National Transportation Safety Board

Office of Aviation Safety
Washington, D.C. 20594-2000
January 31, 2008

METEOROLOGICAL FACTUAL REPORT

ANC08FA025

A. ACCIDENT

Location: Whittier, Alaska
Date: December 3, 2007
Time: Approximately 1718 Alaska standard time (0218 UTC[1] December 4, 2007)
Aircraft: Eurocopter Deutschland BK117C1, registration: N141LG

B. METEOROLOGICAL SPECIALIST

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C. SUMMARY

On December 3, 2007, about 1718 Alaska standard time, a Eurocopter BK117C1 helicopter, N141LG, is presumed to have sustained substantial damage during an in-flight collision with ocean waters, about 3 miles east of Whittier, Alaska. The helicopter was being operated by Evergreen Alaska Helicopters, Inc., under contract to Lifeguard, Providence Hospital, Anchorage, Alaska, as a visual flight rules (VFR) patient transport flight under Title 14, CFR Part 135, when the accident occurred. The flight nurse received fatal injuries. The commercial certificated pilot, paramedic, and patient are missing, and presumed to have received fatal injuries. Instrument meteorological conditions prevailed in the area of the accident, and company VFR flight following procedures were in effect. The flight departed Cordova, Alaska, about 1630.

During the flight from Cordova to Anchorage, the pilot communicated the helicopter's position and estimated time of arrival in Anchorage, to the hospital's communications center

[1] UTC – is an abbreviation for Coordinated Universal Time.

at 10 minute intervals. The helicopter was reported missing when the pilot failed to make a subsequent position report, and attempts to communicate with the pilot failed.

D. DETAILS OF INVESTIGATION

The National Transportation Safety Board's (NTSB) meteorology specialist was not on scene for this investigation and gathered all the weather data for this investigation from the Washington D.C. office from official National Oceanic and Atmospheric Administration (NOAA), National Weather Service (NWS), and National Climatic Data Center (NCDC) sources. All times are Coordinated Universal Time (UTC) based upon the 24 hour clock. Local time of Alaska standard time (AST) is +9 hours to UTC, and UTC=Z. Directions are referenced to true north and distances are in nautical miles. Heights are above mean sea level (MSL) unless otherwise noted. Visibility is in statute miles and fractions of statute miles.

The accident site plots are based on the best estimate position and the recovered wreckage at latitude 60.8113° N and longitude 148.5295° W. All distances and plots on the images are based upon this point.

1.0 Synoptic Situation

The synoptic or large scale migratory weather systems influencing the area were documented using standard NWS charts issued by the National Center for Environmental Prediction (NCEP) located in Camp Springs, Maryland. These are the base products used in describing weather features and in the creation of forecasts and warnings. Reference to these charts can be found in the joint NWS and Federal Aviation Administration (FAA) Advisory Circular "Aviation Weather Services", AC 00-45.

1.0.1 Surface Analysis Chart

The NWS Alaska Surface Analysis Chart for 0000Z and 0300Z are provided as figure 1 and 2 respectively. The chart at 0000Z (figure 1) depicted an area of cyclonic circulations associated with a low pressure system in the Gulf of Alaska to the southwest of Kodiak Island and the accident site with a central pressure less than 980-hectopascals (hPa), with a trough (labeled "TROF") of low pressure extending eastward south of the accident site. An area of high pressure with a central pressure above 1050-hPa was depicted over Beaufort Sea and the Northwest Territories of Canada to the northeast of the accident site. The wind flow pattern over Prince William Sound resulted in a east-southeasterly wind flow pattern.

Figure 2 is the Surface Analysis Chart immediately after the accident at 0300Z and depicted a low pressure system with a central pressure of 978-hPa in the Bering Sea and another separate low with a central pressure near 976-hPa southwest of Kodiak Island with a trough extending eastward in the Gulf of Alaska, south of the accident site.

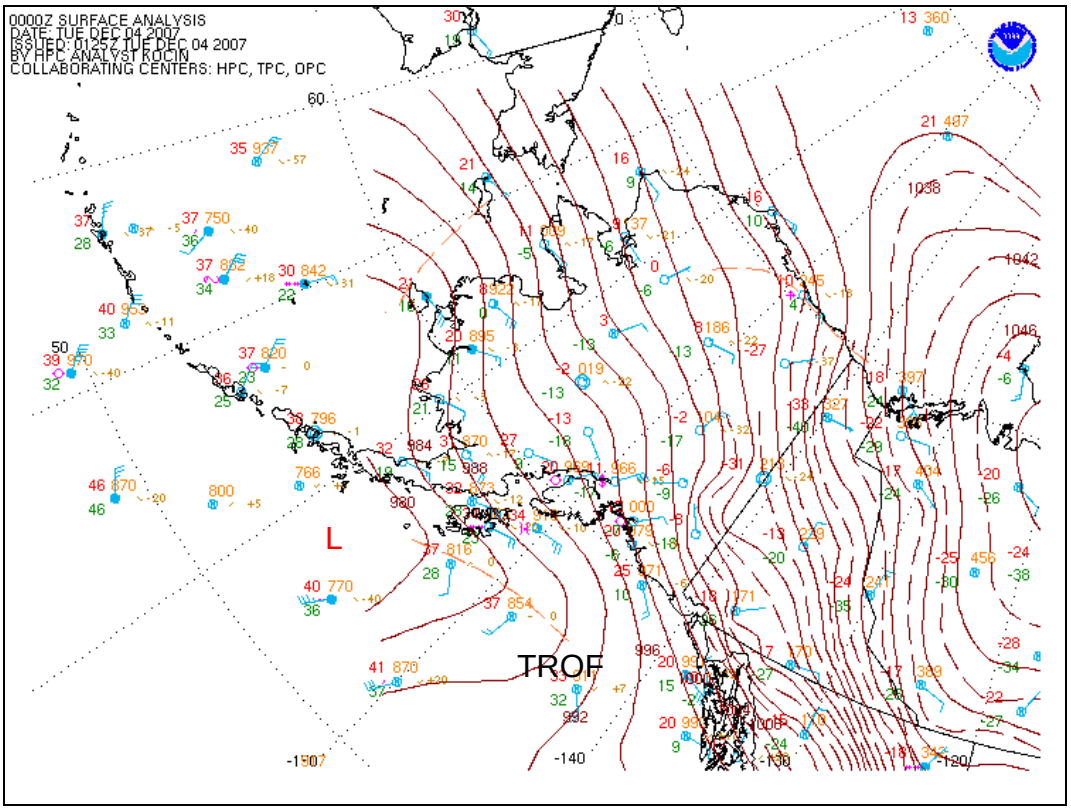

Figure 1 – NWS Alaska Surface Analysis Chart for 0000Z

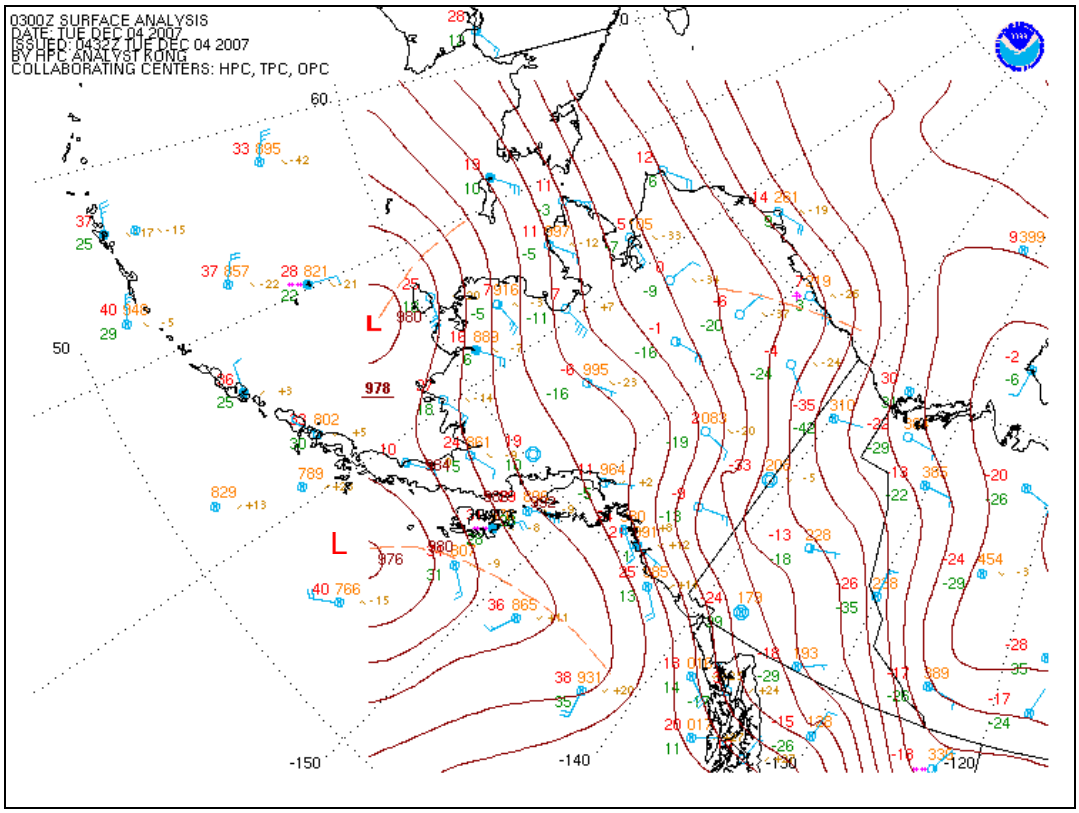

Figure 2 – NWS Alaska Surface Analysis Chart for 0300Z

2.0 Topographical Features

Figure 3 and 4 are topographical charts of the route of flight from Cordova to Whittier, and an enlarged area in the vicinity of the accident site. An X marks the approximate site of the accident site. As seen in figure 4 high terrain surrounds the accident site with terrain rising to over 2,000 feet northwest through northeast.

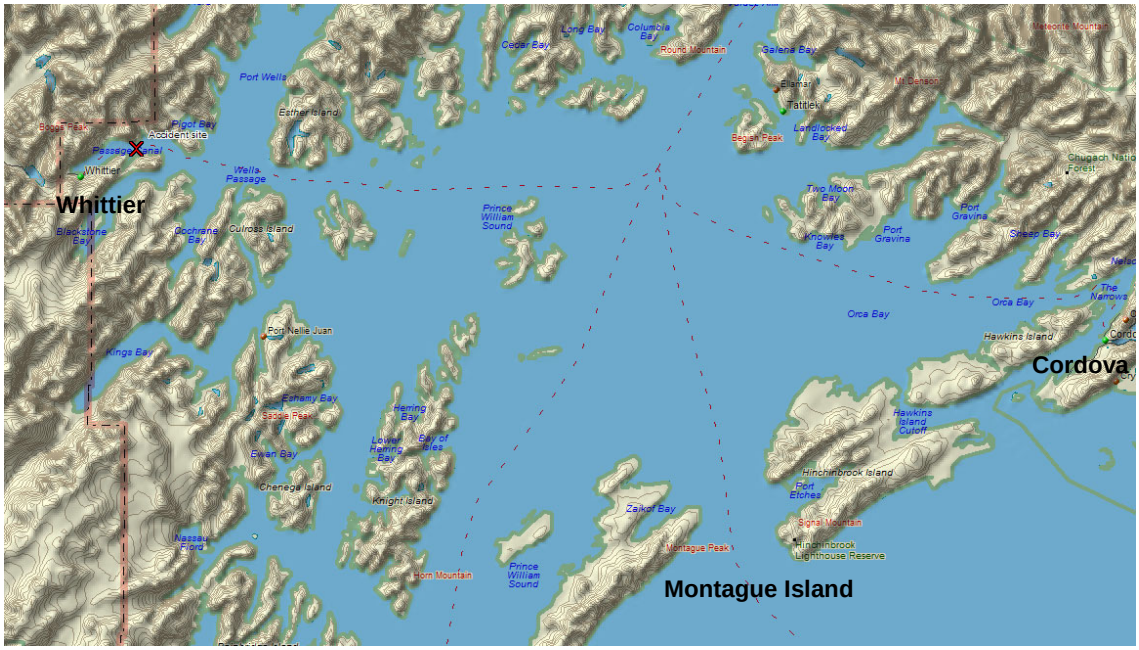

Figure 3 – Topographical map of the area

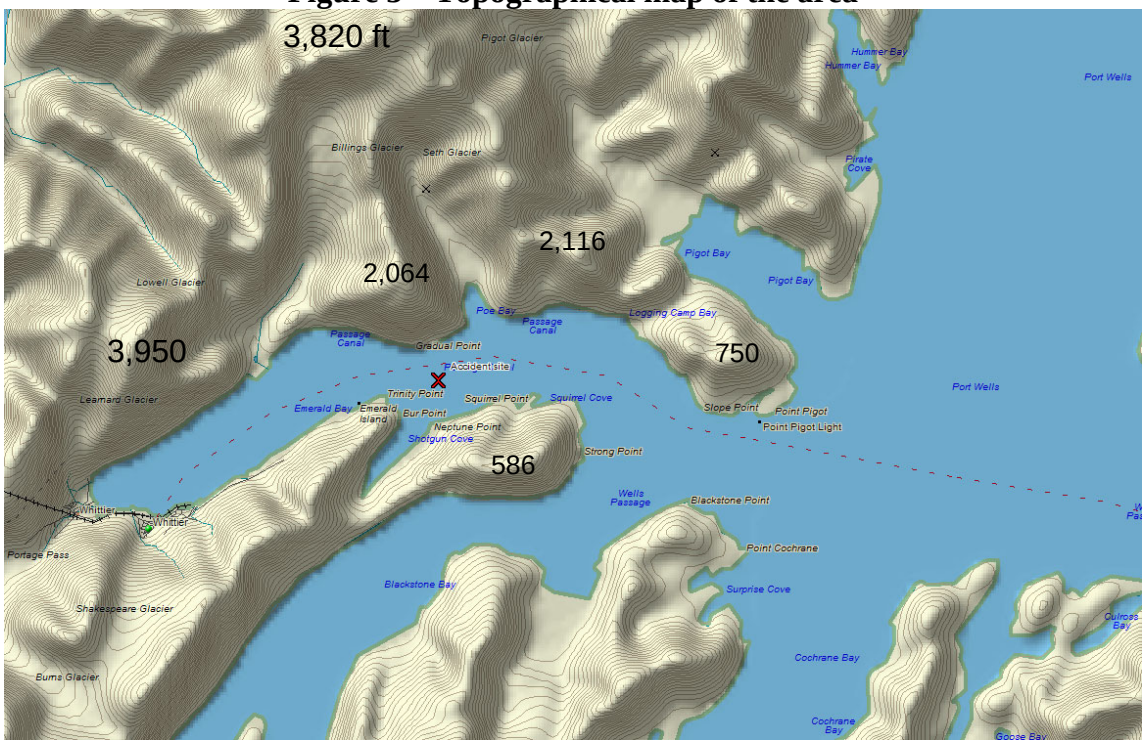

Figure 4 –topographical features in the vicinity of accident site

3.0 Surface Observations

The surrounding area was documented utilizing official NWS Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). The following observations are taken from standard code provided in plain language, with cloud heights reported above ground level (agl).

3.0.1 Whittier Airport (PAWR), Whittier, Alaska

The closest weather reporting facility to the accident site was from Whittier Airport (PAWR)[2], Whittier, Alaska, located approximately 5 miles west-southwest of the accident site at an elevation of 30 feet msl, with a magnetic variation of 25 degrees east. The airport facility director indicated that when available weather reports are hourly only. The following weather conditions were reported surrounding the time of the accident:

PAWR weather observation at 0054Z, wind calm, visibility 20 miles, ceiling[3] overcast at 4,500 feet, temperature minus 5 degrees Celsius (C), dew point minus 7 degrees C, altimeter setting 29.46 inches of Mercury (Hg). Remarks: sea level pressure 997.2-hPa, no specials in between hourly observations.

PAWR weather observation at 0155Z, wind from 120 degrees at 6 knots, visibility 1 mile in light snow and mist, ceiling obscured vertical visibility 300 feet, temperature and dew point minus 6 degrees C, altimeter setting 29.46 inches of Hg. Remarks: sea level pressure 997.6-hPa, no specials.

PAWR weather at 0247Z, wind missing, visibility 1 mile in light snow and fog, sky obscured vertical visibility 300 feet, temperature minus 3 degrees C, dew point minus 9 degrees C, altimeter 29.49 inches of Hg. Remarks: sea level pressure 998.6-hPa, no specials.

PAWR weather at 0452Z, wind from 130 degrees at 9 knots, visibility 1 miles in light snow and fog, sky obscured vertical visibility 300 feet, temperature minus 6 degrees C, dew point minus 7 degrees C, altimeter 29.52 inches of Hg. Remarks: sea level pressure 999.7-hPa, snowfall total 2 inches.

Low Instrument Flight Rule (LIFR) conditions[4] with snow and mist continued to be reported at PAWR through 0255Z on December 5th, with snow changing to rain after that with IFR conditions[5] continued through 0854Z.

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[2] Whittier Airport – does not have an Air Traffic Control (ATC) tower or any published instrument approaches, and no maintenance or services. The airport lists only 2 single engine airplanes based at the airport, and an average of 64 aircraft operations monthly.

[3] Ceiling – is defined as the lowest layer of clouds reported as broken or overcast, or the vertical visibility into a surface based obscuration.

[4] LIFR conditions – are defined as a ceiling below 500 feet and/or visibility less than 1/2 statute mile.

[5] IFR conditions – are defined as a ceiling less than 1,000 feet and/or visibility below 3 miles.

3.0.2 Prince William Sound (PATO), Portage Glacier, Alaska

The Alaska Ocean Observing System (AOOS) maintains an Automated Surface Observation System (ASOS) at Prince William Sound (PATO), located in Portage Glacier, Alaska. The site is located approximately 4 miles west of PAWR or 9 miles west-southwest of the accident site at an elevation of 94 feet msl. The following conditions were reported surrounding the period:

PATO weather observation at 0153Z, automated[6], wind calm, visibility unrestricted at 10 miles, scattered clouds at 3,300 feet, ceiling broken at 4,200 feet, overcast at 5,500 feet, temperature minus 8 degrees c, dew point minus 11 degrees C, altimeter 29.42 inches of Hg. Remarks: automated observation system, sea level pressure 996.4-hPa, temperature minus 8.3, dew point minus 10.6 degrees C, thunderstorm sensor inoperative.

PATO special weather observation at 0218Z, automated, wind calm, visibility 3 miles in light snow and mist, ceiling broken at 1,500 feet, broken at 2,600 feet, overcast at 3,200 feet, temperature minus 8 degrees C, dew point minus 10 degrees C, altimeter 29.42 inches of Hg. Remarks: automated observation system, snow began at 0205Z, hourly precipitation less than 0.01 inches, temperature minus 7.8 degrees C, dew point minus 10.0 degrees C, thunderstorm sensor inoperative.

PATO special weather observation at 0221Z, automated, wind calm, visibility 2 miles in light snow and mist, ceiling broken at 1,300 feet, broken at 2,600 feet, overcast at 3,000 feet, temperature minus 8 degrees C, dew point minus 10 degrees C, altimeter 29.42 inches of Hg. Remarks: automated observation system, snow began at 0205Z, hourly precipitation less than 0.01 inches, temperature minus 7.8 degrees C, dew point minus 10.0 degrees C, thunderstorm sensor inoperative.

PATO special weather observation at 0228Z, automated, wind from 110 degrees at 9 knots, visibility 1 1/4 miles in light snow, ceiling broken at 1,100 feet, broken at 2,400 feet, overcast at 2,800 feet, temperature minus 6 degrees C, dew point minus 9 degrees C, altimeter 29.42 inches of Hg. Remarks: automated observation system, snow began at 0205Z, hourly precipitation less than 0.01 inches, temperature minus 6.1 degrees C, dew point minus 9.4 degrees C, thunderstorm sensor inoperative.

PATO special weather observation at 0237Z, automated, wind from 120 degrees at 10 knots gusting to 17 knots, visibility 3 miles in light snow, ceiling broken at 1,100 feet, broken at 2,100 feet, overcast at 3,600 feet, temperature minus 6 degrees C, dew point minus 10 degrees C, altimeter 29.42 inches of Hg. Remarks: automated observation system, snow began at 0205Z, hourly precipitation less than 0.01 inches, temperature minus 5.6 degrees C, dew point minus 10.0 degrees C, thunderstorm sensor inoperative.

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[6] Automated indicates no human augmentation is present with the observation.

IFR to MVFR conditions in snow continued to be reported through the period with gusting southeasterly winds to 22 knots.

3.0.3 Ted Stevens Anchorage International Airport (PANC), Anchorage

Weather conditions in Anchorage as reported from Ted Stevens Anchorage International Airport (PANC) located approximately 48 miles northwest of the accident site at an elevation of 152 feet msl. PANC had an ASOS installed and was augmented by NWS certified observers reported the following conditions surrounding the period:

PANC weather at 0053Z, wind from 360 degrees at 8 knots, visibility unrestricted at 10 miles, ceiling broken at 8,500 feet, temperature minus 10 degrees C, dew point minus 22 degrees C, altimeter 29.41 inches of Hg. Remarks: automated observation system, sea level pressure 996.1-hPa, temperature minus10.0 degrees C, dew point minus 21.7 degrees C.

PANC weather at 0153Z, wind calm, visibility unrestricted at 10 miles, a few clouds at 8,000 feet, ceiling broken at 9,500 feet, temperature minus 11 degrees C, dew point minus 22 degrees C, altimeter 29.40 inches of Hg. Remarks: automated observation system, sea level pressure 996.0-hPa, temperature minus10.6 degrees C, dew point minus 21.7 degrees C.

PANC weather at 0153Z, wind calm, visibility unrestricted at 10 miles, a few clouds at 8,000 feet, ceiling broken at 9,500 feet, temperature minus 11 degrees C, dew point minus 22 degrees C, altimeter 29.40 inches of Hg. Remarks: automated observation system, sea level pressure 996.0-hPa, temperature minus10.6 degrees C, dew point minus 21.7 degrees C.

PANC weather at 0253Z, wind calm, visibility unrestricted at 10 miles, a few clouds at 7,000 feet, scattered clouds at 9,500 feet, temperature minus 11 degrees C, dew point minus 20 degrees C, altimeter 29.41 inches of Hg. Remarks: automated observation system, sea level pressure 996.3-hPa, temperature minus11.1 degrees C, dew point minus 20.0 degrees C, 3-hour pressure tendency fallen 0.5-hPa.

3.0.4 Merle K. (Mudhole) Smith Airport (PACV), Cordova, Alaska

The departure area of Cordova was located approximately 92 miles east from the accident site. The weather conditions surrounding the time of departure to the accident as recorded from Merle K. (Mudhole) Smith Airport (PACV), Cordova, which had an Automated Weather Observation System (AWOS-3) operating. The station was located at an elevation of 54 feet, and a variation of 22 degrees east. The following conditions were reported surrounding the period:

PACV weather at 0153Z, wind from 060 degrees at 7 knots, visibility unrestricted at 10 miles, scattered clouds at 4,800 feet, ceiling broken at 6,000 feet, broken at 7,000 feet, temperature minus 7 degrees C, dew point minus 20 degrees C, altimeter 29.48 inches of Hg.

Remarks: automated observation system, sea level pressure 998.2-hPa, temperature minus 6.7 degrees C, dew point minus 20.0 degrees C.

PACV weather at 0253Z, wind from 090 degrees at 5 knots, visibility unrestricted at 10 miles, scattered clouds at 2,900 feet, ceiling broken at 3,800 feet, broken at 7,000 feet, overcast at 10,000 feet, temperature minus 6 degrees C, dew point minus 17 degrees C, altimeter 29.50 inches of Hg. Remarks: automated observation system, sea level pressure 999.1-hPa, temperature minus 6.1 degrees C, dew point minus 17.2 degrees C, 3-hour pressure tendency risen 1.2-hPa.

VFR conditions continued to be reported at Cordova through the night.

3.0.5 Middleton Island Airport (PAMD), Middleton Island, Alaska

Middleton Island Airport (PAMD) located approximately 108 miles southeast from the accident site at an elevation of 100 feet msl, and a variation of 21 degrees east, had an Automated Weather Observation System (AWOS-3) installed and reported the following weather conditions surrounding the period:

PAMD weather at 0036Z, wind from 100 degrees at 27 knots gusting to 33 knots, visibility unrestricted at 10 miles, a few clouds at 3,200 feet, scattered clouds at 4,300 feet, ceiling broken at 5,500 feet, temperature minus 3 degrees C, dew point minus 8 degrees C, altimeter 29.36 inches of Hg. Remarks: automated observation system without a precipitation discriminator.

PAMD weather at 0136Z, wind from 090 degrees at 27 knots gusting to 36 knots, visibility 2 1/2 miles (weather missing), a few clouds at 1,300 feet, ceiling broken at 2,000 feet, overcast at 4,400 feet, temperature minus 3 degrees C, dew point minus 8 degrees C, altimeter 29.35 inches of Hg. Remarks: automated observation system without a precipitation discriminator, visibility 2 variable 4 miles, precipitation amount not available.

PAMD weather at 0236Z, wind from 090 degrees at 29 knots gusting to 36 knots, visibility 1 1/4 miles (weather missing), ceiling broken at 800 feet, overcast at 1,300 feet, temperature minus 3 degrees C, dew point minus 6 degrees C, altimeter 29.35 inches of Hg. Remarks: automated observation system without a precipitation discriminator, precipitation amount not available.

PAMD weather at 0336Z, wind from 100 degrees at 35 knots gusting to 42 knots, visibility 1 1/2 miles (weather missing), scattered clouds at 700 feet, ceiling overcast at 1,300 feet, temperature minus 2 degrees C, dew point minus 6 degrees C, altimeter 29.35 inches of Hg. Remarks: automated observation system without a precipitation discriminator, precipitation amount not available.

PAMD weather at 0416Z, wind from 100 degrees at 36 knots gusting to 42 knots, visibility 3/4 of a mile (weather missing), ceiling overcast at 600 feet, temperature minus 2

degrees C, dew point minus 5 degrees C, altimeter 29.36 inches of Hg. Remarks: automated observation system without a precipitation discriminator, precipitation amount not available.

4.0 Upper Air Data

The closest upper air sounding or rawinsonde observation (RAOB) was from the NWS Anchorage (PANC), Alaska, site number 70273, located approximately 48 miles northwest of the accident site at an elevation of 131 feet msl. The observation was obtained from the University of Wyoming's Internet site. The observation was then plotted and analyzed utilizing RAOB[7] software.

The 0000Z sounding on December 4, 2007, from PANC plotted on a standard Skew-T log P diagram[8] with the observed and derived stability parameters and is included as figure 5 from the surface to 500-mb or 18,000 feet. The significant levels, inversions, and a cloud analysis are plotted on the chart. The sounding depicted a frontal inversion at 922-hPa with temperatures remaining below freezing through the depth of the sounding. The Lifted Condensation Level (LCL)[9] was identified at 830-hPa or at 4,432 feet agl, and a Convective Condensation Level (CCL)[10] at 712-hPa or 8,151 feet agl. The tropopause height was identified at 23,204 feet msl. The thermal structure of the sounding supported snow, with precipitable water value was 0.09 inches. The Lifted Index (LI)[11] of 16.3 indicating an absolutely stable atmosphere.

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[7] RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamopras, Pennsylvania.

[8] Skew T log P diagram – is a standard meteorological plot using temperature and the logarithmic of pressure as coordinates, used to display winds, temperature, dew point, and various indices used to define the vertical structure of the atmosphere.

[9] Lifting Condensation Level (LCL) - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

[10] Convective Condensation Level (CCL) - is the height to which a parcel of air, if heated sufficiently from below, will rise adiabatically until condensation starts. This is typically used to identify the base of cumuliform clouds, which are normally produced from surface heating and thermal convection.

[11] Lifted Index (LI) - A common measure of atmospheric instability. Its value is obtained by computing the temperature that air near the ground would have if it were lifted to some higher level (around 18,000 feet, usually) and comparing that temperature to the actual temperature at that level. Negative values indicate instability - the more negative, the more unstable the air is, and the stronger the updrafts are likely to be with any developing thunderstorms.

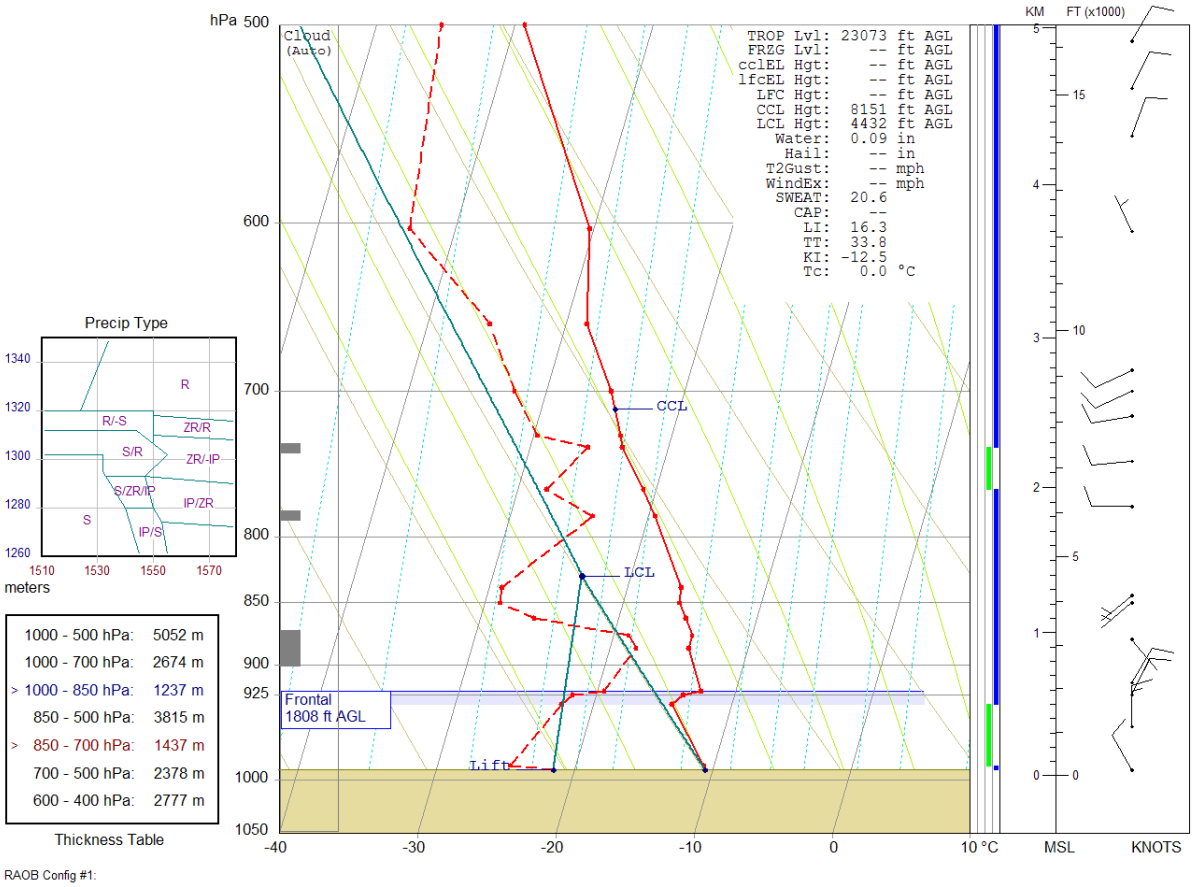


Figure 5 –PANC 0000Z sounding

The sounding wind profile indicated surface wind from the northwest or from 330 degrees at 8 knots with winds backing to the northeast with height until reaching the frontal inversion, and then abruptly shifting to the southeast and then veering to the southwest and west with height through 10,000 feet. Winds were less than 20 knots below 18,000 feet, and no strong vertical wind shears were noted to indicate any significant turbulent layers below 10,000 feet. The mean wind was from 340 degrees at 4 knots.

5.0 Satellite Data

The Geostationary Operations Environmental Satellite number 11 (GOES-11) data was obtained and displayed on the National Transportation Safety Board's Man-computer Interactive Data Access System (McIDAS) workstation. Both long and short wave infrared imagery were obtained surrounding the time of the accident. The infrared imagery band 4 at a wavelength of 10.7 microns (µm) and the infrared band 2 at a wavelength of 3.9 µm provided a 4-kilometer (km) resolution with radiative cloud top temperatures. The satellite imagery surrounding the time of the accident was reviewed and the closest images documented below.

Figure 6 is the GOES-11 shortwave infrared band 2 image at 0200Z at 4X magnification. The image depicts an extensive band of low and mid-level clouds in the Gulf of Alaska organized in a cyclonic pattern associated with an upper level low. The radiative cloud top temperature over the accident site was observed at 247.80 degrees Kelvin (K) or –25.36 degrees C, which according to the PANC sounding indicated cloud tops in the range of 8,000 feet consistent with nimbostratus type clouds.

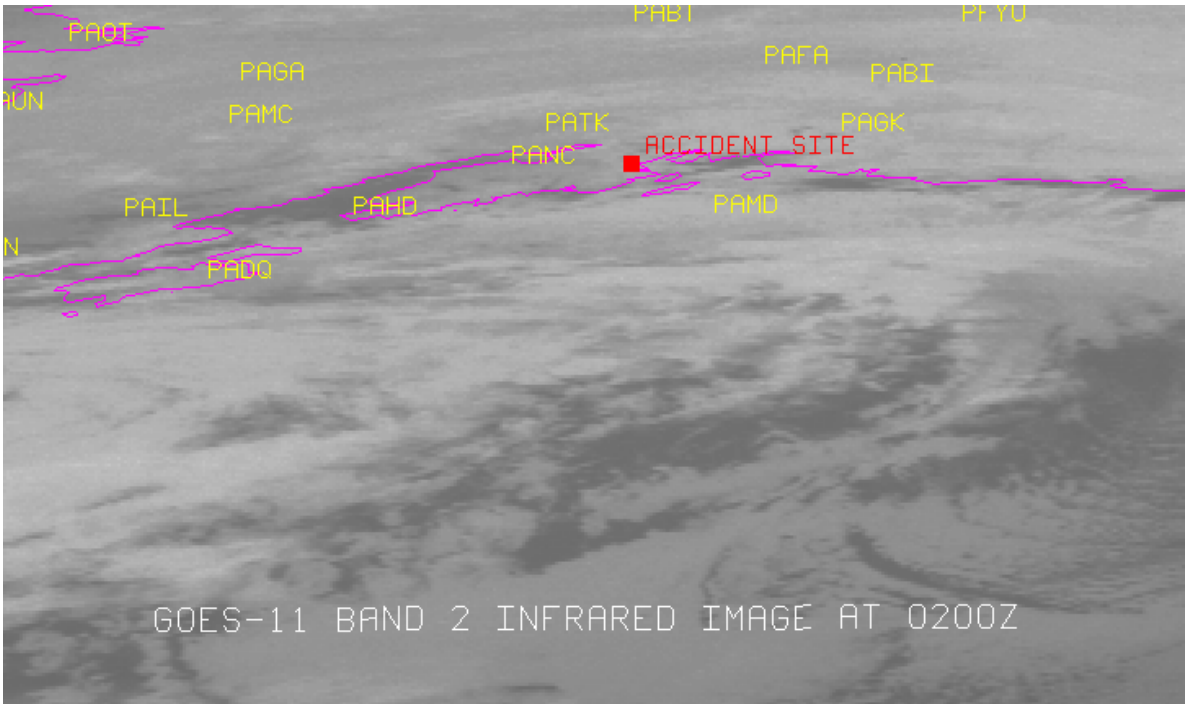


Figure 6 – GOES-11 infrared image at 0200Z

Figure 7 is the GOES-11 band 2 image at 0215Z at 6X magnification. Similar conditions of nimbostratus extend over the accident site with a radiative cloud top temperature of 248.20 degrees K or –24.96 degrees C, corresponding with cloud tops in the range of 8,000 feet.

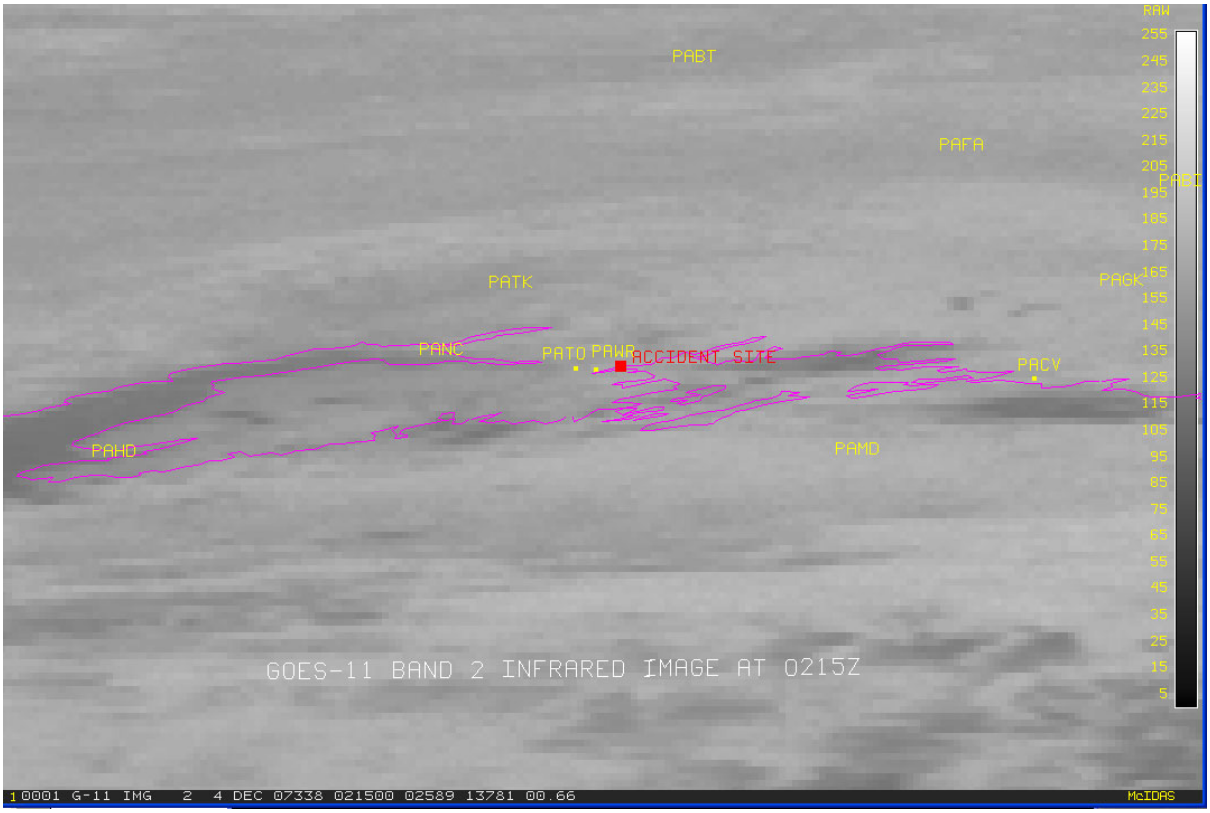


Figure 7 – GOES-11 infrared image at 0215Z

The NWS Polar Orbiting Environmental Satellite (POES) imagery was also examined surrounding the period. Figure 8 is the POES NOAA-15 infrared image at nominal time of 0148Z at 4X magnification, and 4-km resolution. The satellite pass was in a ascending orbit which means the satellite is heading northbound. This results in a reverse image, where true north is oriented towards the bottom of the page and south to the top of the page. The accident site is marked along with the major stations. The image depicts a band of low to mid level clouds extending over Passage Canal through the Whittier area, with a radiative cloud top temperature of 249.20 degrees K or –23.96 degrees C over the accident location, corresponding to cloud tops near 7,800 feet. Clear skies are depicted from west of Cordova over the majority of Prince William Sound to just east of Passage Channel.

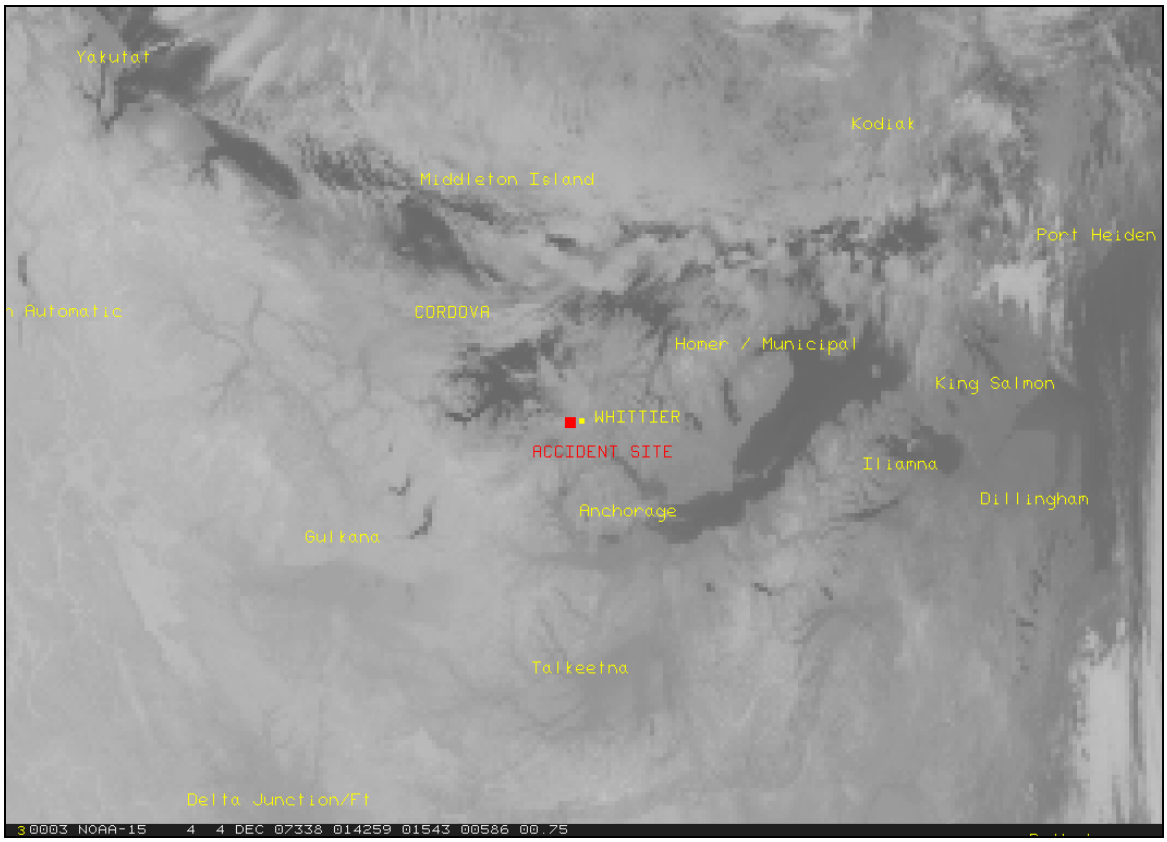


Figure 8 – POES infrared image at 0142Z

6.0 Weather Radar Information

The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D) sites to the accident were Kenai (PAHG) located approximately 83 miles west and Middleton (PAIH) located at 108 miles east-southeast of the accident site. The Level III archive data was obtained from the National Climatic Data Center (NCDC) utilizing the Hierarchical Data Storage System (HDSS) and displayed using NEXRAD Interactive Viewer and Data Exporter software.

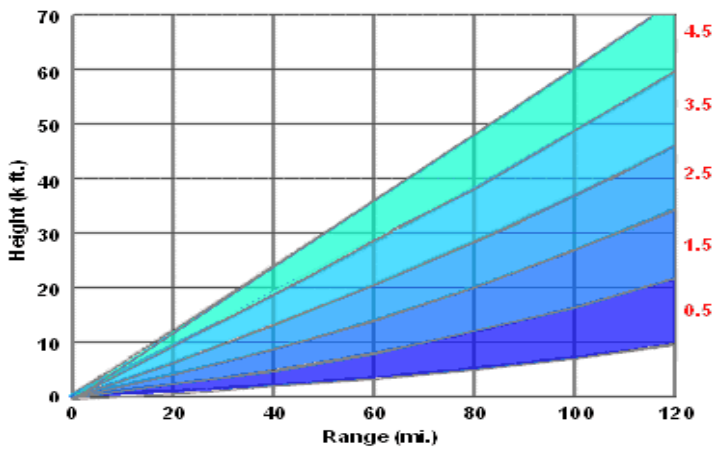
The WSR-88D is an S-band 10 centimeter wavelength radar with a power output of 750,000 watts, with a 28-foot parabolic antenna concentrating the energy into a 0.95-degree beam width. The radar produces three basic types of products reflectivity, radial velocity, and spectral width.

6.0.1 Volume Scan Strategy

The WSR-88D is a computer controlled radar system, which automatically creates a complete series of specific scans in a specific sequence known as a volume scan. Individual elevation scans are immediately available on the WSR-88D's Principle Users Processor

(PUP). Products that require data from multiple elevation scans are not available until the end of the six minute volume scan.

The WSR-88D operates in several different scanning modes, identified as Mode A and Mode B. Mode A is the precipitation scan and has two common scanning strategies. The most common is where the radar makes 9 elevation scans from 0.50 to 19.5 degrees every six minutes. This particular scanning strategy is documented as volume coverage pattern 21 (VCP-21). VCP-21 is used primarily for "stratiform" precipitation where vertical features of rain clouds are not as important as during the convective, thunderstorm-type of rain. Mode B is the clear air mode, where the radar makes 5 elevation scans during a ten minute period. During the period surrounding the accident the PAIH WSR-88D radar was operating in the precipitation mode (Mode A, VCP-21) and the PAHG radar were operating in the normal clear air mode (Mode B, VCP-32). The following chart provides an indication of the different elevation angles in this VCP-32, and the approximate height and width of the radar beam with distance from the radar site.



VCP-32 Clear Air Mode Scan Strategy

6.0.2 Beam Height Calculation

Assuming standard refraction[12] of the 0.95 degree radar beam of the WSR-88D, the following table shows the approximate beam height and width information of the PAHG radar image based on the antenna height of 356 feet msl and PAHI antenna height of 132 feet. The heights have been rounded to the nearest 10 feet.

ANTENNA ELEVATION	BEAM CENTER	BEAM BASE	BEAM TOP	BEAM WIDTH
PAHG 0.5	9,300 feet	5,140 feet	13,500 feet	8,360 feet
PAIH 0.5	13,590 feet	8,150 feet	19,030 feet	10,890 feet

[12] Standard Refraction in the atmosphere is when the temperature and humidity distributions are approximately average, and values set at the standard atmosphere.

6.0.3 Reflectivity

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors[13] it is a function of the drop size distribution, number of particles per unit volume, physical state (ice or water), shape, and aspect. Reflectivity is normally displayed in decibels (dBZ[14]), and is a general measure of echo intensity. The chart below relates the NWS video integrator and processor (VIP) intensity levels versus the WSR-88D's display levels, precipitation mode reflectivity in decibels, and rainfall rates.

NWS VIP/DBZ CONVERSION TABLE

NWS VIP	WSR-88D LEVEL	PREC MODE DBZ	RAINFALL
0	0 1 2	< 5 5 to 9 10 to 14	
1 Very Light	3 4 5	15 to 19 20 to 24 25 to 29	.01 in/hr .02 in/hr .04 in/hr
2 Light to Moderate	6 7	30 to 34 35 to 39	.09 in/hr .21 in/hr
3 Strong	8	40 to 44	.48 in/hr
4 Very Strong	9	45 to 49	1.10 in/hr
5 Intense	10	50 to 54	2.49 in/hr
6 Extreme	11 12 13 14 15	55 to 59 60 to 64 65 to 69 70 to 74 > 75	>5.67 in/hr

[13] Hydrometeors are any product of condensation or sublimation of atmospheric water vapor, whether formed in the free atmosphere or at the earth's surface; also, any water particles blown by the wind from the earth's surface. Hydrometeors are classified as; (a) Liquid or solid water particles suspended in the air: cloud, water droplets, mist or fog. (b) Liquid precipitation: drizzle and rain. (c) Freezing precipitation: freezing drizzle and freezing rain. (d) Solid (frozen) precipitation: ice pellets, hail, snow, snow pellets, and ice crystals. (e) Falling particles that evaporate before reaching the ground: virga. (f) Liquid or solid water particles lifted by the wind from the earth's surface: drifting snow, blowing snow, blowing spray. (g) Liquid or solid deposits on exposed objects: dew, frost, rime, and glaze ice.

[14] Reflected intensities are measured in dBZ (decibels of Z). As the strength of the signal returned to the radar increases the dBZ values increases. The Doppler radar does not determine where rain is located, only areas of returned energy. The "dB" in the dBZ scale is logarithmic and has no numerical value, but is used only to express a ratio. The "z" is the ratio of the density of water drops (measured in millimeters, raised to the 6th power) in each cubic meter (mm^6/m^3). Mathematically: dBz= 10 * log (z/z0). Where z = reflectivity factor and Z0 is defined to be 1 mm^6/m^3

6.0.4 Base Reflectivity

Figure 9 is the PAIH WSR-88D base reflectivity image for the 0.5 degree elevation scan completed at 0216Z provided at a resolution of 1° X 1 kilometers. The accident site is marked by a red circle east of PAWR and PATO. The image depicts a band of echoes ranging from 0 to 45 dBZ stretching west-southwest to east-northeast across Prince William Sound between Middleton Island and Whittier, with scattered echoes behind the band across the sound. Echoes in the range of 5 to 15 dBZ extends from west of Cordova (PACV), to Hawkins, Hinchinbrook, to north of Montague and Green Islands along the flight path. Echoes of 25 to 30 dBZ extend and south of Montague Island and over Middleton Island (PAMD), which is reporting IFR conditions with some visibility restriction, likely light snow and mist during the period. Due to range limitations and the type of physical state of the hydrometeors (ice crystals), no echoes are observed over the accident site.

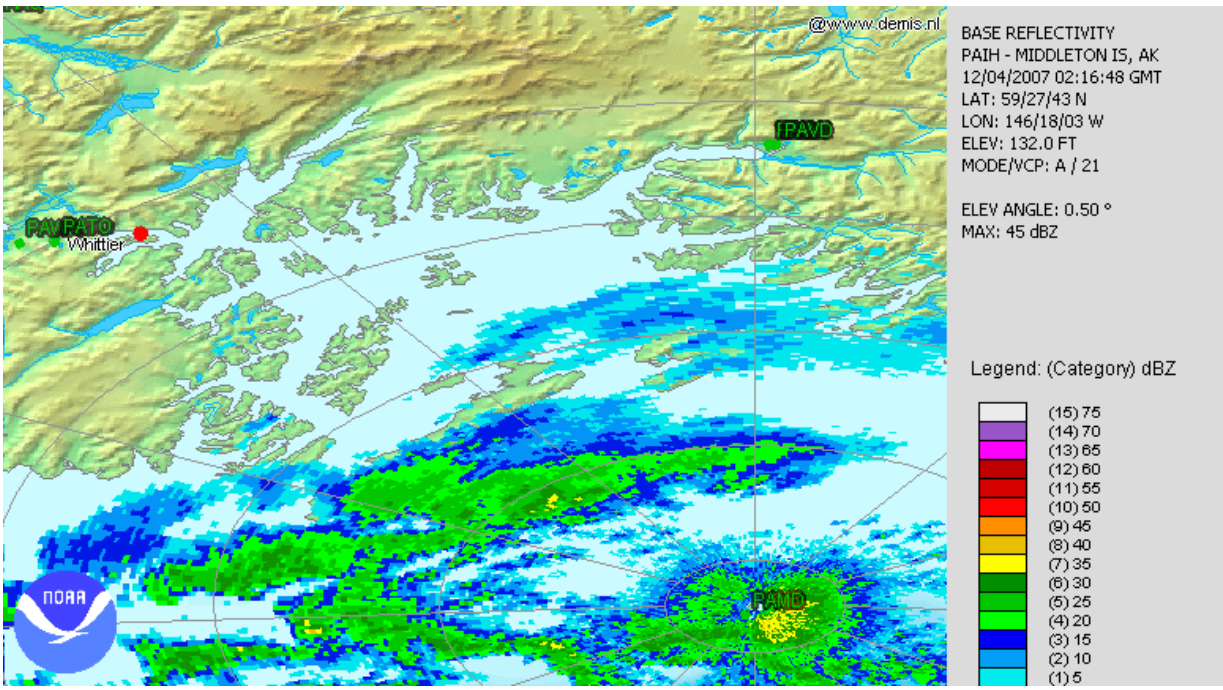


Figure 9 – PAIH WSR-88D 0.5 degree elevation scan for 0216Z

Figure 10 is the image from Kenai (PAHG) WSR-88D at 0218Z. No echoes are observed over the Whittier area or in the vicinity of the accident site. Range limitations are hydrometeors physical state again is implied as PAWR and PATO both report light snow and mist at the time of the image.

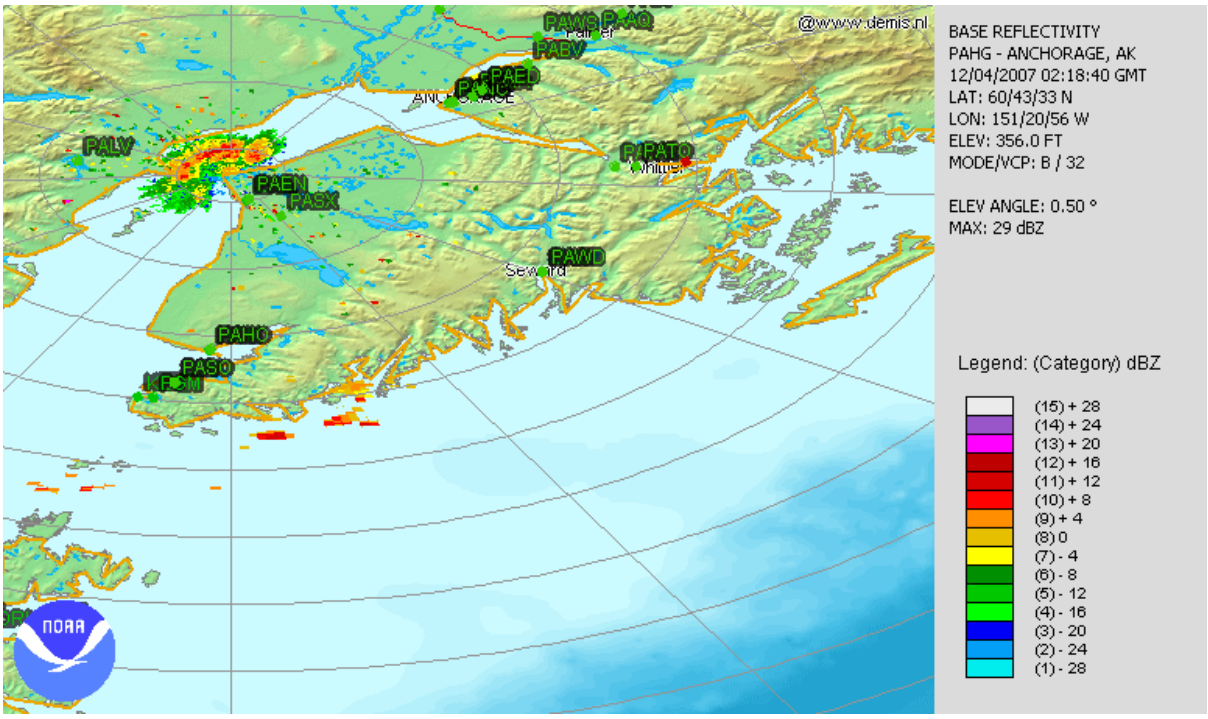


Figure 10 – PAHG WSR-88D 0.5 degree elevation scan for 0218Z

6.0.5 Echo Tops

The WSR-88D echo top product shows how high the precipitation echoes, or reflectivities of 18.5 dBZ, extend into the atmosphere. Cloud tops are somewhat higher than the top of the precipitation echoes. Figure 11 is the PAIH echo tops product for 0216Z. The image depicts echo tops ranging from 5,000 to 10,000 feet in the band of echoes, with maximum echo tops to 14,000 feet.

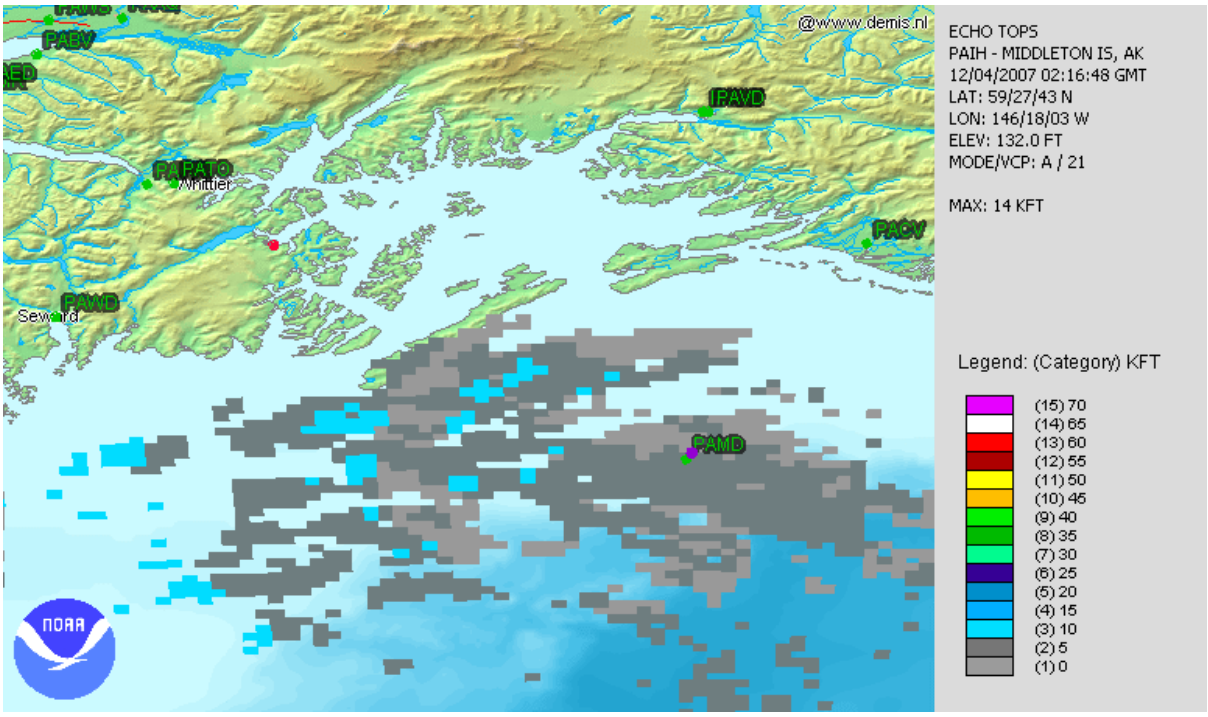


Figure 11 – PAIH WSR-88D echo tops product for 0216Z

7.0 Pilot Reports

The following pilot reports of PIREPs were documented surrounding the period of the accident over southern Alaska. The reports are in plain language from standard format and code as received.

Cordova (CDV) routine pilot report (UA); Over – Cordova VOR (CDV); Time – 1852Z; Flight level – 4,000 feet; Type aircraft – Beechcraft 1900 (B190) multiengine turboprop; Turbulence – occasional light turbulence below 13,000 feet; Remarks – encountered during descent into CDV.

Cordova (CDV) routine pilot report (UA); Over – Cordova VOR (CDV); Time – 1945Z; Flight level – 3,000 feet; Type aircraft – Cessna Skywagon (C180) single engine airplane; Weather – snow encountered near Suckling Hills; Wind – from 360 degrees at 25 to 35 knots; Turbulence – negative; Remarks – snow on ground from east side of Copper River to Controller Bay.

Anchorage (ANC) routine pilot report (UA); Over – Big Lake VOR (BGQ); Time – 2020Z; Flight level – 3,500 feet; Type aircraft – Piper Navajo (PA31) multiengine airplane; Wind – from 050 degrees at 30 knots; Turbulence – occasional light turbulence.

Valdez (VDZ) routine pilot report (UA); Over – between Gulkana (GKN) and Valdez (VDZ); Time – 2104Z; Flight level – 9,500 feet; Type aircraft – Eurocopter (B105) helicopter; Turbulence – smooth through Thompson Pass.

Anchorage (ANC) urgent pilot report (UUA); Over – Anchorage VOR (ANC); Time – 2113Z; Flight level – 2,000 feet; Type aircraft – Boeing 737 air carrier airplane; Turbulence – light; Remarks – low-level wind shear (LLWS) encountered plus/minus 7 to 10 knots of airspeed below 2,000 feet on final approach to runway 7L.

Cordova (CDV) routine pilot report (UA); Over – Cordova VOR (CDV); Time – 0125Z; Flight level – unknown; Type aircraft – Boeing 737 air carrier airplane; Sky cover – broken clouds bases at 2,500 feet; Turbulence – nil; Icing – light rime icing between 9,000 and 2,500 feet; Remarks – during descent to runway 9 at Cordova (CDV).

Anchorage (ANC) routine pilot report (UA); Over – Anchorage VOR (ANC); Time – 0335Z; Flight level – during climb; Type aircraft – Lear 35 (LJ35) business jet; Sky cover – overcast clouds tops 10,000 feet; Turbulence – negative; Icing – negative; Remarks – during climb out from the surface to 30,000 feet.

8.0 Area Forecast

The Area Forecast (FA) is an aviation forecast that contains a regional synopsis, 12-hour geographic specific forecasts, and an 18-hour outlook for each geographic area. Forecast weather elements are sky condition, cloud height, mountain obscuration, visibility, weather and/or obstructions to visibility, strong surface winds, icing, freezing level, and mountain pass conditions. Hazards and flight precautions, including AIRMETs and SIGMETs, may be found in their respective geographic area. It is used to determine forecast en route weather and to interpolate conditions at airports that do not have Terminal Aerodrome Forecasts (TAFs) issued. The NWS Alaska Aviation Weather Unit (AAWU) located in Anchorage, issues the FA at regular intervals and issues specials reports as necessary usually in the form of an AIRMET. The region that covers the route of flight is under the Anchorage (PANC) regional forecast for southern half of Alaska. The forecast valid for this accident was issued at 2045Z, and was valid until 0300Z.

The synopsis section was valid until 1500Z and indicated that a strong artic high pressure system was expected to remain over northwest Canada. A 974-hPa low pressure system was located approximately 80 miles south of Sand Point (PASD) and was expected to move to approximately 50 miles southeast of Pilot Point (PAPN) by 1500Z. An associated occluded front extended southeast from the low to Kodiak (PADQ) and southeastward at 1500Z. A 995-hPa low pressure system located 650 miles southwest of Attu Island was expected to move to 150 miles southwest of Attu Island by 1500Z and deepen[15] to 963-hPa.

The forecast for Cook Inlet and Susitna Valley valid until 0900Z, expected scattered to broken clouds at 7,000 feet with tops to 12,000 feet. South of Homer (PAHO), widely scattered broken 3,000 feet with visibility 3 miles in light snow showers. Surface winds in

[15] Deepen - Used in describing the history of a low pressure system or an area of cyclonic circulation, it means a decrease in the central pressure of the system. Although it usually describes the action of a pressure system on a constant pressure chart, it also means a surface low is increasing in cyclonic circulation and acquiring more energy. The opposite of filling.

Cook Inlet expected to be from the northeast at 20 knots gusting to 35 knots. The outlook from 0900Z through 1800Z expected VFR conditions to prevail and winds greater than 25 knots. After 1800Z on December 4th, south of the Anchorage area IFR conditions due to low ceilings and visibility in snow.

The forecast included an AIRMET for occasional moderate turbulence below 8,000 feet in the vicinity of Matanuska Valley, with low-level wind shear and isolated severe turbulence within 3,000 feet of the surface.

The forecast expected no significant icing. The freezing level was identified at the surface across the region.

9.0 Area Forecast Discussion

The NWS Area Forecast Discussion issued at 0000Z (1700 AST) for southcentral and southwest Alaska indicated that an upper level cut-off high pressure system continued to hold strong north of the state, with a ridge of high pressure extending down over the Bearing Sea. In the northern Pacific Ocean a barotropic low pressure system[16] was slowly moving eastward into the Shelikof Straight, with the increasing pressure gradient and cold air advection was resulting in strong winds, which were expected to during the evening tapering off. However, as the low pressure system progresses further northeast the winds are expected to increase again.

The short term forecast east of the Alaska Mountain Range expected the cold air pooling in the Copper River Basin to continue with gusty winds increasing across the region and the southcentral portion of Alaska. Winds are expected to tapper off during the afternoon and pickup again overnight as the low moves northward and the pressure gradient tightens. Northerly winds through the gaps and down Cook Inlet are expected to continue to cause gale and event storm force winds. Cold temperatures also mean the heavy freezing spray can also be expected in smaller marine areas like Resurrection Bay. Northward progression of the low in the Gulf of Alaska will bring a front to the southcentral region, while winds with this front are note expected to be too strong, there is a fair amount of lift associated with the system and may result in significant snowfalls along the coastal areas. A snowfall advisory is possible for the Homer Bluff area tomorrow with possibly 8 to 10 inches of snow in the Valdez area tomorrow night. Elsewhere the snow will be brief and significant snowfalls are not expected. West of the Alaska Range including the Aleutians, gusty winds are expected to continue to taper off today as the low in the North Pacific moves northeastward and the high pressure ridge moves in behind it. Cold air advection will bring snow showers to the Aleutians in particular, but significant snowfall is not expected. These conditions are expected to continue for the central Aleutians and eastward through the short term. Over the

[16] Barotropic System -A weather system in which temperature and pressure surfaces are coincident, i.e., temperature is uniform (no temperature gradient) on a constant pressure surface. Barotropic systems are characterized by a lack of wind shear, and thus are generally unfavorable areas for severe thunderstorm development.

western mainland and the Alaska Peninsula a brief shot of snow is expected as the low in Shelikof Straight brings an inverted trough of low pressure through the region today and tomorrow. In the western Aleutians, conditions are chilly but calm today, but are expected to deteriorate as a low pressure system approaches from the Sea of Japan, with models forecasting a central pressure of 955-hPA with near hurricane force winds expected in the marine areas Tuesday afternoon. A high wind watch for the land areas is expected this afternoon.

The weather watch/warning section indicated that the western Prince William Sound area (zone 125) including the route of flight and the Whittier area had a Marine Heavy Spray[17] and Gale Force Warnings[18] in effect. A Heavy Snow Advisory was in effect for the Kenai Peninsula, but did not include the Anchorage metro area.

10.0 Terminal Aerodrome Forecast (TAF)

No Terminal Aerodrome Forecast (TAF) are issued for Whittier Airport (PAWR). The closest TAF to the accident site was from Anchorage International Airport (PANC). The forecast issued at 2335Z and valid surrounding the period indicated the following:

PANC weather from 0000Z, wind from 360 degrees at 14 knots gusting to 20 knots, visibility better than 6 miles, a few clouds at 7,000 feet. From 0600Z, wind from 010 degrees at 12 knots, visibility better than 6 miles, ceiling overcast ay 15,000 feet. From 1100Z through 2400Z, wind from 060 degrees at 5 knots visibility better than 6 miles with showers in the vicinity, scattered clouds at 6,000 feet, ceiling overcast at 9,000 feet.

The forecast was amended at 0205Z. The forecast became wind from 360 degrees at 8 knots, visibility better than 6 miles, a few clouds at 7,000 feet, ceiling broken at 12,000 feet. From 1100Z through 2400Z, wind from 060 degrees at 5 knots, visibility better than 6 miles with showers in the vicinity, scattered clouds at 6,000 feet, overcast at 9,000 feet.

The forecast for the departure area of Cordova (PACV) was as follows:

PACV from 0000Z, wind from 060 degrees at 10 knots gusting to 16 knots, visibility better than 6 miles, ceiling broken at 5,000 feet, overcast at 8,000 feet. Temporarily between 0000Z and 0400Z, wind from 040 degrees at 8 knots. From 1200Z, wind from 090 degrees at 12 knots, visibility better than 6 miles in light snow showers, ceiling overcast at 5,000 feet. From 1500Z, wind from 090 degrees at 18 knots, visibility 6 miles in light snow showers, ceiling overcast at 3,500 feet. Temporarily between 1500Z and 1900Z, visibility 1 mile in light snow showers and mist, ceiling overcast at 1,500 feet. From 2200Z through 2400Z,

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[17] Heavy Freezing Spray - An accumulation of freezing water droplets on a vessel at a rate of 2 cm per hour or greater caused by some appropriate combination of cold water, wind, cold air temperature, and vessel movement.

[18] Gale Warning - A warning of sustained surface winds, or frequent gusts, in the range of 34 knots (39 mph) to 47 knots (54 mph) inclusive, either predicted or occurring, and not directly associated with a tropical cyclone.

wind from 090 degrees at 18 knots, visibility better than 6 miles with light rain and snow showers, ceiling overcast at 3,500 feet.

11.0 State Forecasts

The NWS Public Forecast issued at 0100Z (1600 AST) for western Prince William Sound, including Whittier, Sewar, Girdwoon, and Moose Pass areas was for strong winds that were expected to develop during the evening and continuing through Tuesday morning. Snow was expected, with snow accumulations of 2 to 6 inches. The low temperatures were expected in the upper teens to mid 20's (degrees F). Wind 15 to 30 miles per hour except southeast wind increasing to 30 to 45 mph along Portage Valley and Turnagain Arm. Tuesday December 4th, snow with accumulations of 5 to 8 inches. High temperature sin the upper 20's to mid 30's. Southeast winds 20 to 30 mph except east. Snow showers continuing into the evening with an additional 2 inches of snow possible.

The forecast for the southeast Prince William Sound including Cordova, was for strong winds developing during the evening and continuing through Tuesday afternoon. The forecast expected mostly cloudy skies with snow developing after midnight. Snow accumulation around 2 inches. Low temperature in the teens, wind east at 10 to 20 mph increasing to 30 to 45 mph after midnight. Tuesday December 4th, snow in the morning changing to rain and snow during the afternoon. Snow accumulation of 4 to 10 inches. High temperatures in the 30's degrees F, with easterly wind at 35 to 50 mph.

The forecast for Anchorage was for strong winds developing during the evening through Tuesday morning December 4th along the Turnagain Arm and higher elevations. Tonight mostly cloudy skies, with low temperatures –5 to 10 degrees F, winds northwest at 10 to 20 mph. Along Turnagain Arm and higher elevations winds east at 15 to 25 mph increasing to 30 to 45 mph after midnight. Wind chill temperatures –5 to –15 degrees F after midnight into the morning. Tuesday expect mostly cloudy skies with a slight chance of snow in the afternoon. High temperatures in the mid teens to lower 20's, wind north at 10 to 20 mph except east 30 to 45 mph along Turnagain Arm and higher elevations diminishing in the afternoon.

12.0 Weather Briefing

Computer and phone records indicated that the pilot looked at the Middleton Island WSR-88D images, the NWS Area Forecast, and called local AWOS/ASOS stations at the area airports to obtain the latest weather conditions prior to his flight to Cordova. Weather cameras were also part of the pilot's normal preflight weather practice. There was no record of the pilot obtaining an update on the return leg of the flight.

13.0 Statements

A helicopter pilot for Northern Pioneer Helicopters, Mr. Jim Acher, was operating in the area on the day of the accident and provided a statement of the conditions on the day of the

accident to the investigator NTSB Investigator In-Charge (IIC). The following is a summary of that interview.

Mr. Acher was recovering a wrecked airplane from Montague Island, and flew his helicopter over Prince William Sound on the day of the accident. Montague Island is southwest of Cordova, and Mr. Acher's route of flight intercepted the accident helicopter's general route, and continued toward Whittier approximately an hour earlier than the accident helicopter. Mr. Acher stated that he departed Montague Island about 2130Z (1230 AST) and proceeded north-northwest over Green Island and Knight Island, and on to the mainland coast. In the area of Main Bay he was forced to land due to weather. He estimated the ceilings along the route were high in the 6,000 to 8,000 feet range, but that bands of snow squalls down to the surface of the coastal waters brought the visibility to zero. He said he waited about an hour for the visibility to improve, and continued. Upon reaching a point of land near Passage Canal, which is the entrance to the Fjord leading to Whittier and the Portage Pass, he had to set down again, and wait for snow squalls to pass. He said he waited about another hour, and arrived in Portage Pass about 0030Z (1530 AST). He indicated that between the snow squalls, the ceilings were high and visibility good, but when the squalls came through, the visibility was reduced to zero and the winds would increase to 10 to 20 miles per hour.

14.0 Astronomical Data

Astronomical data from the United States Naval Observatory located in Washington, DC, was obtained for Whittier, Valdez-Cordove Borough, Alaska, for December 3, 2007.

Beginning of civil twilight:	1743Z (0843 AST)
Sunrise:	1840Z (0940 AST)
Sunset:	0048Z (1548 AST)
End of civil twilight:	0145Z (1645 AST)
Elevation of Sun at 0218Z:	9.4 degrees below the horizon
Azimuth of Sun at 0218Z:	240 degrees
Moonset:	2247Z (1347 AST)
Moonrise:	1303Z (0403 AST)
Elevation of Moon:	more than 15 degrees below the horizon
Phase of Moon:	Waning crescent with 28 percent of disk illuminated

Donald E. Eick
NTSB Senior Meteorologist