National Transportation Safety Board
Office of Aviation Safety
Washington, D.C. 20594-2000
April 14, 2011
WEATHER STUDY
DCA11IA015

A. Incident

Location: Jackson Hole, Wyoming
Date: December 29, 2010
Time: approximately 1138 mountain standard time (1838 UTC[1])
Aircraft: Boeing 757-223, registration: N668AA

B. Meteorological Specialist

Mike Richards
Meteorologist
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Operational Factors Division, AS-30
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C. Summary

On December 29, 2010, at approximately 1138 mountain standard time, American Airlines flight 2253, a Boeing 757-200, registration N668AA, overran runway 19 upon landing at Jackson Hole Airport (KJAC), Jackson Hole, Wyoming. The airplane came to rest approximately 730 feet past the end of the runway in deep snow. There were no injuries to the 179 passengers and 6 crew members on board and the airplane received minor damage. The 14 Code of Federal Regulations Part 121 regularly scheduled passenger flight had originated from Chicago O'Hare International Airport, Chicago, Illinois.

[1] UTC – abbreviation for Coordinated Universal Time

D. Details of Investigation

The National Transportation Safety Board's (NTSB) meteorological specialist was not on scene and gathered weather data for this investigation from the NTSB's Washington D.C. office from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources, except where noted. All times are reported in mountain standard time (MST) for December 29, 2010, based upon the 24-hour clock. Local time is -7 hours from UTC, and UTC=Z. Directions are referenced to true north unless otherwise noted and distances are in nautical miles (nm). Heights are above mean sea level (msl) unless otherwise noted. Distances along surface of the earth are calculated using the "Great Circle" formula.

Coordinates used for the incident location: 43.60733° North latitude, 110.73775° West longitude; elevation: 6,451 feet.

E. Narrative

Surface Observations

Jackson Hole Airport (KJAC) in Jackson Hole, Wyoming, was equipped with an Automated Weather Observing System-3 (AWOS-3). The following reports were issued from KJAC while an official weather observer was logged into the AWOS-3 system.

METAR KJAC 291355Z 23014KT 3/4SM OVC012 M05/M07 A2920 RMK AO1

SPECI KJAC 291441Z 22012KT 1/2SM SN OVC010 M05/M07 A2919

METAR KJAC 291451Z 22013KT 1/4SM SN OVC008 M05/M07 A2918

SPECI KJAC 291545Z 22013KT 1SM -SN OVC010 M05/M07 A2916

METAR KJAC 291555Z 21013KT 3/4SM -SN OVC010 M05/M07 A2917

METAR KJAC 291656Z 22011KT 3/4SM -SN BKN004 OVC010 M04/M07 A2916

SPECI KJAC 291725Z 23009KT 1/2SM SN BKN004 OVC010 M04/M07 A2916

METAR KJAC 291751Z 22007KT 3/4SM -SN BKN004 OVC010 M04/M06 A2915

SPECI KJAC 291843Z 24010KT 1SM -SN BKN004 OVC019 M03/M06 A2913

At 1051 MST, KJAC reported wind from 220° at 7 knots, visibility of ¾ mile, light snow, a broken ceiling at 400 above ground level (agl) and an overcast cloud base at 1,000 feet agl, temperature -4° Celsius (C), dew point temperature -6°C, altimeter setting 29.15 inches of mercury.

At 1143 MST, KJAC reported wind from 240° at 10 knots, visibility of 1 mile, light snow, a broken ceiling at 400 agl and an overcast cloud base at 1,900 feet agl, temperature -3°C, dew point temperature -6°C, altimeter setting 29.13 inches of mercury.

High-temporal resolution (5-minute) automated observations from the KJAC AWOS-3 were retreved and are presented here. Wind directions in this dataset are referenced to magnetic north.

1800	220	9	1-1/2	SCT010	OVC017	-4	-7	2915	D	0010000001
1805	230	9	1-1/4	OVC017		-4	-7	2915	D	0010000001
1810	230	7	1-1/4	OVC017		-4	-6	2915	D	0010000001
1815	220	7	1-1/2	SCT007	OVC017	-4	-6	2914	D	0010000001
1820	230	6	1-1/4	SCT007	OVC017	-4	-6	2914	D	0010000001
1825	220	7	1-1/4	SCT007	OVC017	-4	-6	2914	D	0010000001
1830	240	6	1-1/4	SCT007	OVC017	-4	-6	2914	D	0010000001
1835	**250**	**8**	**1-1/2**	**SCT007**	**OVC017**	**-4**	**-6**	**2913**	**D**	**0010000001**
1840	**240**	**10**	**1-3/4**	**SCT007**	**OVC019**	**-4**	**-6**	**2913**	**D**	**0010000001**
1845	240	11	1-3/4	SCT007	OVC019	-3	-6	2913	D	0010000001
1850	240	12	2	OVC019		-3	-6	2913	D	0010000001
1855	240	12	3	BKN019	OVC025	-3	-6	2912	D	0010000001

At 1135 MST, the automated observation from the KJAC AWOS-3 indicated wind from 250° (magnetic) at 8 knots, visibility 1 ½ miles, scattered clouds at 700 agl and an overcast ceiling at 1,700 feet agl, temperature of -4°C, dewpoint temperature of -6°C, altimeter setting of 29.13 inches of mercury, daytime conditions, status message indicating this was a daytime observation with an HDLC transmit error noted.

At 1140 MST, the automated observation from the KJAC AWOS-3 indicated wind from 240° (magnetic) at 10 knots, visibility 1 ¾ miles, scattered clouds at 700 agl and an overcast ceiling at 1,900 feet agl, temperature of -4°C, dewpoint temperature of -6°C, altimeter setting of 29.13 inches of mercury, daytime conditions, status message indicating this was a daytime observation with an HDLC transmit error noted.

Snow depth measurements for time periods leading up to the incident time (table 1) were retrieved from five observations stations near KJAC. Difference in snow depth is not a measurement of snowfall, but does allow for *approximation* of snowfall accumulation at the station site. Errors in measurements may include snowfall settling and snow drift.

Data from stations JHMWY, JHB and JHRV were provided courtesy of Jackson Hole Mountain Resort via MesoWest. Phillips Bench and Grand Targhee data were provided by Natural Resources Conservation Service SNOTEL stations.

Station	Elevation	Distance to KJAC	3-HR diff	6-HR diff	12-HR diff
JHMWY	8,179 ft.	4.6 nm	1 in.	2 in.	6 in.
JHB	6,339 ft.	5.2 nm	3 in.	5 in.	8 in.
JHRV	9,608 ft.	5.9 nm	0 in.	1 in.	6 in.
Phillips Bench	8,200 ft.	9.5 nm	4 in.	9 in.	12 in.
Grand Targhee	9,260 ft.	13.6 nm	0 in.	1 in.	4 in.

Table 1 – Snow depth differences for time periods leading up to 1130 MST (for Phillips Bench and Grand Targhee stations they are differences leading up to 1100 MST)

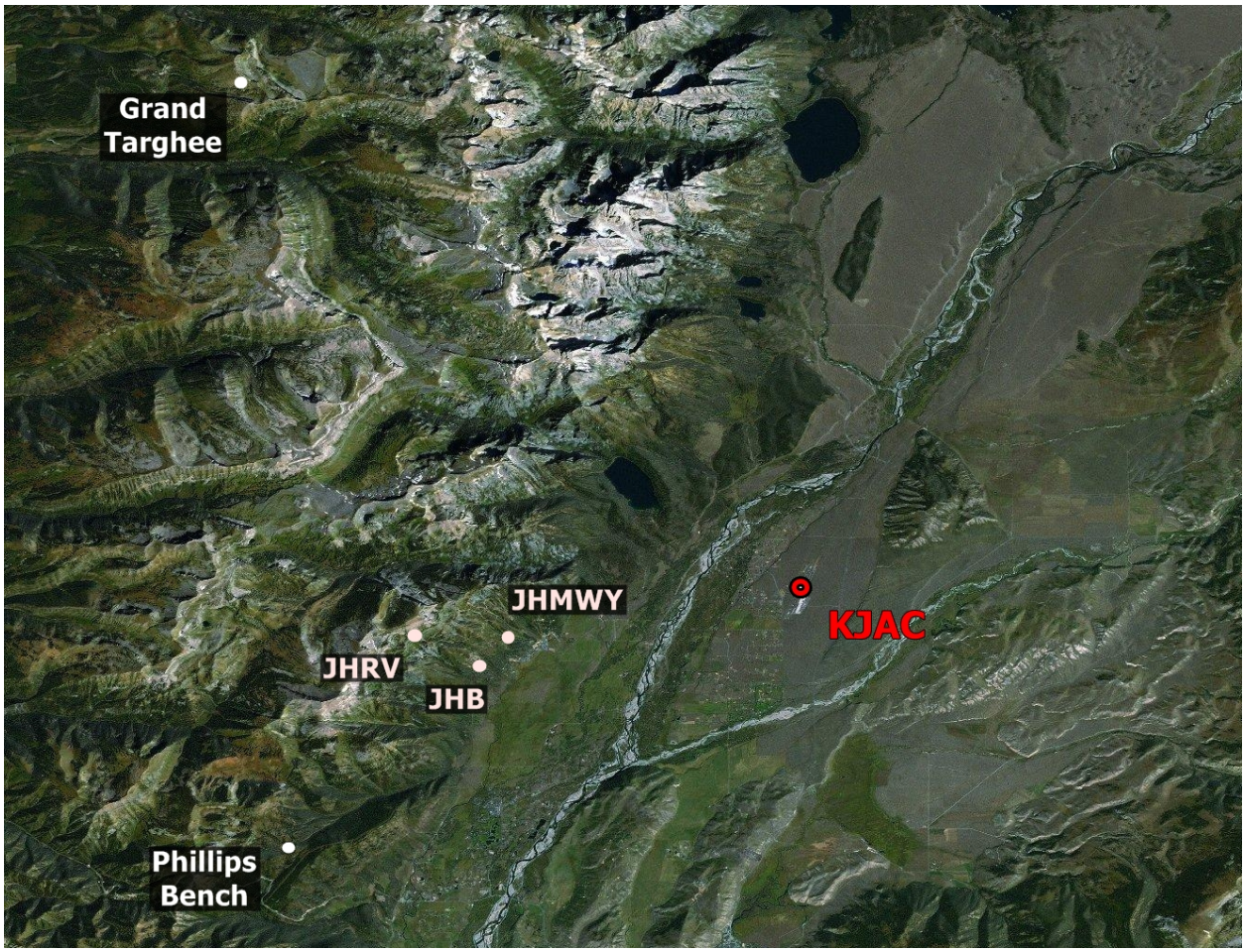

Figure 1 – Snow depth station locations.

Upper-Air Data

A North American Mesoscale (NAM) model sounding (figure 2) for the incident location at 1100 MST was retrieved from the NOAA Air Resources Laboratory.

The wind profile indicated southwesterly winds near the surface with magnitudes near 15 knots, above which the wind *veered*[2] slightly and increased in magnitude to 47 knots at about 11,000 feet. Below about 13,000 feet the atmosphere exhibited relative humidity values greater than 90%, and calculations made by the RAwinsonde OBservation Program (RAOB) indicated conditions conducive for overcast clouds between 11,000 feet to within 1,000 feet of the surface. The freezing level was identified as being below the surface and clear and rime icing severities were calculated to be light to moderate through the lower troposphere. The was a light low-level wind shear (LLWS) risk between 8,000 and 9,000 feet.

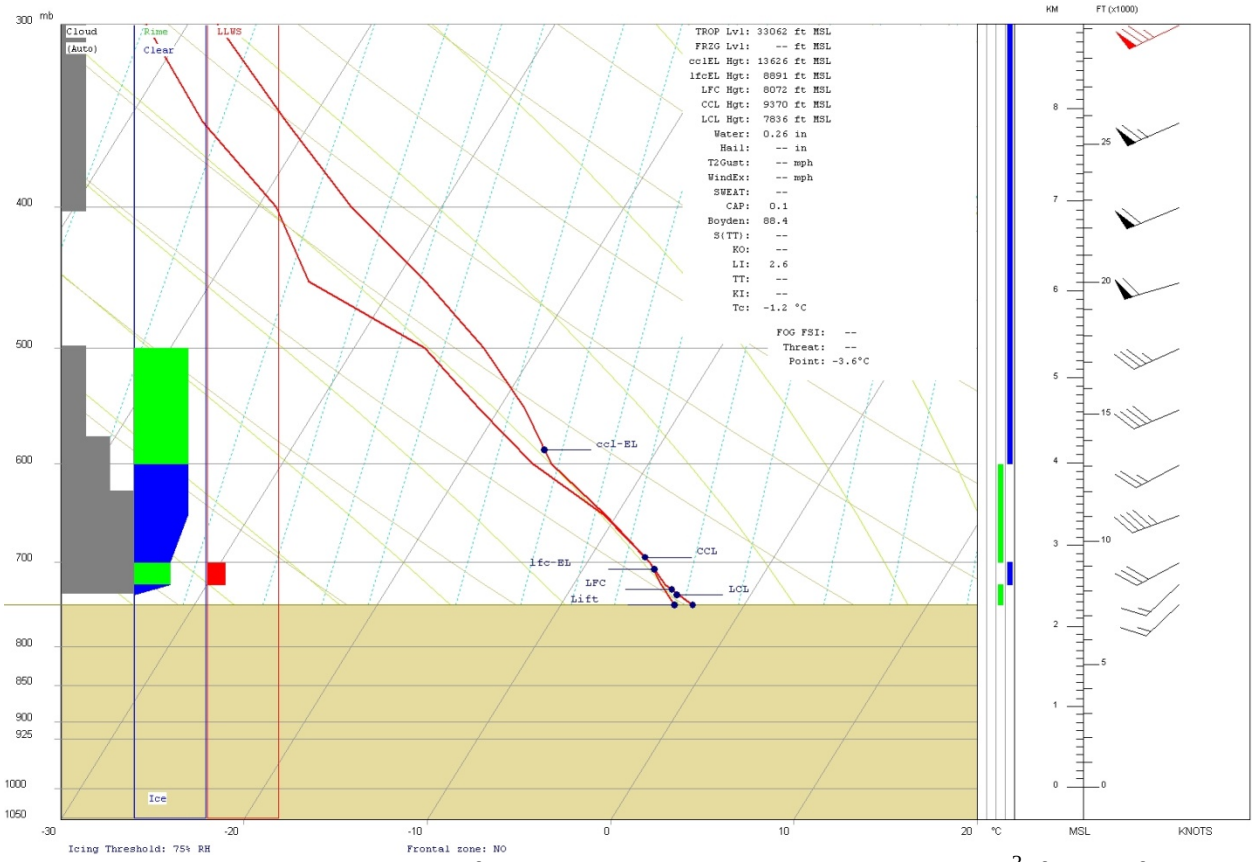

Figure 2 – NAM model sounding for the incident location in SkewT/LogP[3] format for 1100 MST, surface to 300mb.

[2] A "veering" wind is a wind that turns clockwise with increasing height.

[3] SkewT/LogP - A thermodynamic diagram, using the temperature and the logarithm of pressure as coordinates, which allows the plotting of the vertical profile of the temperature, humidity, and atmosphere above a particular point on the earth's surface.

Pilot reports made near KJAC below FL180[4] and near the time of the incident are presented here.

At 0954 MST at an unknown altitude over KJAC, a Pilatus PC-12 reported an overcast cloud layer at 6,900 feet with tops to 14,000 feet and occasional light turbulence and trace rime icing in the layer, air temperature of -8°C, runway 19 braking action was remarked as good.

At 1039 MST at 16,000 feet over the Dunoir VOR/DME (DNW) at Dunoir, Wyoming, a Beech King Air 90 reported an air temperature of -14°C, negative turbulence and negative icing.

At 1127 MST at 15,000 feet over DNW, a Boeing 757-200 reported an air temperature of -16°C with light rime icing during descent to KJAC.

JAC UA /OV JAC /TM 1654 /FLUNKN /TP PC12 /SK OVC069-TOP140 /TA M08 /TB OCNL LGT 069-140 /IC TRACE RIME 069-140 /RM RY19 BRAG=

JAC UA /OV DNW /TM 1739 /FL160 /TP BE9L /TA M14 /TB NEG /IC NEG=

RIW UA /OV DNW/TM 1827/FL150/TP B752/TA M16/IC LGT RIME DURING DESCENT TO JAC/ZLC=

Infrared Satellite Data

Geostationary Operational Environmental Satellite (GOES)-11 infrared (10.7µm) data was obtained from an archive at the Space Science Engineering Center (SSEC) at the University of Wisconsin-Madison (UW) in Madison, Wisconsin, and processed using the Man computer Interactive Data Access System (McIDAS). The satellite imagery (figure 3) identified relatively high cloud and overcast conditions above the incident site. Cloud-top temperatures in the immediate vicinity of the incident site were retrieved as approximately -39°C, corresponding to cloud-top heights of approximately 25,000 feet based on the NAM model 1100 MST sounding.

[4] Flight Level (FL) - standard nominal altitude of an aircraft, in hundreds of feet. This altitude is calculated from the International standard atmosphere using 1013.25 hPa (29.92 in Hg) for surface pressure.

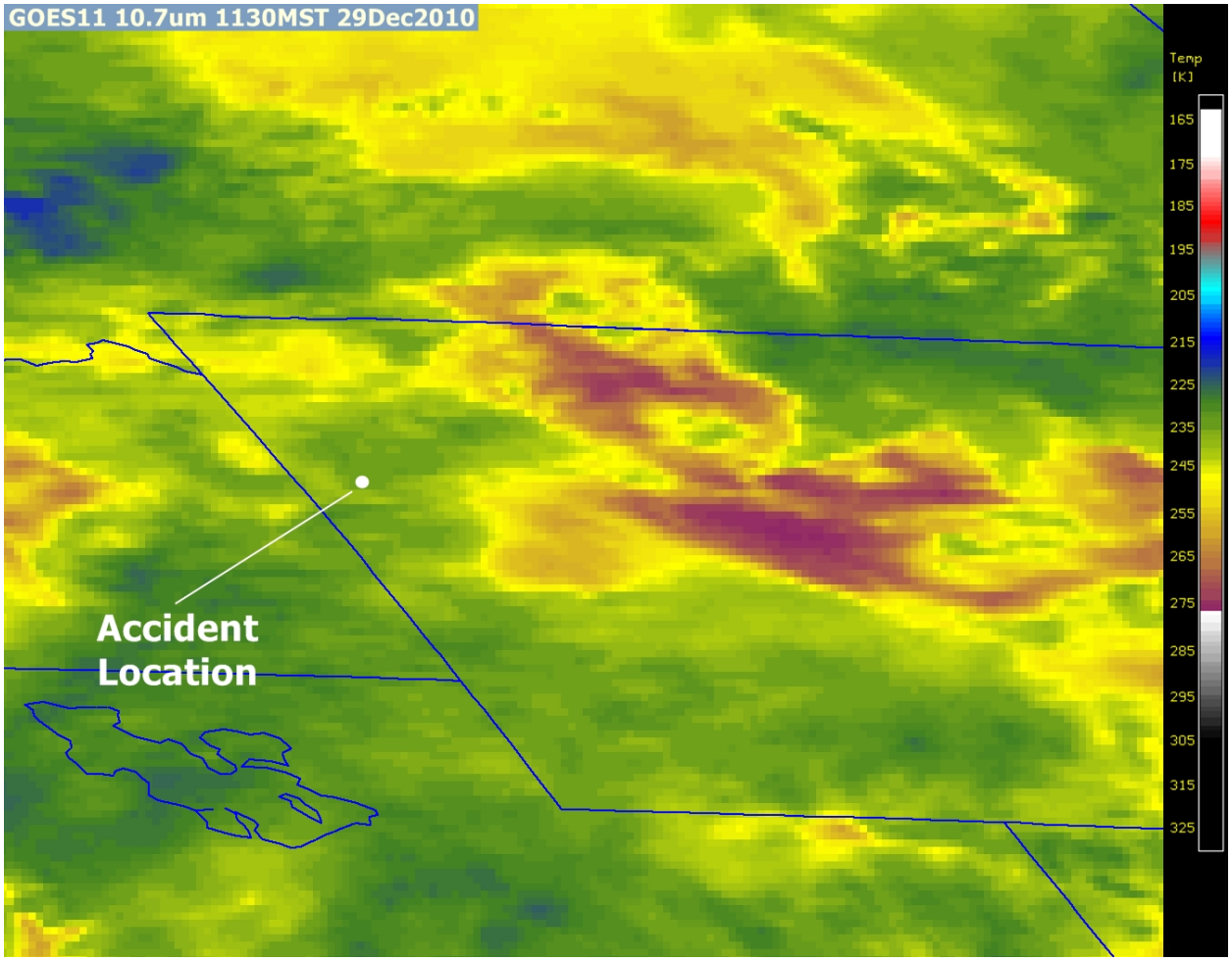

Figure 3 – GOES-11 (10.7µm) scan at 1130 MST. Color-enhanced.

In-Flight Advisories

No SIGMETs were active for KJAC at the incident time.

Several AIRMETs were active for KJAC below FL180 at incident time. These AIRMETs advised of IFR conditions, mountain obscuration, moderate icing and moderate turbulence.

> WAUS45 KKCI 291711 AAA
> WA5T
> _SLCT WA 291711 AMD
> AIRMET TANGO UPDT 7 FOR TURB STG WNDS AND LLWS VALID UNTIL 292100
>
> ...SEE SIGMET YANKEE SERIES...
>
> AIRMET TURB...ID MT WY NV UT CO AZ NM
> FROM 20ESE GTF TO 80SW DIK TO 40ESE CYS TO 40ENE LAA TO 50W LBL TO 20ESE TBE TO INK TO ELP TO 70SSW SSO TO 50N TUS TO BZA TO EED TO 20W BTY TO 50SE REO TO 50SE GEG TO 20ESE GTF

MOD TURB BLW FL180. CONDS CONTG BYD 21Z THRU 03Z.

WAUS45 KKCI 291445
WA5S
_SLCS WA 291445
AIRMET SIERRA UPDT 4 FOR IFR AND MTN OBSCN VALID UNTIL 292100

AIRMET IFR...ID MT WY NV UT CO AZ NM
FROM 50WSW YXC TO 50NNW ISN TO 80SW DIK TO 80SSW BIL TO 40NNW LAR TO 40WNW FTI TO 60W PHX TO 80W ILC TO 50NE BKE TO 50WSW YXC
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 21Z THRU 03Z.

AIRMET MTN OBSCN...ID MT WY NV UT CO AZ NM
FROM 50WSW YXC TO 50SSE YXH TO BIL TO 20ESE SHR TO 50ESE DDY TO 20SW CIM TO 40NNE SSO TO 40ESE PHX TO EED TO 50SE REO TO 50WSW YXC
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 21Z THRU 03Z.

WAUS45 KKCI 291445
WA5Z
_SLCZ WA 291445
AIRMET ZULU UPDT 2 FOR ICE AND FRZLVL VALID UNTIL 292100

AIRMET ICE...ID MT WY CO WA OR
FROM 30SSW YDC TO 50NNW ISN TO 40W RAP TO 20ESE LAR TO CHE TO DBS TO 40ESE BOI TO 40SSE PDT TO 30SSW YDC
MOD ICE BTN FRZLVL AND FL200. FRZLVL SFC-080. CONDS CONTG BYD 21Z THRU 03Z.

At 1130 MST, approximately 8 minutes prior to incident time, a new AIRMET TANGO for moderate turbulence below FL180 was issued for an area containing KJAC.

WAUS45 KKCI 291830 AAB
WA5T
_SLCT WA 291830 AMD
AIRMET TANGO UPDT 8 FOR TURB STG WNDS AND LLWS VALID UNTIL 292100

AIRMET TURB...ID MT WY NV UT CO AZ NM
FROM 20ESE GTF TO 80SW DIK TO 40ESE CYS TO 40ENE LAA TO 50W LBL TO 20ESE TBE TO INK TO ELP TO 70SSW SSO TO 50N TUS TO BZA TO EED TO 20W BTY TO 50SE REO TO 50SE GEG TO 20ESE GTF
MOD TURB BLW FL180. CONDS CONTG BYD 21Z THRU 03Z.

National Weather Service Weather Advisories

At 0439 MST, the NWS forecast office in Riverton, Wyoming (KRIW), issued the following weather advisories: A Weather Watch advised of heavy snowfall in western Wyoming during the daytime period, as well as gusty winds and blowing snow conditions. A Winter Weather Advisory was in effect for the Jackson Hole area, advising that the heaviest snowfall should occur during the morning hours through noon, with total event snowfall accumulations expected to reach 3 to 6 inches for the city of Jackson, and gusty winds to around 20 miles-per-hour with blowing snow possible.

WWUS45 KRIW 291139
WSWRIW
URGENT - WINTER WEATHER MESSAGE
NATIONAL WEATHER SERVICE RIVERTON WY
439 AM MST WED DEC 29 2010
...**SIGNIFICANT SNOWFALL RETURNS TO WESTERN WYOMING TODAY** AND THEN WILL LIKELY SHIFT TO CENTRAL WYOMING EAST OF THE DIVIDE LATE TONIGHT AND CONTINUE THROUGH THURSDAY AND THURSDAY NIGHT...
.A PACIFIC STORM SYSTEM WILL MOVE INTO THE CENTRAL GREAT BASIN TODAY AND IS EXPECTED TO BRING **PERIODS OF HEAVY SNOWFALL TO WESTERN WYOMING THROUGH THIS EVENING. GUSTY SOUTH TO SOUTHWEST WINDS COULD ALSO CREATE AREAS OF BLOWING SNOW.** THEN AN ASSOCIATED TROUGH OF LOW PRESSURE WILL TRACK EAST ACROSS THE ROCKY MOUNTAINS AND AN ASSOCIATED STRONG COLD FRONT WILL TRACK SOUTH ACROSS WYOMING TONIGHT RESULTING IN DEVELOPING SNOWFALL EAST OF THE DIVIDE TONIGHT. THE MAIN LOW PRESSURE CENTER WILL THEN BECOME MORE ORGANIZED EAST OF THE DIVIDE LATE TONIGHT. THIS WILL RESULT IN A POTENTIAL FOR PERIODS OF HEAVY SNOW ALONG ACROSS PORTIONS OF CENTRAL WYOMING EAST OF THE DIVIDE LATE TONIGHT THROUGH THURSDAY AND THURSDAY NIGHT. IN ADDITION...STRONG NORTH TO EAST WINDS MAY CAUSE BLOWING AND DRIFTING SNOW DURING ACROSS SOME AREAS EAST OF THE DIVIDE LATE TONIGHT THROUGH THURSDAY NIGHT.

WYZ013-291945-
/O.CON.KRIW.WW.Y.0045.000000T0000Z-101230T0700Z/
JACKSON HOLE-
INCLUDING THE CITY OF...JACKSON
439 AM MST WED DEC 29 2010
...WINTER WEATHER ADVISORY REMAINS IN EFFECT UNTIL MIDNIGHT MST TONIGHT...
A WINTER WEATHER ADVISORY REMAINS IN EFFECT THROUGH MIDNIGHT TONIGHT.
*** SUMMARY AND TIMING...SNOWFALL WILL CONTINUE OVER JACKSON HOLE THROUGH TODAY AND THIS EVENING. THE HEAVIEST SNOWFALL IS EXPECTED TO OCCUR THIS MORNING THROUGH NOON TODAY. HOWEVER...PERIODS OF LIGHT TO**

MODERATE SNOWFALL WILL CONTINUE THROUGH THIS EVENING.

*** SNOW ACCUMULATIONS...SNOWFALL IS EXPECTED TO VARY ACROSS THE AREA WITH THIS EVENT. THE SOUTHERN HALF OF THE VALLEY INCLUDING THE CITY OF JACKSON ARE EXPECTED TO SEE SNOWFALL OF 3 TO 6 INCHES. SNOWFALL ACCUMULATIONS WILL INCREASE MOVING NORTH THROUGH THE VALLEY WITH 5 TO 8 INCHES EXPECTED NEAR MOOSE AND MORAN THROUGH LATE THIS EVENING.**

*** WIND AND VISIBILITY...WIND OF 10 TO 15 MPH WITH GUSTS TO AROUND 20 MPH WILL BE POSSIBLE ACROSS THE VALLEY. THIS INCREASED WIND MAY CREATE BLOWING AND DRIFTING SNOW WHICH MAY LIMIT VISIBILITIES ON ROADWAYS.**

*** IMPACTS...TRAVEL THROUGH SOUTHERN JACKSON VALLEY IS EXPECTED TO BECOME HAZARDOUS TODAY. THOSE PLANNING OUTDOOR ACTIVITIES SHOULD BE PREPARED FOR DETERIORATING WEATHER CONDITIONS.**

PRECAUTIONARY/PREPAREDNESS ACTIONS...

A WINTER WEATHER ADVISORY MEANS THAT PERIODS OF SNOW AND BLOWING SNOW WILL CAUSE TRAVEL DIFFICULTIES. BE PREPARED FOR SLIPPERY ROADS AND LIMITED VISIBILITIES...AND USE CAUTION WHILE DRIVING.

Mike Richards
NTSB Meteorologist