



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

August 19, 2019

Weather Study

METEOROLOGY

WPR19FA146

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A. ACCIDENT

Location: Santa Ynez, California
Date: May 15, 2019
Time: about 1339 Pacific daylight time
2039 Universal Coordinated Time (UTC)
Airplane: Aviat A1-B Husky; Registration: N236AM

B. METEOROLOGIST

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C. SUMMARY

On May 15, 2019, about 1339 Pacific daylight time, an Aviat Aircraft Inc., A1-B airplane, N236AM, was destroyed when it impacted mountainous terrain about 8 miles northeast of the Santa Ynez Airport (IZA), Santa Ynez, California. The private pilot was fatally injured. The airplane was owned and operated by the pilot under the provisions of Title 14 *Code of Federal Regulations* Part 91 as a personal flight. Visual meteorological conditions prevailed, and no flight plan was filed for the cross-county flight, which originated at 1322 from a private ranch near Montecito, 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 daylight time (PDT) based upon the 24-hour clock, local time is -7 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 was located at latitude 34.691111° N and longitude 119.953333° W, at an elevation of approximately 2,700 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 change 1.

1.1 Surface Analysis Chart

The NWS Surface Analysis Chart issued for 1400 PDT over California is included as figure 1 with the approximate accident site marked by a red star. The chart depicted a low-pressure system at 998-hectopascals (hPa)¹ with an associated cold front trailing southward off the California coast, moving eastward. A thermal low-pressure system² at 1001-hPa was located over the Nevada and California border to the northeast of the accident site with a trough of low pressure extending southeast and then southward over southern California. The accident site was located between these two low pressure areas in an area where the isobars depicted a ridge of high pressure extending northward through the interior of central and northern California.

¹ Hectopascals (hPa) is the new standard 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 15° Celsius (C).

² A thermal low or heat low, are a non-frontal low-pressure areas that occur over the continents in the subtropics during the warm season, as a result of intense heating when compared to their surrounding environments. Thermal low's are common in California's Great Central Valley and over the Mexican plateau.



Figure 1 - NWS Surface Analysis Chart for 1400 PDT

The station models surrounding the accident site on the surface analysis chart depicted broken to overcast sky cover along the coast with clear skies over the Sacramento Valley. The general wind direction was from the south at 5 to 10 knots over the area, with some variations noted inland near higher terrain. Light continuous rain was indicated extending over Oregon and northern California, with another station in southeastern California also reporting rain.

1.2 National Composite Radar Mosaic

The National Composite Radar Mosaic for 1340 PDT was obtained and is included as figure 2 with the approximate accident site marked by a red star. Several small areas of very light intensity echoes associated with light rain or drizzle were identified to the west of the planned destination airport with no significant echoes in the vicinity of the accident site.

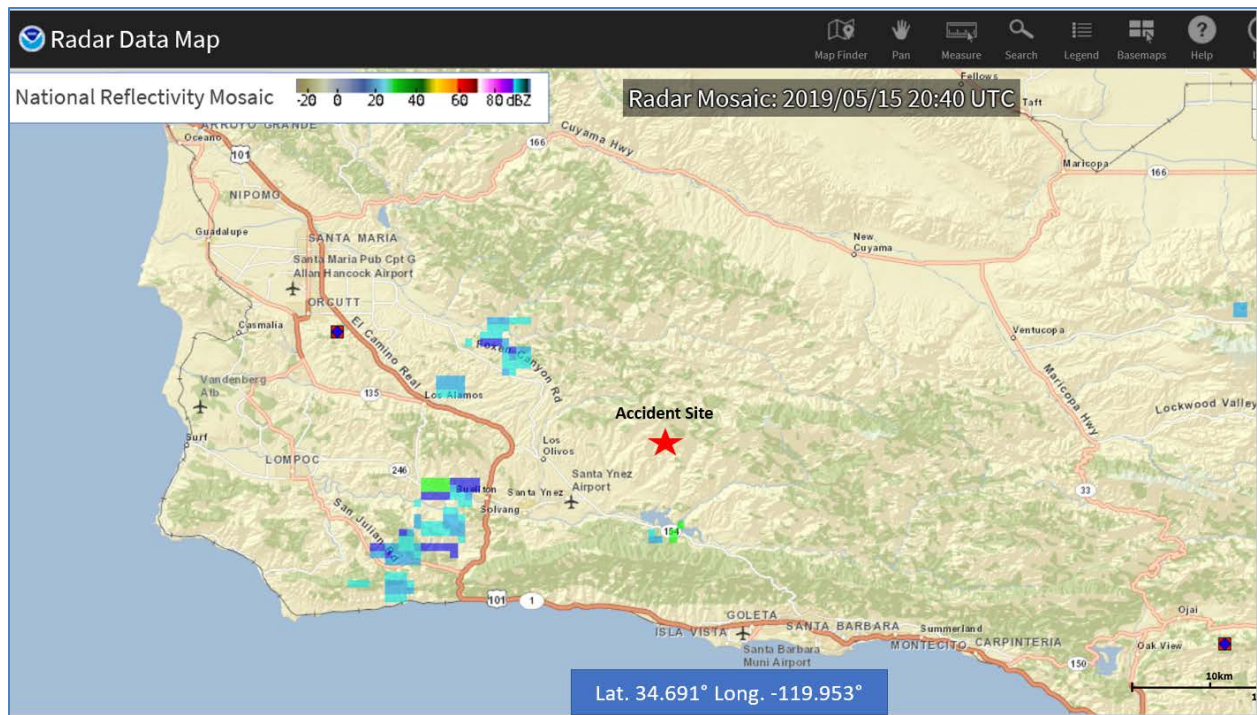


Figure 2 - NWS National Composite Radar Mosaic for 1340 PDT over the region

1.3 12-hour Surface Prognostic Chart

The 12-hour Surface Prognostic Chart that was valid at the time of the accident is included as figure 3 and depicted expected conditions for 2300 PDT. The chart depicted the low-pressure system off the California coast occluding with the front reaching the northern California coast with the cold front impacting the entire California coastal sections with a large area of likely rain over 60% in coverage over coastal sections and into central and northern California. Mixed freezing precipitation was noted over the Sierra Nevada Mountains along the California and Nevada border with an area of thunderstorms expected over the southern California region in the vicinity of the accident site.

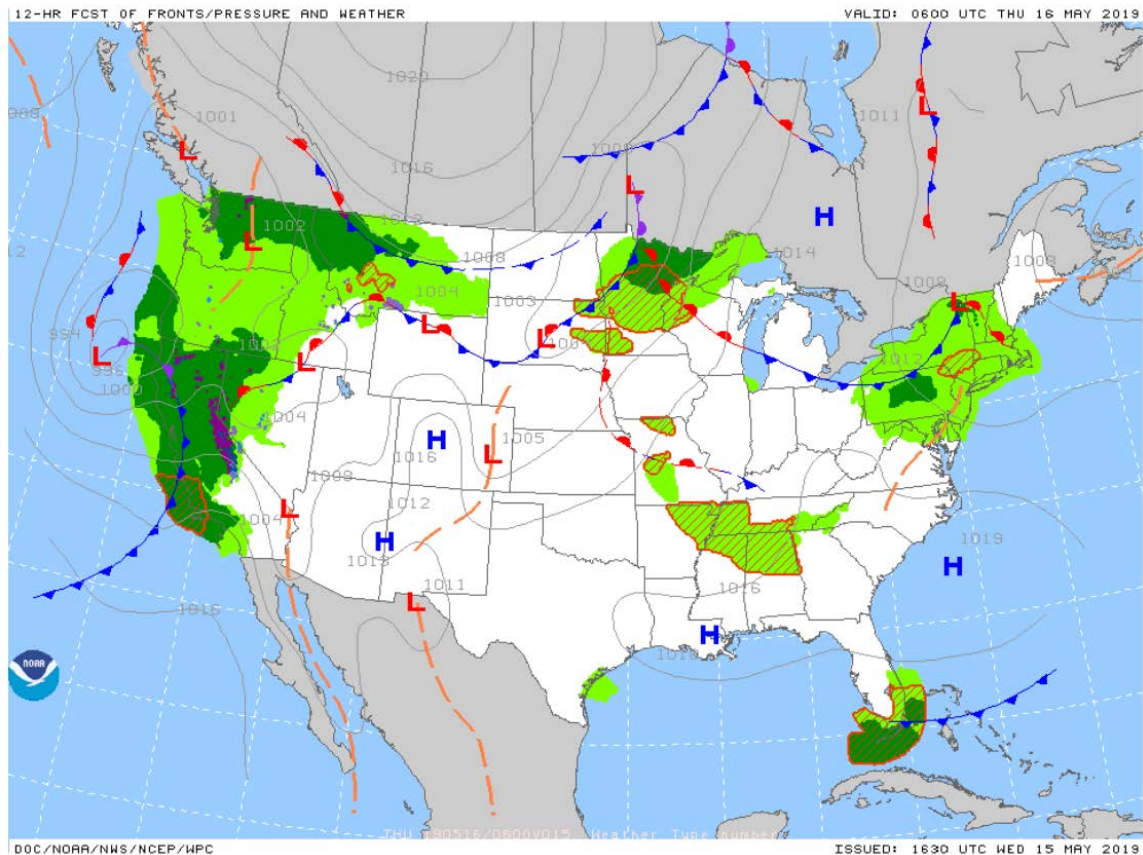


Figure 3 – NWS 12-hour Surface Prognostic Chart valid for 2300 PDT

2.0 Observations

The official observations issued surrounding the accident site were documented using standard meteorological aerodrome reports (METARs) and specials (SPECI). Cloud heights are reported above ground level (agl) in the following section, and the magnetic variation was estimated at 12.5° east based on the latest sectional chart for the area.

2.1 Santa Ynez, CA

The closest weather reporting location to the accident site was from Santa Ynez Airport (KIZA), Santa Ynez, California, located approximately 8 miles southwest of the accident site at an elevation of 674 ft. The airport had an Automated Weather Observation System (AWOS) and issued observations every 20-minutes. The following conditions were reported at the approximate time of the accident.

Weather observation for KIZA at 1335 PDT, automated, wind from 230° at 6 knots, visibility 10 miles or more, scattered clouds at 2,500 ft agl, temperature 20° Celsius (C), dew point temperature 12° C, altimeter 29.92 inches of mercury (Hg). Remarks: automated station with a precipitation discriminator.

The general flight categories³ and raw observations from approximately 0815 through 1600 PDT were as follows:

IFR METAR KIZA 151515Z AUTO 00000KT 10SM OVC005 12/11 A2997 RMK AO2=
IFR METAR KIZA 151535Z AUTO 00000KT 10SM BKN007 OVC013 12/11 A2997 RMK AO2=
IFR METAR KIZA 151555Z AUTO 00000KT 10SM OVC007 13/11 A2997 RMK AO2=
IFR METAR KIZA 151615Z AUTO 00000KT 10SM OVC009 13/11 A2997 RMK AO2=
IFR METAR KIZA 151635Z AUTO 00000KT 7SM OVC009 14/11 A2997 RMK AO2=
MVFR METAR KIZA 151655Z AUTO 00000KT 10SM OVC011 14/11 A2997 RMK AO2=
MVFR METAR KIZA 151715Z AUTO 25003KT 10SM OVC014 15/11 A2996 RMK AO2=
MVFR METAR KIZA 151735Z AUTO 28004KT 10SM OVC014 15/11 A2996 RMK AO2=
MVFR METAR KIZA 151755Z AUTO 26006KT 10SM OVC014 16/11 A2996 RMK AO2=
MVFR METAR KIZA 151815Z AUTO 26005KT 10SM OVC014 17/11 A2996 RMK AO2=
MVFR METAR KIZA 151835Z AUTO 29003KT 10SM OVC014 16/12 A2997 RMK AO2=
MVFR METAR KIZA 151855Z AUTO 26005KT 10SM OVC014 17/12 A2997 RMK AO2=
MVFR METAR KIZA 151915Z AUTO 00000KT 10SM OVC016 18/12 A2996 RMK AO2=
VFR METAR KIZA 151935Z AUTO 23010KT 10SM SCT016 SCT024 SCT030 20/12 A2995 RMK AO2=
VFR METAR KIZA 151955Z AUTO 25006KT 10SM SCT025 20/12 A2993 RMK AO2=
VFR METAR KIZA 152015Z AUTO 24007KT 10SM SCT025 19/12 A2992 RMK AO2=
VFR **METAR KIZA 152035Z AUTO 23006KT 10SM SCT025 20/12 A2992 RMK AO2=**
Accident 2039Z
VFR METAR KIZA 152055Z AUTO 19007KT 10SM CLR 20/12 A2990 RMK AO2=
VFR METAR KIZA 152115Z AUTO 21006KT 10SM SCT120 20/12 A2990 RMK AO2=
MVFR METAR KIZA 152135Z AUTO 17017G23KT 4SM HZ SCT035 SCT042 BKN120 20/11 A2990 RMK AO2=
VFR METAR KIZA 152155Z AUTO 18016G20KT 10SM SCT040 BKN120 18/11 A2991 RMK AO2=
VFR METAR KIZA 152215Z AUTO 18007G16KT 124V214 10SM SCT016 SCT023 BKN120 16/11 A2992 RMK
AO2=
MVFR METAR KIZA 152235Z AUTO 10004KT 10SM OVC018 16/11 A2992 RMK AO2=

A review of the observations indicated that IFR conditions due to low ceilings prevailed prior to 1000 PDT with the ceiling lifting to MVFR conditions being reported through 1235 PDT and gradual clearing thereafter. At the time of the accident VFR conditions were reported with a scattered cloud layer at 2,500 ft agl.

2.2 Santa Barbara, CA

The next closest weather reporting location to the accident site was from Santa Barbara Municipal Airport (KSBA), Santa Barbara, California, located approximately 19 miles south of the accident site at an elevation of 13 ft. The airport was also approximately 10 miles west of the departure ranch. The airport had an Automated Surface Observation System (ASOS) and was

³ 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.

augmented by air traffic control personnel. The following conditions were reported at the approximate time of the accident.

Weather observation for KSBA at 1253 PDT, wind calm, visibility 6 miles in haze, scattered clouds at 900 ft agl, ceiling overcast at 1,600 ft, temperature 17° C, dew point temperature 12° C, altimeter 29.96 inches of Hg. Remarks: automated station with a precipitation discriminator, sea level pressure 1014.5-hPa, temperature 17.2° C, dew point 12.2° C.

The general flight categories and raw observations surrounding the period from approximately 0853 through 1600 PDT were as follows:

IFR METAR KSBA 151553Z 05004KT 3SM BR BKN005 OVC011 15/13 A2996 RMK AO2 SLP146 T01500133=
IFR METAR KSBA 151653Z 13003KT 7SM BKN008 OVC016 16/14 A2996 RMK AO2 CIG 006V010 SLP146 T01560139=
MVFR METAR KSBA 151753Z 14005KT 10SM SCT009 OVC016 16/13 A2997 RMK AO2 SLP147 T01610133 10161 20139 51008=
MVFR METAR KSBA 151853Z 00000KT 6SM HZ SCT009 OVC016 16/13 A2998 RMK AO2 SLP151 T01610133
MVFR METAR KSBA 151953Z 00000KT 6SM HZ SCT009 OVC016 17/12 A2996 RMK AO2 SLP145 T01720122
Accident 2039Z
MVFR METAR KSBA 152053Z 16004KT 10SM OVC025 18/12 A2994 RMK AO2 SLP140 T01780122 58007=
MVFR METAR KSBA 152153Z 17004KT 10SM SCT010 OVC027 18/12 A2993 RMK AO2 SLP135 T01780122=
MVFR SPECI KSBA 152230Z 16003KT 10SM SCT010 OVC030 18/12 A2993 RMK AO2 T01780117=
MVFR METAR KSBA 152253Z 25003KT 10SM SCT010 OVC030 17/12 A2992 RMK AO2 SLP130 T01720117=

The observations from KSBA indicated IFR conditions due to low ceilings during the morning hours with visibility restricted in mist until 1200 PDT with MVFR conditions prevailing at the time of the accident. The observations indicated terrain above 1,600 ft may be obscured by the low overcast clouds at the time of the accident.

3.0 Sounding

To determine the vertical structure and state of the atmosphere over the accident site a High-Resolution Rapid Refresh (HRRR)⁴ numerical model data was retrieved from the NOAA Air Resources Laboratory and plotted on a standard Skew T log P diagram⁵ using the complete Rawinsonde Observation RAOB program software⁶.

⁴ 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.

⁵ 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.

⁶ RAOB software – The complete RAwinsonde OBservation program is an interactive sounding analysis program developed by Environmental Research Services, Matamoras, Pennsylvania, for plotting and analyzing upper air data

Figure 4 is the 1300 PDT HRRR sounding based on the initial 1100 PDT data forecast for 1300 PDT from the surface to approximately 21,000 ft. The sounding depicted an elevation of 2,487 ft with a surface temperature of 13.7° C (57° F), a dew point temperature of 12.7° C (55° F), with a relative humidity of 94%. The lifted condensation level (LCL) and level of free convection (LFC) were identified at 417 ft agl (2,904 ft msl) and represented the base layer of the clouds, with the convective condensation level (CCL) at 10,196 ft msl. The sounding supported a broken cloud layer from the LCL through approximately 3,800 ft msl and in another layer between 14,000 and 17,000 ft, based on the relative humidity greater than 85%. The freezing level was identified at approximately 12,000 ft, and supported icing-in-clouds above that level. The precipitable water content was 0.68 inches. The sounding was characterized as stable and supported stratiform clouds.

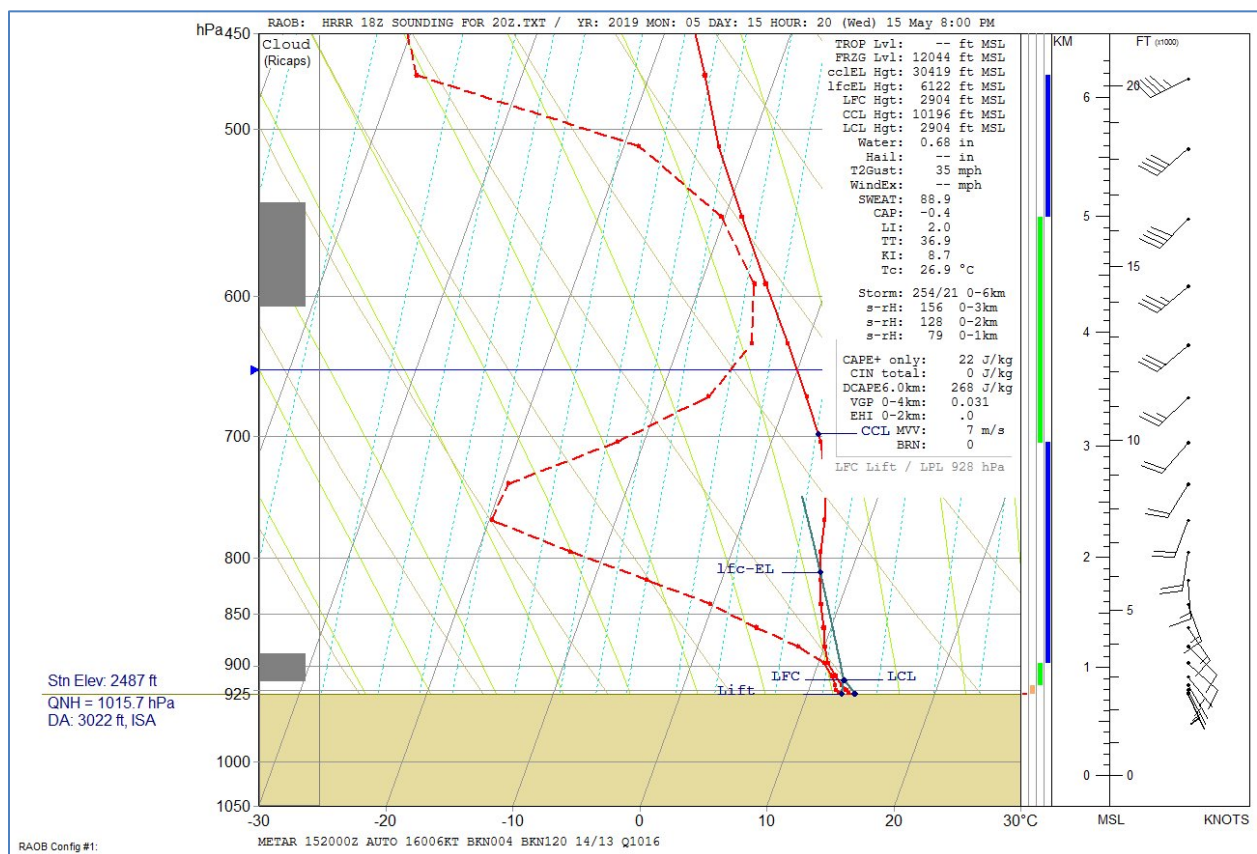


Figure 4 - HRRR 1300 PDT sounding over the approximate accident site

The HRRR wind profile on the right side of the diagram indicated a surface wind from about 160° at 6 knots with wind veering to the southwest with height with increasing wind speeds with height. The mean 0 to 6 kilometer or 18,000 ft⁷ was from 220° at 28 knots. The HRRR sounding wind profile did not indicate any significant strong vertical wind shears below 18,000 ft that would have indicated anything other than light turbulence.

⁷ Wind directions have been rounded to the nearest 10° true direction.

Figure 5 is a table of the HRRR model data of height, pressure (Pres), temperature (T), dew point temperature (Td), relative humidity (RH%), wind direction and speed, and RAOB algorithm derived clear air turbulence (CAT), low-level wind shear (LLWS), and icing potential.

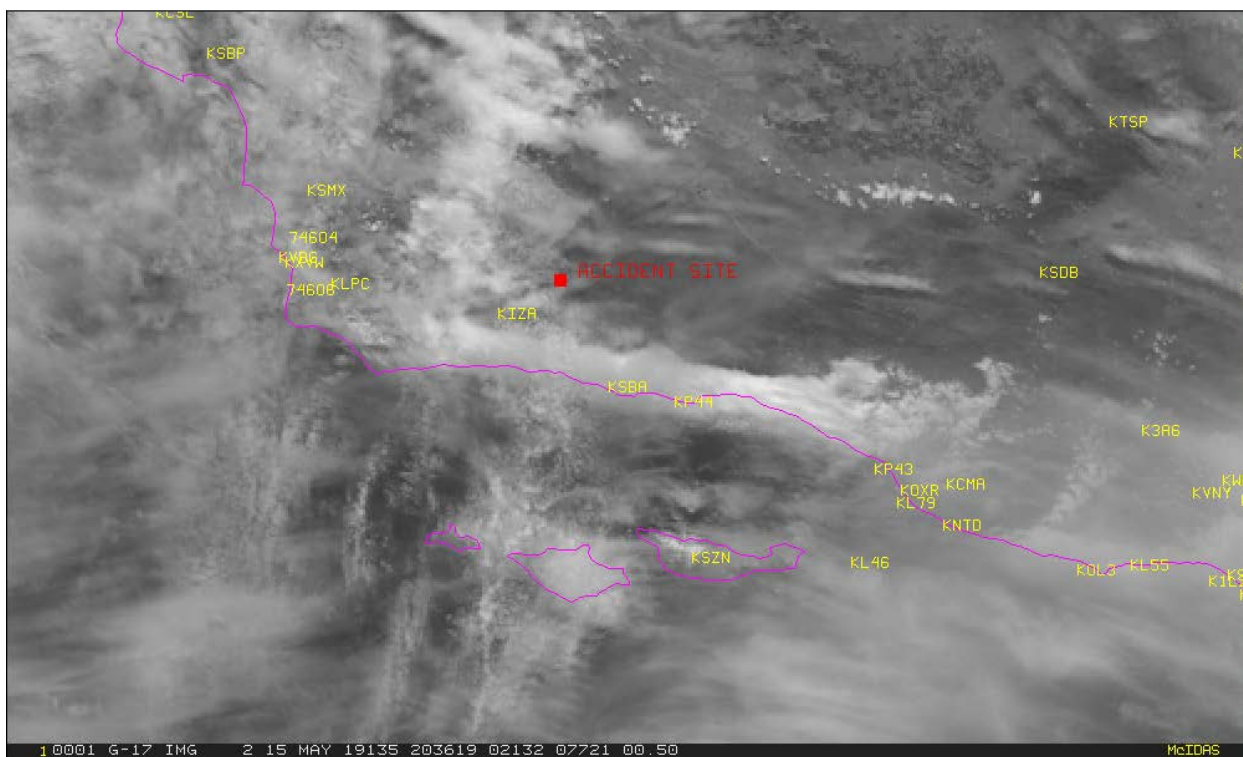
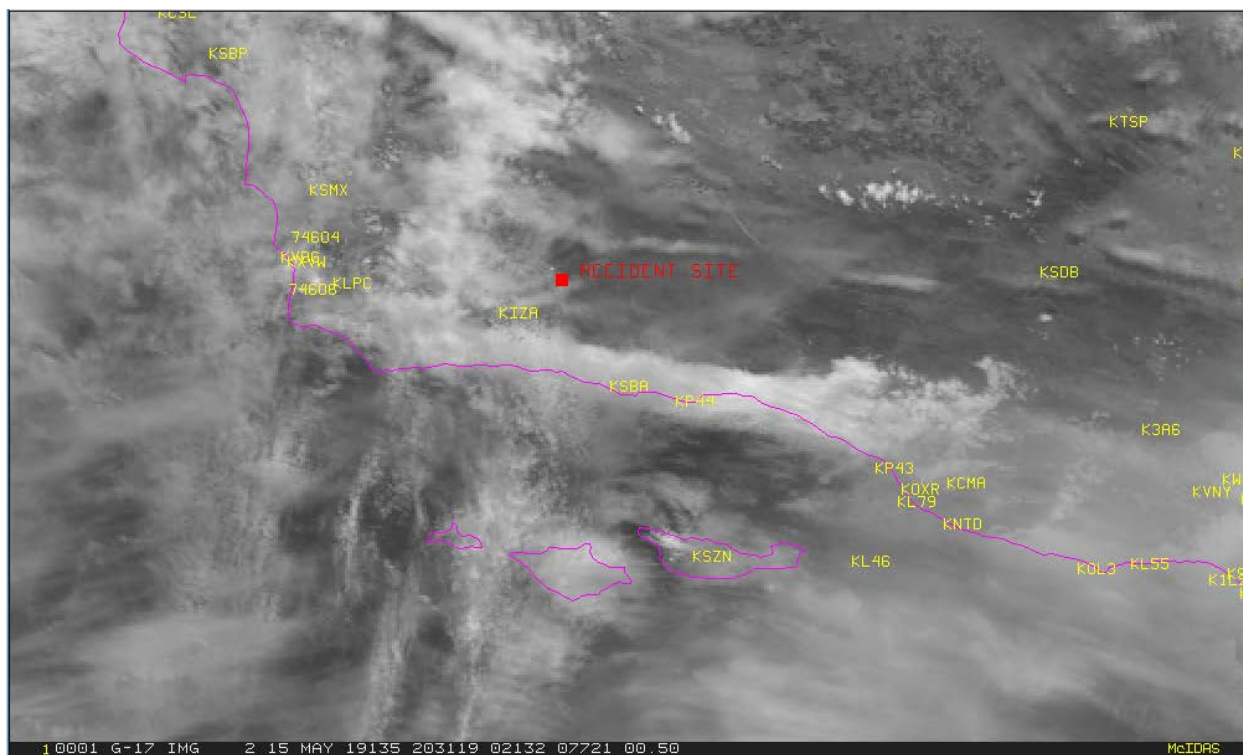
Height (ft-MSL)	Pres (hPa)	T (C)	Td (C)	RH (%)	DD / FF (deg / kts)	CAT (FAA)	LLWS	Icing - Type (AFGWC method)
2487	928	13.7	12.7	94	158 / 6			
2517	927	13.2	12.4	95	158 / 5		LIGHT	
2607	924	12.9	12.1	95	155 / 6			
2757	919	12.4	11.9	97	152 / 6			
3028	910	11.7	11.4	98	144 / 6			
3423	897	10.7	10.4	98	135 / 8			
3916	881	10.0	7.9	87	138 / 10	LGT		
4479	863	9.4	4.1	69	149 / 13	LGT		
5181	841	8.5	-0.2	54	162 / 14	LGT		
5899	819	7.8	-5.9	37	177 / 16	LGT		
6736	794	7.0	-12.7	23	189 / 18	LGT		
7667	767	6.4	-19.8	13	199 / 19	LGT		
8738	737	5.5	-19.5	15	210 / 20	LGT		

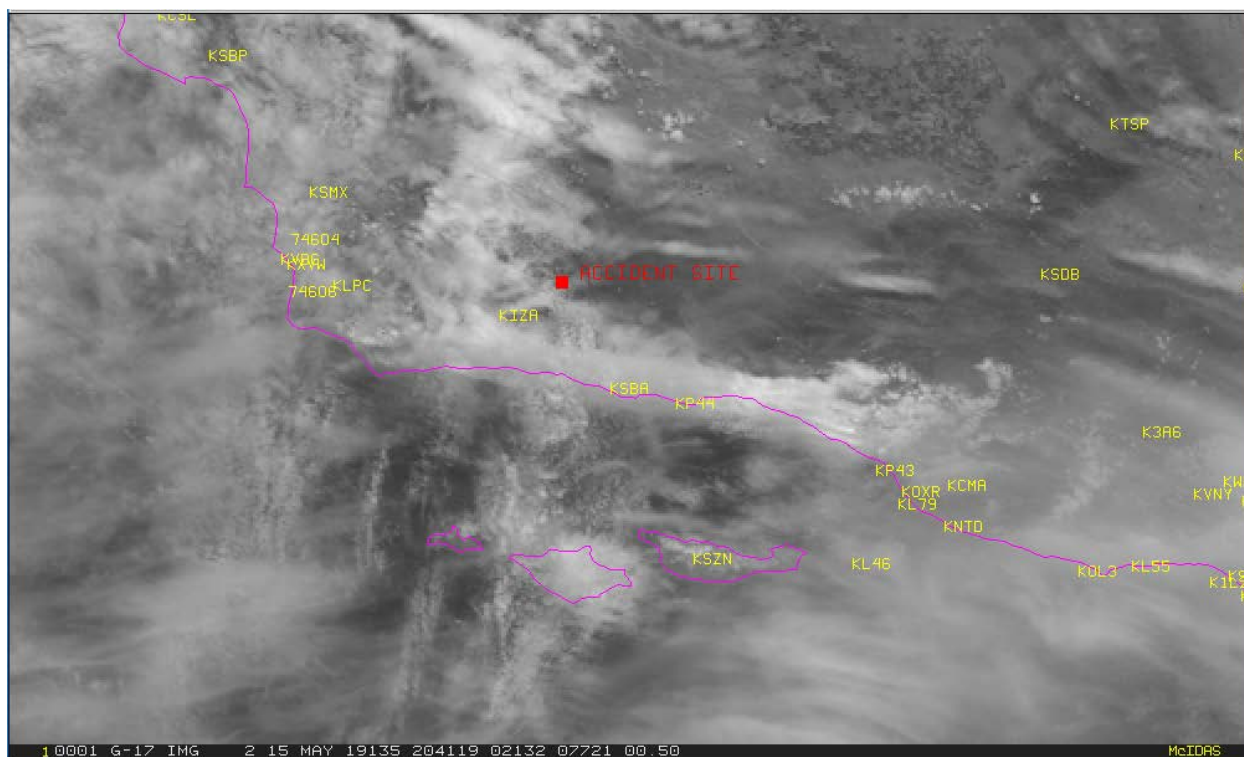
Figure 5 - HRRR model data

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 and visible imagery were obtained surrounding the time of the accident, with the images closest to the time of the accident documented below. 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. The visible (band 2) at a wavelength of 0.64 μm images at a resolution of 0.5 km.

Figures 6 through 8 are the GOES-17 visible imagery at 1331, 1336, and 1341 PDT at 2X magnification with the accident site marked. The images depicted an extensive layer of clouds running east-to-west along the coast obscuring KSBA and the departure ranch area and extends immediately south of KIZA, with broken layer of low stratiform type clouds also obscuring the accident site and the lower terrain to the west of the accident site. The satellite imagery indicated that the terrain was likely obscured by clouds surrounding the period of the accident.





5.0 Pilot Reports

The following pilot reports or PIREPs were recorded over the immediate area during the period from 1000 through 1600 PDT. Cloud heights are reported in msl heights. A plain language decoded report follows the raw observation with time converted to local. The reports were as follows:

SBA UA /OV SBA270002/TM 1625/FL005/TP CRJ7/SK BKN005

Santa Barbara Municipal Airport (SBA) routine pilot report (UA); Over – 2 miles west of SBA; Time – 0925 PDT; Altitude – 500 ft; Type aircraft – Canadair Regional Jet; Sky cover – broken clouds bases at 500 ft.

SDB UA /OV FIM/TM 1636/FL250/TP E75L/TB LGT-MOD CHOP CONT 250-200/RM DURD ZLAWC AWC-WEB

Santa Barbara Municipal Airport (SBA) routine pilot report (UA); Over – Fillmore, CA (FIM) VORTAC⁸; Time – 0936 PDT; Flight Level – 250 (25,000 ft); Type aircraft – Embraer EMB75 regional air carrier jet; Turbulence – light-to-moderate continuous chop between 25,000 and 20,000 ft; Remarks – during descent.

CMA UA/OV CMA/TM 1850/FL016/TP C172/SK BKN016 - TOPS 032

Camarillo Airport (CMA) routine pilot report (UA); Over – CMA VORTAC, Time – 1150 PDT; Altitude – 1,600 ft; Type aircraft – Cessna 172 Sky Hawk single engine airplane; Sky cover – broken clouds bases at 1,600 ft with tops at 3,200 ft.

⁸ A VORTAC is a radio-based navigation aid for pilots that consists of a co-located VHF omnidirectional range (VOR) beacon for azimuth information and a tactical air navigation system (TACON) beacon for distance information.

6.0 NWS Forecasts

The following aviation forecasts were documented for this case.

6.1 Terminal Aerodrome Forecasts

The NWS Los Angeles Weather Forecast Office (WFO), located in Oxnard, California, was responsible for the issuance of the Terminal Aerodrome Forecast (TAF) for KSBA, with no TAFs being issued for KIZA. A TAF is a concise statement of the expected meteorological conditions at an airport during a specified period, usually 24 hours. TAFs are valid for a 5 mile radius around an airport's center point. The forecasts issued surrounding the period relevant to the preflight planning and the time of the accident was as follows. The TAF issued for KSBA was issued at 1022 PDT and was as follows, with cloud heights agl:

***TAF KSBA 151722Z 1518/1618 21008KT P6SM BKN008 OVC015
FM152100 24012KT P6SM SCT025 OVC080
FM160300 16012KT P6SM VCSH BKN025 OVC050
FM160700 12012G20KT 4SM -RA BR BKN015 OVC025
FM161000 13015G25KT 2SM RA BR BKN007 OVC015
FM161300 16010KT 4SM -SHRA BR BKN015 OVC025=***

The forecast valid for the period from 1100 through 1400 PDT expected winds from 210° at 8 knots, visibility 6 miles or more, ceiling broken at 800 ft agl, overcast at 1,500 ft. From 1400 through 2000 PDT the forecast wind was from 240° at 12 knots, visibility 6 miles or more, scattered clouds at 2,500 ft agl, and overcast at 8,000 ft.

The forecast was amended at 1102 PDT removing the IFR conditions during the first part of the forecast with a scattered layer of clouds at 800 ft, and ceiling overcast at 1,500 ft.

***AMD TAF KSBA 151802Z 1518/1618 21008KT P6SM SCT008 OVC015
FM152100 24012KT P6SM SCT025 OVC080
FM160300 16012KT P6SM VCSH BKN025 OVC050
FM160700 12012G20KT 4SM -RA BR BKN015 OVC025
FM161000 13015G25KT 2SM RA BR BKN007 OVC015
FM161300 16010KT 4SM -SHRA BR BKN015 OVC025=***

6.2 Area Forecast Discussion

The NWS Area Forecast Discussions (AFD) are issued by each WFO to describe the short term weather conditions within their region with an aviation section that includes the general conditions as it relates to the creation of the TAF. These are useful for additional aviation related issues that cannot be encoded into the TAF. The discussion also gives some reasoning behind the forecast. These are generated roughly every 6 hours and corresponds to the release of the latest TAFs for that office. The AFD synopsis, short term forecast, and aviation discussion issued during the period was as follows:

*FXUS66 KLOX 151702
AFDLOX*

Area Forecast Discussion

National Weather Service Los Angeles/Oxnard CA
1002 AM PDT Wed May 15 2019

.SYNOPSIS...15/802 AM.

Rain will develop along the Central Coast late this afternoon and will spread across the region by early Thursday. There will be periods of moderate rainfall early Thursday along with a slight chance of thunderstorms. Dry weather returns Friday then there is another chance of showers Saturday night.

.SHORT TERM (TDY-FRI)...15/926 AM.

Everything looks on track for the storm later today into Thursday. Slow, if any, clearing today with a 2000-3000 ft marine layer and onshore trends. A few showers will develop over SLO County during the day today but the lion's share of the precip will fall tonight into Thursday morning. Models still showing a little instability with the front along with the negatively tilted trough so a few thunderstorms are possible. 4-8 hours of light to moderate precip are expected and 1-2 hours on the back end will be moderate to heavy. After FROPA skies will start to clear out and gusty west to northwest winds will develop.

****From previous discussion****

The real action will begin early this evening over the Central Coast as the late season front sweeps over the forecast area. Rain (moderate at times) will move into SLO and western SBA county at first and then move into Southern SBA county and VTA county after midnight and then move into LA county around dawn just in time to ruin the commute. There will be enough dynamics with the front to produce a slight chc of TSTMs over SLO and western SBA counties after midnight.

The front will move through the rest of SBA county and then VTA and LA counties Thursday morning. It will bring periods of rain (ocnl moderate) and a slight chc of TSTMs to these areas during the remainder of the morning hours. A post frontal trof will move through the area in the afternoon and will keep the chc of showers going. Snow levels will be over 7000 feet ahead of the front and down as low as 6000 feet after FROPA.

Rainfall intensities and durations should not quite reach critical levels but the very short term rates (15/30 min) could get close in a few spots near the front. Overall rainfall amounts should be around a half inch for lower elevations and 1-2" for foothills and mountains.

All of the clouds and rain will keep max temps about 10 degrees below normal on Thursday.

Precip expected to taper off pretty quick late in the afternoon but with some lingering showers possible over the mountains in the evening.

A ridge builds in on Friday. It will be dry and warmer (still below normal) with skies partly cloudy at worst. There will be some decent post frontal gusty north to northwest winds as well.

.AVIATION...15/1701Z.

At 1630Z, the marine inversion at KLAX was based at 2900 feet. The top of the inversion was 4000 feet with a temperature of 15 degrees Celsius.

Overall, low to moderate confidence in 18Z TAF package. Combination of deep marine inversion and approaching cold front will generate BKN-OVC skies through the TAF period. Flight categories will vary between VFR and MVFR through this evening with some IFR conditions possible late tonight and Thursday morning. Low confidence in timing of flight category changes and moderate confidence in timing of steady rainfall. There is a slight chance of thunderstorms all sites 06Z-18Z.

KLAX...Low confidence in 18Z TAF. There is a 40% chance of MVFR CIGs not dissipating this afternoon. MVFR/IFR conditions likely with cold frontal passage late tonight/Thursday morning, but low confidence in timing of flight category changes.

KBUR...Low confidence in 18Z TAF. There is a 40% chance of MVFR CIGs not dissipating this afternoon. MVFR/IFR conditions likely with cold frontal passage late tonight/Thursday morning, but low confidence in timing of flight category changes.

6.3 Graphic Forecast for Aviation

The Graphic Forecast for Aviation (GFA) replaced the Area Forecast for providing enroute weather conditions and cloud cover with bases and tops. The GFA static forecast for “Aviation Surface Forecast” issued by the AWC during the period for wind, visibility, and weather phenomena, with the Graphic AIRMET⁹ (G-AIRMET) Sierra for IFR conditions and G-Tango for strong gusty surface winds are included as figure 9 and was issued at about 1200 PDT and valid for 1400 PDT. The GFA forecast expected a wind from the southwest at 15 knots gusting to 20 knots, visibility greater than 5 miles inland, with visibility restricted near the coast in the vicinity of KSBA. The G-AIRMET Sierra for IFR conditions was depicted extending over northern California and did not include the accident site.

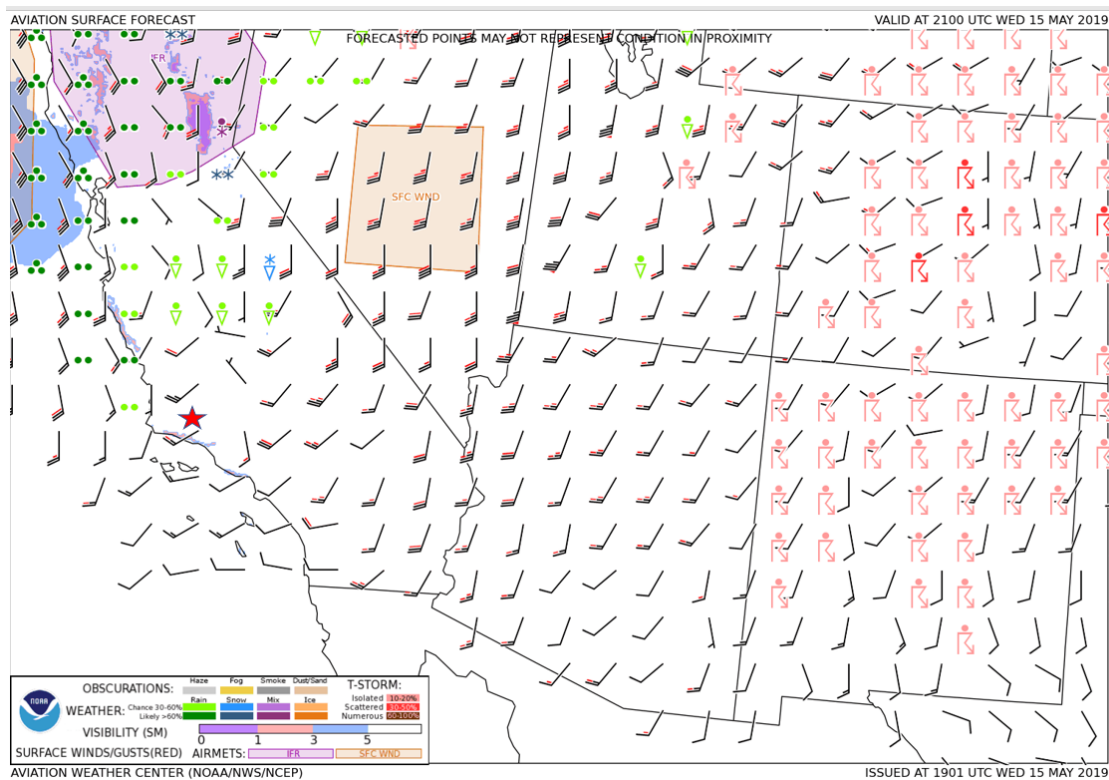


Figure 9 - Graphic Forecast for Aviation Surface Forecast valid for 1400 PDT

⁹ Airmen’s Meteorological Information (AIRMET) is a concise description of weather phenomena that are occurring or may occur (forecast) over an area having a significant impact on the safety of aircraft. AIRMETs are issued for moderate turbulence or icing, sustained surface winds of 30 knots or more, Low-Level Wind Shear (LLWS), widespread restricted visibility below 3 statute miles and/or ceilings less than 1,000 ft agl or IFR conditions and mountain obscuration conditions.

[illegible]

Figure 11 is the updated GFA cloud forecasts issued at 1200 PDT and valid for 1400 PDT. Figure 12 was the forecast valid for 1700 PDT which continued a few to scattered clouds over the accident site.

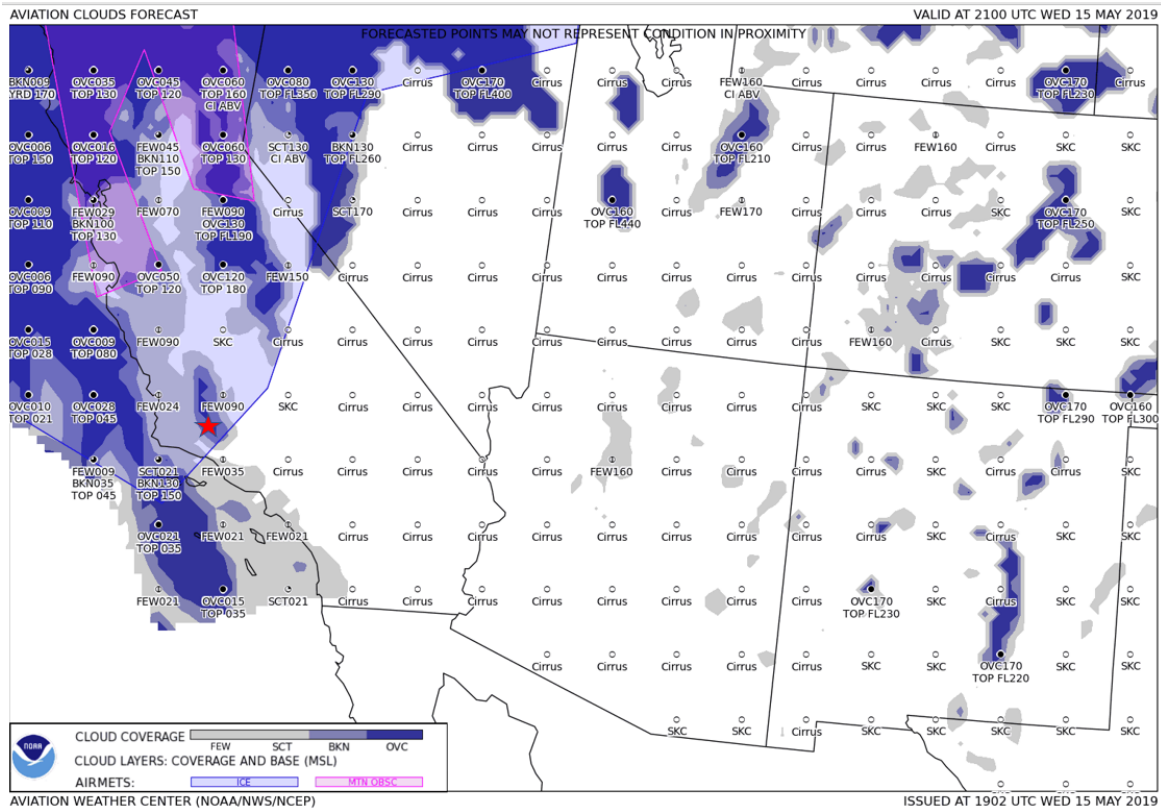


Figure 11 - Graphic Forecast for Aviation Cloud Forecast issued around 1200 PDT and valid for 1400 PDT

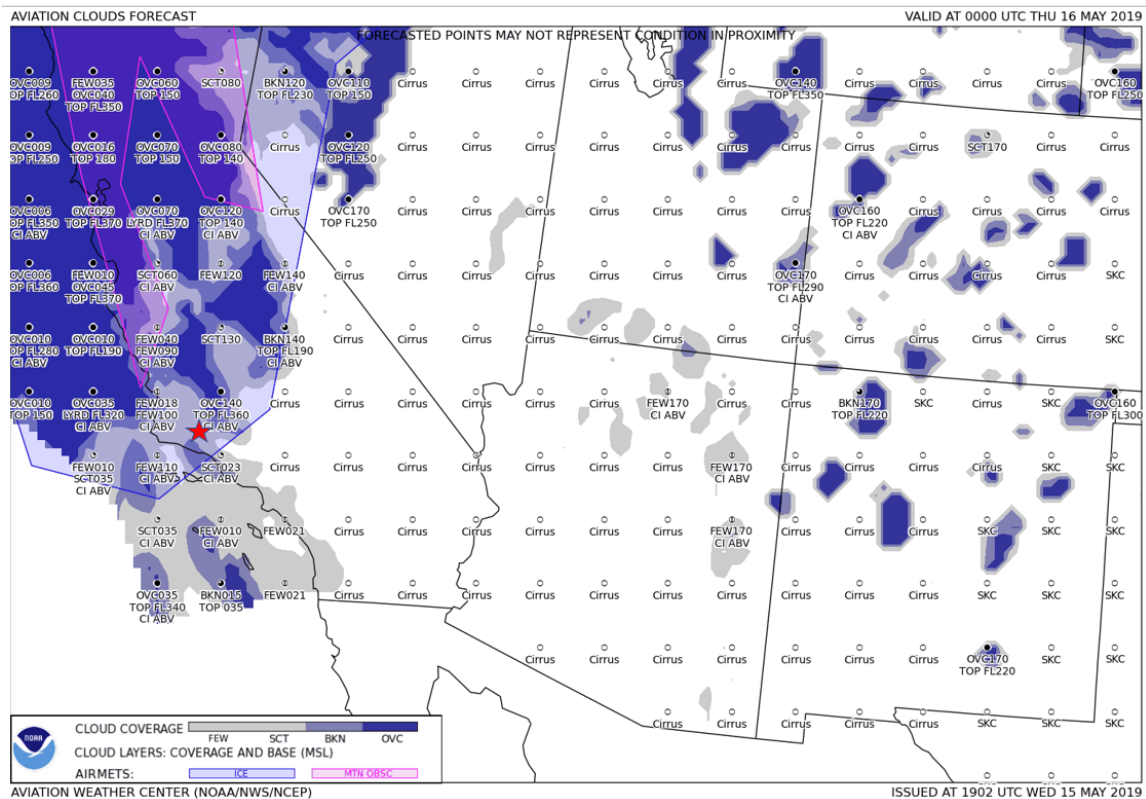


Figure 12 - Graphic Forecast for Aviation Cloud Forecast issued around 1200 PDT and valid for 1700 PDT

6.4 Winds and Temperature Aloft Forecast

The NWS Winds and Temperature Aloft forecast closest to the accident site was for the forecast for KSBA. The forecast valid for 1700 PDT and for use between 1300 and 2000 PDT was as follows:

WINDS ALOFT FORECASTS

DATA BASED ON 151800Z

VALID 160000Z FOR USE 2000-0300Z. TEMPS NEG ABV 24000

FT	3000	6000	9000	12000	18000	24000	30000	34000	39000
SBA	2006	1713+08	2119+05	2229+00	2442-13	2362-24	227041	248250	237757

The forecast wind for 3,000 ft expected the wind from 200° at 6 knots, at 6,000 ft wind from 170° at 13 knots with a temperature of 8° C.

7.0 NWS Inflight Weather Advisories

Inflight Aviation Weather Advisories are forecasts to advise en route aircraft of development of potentially hazardous weather. Inflight aviation weather advisories in the conterminous U.S. are issued by the NWS AWC, as well as from the Center Weather Service Units (CWSU) associated with FAA ARTCCs. There are four basic types of inflight aviation weather advisories: the Significant Meteorological Information (SIGMET), the Convective SIGMET, the AIRMET, and the Center Weather Advisory (CWA). 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 surrounding the time of the accident, the NWS had a full series of AIRMETs current for the forecast area, with the most relevant advisories for mountain obscuration that extended over the accident site. The Graphic-AIRMETs Sierra, Tango, and Zulu valid for 1100 PDT are included below as figures 13 through 15 followed by the text bulletins¹⁰ that cover the period.

¹⁰ The AIRMET text bulletins are typically issued for a 6 hour periods with a 6 hour outlook, while Graphic-AIRMETs usually depict the conditions at 3-hour intervals but are not archived or disseminated to aircraft inflight. The text bulletins are the official bulletins.

SIERRA 2019-05-15 18:00:00

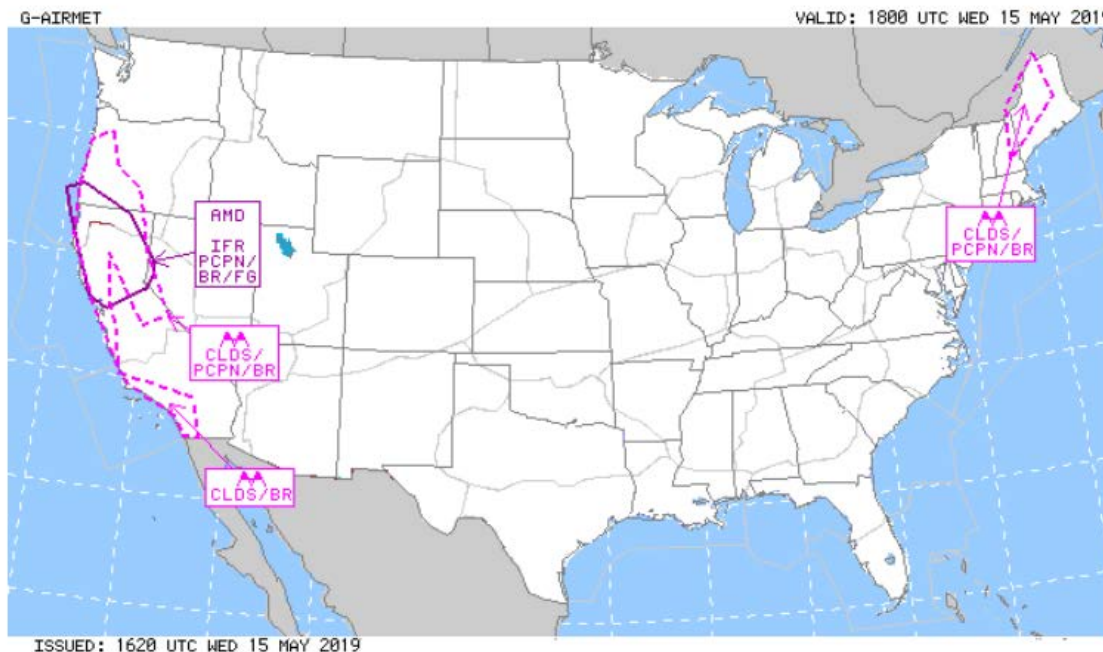


Figure 13 - G-AIRMET Sierra for IFR and mountain obscuration conditions valid for 1100 PDT

WAUS46 KPCI 151620 AAA

-SFOS WA 151620 AMD

AIRMET SIERRA UPDT 4 FOR IFR AND MTN OBSCN VALID UNTIL 152100

AIRMET IFR...CA AND CSTL WTRS

FROM 20NNW RZS TO 30SW HEC TO 20SE MZB TO 220SW MZB TO 150WSW

RZS TO 100W RZS TO 20NNW RZS

CIG BLW 010/VIS BLW 3SM BR/FG. CONDS ENDG 15-18Z.

AIRMET IFR...OR CA AND CSTL WTRS...UPDT

FROM 50NW OED TO 50SW LKV TO 50N FMG TO 50SSE FMG TO 20ESE OAK

TO 20WNW PYE TO 110W OED TO 50NW OED

CIG BLW 010/VIS BLW 3SM PCPN/BR/FG. CONDS CONTG BYD 21Z THRU 03Z.

AIRMET MTN OBSCN...WA OR CA

FROM HUH TO 50ESE SEA TO 80S LKV TO 50WSW OAL TO 20NW CZQ TO

20SE RBL TO 20W SAC TO 30ENE SNS TO 30WSW SNS TO FOT TO HQM TO

TOU TO HUH

MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 21Z THRU 03Z.

AIRMET MTN OBSCN...CA

FROM 30ENE SNS TO 60W EHF TO 40SSW HEC TO 60S TRM TO 20S MZB TO

30SSE LAX TO 40W RZS TO 30SW SNS TO 30ENE SNS

MTNS OBSC BY CLDS/BR. CONDS ENDG 18-21Z.

OTLK VALID 2100-0300Z

AREA 1...IFR OR CA AND CSTL WTRS...UPDT

BOUNDED BY 20WSW OED-40ESE OED-80S LKV-50N FMG-20SSE FMG-20WNW

SNS-60SE SNS-140SSW SNS-130WSW SNS-140WSW FOT-130WNW FOT-110NW

FOT-20WSW OED

CIG BLW 010/VIS BLW 3SM PCPN/BR/FG. CONDS CONTG THRU 03Z.

.

AREA 2...MTN OBSCN CA

BOUNDED BY 60SE EHF-40WSW BZA-20W MZB-20NW LAX-60SE EHF

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

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TANGO 2019-05-15 18:00:00

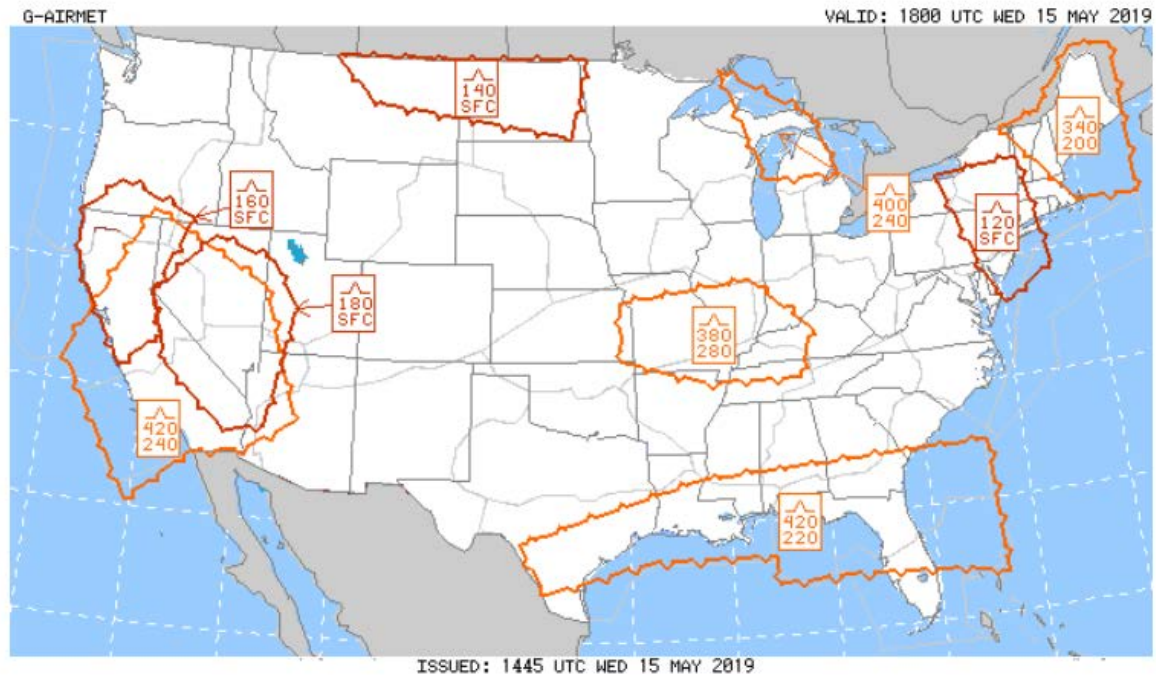


Figure 14 - G-AIRMET Tango for turbulence valid for 1100 PDT

WAUS46 KKCI 151445

WA6T

-SFOT WA 151445

AIRMET TANGO UPDT 2 FOR TURB AND STG SFC WNDZ VALID UNTIL 152100

.

AIRMET TURB...WA OR CA ID NV UT AZ AND CSTL WTRS

FROM 20WNW YKM TO 30SSW PIH TO 20NNW INW TO 80WSW TUS TO BZA TO 20S MZB TO 220SW MZB TO 140WSW FOT TO 100WNW ONP TO 130WSW HQM TO 20WNW YKM

MOD TURB BTN FL180 AND FL420. CONDS CONTG BYD 21Z THRU 03Z.

.

AIRMET TURB...OR CA NV AND CSTL WTRS

FROM 70SSW PDT TO 40WNW BOI TO 30S REO TO 80NNE FMG TO 50SW FMG TO 20NE CZQ TO 50SSE SNS TO 20SW PYE TO 40NW ENI TO 20NNW FOT TO 60WSW OED TO 20ESE EUG TO 70SSW PDT

MOD TURB BLW 160. CONDS CONTG BYD 21Z THRU 03Z.

.

AIRMET TURB...OR CA ID NV UT AZ

FROM 40SSW BOI TO TWF TO 40SSE MTU TO 70NE BZA TO 30ESE MZB TO 30SE EHF TO 20E CZQ TO 50SW FMG TO 20SSE REO TO 40SSW BOI

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

.

AIRMET STG SFC WND...CA AND CSTL WTRS
 FROM 40WNW FOT TO 40WNW ENI TO 50SSW PYE TO 140WSW SNS TO 130WSW
 ENI TO 110W FOT TO 40WNW FOT
 SUSTAINED SURFACE WINDS GTR THAN 30KT EXP. CONDS DVLPG 18-21Z.
 CONDS CONTG BYD 21Z THRU 03Z.

OTLK VALID 2100-0300Z

AREA 1...TURB WA OR CA ID MT WY NV UT CO AZ NM AND CSTL WTRS
 BOUNDED BY YDC-50WSW YXC-30W GTF-60S OCS-30SE DMN-50S TUS-BZA-
 20S MZB-220SW MZB-140WSW FOT-120WNW ONP-140W TOU-YDC
 MOD TURB BTN FL180 AND FL420. CONDS CONTG THRU 03Z.

AREA 2...TURB OR CA ID MT WY NV UT AZ AND CSTL WTRS
 BOUNDED BY 40ESE DLN-20WNW JAC-20E BPI-40SSE MTU-20S HVE-70NE
 BZA-30N BZA-30E MZB-30E RZS-30ESE CZQ-60SW FMG-40SW BOI-30WSW
 LKT-40ESE DLN
 MOD TURB BLW FL180. CONDS CONTG THRU 03Z.

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ZULU 2019-05-15 18:00:00



Figure 15 - G-AIRMET Zulu for icing conditions valid at 1100 PDT

WAUS46 KPCI 151445
 WA6Z
 -SFOZ WA 151445
 AIRMET ZULU UPDT 2 FOR ICE AND FRZLVL VALID UNTIL 152100

AIRMET ICE...WA OR CA ID MT WY NV UT AND CSTL WTRS
 FROM 40S TOU TO 20ESE EPH TO 20E HLN TO 90SSW BIL TO 50WSW DBS TO
 60S TWF TO 70SSW BAM TO 20E EHF TO 60SSW RZS TO 150SW RZS TO
 140WSW FOT TO 120WSW HQM TO 40S TOU
 MOD ICE BTN FRZLVL AND FL240. FRZLVL 070-120. CONDS CONTG BYD 21Z
 THRU 03Z.

OTLK VALID 2100-0300Z...ICE WA OR CA ID MT WY NV UT AND CSTL WTRS
BOUNDED BY 40S YDC-60S YXC-70SSE YQL-40SSW LWT-80SSW BIL-60WSW
DBS-40N BVL-30S BAM-60ENE EHF-180SSW RZS-140WSW FOT-100WNW
ONP-120W TOU-40S YDC
MOD ICE BTN FRZLVL AND FL240. FRZLVL 070-120. CONDS CONTG THRU 03Z.
.
FRZLVL...RANGING FROM 050-145 ACRS AREA
080 ALG 130WSW PYE-20SW OAK-50SE RBL-70S HQM-30NE HQM-60NNE GEG
120 ALG 160SW RZS-40SSW RZS-40WNW BTY
....

Submitted by:

Don Eick
Senior Meteorologist

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