NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

February 15, 2019

Weather Study

METEOROLOGY

WPR19FA080

Table Of Contents

A. ACCIDENT

Location: Desert Hot Springs, California
Date: February 5, 2019
Time: about 1815 Pacific standard time
0215 Universal Coordinated Time (UTC) on February 6, 2019
Airplane: Cessna 172M; Registration: N20556

B. METEOROLOGIST

Don Eick
Senior Meteorologist
Operational Factors Division (AS-30)
National Transportation Safety Board

C. SUMMARY

On February 5, 2019, about 1815 Pacific Standard time, a Cessna 172M airplane, N20556, impacted mountainous terrain near Desert Hot Springs, California while on a cross-country flight to North Las Vegas Airport (VGT), Las Vegas, Nevada. The commercial pilot and his non pilot-rated passenger received fatal injuries, and the airplane was destroyed. The airplane was registered to Flying Academy Los Angeles (FALA), and was being operated as a 14 *Code of Federal Regulations* Part 91 personal flight. Undetermined night meteorological conditions existed at the impact location at the time of the accident. The accident flight leg had originated from San Gabriel Valley Airport (EMT), El Monte, California.

D. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's Senior Meteorologist was not on scene for this investigation and conducted the meteorology phase of the investigation from the Washington D.C. office, collecting data from official National Weather Service (NWS) sources including the Weather Prediction Center (WPC) and the National Center for Environmental Information (NCEI). All times are Pacific standard time (PST) based upon the 24-hour clock, local time is -8 hours from UTC, and UTC=Z. NWS airport and station identifiers use the standard International Civil Aviation Organization 4-letter station identifiers versus the International Air Transport Association 3-letter identifiers, which deletes the initial country code designator "K" for U.S. airports. Directions are referenced to true north and distances in nautical miles. Heights are in feet (ft) above mean sea level (msl) unless otherwise noted. Visibility is in statute miles and fractions of statute miles.

The accident site is based on the reported coordinates of latitude 34.0260° N and longitude 116.5879º W at an elevation of about 2,500 ft.

E. WEATHER INFORMATION

1.0 Synoptic Conditions

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 College Park, 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 00-45H.

1.1 Surface Analysis Chart

The southwest section of the NWS Surface Analysis Chart for 1900 PST is included as figure 1 with the approximate accident site marked by a red star depicting the primary pressure systems and boundaries immediately after the accident. The chart depicted a low-pressure system at 999-hectopascals (hPa)[1] over eastern Utah with a cold front extending southwestward through Utah, Arizona, into the Baja of Mexico. Behind and north of this cold front, a trough of low pressure extended southwest from southern Nevada into southern California and the Pacific Ocean. The accident site was located south of the trough and behind or on the cold air side of the front.

[1] Hectopascal (hPa) is the new NWS term for reporting sea level pressure and is interchangeable with the former term millibar (mb) with the same units. Standard sea-level pressure is 1013.25-hPa at a temperature of 15 Celsius (C).

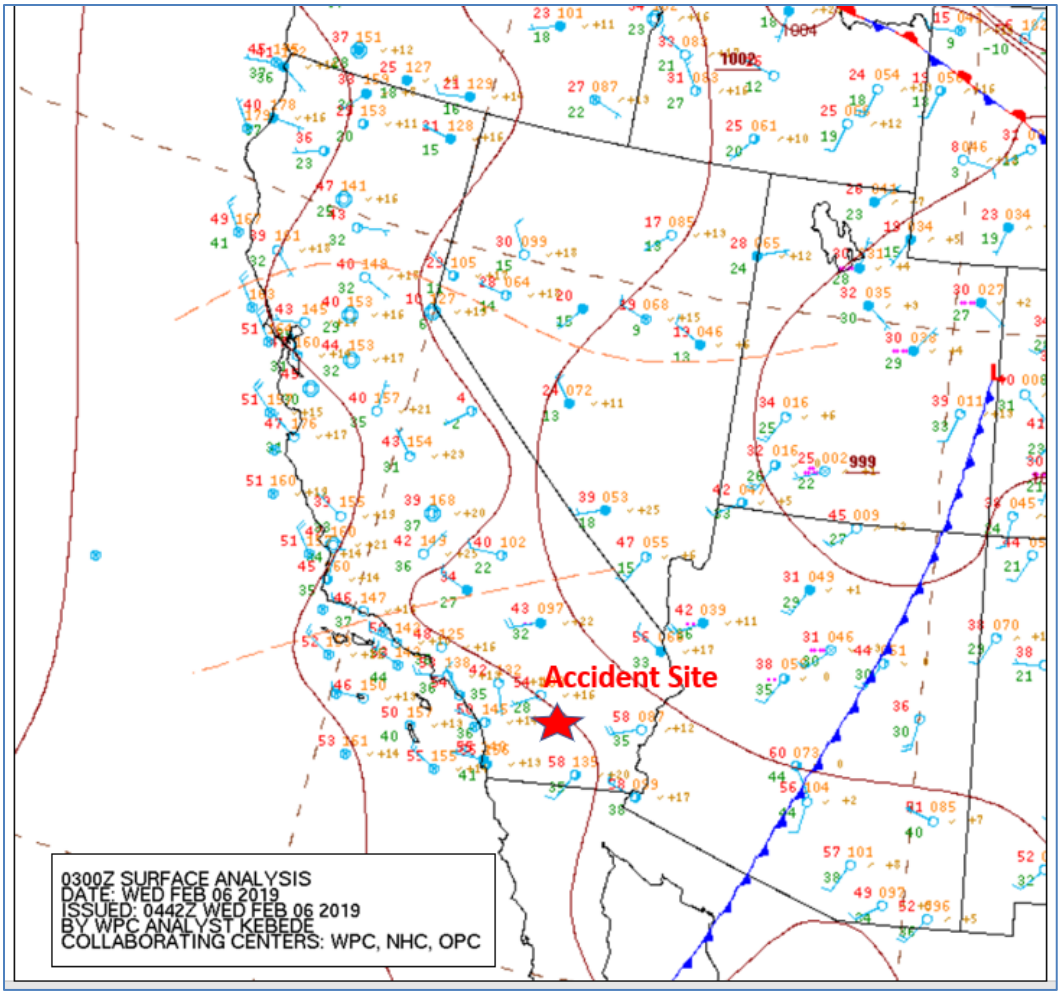

Figure 1 - southwest section of the NWS Surface Analysis Chart for 1900 PST

The station models on the Surface Analysis Chart in the vicinity of the accident site indicated westerly winds from 5 to 20 knots, with scattered cloud cover, with temperatures in the mid 50's degrees Fahrenheit (F). Several stations north of the accident in southcentral California, Arizona, and southern Nevada reported broken to overcast cloud cover with several stations reporting visibility restricted in rain or snow showers. No significant weather was depicted on the chart from the departure location or along the route of flight and in the vicinity of the accident site at the time.

1.2 National Composite Radar Mosaic

The National Composite Radar Mosaic image for 1815 PST is included as figure 2 with the approximate accident site marked by a red star. The image depicted several bands of light to moderate intensity echoes associated with rain and/or snow showers over the high terrain generally north of the route of flight and a small area of echoes located about 4 miles west of the accident site.

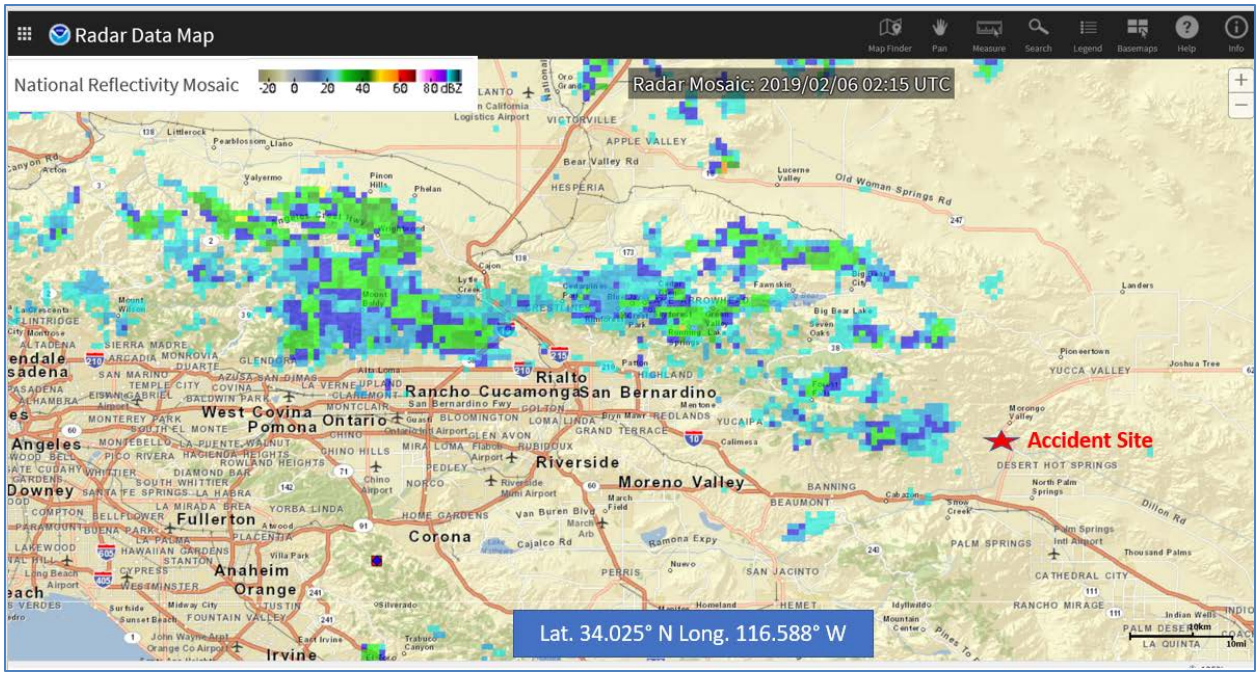

Figure 2 - National Composite radar Mosaic for 1815 PST

1.3 12-hour Surface Prognostic Chart

Figure 3 is the 12-hour Surface Prognostic Chart current at the time of the accident and valid for 2200 PST with the approximate accident site marked by a red star. The chart depicted the general pressure systems, fronts and troughs, and expected precipitation expected during the period. The chart depicted the accident site in an area of general westerly winds behind the cold front with several areas of precipitation expected southwest and east of the accident site, with a chance of precipitation expected over southeastern California, Arizona and over southern Nevada in the form of snow. The planned destination in Las Vegas, Nevada, indicated potential marginal conditions with clouds and precipitation based on the chart.

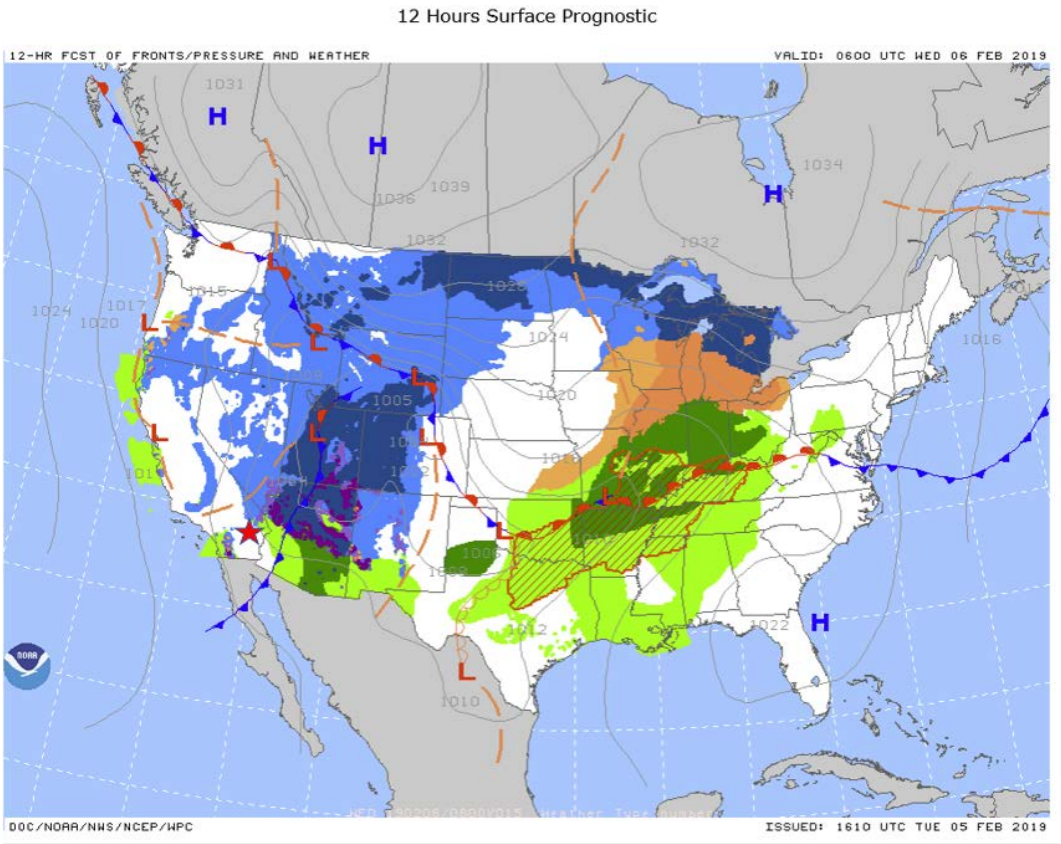

Figure 3 - 12-hour Surface Prognostic Chart valid for 2200 PST

2.0 Observations

The surrounding area was documented using Meteorological Aerodrome Reports (METAR) and Specials observations (SPECI). The area had a magnetic variation of 12° East based on the sectional chart for the area. Cloud heights are reported in height above ground level (agl) in the following section.

2.1 El Monte, California

The accident airplane departed from San Gabriel Valley Airport (KEMT), El Monte, California, at approximately 1740 PST. The airport was located 72 miles west of the accident site at an elevation of 296 ft. The airport was equipped with an Automated Weather Observation System (AWOS) and was augmented by Air Traffic Control (ATC) personnel. A search of the observations indicated that no report was available in the NWS database for 1745 PST. The report issued at 1645 PST was as follows:

KEMT weather observation at 1645 PST, wind from 220° at 11 knots gusting to 19 knots, visibility 10 miles or more, scattered clouds at 6,000 ft, temperature 12° C, dew point temperature 2° C, altimeter 29.89 inches of mercury (Hg).

The following conditions in raw METAR format were reported surrounding the period from 1545 to 1945 PST and indicated visual flight rule (VFR) conditions prevailing during the period.:

METAR KEMT 052345Z 21022G19KT 10SM SCT065 12/02 A2989

METAR KEMT 060045Z 22011G19KT 10SM SCT060 12/02 A2989

Departure 0140Z

METAR KEMT 060145Z MISSING

Accident 0215Z

METAR KEMT 060245Z 25005KT 10SM SCT060 10/03 A2993

METAR KEMT 060345Z 24003KT 10SM SCT060 09/02 A2995

2.2 Palm Springs, California

The closest official weather reporting location to the accident site was 12.5 miles south of the accident site at Palm Springs International Airport (KPSP), Palms Springs, California, which listed an elevation of 476 ft. The airport had a federally installed and maintained Automated Surface Observation System (ASOS) installed and was augmented by ATC. At the approximate time of the accident the following conditions were reported at KPSP.

KPSP weather observation at 1753 PST, wind from 030º at 12 knots, visibility 10 miles or more, ceiling broken at 10,000 ft, temperature of 14º C, dew point -1º C, altimeter 29.80 inches of Hg. Remarks; automated observation with a precipitation indicator, sea level pressure 1009.4-hPa, temperature 13.9º C, dew point -1.1º C.

The raw METAR observations from 1553 through 2353 PST were as follows:

METAR KPSP 052353Z 30012KT 10SM BKN080 OVC090 16/03 A2978 RMK AO2 SLP085

METAR KPSP 060053Z 08009KT 10SM OVC085 13/02 A2979 RMK AO2 SLP090 T01330022

METAR KPSP 060153Z 03012KT 10SM BKN100 14/M01 A2980 RMK AO2 SLP094 T01391011

Accident 0215Z

METAR KPSP 060253Z 24006KT 10SM CLR 12/M02 A2983 RMK AO2 SLP103 T01221022 53016

METAR KPSP 060353Z 03013G20KT 10SM CLR 12/M04 A2986 RMK AO2 WSHFT 0338 SLP113 T01221039

The observations indicated VFR conditions prevailing during the period with winds varying during the period. A wind shift noted at 1938 PST and the highest wind gust of 20 knots reported after the accident.

2.3 Big Bear City, California

The next closest official reporting location to the accident site was from Big Bear City Airport (KL35), located in Big Bear City, California, approximately 19 miles northwest of the accident site at an elevation of 6,752 ft. The airport had an AWOS and issued an observation every 20-minutes. The following conditions were reported surrounding the time of the accident:

KL35 weather observation at 1755 PST, automated, wind from 230° at 11 knots gusting to 23 knots, visibility 4 miles in mist, scattered clouds at 700 ft, ceiling broken at 1,100 ft, overcast at 1,700 ft, temperature -6° C, dew point -8° C, altimeter 29.73 inches of Hg.

KL35 weather observation at 1815 PST, automated, wind from 240º at 12 knots gusting to 19 knots, visibility 10 miles, scattered clouds at 900 ft, ceiling broken at 1,900 ft, overcast at 3,100 ft, temperature -6º C, dew point -9º C, altimeter 29.74 inches of Hg.

The general flight categories[2] and raw observations reporting surrounding the period were as follows:

IFR *METAR KL35 052335Z AUTO 24008G25KT 214V284 1SM -SN OVC006 M03/M05 A2973 RMK AO2 P0001*

LIFR *METAR KL35 052355Z AUTO 23013G20KT 174V264 3SM BR BKN004 OVC009 M05/M06 A2974 RMK AO2 P0001*

IFR *METAR KL35 060015Z AUTO 24010G21KT 10SM OVC009 M05/M07 A2973 RMK AO2*

IFR *METAR KL35 060035Z AUTO 21011G26KT 7SM BKN009 OVC013 M05/M07 A2973 RMK AO2*

MVFR *METAR KL35 060055Z AUTO 21007G25KT 174V274 10SM OVC013 M05/M07 A2973 RMK AO2*

MVFR *METAR KL35 060115Z AUTO 20011G20KT 5SM -SN SCT011 BKN017 OVC024 M05/M08 A2972*

IFR *METAR KL35 060135Z AUTO 21011G24KT 1 3/4SM -SN BKN011 OVC015 M05/M07 A2972*

MVFR ***METAR KL35 060155Z AUTO 23011G23KT 4SM BR SCT007 BKN011 OVC017 M06/M08 A2973***

Accident 0215Z

MVFR ***METAR KL35 060215Z AUTO 24012G19KT 10SM SCT009 BKN019 OVC031 M06/M09 A2974***

MVFR *METAR KL35 060235Z AUTO 24010G17KT 10SM SCT014 BKN021 OVC031 M06/M09 A2974*

---

[2] As defined by the NWS and the FAA Aeronautical Information Manual (AIM) section 7-1-7 defines the following general flight categories:

- Low Instrument Flight Rules (LIFR*) – ceiling below 500 ft above ground level (agl) and/or visibility less than 1 statute mile.
- Instrument Flight Rules (IFR) – ceiling between 500 to below 1,000 feet agl and/or visibility 1 to less than 3 miles.
- Marginal Visual Flight Rules (MVFR**) – ceiling from 1,000 to 3,000 ft agl and/or visibility 3 to 5 miles.
- Visual Flight Rules (VFR) – ceiling greater 3,000 ft agl and visibility greater than 5 miles.

* By definition, IFR is a ceiling less than 1,000 ft agl and/or visibility less than 3 miles while LIFR is a sub-category of IFR.

**By definition, VFR is a ceiling greater than or equal to 3,000 ft agl and visibility greater than 5 miles while MVFR is a sub-category of VFR.

MVFR *METAR KL35 060255Z AUTO 25007G19KT 10SM BKN010 OVC016 M06/M08 A2975*

MVFR *METAR KL35 060315Z AUTO 25005G19KT 7SM BKN010 OVC015 M06/M08 A2975*

2.4 Twentynine Palms, California

Twentynine Palms SELF Airport (KNXP), located in Twentynine Palms, California, was approximately 28 miles east-northeast of the accident site at an elevation of 2,051 ft. The airport had an ASOS and reported the following conditions at the approximate time of the accident:

KNXP weather observation at 1756 PST, wind from 230° at 22 knots gusting to 32 knots, visibility 7 miles, scattered clouds at 6,000 ft, temperature 9° C, dew point -7° C, altimeter 29.82 inches of Hg. Remarks: automated observation system with a precipitation discriminator, peak wind from 250º at32 knots occurred at 1756 PST, sea level pressure 1008.2-hPa, temperature 9.4° C, dew point -6.7° C, maintenance needed on system.

The raw observations surrounding the period were as follows:

METAR KNXP 052356Z 22021G28KT 7SM SCT070 12/M02 A2979 RMK AO2 PK WND 23033/2331 SLP068 T01221022 10144 20111 58003 $

METAR KNXP 060056Z 23025G31KT 10SM SCT070 10/M02 A2981 RMK AO2 PK WND 23033/0042 SLP078 T01001017 $

METAR KNXP 060156Z 23022G32KT 7SM SCT060 09/M07 A2982 RMK AO2 PK WND 25032/0156 SLP082 T00941067 $

Accident 0215Z

METAR KNXP 060256Z 24019G25KT 7SM SCT060 08/M06 A2985 RMK AO2 PK WND 23035/0202 SLP096 T00831056 53021 $

METAR KNXP 060356Z 22016G24KT 7SM SCT060 07/M06 A2988 RMK AO2 PK WND 23030/0317 SLP104 T00721061 $

METAR KNXP 060456Z 24018G25KT 7SM FEW060 07/M07 A2989 RMK AO2 SLP106 T00671067 $

METAR KNXP 060556Z 29015KT 7SM FEW060 05/M01 A2995 RMK AO2 PK WND 30028/0541 WSHFT 0444 SLP126 T00501011 10122 20050 53030 $

METAR KNXP 060556Z 29015KT 7SM FEW060 05/M01 A2995 RMK AO2 PK WND 30028/0541WSHFT 0444 SLP126 T00501011 10122 20050 53030 $

The observations from KNXP noted sustained southeasterly winds from 230° to 250° with gusts between 24 to 35 knots immediately surrounding the accident, with the peak gust of 35 knots recorded at 1802 PST. Visibility was reported at 7 miles and indicated that visibility lowered from the previous report of 10 miles, and no precipitation was reported. The type of obscuring phenomena was required to be reported at 6 miles or less.

2.5 METAR Display

A display of the observations over southern California at 1800 PST is depicted graphically from the NWS Aviation Weather Center (AWC) website[3] in figure 4. The station models are color coded and depicted generally VFR conditions over the area, with KL35 immediately north of the accident site reporting MVFR conditions at the time of the accident with gusting winds to 25 knots. Temperature and dew points are provided in degrees Fahrenheit.

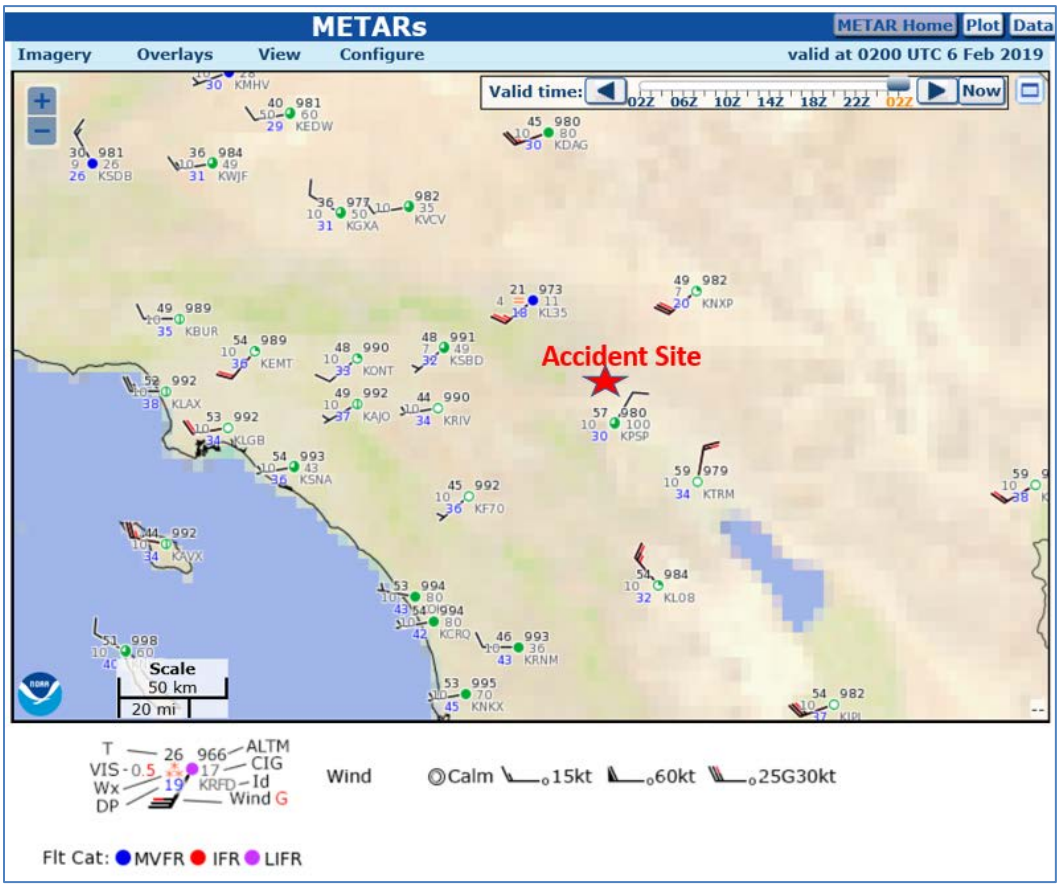

Figure 4 - METAR display at 1800 PST

2.6 Remote Automatic Weather Stations

A search of Remote Automatic Weather Stations (RAWS) operated by the U.S. Forest Service and the Bureau of Land Management were obtained from the MesoWest website[4] provided several additional stations reporting temperature and winds over the area. Temperatures are provided in °F, and wind speeds in miles per hour (mph). Figure 5 is a plot of the NWS weather reporting and RAWS reporting locations and the reported wind direction and speed by the pendent with peak gust in the box at 1815 PST. The Cabazon and Whitewater RAWS sites were located near the entrance of the Banning Pass. Yucca Valley RAWS was located 10 miles northeast of the accident

[3] https://aviationweather.gov/
[4] https://mesowest.utah.edu/

site and Burns Canyon 10 miles north. The bold italic print below indicated the conditions displayed at the time of the accident.

Cabazon RAWS *(BACZ1 - 33.93N, -116.81W, elevation 2,155 ft):*

Time	*T*	*Td*	*RH*	*Wind*	*Speed (mph)*
05 Feb 4:14 pm	*42*	*36*	*78%*	*WNW*	*17G28*
05 Feb 5:14 pm	*43*	*38*	*81%*	*W*	*13G26*
05 Feb 6:14 pm	***42***	***38***	***85%***	***W***	***13G20***
05 Feb 7:14 pm	*40*	*33*	*77%*	*W*	*14G22*

Whitewater RAWS *(WWAC1 - 33.95N, -116.66W, elevation 2,546 ft):*

Time	*T*	*Td*	*RH*	*Wind*	*Speed (mph)*
05 Feb 3:50 pm	*40*	*36*	*87%*	*WNW*	*37G48*
05 Feb 4:50 pm	*41*	*32*	*71%*	*W*	*30G58*
05 Feb 5:50 pm	***41***	***32***	***70%***	***WNW***	***36G49***
05 Feb 6:50 pm	*40*	*32*	*72%*	*WNW*	*32G47*

Yucca Valley RAWS *(UCCC1 - 34.12N, -116.41W, elevation 3,246 ft):*

Time	*T*	*Td*	*RH*	*Wind*	*Speed (mph)*
05 Feb 3:56 pm	*46*	*29*	*51%*	*SW*	*9G26*
05 Feb 4:56 pm	*42*	*26*	*54%*	*SW*	*6G29*
05 Feb 5:56 pm	***41***	***21***	***44%***	***SW***	***7G23***
05 Feb 6:56 pm	*39*	*23*	*53%*	*WSW*	*8G29*

Burns Canyon RAWS *(BCNC1 – 34.20N, -116.62 W, elevation 6,284 ft)*

Time	*T*	*Td*	*RH*	*Wind*	*Speed (mph)*
05 Feb 3:51 pm	*37*	*16*	*42%*	*WSW*	*10G41*
05 Feb 4:51 pm	*31*	*10*	*42%*	*SW*	*12G31*
05 Feb 5:51 pm	***28***	***9***	***45%***	***WSW***	***35G56***
05 Feb 6:51 pm	*27*	*9*	*48%*	*WSW*	*27G69*

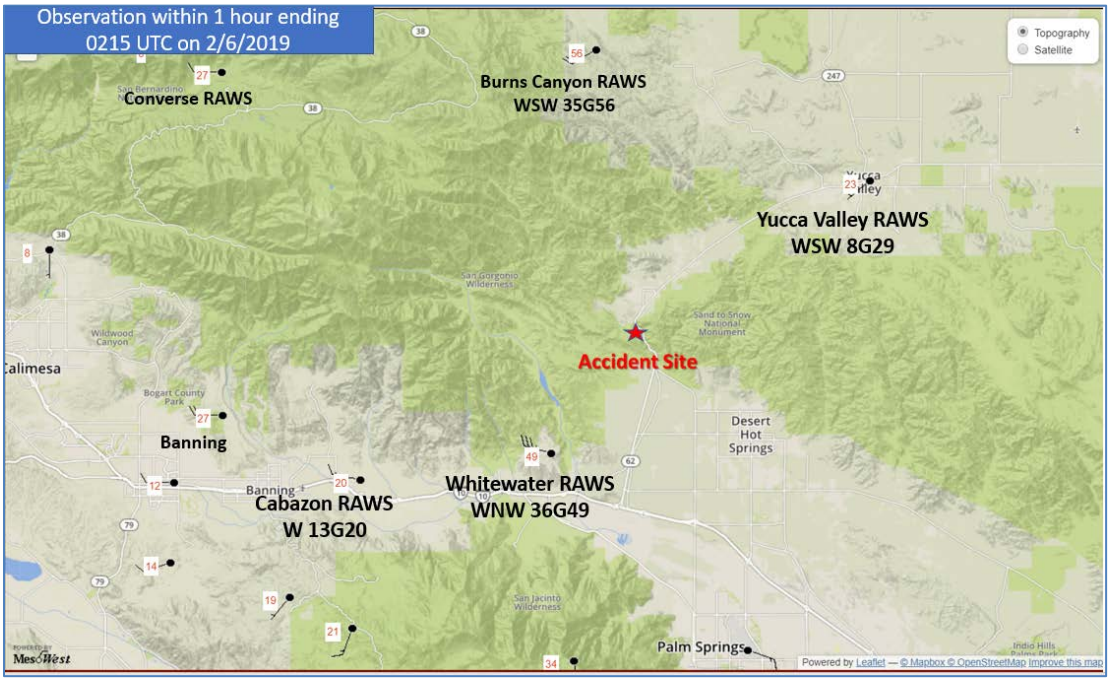

Figure 5 - MesoWest plot of RAWS sites and wind at 1815 PST

According to the local NWS Weather Forecast Office (WFO) Meteorologist "the winds at the Whitewater RAWS were gusting from 45 to 60 mph during the period of the accident. The flight would have traversed Banning Pass/San Gorgonio Pass which funnels strong winds. This is a peak area for winds and the Whitewater RAWS site would have been very representative of those winds in the vicinity of the accident site".

The data also indicated that the winds at Burns Canyon RAWS 10 miles north of the accident site at the time of the accident were from the west-southwest at 35 mph gusting to 56 mph with a maximum of 69 mph within the hour after the accident. The temperature-dew point spread, and low relative humidity indicated no low cloud cover existed during the period over the site, which was also confirmed in the satellite imagery.

3.0 Sounding

To determine the vertical structure and state of the atmosphere over the accident site a High-Resolution Rapid Refresh (HRRR)[5] numerical model data was retrieved from the NOAA Air Resources Laboratory and plotted on a standard Skew T log P diagram[6] using the complete Rawinsonde Observation RAOB program software[7]. Figure 6 is the HRRR sounding plot for 2200 PST[8] from the surface to 450-hPa or approximately 21,000 ft.

[5] The HRRR is a National Oceanic and Atmospheric Administration (NOAA) real-time three-kilometer resolution, hourly-updated, cloud-resolving, convection-allowing atmospheric model, initialized by three-kilometer grids with three-kilometer radar assimilation. Radar data is assimilated in the HRRR every 15 minutes over a one-hour period.

[6] Skew T log P diagram – is a standard meteorological plot or thermodynamic diagram 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.

[7] RAOB software – The complete RAwinsonde OBservation program is an interactive sounding analysis program developed by Environmental Research Services, Matamopras, Pennsylvania, for plotting and analyzing upper air data.

[8] The NOAA ARL archive data did not have data for the HRRR model from 1600 through 2100 PST, the next availed data was at 2200 PST.

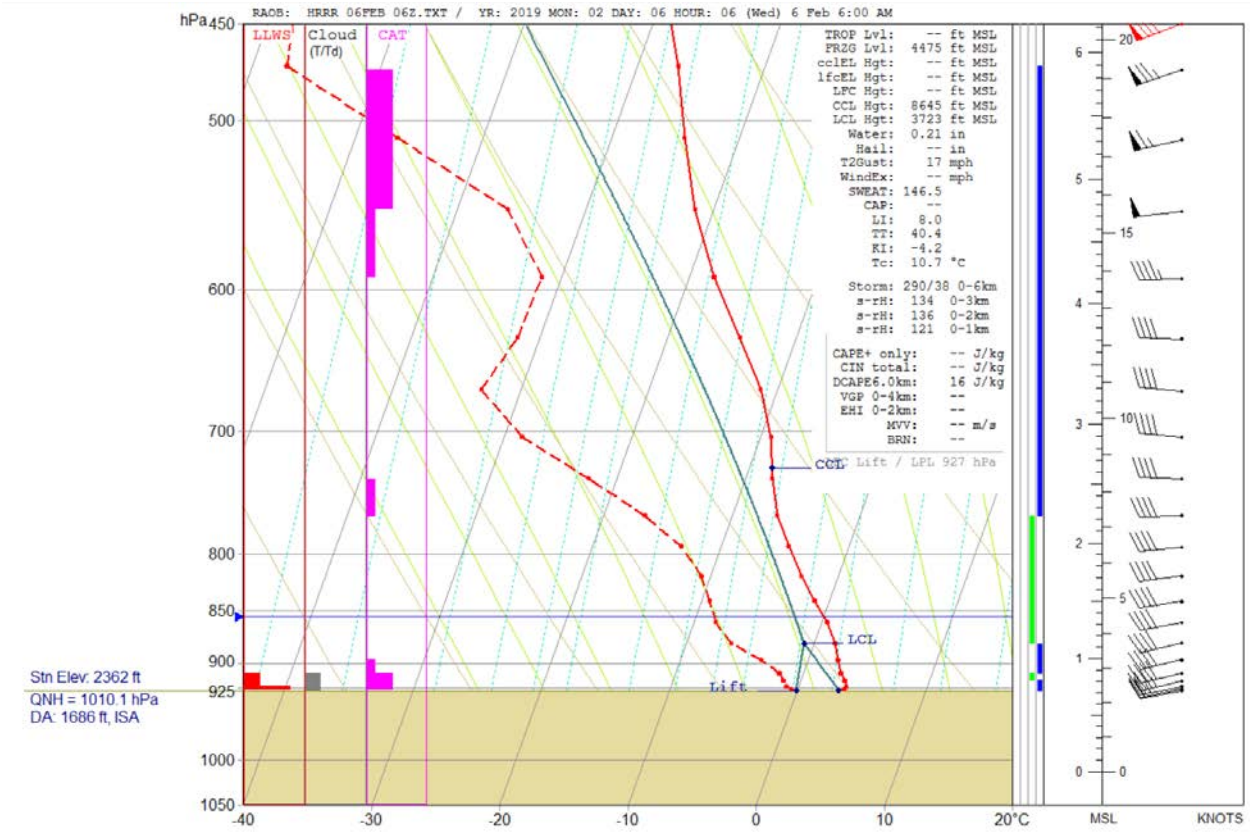

Figure 6 - HRRR model sounding for 2200 PST

The HRRR sounding the lifted condensation level (LCL) at 1,361 ft agl (3,723 ft msl). The freezing level was identified immediately above this at 4,475 ft msl and is indicated by the blue horizontal bar. The wind profile indicated a surface wind from 260° at 19 knots with little directional variation with height. The mean 0 to 6 kilometer (or 18,000 ft) wind was from 260° at 61 knots, with the level of maximum wind at 21,000 ft from 250° at 78 knots. The accident airplane was last observed at approximately 4,000 ft msl and the model indicated a wind from approximately 260° at 42 knots with a temperature of 1.0° C. The RAOB algorithm indicated a high probability of 100% of moderate turbulence below 1,000 ft of the surface and with a strong potential for low-level wind shear (LLWS).

Figure 7 is a table of the HRRR 2200 PST sounding parameters of height, pressure, temperature (T), dew point (Td), relative humidity (RH), wind direction and speed, and the RAOB algorithm clear air turbulence, low-level wind shear, and icing potential.

Height (ft-MSL)	Pres (hPa)	T (C)	Td (C)	RH (%)	DD / FF (deg / kts)	CAT (FAA)	LLWS	Icing - Type (AFGWC method)
2362	927	3.2	-0.1	79	258 / 19			
2391	926	3.6	-0.5	75	258 / 18	MDT	STRNG	
2478	923	3.7	-1.0	71	257 / 27	MDT	LIGHT	
2652	917	3.4	-1.4	71	256 / 33	MDT	LIGHT	
2856	910	2.9	-1.9	71	256 / 39	LGT		
3238	897	2.3	-3.7	64	256 / 42			
3715	881	1.6	-6.5	55	256 / 42			
4321	861	0.4	-8.3	52	258 / 41			
4938	841	-1.2	-9.4	54	260 / 39			
5629	819	-2.9	-10.7	55	262 / 39			
6465	793	-4.7	-13.1	52	264 / 38			
7323	767	-6.5	-16.8	44	268 / 39	LGT		
8343	737	-7.9	-22.2	31	273 / 41			
9508	704	-9.2	-28.6	19	276 / 41			
10797	669	-11.3	-33.1	15	275 / 42			
12220	632	-14.4	-31.7	22	272 / 41			
13835	592	-18.1	-31.5	30	268 / 43	LGT		
15627	550	-21.5	-36.1	26	263 / 51	MDT		
17490	509	-24.3	-46.7	11	256 / 64	MDT		
19229	473				250 / 75			

Figure 7 - HRRR model parameters from the surface to 20,000 ft

A review of the topographical features indicated that the accident site was located about 15 miles east of Little San Gorgonio Peak at 9,133 ft, with winds at that level from 275º at 41 knots. The RAOB algorithms did not detect any mountain wave conditions from the HRRR sounding over the accident site; however, the wind profile and stable atmosphere favored the development of waves downstream of the higher terrain. The NWS San Diego sounding for 1600 PST upwind of the mountains with a similar wind profile with lower wind speed magnitudes also depicted favorable conditions for mountain wave conditions and is included as figure 8. That sounding using the worst case parameters for mountain wave conditions indicated a predominate wave at 24,000 ft with a secondary wave at about 6,000 ft. That secondary wave at 6,000 ft had a wavelength of 3.2 miles, an amplitude of 1,761 ft, a maximum vertical velocity of the updrafts/downdrafts of 1,055 fpm and indicated a high probability of moderate-to-severe turbulence at that level.

Figure 9 is the observed KSAN sounding parameters with the addition of mountain wave conditions from the RAOB algorithm.

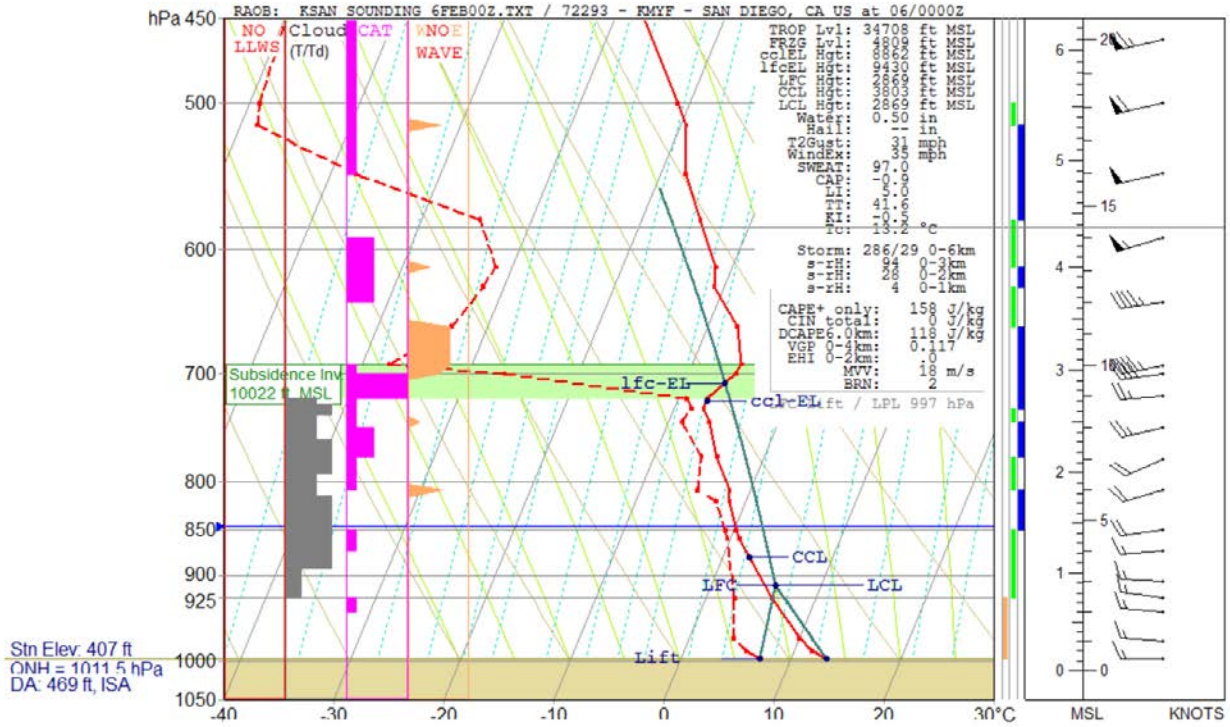

Figure 8 - NWS KSAN 1600 PST observed sounding

Height (ft-MSL)	Pres (hPa)	T (C)	Td (C)	RH (%)	DD / FF (deg / kts)	CAT (FAA)	LLWS	Icing - Type (AFGWC method)	Wave/x---W---Turb nm	fpm	max
407	997	13.2	7.2	67	270 / 13						
657	988	11.6	5.6	67							
1000	976				275 / 13						
1104	972	10.0	4.0	66							
2000	940				275 / 13	LGT					
2447	925	6.0	2.6	79	280 / 17						
3000	906				275 / 16						
4000	873				265 / 15						
4420	859	0.8	-0.3	92		LGT					
4698	850	0.2	-0.8	93	260 / 19						
5641	820	-1.5	-2.7	92				TRC Rime			
5994	809	-1.9	-4.8	81	250 / 20	LGT			3.32	1055	MD-SV
7077	776	-4.3	-5.7	90	240 / 19	MDT		TRC Rime			
8000	749				255 / 24						
8198	743	-6.3	-8.8	82					4.86	417	LIGHT
8615	731	-7.3	-8.4	92		LGT		TRC Rime			
8932	722	-7.3	-9.2	86	265 / 23	XTR		TRC Rime			
9726	700	-5.7	-26.7	17	260 / 40	LGT			2.64	797	MD-SV
10022	692	-5.5	-37.5	6	255 / 43				4.83	1616	MD-SV
11236	660	-7.3	-33.3	10					14.93	2256	MD-SV
12000	640				260 / 46						
12497	628	-10.9	-31.9	16							
13106	613	-11.5	-31.5	17		MDT			8.55	873	LT-MD
14000	591				250 / 55						
14576	578	-14.7	-34.7	17							
15982	546	-17.7	-47.7	5	255 / 52						
17459	514	-19.5	-58.5	2		LGT			9.53	1291	MD-SV
18130	500	-21.1	-59.1	2	255 / 59	LGT					

Figure 9 - KSAN Sounding parameters at 1600 PST

4.0 Satellite Imagery

The Geostationary Operational Environmental Satellite number 17 (GOES-17) data was obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison in Madison, Wisconsin, and processed using the Man-computer Interactive Data Access System (McIDAS) software. The infrared long wave, water vapor, and visible imagery were obtained surrounding the time of the accident. The infrared long wave imagery (band 13) at a wavelength of 10.3 microns (μm) provided radiative cloud top temperatures with a nominal spatial resolution of 2 km. Due to the low Sun angle and the onset of nighttime conditions the visible imagery was not useable at the time of the accident.

Figure 10 is the GOES-17 infrared image at 1812 PST at 6X magnification. The image detected no clouds over the accident site but did indicate mid to higher cloud cover over the higher terrain immediately west and northwest of the accident site, with overcast clouds over the Big Bear City area (KL35), and to the northeast of KNXP over eastern California into Nevada. The infrared image depicted a small gap in the clouds between Banning Pass with relatively clear skies over the KPSP and KNXP areas as reported in the METARs in section 2.0. The satellite imagery also detected several bands of clouds oriented perpendicular to the wind flow south of the accident site indicative of transverse banding, which is often observed with turbulence. The transverse bands had a cloud top temperatures between 256º to 260º Kelvin or -17º to -13º C, which corresponded to cloud tops near 14,000 to 15,000 ft.

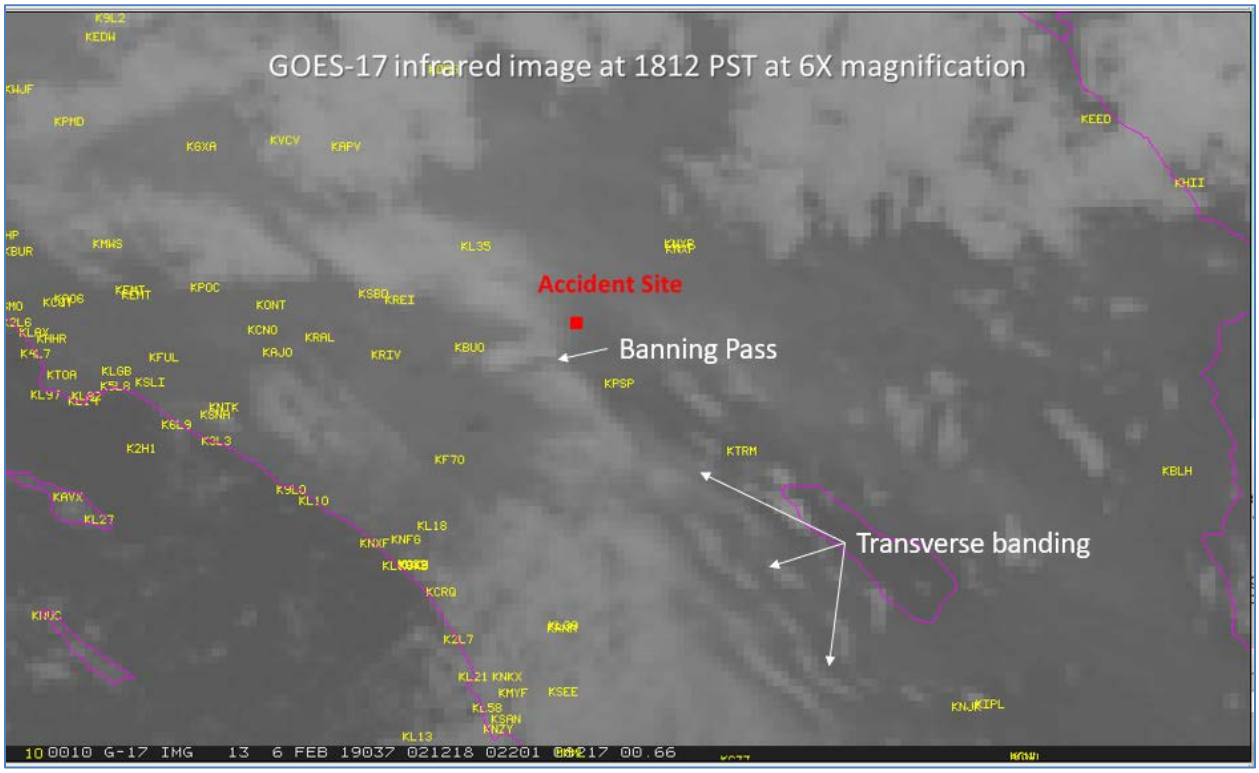

Figure 10 - GOES-17 infrared image at 1812 PST at 6X magnification

Figure 11 is the GOES-17 water vapor imagery (band 8) at 1812 PST at the same 6X magnification. The image depicted a pronounced dark area immediately downwind of the high

terrain, which extended over the accident site and KPSP associated with descending motion and evaporation. This moisture channel darkening is a common signature of mountain wave conditions and downdrafts. The image also showed several transverse bands immediately east of the accident site, showing the wave like flow occurring over the region.

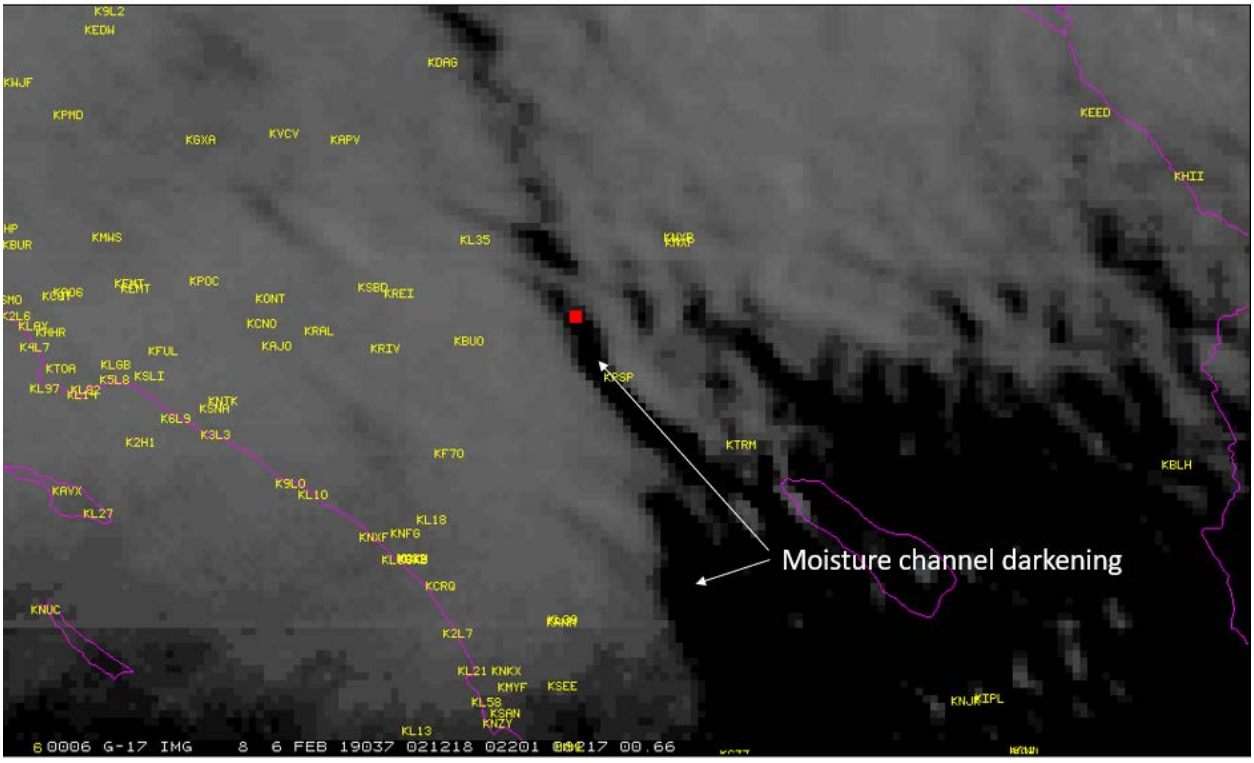

Figure 11 - GOES-17 water vapor imagery at 1812 PST at 6X magnification

5.0 Pilot Reports

The following pilot reports or PIREPs below 18,000 ft and within 100 miles of the accident site were in the NWS database for the period from 1200 through 2200 PST. Cloud bases and tops are reported in msl heights. The reports in raw format were as follows:

LAS UA /OV LAS230020 /TM 2016 /FL090 /TP E135 /TA M15 /IC LGT RIME 090-120 /RM DURC 090-120 ZLATMUWC AWC-WEB

VGT UA /OV LAS300010/TM 2024/FL100/TP B757/TA M02/TB MOD/IC LGT RIME/RM COR SA-ID. ZLA CWSU

CNO UA /OV PDZ340004/TM 2112/FL020/TP PA28/WX FV 3SM +RA

VGT UUA /OV LAS280020/TM 2025/FL090/TP B737/TA M03/TB MOD/IC SEV MX/RM COR SA-ID AND TEMP. ZLA CWSU

VGT UUA /OV LAS280025/TM 2027/FL140/TP B737/TA M03/TB SEV/IC SEV MX/RM COR SA-ID AND TEMP. ZLA CWSU

CNO UA /OV CNO/TM 2042/FL014/TP P28A/TB NEG TB

ONT UA /OV 6 SOUTH POM/TM 2100/FL060/TP SR22/IC LT RIME ICING
PTV UA /OV TTE116027/TM 2103/FL170/TP CRJ7/TA M12/IC LGT RIME 160-170/RM ZOA CWSU

LAS UA /OV LAS070010 /TM 2137 /FL120 /TP A321 /TA M00 /IC LGT RIME/RM AWC-WEB

CNO UA /OV CNO/TM 2138/FL020/TP P28A/TB NEG BLO 020

LAS UA /OV LAS270020/TM 2203/FL160/TP B737/TB LIGHT TURB/RM SFC-160

SMO UA /OV SMO030001/TM 2211/FL005/TP CRUZ/RM LLWS +/-20 KT SHORT FINAL

ONT UA /OV 7SM SW L35/TM 2215/FL140/TP B737/IC MODERATE RIME

VNY UA /OV FIM33007/TM 2218/FL110/TP E135/TA M07/IC MOD RIME

CNO UA /OV CNO045015/TM 2219/FLDURD/TP L45/TB LGT TB AT 110/RM BRAKING ACTION GOOD RY 26L

LAS UA /OV 40 SE LAS/TM 2220/FL120/TP F2TH/TB MOD/IC MOD RIME

PSP UA /OV 12SM SW PSP/TM 2220/FL110/TP C208/IC TRACE RIME

LAS UA /OV 2SE LAS/TM 2225/FL040/TP B737/TB MOD TURB

SMO UUA /OV SMO/TM 2235/FL003/TP LTSP/RM LLWS +/-20KT DURC RWY21

CNO UA /OV CNO/TM 2237/FL014/TP P28A/TB LGT

LAS UA /OV KLAS/TM 2301/FL000/TP B739/TB LT CHOP/IC NEG/RM NOTHING WORSE THAN LT CHOP IN DESCENT /NEG IC AS WE STAYED HIGH / RNAV 19R +/- 10KTS ON SHORT FINAL AWC-WEB/

LAS UA /OV LAS050033/TM 2330/FL110/TP B737/IC LGT RIME

PSP UUA /OV PSP-TRM/TM 2344/FL060/TP GLF3/TB OCNL 060-020/RM ZAB/FDCS

LAS UUA /OV LAS080003/TM 0014/FL002/TP B737/RM LLWS +10KT 002-SFC DURD RY26L KLAS

LAS UUA /OV LAS080003/TM 0017/FL003/TP A320/RM LLWS -5KT 003-SFC DURD RY26L KLAS

LAS UA /OV LAS213035 /TM 0020 /FL130 /TP LJ45 /TA M19 /IC LGT MX/RM AWC-WEB

PSP UUA /OV KPSP/TM 0021/FL001/TP B737/RM LLWS +/-20 KT DURC RY31L PSP

PSP UUA /OV KPSP293007/TM 0030/FL015/TP HELO/TB SEV 015

- ***Based on elevations, altitude likely reported at 1,500 ft agl in this report***

LAS UUA /OV LAS080003/TM 0032/FL002/TP B737/WV LLWS/RM ZAB/FDCS

CNO UA /OV CNO/TM 0045/FL015/TP C172/TB MOD TURB

LAS UA /OV LAS095035/TM 0120/FL110/TP A319/TA M13/IC LGT RIME

LAS UA /OV LAS200010/TM 0126/FL090/TP B737/TB MOD

CNO UA /OV CNO080007/TM 0128/FL029/TP BE9L/TB NEG 029

PSP UUA /OV KPSP/TM 0150/FL005/TP A21N/RM LLWS -20 KT DURD RY31L PSP

EDW UA /OV PMD240015/TM 0156/FL080/TP GLEX/TA M10/TB MOD/IC LGT RIME

EMT UA /OV EMT/TM 0208/FL050/TP C208/IC LT MIXED ICING 050-060

ONT UA /OV 20NM N ONT/TM 0209/FL100/TP MD11/IC LT RIME/RM OAT -14
Accident 0215Z

Of the reports, 17 PIREPs reported encountering icing conditions, 12 PIREPs reported turbulence, and 8 PIREPs reported LLWS. There were 4 PIREPs in the immediate vicinity of KPSP highlight in bold type above, with 2 PIREPs encountering severe LLWS with a loss of 20 knots on approach below 500 ft agl, and the other 2 PIREPs reported occasional turbulence below 6,000 ft, with a helicopter pilot at 1630 PST encountering severe turbulence at 1,500 ft (agl).

6.0 NWS Terminal Aerodrome Forecast

The NWS San Diego (KSAN) Weather Forecast Office (WFO) was responsible for the issuance of the Terminal Aerodrome Forecast (TAF) and local weather warnings for southern California. TAFs are valid for a 5 mile radius around an airport's center. When planning a flight to an airport that does not have a TAF, pilots typically refer to the closest available TAFs to supplement the information in weather forecast products that cover large areas, such as the Graphic Aviation Forecast (GFA), Airmen's Meteorological Information (AIRMET) bulletins, and other graphical products. The forecast available for preflight planning prior to the accident airplanes departure was as follows for KPSP the closest airport to the accident site:

TAF KPSP 051739Z 0518/0618 VRB06KT P6SM VCSH FEW050 OVC080
FM051900 35011KT P6SM VCSH BKN050
FM052100 33014G24KT P6SM -SHRA SCT030 BKN050
FM060400 32015G25KT P6SM SCT050 SCT080
FM060900 33006KT P6SM SCT050=

The forecast expected VFR conditions to prevail during the period with wind from 330° at 14 knots gusting to 24 knots, with visibility better than 6 miles with light rain showers with scattered clouds at 3,000 ft agl, and ceiling broken at 5,000 ft. No LLWS was forecasted during the period.

The next scheduled forecast was issued at 1532 PST and expected VFR conditions to prevail with northwest winds gusting to 24 knots and was as follows:

TAF KPSP 052320Z 0600/0624 34014G24KT P6SM SCT070
FM060700 33011KT P6SM FEW070
FM061900 33012G22KT P6SM FEW250=

7.0 NWS Area Forecast Discussion

The NWS San Diego WFO issued the following Area Forecast Discussion's (AFD) during the period, which provided the synoptic conditions, short term forecast, and additional information of the reasoning behind the NWS TAF's issued during the period. The AFD is in plain language with a few abbreviations and were as follows:

FXUS66 KSGX 051712
AFDSGX
Area Forecast Discussion
National Weather Service San Diego CA
912 AM PST Tue Feb 5 2019

.SYNOPSIS...
A low pressure system over California will continue to move inland this afternoon. Scattered showers with lowering snow levels will continue into this evening, with showers decreasing from the northwest tonight. Stronger and gusty southwest to west winds in the mountains and deserts will decrease during the late afternoon and evening. Drying with slow warming for Wednesday through Friday with high temperatures remaining below average. Another low pressure system from the northwest will bring another chance for showers for late Friday night and Saturday. Continued cooler for Sunday and Monday, but with lower confidence in shower chances.

...Previous Discussion (Issued at 410 AM PST Tue Feb 5 2019)...

A closed low pressure system is centered over northern California and will continue to move inland today and tonight. Periods of showers will continue into this evening, decreasing from the northwest late tonight. The snow level will lower from 3500 to 4000 feet early this morning, to 2500 to 3500 feet by early this evening, and 2000 to 3000 feet late tonight.

Additional rainfall will range from one quarter to one third inch near the coast, to one half to one inch in the mountains with locally greater amounts. Additional snowfall will range from 2 inches or less below 3500 feet, to 2 to 4 inches from 3500 to 4500 feet, 4 to 8 inches from 5500 to 6500 feet, with local amounts exceeding 10 inches above 7500 feet.

While radars are currently showing no showers over the Cajon Pass, snow levels are low enough that snow showers could impact travel through the Cajon Pass at times into this evening. Lowering snow levels and scattered snow showers could impact portions of Interstate 8 through the San Diego County Mountains, mainly near the passes this morning, lowering to around 3000 feet for tonight.

High temperatures should be coolest today. There will be slow warming for Wednesday through Friday but with high temperatures remaining below average. Patchy frost is possible in some of the inland valleys for late tonight into early Wednesday morning. Wednesday night is expected to be the coldest night with more widespread frost in the valleys and some lower wind-sheltered coastal areas with low temperatures below freezing in some of the colder wind-sheltered locations in the valleys. Low temperatures will begin to moderate Thursday night with frost less widespread.

Another low pressure system from the northwest will bring another chance of showers for late Friday night and Saturday with less spread in the model forecasts into Saturday. Continue cool for Sunday and Monday with larger spread in the global model solutions in the vicinity of the West Coast which will maintain at least some possibility of showers.

.AVIATION...
051650Z...Coast/Valleys/Mountains...Scattered showers will continue through tonight. BKN-OVC CIGS, varying from 2500 to 4000 feet MSL. Local cigs around 1500 feet MSL and vis 2-4SM at times during heavier showers. Coastal mountain slopes will remain obscured in clouds/precip through tonight.

Southwest to west winds 25-45 kt will occur along the ridges and desert mountain slopes, producing locally MDT-STG up/downdrafts over and east of the mtns.

Deserts...SCT-BKN clouds 4000-8000 feet MSL with unrestricted vis will continue through tonight, accompanied by isolated -SHRA and local cigs below 3000 feet MSL, mainly in the high desert.

Updated discussion at 1430 PST:

FXUS66 KSGX 052243
AFDSGX
Area Forecast Discussion
National Weather Service San Diego CA
230 PM PST Tue Feb 5 2019

.SYNOPSIS...
Showers will continue tonight, with greatest amounts in San Diego County. The snow level will fall from around 3000 feet late this afternoon to 2000 to 2500 feet overnight, with several inches of snow in the mountains. Fair but chilly weather will occur Wednesday with slight warming Thursday and Friday. Frost will occur in many valley locations Wednesday night. A trough of low pressure over the western United States will bring a couple of waves through southern California along with chances of precipitation Saturday and Monday.

.DISCUSSION...FOR EXTREME SOUTHWESTERN CALIFORNIA INCLUDING ORANGE...
SAN DIEGO...WESTERN RIVERSIDE AND SOUTHWESTERN SAN BERNARDINO
COUNTIES...

Scattered showers continued, with the greatest concentration in San Diego County. There will be a bit of a decrease the rest of this afternoon, but another wave, now near Point Conception, will move through this evening and enhance the precipitation again for awhile. The wave will bring even colder air aloft, with 850 MB temps falling to -2 to -4 deg C. Snow levels could fall to as low as around 2000 feet overnight. Model QPF for the remaining part of the storm is generally 1/2 to 3/4 inch in the San Diego County Mountains, which would translate to generally 3 to 5 inches of snow, locally higher. Lower amounts will occur farther north. Periods of windy weather will occur in the mountains overnight as well, along with fog where clouds obscure the mountain slopes.

Models are consistent with ending the last bit of the precipitation by 4-5 AM Wed, and Wed will be partly cloudy with the continued onshore flow in San Diego County and sunny elsewhere. 850 MB temps do not start to recover until Wednesday night, so it will be quite chilly across the region, with lower elevation highs mostly in the 50s to near 60 Wednesday. Some weak ridging will bring warming Thursday and Friday, though temperatures will remain below normal. A trough of low pressure will reestablish itself over the West Coast or a little bit inland, and a couple of short waves could bring light amounts of precipitation Saturday and/or Monday. Models are inconsistent with projections after next Monday, though pretty much all projections keep our window open for future precipitation, especially the second half of next week.

.AVIATION...
052025Z...Coast/Valleys/Mountains...Scattered showers will continue through tonight. BKN-OVC CIGS, varying from 2500 to 4000 feet MSL. Local cigs around 1500 feet MSL and vis 2-4SM at times during heavier showers. Coastal mountain slopes will remain obscured in clouds/precip through tonight. Showers and clouds decrease from northwest to southeast late tonight.

Southwest to west winds 25-45 kt will continue through tonight along the ridges and desert mountain slopes, producing locally MDT-STG up/downdrafts over and east of the mtns.

Deserts...SCT-BKN clouds 4000-8000 feet MSL with unrestricted vis will continue through tonight, accompanied by isolated -SHRA and local cigs below 3000 feet MSL, mainly in the high desert.

.SGX WATCHES/WARNINGS/ADVISORIES...
CA...Winter Storm Warning until 4 AM PST Wednesday for Riverside
County Mountains-San Bernardino County Mountains-San Diego County Mountains.

Wind Advisory until 4 PM PST this afternoon for Apple and Lucerne Valleys.

The Aviation section of the discussion indicated that southwest to west winds 25 to 45 knots were expected to continue through the period along the ridges and desert mountain slopes, producing locally moderate to strong updrafts and downdrafts over and east of the mountain. None of the standard NWS inflight weather advisories or forecasts current during the period indicated winds and/or up/downdrafts of this magnitude.

8.0 Winds and Temperature Aloft Forecast

The NWS Forecast Winds and Temperature Aloft Forecast current during the period valid for 2200 PST and for use between 1800 through 0300 PST were as follows for the route of flight:

WINDS ALOFT FORECASTS
DATA BASED ON 060000Z
VALID 060600Z FOR USE 0200-0900Z. TEMPS NEG ABV 24000

FT	*3000*	*6000*	*9000*	*12000*	*18000*	*24000*	*30000*	*34000*	*39000*
ONT	*2712*	*2919-05*	*2821-11*	*2840-15*	*2748-29*	*2666-36*	*257243*	*256946*	*267245*
WJF		*3130-06*	*3130-12*	*3038-16*	*2943-29*	*2943-38*	*265444*	*265844*	*266545*
SAN	*2823*	*2925-04*	*2829-10*	*2748-12*	*2582-22*	*2687-34*	*258346*	*258248*	*257846*
SBA	*3413*	*3424-06*	*3329-10*	*3137-16*	*3039-29*	*3141-39*	*295044*	*285345*	*276247*
LAS		*2634-04*	*2431-11*	*2326-17*	*2341-28*	*2349-38*	*237545*	*247645*	*256544*

The forecast for Las Vegas (LAS) for 6,000 ft expected a wind from 260° at 34 knots with a temperature of -4° C.

9.0 NWS Inflight Weather Advisories

The NWS issues inflight weather advisories designated as Severe Weather Forecast Alerts (AWW's), Convective Significant Meteorological Advisories (SIGMET) (WST's), SIGMET's (WS's), Center Weather Advisories (CWA's), and AIRMET's (WA's). Inflight advisories serve to notify en route pilots of the possibility of encountering hazardous flying conditions which may not have been forecast at the time of the preflight briefing. Whether or not the condition described is potentially hazardous to a particular flight is for the pilot to evaluate on the basis of experience and the operational limits of the aircraft.

During the period the NWS had no AWW’s or Convective SIGMETs, and there were no CWA or Meteorological Impact Statement (MIS) issued from the Oakland (KZOA) Center Weather Service Unit (CWSU) during the period. The NWS AWC had a SIGMET for severe icing current

between 10,000 and 16,000 ft from 1200 through 1600 PST. The NWS AWC also had a full series of AIRMETs current, which is included below:

SIGMET

WSUS06 KKCI 052006
WS6V
-SFOV WS 052006
SIGMET VICTOR 1 VALID UNTIL 060006
CA NV UT AZ
FROM 50W BCE TO 50NE PGS TO EED TO 40SSE BTY TO 50W BCE
OCNL SEV RIME/MXD ICGICIP BTN 100 AND 160. RPTD BY ACFT.
CONDS CONTG BYD 0006Z.
....

WSUS06 KKCI 052339
WS6V
-SFOV WS 052339
CANCEL SIGMET VICTOR 1. CONDS MSTLY MOD.
....

The SIGMET Victor for severe icing conditions was validated by several PIREPs of severe icing conditions.

AIRMETs

The following Graphic-AIRMETs followed by their equivalent text advisories follow:

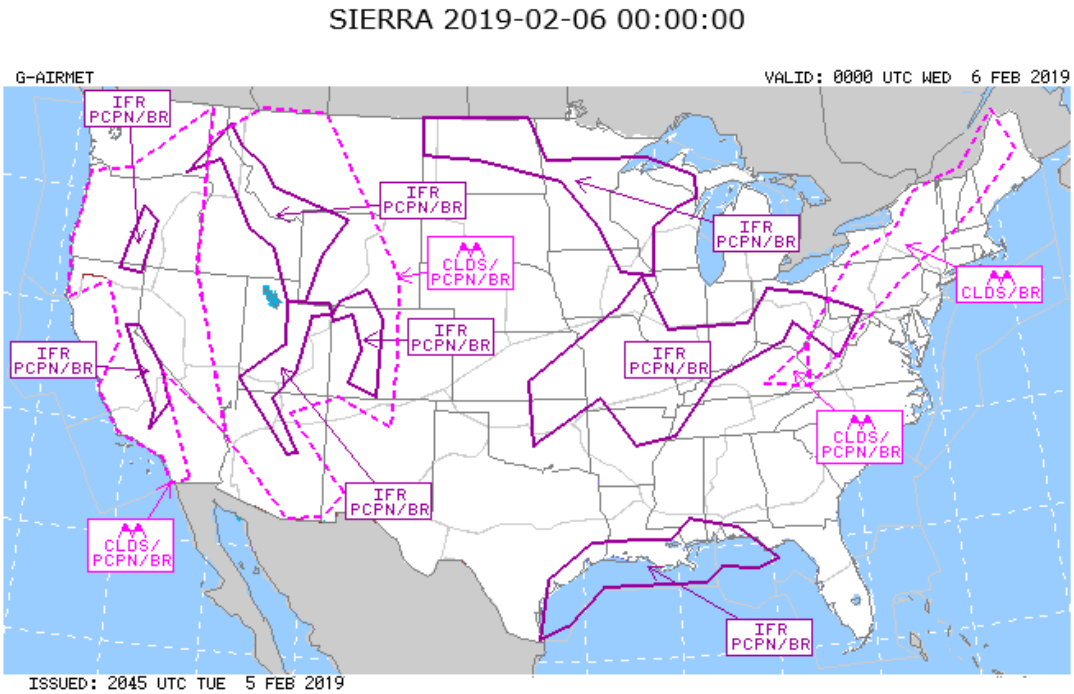

Figure 12 -G-AIRMET Sierra for IFR and mountain obscuration conditions valid for the period

WAUS46 KKCI 052045
WA6S
-SFOS WA 052045
AIRMET SIERRA UPDT 4 FOR IFR AND MTN OBSCN VALID UNTIL 060300
.
AIRMET IFR...WA OR CA NV
FROM 50ESE SEA TO 70SW PDT TO 50S PDT TO 70N FMG TO 70SW LKV TO 60SSW OED TO 40WNW OED TO 50ESE SEA
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 03Z THRU 09Z.
.
AIRMET IFR...CA NV
FROM 30NW FMG TO 40WSW OAL TO 70SW BTY TO 20WNW LAX TO 30ESE MOD TO 50WSW FMG TO 30NW FMG
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG BYD 03Z ENDG 06-09Z.
.
AIRMET MTN OBSCN...WA OR CA ID NV
FROM 50SW YXC TO 50SE REO TO EED TO 50WSW BZA TO 20S MZB TO 40W RZS TO 50S FOT TO 50NNW ONP TO 50SW YXC
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 03Z THRU 09Z.
.
OTLK VALID 0300-0900Z...IFR WA OR ID MT WY UT
BOUNDED BY 30SSE YQL-40W HVR-50E GGW-50NNW ISN-60NW RAP-30N MTU-20W SLC-20S MLD-20SSE PIH-40NE BOI-30WNW DNJ-20N PDT-60SW YXC-30SSE YQL
CIG BLW 010/VIS BLW 3SM PCPN/BR. CONDS CONTG THRU 09Z.
....

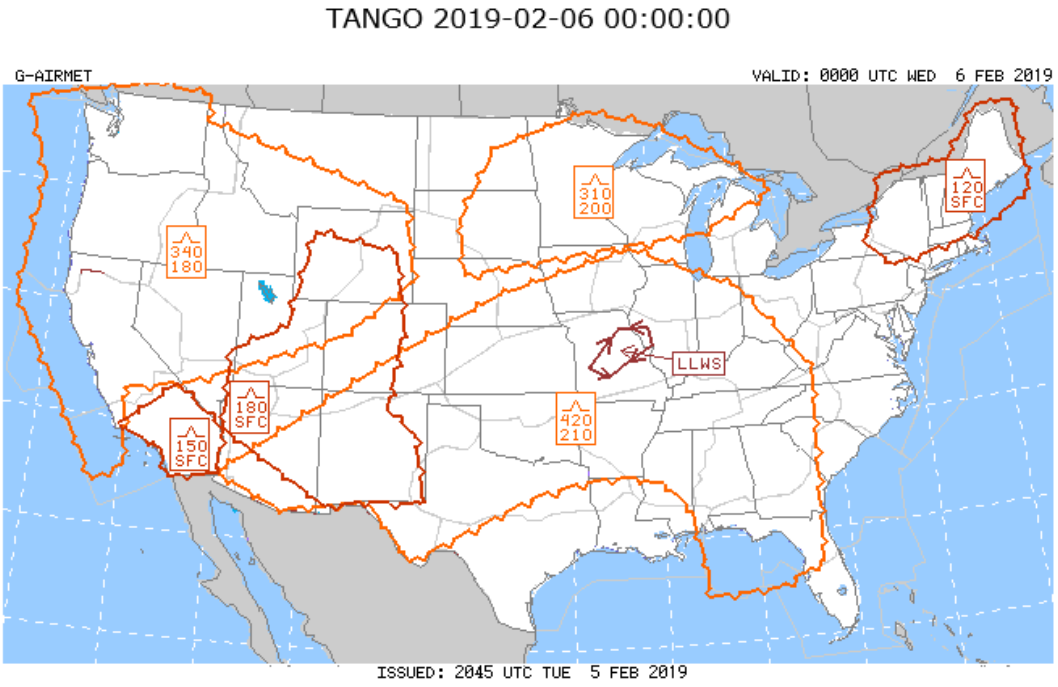

Figure 13 - G-AIRMT Tango current for turbulence and low-level wind shear

WAUS46 KKCI 052045
WA6T

-SFOT WA 052045
AIRMET TANGO UPDT 3 FOR TURB VALID UNTIL 060300
.
AIRMET TURB...WA OR CA ID MT WY NV UT CO AZ AND CSTL WTRS
FROM YDC TO 50WSW YXC TO 30NNE MLS TO 80SW DIK TO 70SW RAP TO
BFF TO 40E AKO TO 30WNW PUB TO 20WNW TBC TO 20S MZB TO 220SW MZB
TO 140WSW FOT TO 110WNW ONP TO 140W TOU TO YDC
MOD TURB BTN FL180 AND FL340. CONDS CONTG BYD 03Z THRU 09Z.
.
AIRMET TURB...CA AND CSTL WTRS
FROM 20SW BTY TO EED TO BZA TO 20S MZB TO 30SE LAX TO 30W RZS TO 20SW BTY
MOD TURB BLW 150. CONDS CONTG BYD 03Z THRU 09Z.
.
OTLK VALID 0300-0900Z...TURB WA OR CA ID MT WY NV UT CO AZ NM AND CSTL WTRS
BOUNDED BY YDC-50WSW YXC-60S YXC-20SE MLP-50SW LWT-20SW ISN-70SW
RAP-BFF-20N AKO-30E HBU-60ENE INW-50E BZA-BZA-20S MZB-220SW MZB-
140WSW FOT-120WNW ONP-140W TOU-YDC
MOD TURB BTN FL180 AND FL340. CONDS CONTG THRU 09Z.
....

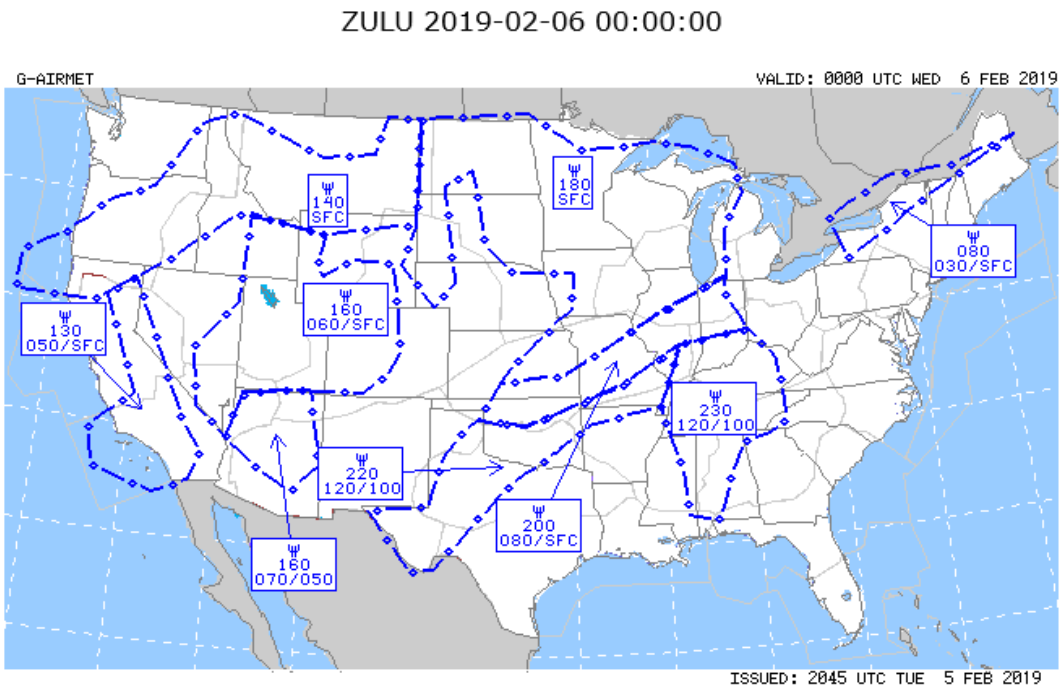

Figure 14 - G-AIRMET Zulu for icing conditions current at the time

WAUS46 KKCI 052340 AAA
WA6Z
-SFOZ WA 052340 AMD
AIRMET ZULU UPDT 4 FOR ICE AND FRZLVL VALID UNTIL 060300
.
AIRMET ICE...OR CA NV AND CSTL WTRS
FROM 40W FMG TO 20SSW EED TO 40WSW BZA TO 20S MZB TO 200SW MZB TO
130SSW RZS TO 150SW RZS TO 130SW SNS TO 60SW OAK TO 20ESE OAK TO
40S RBL TO 40W FMG
MOD ICE BTN FRZLVL AND 130. FRZLVL SFC-050. CONDS CONTG BYD 03Z THRU 09Z.
.

AIRMET ICE...WA OR CA ID MT WY NV UT AND CSTL WTRS
FROM 40WSW YQL TO 60SSW HVR TO 20W GGW TO 60NNE GGW TO 50NNW ISN
TO 90SSW DIK TO 40SSW DLN TO 70N DNJ TO 80S BOI TO 40W FMG TO 90W
ENI TO 150WSW FOT TO 190WSW ONP TO 70WSW YXC TO 40WSW YQL
MOD ICE BLW 140. CONDS CONTG BYD 03Z THRU 09Z.
.
OTLK VALID 0300-0900Z...ICE WA OR CA ID MT WY NV UT AND CSTL WTRS
BOUNDED BY 50WSW YXC-50NNW ISN-100SE MLS-70ENE CZI-30NNE BPI-20N
OAL-40E SAC-50SE RBL-90W ENI-100WNW FOT-30SE OED-50SSW PDT-50WSW YXC
MOD ICE BLW 140. CONDS CONTG THRU 09Z.
.
FRZLVL...RANGING FROM SFC-100 ACRS AREA
MULT FRZLVL 070-100 BOUNDED BY 130WSW MZB-110SW MZB-220SW MZB-190SSW RZS-130WSW MZB
SFC ALG 40NW TOU-30SW BTG-70S OED-30N EHF-40E EHF-70SSW BTY-30SSE BTY
040 ALG 160SW RZS-140SSW RZS-80SSW LAX-50ESE LAX-20SSW HEC-40W LAS
....

10.0 Preflight Weather Briefing

A search of AFSS Leidos indicated no contacts for any weather briefings, flight plans, or other services were provided. It is therefore, unknown what the pilot used in familiarizing himself regarding the weather conditions prior to departure.

11.0 Astronomical Data

The United States Naval Observatory's website provided the following astronomical conditions for Desert Hot Springs, Riverside County, California. The time of the accident has been inserted in italic bold print for reference.

<u>Sun</u>	
Beginning civil twilight	0614 PST
Sunrise	0640 PST
Sun transit	1200 PST
Sunset	1720 PST
End civil twilight	1746 PST
Accident	***1815 PST***
<u>Moon</u>	
Moonrise	0719 PST
Moonset	1816 PST

At the time of the accident the Sun was more than 11° below the horizon at an azimuth of 258°, and official night had begun at 1746 PST. The Moon was just setting and was at an elevation of approximately 0.7° above the horizon at an azimuth of 252°. The phase of the Moon was a waxing crescent with 1% of the Moon's visible disk illuminated.

Submitted by:

_____

Don Eick
Senior Meteorologist