



The Front



NOAA's National Weather Service

April 2013

Southwest Aviation Weather Safety (SAWS) Workshop to be Held in California June 2013

By [Jessica Nolte](#), Aviation Program Manager, NWS Phoenix, AZ

A Southwest Aviation Weather Safety (SAWS) Workshop first is expected this summer when the 5th Workshop is hosted in a completely virtual environment.

SAWS was originally created by a cross-regional partnership between the NWS Phoenix, AZ, and Albuquerque, NM, Weather Forecast Offices (WFO) and the Albuquerque Air Traffic Control Center Weather Service Unit (CWSU).

The last four SAWS workshops drew aviators and weather forecasters from Ohio to California, and have featured presenters from the following organizations and agencies:

- ◆ NWS Forecast Offices and Center Weather Service Units
- ◆ FAA Safety Team
- ◆ NWS Headquarters Aviation Services Branch
- ◆ NWS Aviation Weather Center (AWC)
- ◆ Lockheed Martin
- ◆ Embry-Riddle Aeronautical University
- ◆ Phoenix and Albuquerque Air Traffic Control Towers
- ◆ Southwest Airlines
- ◆ Mesa Airlines and dozens of other companies and organizations

For a sampling of previous topics and presentations, check out previous workshops:

- ◆ [SAWS II - Phoenix, AZ, October 2008](#)
- ◆ [SAWS III - Phoenix, AZ, April 2010](#)
- ◆ [SAWS IV - Albuquerque, NM, October 2011](#)



Inside

Mountain Waves Across the Intermountain West
2

Mountain Flying: Know Before You Go!
3

NWS Riverton Reaction: Getting the Word Out
6

When's the Next Front?

Would you like an email when a new edition of **The Front** is online? Get on our free list. Write melody.magnus@noaa.gov.

The Front

Program Manager:
[Michael Graf](#)
Managing Editor:
[Melody Magnus](#)
Editor: Nancy Lee

Mission Statement

To enhance aviation safety by increasing the pilot's knowledge of weather systems and processes and National Weather Service products and services.

WFOs Los Angeles/Oxnard, CA, and San Diego, CA, and the Los Angeles Air Route Traffic Control CWSU will host the virtual SAWS V on June 19, 2013.

The 1-day free workshop will feature an Aviator and Controller Weather session and an Aviation Weather Forecast session. Please reference and bookmark the [SAWS V Webpage](#). Registration for

the workshop will open late April. We are looking forward to carrying on the tradition of bringing aviation users and aviation weather service providers together from across, but not limited to, the Southwest and West Coast regions.

Safe flying and hope to “see you” in June!

Mountain Waves Across the Intermountain West

By [Sarah Allen Rogowski](#), CWSU Salt Lake City (ZLC)

Mountain waves can pose significant impacts to air traffic operations across the Intermountain West and Great Basin. CWSU meteorologists work directly with air traffic controllers to provide forecasts and observations of mountain waves activity that are then relayed to pilots in flight and on the ground.

The key for forecasting mountain wave activity across ZLC airspace is wind. Mountain wave activity increases with strong winds across mountainous terrain.

The primary areas impacted by mountain waves are western Montana and northwest Wyoming. With strong enough winds, this activity can extend further east into central and western Montana and Wyoming. Northern Nevada and southeast Oregon often feel the impacts as well.

Observing Mountain Waves

When there is sufficient moisture present, clouds will alert you to mountain wave activity. Look for cap clouds, cirrocumulus standing lenticular clouds, altocumulus standing lenticular clouds, and rotor clouds. You can see these clouds in satellite data by looking for a washboard or ripple pattern in the clouds downwind of a mountain range.

Another source of mountain wave observations is pilot reports (PIREPs). PIREPs classify a mountain

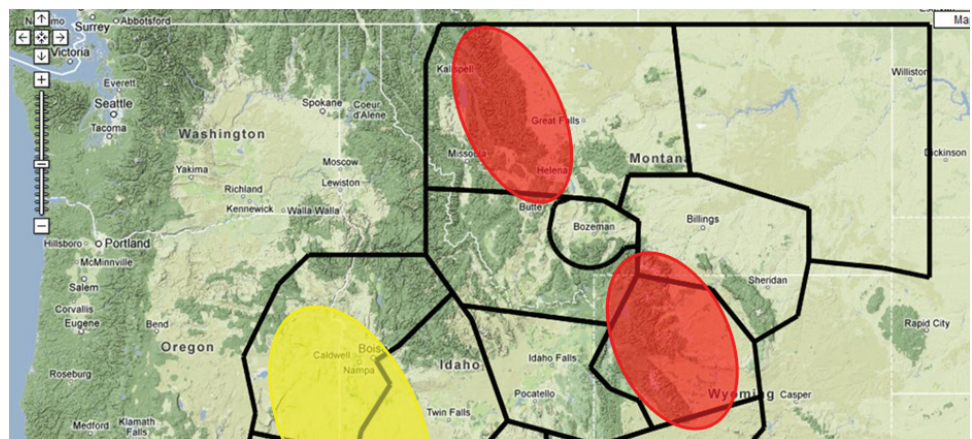
wave as light, moderate or severe, and provide speed and altitude changes. For example, on December 18, 2012, PIREPS alerted other pilots to several mountain waves across ZLC airspace:

```
GTF UA/ OV GTF250060/ TM 1748/ FL380/ TP B738/  
WV MOD MTN WAVE -20-25KT  
ELY UA/ OV ELY150030/ TM 1812/ FL370/ TP  
A319/ WV MOD MTN WAVE +-15KT  
WMC UA/ OV BAM/ TM 1835/ FL350/ TP A320/ WV MOD  
MTN WAVE +10 -20KT +-100FT
```

Mountain wave PIREPs are relayed to the local NWS forecast office and the AWC. These reports can help forecasters decide whether to issue additional hazard products.

Decision Support Services

When the CWSU meteorologists expect a significant and widespread mountain wave event, we issue a Meteorological Information Statement (MIS) to alert users about potential hazards to air traffic operations.



Map highlighting ZLC Airspace. Primary mountain wave activity areas are shaded in red, with a secondary region in yellow.

When the CWSU meteorologists observe mountain waves, especially severe waves, they may issue a Center Weather Advisory. The CWSU includes information from pilot reports such as altitude or speed changes. They also coordinate with the AWC about issuing AIRMETs or SIGMETs.

CWSU meteorologists create graphics to highlight the threat area. These graphics are presented during the morning and afternoon briefings to supervisory controllers. The graphics also are sent to the control room floor through briefing terminals. Controllers are asked to request PIREPs about mountain waves to share with other pilots. Strong mountain wave events are also highlighted in local weather story graphics available through the [ZLC Webpage](#) and through Facebook and Twitter.

Outreach and Education

The CWSU meteorologists work with the local FAA training department to create weather refresher training for air traffic controllers. Each fall, CWSU meteorologists conduct mandatory briefings for controllers addressing winter weather hazards. CWSU staff regularly review favored



Strong Winds, especially at ridge-top level, and mountain snow to continue through this evening. Snow will extend south across the Great Basin by this evening.

Aviation Impacts

- Mountain waves
- Strong gap winds
- Isolated severe turbulence
- Areas of low level wind shear
- Widespread mountain obscurations and IFR conditions
- Significantly reduced flight level visibilities
- Increased low-level icing threat with lowering snow levels

ZLC weather story on Dec. 18, 2012, highlighting mountain waves posted on the ZLC Webpage and social media pages.

meteorological conditions for mountain waves and the threats posed to aircraft.

The CWSU also works with the local FAA Safety team and other general aviation groups to conduct weather training for aviation safety. Several outreach events are conducted each year to address winter weather hazards, including mountain waves. Working together, we help keep pilots safe.

Mountain Flying: Know Before You Go!

By [Katy Branham](#), NWS, Riverton, WY
[Sarah Allen Rogowski](#), CWSU, Salt Lake City, UT

Imagine the following scenario: A pilot wakes up one morning in Flatland, U.S.A., to beautiful sunny skies and pristine flight conditions. Excitement grows, his family has decided to take a late-fall vacation to the Mountain West. They pack their bags, head to the airfield, load their luggage on the plane, receive the standard flight briefing, get clearance from the tower, and are off on their adventure. But they don't know how much of an adventure they are in for in the rugged terrain of the Mountain West.

There are many threats associated with mountain flying: obscuration, mountain wave activity and severe icing are just some of the hazards logged in fatal mountain crashes.

Mountain Obscuration

During the fall and winter, obscured mountain tops are commonplace. With frequent atmospheric disturbances, cloud development over mountain tops can occur even with generally dry systems due to orographic lifting. As air moves perpendicular to a mountain range, it rises and cools. This rising action to cooler temperatures drives the air closer

to its dewpoint temperature. Once these two values are close, the chance for cloud development increases (see **Figure 1**).

These clouds, in turn, obscure mountain tops, hiding their peak heights. For pilots unfamiliar with the airspace, this obscuration can be costly.

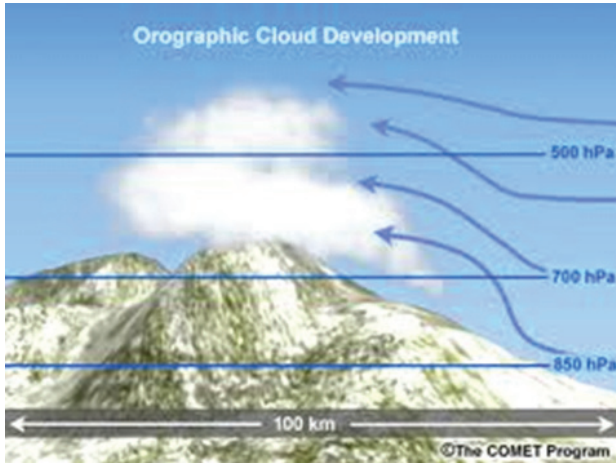


Figure 1: Orographic Cloud Development graphic from COMET training program

Mountain Wave Activity

A mountain wave is defined as an atmospheric wave disturbance formed when stable air flows over a mountain or mountain barrier. Mountain waves form above and downwind of mountain barriers when strong winds blow perpendicular to the barrier.

When there is sufficient moisture, pilots will see cap clouds, cirrocumulus standing lenticular clouds (CCSL), altocumulus standing lenticular clouds (ACSL) or rotor clouds (see **Figure 2**). These clouds often can be seen on satellite graphics by looking for a washboard or ripple pattern in the clouds downwind of a mountain range.

With the downsloping feature of mountain

waves, pilots flying into these dangerous features can quickly become disoriented by strong turbulence. These winds can force a quick descent that pilots may be unable to overcome, causing them to crash.

Icing Threat

Icing poses significant risk to aircraft through increased drag, decreased lift, and increased weight. Like mountain waves, icing is affected by orographic lift. As a pocket of moist air moves upslope, it cools rapidly and can become super cooled. This super cooled water then collects on the plane's freezing chassis, forming ice. The added weight can make turbulence much more dangerous.

Icing is dependent on the aircraft type and design, flight altitude, airspeed and other meteorological factors. Commercial jets are less vulnerable to icing due to their more powerful deicing equipment and because they fly at higher altitudes where icing is less common. The primary way to avoid icing is to ascend or descend to warmer temperatures, or ascend to altitudes where temperatures are generally too cold for icing.

Flat Land vs. Mountain Forecasting

Mountain ranges increase forecasting difficulty. Systems moving across the western mountain ranges have had less land-air interaction, allowing

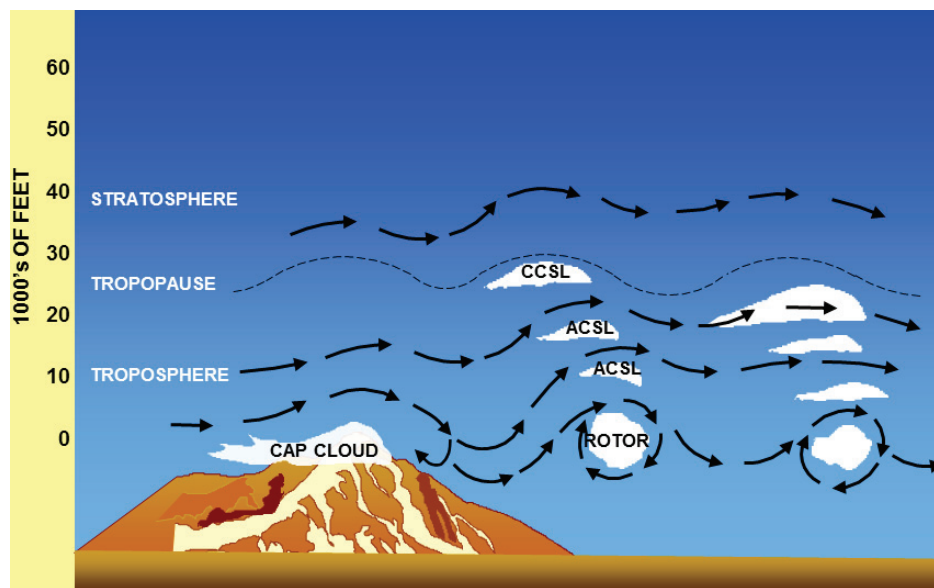


Figure 2: Turbulence Aviation Weather training for FAA Air Traffic Controllers, offered by NWS Training Division

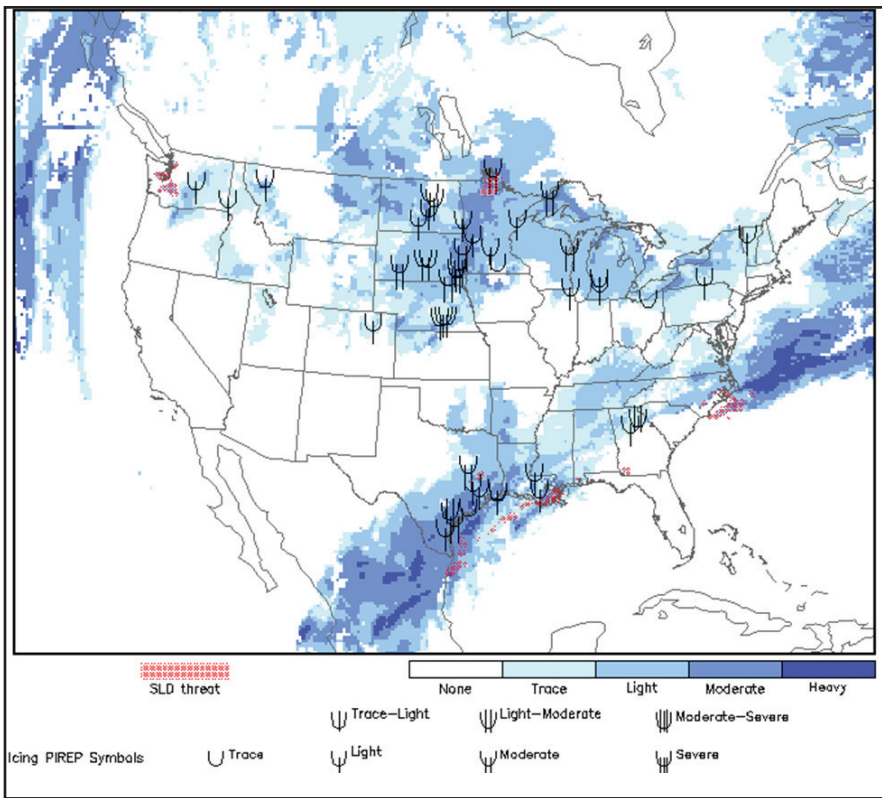


Figure 3: Sample Aviation Weather Center [Icing Map](#)

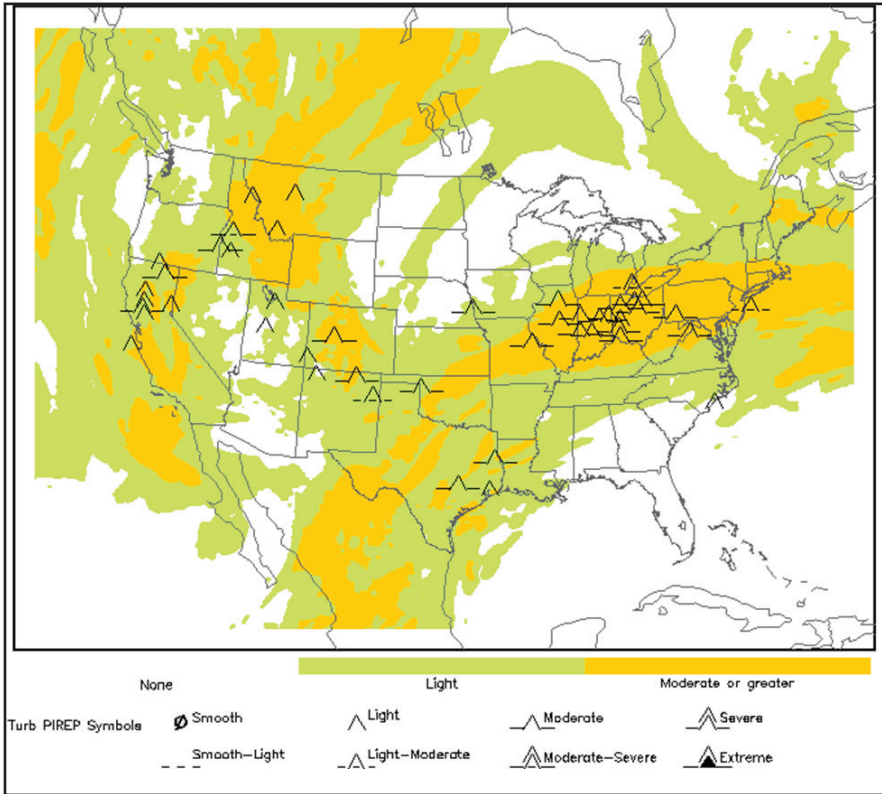


Figure 4: Sample Aviation Weather Center [Turbulence Map](#)

them to morph quickly as they approach mountain ranges.

Microclimates over the mountain ranges aid in these alterations, with some areas more prone to enhancing mountain dangers, even in weak systems.

Prepare for Mountain Flying

In addition to the standard pilot briefing, there are some great resources pilots should use to better understand potential weather over mountain passes. Most information is provided by the AWC, with additional options offered through CWSU and NWS forecast offices.

Icing AWC: Your first stop for icing information is AWC's [Icing Webpage](#). Here you will find:

- ◆ Graphics for the expected freezing levels
- ◆ PIREPS
- ◆ Forecast icing graphic highlighting anticipated areas of moderate to severe icing
- ◆ Current SIGMET information

The forecast icing graphics provide forecast information for up to 12 hours (see Figure 3).

Turbulence: Your next vital stop is the AWC [turbulence Webpage](#), which offers a forecast graphic showing moderate to severe turbulence across the area (see Figure 4).

Meteorological Information Statements (MIS) & Center Weather Advisories (CWA) - CWSU: Some CWSUs offer locally produced MIS and CWA to alert pilots about mountain wave threats.

CWSUs issue these products when mountain waves are

observed without AIRMETs for turbulence or when severe mountain waves are reported in PIREPs. Though these products may be reactionary, the information is vital for pilots with flight plans including flight over mountain passes. These scenarios easily promote PIREP usage among pilots. As a pilot, please submit these crucial PIREPs. They can be critical to the safety of other pilots because they can result in an MIS or CWA.

High Wind Warnings: NWS forecasters use their knowledge of local microclimates to evaluate the threat for mountain wave activity across mountain ranges. As with most weather phenomena, there are favored locations and timing for mountain wave development. When specific weather signatures appear in forecast data, forecasters may issue High Wind Warnings for mountain wave activity. These warnings are highlighted on the office's Webpage.

Aviation Discussions: NWS local forecast offices include an Aviation discussion as part of their Area Forecast Discussion (AFD). The Aviation section is created when they issue a Terminal Aerodrome Forecast (TAF). The AFD allows local NWS meteorologists to convey thoughts regarding aviation-related information and threats, and to

include aviation specific wording that may not be useful to the public. When appropriate, NWS meteorologists mention turbulence confirmed by AWC graphics. Though not specified by the AWC, local WFO forecasters may be able to better define the cause of the expected turbulence based on their local expertise with convection, mountain waves, etc., in discussions. Additionally, forecasters may include their confidence regarding the formation of mountain obscuration and wave activity over local mountain passes.

Know Before You Go

By using the resources provided in this article as supplemental information to the standard briefing, you can improve your understanding of expected weather across mountainous terrain. Regardless of pilot experience, each mountain pass attempt offers unique weather conditions. Pilots should be prepared to turn around due to adverse weather. Weather observing equipment over mountain passes is especially sparse. Actual conditions may vary significantly from the forecast. PIREPs conveying these differences are vital to other pilots. Most important, always respect the mountains.

NWS Riverton Reaction: Getting the Word Out

By [Katy Branham](#), NWS, Riverton, WY

During a peak time-frame between 2010 and 2011, there were 10 aviation-related deaths in the Wind River Mountains partially attributed to mountain waves, icing and/or turbulence. This extreme year motivated NWS Riverton to begin an outreach program regarding mountain flying and these hazardous flying conditions.

Outreach Materials Available

After the last mountain-related aviation death in October 2011, NWS Riverton created a poster and trifold pamphlet explaining mountain flying.

The poster emphasizes the dangers of the otherwise majestic mountain range. It also offers QR codes for pilots to scan with a smart phone for more weather-related information. The pamphlet contains information forecast pilots can use to find

websites offering graphics and data. Additionally, NWS Riverton staff developed an [Aviation Portal webpage](#) for pilots and airport management. Included in the portal Website are conditions over select mountain passes, warning information regarding high wind, and the current forecast for points over mountain passes.

Distribution of Outreach Materials

NWS began distributing these new outreach materials in June 2012. During airport visits, staff from NWS Riverton encouraged airport management to display the poster in a pilot briefing area or lounge. In addition, NWS Riverton staff left pamphlets with airport managers, suggesting they be given to pilots. The brochures are popular. Some airport managers across central and western Wyoming have requested digital versions of these documents so they may print out more as needed.

To further expand the program, NWS Riverton and CWSU Salt Lake City staff members offered a presentation on this topic at the Wyoming Airport Operator's Association conference in September 2012. Before the presentation, copies of the trifold pamphlet were distributed to attendants. Copies of the poster also were made available. Additionally, NWS speakers offered a demonstration of the proposed portal page and a summary of daily operations at the forecast office and the CWSU.

The Aviation portal was developed with pilots and airport management in mind. The page includes sections on summer and winter flying, forecast information for terminals separated by the Continental Divide, mountain pass information such as point forecasts, current highlights and observations, and links to outreach materials. You can also download the poster and brochure from the portal Website.

Potential Outreach Opportunities

A wide potential exists for additional outreach across central and western Wyoming. The NWS Riverton office hopes to continue its efforts by

Get to Know Us
 Your National Weather Service (NWS) Office
 Get to know the agency producing general forecasts and the Terminal Aerodrome Forecast (TAF) products used to indicate upcoming weather at specific airports.

Friendly Reminders

- No flight is a 100% flight.
- Consideration for altitude to gross weight (passenger, baggage, etc.) must be included when evaluating the wing threat.
- Changing weather over mountain ranges will drastically increase the difficulty of making a mountain pass.
- Regardless of the experience one has making a specific mountain pass, each situation is different and should receive a full pre-flight evaluation.
- Weather observing equipment is sparse on mountains, so conditions may vary from the forecast.
- Turn around if conditions are deemed too hazardous, especially before making your mountain ascent.
- File your flight plan.
- Report the recovery!

Mountain Flight Planning
 Information to help assist pilots on their decision to fly during significant mountain weather.

Contacting Us
 National Weather Service
 Riverton
 Mountain Center
 Service Unit
 Salt Lake City

Why Plan?
 Expedited for pilot benefit, changing mountain passes can be extremely dangerous during the winter months when mountain conditions can change rapidly. Unplanned planning may result in aircraft accidents, or even pilot and/or passenger death. The purpose of this brochure is to encourage pilots to use various National Weather Service products both while creating their initial flight plan, and making the last minute decision on whether to fly.

How Can We Help?
 Expected Weather Conditions—Specialized weather conditions can be reviewed in real-time detail, which can help you plan the potential window when mountain pass conditions may be more optimal. The image shows the associated hourly graphic.

Other Products
 Potential Alternate Airports—Local National Weather Service Offices issue Terminal Aerodrome Forecasts for various airports across their forecast area. These forecasts can be obtained by pilots to find a compatible airport that is acceptable in emergency situations. These forecasts can be found on the Aviation Weather Center's website at: <http://aviationweather.gov/altair/>

NWS Riverton Mountain Flying Trifold

Mountain flying is dangerous

BETWEEN OCTOBER 2010 AND OCTOBER 2011,
10 PEOPLE WERE KILLED
 FLYING OVER AND NEAR THE WIND RIVER MOUNTAINS.

Don't become a statistic.

KNOW BEFORE YOU GO

Please contact any of these sources for weather information:

National Weather Service Riverton, Wyoming 1-800-211-1234 www.weather.gov/riverton	Central Weather Service Unit Salt Lake City, UT www.weather.gov/zlc	Aviation Weather Center www.aviationweather.gov
---	--	---

Help others fly safely by relaying PIREPs

Photo Courtesy of Fremont County Search and Rescue

NWS Riverton Mountain Flying Poster

approaching pilot groups, flying clubs, training programs, and airport management about virtual or actual presentations.

NWS Riverton staff members also are using Facebook and Twitter to reach pilots. Staff at NWS Riverton members have created pilot graphics explaining special weather phenomena such as lenticulars and inversions. This outlet may be an option to explain some aviation hazards with the understanding that if the graphics and/or posts include any date information, they will need to specifically state any information should be considered supplementary to the standard briefings pilots receive before takeoff.

Regardless of what methods are used to convey this information to the public, the end goal is the same: To raise awareness of the hazards of winter flying, especially over mountain ranges. Increased knowledge may aid pilots in making better decisions, and help NWS to reach its mission to create a Weather-Ready Nation.