National Transportation Safety Board

Office of Aviation Safety
Washington, D.C. 20594-2000
July 11, 2011

WEATHER STUDY

WPR11FA230

A. Accident

Location: Pioneer, California
Date: May 18, 2011
Time: approximately 1545 Pacific daylight time (2245 UTC[1])
Aircraft: Cameron Lancair Legacy, registration: N121J

B. Meteorological Specialist

Mike Richards
Meteorologist
National Transportation Safety Board
Operational Factors Division, AS-30
Washington, DC 20594-2000

C. Narrative

The National Transportation Safety Board's (NTSB) meteorological specialist was not on scene and gathered weather data for this investigation from the NTSB's Washington D.C. office from official National Ocean and Atmospheric Administration (NOAA) and National Weather Service (NWS) sources, except where noted. All times are reported based upon the 24-hour clock. Local time is -7 hours from UTC, and UTC=Z. Directions are referenced to true north and distances in nautical miles. Heights are above mean sea level unless otherwise noted. Visibility

[1] UTC – abbreviation for Coordinated Universal Time

is in statute miles (sm) and fractions of sm. Distances along surface of the earth are calculated using the "Great Circle" formula.

Coordinates used for the accident location: 38.53056° North latitude, 120.22889° West longitude, elevation approximately 6,450 feet.

Surface Analysis and Observations

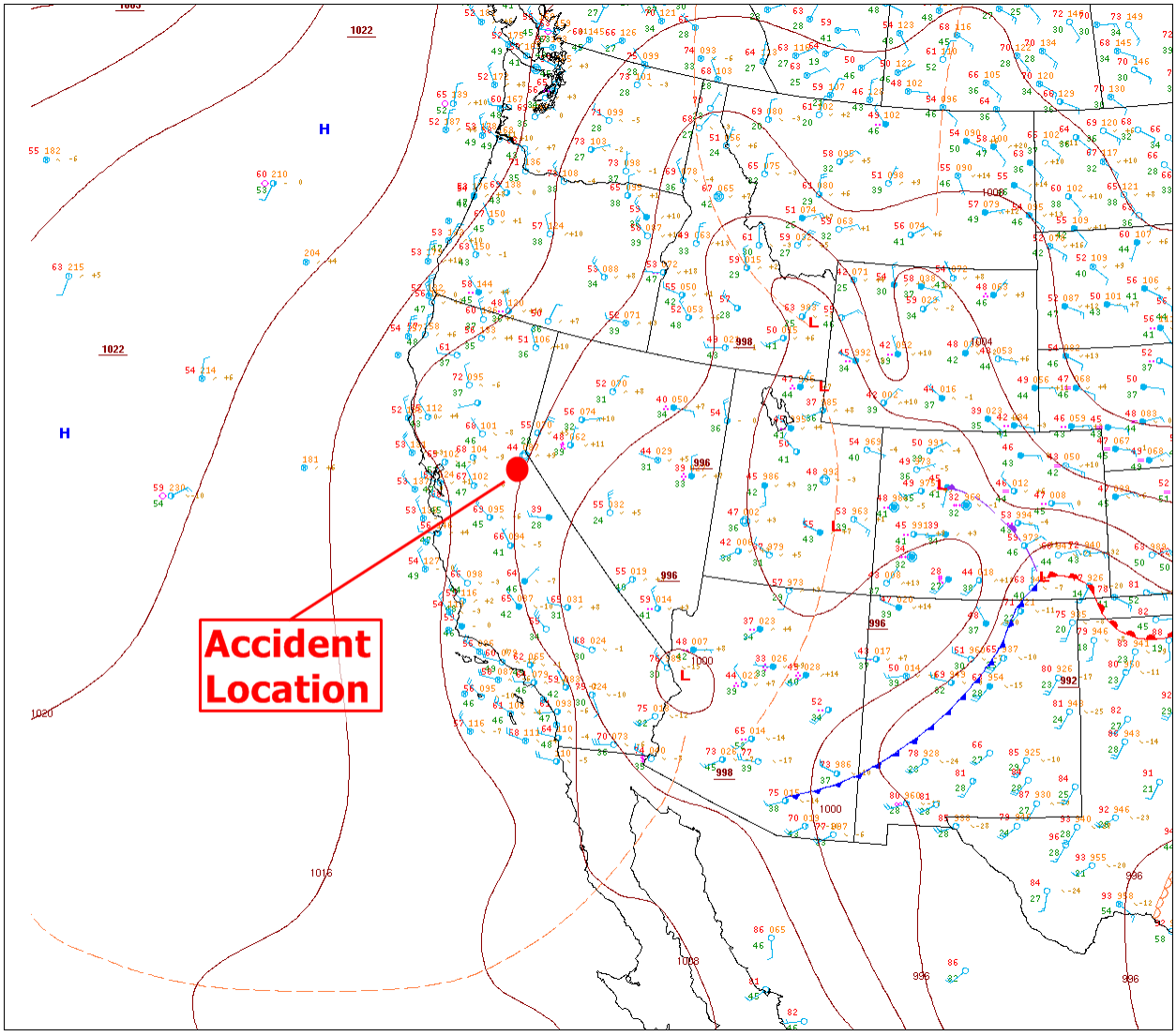

Figure 1 – NWS Surface Analysis chart valid at 1700 PDT.

The NWS Surface Analysis Chart for 1700 PDT is included as figure 1. The chart depicted a low pressure center near the California-Arizona-Nevada borders. Station models in the accident region were indicating clear or partly cloudy skies, with some overcast skies reported in the southern Sierras and central valley. Surface wind directions were generally from the northwest in the valley, with the wind becoming more variable in the mountains and in Nevada. Wind magnitudes were generally depicted as at or below 15 knots, with Reno indicating a 20-knot northerly wind. Temperatures across the region were generally in the low to mid-50's Fahrenheit (F) along the coast, mid-60's F in the valley, and high 30's to mid-50's F in the mountains and far western Nevada.

Automated surface weather observations made near the time of the accident at Lake Tahoe Airport (KTVL; elevation 6,269 feet) in South Lake Tahoe, California, which was located approximately 24 miles north-northeast of the accident location, are presented here:

[1430 PDT] SPECI KTVL 182130Z AUTO 00000KT 10SM BKN026 04/M01 A2983 RMK AO2 TSNO $

[1453 PDT] METAR KTVL 182153Z AUTO 00000KT 10SM SCT017 SCT022 04/00 A2984 RMK AO2 SLP093 T00440000 TSNO $

[1553 PDT] METAR KTVL 182253Z AUTO 01007G15KT 330V030 10SM SCT030 06/M01 A2984 RMK AO2 SLP088 T00611011 TSNO $

[1653 PDT] METAR KTVL 182353Z AUTO 00000KT 10SM FEW032 07/M03 A2984 RMK AO2 SLP087 T00671028 10072 20039 50009 TSNO $

At 1553 PDT, KTVL reported wind from 010° at 7 knots with gusts to 15 knots, wind direction variable between 330° and 030°, visibility of 10 miles or greater, scattered clouds at 3,000 feet above ground level (agl), temperature 6° Celsius (C), dew point temperature -1°C, altimeter setting 29.84 inches of mercury. Remarks: station with a precipitation discriminator, sea-level pressure 1008.8 hectopascals (hPa), hourly temperature 6.1°C and hourly dew point temperature -1.1°C, thunderstorm information not available, maintenance needed on the system.

Automated surface weather observations made near the time of the accident at Lincoln Regional Airport (KLHM; elevation 121 feet) in Lincoln, California, which was located approximately 57 miles west-northwest of the accident location, are presented here:

[1455 PDT] METAR KLHM 182155Z AUTO 32007KT 260V350 10SM SCT041 18/07 A2984 RMK AO1 T01840072

[1515 PDT] METAR KLHM 182215Z AUTO 30006KT 10SM SCT043 19/07 A2984 RMK AO1 T01910069

[1535 PDT] METAR KLHM 182235Z AUTO 32009KT 10SM BKN043 19/07 A2984 RMK AO1 T01940071

[1555 PDT] METAR KLHM 182255Z AUTO 26004KT 10SM SCT045 19/07 A2983 RMK AO1 T01900065

[1615 PDT] METAR KLHM 182315Z AUTO 33006KT 10SM CLR 20/08 A2983 RMK AO1 T01960075

At 1535 PDT, KLHM reported wind from 320° at 9 knots, visibility of 10 miles or greater, ceiling broken at 4,300 feet agl, temperature 19°C, dew point temperature 7°C, altimeter setting 29.84 inches of mercury. Remarks: station without a precipitation discriminator, hourly temperature 19.4°C and hourly dew point temperature 7.1°C.

At 1555 PDT, KLHM reported wind from 260° at 4 knots, visibility of 10 miles or greater, scattered clouds at 4,500 feet agl, temperature 19°C, dew point temperature 7°C, altimeter setting 29.83 inches of mercury. Remarks: station without a precipitation discriminator, hourly temperature 19.0°C and hourly dew point temperature 6.5°C.

Unofficial weather observations were retrieved from the Bureau of Land Management weather station COKC1, which was located about 5 miles to the west-southwest of the accident site at an elevation of approximately 5,000 feet. Data from this station is presented in table 1.

Time	Temp(°C)	D Temp(°C)	RH(%)	W Sp(kts)	W Gust(kts)	W Dir.	Precip (in)
1207	8.9	3.3	68	1.7	3.5	200°	52.4
1307	10.0	3.7	65	0.8	7.0	332°	52.8
1407	10.0	5.6	74	0.0	6.0	220°	52.8
1507	6.7	3.1	78	0.0	7.0	275°	52.8
1607	5.6	5.6	100	0.8	7.0	194°	52.9
1707	5.6	4.8	95	1.7	4.3	139°	52.9

Table 1 – Data collected from COKC1. D_Temp = dew point temperature; RH = relative humidity; W_Sp = wind speed; W_Gust = wind gust; W_Dir = wind direction; Precip = precipitation accumulation for unknown duration.

Upper-Air Observations

Atmospheric data was retrieved from a rawinsonde launch at 1700 PDT from Reno, Nevada (REV), which was located about 65 miles to the north-northeast of the accident site.

The 1700 PDT REV sounding (figure 2) indicated the freezing level was at approximately 8,400 feet. No temperature inversions were noted below 25,000 feet. The lower-troposphere was mostly conditionally-unstable. Relative humidity (RH) values were less than 70 percent below 25,000 feet. Calculations made by the RAwinsonde OBservation Program (RAOB) indicated no icing threat in this layer. The vertical wind profile indicated a generally northerly wind below 20 knots from the surface through 17,000 feet. RAOB calculations of clear-air turbulence (CAT)

due to wind-shear did not identify any significant levels of CAT below 23,000 feet. Convective Available Potential Energy[2] (CAPE) values for this atmosphere were 274 J/kg. The Lifting Condensation Level[3] (LCL) was calculated as about 11,782 feet.

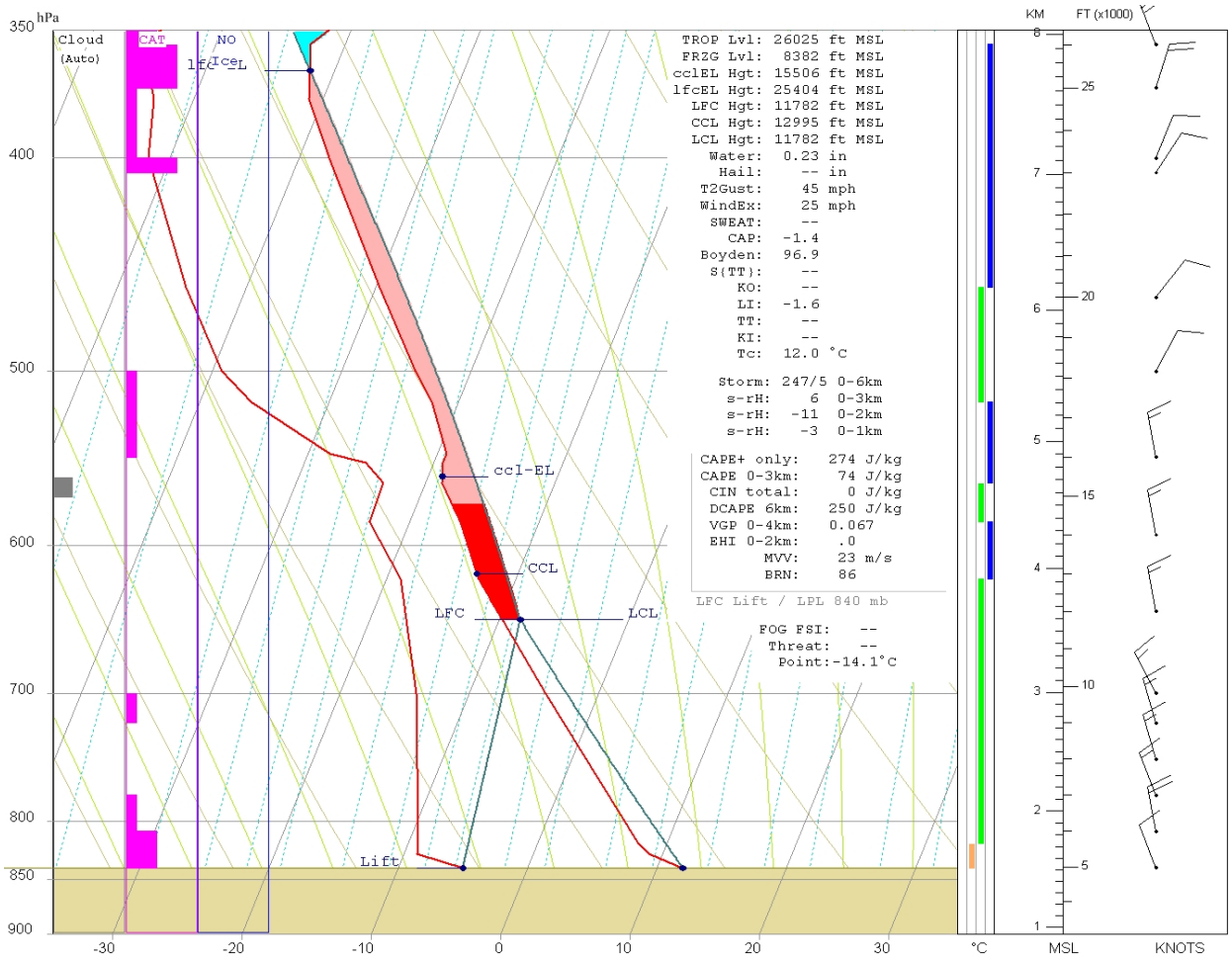

Figure 2 - Rawinsonde sounding from REV in SkewT/LogP[4] format for 1700 PDT, surface to 350 hPa.

Meteorological data from an AMDAR[5] reporting aircraft departing from Sacramento International Airport (KSMF) in Sacramento, California, near the time of the accident is

[2] Convective Available Potential Energy - A measure of the amount of energy available for convection. CAPE is directly related to the maximum potential vertical speed within an updraft; thus, higher values indicate greater potential for severe weather.

[3] Lifting Condensation Level - The level at which a parcel of moist air lifted dry-adiabatically would become saturated.

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

[5] *AMDAR* is the generally-accepted worldwide term for automated weather reports from commercial aircraft.

presented in table 2, where altitudes (in feet) are determined by conversion from pressure using the International Standard Atmosphere. Figure 3 presents the flight path for the aircraft that supplied the meteorological data presented in table 2.

Time(Z)	Latitude	Longitude	Altitude(ft.)	Pressure(hPa)	Temp(°C)	Wind_Dir	Wind_Mag
2236	38.692	-121.582	110	1009	17.6	342°	4
2236	38.702	-121.582	110	1009	17.5	007°	2
2236	38.702	-121.582	150	1008	17.1	145°	4
2236	38.702	-121.582	350	1000	16.6	066°	2
2237	38.712	-121.582	630	990	15.8	268°	7
2237	38.712	-121.582	920	980	15.1	225°	2
2237	38.722	-121.582	1150	972	14.1	166°	6
2237	38.722	-121.572	1330	965	13.6	166°	7
2237	38.722	-121.572	1490	960	12.8	211°	4
2237	38.732	-121.562	1700	953	12.3	224°	9
2237	38.732	-121.562	1910	945	11.6	244°	9
2237	38.732	-121.552	2070	940	11.0	253°	9
2237	38.722	-121.552	2170	936	10.5	255°	12
2237	38.722	-121.542	2280	933	10.1	292°	10
2238	38.722	-121.532	2460	926	9.8	299°	9
---	---	---	2500	925	9.7	299°	9
2238	38.712	-121.532	2710	918	9.3	300°	10
2238	38.692	-121.482	4130	871	6.3	313°	14
---	---	---	4778	850	5.1	321°	15
2239	38.662	-121.432	6150	807	2.6	337°	16
2239	38.642	-121.392	8580	736	-2.4	338°	23
---	---	---	9881	700	-5.4	348°	21
2240	38.612	-121.342	10160	693	-6.0	350°	21
2241	38.572	-121.302	11220	664	-8.9	353°	19
2241	38.532	-121.262	12540	631	-10.5	339°	19
2242	38.492	-121.222	14110	593	-14.4	337°	16
2242	38.442	-121.172	15930	551	-19.0	338°	18
2243	38.402	-121.122	17250	522	-22.0	334°	26
2244	38.352	-121.062	18210	502	-23.5	328°	35
---	---	---	18288	500	-23.7	328°	35
2244	38.312	-121.012	19440	477	-26.3	329°	32
---	---	---	23561	400	-31.8	321°	58
2247	38.062	-120.702	24340	387	-32.8	320°	63
2250	37.762	-120.352	27900	331	-35.8	319°	97

Table 2 – Data collected from an AMDAR reporting aircraft on ascent from KSWF, where time is UTC on May 18, 2011. Altitude is pressure altitude in feet. Flight path is depicted in figure 3. Wind_Dir = wind direction; Wind_Mag = wind magnitude (knots).

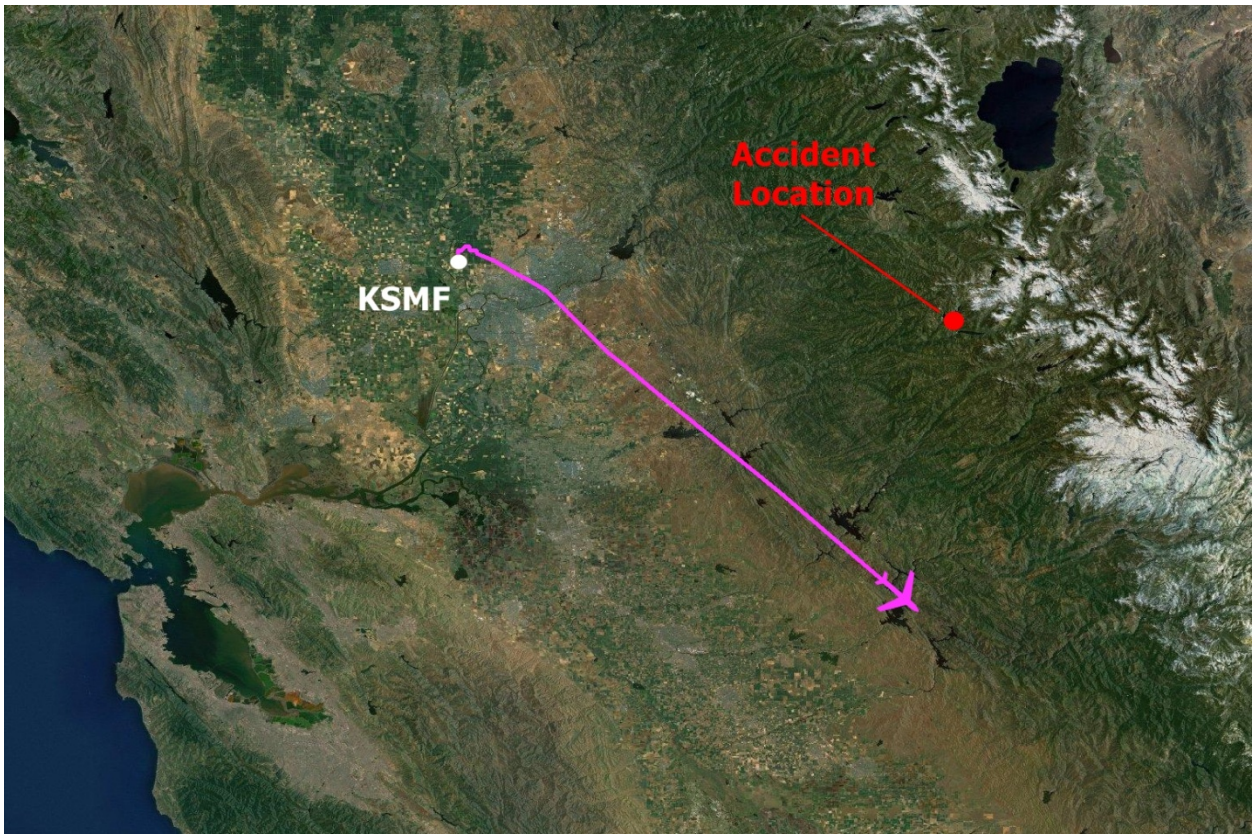

Figure 3 – Flight path for AMDAR reporting aircraft.

No PIREPs were found below FL300[6] with three hours of the accident time and 100 miles of the accident site.

Satellite Data

Geostationary Operational Environmental Satellite (GOES)-11 visible (0.65µm) and infrared (10.7µm) 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 Man computer Interactive Data Access System. The imagery from these platforms are presented in figure 4. The 1545 PDT GOES-11 visible imagery indicated the accident site was under cloudy skies at the accident time. GOES-11 infrared data indicated cloud-top brightness temperature near the accident site at 1545 PDT were between approximately -17°C and -30°C, which, when considering the AMDAR data, corresponded to cloud-top heights of about 15,000 and 21,000 feet, respectively. It should be noted that these images are not corrected for parallax error.

[6] Flight Level - a standard nominal altitude of an aircraft, in hundreds of feet. This altitude is 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 msl or agl.

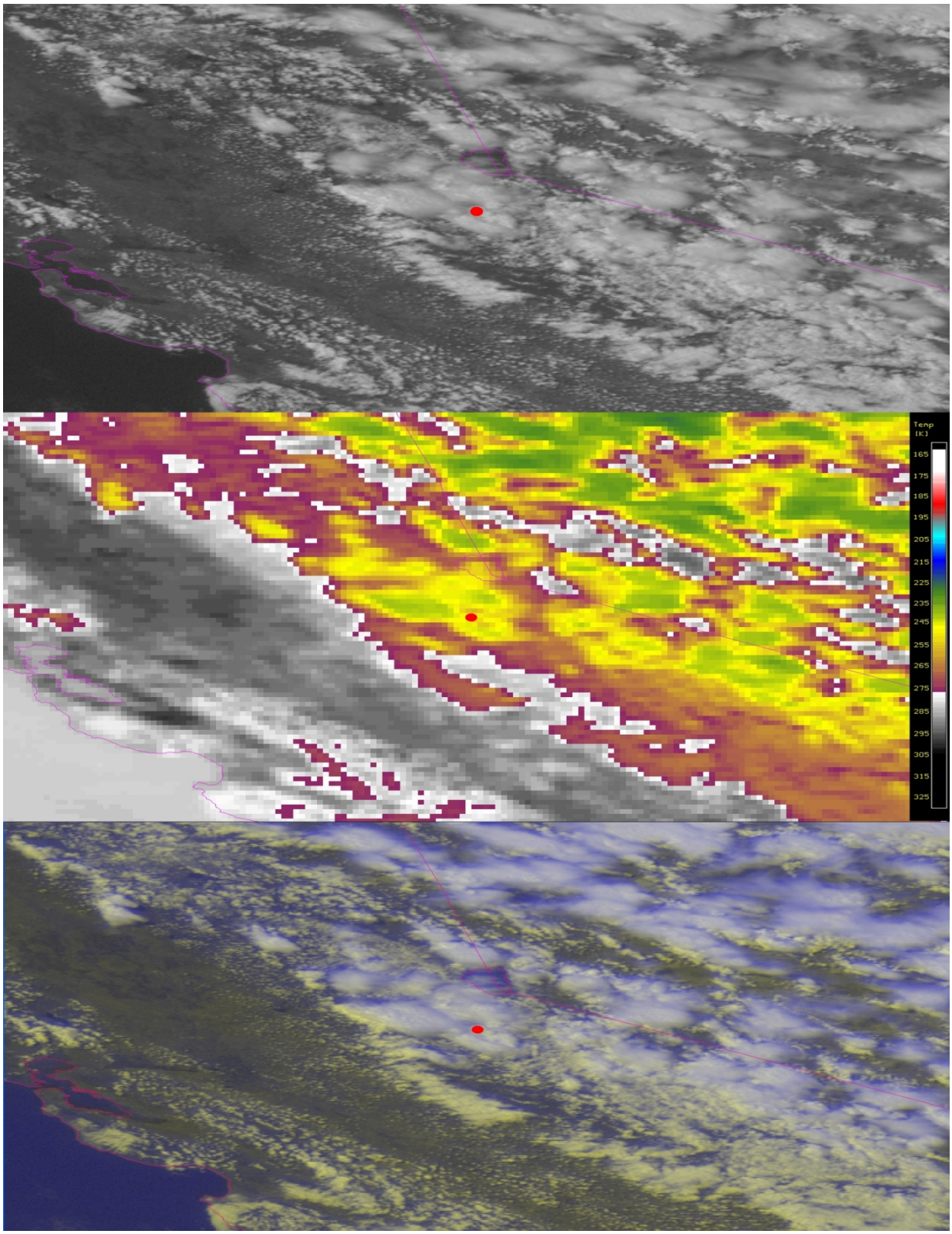

Figure 4 – GOES-11 imagery from 1545 PDT. Top Panel: "visible"; Middle Panel: infrared; Bottom Panel: RGB composite. Images not corrected for parallax. Red circles denote accident location.

Visible/infrared RGB[7] composite images (figure 4; bottom panel), which are comprised of the 0.65µm information projected as the red and green colors and the 10.7µm information projected as blue, separate higher-topped cloud features (colder, look whiter) from lower-topped clouds (warmer, look more yellow). In the GOES-11 data, the RGB images indicated the presence of colder (higher) cloud tops in western California and Nevada, including in the area of the accident site. Due to the presence of high cloud near the accident site, it cannot be determined from the satellite imagery where exactly the lower-topped clouds were in relation to the accident location at 1545 PDT.

Radar Data

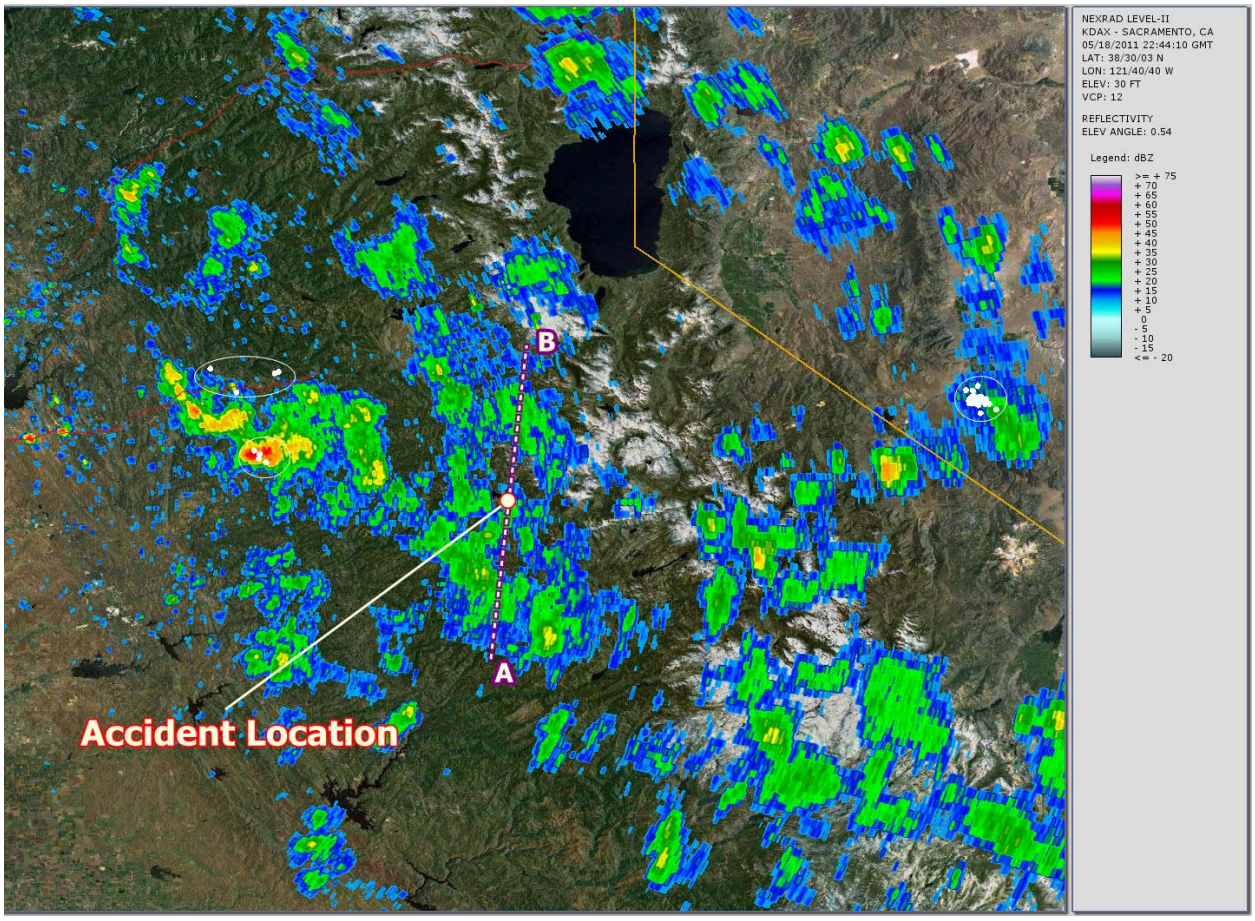

Figure 5 – KDAX 0.54° base reflectivity imagery (values greater than 10 dBZ) from 1544 PDT. This data has been smoothed. Areas of lightning activity within previous forty minutes plotted as white dots and circled. Vertical cross section slice for figure 6 is identified by the purple/white dashed line.

[7] RGB = **R**ed **G**reen **B**lue

WSR-88D Level-II 0.54° base reflectivity at 1544 PDT from Sacramento, California (KDAX), located approximately 68 miles to the west of the accident site, is presented in figures 5 and 6. Assuming standard refraction and considering the WSR-88D 0.95° beamwidth[8], at this tilt the radar would have "seen" altitudes between about 3,560 and 10,400 feet msl at the accident site. This however puts some of the beam below ground level at the accident location. It is unknown what type of clutter-suppression algorithm was applied to this data (or if any was in use), and it is not known what contribution to the total reflectivity values near the accident site came from ground returns (if any). The KDAX WSR-88D retrieved light and some moderate values of reflectivity in the accident area at accident time. At 1544 PDT, the accident site was under/amidst an area of light reflectivity.

A vertical cross-section of the KDAX entire-volume base reflectivity data at 1544 PDT (figure 6) from zero to 30,000 feet msl was taken along a line defined in figure 5. This slice was chosen to depict the depth of retrieved reflectivities in the vicinity of the accident site near the accident time. Again, some of the lower portion of the lowest elevation scan depicted in figure 6 would have been below ground level, and it is not known what contribution to the total reflectivity values near the accident site came from ground returns (if any).

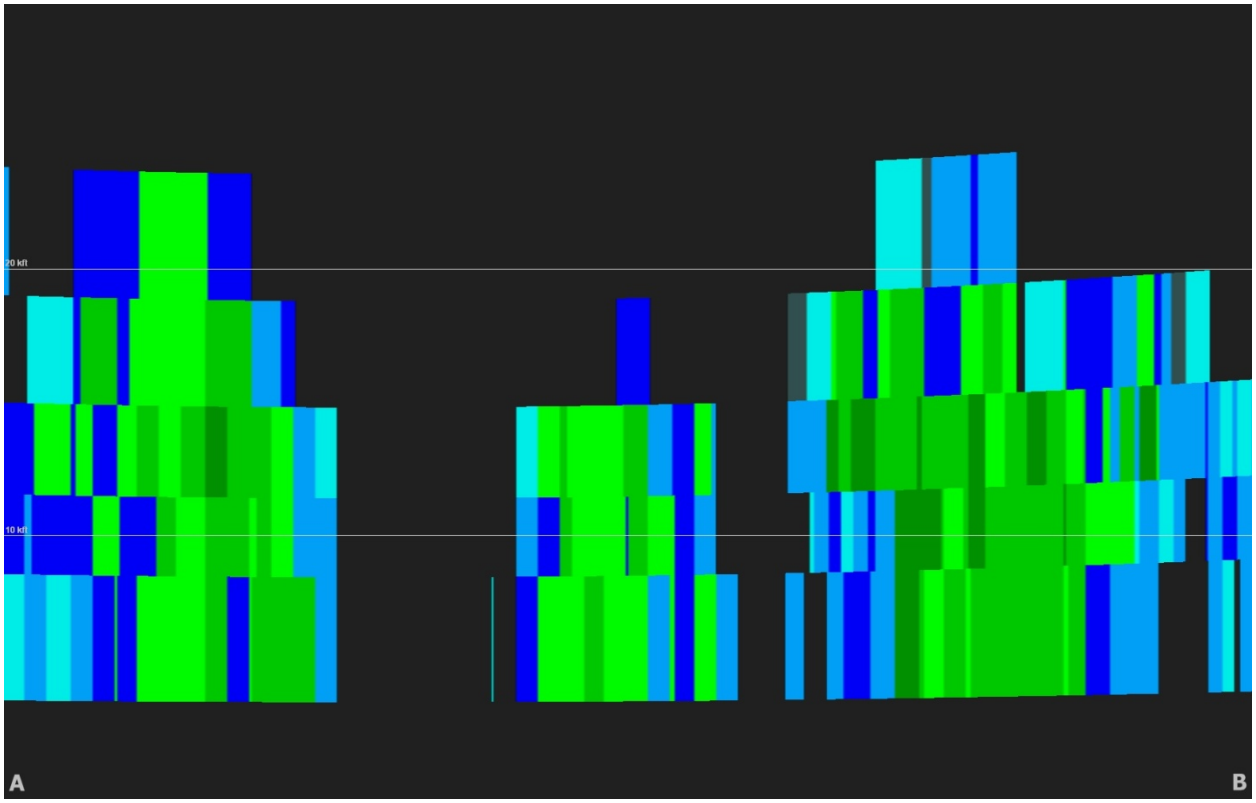

Figure 6 – Vertical-cross section from zero to 30,000 feet of the KDAX base reflectivity from 1544 PDT. Cross section boundaries are defined in figure 5.

[8] Beam width - the angular separation between the half power points on the antenna radiation pattern, where the gain is one half the maximum value.

In-Flight Advisories

No SIGMETs were active for the accident location at the accident time.

Numerous AIRMETs for mountain obscuration, turbulence, strong surface winds and icing conditions were active over the western portion of the United States during the time of the accident (figure 7). These advisories are listed here. At the time of the accident, two AIRMETs (in bold below) were active for the accident location:

An AIRMET SIERRA for mountain obscuration was issued at 1345 PDT, advising of mountains obscured by clouds, precipitation and mist.

An AIRMET TANGO for turbulence was issued at 1345 PDT and advised of moderate turbulence between FL180[9] and FL410.

WAUS46 KKCI 182045
WA6S
-SFOS WA 182045
AIRMET SIERRA UPDT 5 FOR IFR AND MTN OBSCN VALID UNTIL 190300
.
NO SGFNT IFR EXP OUTSIDE OF CNVTV ACT.
.
AIRMET MTN OBSCN...WA OR CA ID MT WY NV UT CO AZ NM
FROM 20NE MLP TO 60E DLN TO SHR TO 20S CYS TO 20NE DEN TO 40SSE PUB TO 20ENE FTI TO 40W INW TO EED TO 40SSW OAL TO 30SSE CZQ TO 30SSW SNS TO 20WNW ENI TO 30WNW OED TO 50E PDX TO 20NE MLP
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 03Z THRU 09Z.
.
AIRMET MTN OBSCN...CA
FROM 30SSE CZQ TO 50NNW HEC TO 20W HEC TO 60S TRM TO 20S MZB TO 20SSE LAX TO 50WSW RZS TO 30SSW SNS TO 30SSE CZQ
MTNS OBSC BY CLDS/PCPN/BR. CONDS CONTG BYD 03Z ENDG 03-06Z.
....

WAUS46 KKCI 182045
WA6T
-SFOT WA 182045
AIRMET TANGO UPDT 4 FOR TURB AND STG SFC WNDS VALID UNTIL 190300
.
AIRMET TURB...WA OR CA AND CSTL WTRS

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

FROM 140W TOU TO 50ESE TOU TO 30WNW DNJ TO 50SE REO TO 40SE LKV TO 40SSW FMG TO EED TO BZA TO 20S MZB TO 150SW SNS TO 140WSW FOT TO 110W ONP TO 140W TOU
MOD TURB BTN FL180 AND FL410. CONDS CONTG BYD 03Z THRU 09Z.
.
AIRMET TURB...CA WY NV UT CO AZ NM AND CSTL WTRS
FROM BFF TO GLD TO 50W LBL TO 30ESE TBE TO INK TO ELP TO 50S TUS TO BZA TO 30S MZB TO 60W RZS TO 20SE PYE TO 30ENE OAL TO 20NE DTA TO BFF
MOD TURB BLW FL180. CONDS CONTG BYD 03Z THRU 09Z.
.
AIRMET STG SFC WNDS...CA
FROM 50S BTY TO 30SE HEC TO 20N LAX TO EHF TO 50S BTY
SUSTAINED SURFACE WINDS GTR THAN 30KT EXP. CONDS ENDG 00-03Z.
.
AIRMET STG SFC WNDS...CA
FROM 30SSE EED TO BZA TO 50ESE MZB TO 20W TRM TO 30SSE EED
SUSTAINED SURFACE WINDS GTR THAN 30KT EXP. CONDS ENDG 00-03Z.
....

WAUS46 KKCI 182045
WA6Z
-SFOZ WA 182045
AIRMET ZULU UPDT 3 FOR ICE AND FRZLVL VALID UNTIL 190300
.
AIRMET ICE...WA OR ID MT WY NV UT CO AZ NM
FROM 20NNW FCA TO 40S HLN TO 100SE MLS TO 70SW RAP TO 20E ALS TO 30N ABQ TO 60E PHX TO 20SE PHX TO 20SSE BTY TO OAL TO 30W DNJ TO 30ESE EPH TO 50NNE GEG TO 20NNW FCA
MOD ICE BTN FRZLVL AND FL200. FRZLVL 050-110. CONDS CONTG BYD 03Z THRU 09Z.
.
FRZLVL...RANGING FROM 050-145 ACRS AREA
080 ALG 150SW FOT-60W SNS-80WNW RZS-50W TRM-40WSW EED-20S EED
120 ALG 160SW RZS-90SW MZB

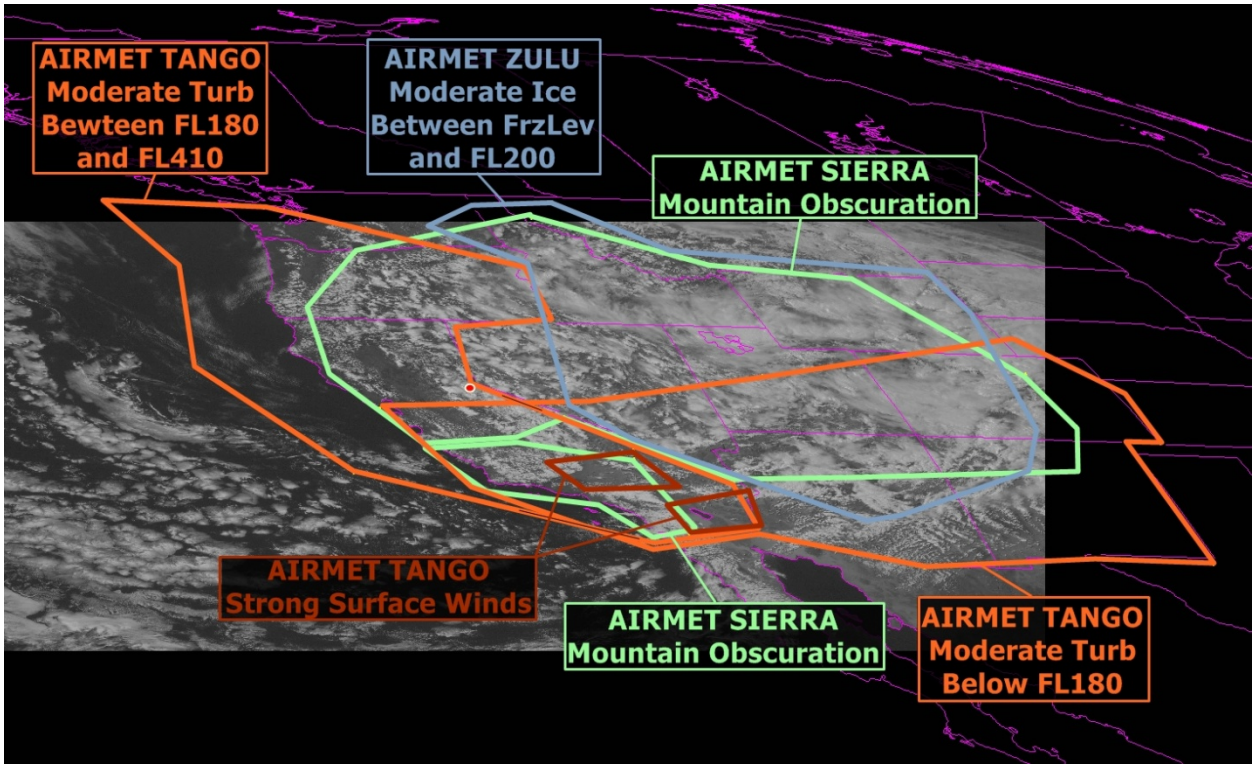

Figure 7 – Active AIRMETs for western U.S. at accident time. The accident location is indicated by the red/white circle.

Terminal Aerodrome Forecasts

A terminal aerodrome forecast (TAF) issued for KTVL at 1020 PDT forecasted for the accident time: wind from 030° at 7 knots, visibility 5 miles, light rain or small hail/snow pellet[10] showers, thunderstorms in the vicinity[11], ceiling broken at 3,500 feet agl, broken clouds at 6,000 feet with cumulonimbus. Conditions forecasted in the TAF are only official for 5 miles from the forecast site.

TAF KTVL 181720Z 1818/1918 03007KT P6SM VCSH SCT025 BKN040
FM182000 03007KT 5SM -SHRAGS VCTS BKN035 BKN060CB
FM190100 VRB03KT P6SM SCT060
FM191000 VRB03KT 1SM BR SCT001
FM191500 VRB03KT P6SM SCT030

[10] Less than ¼ inch in diameter.
[11] "In the vicinity" refers to between 5 to 10 statute miles away from the point of observation.

Area Forecast

An Area Forecast for the Sierra Nevada mountain range in California, issued at 1245 PDT, forecasted for the time of the accident: broken ceiling at 10,000 feet msl with layered clouds to 24,000 feet msl, isolated light rain showers and isolated thunderstorms with right rain, with cumulonimbus tops to FL280 and FL240 in the northern and southern portions of the mountains, respectively.

FAUS46 KKCI 181945
FA6W
_SFOC FA 181945
SYNOPSIS AND VFR CLDS/WX
SYNOPSIS VALID UNTIL 191400
CLDS/WX VALID UNTIL 190800...OTLK VALID 190800-191400
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...ALF..20Z TROF OVR WRN NV-SRN CA WL MOV E OVR SE UT-S AZ BY 14Z. RDG WL BLD OVR WRN US CSTL WTRS BY 14Z. SFC..20Z CDFNT OVR CNTRL CO-NW NM-SRN AZ-OLD MEX CSTL WTRS WL MOV E OVR ERN CO-TX PNHDL-ERN NM-SW NM AT 14Z.
.
NRN CA...STS-SAC-TVL LN NWD
CSTL SXNS...SCT050 BKN CI. OTLK...VFR.
SAC VLY...BKN050 TOP 120 BKN CI. 00Z SCT050 BKN CI. OTLK...VFR.
SHASTA-SISKIYOUS-NERN CA...BKN100 LYRD FL240. ISOL -SHRA/-TSRA. CB TOP FL280. 02Z SCT100. OTLK...VFR.
NRN SIERNEV...BKN100 LYRD FL240. ISOL -SHRA/-TSRA. CB TOP FL280. 02Z BKN140. OTLK...VFR.
.
CNTRL CA
CSTL SXNS...BKN050 TOP 100 BKN CI. 23Z BKN CI. OTLK...VFR.
SAN JOAQUIN VLY...BKN050 TOP 120 BKN CI. 03Z SCT050 BKN CI. OTLK...VFR.
SRN SIERNEV...BKN100 LYRD FL240. ISOL -SHRA/-TSRA. CB TOP FL240. 04Z BKN140. OTLK...VFR.

Center Weather Advisories/Meteorological Impact Statements

At 1548 PDT (near the time of the accident) a Center Weather Advisory (CWA) was issued for ZOA airspace that indicated that an area of isolated thunderstorms (figure 8) were moving from 360° at 15 knots with tops to FL290.

FAUS21 KZOA 182248
ZOA1 CWA 182248
ZOA CWA 101 VALID UNTIL 190048
FROM 86NNE FMG-37NE OAL-15NNW CZQ-10NE RBL-86NNE FMG
AREA ISOLD TS. MOV FM 36015KT. TOPS TO FL290. ZOA CWSU.

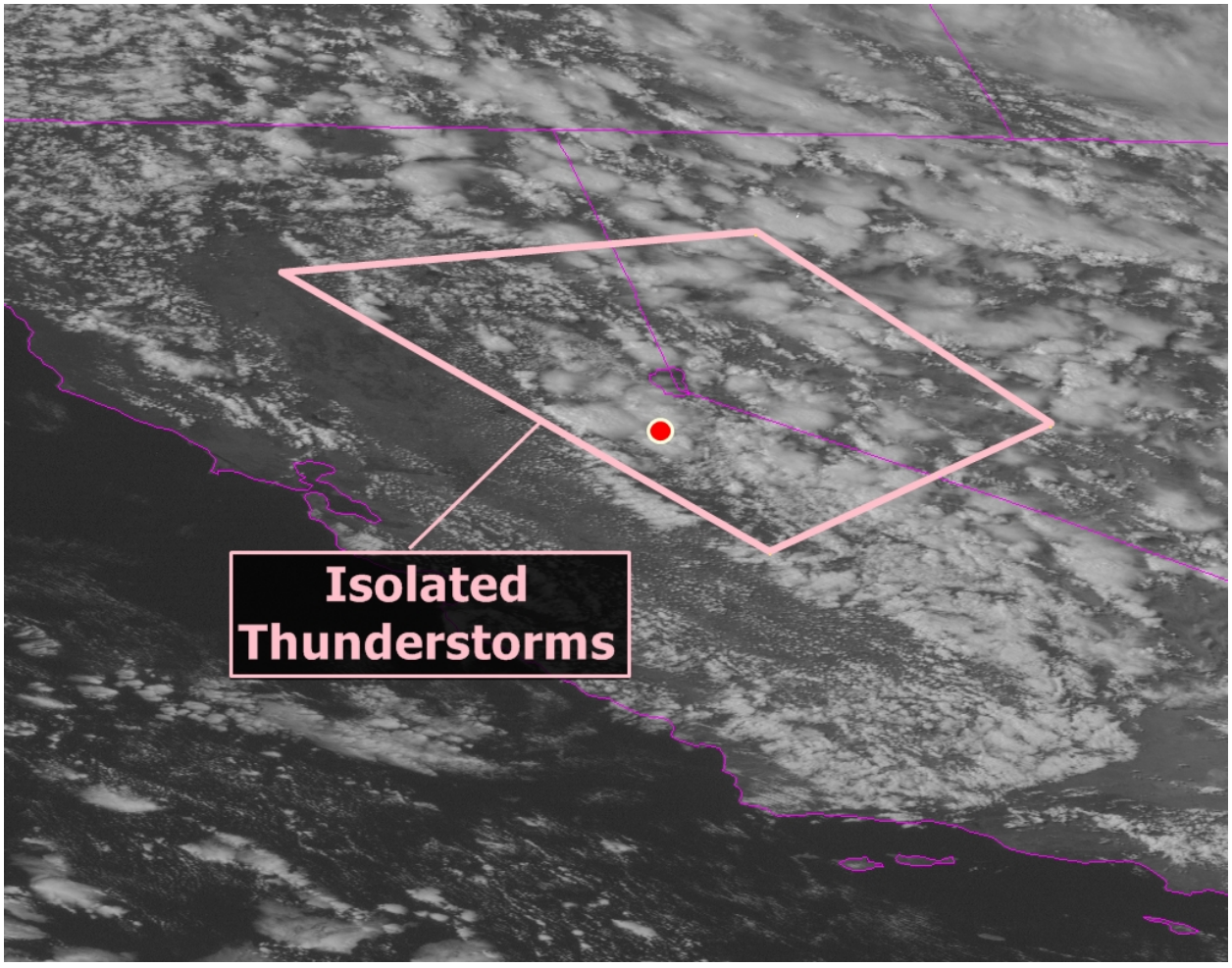

Figure 8 – CWA issued at 1548 PDT. The accident location is indicated by the red/white circle.

Weather Watches

There were no applicable weather watches issued.

Icing Analysis

Current Icing Potential (CIP) products are produced by the NWS' Aviation Weather Center and are intended to be supplemental to other icing advisories (e.g. AIRMETs and SIGMETs). CIP graphical products issued for 1600 PDT for 7,000, 9,000 and 11,000 feet are provided in figures 9-14. CIP analyses indicated there was a small area of significant icing probabilities in the accident area at 9,000 feet. In addition, CIP icing severity and SLD[12] analyses indicated a SLD threat in the accident area at 7,000, 9,000 and 11,000 feet.

[12] SLD = **S**upercooled **L**arge **D**roplet

By FAA policy CIP is a Supplementary Weather Product for enhanced situational awareness only and must be used with one or more primary products (safety decision) such as an AIRMET or SIGMET (see AIM 7-1-3).

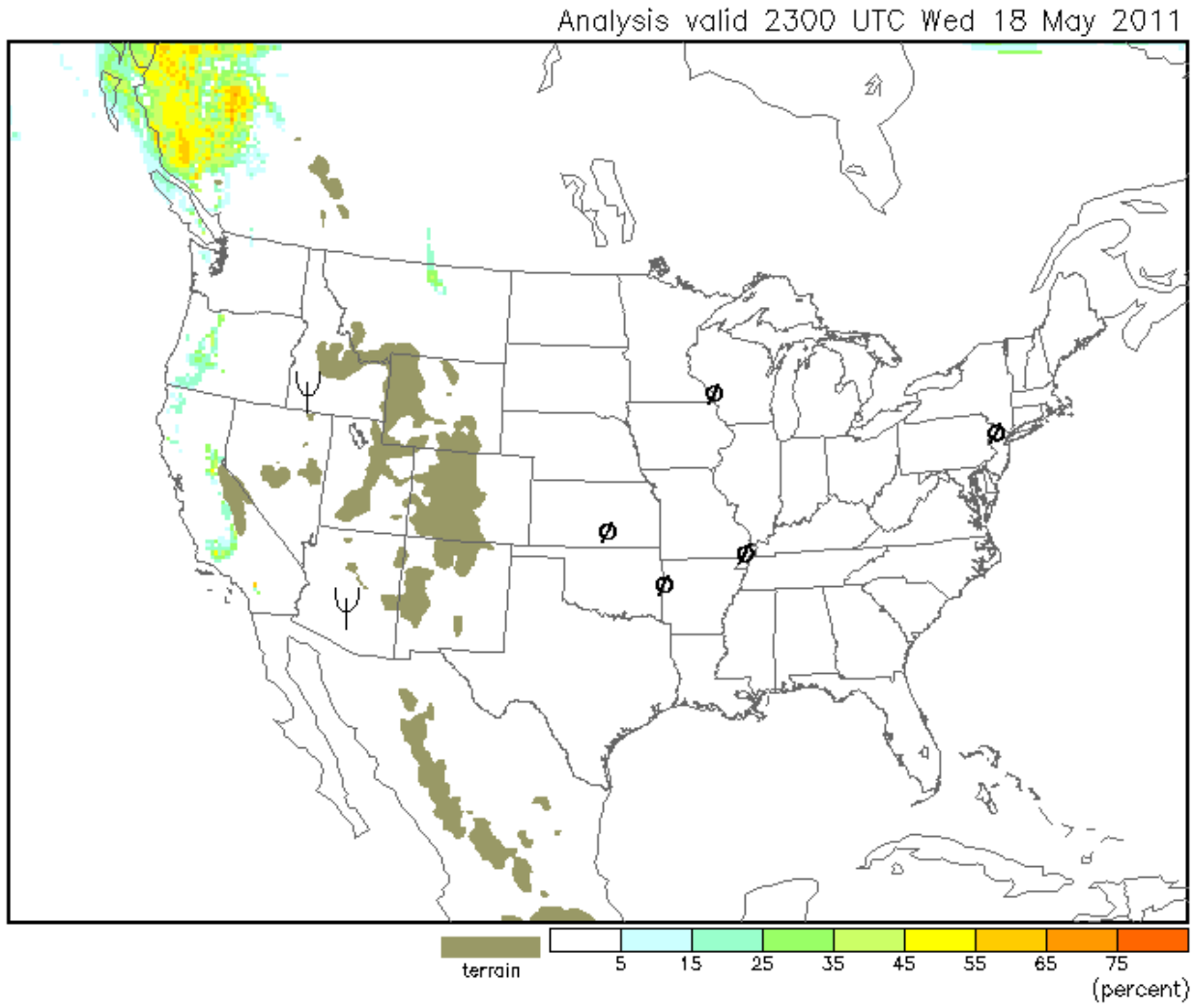

Figure 9 – CIP icing probabilities for 1600 PDT at 7,000 feet.

By FAA policy CIP is a Supplementary Weather Product for enhanced situational awareness only and must be used with one or more primary products (safety decision) such as an AIRMET or SIGMET (see AIM 7-1-3).

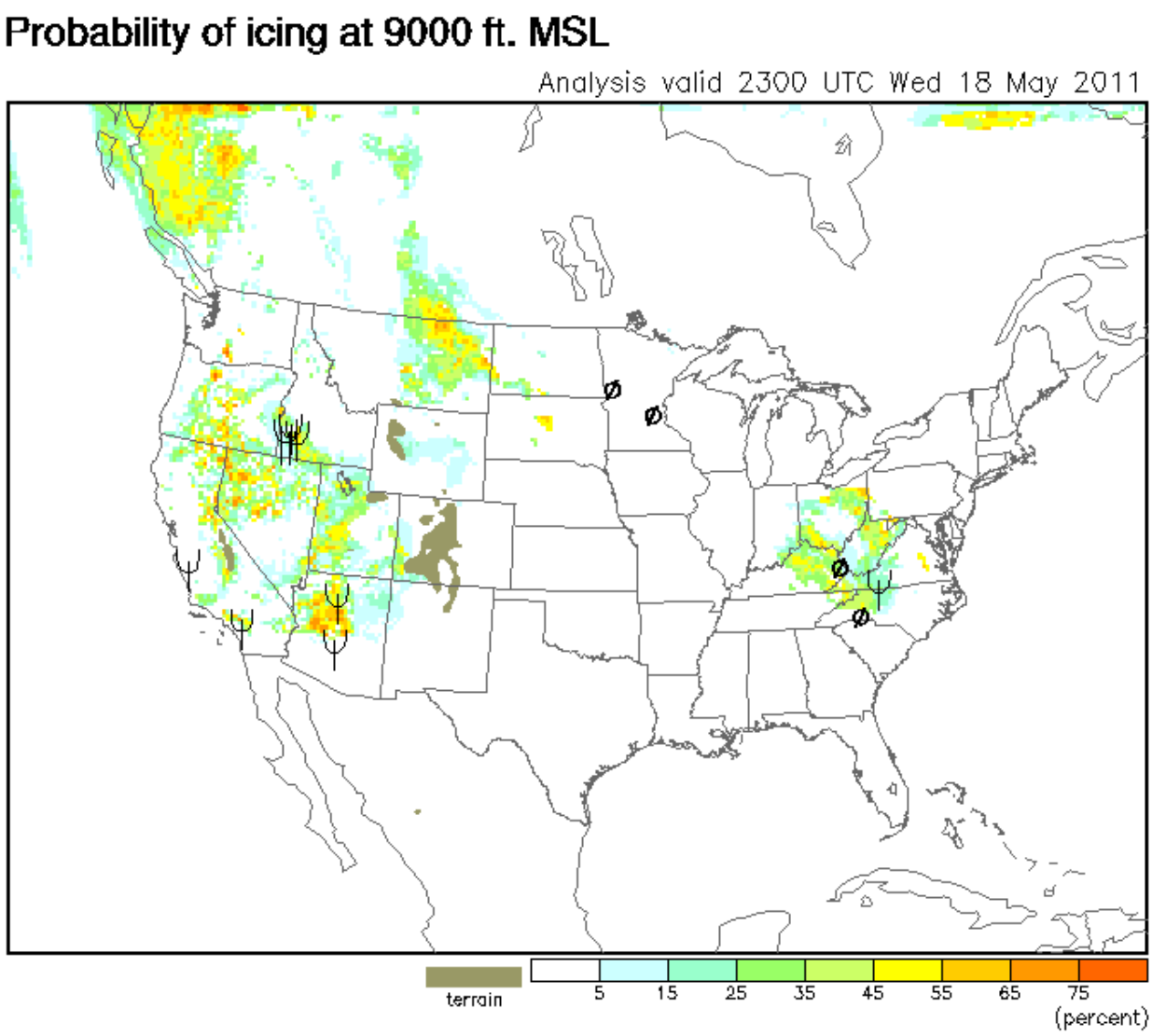

Figure 10 – CIP icing probabilities for 1600 PDT at 9,000 feet.

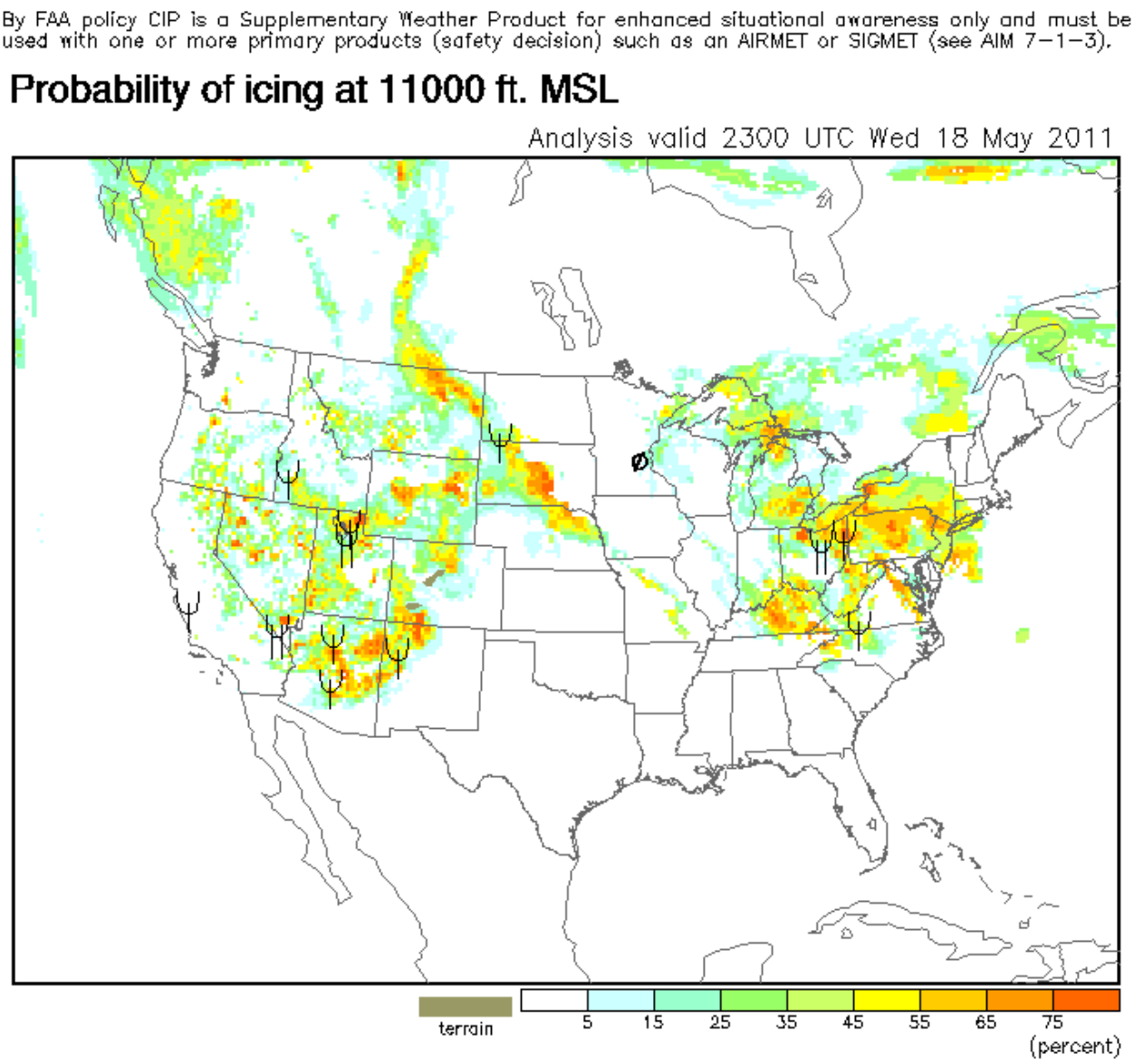

Figure 11 – CIP icing probabilities for 1600 PDT at 11,000 feet.

By FAA policy CIP is a Supplementary Weather Product for enhanced situational awareness only and must be used with one or more primary products (safety decision) such as an AIRMET or SIGMET (see AIM 7-1-3).

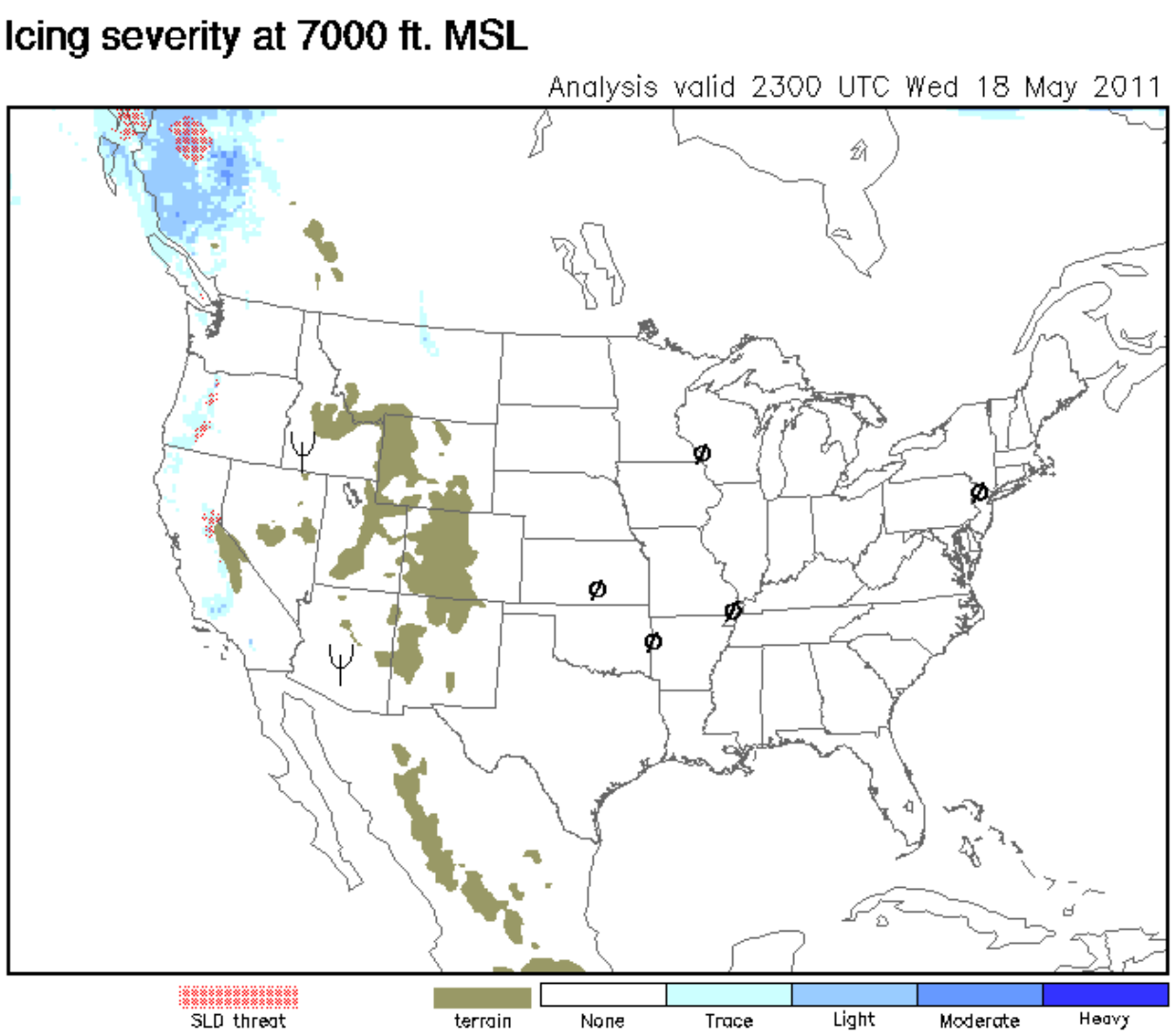

Figure 12 – CIP icing severities and SLD for 1600 PDT at 7,000 feet.

By FAA policy CIP is a Supplementary Weather Product for enhanced situational awareness only and must be used with one or more primary products (safety decision) such as an AIRMET or SIGMET (see AIM 7-1-3).

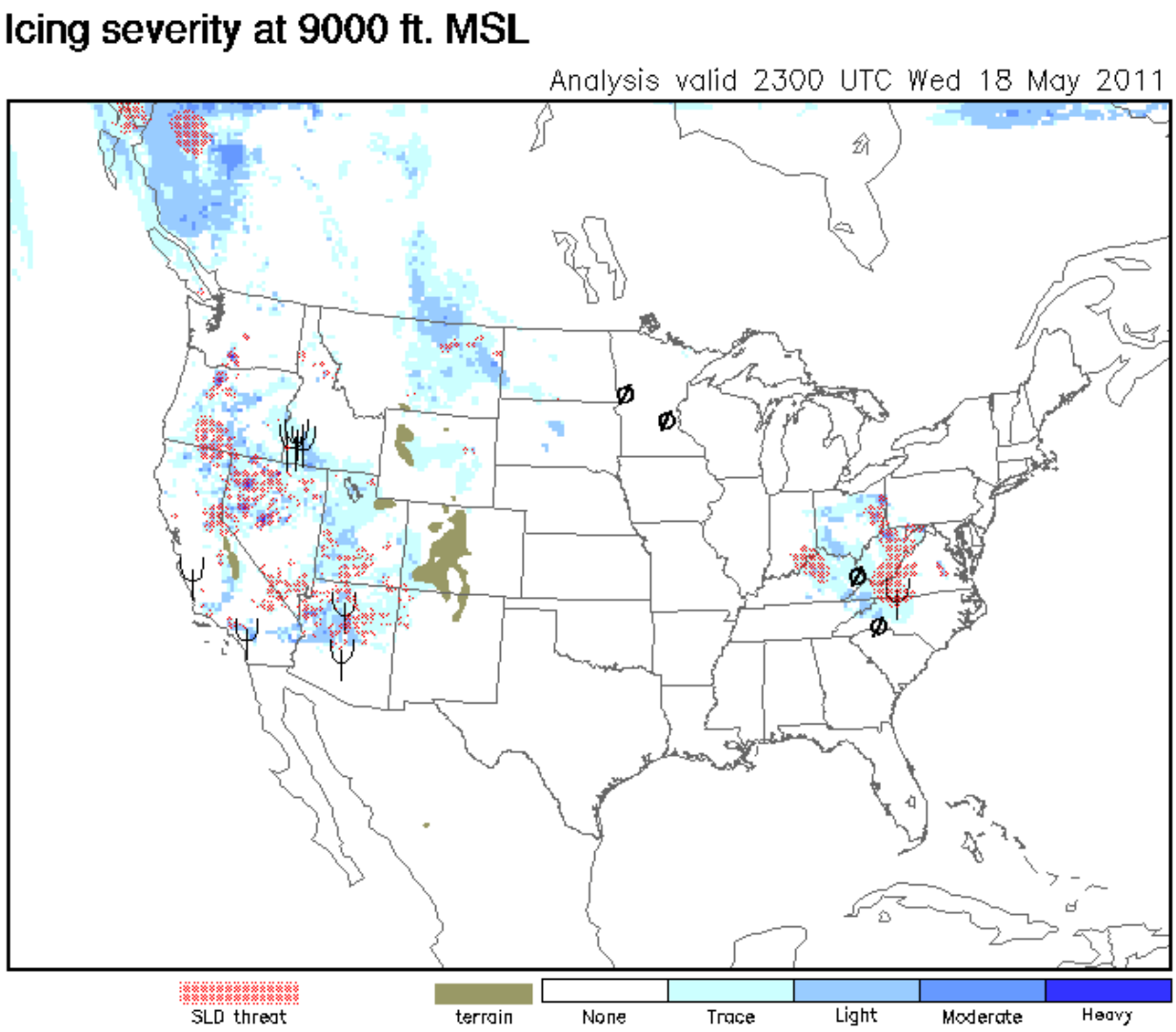

Figure 13 – CIP icing severities and SLD for 1600 PDT at 9,000 feet.

By FAA policy CIP is a Supplementary Weather Product for enhanced situational awareness only and must be used with one or more primary products (safety decision) such as an AIRMET or SIGMET (see AIM 7-1-3).

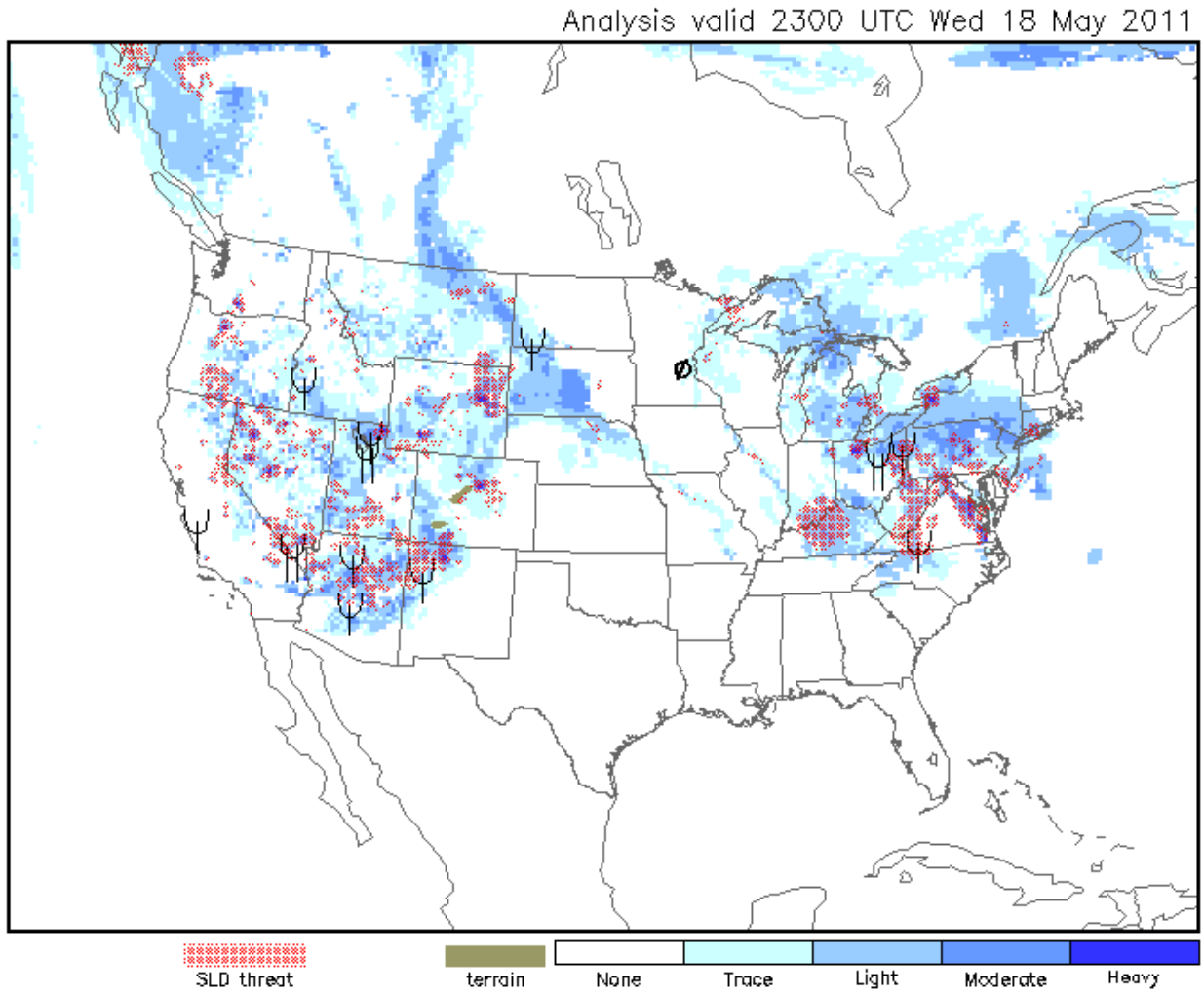

Figure 14 – CIP icing severities and SLD for 1600 PDT at 11,000 feet.

U.S. Surface Prognostic Chart

At approximately 0800 PDT, a 12-hour surface prognostic chart (figure 15) was issued for the continental United States and valid for 1700 PDT.

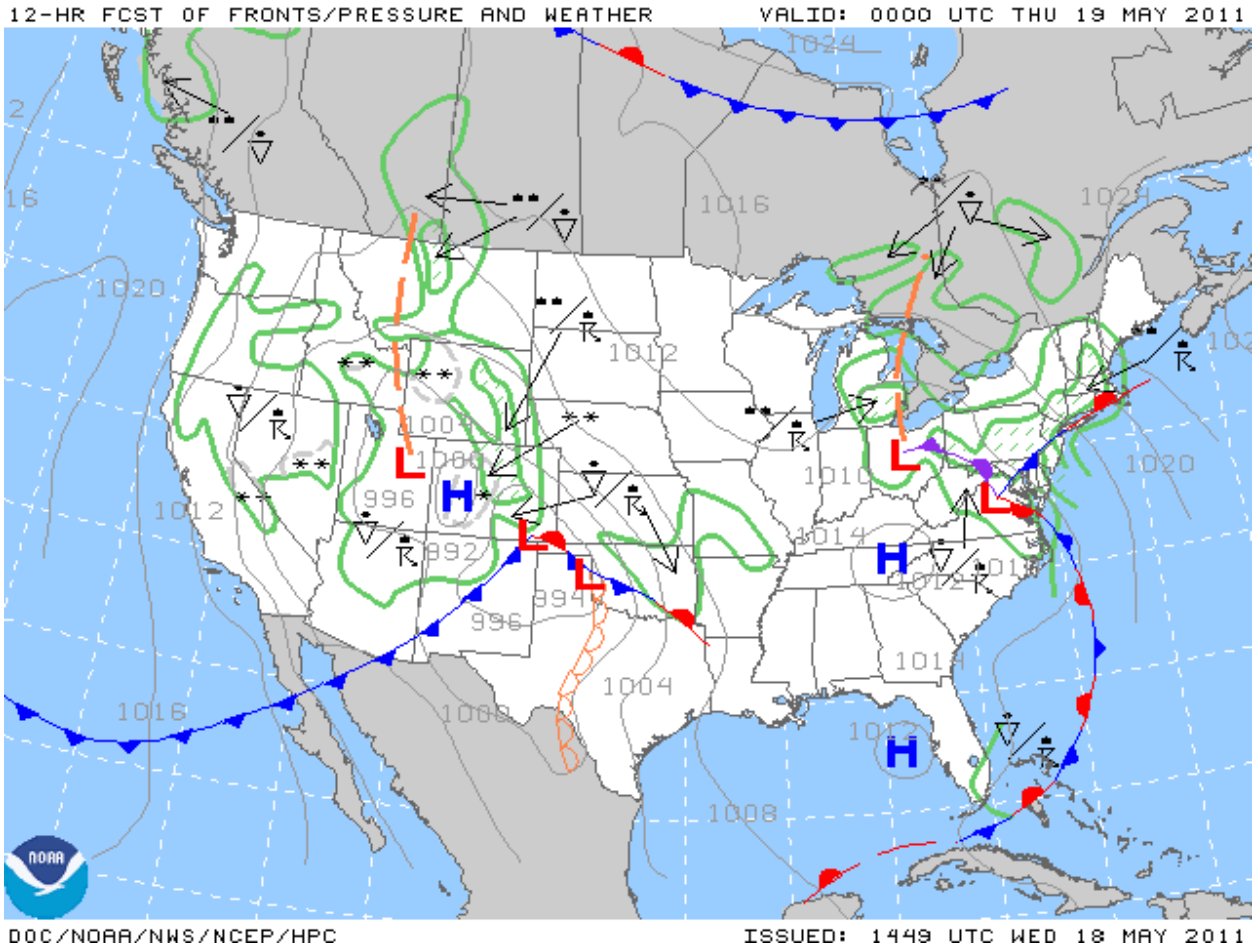

Figure 15 – U.S. Surface 12-hr Prognostic Chart valid for 0600 MDT.

Astronomical Data

The astronomical data obtained from the United States Naval Observatory for 38.5°N and 120.2°W on May 18, 2011, indicated the following:

SUN	
Sunrise	0547 PDT
Sun transit	1257 PDT
Sunset	2008 PDT

Mike Richards
NTSB Meteorologist