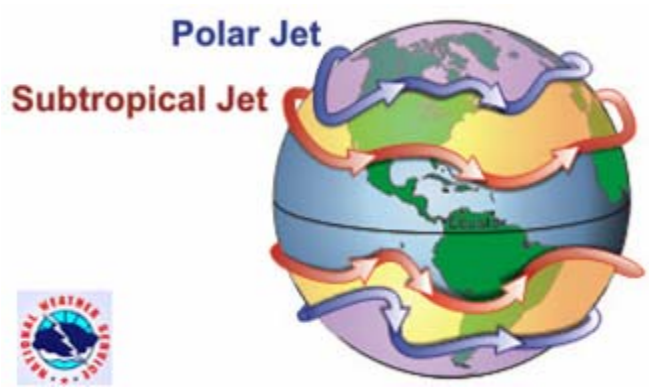
The following observations show the wind and visibility impact this gust front had on PHX:

KPHX **070051Z** AUTO **34008KT 10SM** FEW090 SCT160 SCT250 43/06 A2977 RMK AO2 SLP058 CB DSNT N-SE T04330056 TSNO

KPHX **070139Z 06028G34KT 7SM BLDU** FEW090TCU SCT150 BKN250 41/08 A2980 RMK AO2 **PK WND 06034/0138 WSHFT 0119** TCU N-SE

Jet Stream Winds

Neil Haley, Meteorologist, CWSU Albuquerque, NM



The Polar Jet meanders seasonally as the earth's axis tilts. The Subtropical Jet most commonly visits the southern US during the summer months. It is generally higher in the atmosphere and weaker than the Polar Jet. The Polar Jet is associated with colder temperatures and frontal systems.

OK. It's that time of year again. The Balloon Fiesta is over, fall is setting in, and the Jet Stream is returning to the Southwest. Why is the Jet Stream becoming more prominent? The answer has to deal with the earth tilting on its axis, which changes the elevation of the sun through the seasons. The elevation of the sun increases during the spring as the northern hemisphere tilts toward the sun; the jet stream shifts north in response. The opposite occurs during autumn.

The Jet Stream is a "river" of relatively strong winds in the upper atmosphere. The CWSU Jet Stream map is prepared for winds at FL340 and shows a band of winds that are ≥ 50-60 knots. A green ribbon shows the general location of the jet stream. It is prepared and transmitted via WARP to the briefing terminals as early as 11 am, and again at 8 pm for the 00Z and 12Z forecasts, respectively. **Figure 1** is an example of the CWSU Jet Stream map:

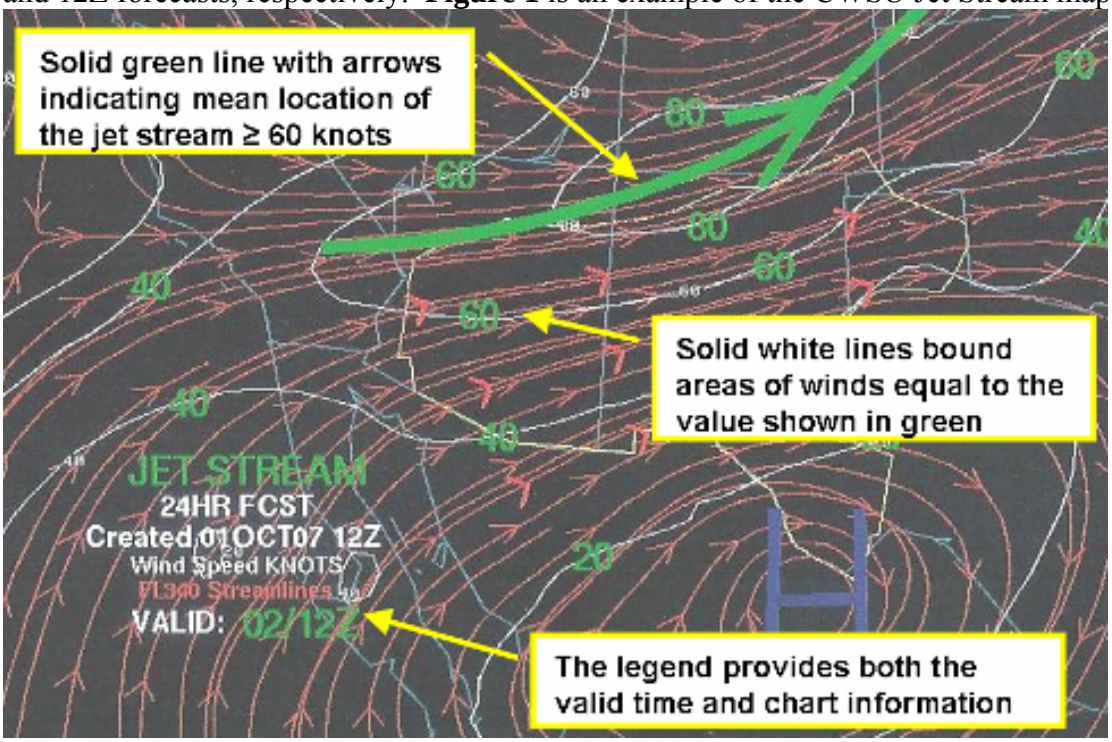


Figure 1

The stronger wind flow affects aircraft spacing, vectoring and routes of flight. Average jet stream flow across ZAB is westerly with winds varying from the southwest to northwest. They commonly are between 60 and 140 knots, but can reach speeds of 180 knots or more.

Impacts on air traffic management include compression, turbulence and low-level wind shear. Compression issues arise when there is ≥ 50 knots of wind difference between FL250 and 100 on the Phoenix approach streams ARLIN, COYOTE, BUNTR, SLIDR, and SUNNS. **Figure 2** provides examples of Tail wind, Tail to Head wind and Head wind compression. Knowing the magnitude and direction of wind differences at various levels is very important.

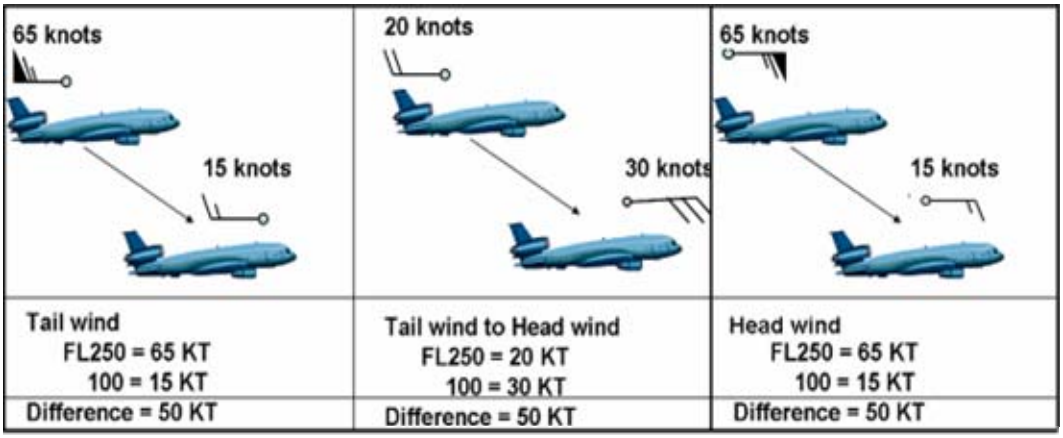


Figure 2

Figure 3 shows general results of westerly winds across the region. The shaded areas are in varying degree of turbulence intensity, with southwest to west winds producing moderately turbulent impacts and northwest winds having the greatest turbulent impact due to terrain interaction. **Figure 4** highlights how turbulent wind flow is induced by rough terrain. The red box with the "tumbling" winds is a good depiction of the stronger winds mixing into the lower layers--a contributor to low-level wind shear commonly experienced in areas such as Grand Canyon, Flagstaff, Santa Fe, and Las Vegas to name a few ZAB locations.

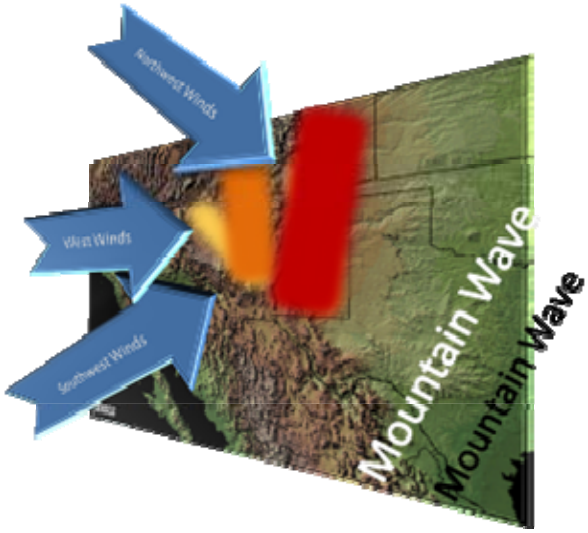


Figure 3

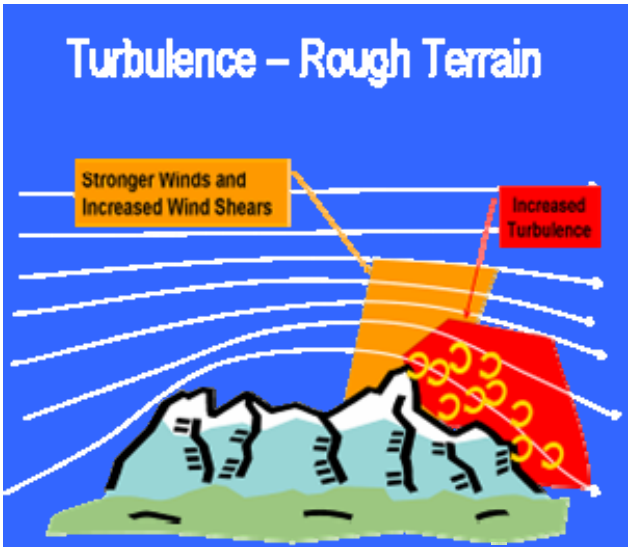


Figure 4

Feedback from the Ops Floor:

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

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

"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. Yet, some advantages can be using the winds when possible to slow aircraft by turning them into the wind." -Steve Wright, Supervisor Southwest Specialty

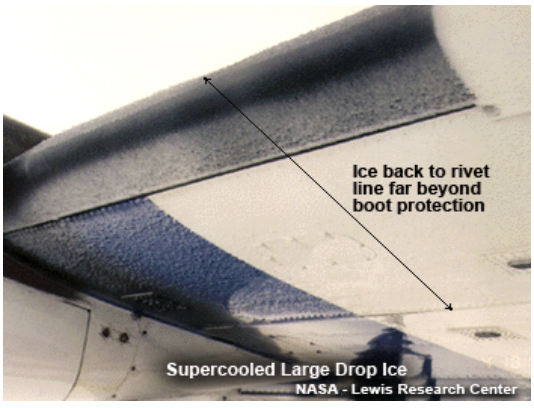
In summary, what does it matter, stronger winds, turbulence and low-level wind shear?

- Increases Miles-in-Trail
- Increases staff stress
- Pilots requesting altitude changes
- Low-level turbulence and/or strong cross winds at a hub can decrease arrival and departure rates

Pilots are a great source for finding out the upper level winds areas of turbulence and low-level wind shear. Another source available is The User Request Evaluation Tool (URET), it graphically depicts winds for any altitude. So on one hand, the strengthening Jet stream helps us by ushering out the thunderstorm producing monsoonal moisture. On the other hand, vectoring aircraft where strong winds are present can be tricky, and something we haven't dealt with for a while.

Aircraft Icing

Gregory Harris, Meteorologist, CWSU Albuquerque, NM



While we are discussing fall and winter weather in this issue, why don't we throw the book at you and include aircraft icing? You may have thought that stronger winds, turbulence, low level wind shear and meteorological compression were enough; yet, with the lower sun elevation and the dipping jet stream pattern, we begin to see lower freezing levels region-wide and more Pacific Low pressure systems move through the Southwest. As these lows sweep across eastern New Mexico and into the High Plains, low-level cold air pushes south along the base of the Rockies, undercutting warm moist Gulf air. That moisture is forced aloft—high enough to become supercooled below freezing—and adheres to exposed portions of airframes.

Figure 1 depicts both the Pacific Low and cold front scenarios. The Pacific Low is migratory so it will produce a variety of possible icing conditions as it moves across the region. The weather across eastern portions of ZAB can be longer lasting and produce more severe icing conditions, especially as liquid rain falls through shallow sub-freezing layer resulting in freezing rain…***severe clear icing***.

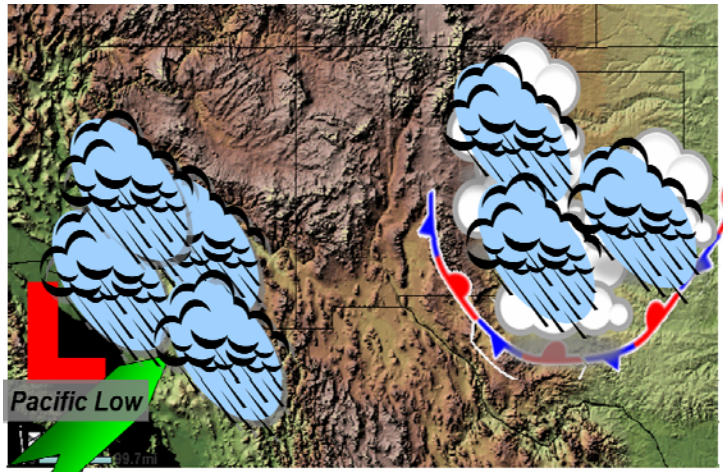
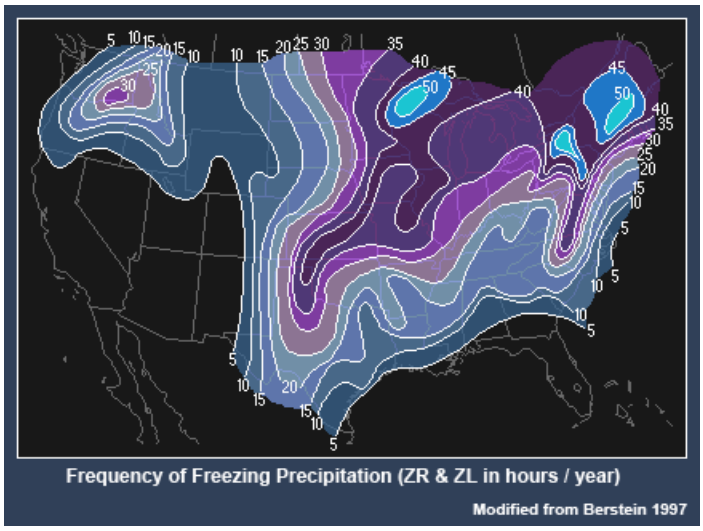


Figure 1

Figure 2 depicts the freezing rain climatology which includes a maximum across the Texas Panhandle with decreasing frequencies across eastern NM. Yet, unlike the flat 2 dimensional figures used to show the icing hazard areas, aircraft icing occurs in a three dimensional realm. It occurs in layers of the atmosphere and this is where pilot reports are a vital source of information for meteorologists, controllers, and most importantly, pilots. So with that in mind when receiving pilot reports it is important to include the outside air temperature. This is important in determining the depth and nature of the icing threat.

While chop is a nuisance, 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. So urgency and expediency in handling reports of moderate or greater icing is of utmost importance.

Using a combination of pilot reports and upper air observations, the Center Weather Service Unit Meteorologists can assist you in determining how best to get aircraft out of harms way.



AIRMET / SIGMET Review

An AIRMET (AIRman's METeorological information) advises of weather potentially hazardous to all aircraft, but does not meet significant (SIGMET) criteria. AIRMETs are routinely issued for 6 hour periods beginning at 0245 UTC. AIRMETs are also amended as necessary due to changing weather conditions or issuance/cancellation of a SIGMET.

AIRMETs are issued for the following reasons:

- Instrument Flight Rules (IFR) or Mountain Obscuration:
  - Ceilings < 1000 feet and/or visibility < 3 miles affecting over 50% of an area at one time.
  - Extensive mountain obscuration
- Turbulence
  - Moderate Turbulence
  - Sustained surface winds of ≥ 30 knots
- Icing
  - Moderate icing
  - Freezing levels

A SIGMET (SIGnificant METeorological Information) advises of weather, other than convective weather, that is potentially hazardous to all aircraft. They are issued for the following reasons:

- Severe Icing
- Severe or Extreme Turbulence
- Duststorms and sandstorms lowering visibilities to less than three (3) miles
- Volcanic Ash

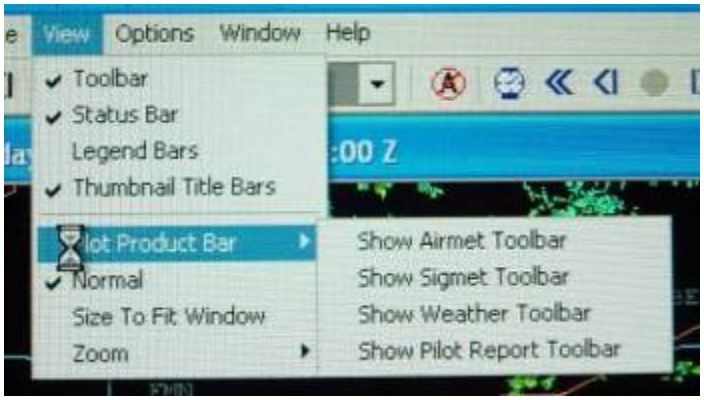
A CONVECTIVE SIGMET is issued in the conterminous U.S. for the following criteria:

- Thunderstorms that produce:
  - surface winds ≥ 50kts
  - hail at the SFC ≥ 3/4 inches in diameter
  - tornadoes
- embedded cells
- a significant line or cluster
- any area of at least 3000 square miles that experiences ≥ heavy precipitation of at least 40% coverage

Convective SIGMETs imply severe or greater turbulence, severe icing, and low level wind shear. They may be issued for any convective situation which the forecaster feels is hazardous to all categories of aircraft. When issued are transmitted hourly at Hour+55 and is valid for up to 2 hours.

Where to find it!

All AIRMET and SIGMET information can be viewed with either the Briefing Terminal or via the web on the Aviation Weather Center website http://www.aviationweather.gov
On the left had side, under Advisories > SIGMET/AIRMET.



If you need more information on Briefing Terminal procedures please stop by the CWSU office and request a Briefing Terminal guide and if time permits Briefing Terminal familiarity training can be completed.

There are three AIRMET designations; correctly match the designation with the description:
A. Sierra B. Tango C. Zulu

1. ____. …describes moderate turbulence, sustained surface winds of 30 knots or greater, and/or non convective low-level wind shear.

2. ____. …describes IFR conditions and/or extensive mountain obscurations.

3. ____. …describes moderate icing and provides freezing level heights.
* Answers below:

For more information on AIRMETs/SIGMETs please go to:
Chapter 7, Aeronautical Information Manual (AIM) at
http://www.faa.gov/airports_airtraffic/air_traffic/publications/atpubs/aim/Chap7/aim0701.html

Or

The Aviation Weather Center (AWC) website at http://adds.aviationweather.gov/airmets/

1. B (Tango), 2. A (Sierra), 3. C (Zulu)