



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

September 27, 2019

Group Chairman's Factual Report

METEOROLOGY

DCA19CA081

Table Of Contents

A.	ACCIDENT	3
B.	METEOROLOGY GROUP	3
C.	DETAILS OF THE INVESTIGATION	3
D.	FACTUAL INFORMATION	3
1.0	Synoptic Conditions.....	3
2.0	Weather Radar	6
3.0	Upper Air Data.....	11
4.0	Satellite Imagery	12
5.0	Lightning.....	13
6.0	Pilot Reports.....	13
7.0	SIGMETs	15
8.0	CWSU Products	16
9.0	AIRMETs for Turbulence.....	17
10.0	Area Forecast Discussion.....	18
11.0	NWSChat logs	20
12.0	CIWS.....	20
13.0	Astronomical Data	27
E.	LIST OF ATTACHMENTS	28

A. ACCIDENT

Location: Reno, Nevada¹
Date: February 13, 2019
Time: about 1231 Pacific standard time (2031 UTC²)
Aircraft: Embraer ERJ170; N613CZ

B. METEOROLOGY GROUP

Mike Richards	Brian Hirsch
Group Chairman	Group Member
Senior Meteorologist	Regional Aviation Meteorologist
Operational Factors Division (AS-30)	Central Region Headquarters - Kansas City
National Transportation Safety Board	National Weather Service

C. DETAILS OF THE INVESTIGATION

The Meteorology Group traveled in support of this event to the Oakland Air Route Traffic Control Center (ZOA) and also gathered data for this accident investigation remotely. Unless otherwise noted, all times are in Pacific standard time (PST) for February 13, 2019 (based upon the 24-hour clock), directions are referenced to true north, distances are in nautical miles and heights are above mean sea level (msl).

Coordinates used for the accident location in this report: 37.8206° north latitude, 119.684° west longitude at FL340³.

D. FACTUAL INFORMATION

1.0 Synoptic Conditions

Upper air maps from the NWS Storm Prediction Center (SPC) at 1600 PST for 300 hectopascals

¹ This location is often recorded as the nearest community with a US Post Office within the state where the accident/incident occurred. However, this location may not directly correlate to the coordinates of the accident site. Such situations include when the accident/incident occurred in a remote area, in international territories or aloft (where the aircraft landed safely at another location).

² UTC – abbreviation for Coordinated Universal Time

³ 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 hectopascals (29.92 in Hg), the average sea-level pressure, and therefore is not necessarily the same as the aircraft's true altitude either above msl or above ground level (agl).

(hPa) and 250 hPa depicted regional wind conditions for about FL300 and about FL340, respectively. The 300 hPa chart (figure 1) depicted a westerly wind of between 75 and 125 knots around the accident location. The 250 hPa chart (figure 2) depicted a west-southwesterly wind of between 125 and 175 knots around the accident location.

A WSR-88D regional radar composite reflectivity mosaic obtained from the National Centers for Environmental Information (NCEI) for 1230 PST (figure 3) depicted light (<26 dBZ) to extreme (>50 dBZ) values of reflectivity across northern California and western Nevada. Mainly light to moderate values of reflectivity were depicted in the immediate vicinity of the accident location, with a small area of extreme values to the west and southwest.

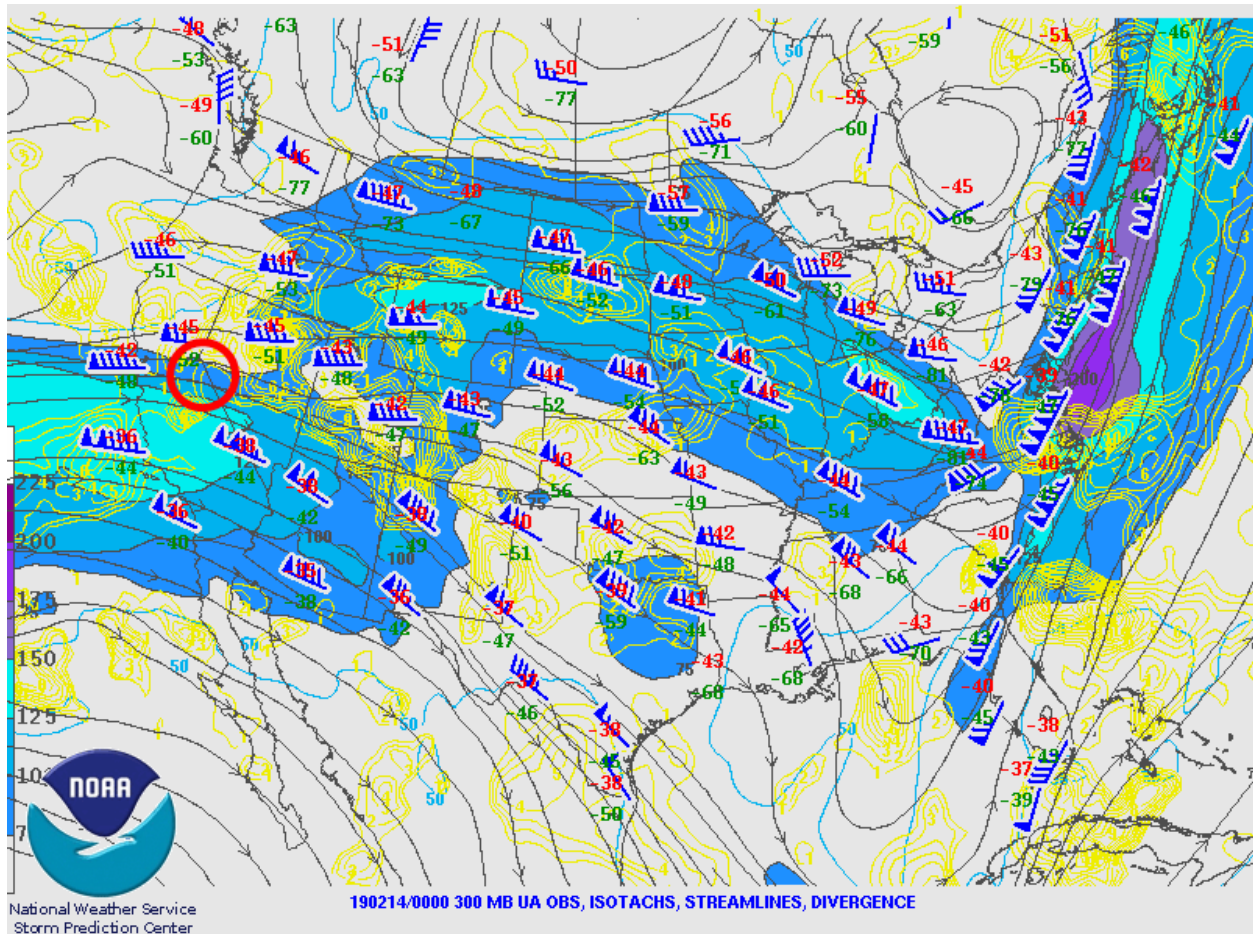


Figure 1 – SPC 300 hPa chart valid at 1600 PST. The accident location is denoted by the red circle.

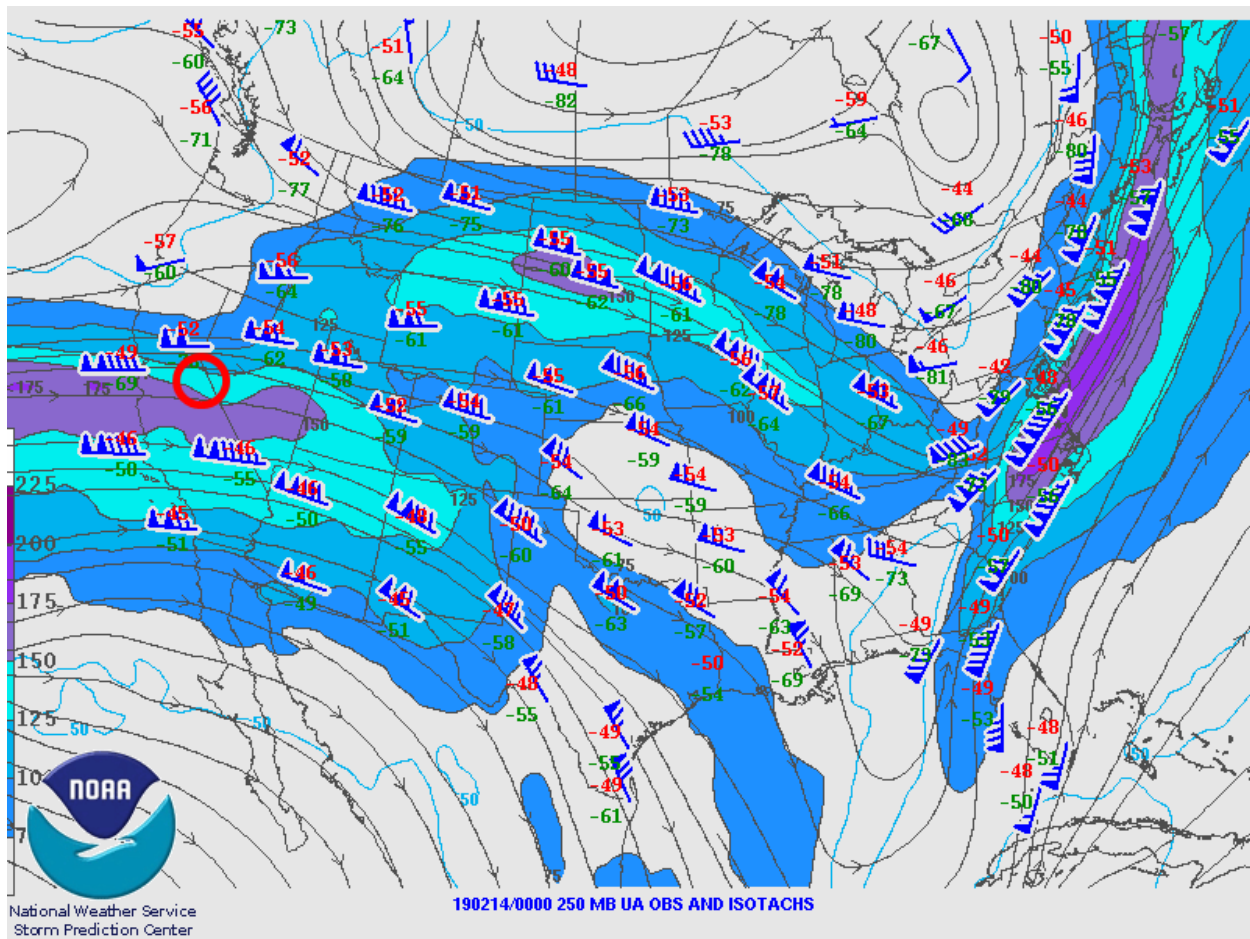


Figure 2 – SPC 250 hPa chart valid at 1600 PST. The accident location is denoted by the red circle.

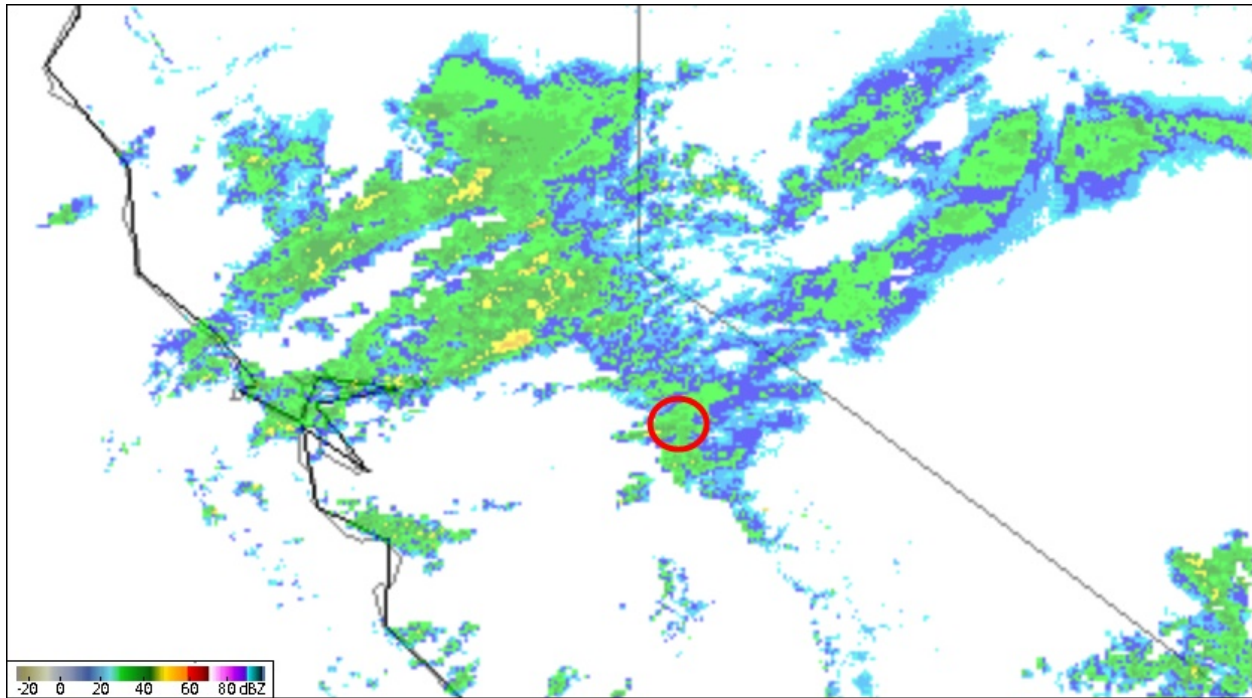


Figure 3 – NCEI WSR-88D mosaic from 1230 PST.

2.0 Weather Radar

WSR-88D Level-II weather radar imagery from near Sacramento, California (KDAX), are presented in figures 4-5. KDAX was located approximately 103 miles northwest of the accident site at an elevation of about 140 feet. Assuming standard refraction and considering the 0.95° beam width for the WSR-88D radar beam, the KDAX 0.48° and 2.41° tilts would have “seen” altitudes above the accident location of between about 7,200 and 17,600 feet msl and between about 28,300 and 38,700 feet msl, respectively.

A vertical cross-section of the Level-II weather radar imagery around this time along and in front of the accident aircraft’s trajectory at the accident time is presented in figure 6.

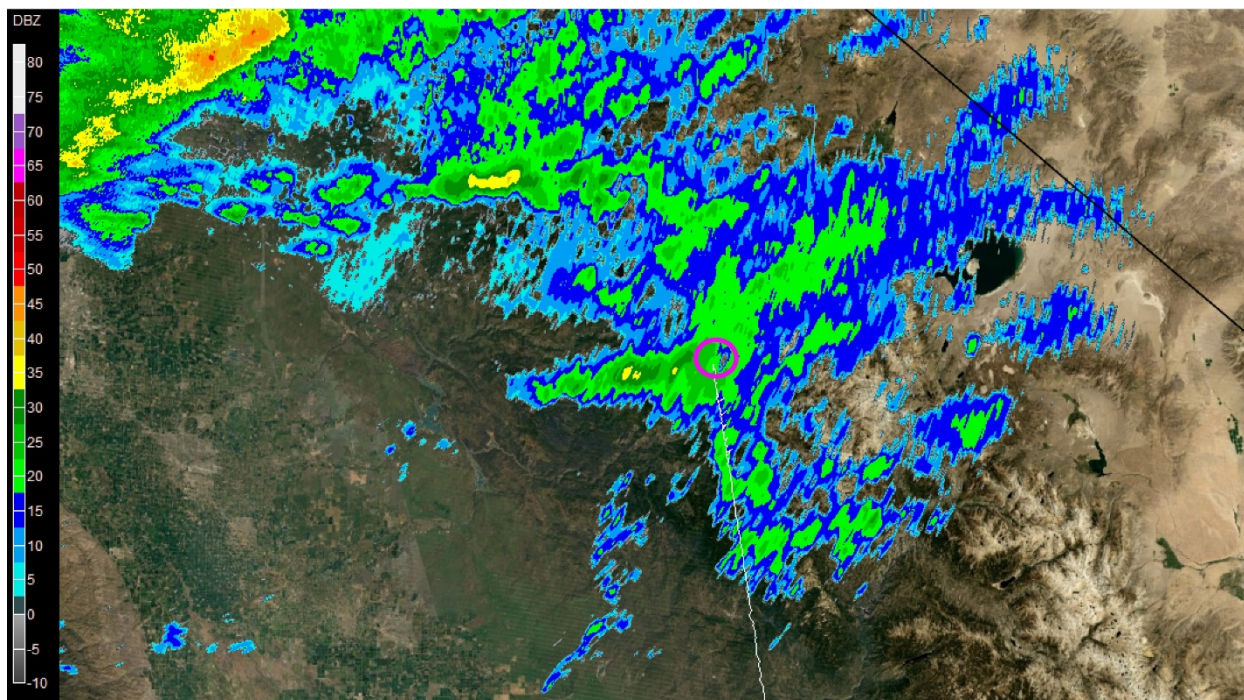


Figure 4 – KDAX 0.48° Level-II reflectivity product from a sweep initiated at 1230:53 PST. The accident aircraft’s flight path through 1231:34 PST is depicted by white line. The accident location is within the pink circle.

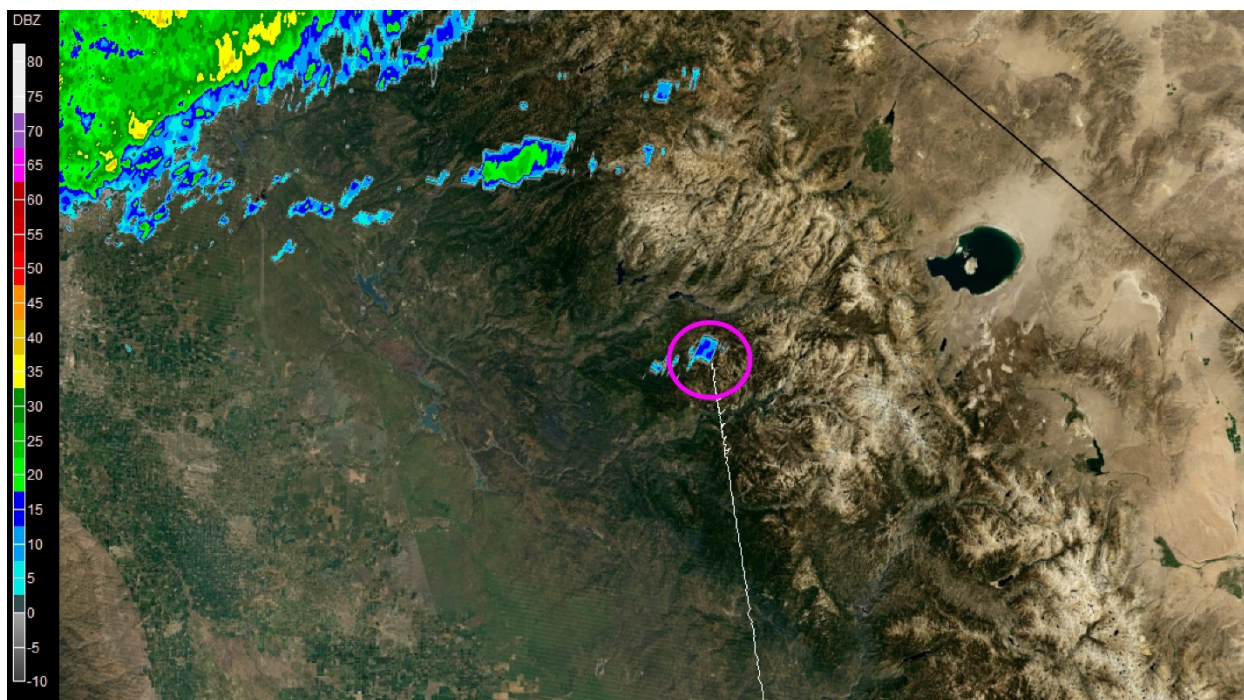


Figure 5 – KDAX 2.41° Level-II reflectivity product from a sweep initiated at 1232:41 PST. The accident aircraft’s flight path through 1231:34 PST is depicted by white line. The accident location is within the pink circle.

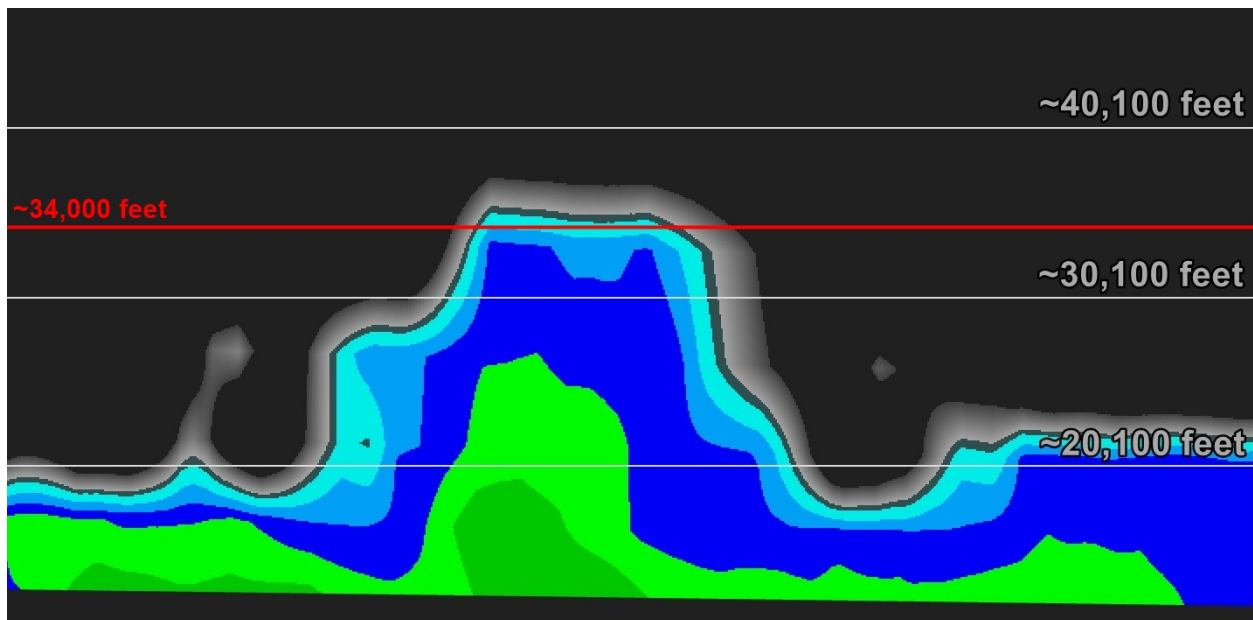


Figure 6 – Vertical cross-section of the KDAX Level-II weather radar imagery for the volume scan initiated at 1230:53 PST along and in front of the accident aircraft’s trajectory at the accident time (mostly within the pink circle in figure 5). Color table is as presented in figures 4 and 5.

Figure 7 is a brightened screen capture of a replay of the ZOA Weather and Radar Processor (WARP) radar mosaic applicable to 1231 PST. “Precipitation” intensities are “moderate” (blue color), “heavy” (green/black “checkerboard” color) and “extreme” (light green color; not seen in figure 7). Altitude composite is not known.

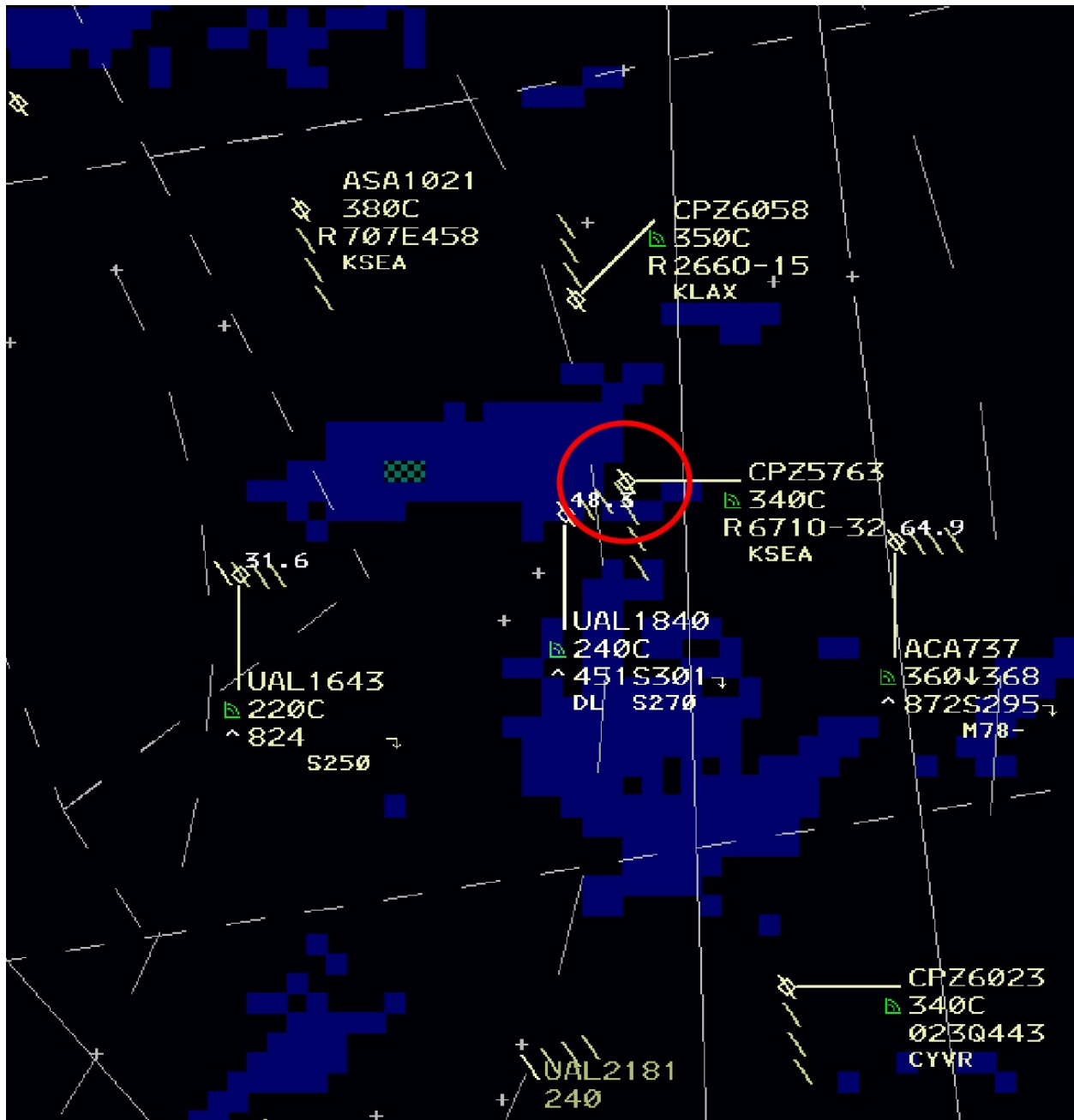
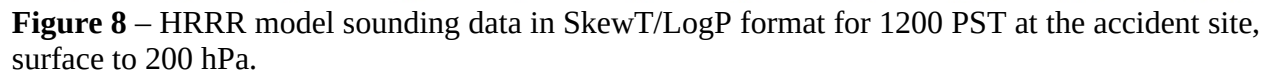


Figure 7 – Brightened screen capture of a replay of the ZOA WARP radar mosaic applicable to 1231 PST. The accident location is denoted by the red circle.

A High-Resolution Rapid Refresh (HRRR) model⁴ sounding (figure 8) for the accident site at 1200 PST was retrieved from the National Oceanic and Atmospheric Administration's Air Resources Laboratory. At 34,000 feet the wind was from the west-southwest at about 150 knots. Below this level, the wind remained from the west-southwest but decreased dramatically in magnitude to about 80 knots at 29,000 feet. Calculations made by the Rawinsonde OBservation Program (RAOB) indicated the potential for extreme or severe turbulence conditions between about 34,000 feet and 28,500 feet. RAOB also identified the potential for cloudy conditions at various levels between the surface and the tropopause, including the layer between about 31,500 and 37,000 feet.



MET FACTUAL REPORT

4.0 Satellite Imagery

Geostationary Operational Environmental Satellite (GOES)-17 visible ($0.64\mu\text{m}$) and infrared ($10.3\mu\text{m}$) data were obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison. Imagery from about 1227 PST is presented in figures 9 and 10. Maximum GOES-17 infrared cloud-top temperatures within about 10 miles of the accident location were -50°C , which, when considering the HRRR model sounding, corresponded to cloud top heights of about 34,600 feet. Due to parallax error in the satellite imagery, cloud tops of a height of 34,600 feet are displaced to the north-northeast about 6 miles from its ground location. In figures 9 and 10, the accident aircraft's ground position has been adjusted to reflect its height of approximately 35,000 feet at accident time, which provides a more accurate location of the accident location relative to the highest cloud tops in the area.

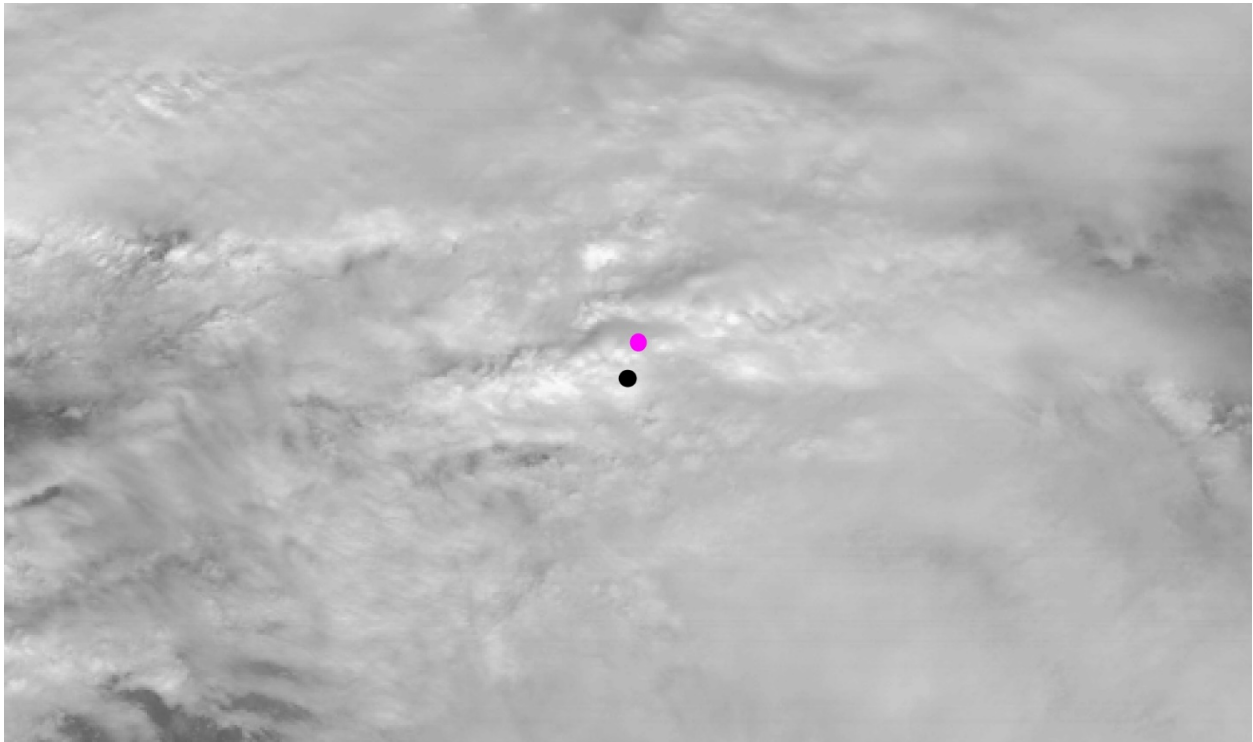


Figure 9 – GOES-17 visible imagery from about 1227 PST. Accident location denoted by black circle with accident location corrected for parallax error denoted by the pink circle.

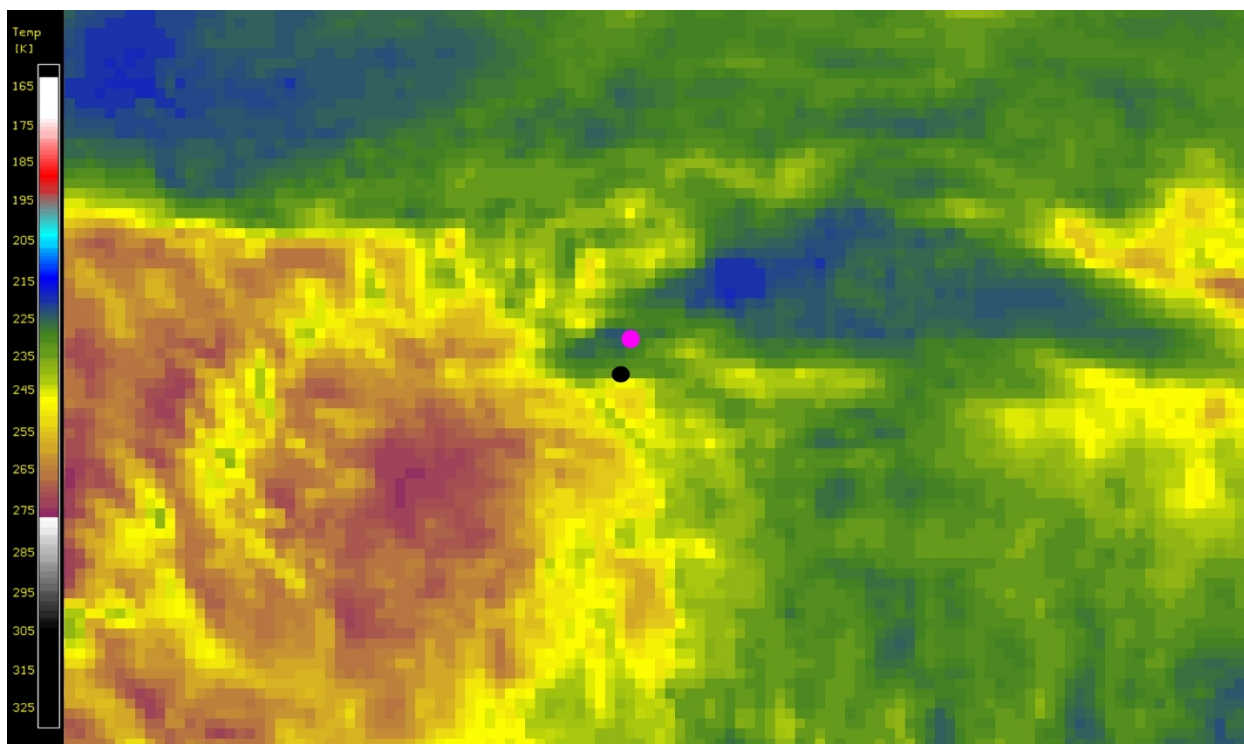


Figure 10 – GOES-17 infrared imagery from about 1227 PST. Accident location denoted by black circle with accident location corrected for parallax error denoted by the pink circle.

5.0 Lightning

The Earth Networks Total Lightning Network did not detect any lightning within about 15 miles of the accident site between 1200 and 1300 PST.

6.0 Pilot Reports

The following pilot reports (PIREPs) and AIREPs⁵ were made between 1100 and 1400 PST within 200 miles of the accident site between FL280 and FL450 (inclusive) and publicly-disseminated to the Federal Aviation Administration’s public database. All of these reports indicated moderate or greater turbulence, and the PIREPs reporting severe turbulence are highlighted below.

⁵ An AIREP is a routine, often automated report of in-flight weather conditions such as wind and temperature. AIREPs may contain information provided manually by the flight crew.

**MOD UUA /OV MOD075060/TM 1903/FL310/TP E175/TB SEV 310-325/RM
ZOA CWSU**

MCE UA /OV HYP/TM 1907/FL320/TP A333/TB MOD CAT 320/RM ZOA CWSU

ARP UAL363 3833N 11802W 1916 F300 M42 244/078 TB MOD SK IN CLOUDS
RM B764 OV MVA MVA MOD TBLNCE

BIH UA /OV BIH/TM 1925/FL300/TP E75/TB CONT LGT-MOD/RM ZOA CWSU

PRB UA /OV AVE160020 /TM 1950 /FL290 /TP A333 /TB MOD/RM AWC-WEB

MOD UA /OV MOD250090/TM 1957/FL260/TP B738/TB MOD CHOP/RM ZOA
CWSU

SAC UA /OV SAC200018/TM 2004/FL360/TP B787/TB MOD/RM ZOA CWSU

FAT UA /OV FRA009050 /TM 2021 /FL280 /TP A320 /TA M11 /IC LGT MX 280-
240 /RM ZOA CWSU AWC-WEB

**MOD UUA /OV MOD065061/TM 2033/FL340/TP E75S/TB SEV/RM ZOA
CWSU**

**MOD UUA /OV MOD065061/TM 2034/FL350/TP E75L/TB SEV/RM ZOA
CWSU**

**RNO UUA /OV MOD065061/TM 2034/FL310/TP E75S/TB SEV/RM TWO
FLIGHT ATTENDANTS INCAPACITATED. POSSIBLE DAMAGE TO
AIRCRAFT. DIVERTED TO RNO. CORRECTED PREVIOUS PIREP OF
FL WITH ADDITIONAL INFORMATION-ZOA CWSU**

ARP UAL2063 3840N 11717W 2048 F290 TB MOD RM B739 OV INSLO

**RNO UUA /OV TVL230040/TM 2056/FL280/TP H25/TB SEV INTMT
CHOP/RM KICKED AUTO PILOT OFF. CAUSED 60 DEGREE BANK-
ZOA CWSU**

MOD UA /OV MOD055060/TM 2110/FL320/TP E75L/TB MOD CHOP/RM ZOA
CWSU

**BIH UUA /OV BIH2700035/TM 2130/FL300/TP GLF5/TB MOD-SEV CAT /RM
WEST BOUND-ZOA CWSU**

**BIH UUA /OV BIH270035/TM 2130/FL300/TP GLF5/TB MOD-SEV CAT/RM
WEST BOUND. CORRECTED LOCATION-ZOA CWSU**

TPH UA /OV MVA260015/TM 2131/FL310/TP CL60/TB MOD/RM ZOA CWSU

TPH UA /OV MVA/TM 2132/FL370/TP B737/TB CONS LGT-OCNL MOD/RM
ZOA CWSU

**FAT UUA /OV CZQ160015/TM 2151/FL330/TP E75L/TB SEV CHOP/RM FOR
ABOUT 30 SECONDS SOUTH BOUND-ZOA CWSU**

**SFO UA /OV OSI220040/TM 2156/FL300/TP B77W/TB MOD 300-320/RM ZOA
CWSU**

7.0 SIGMETs

There were two non-convective Significant Meteorological Information (SIGMET) advisories active in the region at the accident time. One SIGMET (issued at 1116 PST) advised of occasional severe turbulence below 10,000 feet, and the other SIGMET (issued at 1022 PST) advised of occasional severe turbulence between FL200 and FL300. While both SIGMETs covered the geographic area of the accident location, neither was applicable for the accident altitude of FL340 (see figure 11).

WSUS06 KPCI 131916

WS6R

-SFOR WS 131916

SIGMET ROMEO 2 VALID UNTIL 132316

CA NV AND CSTL WTRS

FROM 50NNW FMG TO OAL TO 70SSE SNS TO PYE TO 50NNW FMG

OCNL SEV TURB BLW 100. DUE TO STG LOW LVL WND AND STG UDDFS AND
LLWS. RPTD BY ACFT. CONDS CONTG BYD 2316Z.

WSUS06 KPCI 131822

WS6V

-SFOV WS 131822

SIGMET VICTOR 1 VALID UNTIL 132222

CA NV AZ AND CSTL WTRS

FROM 80N OAL TO EED TO 120SSW RZS TO 70W PYE TO 80N OAL

OCNL SEV TURB BTN FL200 AND FL300. DUE TO WND SHR ASSOCD WITH JTST
AND MTN WV ACT. RPTD BY ACFT. CONDS CONTG BYD 2222Z.

There were two Convective SIGMET advisories issued at 1155 PST that were active in the region at the accident time. One Convective SIGMET advised of an area of embedded thunderstorms with tops to FL360 to the west of the accident location. The other Convective SIGMET advised of a diminishing area of embedded thunderstorms with tops to FL310 and was active for the accident location (see figure 11).

WSUS33 KPCI 131955

SIGW

-MKCW WST 131955

CONVECTIVE SIGMET 6W

VALID UNTIL 2155Z

CA AND CSTL WTRS

*FROM 20NE RBL-40WNW FMG-30NE SNS-150SW PYE-150WSW ENI-20NE RBL
AREA EMBD TS MOV FROM 24035KT. TOPS TO FL360.*

CONVECTIVE SIGMET 7W

VALID UNTIL 2155Z

NV CA

*FROM 50ESE FMG-50NW OAL-50N CZQ-30NE MOD-60NE MOD-50ESE FMG
DMSHG AREA EMBD TS MOV FROM 24035KT. TOPS TO FL310.*

8.0 CWSU Products

There was one Center Weather Advisory (CWA) active in the accident region at the accident time and this was issued by the Center Weather Service Unit (CWSU) at ZOA. At 1116 PST, the ZOA CWSU issued the following CWA advising of an area of occasional severe turbulence between FL250 and FL330. This CWA was located immediately to the west of the accident location (see figure 11).

FAUS22 KZOA 131917

ZOA2 CWA 131916

ZOA CWA 201 VALID UNTIL 132116

*FROM 80N MOD-50NNE EHF-60S CZQ-15NW SAC-80N MOD
AREA OCNL SEV TURB. FL250-330. . RPRTD BY ACFT. ZOA CWSU*

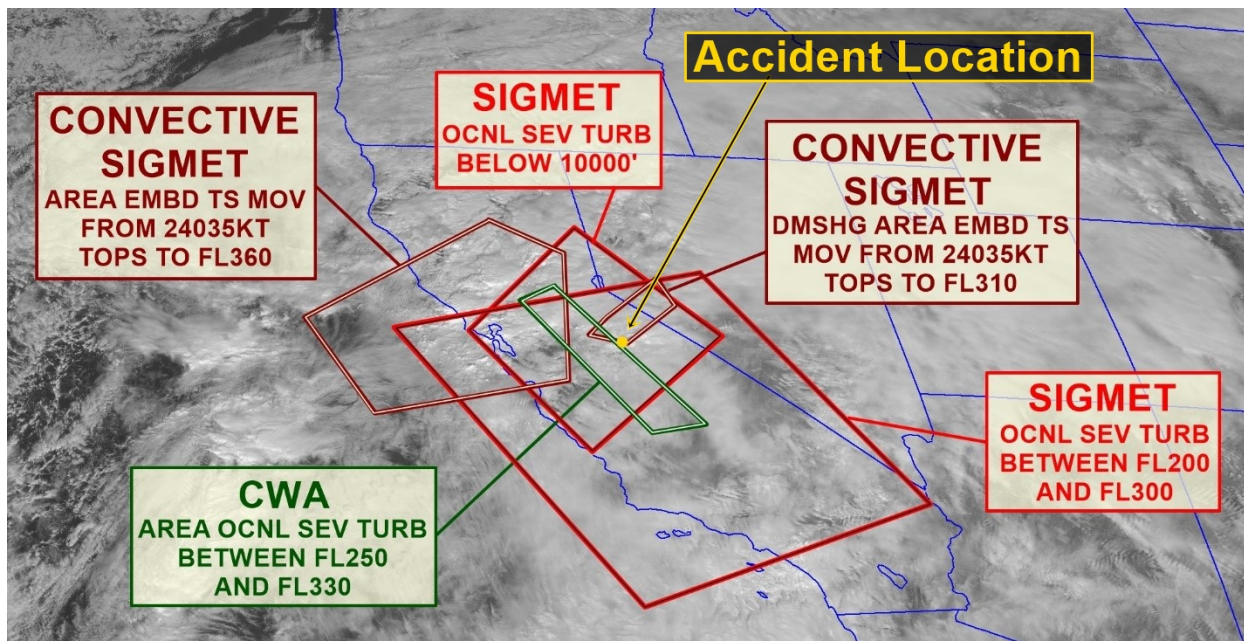


Figure 11 – Depiction of SIGMETs, Convective SIGMETs and CWAs active in the accident region at the accident time. The accident location is denoted by the yellow circle.

Copies of the Pre-Duty Weather Briefing videos produced by the ZOA CWSU at the nominal times of 2030 PST on February 12, 2019, and 0545 PST on the accident day can be found in the NTSB’s public docket for this accident investigation.

9.0 AIRMETs for Turbulence

An Airmen’s Meteorological Information (AIRMET) Tango was active for moderate turbulence between FL200 and FL400 for a region that included the accident site.

WAUS45 KPCI 131822 AAB
 WA5T
 -SLCT WA 131822 AMD
 AIRMET TANGO UPDT 7 FOR TURB STG WNDS AND LLWS VALID UNTIL 132100
 .
 ...SEE SIGMET QUEBEC SERIES...
 .
 ...SEE SIGMET ROMEO SERIES...
 .

...SEE SIGMET VICTOR SERIES...UPDT

*.
AIRMET TURB...ID WY NV UT CO AZ NM OR CA AND CSTL WTRS
FROM 60E DSD TO 70SW RAP TO BFF TO GLD TO 50W LBL TO 30ESE TBE TO
INK TO ELP TO 50S TUS TO BZA TO 20S MZB TO 220SW MZB TO
140WSW FOT TO 130WNW FOT TO 60E DSD
MOD TURB BTN FL200 AND FL400. CONDS CONTG BYD 21Z THRU 03Z.*

10.0 Area Forecast Discussion

The following Aviation section of an Area Forecast Discussion was issued by the NWS Weather Forecast Office (WFO) in Reno, Nevada, (REV) at 0429 PST on the accident day. This information was repeated in the next AFD issued by REV at 0933 PST, which was the current REV AFD for the accident time. The accident did not occur within the County Warning Area (i.e., jurisdiction) of REV (the border of the REV County Warning Area was about 18 miles away at its closest point). The summary of an interview conducted with the REV meteorologist who wrote the Aviation section of the AFD is provided in Attachment 2.

*FXUS65 KREV 131229
AFDREV
Area Forecast Discussion
National Weather Service Reno NV
429 AM PST Wed Feb 13 2019*

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.AVIATION...*

A very strong Pacific storm will impact the region through the end of the week, and to a lesser extent, into the weekend. Conditions have already deteriorated in the Sierra and are only expected to get worse through Thursday. Periods of torrential rain, very heavy snow, and damaging winds should be expected.

The wind in western Nevada could cause extensive delays to air traffic and periods of downright dangerous flying conditions with extreme turbulence, very strong low level wind shear, and unpredictable near-surface rotors. A High Wind Warning is in affect Wednesday and Thursday. Ridge top winds in excess of 130+ knots are likely with the jet stream over the Sierra strengthening to 180+ knots as the polar and subtropical jets collide over the region. This is a particularly dangerous situation for aviation in the lee of the Sierra over the next few days.

Very heavy precipitation is expected to keep mainly IFR/LIFR conditions in the Sierra for the next 48+ hours. Snow levels will vary considerably during that time period likely changing p-type at Sierra terminals from snow (now) to rain (today) and back to snow (Thursday evening). Significant snow accumulations at Sierra terminals are expected again of 1-2 feet by Friday morning. Snow accumulations of up to a few inches will again be possible at KRNO/KCXP as by Friday morning. -Zach

The accident occurred within the County Warning Area of the San Joaquin Valley/Hanford, California, NWS WFO (HNL). The Aviation section of the HNL AFD that was current at the time of the accident was issued at 0411 PST and is presented here. This Aviation section was originally issued in the 1449 PST HNL AFD the previous day, but this was not indicated in the 0411 PST AFD.

FXUS66 KHNH 131211

AFDHNL

Area Forecast Discussion

National Weather Service San Joaquin Valley - Hanford CA

411 AM PST Wed Feb 13 2019

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.AVIATION...

Increasing cloud cover with areas of mountain obscuring in low clouds and precipitation in the high Sierra Nevada after 03Z Wed and overspreading over the lower sierra foothills and the Tehachapi Mountains around 15Z Wed. Areas of MVFR with local IFR in low clouds and showers in the San Joaquin Valley after 15Z Wed. Increasing wind +35kt gusts over the high sierra after 03z overspreading into the San Joaquin Valley and Tehachapi Mountains by 12z Wed. Otherwise, VFR conditions can be expected over the central CA interior during the next 24 hours..

The accident also occurred close to (about 6 miles at its closest point) the County Warning Area of the Sacramento, California, NWS WFO (STO). The Aviation section of the STO AFD that was issued at 0900 PST and was current at the time of the accident is presented here. This Aviation section was originally issued in the 0426 PST STO AFD on that day, but this was not indicated in the 0900 PST AFD.

FXUS66 KSTO 131700

AFDSTO

Area Forecast Discussion

National Weather Service Sacramento CA

900 AM PST Wed Feb 13 2019

·
..AVIATION...

Widespread precipitation has spread over NorCal with deteriorating conditions seen at sites. Primarily MVFR/IFR ceilings and visibilities are expected through the forecast period, although localized LIFR will be possible with any heavy precipitation. South winds pick up in the southern Sacramento Valley this morning with gusts up to 35 kts possible.

11.0 NWSChat logs

Attachment 3 contains NWSChat logs for the AWC, ZOA CWSU and HNX chatrooms for February 12, 2019, and February 13, 2019, as well as the NWSChat logs for the STO chatroom for February 12, 2019. No activity was recorded in the NWSChat REV chatroom on February 12, 2019, or February 13, 2019. No activity was recorded in the NWSChat STO chatroom on February 12, 2019.

12.0 CIWS

Archive data from the Federal Aviation Administration's Corridor Integrated Weather System (CIWS) for the accident region between 1215 and 1245 PST is presented in figures 12-18. These images present a weather radar depiction, echo top heights, cloud-to-ground lightning flash detections from the National Lightning Detection Network for the previous 6 minutes and convective growth and decay trends.

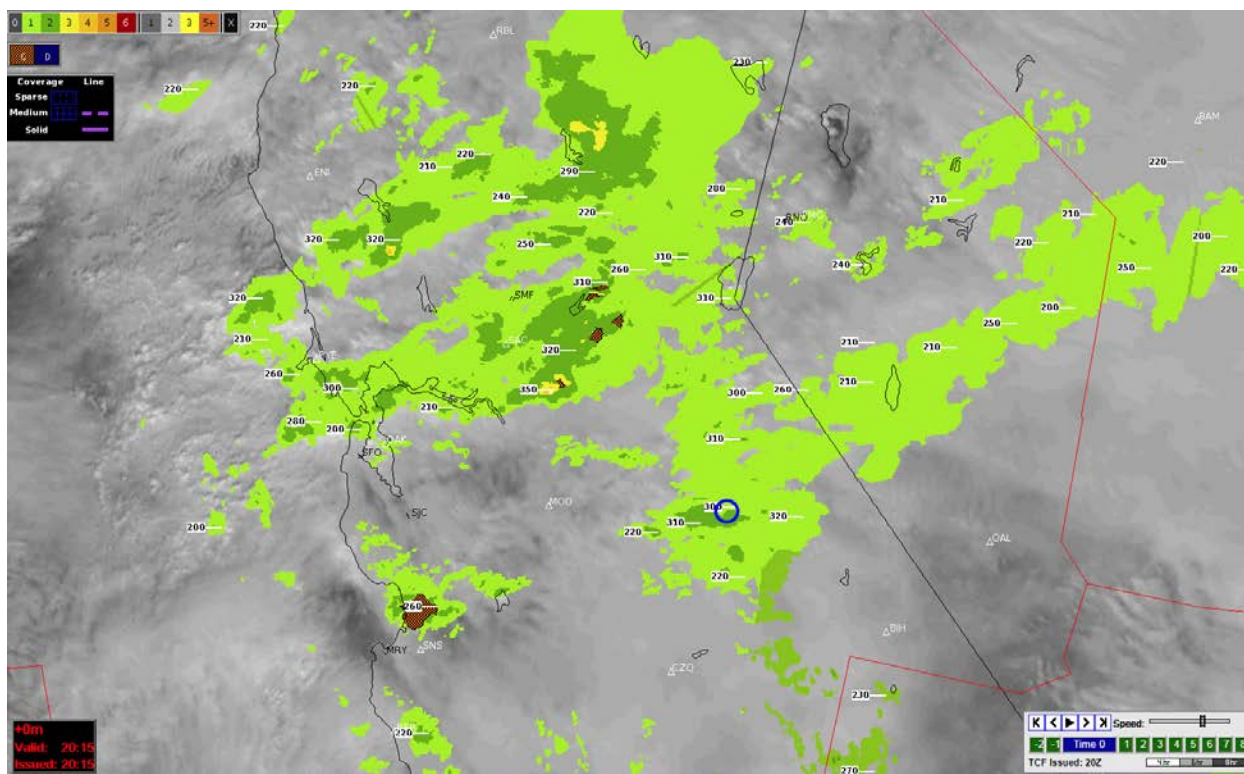


Figure 12 – Archive CIWS display from 1215 PST. Numbers indicate echo top heights (hundreds of feet).

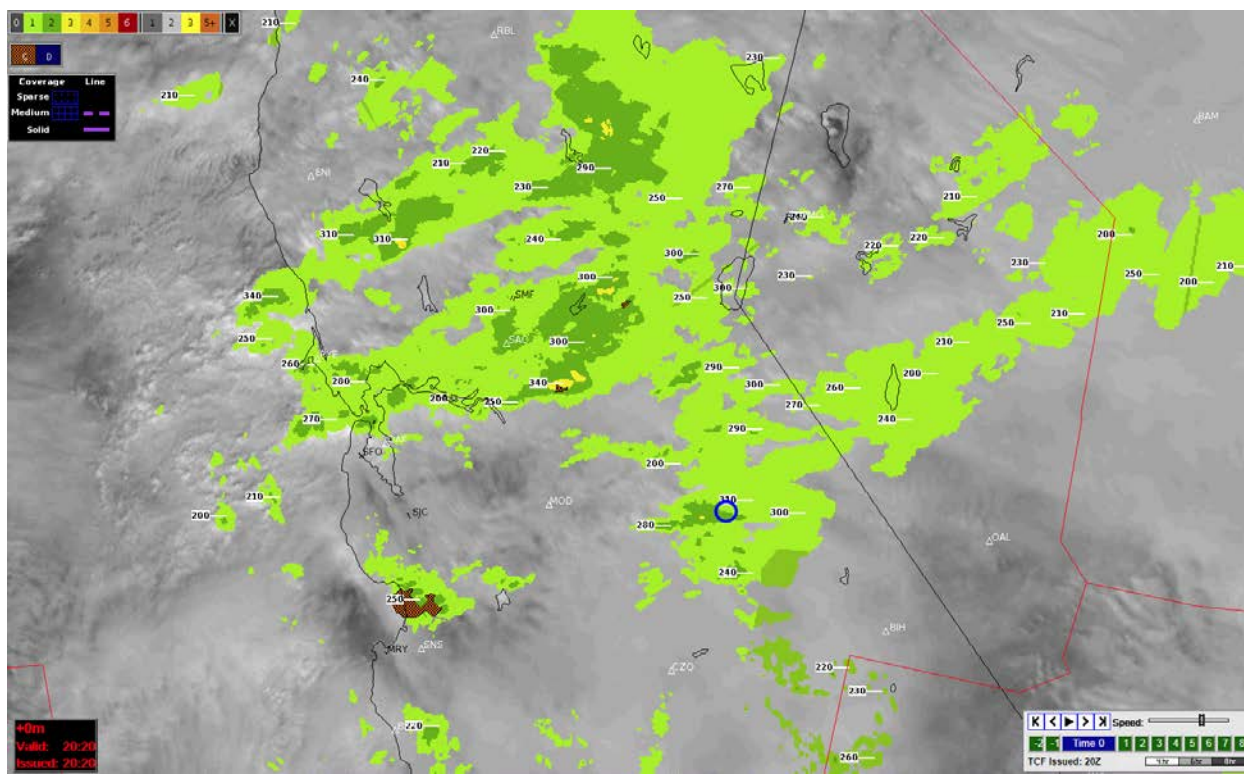


Figure 13 – Archive CIWS display from 1220 PST. Numbers indicate echo top heights (hundreds of feet).

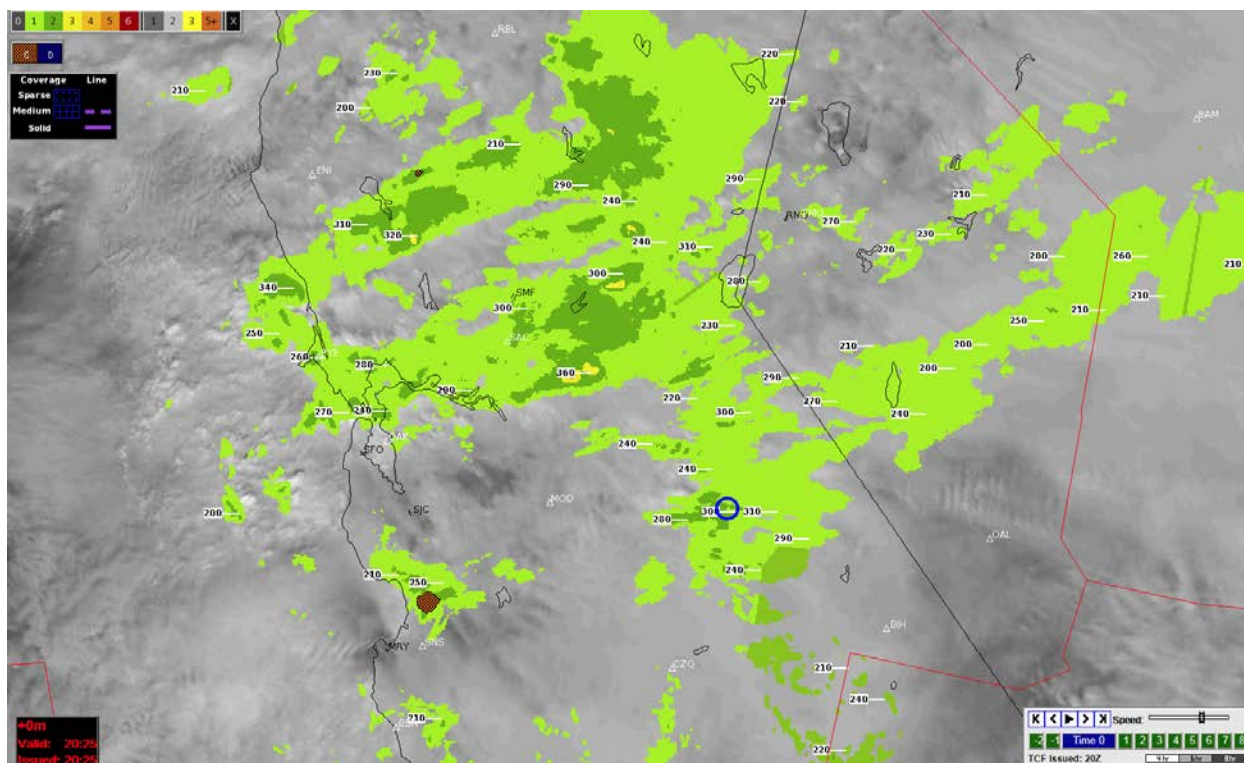
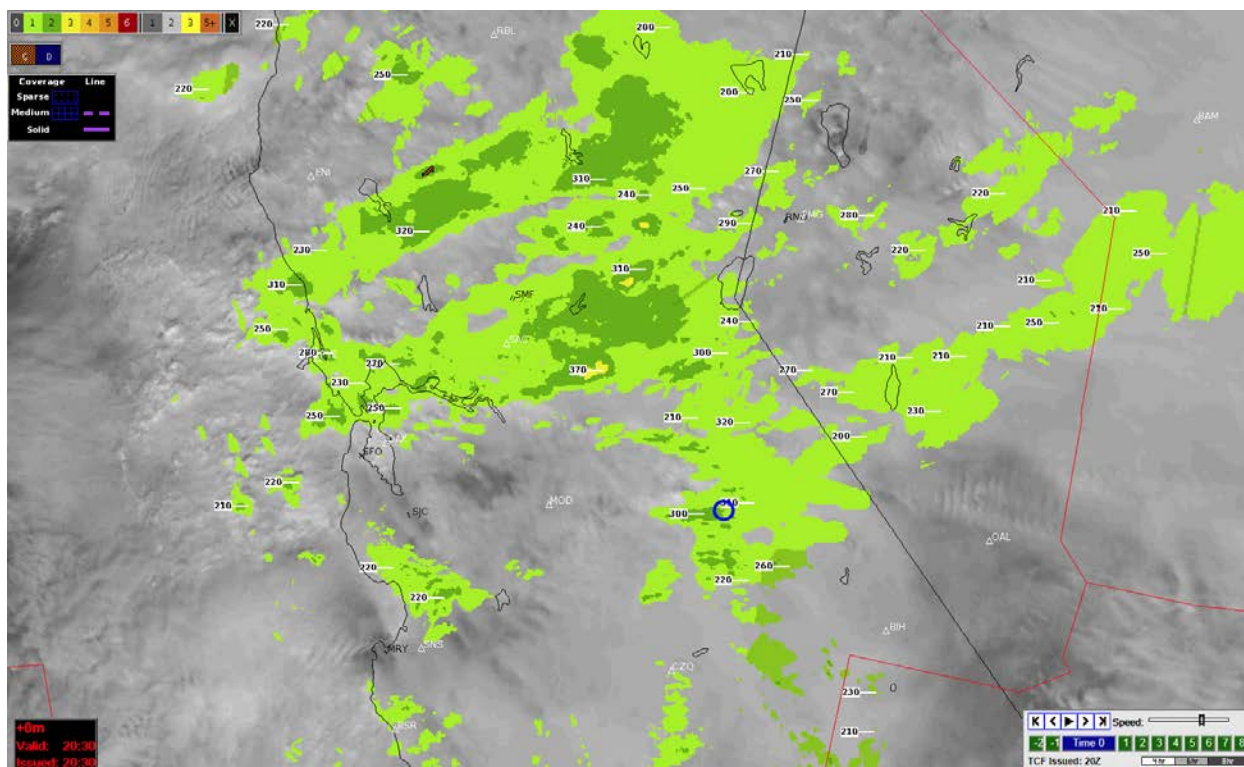


Figure 14 – Archive CIWS display from 1225 PST. Numbers indicate echo top heights (hundreds of feet).



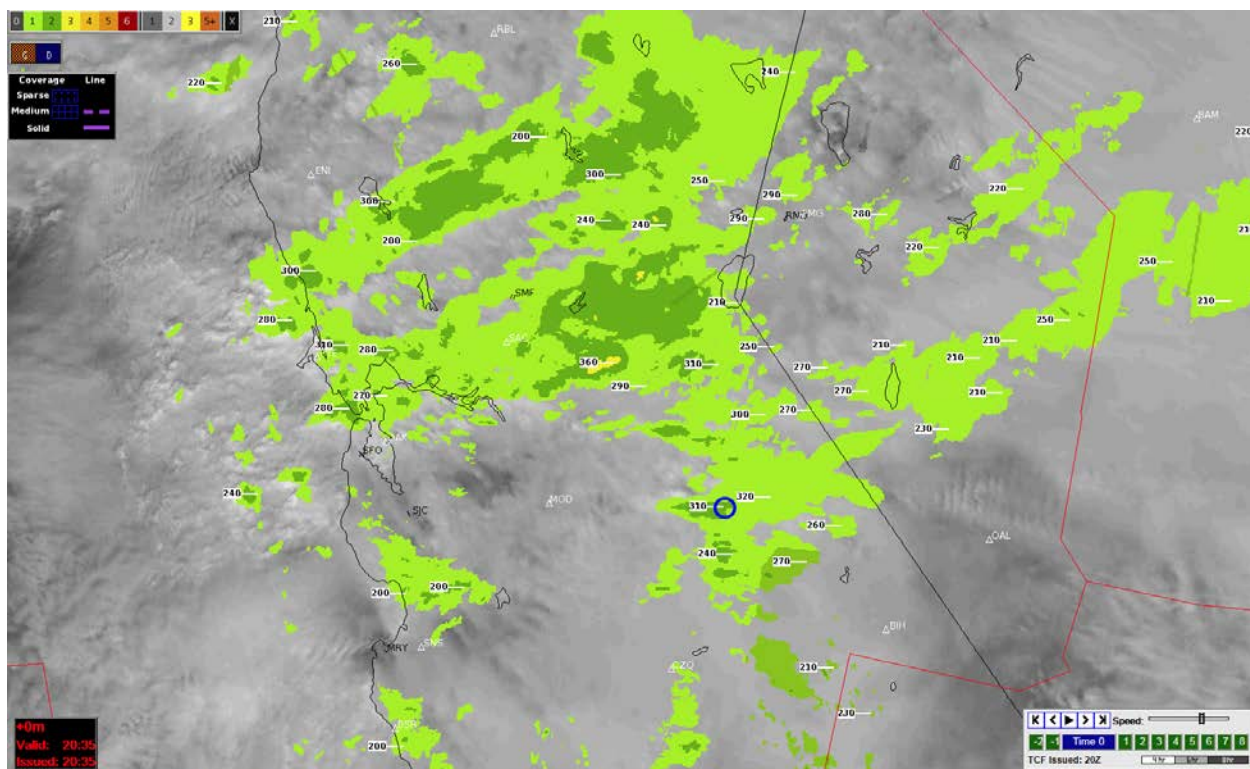


Figure 16 – Archive CIWS display from 1235 PST. Numbers indicate echo top heights (hundreds of feet).

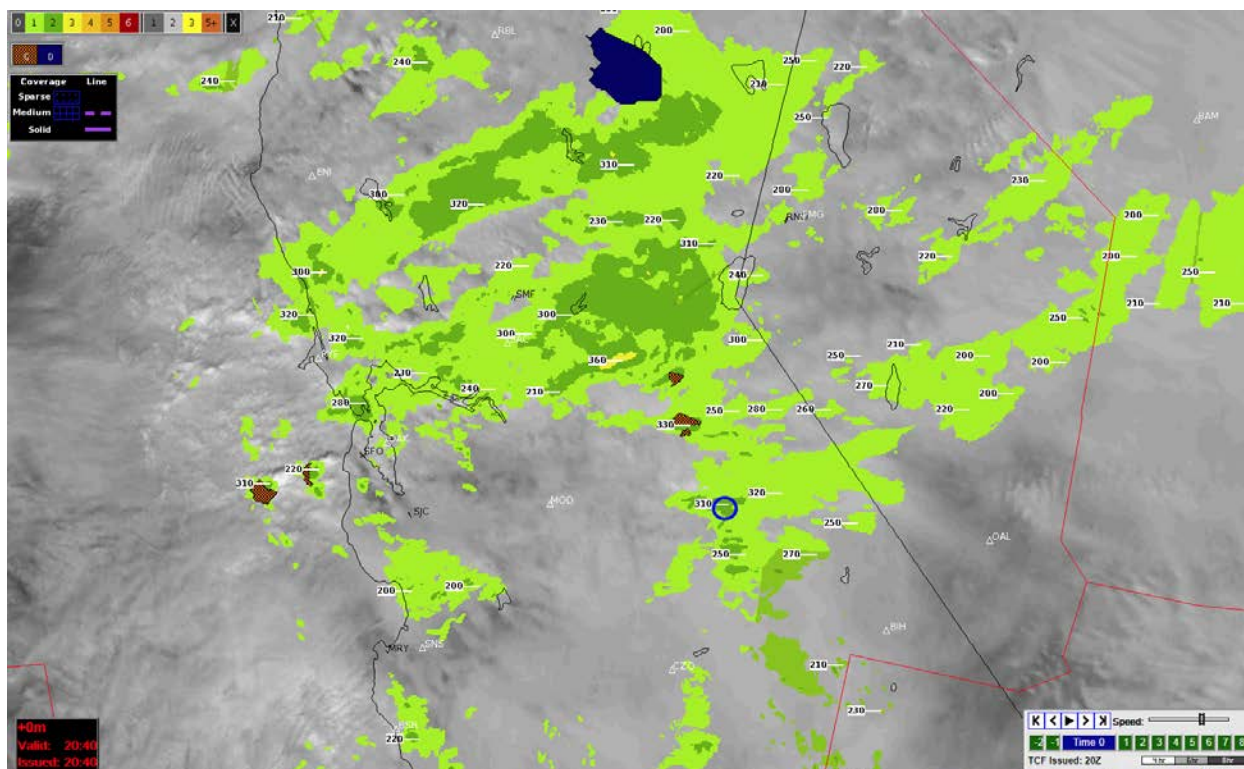


Figure 17 – Archive CIWS display from 1240 PST. Numbers indicate echo top heights (hundreds of feet).

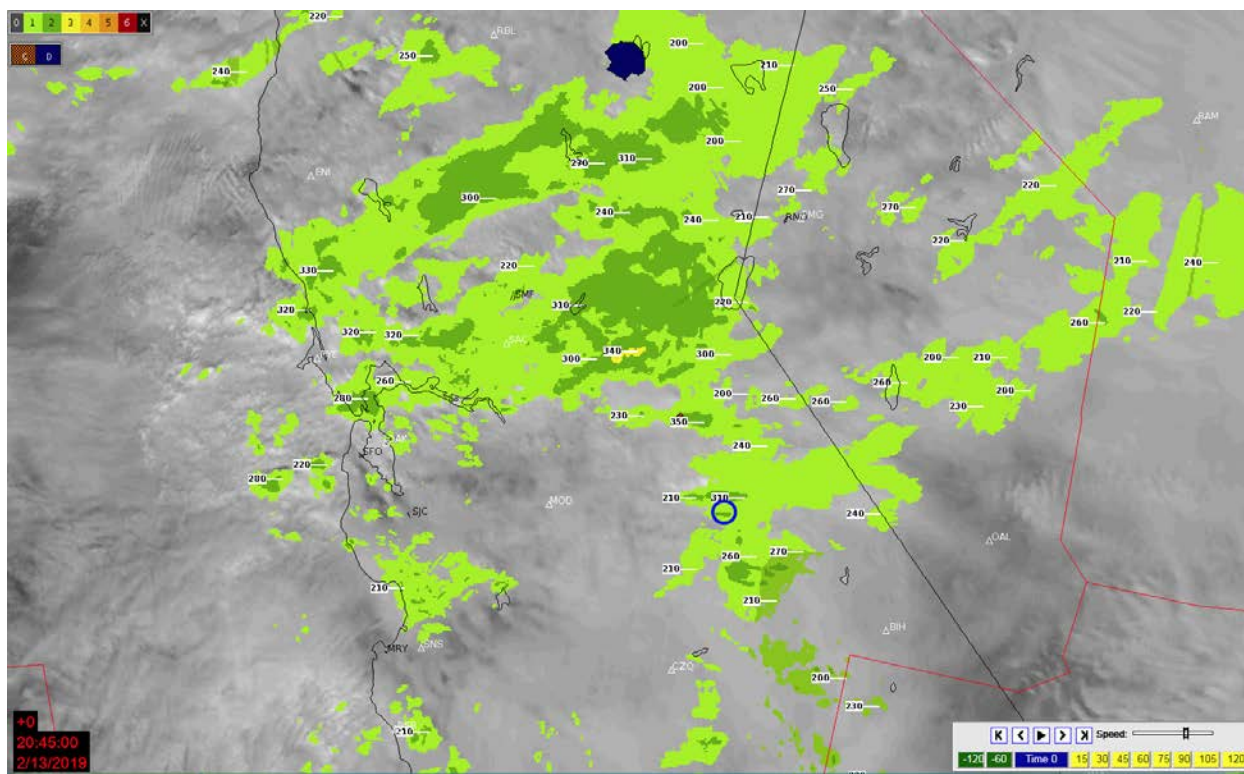


Figure 18 – Archive CIWS display from 1245 PST. Numbers indicate echo top heights (hundreds of feet).

13.0 Astronomical Data

The astronomical data obtained from the United States Naval Observatory for 37° 51' north latitude and 119° 41' west longitude, indicated sunrise occurred at 0624 PST and sunset occurred at 1735 PST.

E. LIST OF ATTACHMENTS

- Attachment 1 - Summary of an interview conducted with the National Weather Service meteorologist at the Oakland Center Weather Service Unit who was on duty the morning of the accident.
- Attachment 2 - Summary of an interview conducted with the National Weather Service meteorologist who wrote the Aviation section of the Area Forecast Discussion issued at 0429 and 0933 PST on February 23, 2019, by the National Weather Service Weather Forecast Office in Reno, Nevada.
- Attachment 3 - NWSChat logs for the Center Weather Service Unit at the Oakland Air Route Traffic Control Center, the Aviation Weather Center and the San Joaquin Valley/Hanford, California, National Weather Service Weather Forecast Office chatrooms for February 12, 2019, and February 13, 2019, as well as the NWSChat logs for the Sacramento, California, National Weather Service Weather Forecast Office chatroom for February 12, 2019.

Submitted by:

Mike Richards
Senior Meteorologist

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