

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



DCA21FA174

METEOROLOGY

Specialist's Factual Report

August 23, 2021

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A. ACCIDENT

Location: Honolulu, Hawaii

Date: July 2, 2021

Time: about 0145 Hawaii standard time (1145 UTC)¹

Aircraft: Type - Boeing 737-275C; Registration - N810TA

B. METEOROLOGY INVESTIGATOR

Mike Richards

Senior Meteorologist

Office of Aviation Safety

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 Hawaii standard time (HST) for July 2, 2021 (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 about: 21.27706289° north latitude; 158.02551985° west longitude at sea level.

This report provides information on the weather conditions and forecasts applicable to the accident time and region.

D. WEATHER INFORMATION

1.0 Surface Observations

An Automated Surface Observing System (ASOS) was located at Daniel K Inouye International Airport (HNL²) which was in Honolulu, Hawaii, about 6 miles east-

¹ UTC - abbreviation for Coordinated Universal Time

² This report uses the 3-digit International Air Transport Association format for airport identification, which does not use the geographic designating digit (e.g., "K" for stations in the continental U.S. and "P" for U.S. stations in Alaska and the Pacific region) as found in the 4-digit International Civil Aviation Organization (ICAO) identifier format. Weather observations from airports in this report are referenced by their reporting station's identifier (using ICAO format that includes the geographic designating digit), not by the airport at which the reporting station is located.

northeast of the accident location at an elevation of about 10 feet and had a magnetic variation of about 9° east. Automated longline³ reports from the HNL ASOS during the times surrounding the accident time are presented here.

[2353 HST]⁴ METAR PHNL 020953Z 06009KT 10SM FEW025 SCT050 26/18
A3005 RMK AO2 SLP175 T02560178 403110244=

[0053 HST] METAR PHNL 021053Z 07013KT 10SM FEW025 SCT045 26/18
A3004 RMK AO2 SLP170 T02560183=

**[0153 HST] METAR PHNL 021153Z 06010G21KT 10SM FEW025 SCT050
26/17 A3003 RMK AO2 SLP169 60000 T02560172 10267
20256 56008=**

[0253 HST] METAR PHNL 021253Z 07010KT 10SM FEW024 FEW046 26/17
A3002 RMK AO2 SLP166 T02560167=

At 0153 HST, the HNL ASOS reported a wind from 060° at 10 knots with gusts to 21 knots, visibility of 10 statute miles or greater, few clouds at 2,500 feet above ground level (agl), scattered clouds at 5,000 feet agl, temperature of 26° Celsius (C) and dew point temperature of 17°C, altimeter setting of 30.03 inches of mercury; Remarks included: automated station with a precipitation discriminator, sea level pressure of 1016.9 hectopascals (hPa).

Five-minute data from the HNL ASOS for about the accident time are provided here.

[0130 HST] 5-MIN PHNL 021130Z 06014KT 10SM BKN050 26/18 A3003 -80 64
1200 050/14 RMK AO2 T02560183

[0135 HST] 5-MIN PHNL 021135Z 05009KT 10SM BKN050 26/18 A3003 -80 61
1200 040/09 RMK AO2 T02560178

[0140 HST] 5-MIN PHNL 021140Z 05011KT 10SM SCT050 26/18 A3003 -80 61
1200 040/11 RMK AO2 T02560178

**[0145 HST] 5-MIN PHNL 021145Z 06014KT 10SM SCT050 26/18 A3003 -
80 61 1200 050/14 RMK AO2 T02560178**

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.

⁴ July 1, 2021

[0150 HST] 5-MIN PHNL 021150Z 07015G21KT 10SM FEW025 SCT050 26/17
A3003 -80 59 1200 060/15G21 RMK AO2 SLP169 60000 T02560172
10267 20256 50008

[0155 HST] 5-MIN PHNL 021155Z 06012G21KT 10SM SCT050 26/17 A3003 -80
59 1200 050/12G21 RMK AO2 T02560172

At 0145 HST, the HNL ASOS five-minute report indicated a wind from 060° at 14 knots, visibility of 10 statute miles or greater, scattered clouds at 5,000 feet agl, temperature of 26°C and dew point temperature of 18°C, altimeter setting of 30.03 inches of mercury, pressure altitude of -80 feet, relative humidity of 61 percent, density altitude of 1,200 feet, magnetic wind direction of 050° with a wind magnitude of 14 knots; Remarks included: automated station with a precipitation discriminator, temperature of 25.6°C and dew point temperature of 17.8°C.

2.0 Weather Radar

WSR-88D⁵ Level-II base reflectivity weather radar imagery from the Molokai, Hawaii, site (PHMO) is presented in figures 1 and 2. PHMO was located approximately 47 miles east of the accident location at an elevation of about 1,450 feet. Assuming standard refraction and considering the 0.95° beam width⁶ for the WSR-88D radar beam, the KAKQ 0.571° tilt would have “seen” altitudes above the accident location of between about 3,400 and 8,100 feet above msl. The imagery revealed light values of reflectivity along a part of the final portion of the accident aircraft’s flight path.

⁵ Weather Surveillance Radar 88 Doppler (WSR-88D)

⁶ 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.

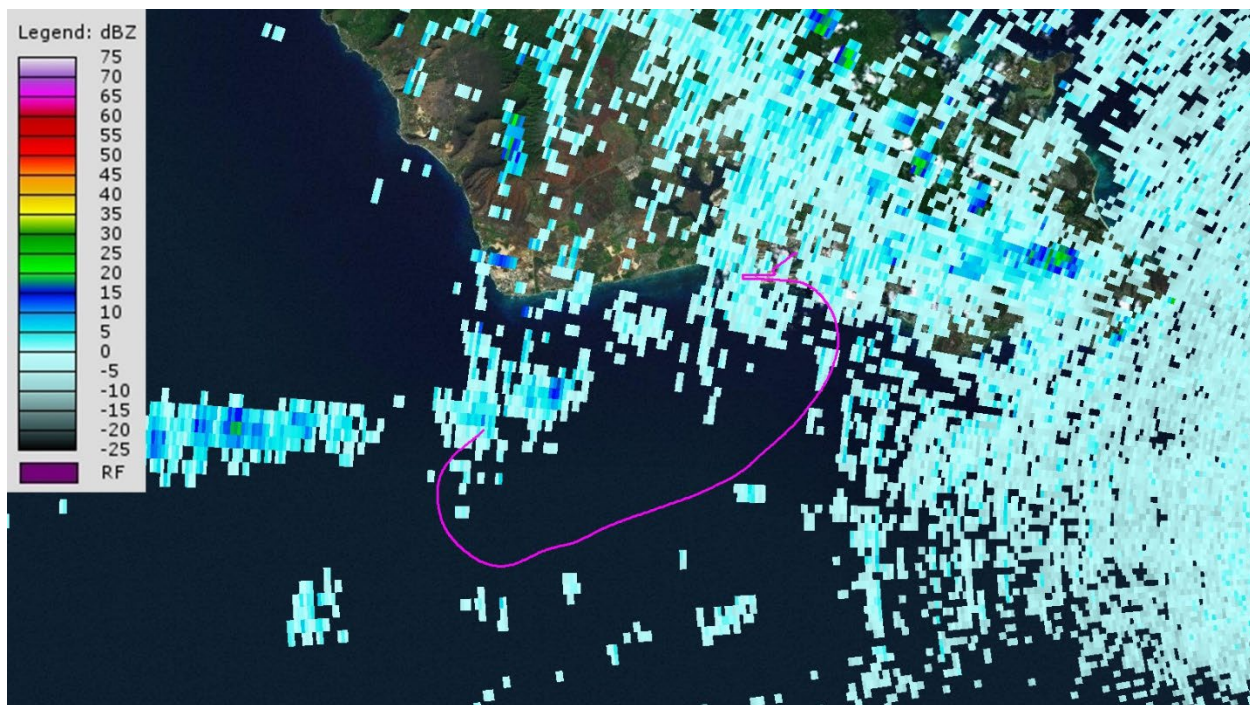


Figure 1 - PHMO 0.571° Level-II base reflectivity product from a sweep initiated at 0141:48 HST. Accident aircraft flight path through 0142:00 HST depicted by the purple line.

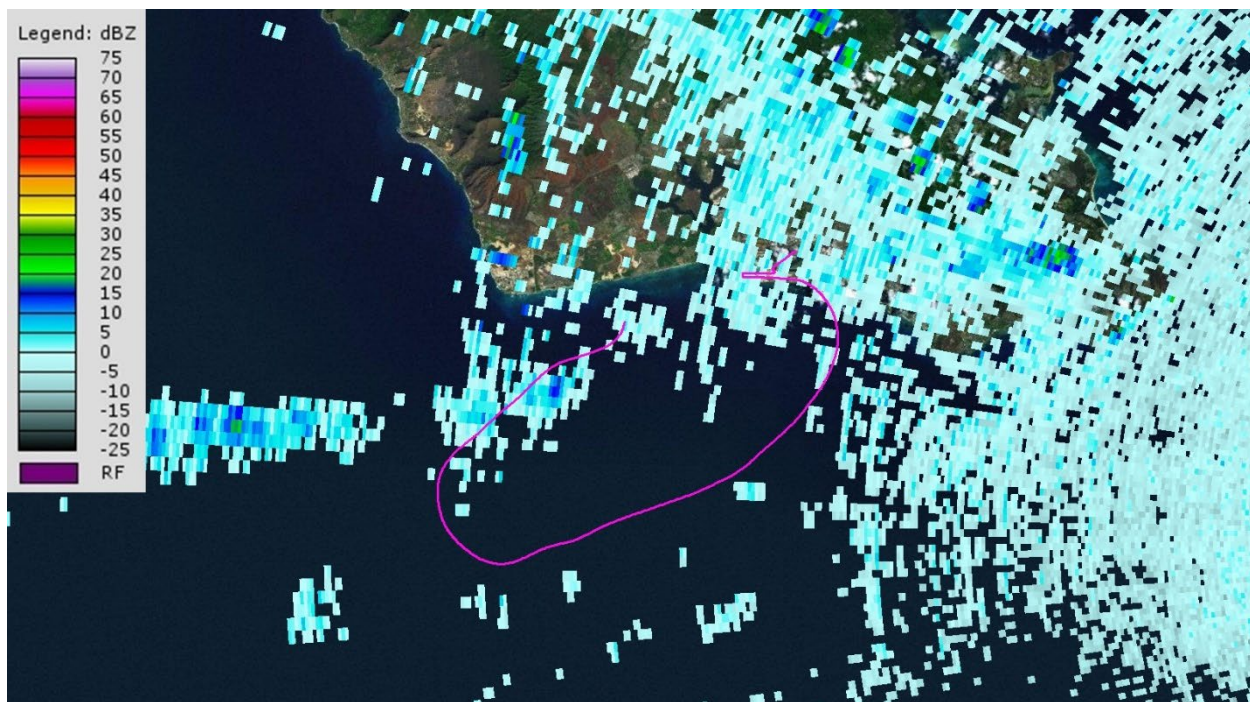


Figure 2 - PHMO 0.571° Level-II base reflectivity product from a sweep initiated at 0141:48 HST. Accident aircraft flight path through the accident time depicted by the purple line.

3.0 Upper Air Data

Atmospheric data were retrieved from a rawinsonde launch at 0200 HST from Lihue, Hawaii (station identifier PHLI). PHLI was located approximately 85 miles northwest of the accident site. While the data from this rawinsonde are considered to be valid at 0200 HST, these launches usually occur closer to the top of the previous hour (0100 HST), so the environmental sampling closest to the surface generally occurs about one hour prior to the data's nominally valid time. The rawinsonde (sounding) data from this launch are presented in SkewT/LogP format in figure 3.

The PHLI sounding identified several temperature inversions⁷ near 6,000 feet. Assessments made by the Universal RAwinsonde OBbservation program (RAOB) suggested cloudy conditions between about 4,500 and 5,600 feet. Below 4,000 feet the relative humidity was less than 90 percent. The freezing level was approximately 15,000 feet. RAOB did not identify any areas of significant turbulence below 5,000 feet, where the wind was generally out of the east at magnitudes between about 15 and 20 knots.

⁷ A temperature inversion is a layer in the atmosphere in which air temperature increases with height.

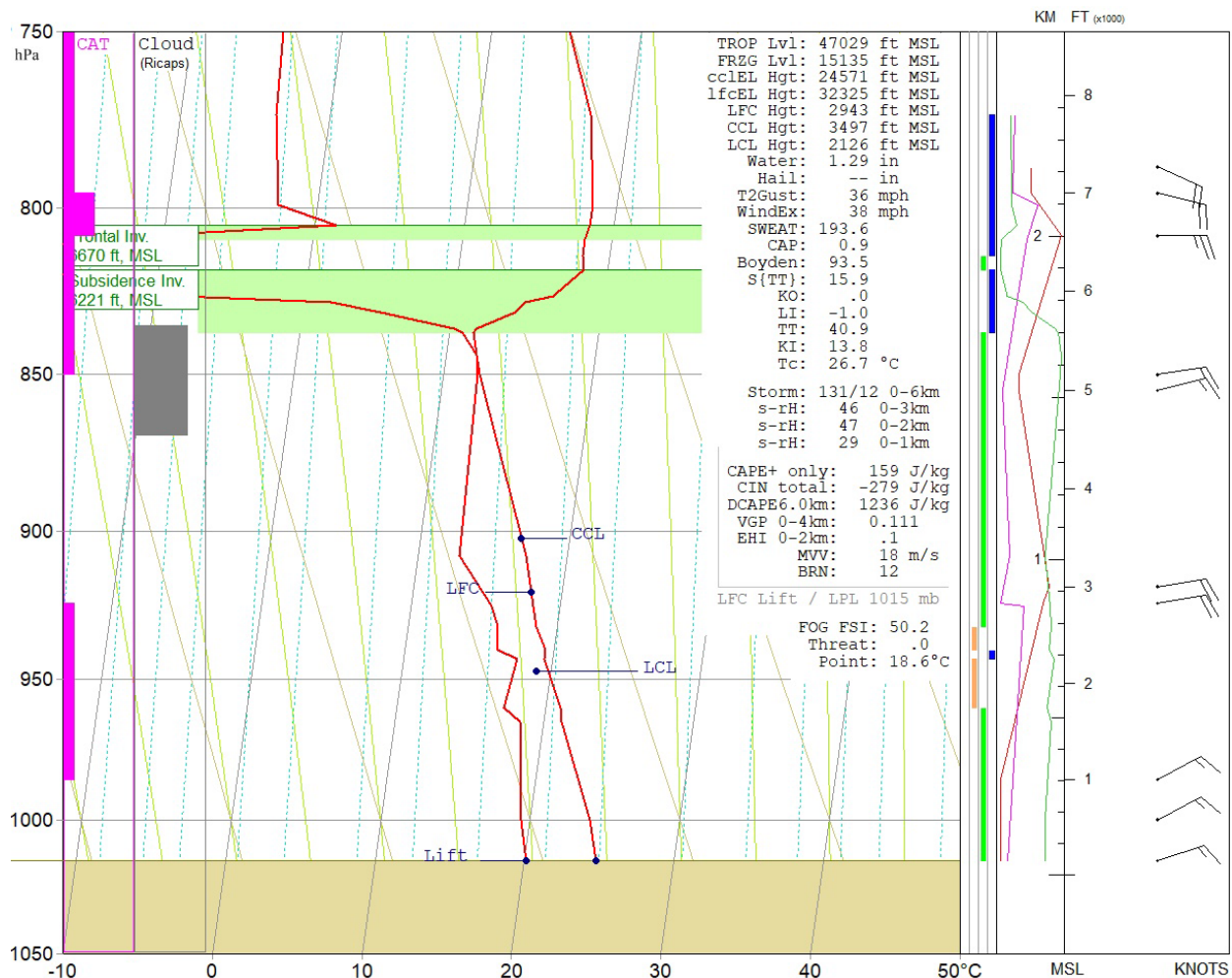


Figure 3 - PHLI rawinsonde sounding data in SkewT/LogP format for 0200 HST, surface to 750 hPa.

4.0 Satellite Imagery

Geostationary Operational Environmental Satellite (GOES)-17 infrared (10.3 μ m) data were obtained from an archive at the Space Science Engineering Center at the University of Wisconsin-Madison. An image from 0145 HST is presented in figure 4. Infrared cloud-top temperatures over the accident site were 14°C.

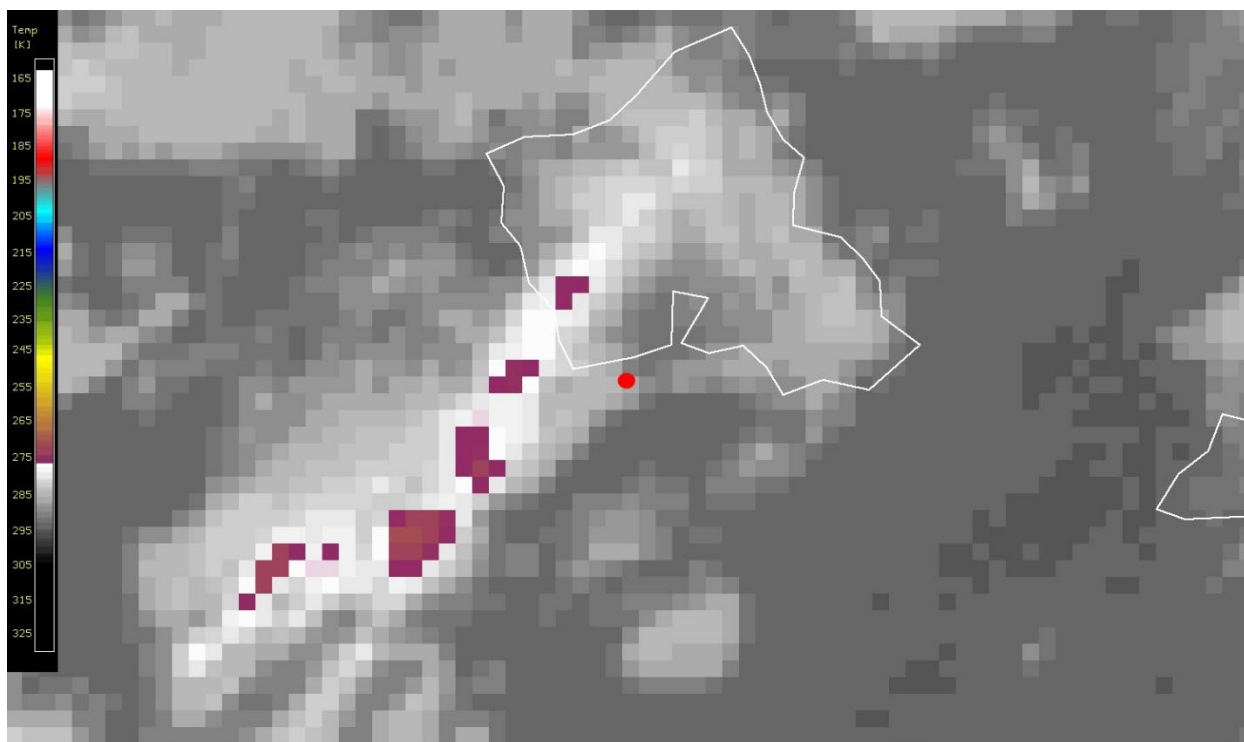


Figure 4 - GOES-17 infrared imagery from 0146 HST. Accident location denoted by red dot. Image is not corrected for parallax error.

5.0 Lightning

A review of the Earth Networks Total Lightning Network (ENTLN) lightning database indicated that there was no lightning activity between 0130 and 0200 HST around the accident location.⁸

6.0 Pilot Reports

There were no publicly longline-disseminated pilot reports⁹ (PIREPs) within 100 miles of the accident location made between two hour prior to and two hours after the accident time.

⁸ The ENTLN was queried for a geographic area bounded by latitudes 21.4058°N and 21.1024°N, and longitudes 158.1564°W and 157.7609°W.

⁹ These do not include pilot reports only broadcast via radio.

7.0 Terminal Aerodrome Forecasts

At 0120 HST a Terminal Aerodrome Forecast was issued by the National Weather Service for HNL that forecasted for the accident time: a wind from 070° at 11 knots, visibility greater than six statute miles, few clouds at 3,000 feet agl and scattered clouds at 5,000 feet agl.

TAF PHNL 021120Z 0212/0318 **07011KT P6SM FEW030 SCT050**
FM022000 06018G25KT P6SM FEW035 BKN050
FM030500 06010G18KT P6SM FEW030 SCT050=

8.0 Area Forecast

The Area Forecast issued by the National Weather Service Honolulu Weather Forecast Office (WFO) at 2324 HST the day before the accident and current at the time of the accident is presented below. For the areas of the island of Oahu that were not on the north through east sections of the island it forecasted: broken to scattered clouds at 30,000 feet with lower clouds and weather to follow. Synoptically the forecast called for "locally strong trade winds [that] will deliver stable low clouds and isolated light showers from the east."

FAHW31 PHFO 020924
FA0HI

HNLC FA 020935
SYNOPSIS AND VFR CLD/WX
SYNOPSIS VALID UNTIL 030400
CLD/WX VALID UNTIL 022200...OUTLOOK VALID 022200-030400

SEE AIRMET SIERRA FOR IFR CLD AND MTN OBSC. TS IMPLY SEV OR GREATER TURB SEV ICE LOW LEVEL WS AND IFR COND. NON MSL HGT INDICATED BY AGL OR CEILING.

SYNOPSIS...LOCALLY STRONG TRADE WINDS WILL DELIVER STABLE LOW CLOUDS AND ISOLATED LIGHT SHOWERS FROM THE EAST.

KAUAI AND OAHU.

BKN-SCT300. LOWER CLD AND WX FOLLOW.

BIG ISLAND LOWER SLOPES...COAST AND ADJ WATERS FROM UPOLU POINT TO CAPE KUMUKAHI TO APUA POINT.
BKN035 BKN050 TOPS 080 ISOL BKN030 TOPS 090 VIS 5SM SHRA BR.
OUTLOOK...VFR.

BIG ISLAND LOWER SLOPES AND COAST FROM APUA POINT TO SOUTH CAPE TO 15NM NE PHKO. SCT-BKN035 TOPS 090 ISOL -SHRA. 15Z SCT030.

OUTLOOK...VFR.

MTN...N THRU E SECTIONS AND ADJ WATERS OF KAUAI OAHU MOLOKAI MAUI.

FEW025 SCT-BKN045 TOPS 080 ISOL BKN025 VIS 5SM SHRA BR.

OUTLOOK...VFR.

REST OF AREA.

FEW025 SCT050 ISOL BKN030 TOPS 070

OUTLOOK...VFR.

9.0 Area Forecast Discussion

The "Aviation" section of the Area Forecast Discussion issued by the Honolulu WFO at 2000 HST the day before the accident and current at the time of the accident is presented below.

FXHW60 PHFO 020636

AFDHFO

Area Forecast Discussion

National Weather Service Honolulu HI

836 PM HST Thu Jul 1 2021

.AVIATION...

Locally strong trade winds and a very stable island atmosphere will lead to moderate low-level turbulence over and downwind of the mountains on all islands. AIRMET TANGO will therefore remain posted for the foreseeable future. With a strong subsidence inversion keeping low clouds capped near 6000 feet, shower intensity and coverage will remain limited, with VFR conditions prevailing. Isolated MVFR will remain possible, mainly over windward areas.

10.0 AIRMETS

An Airmen's Meteorological Information (AIRMET) advisory for temporary moderate turbulence below 8,000 feet was active at the time of the accident for areas over and immediately southwest of mountains on all Hawaiian Islands.

WAHW31 PHFO 020924

WA0HI

=HNLT WA 021000

AIRMET TANGO UPDATE 1 FOR TURB VALID UNTIL 021600

*AIRMET TURB...HI
OVER AND IMT SW THRU NW OF MTN ALL ISLANDS.
TEMPO MOD TURB BLW 080.
COND CONT BEYOND 1600Z*

11.0 SIGMETs

There were no Significant Meteorological Information (SIGMET) advisories active for the Hawaiian Islands at the accident time.

12.0 Astronomical

According to the Federal Aviation Administration¹⁰, on the evening prior to the accident day, sunset occurred at 1918 HST, civil twilight ended at 1942 HST, and on the day of the accident, civil twilight began at 0529 HST and sunrise occurred at 0554 HST. According to mooncalc.org¹¹, at the time of the accident and relative to the accident location, the moon was at an azimuth of 91° and an elevation of 10.65° with 44 percent of its disk illuminated.

Submitted by:

Mike Richards
Senior Meteorologist

¹⁰ https://avcams.faa.gov/sunrise_sunset.php

¹¹ <https://www.mooncalc.org/>