



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

August 8, 2017

Weather Study

METEOROLOGY

WPR17FA125

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A. ACCIDENT

Location: Near Mountain Ranch, California
Date: June 9, 2017
Time: 1430 Pacific Daylight Time
2130 Coordinated Universal Time (UTC)
Airplane: Beech 95-C55, N3717Q

B. METEOROLOGIST

Paul Suffern
Senior Meteorologist
Operational Factors Division (AS-30)
National Transportation Safety Board

C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board's (NTSB) Meteorologist did not travel for this investigation and gathered the weather data for this investigation from the NTSB's Washington D.C. office and from official National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) sources including the National Centers for Environmental Information (NCEI). All times are Pacific Daylight Time (PDT) on June 9, 2017, and are based upon the 24-hour clock, where local time is -7 hours from UTC, and UTC=Z (unless otherwise noted). Directions are referenced to true north and distances 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 was located at latitude 38.276° N, longitude 120.445° W, at an approximate elevation of 2,970 feet (ft).

D. WEATHER INFORMATION

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 and the Weather Prediction Center, located in College Park, Maryland. These are the base products used in describing synoptic weather features and in the creation of forecasts and warnings for the NWS. 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 NWS Surface Analysis Chart for 1400 PDT is provided as figure 1 with the approximate location of the accident site marked with the red circle. The chart depicted a stationary frontal boundary that stretched from northcentral Wyoming southwestward through southern California and into the eastern Pacific Ocean. A surface low pressure center was located in eastern Nevada with a surface pressure of 998-hectopascals (hPa). The station models around the accident site depicted air temperatures in the mid 50's to mid 70's degrees Fahrenheit (°F), with temperature-dew point spreads of 9° F or more, a south to west wind between 5 to 15 knots, mostly cloudy skies, and light rain.

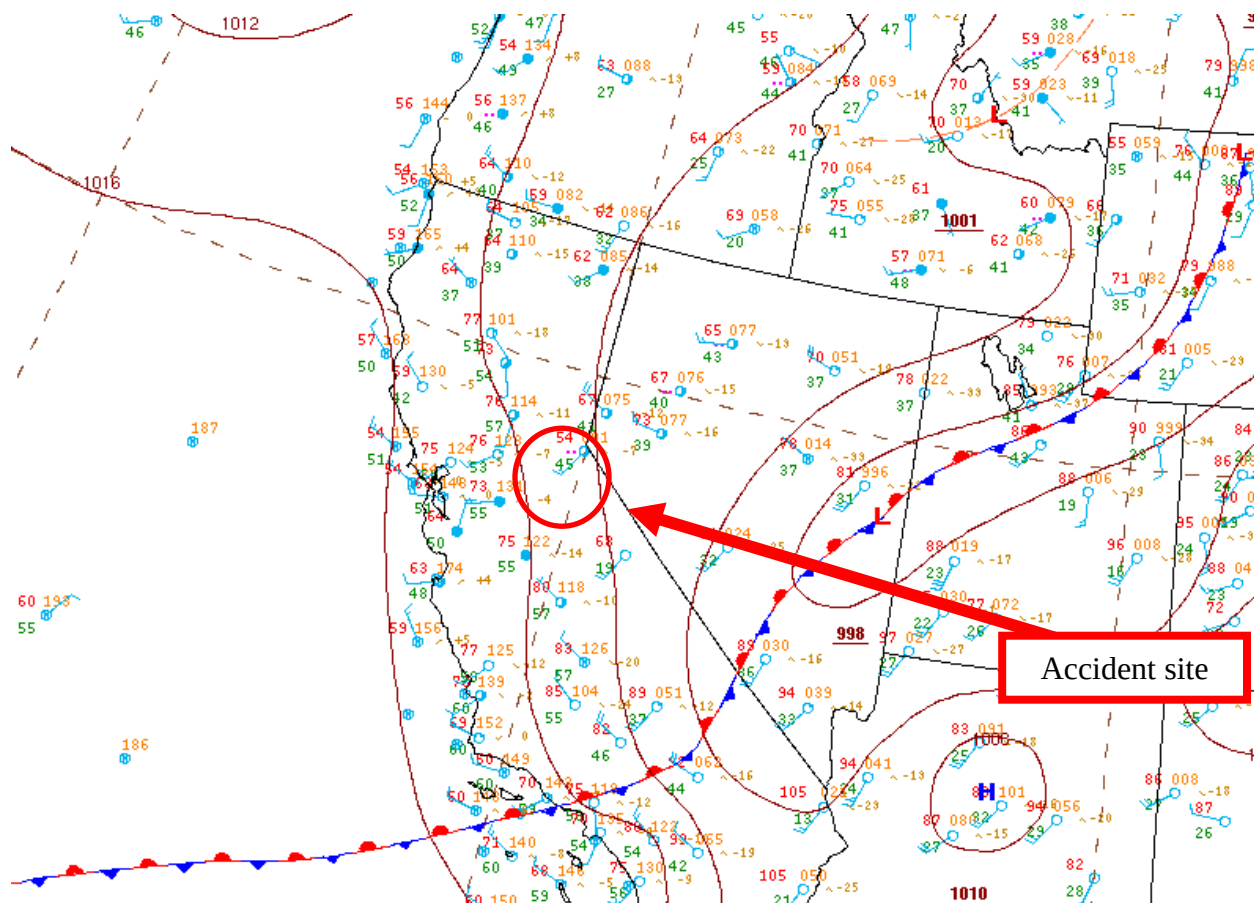


Figure 1 – NWS Surface Analysis Chart for 1400 PDT

1.2 Upper Air Charts

The NWS Storm Prediction Center (SPC) Constant Pressure Charts for 1700 PDT at 925-, 850-, 700-, 500-, and 300-hPa are presented in figures 2 through 6. The 700-hPa chart depicted a mid-level trough¹ just east of the accident site (figure 3). Troughs typically act as lifting mechanisms where enhanced lift, fronts, clouds, and precipitation can occur. There was a southwest wind of about 25 knots at 700-hPa (figure 4) with the wind turning westerly by 500-hPa with a wind speed of 80 knots (figure 5). The 80-knot westerly wind at 500-hPa became a 100-knot west-southwest wind by 300-hPa (figure 6).

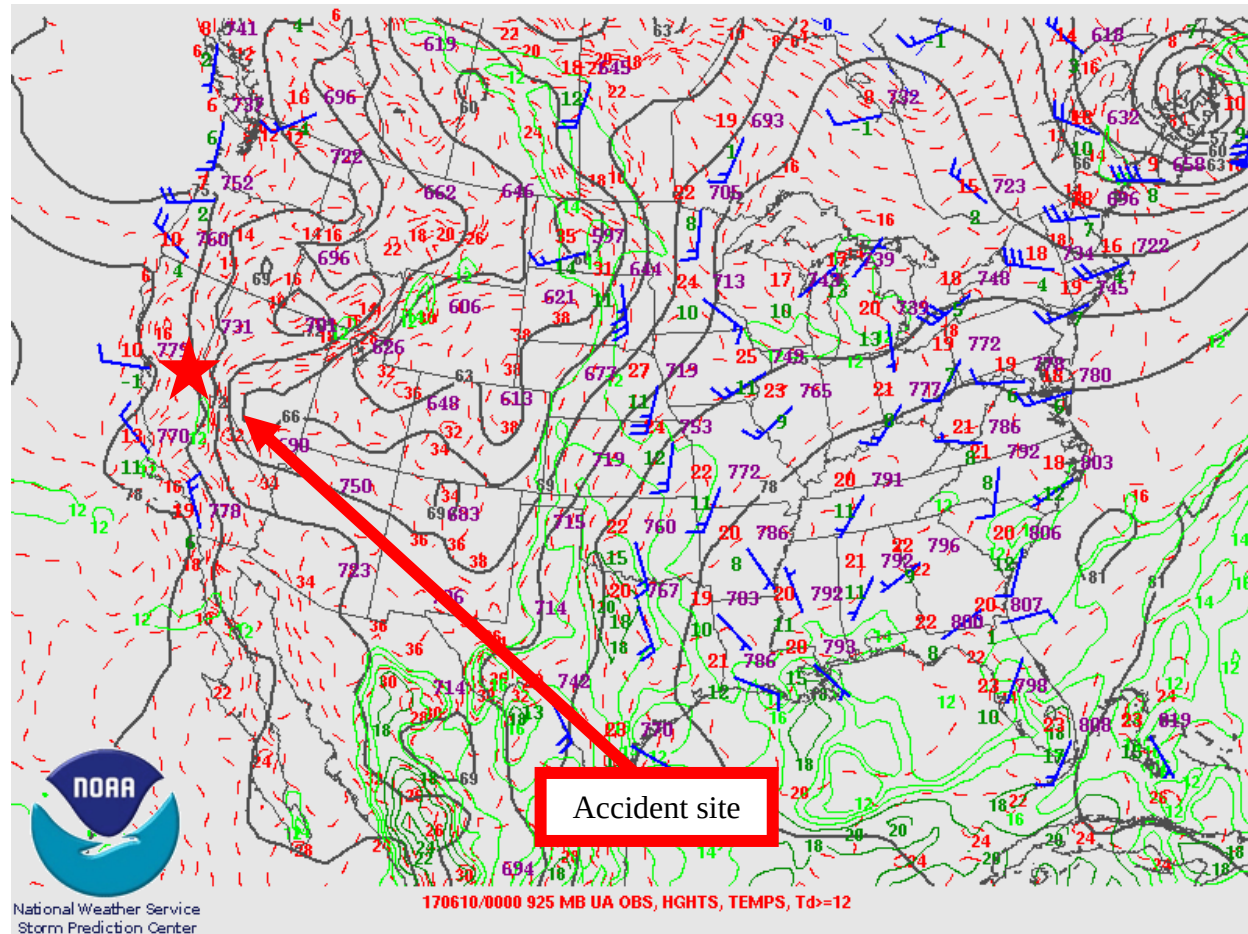


Figure 2 – 925-hPa Constant Pressure Chart for 1700 PDT

¹ Trough – An elongated area of relatively low atmospheric pressure or heights.

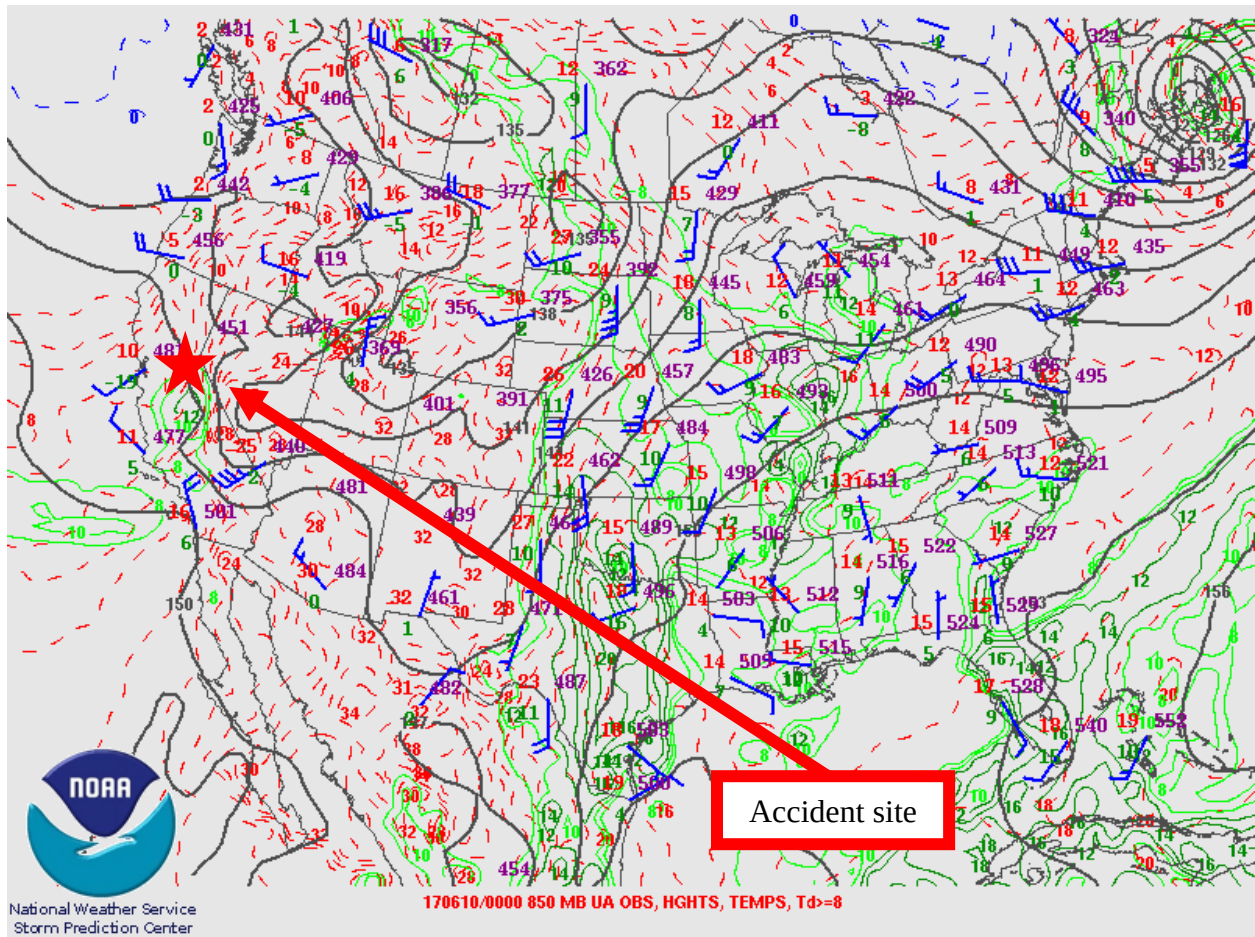


Figure 3 – 850-hPa Constant Pressure Chart for 1700 PDT

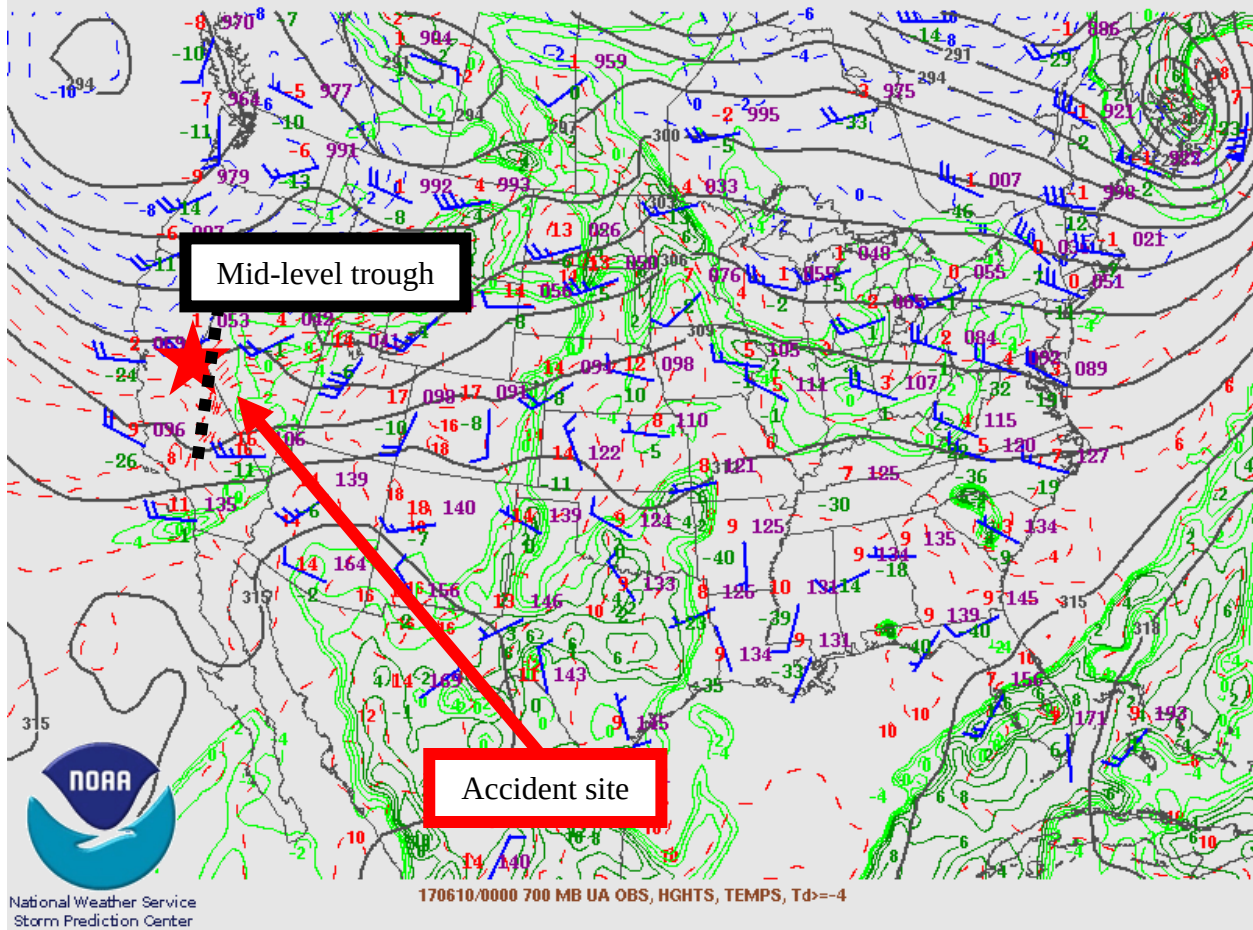


Figure 4 – 700-hPa Constant Pressure Chart for 1700 PDT

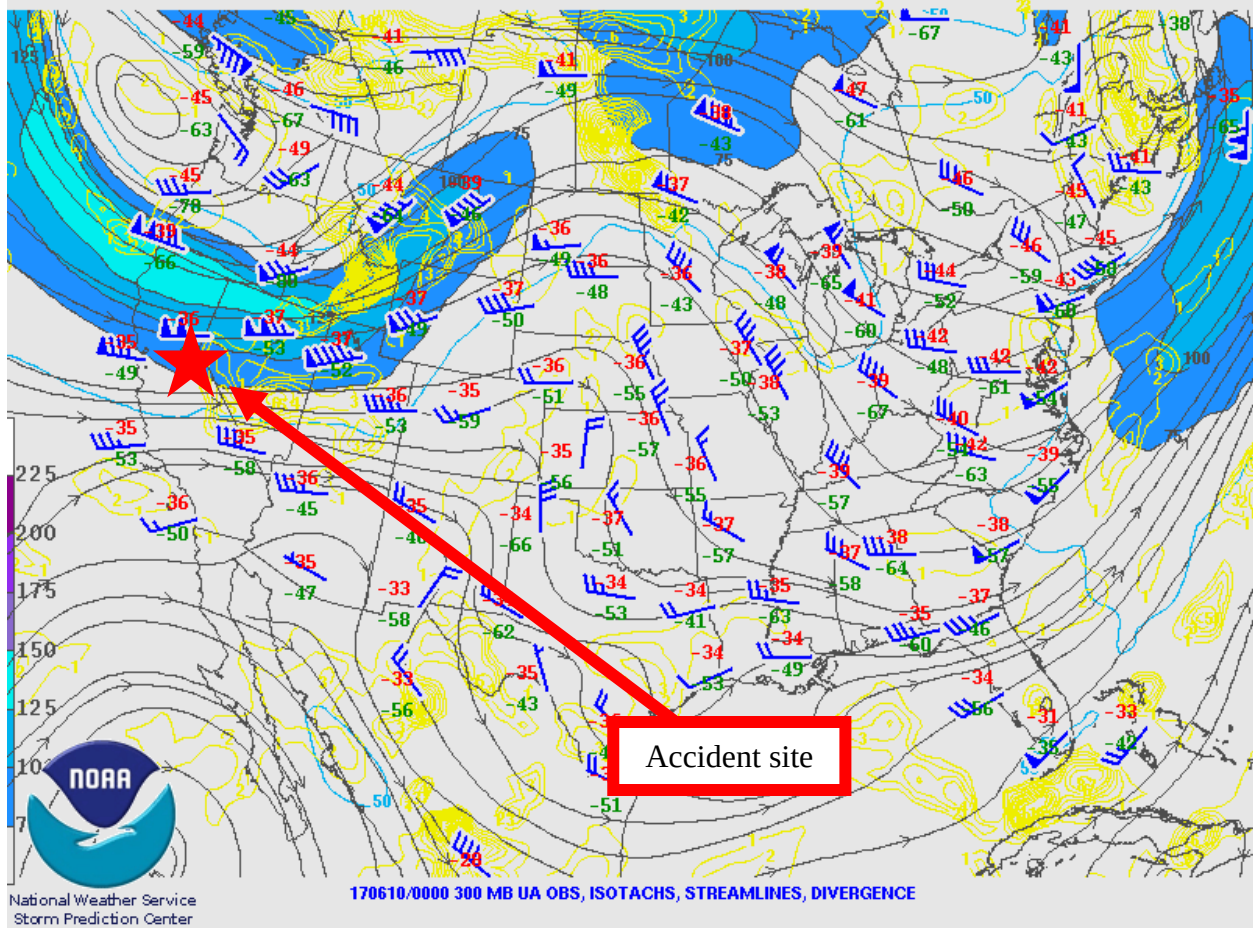


Figure 6 – 300-hPa Constant Pressure Chart for 1700 PDT

2.0 Storm Prediction Center Products

SPC did not forecast any thunderstorms for the accident site for the accident day.

3.0 Surface Observations

The area surrounding the accident site was documented using official Meteorological Aerodrome Reports (METARs) and Specials (SPECIs). Figure 7 is a sectional map of the region with the accident site, the closest weather reporting locations marked, and the intended route of flight (pink line).

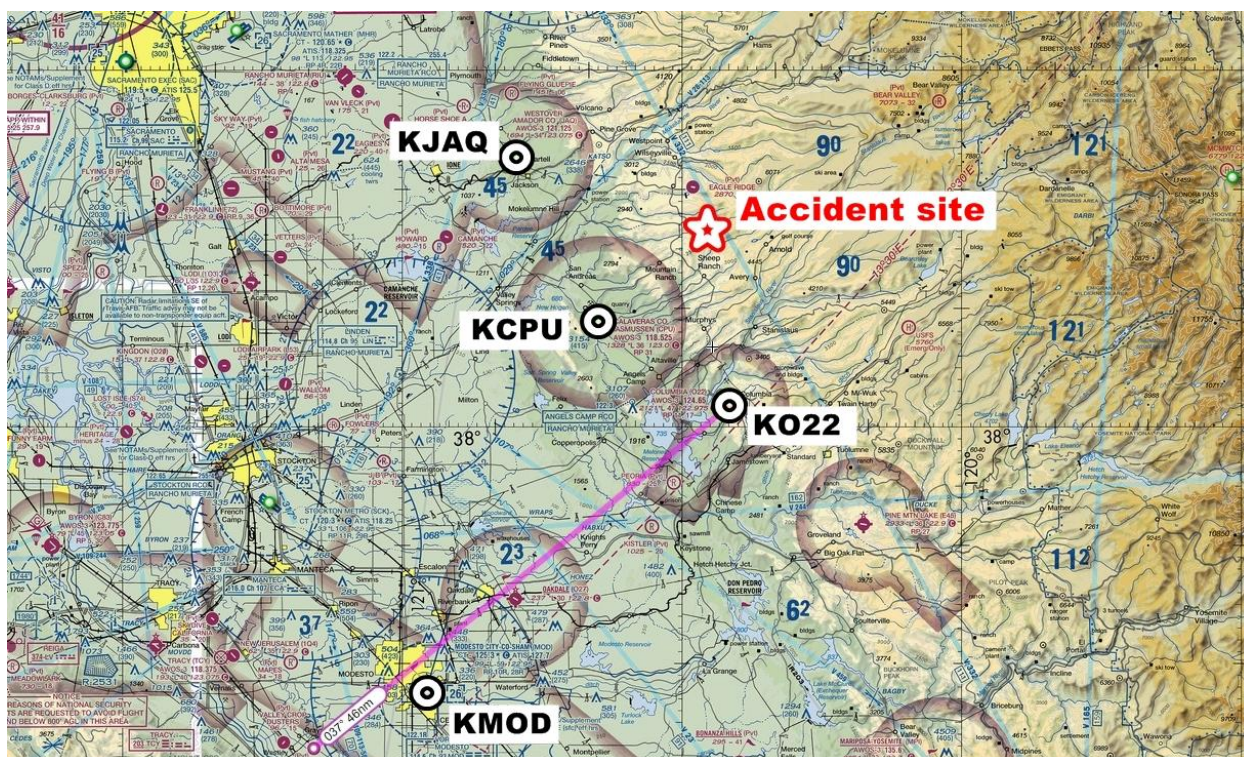


Figure 7 – Sectional Chart with the location of the accident site, surface observation sites, and the intended route of flight (pink line)

Calaveras County Airport (KCPU) was the closest official weather station to the accident site, and was located 4 miles southeast of San Andreas, California. KCPU had an Automated Weather Observing System (AWOS²) whose reports were not supplemented. KCPU was located 12 miles southwest of the accident site, at an elevation of 1,328 ft, and had a 15° easterly magnetic variation³ (figure 7). The following observations were taken and disseminated during the times surrounding the accident:⁴

- [1215 PDT] METAR KCPU 091915Z AUTO 0000KT 4SM BR OVC020 16/14 A2995
RMK AO2 T01600138=
- [1235 PDT] METAR KCPU 091935Z AUTO 07003KT 7SM OVC020 17/15 A2996 RMK
AO2 T01650151=
- [1255 PDT] METAR KCPU 091955Z AUTO 12003KT 10SM BKN018 OVC025 18/16
A2995 RMK AO2 T01750155=

² AWOS – Automated Weather Observing System is equipped with meteorological instruments to observe and report temperature, dewpoint, wind speed and direction, visibility, cloud coverage and ceiling up to twelve thousand ft, and altimeter setting.

³ Magnetic variation – The angle (at a particular location) between magnetic north and true north. 1995, latest measurement taken from <http://www.airnav.com/airport/KCPU>

⁴ Bolded sections in this report highlight information that directly reference the weather conditions that affected the accident location around the accident time.

[1315 PDT] METAR KCPU 092015Z AUTO 09003KT 10SM SCT012 OVC023 17/15
A2995 RMK AO2 T01730150=

[1335 PDT] METAR KCPU 092035Z AUTO 08004KT 10SM BKN014 OVC027 18/16
A2995 RMK AO2 T01780158=

**[1355 PDT] METAR KCPU 092055Z AUTO 06006KT 10SM SCT009 BKN016 OVC033
18/15 A2995 RMK AO2 T01820153=**

**[1415 PDT] METAR KCPU 092115Z AUTO 02003KT 10SM SCT009 BKN016 OVC027
18/15 A2995 RMK AO2 T01750145=**

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**[1435 PDT] METAR KCPU 092135Z AUTO 33003KT 10SM SCT016 BKN029 OVC065
20/15 A2994 RMK AO2 T01970148=**

**[1455 PDT] METAR KCPU 092155Z AUTO 01003KT 10SM BKN031 OVC039 19/14
A2994 RMK AO2 T01870142=**

[1515 PDT] METAR KCPU 092215Z AUTO 35004KT 10SM SCT024 BKN030 OVC037
19/14 A2994 RMK AO2 T01850140=

[1535 PDT] METAR KCPU 092235Z AUTO 33006KT 10SM SCT024 BKN038 OVC070
20/14 A2994 RMK AO2 T01960138=

[1555 PDT] METAR KCPU 092255Z AUTO 02004KT 10SM BKN026 BKN043 OVC070
20/14 A2993 RMK AO2 T02000139=

KCPU weather at 1355 PDT, automated, wind from 060° at 6 knots, 10 miles visibility, scattered clouds at 900 ft above ground level (agl), broken ceiling 1,600 ft agl, overcast skies at 3,300 ft agl, temperature of 18° Celsius (C), dew point temperature of 15° C, and an altimeter setting of 29.95 inches of mercury. Remarks: automated station with a precipitation discriminator, temperature 18.2° C, dew point temperature 15.3° C.

KCPU weather at 1415 PDT, automated, wind from 020° at 3 knots, 10 miles visibility, scattered clouds at 900 ft agl, broken ceiling 1,600 ft agl, overcast skies at 2,700 ft agl, temperature of 18° C, dew point temperature of 15° C, and an altimeter setting of 29.95 inches of mercury. Remarks: automated station with a precipitation discriminator, temperature 17.5° C, dew point temperature 14.5° C.

KCPU weather at 1435 PDT, automated, wind from 330° at 3 knots, 10 miles visibility, scattered clouds at 1,600 ft agl, broken ceiling 2,900 ft agl, overcast skies at 6,500 ft agl, temperature of 20° C, dew point temperature of 15° C, and an altimeter setting of 29.94 inches of mercury. Remarks: automated station with a precipitation discriminator, temperature 19.7° C, dew point temperature 14.8° C.

KCPU weather at 1455 PDT, automated, wind from 010° at 3 knots, 10 miles visibility, broken ceiling 3,100 ft agl, overcast skies at 3,900 ft agl, temperature of 19° C, dew point temperature of 14° C, and an altimeter setting of 29.94 inches of mercury. Remarks: automated station with a precipitation discriminator, temperature 18.7° C, dew point temperature 14.2° C.

Columbia Airport (KO22) was the intended destination airport, and was located 1 mile southwest of Columbia, California. KO22 had an AWOS whose reports were not supplemented. KO22 was located 15 miles south of the accident site, at an elevation of 2,121 ft, and had a 16° easterly magnetic variation⁵ (figure 7). The following observations were taken and disseminated during the times surrounding the accident:

[1215 PDT] METAR KO22 091915Z AUTO 21004KT 5SM FEW008 BKN012 OVC032
15/14 A3000 RMK AO1=

[1235 PDT] METAR KO22 091935Z AUTO 00000KT 2 1/2SM 16/15 A3000 RMK AO1=

[1255 PDT] METAR KO22 091955Z AUTO 20003KT 4SM FEW006 SCT010 BKN019
16/15 A3000 RMK AO1 P0001=

[1315 PDT] METAR KO22 092015Z AUTO 00000KT 7SM FEW006 BKN012 BKN019
17/15 A3000 RMK AO1=

[1335 PDT] METAR KO22 092035Z AUTO 00000KT BKN008 BKN014 OVC027 17/14
A2999 RMK AO1=

**[1355 PDT] METAR KO22 092055Z AUTO 24003KT SCT008 BKN024 OVC033 18/14
A2999 RMK AO1=**

**[1415 PDT] METAR KO22 092115Z AUTO 00000KT SCT013 BKN021 OVC037 17/14
A2999 RMK AO1=**

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**[1435 PDT] METAR KO22 092135Z AUTO 00000KT SCT013 OVC022 18/14 A2998
RMK AO1=**

**[1455 PDT] METAR KO22 092155Z AUTO 20003KT SCT013 BKN024 OVC045 18/14
A2998 RMK AO1=**

[1515 PDT] METAR KO22 092215Z AUTO 24003KT SCT015 BKN034 OVC045 18/14
A2998 RMK AO1=

⁵ Magnetic variation – The angle (at a particular location) between magnetic north and true north. 1985, latest measurement taken from <http://www.aimav.com/airport/O22>

[1535 PDT] METAR KO22 092235Z AUTO 17003KT FEW025 BKN032 OVC044 18/14
A2998 RMK AO1=

[1555 PDT] METAR KO22 092255Z AUTO 00000KT FEW018 SCT027 BKN034 18/13
A2997 RMK AO1=

KO22 weather at 1355 PDT, automated, wind from 240° at 3 knots, scattered clouds at 800 ft agl, broken ceiling 2,400 ft agl, overcast skies at 3,300 ft agl, temperature of 18° C, dew point temperature of 14° C, and an altimeter setting of 29.99 inches of mercury. Remarks: automated station without a precipitation discriminator.

KO22 weather at 1415 PDT, automated, wind calm, scattered clouds at 1,300 ft agl, broken ceiling 2,100 ft agl, overcast skies at 3,700 ft agl, temperature of 17° C, dew point temperature of 14° C, and an altimeter setting of 29.99 inches of mercury. Remarks: automated station without a precipitation discriminator.

KO22 weather at 1435 PDT, automated, wind calm, scattered clouds at 1,300 ft agl, overcast ceiling 2,200 ft agl, temperature of 18° C, dew point temperature of 14° C, and an altimeter setting of 29.98 inches of mercury. Remarks: automated station without a precipitation discriminator.

KO22 weather at 1455 PDT, automated, wind from 200° at 3 knots, scattered clouds at 1,300 ft agl, broken ceiling 2,400 ft agl, overcast skies at 4,500 ft agl, temperature of 18° C, dew point temperature of 14° C, and an altimeter setting of 29.98 inches of mercury. Remarks: automated station without a precipitation discriminator.

Westover Field/Amador County Airport (KJAQ) was located 2 miles northwest of Jackson, California. KJAQ had an AWOS whose reports were not supplemented. KJAQ was located 18 miles west-northwest of the accident site, at an elevation of 1,694 ft, and had a 16° easterly magnetic variation⁶ (figure 7). The following observations were taken and disseminated during the times surrounding the accident:

[1215 PDT] METAR KJAQ 091915Z AUTO 34006KT 7SM OVC010 17/14 A2996 RMK
AO1 T01680138=

[1235 PDT] METAR KJAQ 091935Z AUTO 30006KT 10SM OVC012 17/14 A2996 RMK
AO1 T01710136=

[1255 PDT] METAR KJAQ 091955Z AUTO 28007KT 10SM OVC012 17/14 A2996 RMK
AO1 T01690139=

[1315 PDT] METAR KJAQ 092015Z AUTO 27005KT 10SM OVC010 17/14 A2995 RMK
AO1 T01690140=

⁶ Magnetic variation – The angle (at a particular location) between magnetic north and true north. 1990, latest measurement taken from <http://www.aimav.com/airport/KJAQ>

[1335 PDT] METAR KJAQ 092035Z AUTO 28006KT 10SM OVC010 17/14 A2995 RMK AO1 T01670137=

[1355 PDT] METAR KJAQ 092055Z AUTO 26004KT 10SM OVC012 17/14 A2995 RMK AO1 T01660139=

[1415 PDT] METAR KJAQ 092115Z AUTO 28005KT 10SM OVC010 17/14 A2995 RMK AO1 T01650138=

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[1435 PDT] METAR KJAQ 092135Z AUTO 30004KT 10SM OVC012 17/14 A2995 RMK AO1 T01700138=

[1455 PDT] METAR KJAQ 092155Z AUTO 28005KT 10SM OVC016 18/14 A2995 RMK AO1 T01800137=

[1515 PDT] METAR KJAQ 092215Z AUTO 24004KT 10SM BKN016 OVC023 18/14 A2995 RMK AO1 T01790138=

[1535 PDT] METAR KJAQ 092235Z AUTO 26003KT 10SM SCT016 BKN021 OVC045 19/14 A2994 RMK AO1 T01880136=

[1555 PDT] METAR KJAQ 092255Z AUTO 27006KT 10SM SCT018 SCT024 BKN044 19/14 A2993 RMK AO1 T01910135=

KJAQ weather at 1355 PDT, automated, wind from 260° at 4 knots, 10 miles visibility, overcast ceiling at 1,200 ft agl, temperature of 17° C, dew point temperature of 14° C, and an altimeter setting of 29.95 inches of mercury. Remarks: automated station without a precipitation discriminator, temperature 16.6° C, dew point temperature 13.9° C.

KJAQ weather at 1415 PDT, automated, wind from 280° at 5 knots, 10 miles visibility, overcast ceiling at 1,000 ft agl, temperature of 17° C, dew point temperature of 14° C, and an altimeter setting of 29.95 inches of mercury. Remarks: automated station without a precipitation discriminator, temperature 16.5° C, dew point temperature 13.8° C.

KJAQ weather at 1435 PDT, automated, wind from 300° at 4 knots, 10 miles visibility, overcast ceiling at 1,200 ft agl, temperature of 17° C, dew point temperature of 14° C, and an altimeter setting of 29.95 inches of mercury. Remarks: automated station without a precipitation discriminator, temperature 17.0° C, dew point temperature 13.8° C.

KJAQ weather at 1455 PDT, automated, wind from 280° at 5 knots, 10 miles visibility, overcast ceiling at 1,600 ft agl, temperature of 18° C, dew point temperature of 14° C, and an altimeter setting of 29.95 inches of mercury. Remarks: automated station without a precipitation discriminator, temperature 18.0° C, dew point temperature 13.7° C.

Modesto City-County Airport (KMOD) was the closest airport with official weather observations to the departure airport and was located 2 miles southeast of Modesto, California. KMOD had an Automated Surface Observing System (ASOS⁷) whose reports were made with air traffic control (ATC) logged on to the ASOS and ATC able to augment the METARs and SPECIs information. KMOD was located 46 miles southwest of the accident site and within 11 miles of the departure airport, at an elevation of 99 ft, and had a 16° easterly magnetic variation⁸ (figure 7). The following observations were taken and disseminated during the times surrounding the accident:

[0953 PDT] METAR KMOD 091653Z VRB04KT 10SM SCT024 OVC047 21/15 A2992
RMK AO2 SLP131 T02110150=

[1053 PDT] METAR KMOD 091753Z 31005KT 10SM SCT025 OVC048 22/15 A2992
RMK AO2 SLP130 60000 T02170150 10222 20178 55000=

[1108 PDT] SPECI KMOD 091809Z 00000KT 10SM BKN027 OVC050 22/14 A2992
RMK AO2 T02220144=

[1153 PDT] METAR KMOD 091853Z 26003KT 10SM OVC031 22/14 A2992 RMK AO2
SLP131 T02220144=

[1238 PDT] SPECI KMOD 091938Z 33010KT 10SM OVC029 22/16 A2993 RMK AO2
T02170156=

**[1253 PDT] METAR KMOD 091953Z 31012KT 10SM BKN029 OVC040 23/16 A2992
RMK AO2 SLP132 T02280156=**

**[1353 PDT] METAR KMOD 092053Z 32007KT 10SM BKN025 23/15 A2991 RMK AO2
SLP127 T02330150 58003=**

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**[1453 PDT] METAR KMOD 092153Z 10SM BKN028 23/15 A2990 RMK AO2 SLP124
T02330150=**

**[1500 PDT] SPECI KMOD 092200Z 33007KT 10SM BKN033 OVC041 24/15 A2990
RMK AO2 T02390150=**

[1553 PDT] METAR KMOD 092253Z 33010KT 10SM BKN050 25/14 A2989 RMK AO2
SLP121 T02500139=

⁷ ASOS – Automated Surface Observing System is equipped with meteorological instruments to observe and report wind, visibility, ceiling, temperature, dewpoint, altimeter, and barometric pressure.

⁸ Magnetic variation – The angle (at a particular location) between magnetic north and true north. 1985, latest measurement taken from <http://www.aimav.com/airport/KMOD>

[1653 PDT] METAR KMOD 092353Z 10SM FEW047 26/12 A2987 RMK AO2 SLP116
T02560117 10256 20217 58011=

KMOD weather at 1253 PDT, wind from 310° at 12 knots, 10 miles visibility, broken ceiling at 2,900 ft agl, overcast skies at 4,000 ft agl, temperature of 23° C, dew point temperature of 16° C, and an altimeter setting of 29.92 inches of mercury. Remarks, station with a precipitation discriminator, sea level pressure 1013.2 hPa, temperature 22.8° C, dew point temperature 15.6° C.

KMOD weather at 1353 PDT, wind from 320° at 7 knots, 10 miles visibility, broken ceiling at 2,500 ft agl, temperature of 23° C, dew point temperature of 15° C, and an altimeter setting of 29.91 inches of mercury. Remarks, station with a precipitation discriminator, sea level pressure 1012.7 hPa, temperature 23.3° C, dew point temperature 15.0° C, 3-hourly pressure decrease of 0.3 hPa.

KMOD weather at 1453 PDT, 10 miles visibility, broken ceiling at 2,800 ft agl, temperature of 23° C, dew point temperature of 15° C, and an altimeter setting of 29.90 inches of mercury. Remarks, station with a precipitation discriminator, sea level pressure 1012.4 hPa, temperature 23.3° C, dew point temperature 15.0° C.

KMOD weather at 1500 PDT, wind from 330° at 7 knots, 10 miles visibility, broken ceiling at 3,300 ft agl, overcast skies at 4,100 ft agl, temperature of 24° C, dew point temperature of 15° C, and an altimeter setting of 29.90 inches of mercury. Remarks, station with a precipitation discriminator, temperature 23.9° C, dew point temperature 15.0° C.

The observations from KCPU, KO22, KJAQ, and KMOD surrounding the accident time indicated MVFR⁹ to VFR¹⁰ conditions due to ceilings. Ceilings varied between 1,000 ft and 3,300 ft agl or 2,500 ft and 4,200 ft msl in the mountainous terrain.

⁹ Marginal Visual Flight Rules – Refers to the general weather conditions pilots can expect at the surface. MVFR criteria means a ceiling between 1,000 and 3,000 ft agl and/or 3 to 5 miles visibility.

¹⁰ Visual Flight Rules – Refers to the general weather conditions pilots can expect at the surface. VFR criteria means a ceiling greater than 3,000 feet agl and greater than 5 miles visibility.

4.0 Upper Air Data

A High-Resolution Rapid Refresh (HRRR)¹¹ model sounding was created for the accident site for 1400 PDT. The 1400 PDT sounding was plotted on a standard Skew-T log P diagram¹² with the derived stability parameters included in figure 8 (with data from the surface to 600-hPa, or 14,000 ft msl.) This sounding data was analyzed utilizing the RAOB¹³ software package. The sounding depicted the lifted condensation level (LCL)¹⁴ at 3,907 ft, a convective condensation level (CCL)¹⁵ of 4,951 ft, and a level of free convection (LFC)¹⁶ at 3,907 ft. The freezing level was located at 10,600 ft. The precipitable water value was 0.86 inches.

¹¹ The HRRR is a 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.

¹² 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.

¹³ RAOB – (The complete Rawinsonde Observation program) is an interactive sounding analysis program developed by Environmental Research Services, Matamoras, Pennsylvania.

¹⁴ Lifting Condensation Level (LCL) - The height at which a parcel of moist air becomes saturated when it is lifted dry adiabatically.

¹⁵ Convective Condensation Level (CCL) – The level in the atmosphere to which an air parcel, if heated from below, will rise dry adiabatically, without becoming colder than its environment just before the parcel becomes saturated.

¹⁶ Level of Free Convection (LFC) – The level at which a parcel of saturated air becomes warmer than the surrounding air and begins to rise freely. This occurs most readily in a conditionally unstable atmosphere.

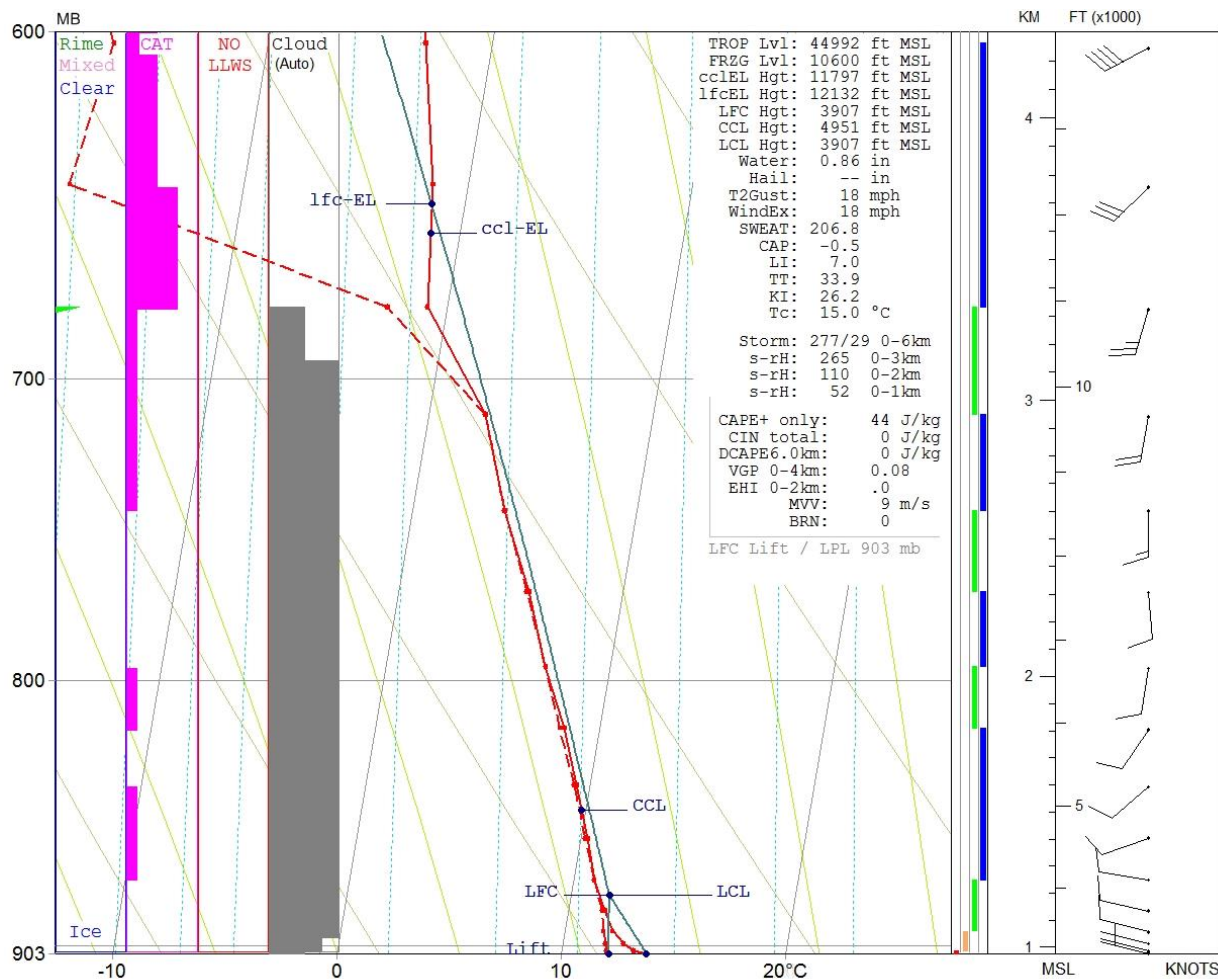


Figure 8 – 1400 PDT HRRR sounding for the accident site

The 1400 PDT HRRR sounding indicated several conditionally unstable and stable layers between the surface and 14,000 ft. With the mid-level trough (section 1.2) in the area of the accident site around the accident time and the wind below 5,000 ft directed towards the mountainous terrain, this environment would have been supportive of cloud formation and light precipitation. Only light, if any, precipitation would be expected because the relative humidity within the vertical environment dropped well below 70% above 11,000 ft and below -1°C . With only 44 J/kg of CAPE¹⁷, there was not enough instability to allow for the formation of thunderstorm activity at the accident time. RAOB identified the possibility of clouds from the surface through 11,000 ft. No areas of icing were indicated by RAOB for below 10,000 ft.

¹⁷ Convective Available Potential Energy (CAPE) – CAPE is a measure of the amount of energy available for convection and is directly related to the maximum potential vertical speed within an updraft.

The 1400 PDT HRRR sounding wind profile indicated a surface wind from 285° at 6 knots with the wind remaining primarily westerly through 4,500 ft. The wind speed remained below 15 knots through 8,500 ft. Between 4,500 and 14,000 ft the wind became southerly and then became southwesterly. The wind speed increased to 20 knots by 10,000 ft and then to 40 knots by 14,000 ft. No low-level wind shear was indicated by RAOB. Several layers of possible clear-air turbulence were identified between the surface and 14,000 ft.

5.0 Satellite Data

Visible and infrared data from the Geostationary Operational Environmental Satellite number 15 (GOES-15) data were obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison in Madison, Wisconsin, and processed using the NTSB's Man-computer Interactive Data Access System software. Visible and infrared imagery (GOES-15 band 1 and 4) at wavelengths of 0.65 microns (μm) and 10.7 μm , respectively, were retrieved for the period. Satellite imagery surrounding the time of the accident, from 1200 PDT through 1700 PDT at approximately 15-minute intervals were reviewed, and the closest images to the time of the accident are documented here.

Figures 9 and 10 present the GOES-15 visible imagery from 1430 and 1445 PDT at 3X magnification with the accident site highlighted with a red square. The visible imagery indicated abundant cloud cover above the accident site at the accident time with the cloud cover moving from southwest to northeast (attachment 1). Figure 12 presents the GOES-15 infrared imagery from 1430 PDT at 6X magnification with the accident site highlighted with a red square. The infrared imagery indicated cooler brightness temperatures and higher cloud tops (red and yellow colors) located over the accident site at the accident time. Based on the brightness temperatures above the accident site and the vertical temperature profile provided by the 1400 PDT HRRR sounding, the approximate cloud-top heights over the accident site were 16,000 ft at 1430 PDT. It should be noted these figures have not been corrected for any parallax error.

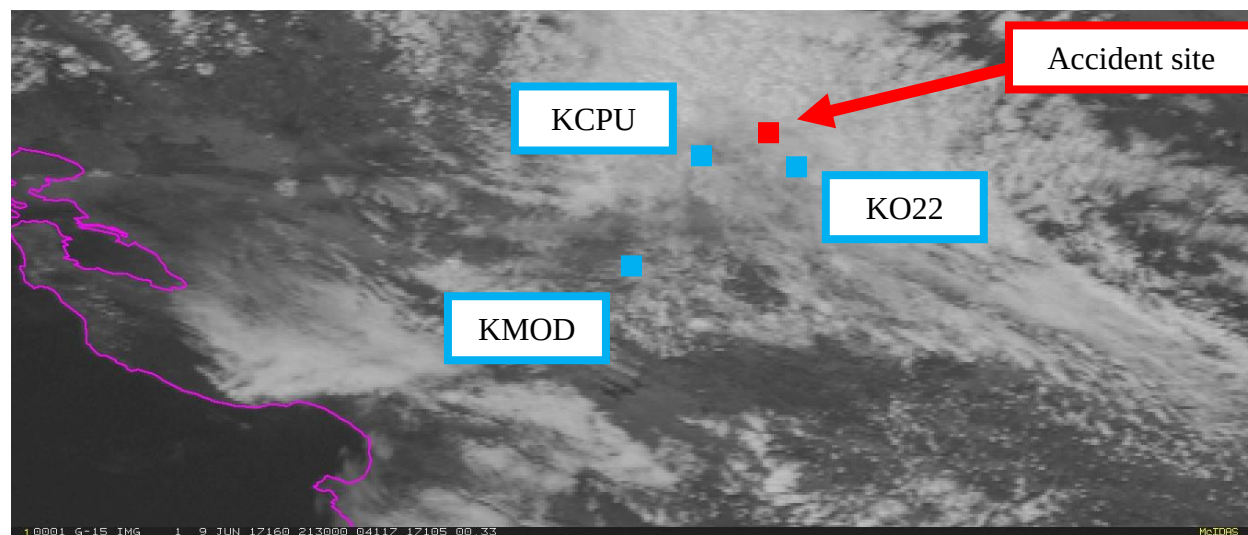


Figure 9 – GOES-15 visible image at 1430 PDT

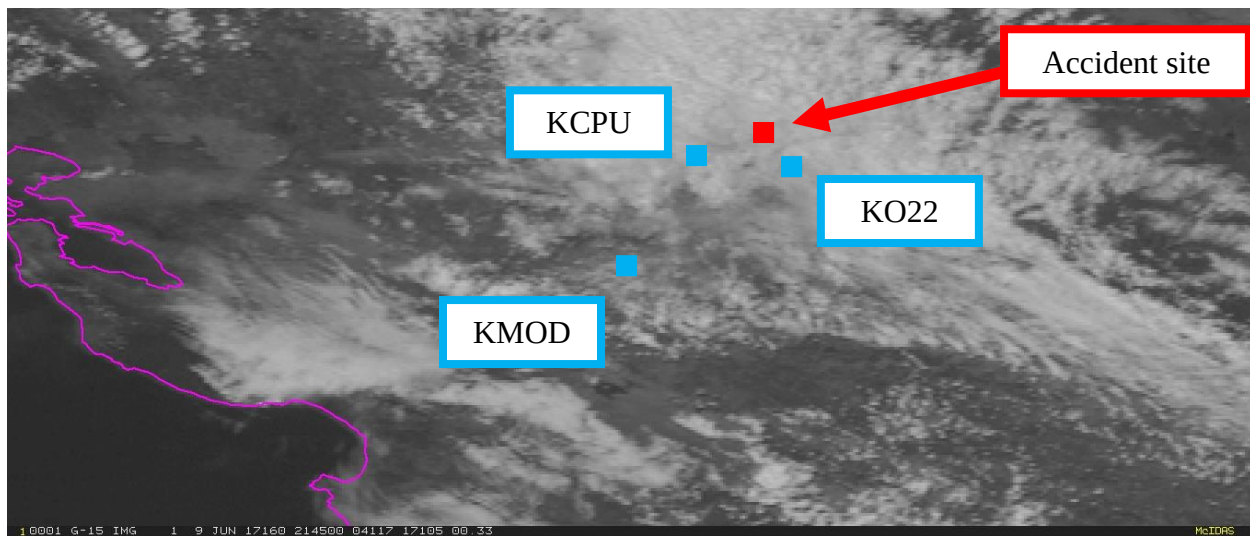


Figure 10 – GOES-15 visible image at 1445 PDT

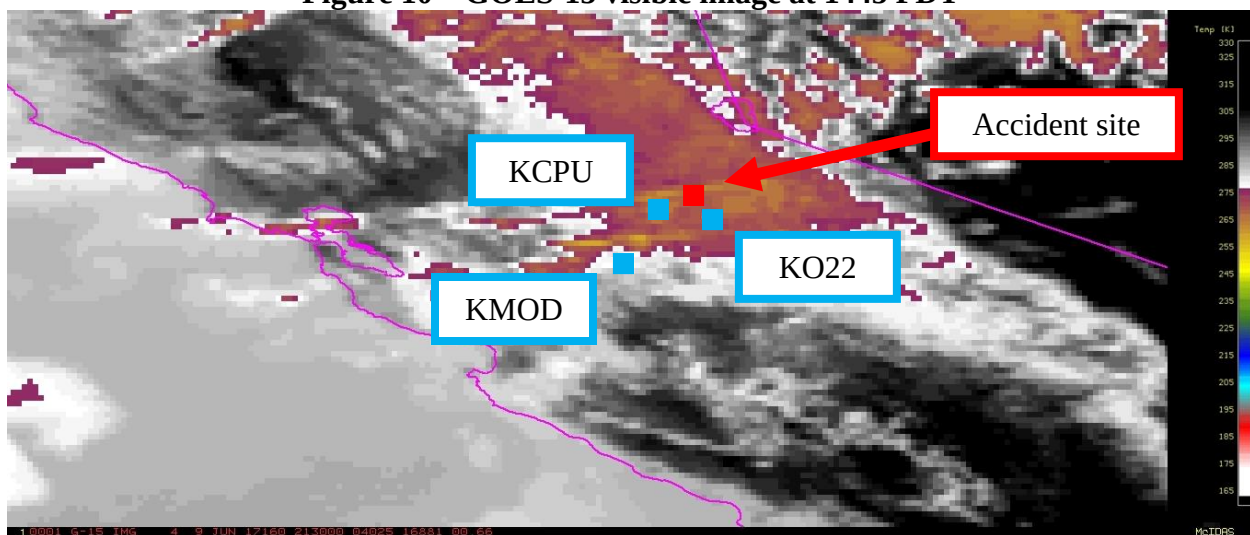


Figure 11 – GOES-15 infrared image at 1430 PDT

6.0 Radar Imagery Information

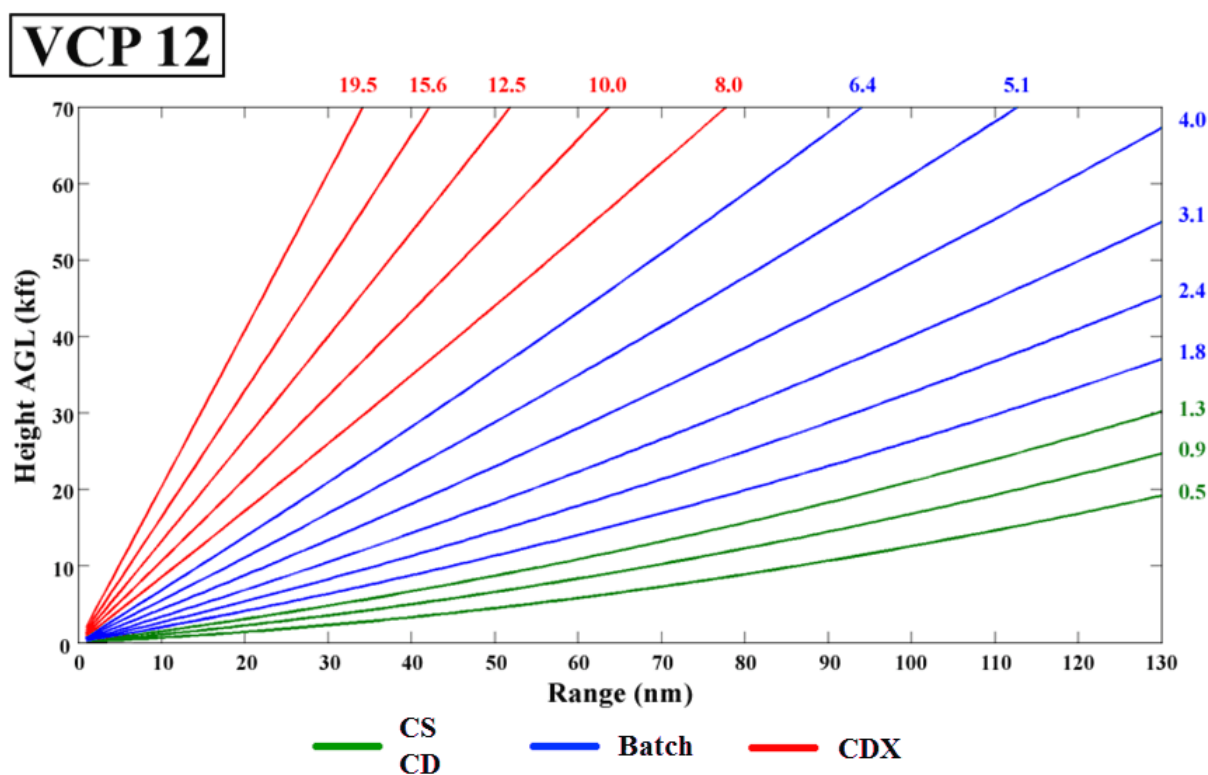
The closest NWS Weather Surveillance Radar-1988, Doppler (WSR-88D)¹⁸ to the accident site was the Sacramento, California, radar (KDAX), which was located 60 miles east-southeast of the accident site at an elevation of 30 ft. Level II and III archive radar data were obtained from the NCEI utilizing the NEXRAD Data Inventory Search and displayed using the NOAA's Weather and Climate Toolkit software.

¹⁸ The WSR-88D is an S-band 10-centimeter wavelength radar with a power output of 750,000 watts, and with a 28-foot parabolic antenna that concentrates the energy between a 0.87° and 0.96° beam width. The radar produces three basic types of products: base reflectivity, base radial velocity, and base spectral width.

6.1 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 five to ten 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 three common scanning strategies. The most common is where the radar makes 14 elevation scans from 0.5° to 19.5° every four and a half minutes. This particular scanning strategy is documented as volume coverage pattern 12 (VCP-12). 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 KDAX WSR-88D radar was operating in the precipitation mode (Mode A, VCP-12). The following chart provides an indication of the different elevation angles in this VCP, and the approximate height and width of the radar beam with distance from the radar site.



VCP-12 Precipitation Mode Scan Strategy¹⁹

¹⁹ Contiguous Surveillance (CS)--The low Pulse Repetition Frequency (PRF) scan of the split cut. Gives a high $R_{\max}$ value to determine proper target location and intensity, but a low $V_{\max}$ value limits the velocities that can be measured.

Contiguous Doppler (CD)--The high PRF scan of the split cut. Gives a low $R_{\max}$ value causing more range folded (multiple trip) echoes, but a high $V_{\max}$ value to get higher, more accurate velocity values.

Batch Mode -- Uses alternating low and high PRFs on each radial for one full rotation at each elevation angle. The two resulting data sets (low PRF and high PRF) are combined to resolve range ambiguity. Used in the middle

6.2 Beam Height Calculation

Assuming standard refraction²⁰ of the WSR-88D 0.95° wide radar beam, the following table shows the approximate beam height and width²¹ information²² of the radar display over the site of the accident. The heights have been rounded to the nearest 10 ft.

ANTENNA ELEVATION	BEAM CENTER	BEAM BASE	BEAM TOP	BEAM WIDTH
0.5°	5,820 ft	2,860 ft	8,780 ft	5,920 ft

Based on the radar height calculations, the 0.5° elevation scans depicted the conditions between 2,860 ft and 8,780 ft msl over the accident site and these are the closest altitudes to the ground that were available.

6.3 Reflectivity

Reflectivity is the measure of the efficiency of a target in intercepting and returning radio energy. With hydrometeors²³ 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 (dBZ²⁴), and is a general measure of echo intensity. FAA Advisory Circular AC 00-24C, “Thunderstorms,” dated February 19, 2013, also defines the echo intensity levels and weather radar echo intensity terminology associated with those levels. For dBZ values less than 30 the weather radar echo intensity terminology should be “light.” For dBZ values between 30 and 40, the terminology should be “moderate.” “Heavy” terminology is used for dBZ values greater than 40 dBZ but less than 50 dBZ, inclusive. Finally, any dBZ values above 50 dBZ shall be described as “extreme.” From the NWS, precipitation conditions at the surface can be inferred from VIP Levels described in the chart below:

elevation angles.

W – With range unfolding (W)

WO – Without range unfolding (WO)

²⁰ Standard Refraction in the atmosphere is when the temperature and humidity distributions are approximately average, and values set at the standard atmosphere.

²¹ Beam width – A measure of the angular width of a radar beam.

²² Beamwidth values are shown for legacy resolution products. Super resolution products would an effective beamwidth that would be approximately half these values.

²³ 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 glazed ice.

²⁴ dBZ – A non-dimensional “unit” of radar reflectivity which represents a logarithmic power ratio (in decibels , or dB) with respect to radar reflectivity factor, Z.

- VIP 1 (Level 1, 18-30 dBZ) - Light precipitation
- VIP 2 (Level 2, 30-38 dBZ) - Light to moderate rain.
- VIP 3 (Level 3, 38-44 dBZ) - Moderate to heavy rain.
- VIP 4 (Level 4, 44-50 dBZ) - Heavy rain
- VIP 5 (Level 5, 50-57 dBZ) - Very heavy rain; hail possible.
- VIP 6 (Level 6, >57 dBZ) - Very heavy rain and hail; large hail possible.

6.4 Base Reflectivity and Lightning Data

Figure 12 presents the KDAX WSR-88D base reflectivity images for the 0.5° elevation scans initiated at 1430 PDT with a resolution of 0.5° X 250 m. The KDAX base reflectivity imagery indicated no precipitation targets above the accident site at the accident time. An archived lightning database²⁵ was reviewed and there were no lightning strikes near the accident site in the two hours surrounding the accident time.

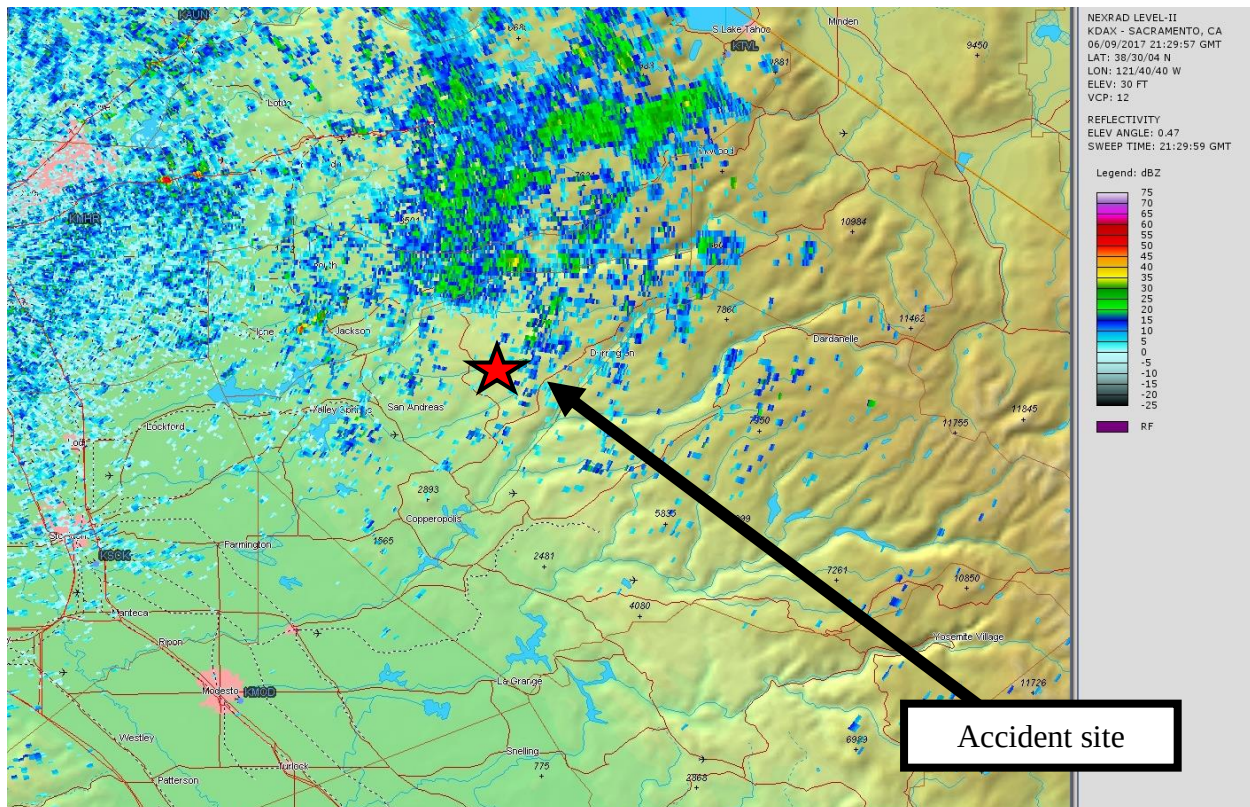


Figure 12 – KDAX WSR-88D reflectivity for the 0.5° elevation scan initiated at 1430 PDT

7.0 Pilot Reports²⁶

All pilot reports (PIREPs) close to the accident site from about two hours prior to the accident time to about two hours after the accident time for below FL180²⁷ are provided below:

²⁵ A review of Earth Networks Total Lightning network was done.

²⁶ Only pilot reports with the WMO header UBCA** identifier were considered.

²⁷ Flight Level – A Flight Level (FL) is a standard nominal altitude of an aircraft, in hundreds of ft. This altitude is

MAE UA /OV PXN155017/TM 2002/FL090/TP AA5/TB MOD/RM SMTH ABV 095/ZOA CWSU=

MOD UA /OV MOD200002/TM 2034/FL080/TP PA28/TA 0/IC LGT CLR=

STS UA /OV STS/TM 2147/FL090/TP DH8C/SK SKC/TB NEG/IC NEG/RM ZOA CWSU=

TRK UUA /OV SWR160020/TM 2312/FL130/TP SR22/RM SEV UP AND DWN DRFTS +-2000FT/ZOA CWSU=

TVL UA /OV TVL190010/TM 2319/FL120/TP SR22/TA M04/IC LGT RIME 120/RM ZOA CWSU=

Routine pilot report (UA); 17 miles from Panoche, California, on the 155° radial; Time – 1302 PDT (2002Z); Altitude – 9,000 ft; Type aircraft – Grumman American AA-5; Turbulence – Moderate; Remarks – Smooth above 9,500 ft.

Routine pilot report (UA); 2 miles from Modesto, California, on the 200° radial; Time – 1334 PDT (2034Z); Altitude – 8,000 ft; Type aircraft – Piper PA-28; Temperature – 0° C; Icing – Light clear.

Routine pilot report (UA); Over Santa Rosa, California; Time – 1447 PDT (2147Z); Altitude – 9,000 ft; Type aircraft – Bombardier Dash 8; Sky – Skies clear; Turbulence – Negative; Icing – Negative.

Urgent pilot report (UUA); 20 miles from South Lake Tahoe, California, on the 160° radial; Time – 1612 PDT (2312Z); Altitude – 13,000 ft; Type aircraft – Cirrus SR22; Remarks – Severe up and downdrafts +/- 2,000 ft.

Routine pilot report (UA); 10 miles from South Lake Tahoe, California, on the 190° radial; Time – 1619 PDT (2319Z); Altitude – 12,000 ft; Type aircraft – Cirrus SR22; Temperature – -4° C; Icing – Light rime at 12,000 ft.

8.0 SIGMET and CWSU Advisories

There were no Significant Meteorological Information (SIGMET) advisories valid for the accident site at the accident time.

There were no Center Weather Service Unit (CWSU) Meteorological Impact Statements (MIS)s or Center Weather Advisories (CWA)s were valid for the accident site at the accident time.

calculated from the International standard pressure datum of 1013.25 hPa (29.92 inHg), the average sea-level pressure, and therefore is not necessarily the same as the aircraft's true altitude either above mean sea level or above ground level.

9.0 AIRMETs

Airmen's Meteorological Information (AIRMET) advisories Tango and Sierra were issued at 1345 PDT and valid at the accident time for the accident site. AIRMETs Tango and Sierra forecast moderate turbulence below FL180 and forecast mountain obscuration conditions due to clouds and mist. The AIRMETs Tango and Sierra issued at 0745 PDT (and valid at the time of takeoff) forecast similar conditions for the accident site and along the intended route of flight:

WA6T

-SFOT WA 092045

AIRMET TANGO UPDT 3 FOR TURB VALID UNTIL 100300

.
AIRMET TURB...OR CA ID MT WY NV UT CO AND CSTL WTRS
FROM 50SE YQL TO 50NNW ISN TO 60NW RAP TO DBL TO BCE TO 40SSW
BTY TO 20S PYE TO 140WSW FOT TO 120WSW ONP TO 50NE DSD TO 90SSW
MLP TO 50SE YQL
MOD TURB BTN FL180 AND FL390. CONDS CONTG BYD 03Z THRU 09Z.

.
AIRMET TURB...CA WY NV UT CO AZ NM
FROM DDY TO 50SSW BFF TO TBE TO 40WSW CIM TO SJN TO 50N BZA TO
TRM TO 40NE LAX TO EHF TO SLC TO DDY
MOD TURB BLW 160. CONDS CONTG BYD 03Z THRU 09Z.

.
AIRMET TURB...OR CA ID MT WY NV UT AND CSTL WTRS
FROM LWT TO 60SSE BOY TO SLC TO EHF TO 30WNW RZS TO PYE TO FOT
TO 60WSW OED TO 50ESE OED TO LWT
MOD TURB BLW FL180. CONDS CONTG BYD 03Z THRU 09Z.

.
OTLK VALID 0300-0900Z
AREA 1...TURB WA OR CA ID MT WY NV UT CO AND CSTL WTRS
BOUNDED BY 40ESE YQL-50N ISN-70SW RAP-BFF-40SSW DEN-BCE-80WSW
ILC-60SSW FMG-120WSW FOT-160NW FOT-130WSW ONP-110WNW ONP-40ESE
YQL
MOD TURB BTN FL180 AND FL390. CONDS CONTG THRU 09Z.

.
AREA 2...TURB WA OR CA ID MT WY NV UT AND CSTL WTRS
BOUNDED BY 20NW GGW-20W ISN-50WSW RAP-20ENE DDY-SLC-30NW RZS-PYE-
FOT-80SSW ONP-20NW GGW
MOD TURB BLW FL180. CONDS CONTG THRU 09Z.

....

587

WAUS46 KKCI 092045

WA6S

-SFOS WA 092045

AIRMET SIERRA UPDT 3 FOR IFR AND MTN OBSCN VALID UNTIL 100300

.
AIRMET IFR...CA AND CSTL WTRS
FROM 40S SNS TO 30S RZS TO 30SE LAX TO 30ESE MZB TO 220SW MZB TO
130W RZS TO 40S SNS
CIG BLW 010/VIS BLW 3SM BR/FG. CONDS CONTG BYD 03Z THRU 09Z.

.
AIRMET MTN OBSCN...WA OR CA
FROM YDC TO 60SSW YKM TO 40NE OED TO 20SSW FOT TO 80WNW OED TO

20NW ONP TO HQM TO TOU TO HUH TO YDC
MTNS OBSC BY CLDS/BR. CONDS DVLPG 21-00Z. CONDS CONTG BYD 03Z
THRU 09Z.

.
AIRMET MTN OBSCN...CA
FROM 50NE RBL TO 50NNW FMG TO 40SSW FMG TO 40WSW OAL TO 20NNE
CZQ TO 30E SAC TO 20SSE RBL TO 50NE RBL
MTNS OBSC BY CLDS/BR. CONDS CONTG BYD 03Z ENDG 06-09Z.

.
OTLK VALID 0300-0900Z
AREA 1...MTN OBSCN CA
BOUNDED BY 40SW HEC-40E MZB-20S MZB-40SE LAX-20SSE RZS-40SW HEC
MTNS OBSC BY CLDS/BR. CONDS DVLPG 06-09Z. CONDS CONTG THRU 09Z.

.
AREA 2...MTN OBSCN WA OR CA
BOUNDED BY 20ENE YDC-40SSE YDC-40E OED-40SE FOT-20SSW SAC-RZS-
60W RZS-20S PYE-20SW FOT-80WNW OED-HQM-TOU-HUH-20ENE YDC
MTNS OBSC BY CLDS/BR. CONDS CONTG THRU 09Z.

....

285
WAUS46 KKCI 091445
WA6T
-SFOT WA 091445
AIRMET TANGO UPDT 2 FOR TURB VALID UNTIL 092100

.
AIRMET TURB...CA AND CSTL WTRS
FROM 170SW RZS TO 20S MZB TO 220SW MZB TO 170SW RZS
MOD TURB BTN FL310 AND FL410. CONDS DVLPG 18-21Z. CONDS CONTG
BYD 21Z THRU 03Z.

.
AIRMET TURB...OR CA ID MT WY NV UT
FROM 70S YYN TO MLS TO BOY TO 50SSE BOY TO SLC TO 30WNW BTY TO
40NNE EHF TO MOD TO RBL TO 50SE YQL TO 70S YYN
MOD TURB BLW FL180. CONDS CONTG BYD 21Z THRU 03Z.

.
AIRMET TURB...CA WY NV UT CO AZ NM
FROM DDY TO 30ESE CYS TO 60SE DEN TO TBE TO SJN TO 60S EED TO
40NNE LAX TO EHF TO SLC TO DDY
MOD TURB BLW 160. CONDS DVLPG 15-18Z. CONDS CONTG BYD 21Z THRU
03Z.

.
AIRMET TURB...WA OR CA ID MT WY NV UT AND CSTL WTRS
FROM 60SE YQL TO 40NNW ISN TO BOY TO SLC TO BTY TO 130SW PYE TO
140WSW FOT TO 150W ONP TO 60SSW DSD TO 20WNW FCA TO 60SE YQL
MOD TURB BTN FL240 AND FL390. CONDS CONTG BYD 21Z THRU 03Z.

.
OTLK VALID 2100-0300Z
AREA 1...TURB CA AZ NM AND CSTL WTRS
BOUNDED BY EED-SSO-60S SSO-50S TUS-BZA-20S MZB-220SW MZB-150WSW
RZS-20N LAX-EED
MOD TURB BTN FL310 AND FL410. CONDS CONTG THRU 03Z.

.
AREA 2...TURB WA OR CA ID MT WY NV UT AND CSTL WTRS
BOUNDED BY 40SSE YQL-50NNW ISN-60NW RAP-MTU-BTY-130SW PYE-140WSW
FOT-160WNW ONP-40NE DSD-40SSE YQL

MOD TURB BTN FL240 AND FL390. CONDS CONTG THRU 03Z.

....

828

WAUS46 KPCI 091445

WA6S

-SFOS WA 091445

AIRMET SIERRA UPDT 2 FOR IFR AND MTN OBSCN VALID UNTIL 092100

.

AIRMET IFR...OR CA AND CSTL WTRS

FROM 70WNW OED TO 60SSW OED TO 40SSE FOT TO 80SSW FOT TO 90NW
FOT TO 70WNW OED

CIG BLW 010/VIS BLW 3SM BR/FG. CONDS ENDG 18-21Z.

.

AIRMET IFR...CA AND CSTL WTRS

FROM 20SSE ENI TO 40SSW MOD TO 20NNW RZS TO 20S MZB TO 220SW MZB
TO 140SW SNS TO 20SSE ENI

CIG BLW 010/VIS BLW 3SM BR/FG. CONDS ENDG 18-21Z.

.

AIRMET MTN OBSCN...CA

FROM RZS TO 40S HEC TO 50ESE MZB TO 30SSW MZB TO 40SE LAX TO RZS
MTNS OBSC BY CLDS/BR. CONDS ENDG 15-18Z.

.

AIRMET MTN OBSCN...WA OR CA

**FROM YDC TO 40ESE OED TO 60S LKV TO 40SSW FMG TO 50ENE CZQ TO
30SE SAC TO 30WSW RZS TO 20SW FOT TO 80WNW OED TO 20N HUH TO YDC
MTNS OBSC BY CLDS/BR. CONDS ENDG 18-21Z.**

.

OTLK VALID 2100-0300Z...MTN OBSCN WA OR CA

BOUNDED BY YDC-60SSW YKM-40ENE OED-20SSW FOT-80WNW OED-20WNW ONP-
HQM-TOU-HUH-YDC

MTNS OBSC BY CLDS/BR. CONDS DVLPG 21-00Z. CONDS CONTG THRU 03Z.

....

394

WAUS46 KPCI 091445

WA6Z

-SFOZ WA 091445

AIRMET ZULU UPDT 2 FOR ICE AND FRZLVL VALID UNTIL 092100

.

AIRMET ICE...WA OR CA AND CSTL WTRS

FROM HUH TO DSD TO 20WSW OED TO 70NNW FOT TO 140WNW FOT TO 140W
TOU TO HUH

MOD ICE BTN 050 AND 150. CONDS CONTG BYD 21Z THRU 03Z.

.

FRZLVL...RANGING FROM 045-175 ACRS AREA

080 ALG 140SW FOT-90S LKV-70SSW BKE-30E BKE

120 ALG 120WSW PYE-70SSE FMG

160 ALG 140SW SNS-70WSW BTY-20W BTY

....

10.0 Area Forecast

The Area Forecast issued at 1245 PDT, valid at the accident time (and departure time), forecast a broken ceiling at 3,500 ft to 5,000 ft msl with broken skies at 8,000 to 10,000 ft msl and cloud tops at FL180. Isolated light rain showers were also forecast:

272

FAUS46 KPCI 091945

FA6W

-SFOC FA 091945

SYNOPSIS AND VFR CLDS/WX

SYNOPSIS VALID UNTIL 101400

CLDS/WX VALID UNTIL 100800...OTLK VALID 100800-101400

WA OR CA AND CSTL WTRS

.
SEE AIRMET SIERRA FOR IFR CONDS AND MTN OBSCN.

TS IMPLY SEV OR GTR TURB SEV ICE LLWS AND IFR CONDS.

NON MSL HGTS DENOTED BY AGL OR CIG.

.
SYNOPSIS...LARGE UPR LVL TROF OVR PAC NW AND ERN PAC. AN UPR LVL LOW PRES SYS WAS OVR ERN PAC JUST W OF BC/WA CSTL WTRS. UPR LVL LOW IS EXPCD TO SLIDE SLOLY SEWD DURG PD. BY 14Z...UPR LVL LOW PRES SYS WILL BE OVR OR CSTL WTRS.

.
WA CASCDS WWD

CSTL SXNS

CSTLN-INLAND...SCT025 BKN035-050 TOPS 120-140. WDLY SCT

-SHRA BECMG ISOL 05Z-08Z. OTLK...MVFR CIGS.

PUGET SOUND-INTR VLY...SCT025 BKN035-050 TOPS 120-140. WDLY SCT

-SHRA BECMG ISOL 05Z-08Z. OTLK...MVFR CIGS.

CASCDS...BKN060-080 TOPS 160. WDLY SCT -SHRA. OTLK...MVFR CIGS

SHRA.

.
WA E OF CASCDS

CNTRL WA...SCT060 BKN100 TOPS 160. ISOL -SHRA. BECMG 0205

SCT120-140. OTLK...VFR.

ERN WA...BKN100 BKN140 TOPS FL200. BECMG 2302 FEW080 SCT100

SCT140. OTLK...VFR.

.
OR CASCDS WWD

CSTL SXNS

CSTLN-INLAND...SCT015-025 BKN035-050 TOPS 120-140. WDLY SCT

-SHRA BECMG ISOL 05Z-08Z. OTLK...MVFR CIGS.

WILLAMETTE VLY-SWRN INTR...SCT-BKN025 BKN035-050 TOPS 120-140.

WDLY SCT -SHRA. OTLK...MVFR CIGS SHRA.

CASCDS...BKN060-080 TOPS 160. WDLY SCT -SHRA. OTLK...MVFR CIGS

SHRA.

.
OR E OF CASCDS

NRN PTNS...BKN060-080 BKN120-140 TOPS FL220. WDLY SCT -TSRA

CB TOPS FL340 BECMG ISOL 05Z-08Z. OTLK...VFR.

SRN PTNS...SCT-BKN080-100 TOPS 150-160. ISOL -TSRA/-SHRA

DVLPG CB TOPS FL300. OTLK...VFR.

.
NRN CA...STS-SAC-TVL LN NWD

CSTL SXNS...
 FOT NWD...SCT015-025 BKN035-050 TOPS 120-140. WDLY SCT
 -SHRA BECMG ISOL 05Z-08Z. OTLK...MVFR CIGS.
 S OF FOT...SCT-BKN035-050 TOPS 060-080. OTLK...VFR BECMG 0811
 MVFR CIGS BR.
 SAC VLY...SCT-BKN035-050 TOPS 060-080. OTLK...VFR.
 SHASTA-SISKIYOU-S-NERN CA-NRN SIERRAS...BKN-SCT100 TOPS FL180.
 ISOL -SHRA. OTLK...VFR.
 .
 CNTRL CA
 CSTL SXNS...
 CSTLN-INLAND...BKN015 TOPS 030-050. OTLK...MVFR CIGS.
SAN JOAQUIN VLY...
NRN PTNS...BKN035-050 BKN080-100 TOPS FL180. ISOL -SHRA.
OTLK...VFR.
 SRN PTNS...SCT080-100. OTLK...VFR.
 SRN SIERRAS
 NRN PTNS...BKN080-100 TOPS FL180. OTLK...VFR.
 SRN PTNS...FEW150 SCT CL. WIND W G25KT. OTLK...VFR.
 .
 SRN CA..VBG-NID-60NNW BIH LN SWD
 CSTL SXNS...
 CSTLN...SKC OCNL SCT015-025. BECMG 0205 BKN-OVC015 TOPS 030.
 OTLK...MVFR CIGS.
 INLAND...SKC. OTLK...MVFR CIGS.
 INTR MTNS AND DESERTS...SKC. WIND SW 25G35KT. OTLK...VFR WIND.
 .
 CSTL WTRS
 WA/OR/NRN CA...SCT015-025 BKN035-050 TOPS 120-140. WDLY SCT
 -SHRA BECMG ISOL 05Z-08Z. OTLK...MVFR CIGS.
 CNTRL AND SRN CA...BKN015 TOPS 030-050. OTLK...MVFR CIGS.

11.0 Terminal Aerodrome Forecast

There were no Terminal Aerodrome Forecast (TAF) sites located within 40 miles of the accident site. The closest TAF site to the departure location was Stockton Metropolitan Airport (KSCK) located 21 miles north of the departure airport. The TAF valid at the time of the accident was issued at 1124 PDT and was valid for a 24-hour period beginning at 1100 PDT. The TAF for KSCK was as follows:

KSCK 091824Z 0918/1018 30008KT P6SM VCSH BKN035
FM092100 29011G19KT P6SM OVC050
 FM100400 28010KT P6SM FEW250=

The forecast expected a wind from 290° at 11 knots with gusts to 19 knots, greater than 6 statute miles visibility, and an overcast ceiling at 5,000 ft agl.

12.0 NWS Area Forecast Discussion

The NWS Office in Sacramento, California, issued the following Area Forecast Discussion (AFD) at 0356 PDT (closest AFD to the accident time). The aviation section of the AFD discussed that MVFR ceiling conditions were expected to clear over much of the area by the afternoon. Lower ceiling conditions were expected to persist in the mountainous terrain with scattered showers:

351
FXUS66 KSTO 091056
AFDSTO

Area Forecast Discussion
National Weather Service Sacramento CA
356 AM PDT Fri Jun 9 2017

.Synopsis...

A few showers mainly over the mountains today and Saturday. Cooler system this Sunday may bring showers, thunderstorms, and light mountain snow most areas. Dry and warmer next week.

&&

.Discussion...

Southwest flow aloft over Norcal this morning as a late season upper low drops into the eastern Pacific. Orographics may be able to squeeze out a few light showers over the northern mountains and Sierra Cascade range but elsewhere should remain dry today. Max temperatures will warm a bit over Thursday but still come in about 10 degrees below normal. Upper low center continues moving southeast tonight and forecasted to be off the southern Oregon coast by Saturday. Lift and instability nearest the low center will bring a chance of showers over the northwest half of the forecast area. Models now in good agreement in moving the low center across the northeast corner of the state on Sunday. Cold air aloft will bring instability to the entire CWA with enough mid and upper level CAPE indicated by GFS to keep thunderstorm chances over most of the forecast area in the afternoon and evening hours. Cold air associated with the low will bring down daytime temperatures still further. Daytime highs could be as low as 20 degrees below normal. Cold airmass will bring down snow levels to below pass levels over the Sierra. An inch or two of snow will be possible with some minor travel impacts likely. Upper low finally shifts into the Great Basin on Monday with upper northerly flow and more stable conditions bringing an end to precipitation threat across the forecast area. Upper ridging will bring the beginning of a warming trend that will last through the extended period.

&&

.EXTENDED DISCUSSION (Tuesday THROUGH Friday)

Warming and drying trend expected during the EFP as the upper low moves into the Nrn Plains and Srn Canada during the period. The flow

aloft transitions to Wly as 5H heights rise over the area. This will allow warmer air to advect into the area and temps will be trending upward through the period. Slightly below normal max temps on Tue rise to near normal on Wed and then rapidly warm well above normal Thu/Fri, especially on Fri with readings some 9 to 14 degrees above normal, and reaching triple digits in the Valley.

09/00z GFS a little cooler than the ECMWF on Thu and have blended the two while leaning towards the warmer ECMWF due to the strength of the ridge. By Fri, there is better model agreement and confidence is higher that triple digit heat will return to the Valley. 850 mbs temps forecast in the low to mid 20s degrees C support max temps in the 90s to low 100s and 70s and 80s in the mountains for the latter half of the EFP. Lowering humidities and drying katabatic winds will accompany the warming trend. JHM

&&

&&

.AVIATION...

Areas MVFR cigs in the Nrn Sac Vly will gradually lift with general clearing/eroding of lower level clouds over much of the Valley this afternoon. Areas IFR/LIFR cigs will continue over Sierra with scattered showers through 06z Sat.

&&

&&

.STO WATCHES/WARNINGS/ADVISORIES...

None.

&&

\$\$

13.0 Winds and Temperature Aloft Forecast

The NWS 1302 PDT Winds and Temperature Aloft forecast valid for the accident flight are included below:

```
819
FBUS31 KWNO 092002
FD1US1
- DATA BASED ON 091800Z
VALID 100000Z FOR USE 2000-0300Z. TEMPS NEG ABV 24000

FT 3000 6000 9000 12000 18000 24000 30000 34000 39000

SAC 2314 2311+08 2417+03 2527-01 2664-06 2676-18 267835 267846 278258
```

The closest forecast point was Sacramento, California, (SAC). The 1302 PDT SAC forecast indicated a wind at 3,000 ft from 230° at 14 knots, a wind at 6,000 ft from 230° at 11 knots with a temperature of 8° C, and a wind at 9,000 ft from 240° at 17 knots with a temperature of 3° C.

14.0 Pilot Weather Briefing and Information

A search of official weather briefing sources, such as Leidos and Direct User Access Terminal Service (DUATS), revealed that the accident pilot did contact Leidos on two occasions during the accident day and received three text weather briefing packages.

The accident pilot first contacted Leidos at 0457 PDT (attachment 5) and received an outlook text weather briefing (attachment 2). In the text weather briefing, the accident pilot received all the standard weather information including AIRMETs, Area Forecast, METAR, TAF, and Winds Aloft information. During the contact with Leidos at 0457 PDT, the weather briefer provided the current AIRMET information, the current KSCCK TAF, and Winds Aloft at 6,000 ft. The accident pilot only requested the current KSCCK TAF and Winds Aloft at 6,000 ft during the 0457 PDT abbreviated briefing (attachment 5).

The accident pilot contacted Leidos a second time at 1304 PDT (attachment 6) and received two standard text weather briefings (attachments 3 and 4). In the text weather briefings from 1305 and 1309 PDT, the accident pilot received all the standard weather information including AIRMETs Tango and Sierra valid for the accident flight (section 9.0), Area Forecast (section 10.0), METAR, and Winds Aloft information. During the contact with Leidos at 1304 PDT, the weather briefer provided AIRMET Tango and Sierra, the current KO22 METAR, Winds Aloft at 6,000 ft, and that “VFR flight is not recommended.” The accident pilot requested the current KO22 METAR, KSCCK TAF, and Winds Aloft at 6,000 ft during the 1304 PDT abbreviated briefing (attachment 6). For more information please see attachments 2 through 6. It is unknown if the accident pilot checked or received additional weather information before or during the accident flight

15.0 Astronomical Data

The astronomical data obtained from the United States Naval Observatory for the accident site on June 9, 2017, indicated the following:

SUN	
Begin civil twilight	0507 PDT
Sunrise	0538 PDT
Sun transit	1301 PDT
Sunset	2024 PDT
End civil twilight	2056 PDT

E. LIST OF ATTACHMENTS

Attachment 1 – GOES-15 visible satellite animation from 1330 to 1530 PDT

Attachment 2 – Leidos outlook weather briefing from 0458 PDT

Attachment 3 – Leidos standard weather briefing from 1305 PDT

Attachment 4 – Leidos standard weather briefing from 1309 PDT

Attachment 5 – Leidos weather briefing from 0457 PDT

Attachment 6 – Leidos weather briefing from 13047 PDT

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