



NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

September 1, 2020

Weather Study

METEOROLOGY

WPR20LA212

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A. ACCIDENT

Location: Lake Tahoe, California
Date: July 7, 2020
Time: 1523 Pacific daylight time (2223 UTC)¹
Aircraft: Type – Cessna 172; Registration – N6328D

B. METEOROLOGIST

Mike Richards
Senior Meteorologist
Operational Factors Division (AS-30)
National Transportation Safety Board

C. DETAILS OF THE INVESTIGATION

The National Transportation Safety Board’s meteorological specialist did not travel in support of this accident investigation and gathered all weather data remotely. Unless otherwise noted, all times are in Pacific daylight time (PDT) for July 7, 2020 (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).

The accident site was located at: 38.84463333° north latitude, 120.02370833° west longitude, at an elevation of about 6,365 feet.

D. WEATHER INFORMATION

1.0 Synoptic Conditions

A western portion of the National Weather Service (NWS) Surface Analysis Chart for 1400 PDT is presented in figure 1. The surface analysis chart identified a generally east-to-west-oriented cold front stretching from Utah into western Nevada to the east of the accident site. A trough of low-pressure was also depicted extending northwest-to-southeast across southern Oregon, northern California, Lake Tahoe and along the Nevada-California border south of Lake Tahoe. Temperatures in the accident region were in the low 80’s Fahrenheit (F), with dew point temperatures in the teens °F. Station models in the region depicted clear skies with variable winds with magnitudes ranging from calm to 10 knots.

¹ UTC – abbreviation for Coordinated Universal Time

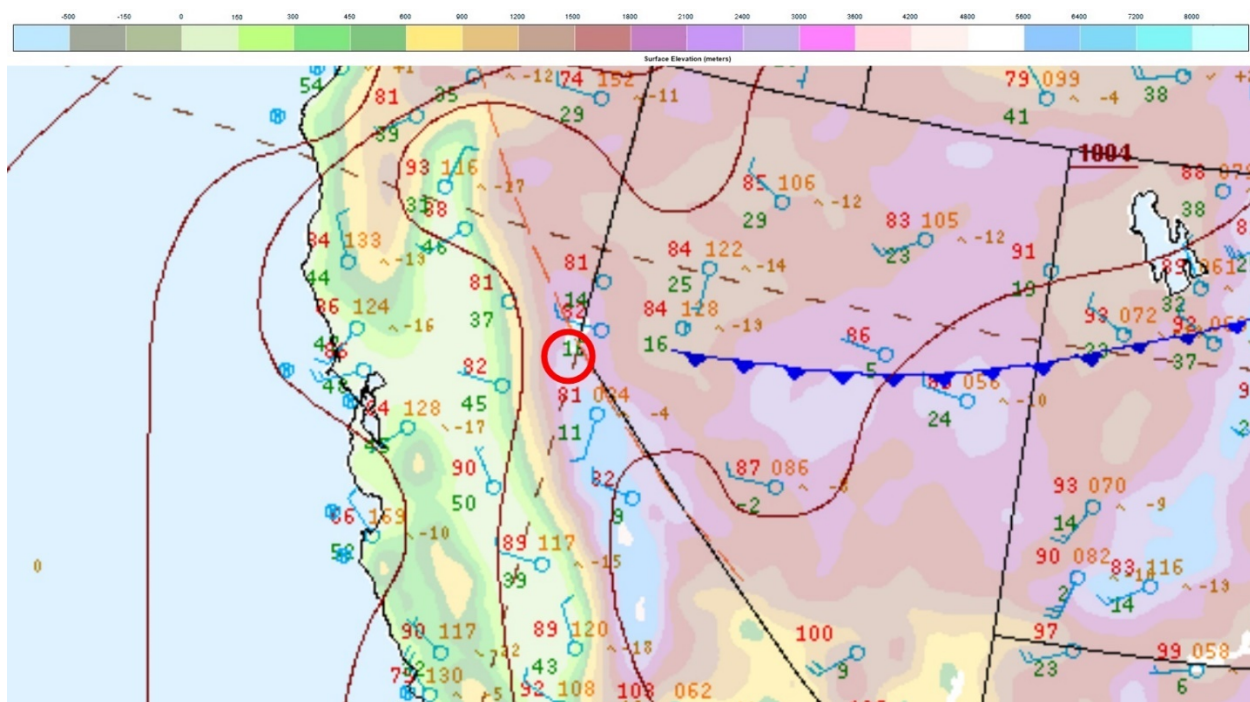


Figure 1 - NWS Surface Analysis Chart for 1400 PDT. Accident location is inside the red circle.

2.0 Surface Observations

An Automated Surface Observing System (ASOS) was located at Lake Tahoe Airport (TVL²) in South Lake Tahoe, California, which was located about 3 miles north-northeast of the accident location at an elevation of 6,268 feet and had a magnetic variation of about 13° east. Automated longline³ reports from the TVL ASOS during the times surrounding the accident time are presented here.

[1253 PDT] METAR KTVL 071953Z AUTO VRB05G14KT 10SM CLR 23/M06 A3015
RMK AO2 SLP145 T02331056=

[1353 PDT] METAR KTVL 072053Z AUTO VRB06G22KT 10SM CLR 24/M05 A3014
RMK AO2 SLP150 T02391050 58003=

**[1453 PDT] METAR KTVL 072153Z AUTO VRB06G16KT 10SM CLR 24/M02
A3014 RMK AO2 SLP153 T02441022=**

² The National Weather Service uses the 4-digit International Civil Aviation Organization (ICAO) format for station identifiers (as seen in the body of some formatted weather observations). This report uses the 3-digit International Air Transport Association format for station identification, which does not use the geographic designating digit ("K" for stations in the continental U.S. and "P" for U.S. stations in Alaska and the Pacific region) as found in the ICAO format.

³ "Longline" refers to the dissemination of weather observations with the intent that they are available in near-real time to national databases (effectively, the whole world) and accessible to the general global public from a large number of vendors. This does not include public accessibility to observations from a reporting station's Very High Frequency (VHF; line-of-site) or telephone broadcast, where applicable. Longline-dissemination of weather observations is the primary vehicle through which the general global public has access to surface weather observations, particularly outside of the aviation community.

[1553 PDT] METAR KTVL 072253Z AUTO 10SM CLR 24/M02 A3013 RMK AO2
SLP154 T02391017=

At 1453 PDT, the TVL ASOS reported a variable wind at 6 knots with gusts to 16 knots, visibility greater than 10 statute miles, clear skies, temperature of 24° Celsius (C) and a dew point temperature of -2°C, altimeter setting of 30.14 inches of mercury; remarks: automated station with a precipitation discriminator, sea level pressure of 1015.3 hectopascals (hPa), temperature of 24.4°C and a dew point temperature of -2.2°C.

One-minute ASOS data from TVL for times surrounding the accident were retrieved and the wind information is presented below:⁴

<u>Time</u>	<u>W Dir</u>	<u>W Mag</u>	<u>G Dir</u>	<u>G Mag</u>
1512	208°	9	217°	14
1513	212°	7	208°	7
1514	215°	6	231°	12
1515	208°	8	188°	12
1516	195°	11	198°	17
1517	194°	11	183°	13
1518	195°	8	213°	9
1519	221°	4	253°	7
1520	244	3	167°	6
1521	M	M	M	M
1522	M	M	M	M
1523	M	M	M	M
1524	M	M	190°	15

3.0 Upper Air Data

A High-Resolution Rapid Refresh (HRRR) model⁵ sounding (figure 2) for the accident site at 1500 PDT was retrieved from the National Oceanic and Atmospheric Administration's Air Resources Laboratory. Near the surface, the wind was from the west-southwest at about 10 knots and backed⁶ slightly to a south-southwest wind of 10 knots near 10,000 feet. Calculations made by the Rawinsonde OBservation Program (RAOB) indicated the potential for "light" low-level wind shear near the surface and light turbulence owed to thermals below about 11,000 feet. The relative humidity was below 35 percent for the entire atmosphere below 30,000 feet. The downdraft

⁴ W_Dir = Direction of two-minute averaged wind (true); W_Mag = Magnitude of two-minute averaged wind (knots); G_Dir = Direction of five-second averaged wind (true); G_Mag = Magnitude of five-second averaged wind (knots); M = missing

⁵ 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.

⁶ A veering wind's wind barbs turns counter clockwise with increasing height.

convective available potential energy (DCAPE; 6 kilometers above ground level; density weighted average method) was measured at 1,376 Joules/kilogram and is considered a strong value.⁷

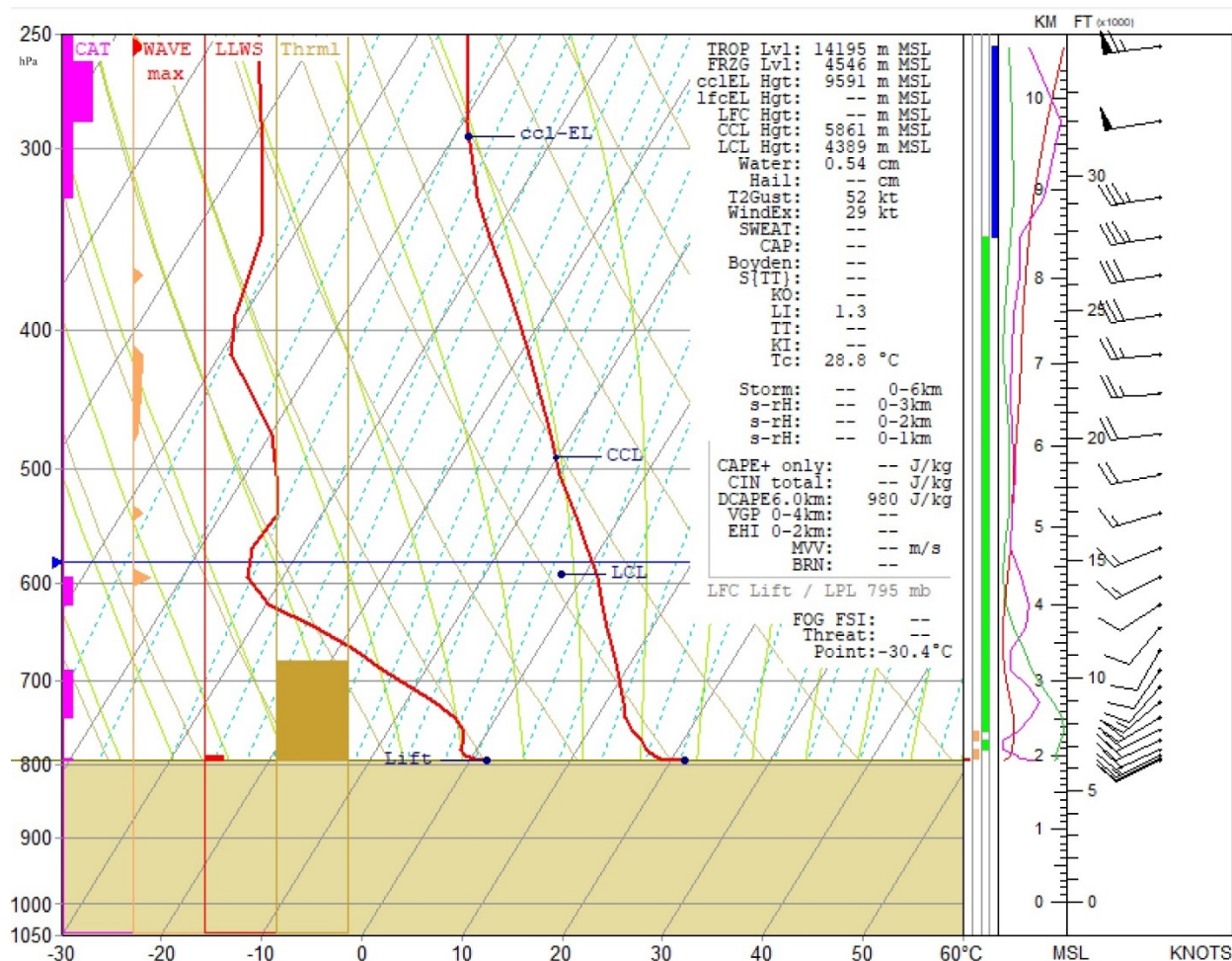


Figure 2 – HRRR model sounding data in SkewT/LogP format for 1500 PDT at the accident site, surface to 250 hPa.

4.0 Satellite Imagery

Geostationary Operational Environmental Satellite (GOES)-17 “visible” (0.64 μ m data were obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison. Imagery from 1521 PDT is presented in figure 3 and depicts clear skies over the accident area. An area of smoke and/or fire-related clouds was observed to the east of the accident site over Nevada.

⁷ The DCAPE can be used to estimate the potential strength of rain-cooled downdrafts within thunderstorm convection.

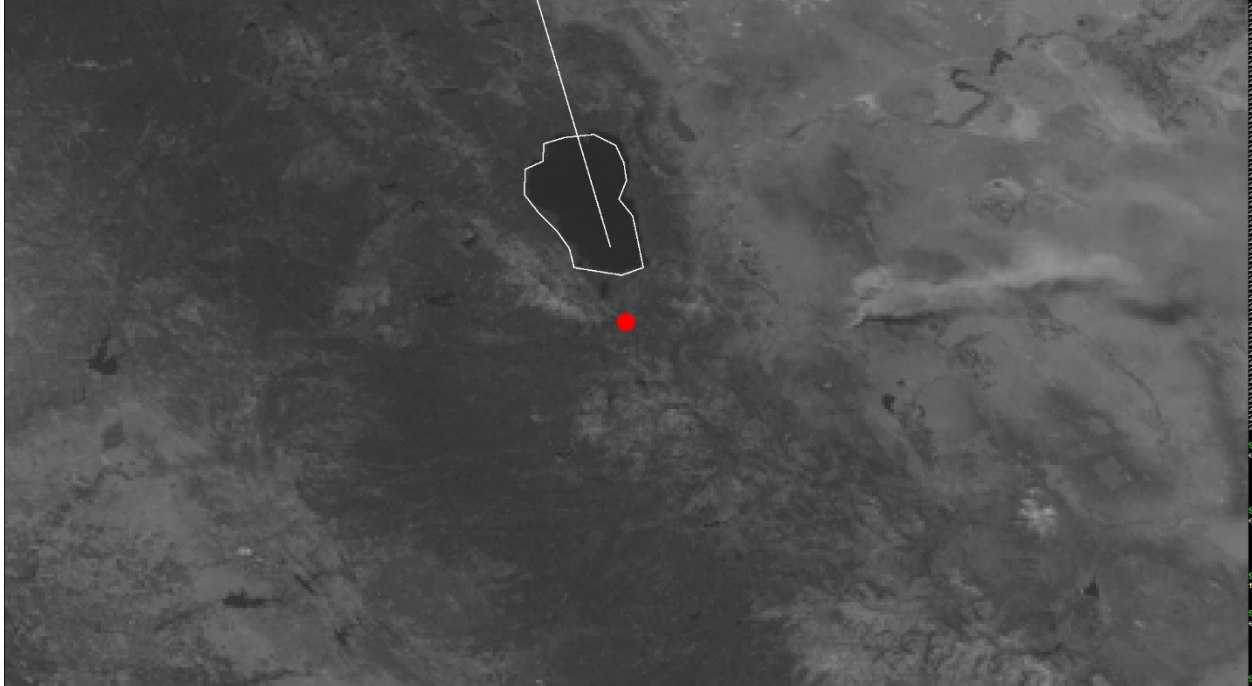


Figure 3 – GOES-17 visible imagery from 1521 PDT. Accident location denoted by red dot. This image has not been corrected for any parallax error.

5.0 Weather Radar

The WSR-88D⁸ Level-II base reflectivity weather radar imagery from the Reno, Nevada, site (KRGX) is presented in figure 4. KRGX was located approximately 61 miles north-northeast of the accident location at an elevation of about 8,396 feet. Assuming standard refraction and considering the 0.95° beam width⁹ for the WSR-88D radar beam, the PHKI 0.486 tilt would have “seen” altitudes above the accident location of between about 10,900 and 17,100 feet above msl. At the time of the accident, the weather radar did not depict anything significant above the accident location. A loop of radar imagery for times surrounding this time depicted “standing” reflectivity located to the east of the accident site, presumably along the tops of higher terrain and the area of fire.

⁸ Weather Surveillance Radar 88 Doppler (WSR-88D)

⁹ Here we define the angular width of the radar beam as the region of transmitted energy that is bounded by one-half the maximum power. The maximum power lies along the beam centerline and decreases outward from the radar antenna.

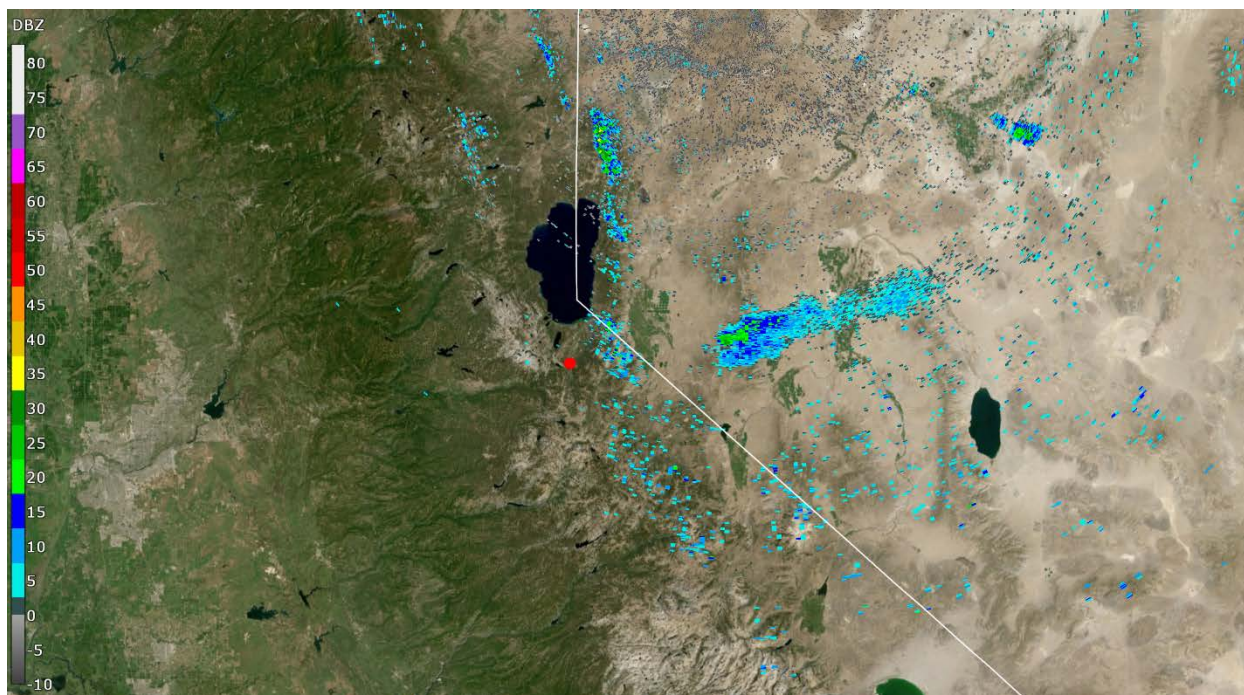


Figure 4 – KRGX 0.486° Level-II base reflectivity product from a sweep initiated at 1523:12 PDT. Accident location marked by red circle.

6.0 Pilot Reports

Publicly longline-disseminated pilot reports¹⁰ (PIREPs) made between 1300 and 1700 PDT within 50 miles of the accident located at or below 10,000 feet are presented here.

*RNO UA /OV KRNO164001/TM 2105/FL049/TP B738/TB LGT CHOP/RM +/- 5KTS
DURD*

Prior to the accident, at 1405 PDT a Boeing 737-800 aircraft at 4,900 feet one mile away and on the 164° radial from Reno/Tahoe International Airport in Reno, Nevada, reported light chop and loss/gain of 5 knots during descent.

*RNO UA /OV FMG130005/TM 2215/FL070/TP B737/TB MOD CHOP/RM FL070-
120 DURC*

Prior to the accident, at 1515 PDT a Boeing 737 aircraft at 7,000 feet five miles away and on the 130° radial from the Mustang VORTAC in Reno, Nevada, reported moderate chop between 7,000 and 12,000 feet during climb.

¹⁰ These do not include pilot reports only broadcast via radio.

7.0 Terminal Aerodrome Forecasts

At 1020 PDT a Terminal Aerodrome Forecast was issued by the NWS for TVL that forecasted for the accident time: wind from 200° at 10 knots with gusts to 20 knots, visibility greater than six statute miles, sky clear below 12,000 feet above ground level.

TAF KTVL 071720Z 0718/0818 VRB04KT P6SM SKC
FM071900 20010G20KT P6SM SKC
FM080300 VRB04KT P6SM SKC=

8.0 Area Forecast Discussion

Presented here is the “Aviation” section of the Area Forecast Discussion issued by the NWS Weather Forecast Office in Reno, Nevada, at 1428 PDT.

*FXUS65 KREV 072128
AFDREV
Area Forecast Discussion
National Weather Service Reno NV
228 PM PDT Tue Jul 7 2020*

.AVIATION...

** Pretty quiet on the aviation weather front much of this week. Zonal flow aloft leading to typical afternoon and early evening westerly breezes. Gusts generally at or below 25 kts.*

** One exception is smoke and haze from the Numbers Fire SE of MEV. Assuming continued fire activity, which seems like a safe bet looking out the window, HRRR smoke model shows good potential for MVFR conditions at MEV and possibly HTH tonight into Wednesday morning. Smoke will transport east/southeast from the fire in the afternoon and evening, and then settle in to the valleys late at night. Radar showing plume lofting to about 20,000 feet before spreading out to the east.*

9.0 AIRMETs

There were no AIRMETs active for the accident site at the accident time.

10.0 SIGMETs

There were no convective or non-convective Significant Meteorological Information (SIGMET) advisories active for the accident location at the accident time.

11.0 CWSU Products

There were no Center Weather Advisories or Meteorological Impact Statements issued by the Oakland Air Route Traffic Control Center active for the accident location at the accident time.

12.0 WRF Data

A Weather Research and Forecasting Model (WRF) simulation was run to model the weather conditions surrounding the time of the accident using initialization data from the GFS4.¹¹ WRF ARW (Advanced Research WRF core) version 4.1.2 was run with 3 domains with horizontal grid spacing of 8 kilometers, 1.6 kilometers, and 320 meters over the accident site. Other WRF simulation parameters included: 60 vertical levels, the multi-scale Kain-Fritsch cumulus parameterization scheme used on the outer domain, a Lin et al. microphysics scheme, a Yonsei University boundary layer scheme, Noah land surface physics, the Dudhia scheme used for short wave radiation and the RRTM scheme for the long wave radiation.

Figure 5 presents imagery of WRF vertical velocity from around the accident time. In the area of the accident, the absolute value of vertical velocity was less than 100 feet/min; however, values as strong as -400 feet/min were identified at slightly higher altitudes within about one mile of the accident location.

¹¹ <https://nomads.ncdc.noaa.gov/data/gfs4/>

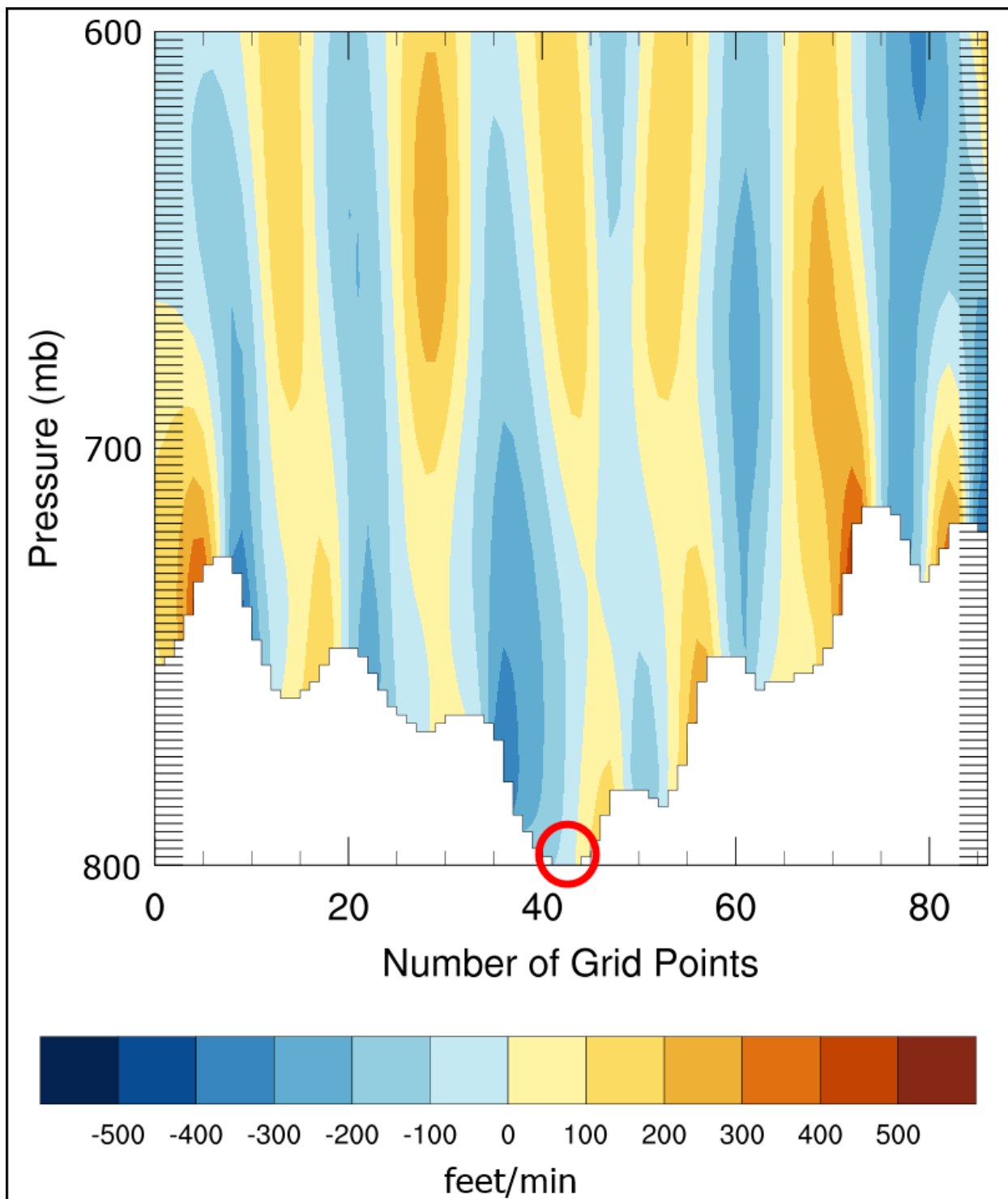


Figure 5 – WRF west-to-east (left-to-right) vertical cross-section of vertical velocity at 1520 PDT along the 38.8446° North parallel. Accident location denoted by the red circle. West and east plot boundaries are on the 120.1817° West and 119.8637° West meridians, respectively.

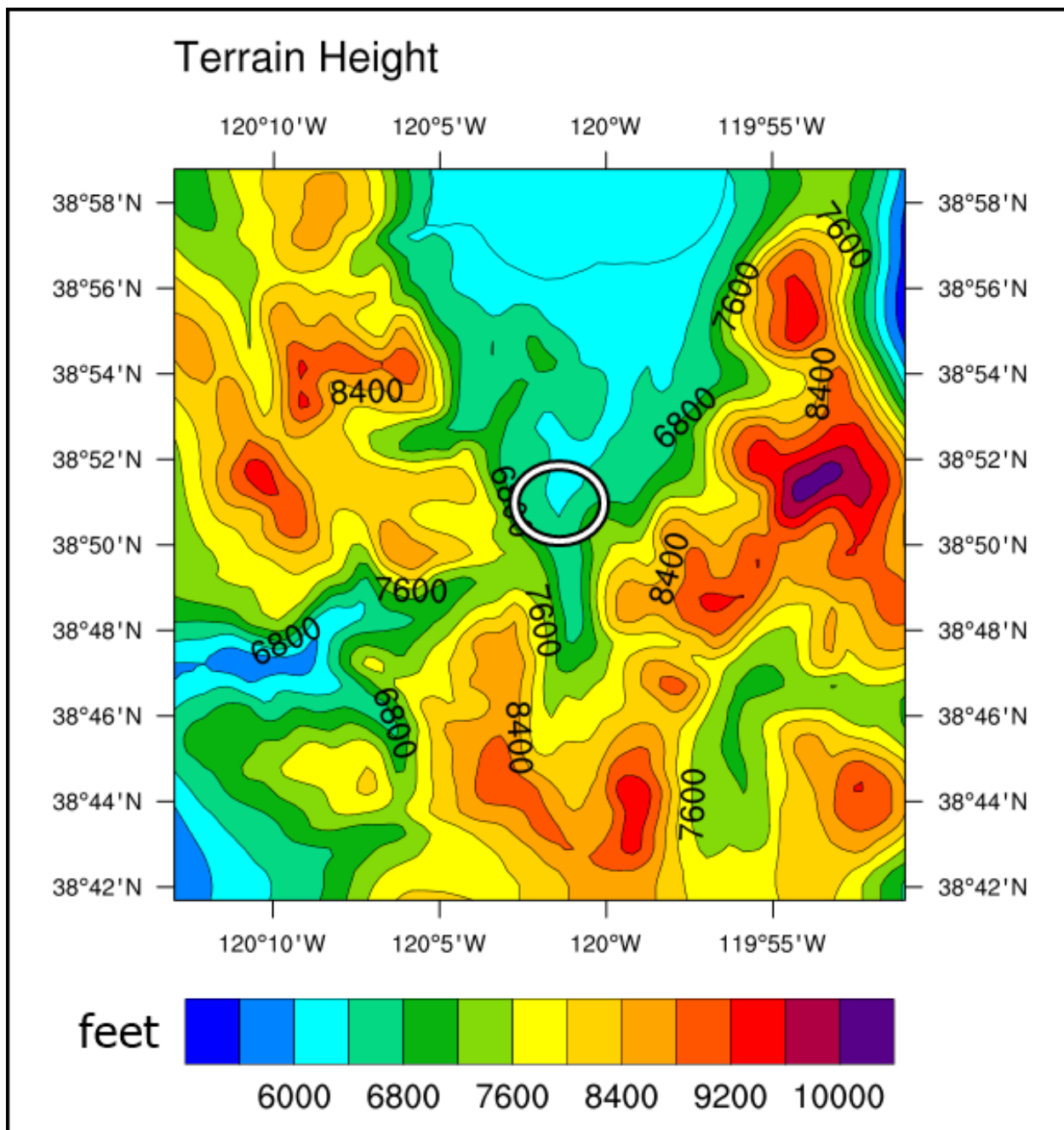


Figure 6 – WRF plan view plot of terrain considered by the model in creation of data plotted in figure 5. Accident location is denoted by the white/black circle.

Submitted by:

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