

NATIONAL TRANSPORTATION SAFETY BOARD

Vehicle Recorder Division

Washington, D.C. 20594

November 15, 2021

Cockpit Display – Recorded Flight Data

Specialist's Factual Report

By W. Deven Chen

1. EVENT SUMMARY

Location: Cordes Lakes, Arizona
Date: October 24, 2020
Aircraft: Lancair 235
Registration: N25NL
Operator: Private
NTSB Number: WPR21FA025

2. RECORDED FLIGHT DATA GROUP

A recorded flight data group was not convened.

3. DETAILS OF INVESTIGATION

On January 22, 2021, the National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following electronic devices:

Device 1 Manufacturer/Model: **Dynon SV D700**
Serial Number: **2084**

Device 2 Manufacturer/Model: **Dynon SV HDX**
Serial Number: **N/A**

3.1. Devices Description

The Dynon Skyview (SV) D700 is a panel-mounted combination Electronic Flight Instrumentation System (EFIS) and Engine Monitoring System (EMS). The device is capable of displaying both EFIS and EMS data on a 7 inches LCD display. Data are stored on non-volatile memory¹.

The Dynon SV HDX series device has an 11" screen with both a touchscreen and softkey interface. The device can serve as either a Primary Flight Display (PFD) or a Multifunction Display (MFD) depending on the installation. The unit has a solid-state Air Data and Attitude Heading Reference System (ADAHRS) and displays aircraft parameter data including altitude, airspeed, attitude, vertical speed, and heading. The unit also has external pitot/static inputs for altitude, airspeed, and vertical speed information. The device contains an internal

¹ Non-volatile memory is semiconductor memory that does not require external power for data retention.

flash memory device. The flash memory stores information sampled every 60 milliseconds for the last two hours of flight in a file called a “Black_Box_Log,” detailed alert logs that show both caution, warning and aural alerts generated by the display in a file called “Alert_Data,” as well as a flight history log which is sampled at a lower rate that can record many more hours of operation. The flight history is recorded as a file called “User_Log” and is sampled about every 250 milliseconds.

3.2. Devices Data Recovery

The Dynon SV D700 and HDX sustained severe impact damage upon arrival at the Vehicle Recorder Division, as shown in Figures 1 and 2. The memory modules of each device were removed from the devices, as shown in Figure 3. Both memory modules were unreadable due to damage. A support request was sent to the device manufacturer, and the response was that the level of damage precluded their recovery ability. A subsequent support request was sent to the memory module manufacturer – Innodisk based in California, USA. Innodisk recovered data from the damaged memory modules.

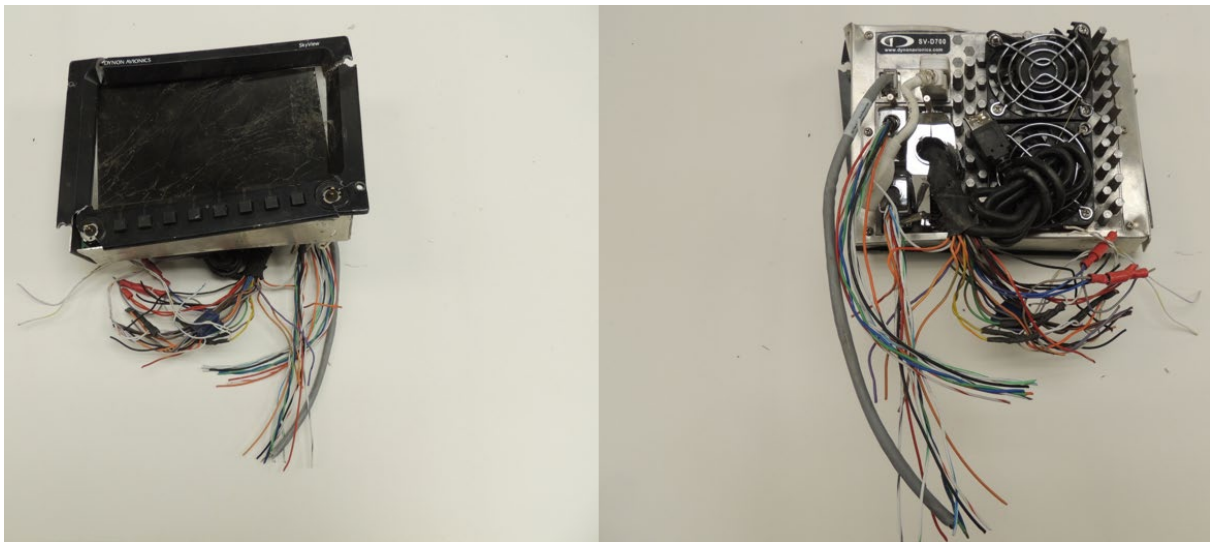


Figure 1: Front and back view of Dynon SV D700 as received.

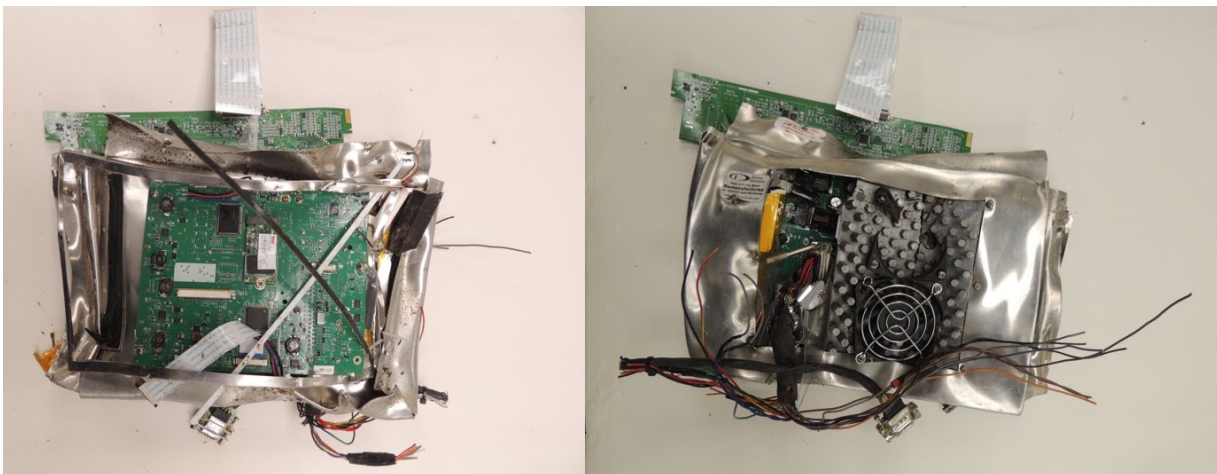


Figure 2: Front and back view of Dynon SV HDX as received.



Figure 3: Memory modules from SV D700 (left) and SV HDX (right).

3.3. Devices Data Description

The recovered data contained 3 data files: User_Log, Alert_Data and Black_Box_Log. The first session of data from each of the 3 files were recorded at different times, but all had last session recorded on October 24, 2020. The User_Log file contained data at a sampling frequency of approximately 4 data points per second, while the Black_Box_Log file contained data at a sampling frequency of approximately 16 data points per second. The Alert_Data file only contained data recorded whenever an event occurred. Those 3 data files all contained the accident flight recorded on October 24, 2020. The duration of the accident recording was approximately 18 minutes and 3 seconds. Table 1 is a summary of the data recovered.

Table 1: Summary of recovered data.

Data File	First Session	Last Session	Sample Frequency	Contained Accident flight (Y/N)
User_Log	October 13, 2020	October 24, 2020	~ 4	Y
Alert_Data	December 17, 2019	October 24, 2020	Whenever events occurred	Y
Black_Box_Log	October 21, 2020	October 24, 2020	~16	Y

3.3.1. Time Correlation

Data were recorded in Universal Coordinated Time (UTC). All time were converted to mountain standard time (MST), the local time of the accident, for the rest of this report. The difference between UTC and MST is 7 hours.

3.3.2. Parameters Provided

Table 2 shows the data parameters recovered from the devices.

Table 2: Data Parameters.

Parameter Name	Parameter Description
Time	MST for recorded data point (HH:MM:SS)
Latitude (deg)	Geographic latitude (degrees)
Longitude (deg)	Geographic longitude (degrees)
Lateral Accel (g)	Lateral Acceleration (g)
Vertical Accel (g)	Vertical Acceleration (g)
Pitch (deg)	Pitch (degrees)
Roll (deg)	Roll (degrees)
Angle of Attack (%)	Angle of Attack (%)
Vertical Speed (ft/min)	Aircraft vertical speed (feet per minute)
Ground Speed (kts)	Average groundspeed between current and previous data point (knots)
Indicated Speed (kts)	Airspeed read from airspeed indicator onboard (knots)
True Speed (kts)	Airspeed corrected for temperature and pressure altitude (knots)
GPS Altitude (ft)	Geometric altitude above Mean Sea Level (feet)
Pressure Altitude (ft)	Altitude recorded at a 29.92 inHg pressure setting (feet)
Density Altitude (ft)	Altitude relative to standard atmospheric conditions (feet)
Ground Track (deg)	Path on the surface of the Earth directly below aircraft (degrees)
Magnetic Heading (deg)	Direction relative to magnetic north (degrees)
Turn Rate (deg/s)	Aircraft turn rate (degrees per second)
Wind Direction (deg)	Measured wind direction (degrees)
Wind Speed (kts)	Measured wind speed (knots)
CHT 1-4 (deg F)	Cylinder Head Temperature Location # (degrees Fahrenheit)
EGT 1-4 (deg F)	Exhaust Gas Temperature Location # (degrees Fahrenheit)
RPM (rpm)	Engine Rotational Speed (revolutions per minute)
Percent Power (%)	Engine power percentage (%)
Manifold Pressure (inHg)	Manifold Pressure (inches of mercury)
Fuel Pressure (PSI)	Fuel Pressure (pounds per square inch)
Fuel Flow (gph)	Fuel flow rate (gallons per hour)
Fuel Remaining (gal)	Fuel Remaining (gallons)
Oil Pressure (PSI)	Oil Pressure (pounds per square inch)
Oil Temperature (deg F)	Oil Temperature (degrees Fahrenheit)
OAT (deg F)	Outside Air Temperature (degrees Fahrenheit)
Volts (V)	Bus Voltage (voltage)
Amps (A)	Bus Load Current (amperes)

3.3.3. Plots and Corresponding Tabular Data

The following eight figures contain data recorded on the Dynon devices on October 24, 2020. Figures 4 through 7 show parameters plots and figures 8 through 11 show Google Earth overlays of the accident flight.

Figure 4 is a plot of the engine parameters for the entire accident flight. The time interval displayed is 10:10:00 to 10:30:00 MST.

Figure 5 is a plot of the engine parameters for the final portion of the accident flight. The time interval displayed is 10:28:15 to 10:29:15 MST. Alert data from the Alert_Data file are overlaid on the plot. At 10:28:53, the Dynon system was displaying “OIL PRES LOW” in text and playing “EMS_OIL_PRES” in audio.

Figure 6 is a plot of the operational parameters for the entire accident flight. The time interval displayed is 10:10:00 to 10:30:00 MST.

Figure 7 is a plot of the operational parameters for the final portion of the accident flight. The time interval displayed is 10:28:15 to 10:29:15 MST.

Figure 8 is a Google Earth overlay of the entire accident flight recorded on October 24, 2020. The weather and lighting conditions in Google Earth are not necessarily the weather and lighting conditions present at the time of the recording.

Figure 9 is a Google Earth overlay of the beginning of the accident flight. It shows the aircraft took off at Phoenix Deer Valley Airport around 10:11:09 MST.

Figure 10 is a Google Earth overlay of the final portion of the accident flight. It shows the aircraft started descending rapidly at around 10:28:42 MST.

Figure 11 is a Google Earth overlay of the final portion of the accident flight viewed at a top angle.

The corresponding tabular data used to create figures 3 through 10 are provided in electronic comma-delimited (.csv) format as Attachment 1 to this report. The Alert_Data file is provided in (.csv) format as Attachment 2 to this report. Not every additional parameter in the attachments have been validated by the specialist.

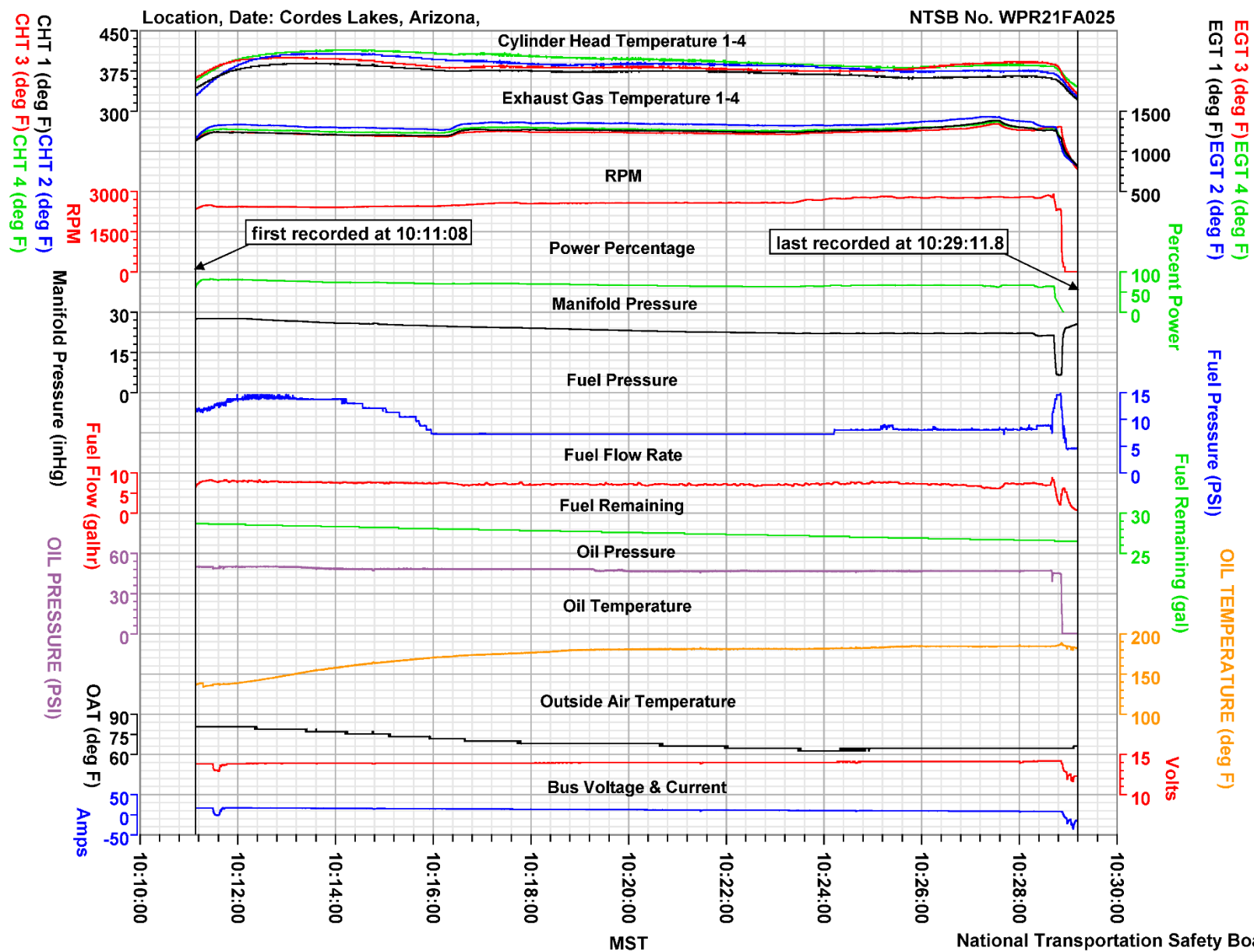


Figure 4: Plot of engine parameters for the entire accident flight recorded on October 24, 2020.

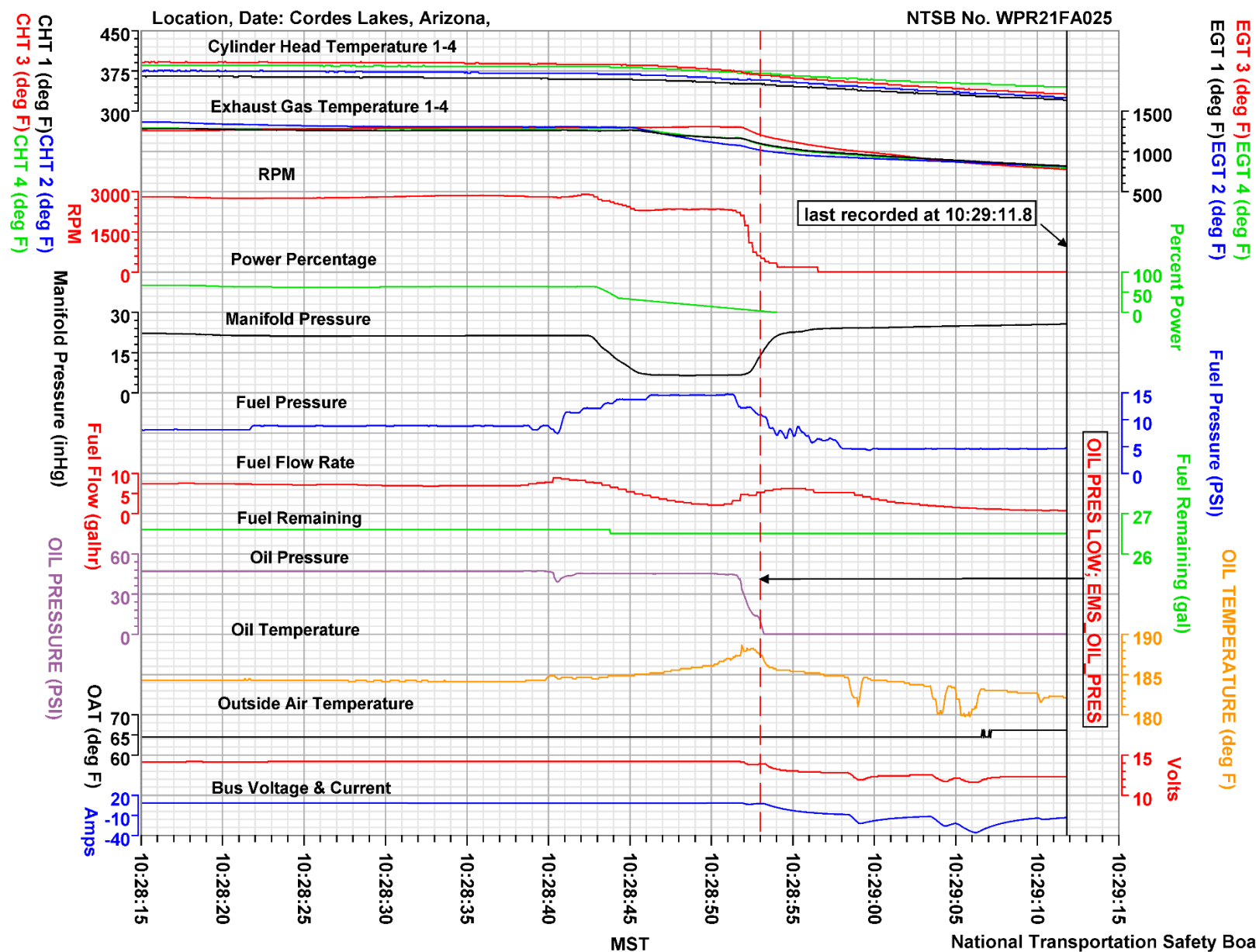


Figure 5: Plot of engine parameters for the final portion of the accident flight.

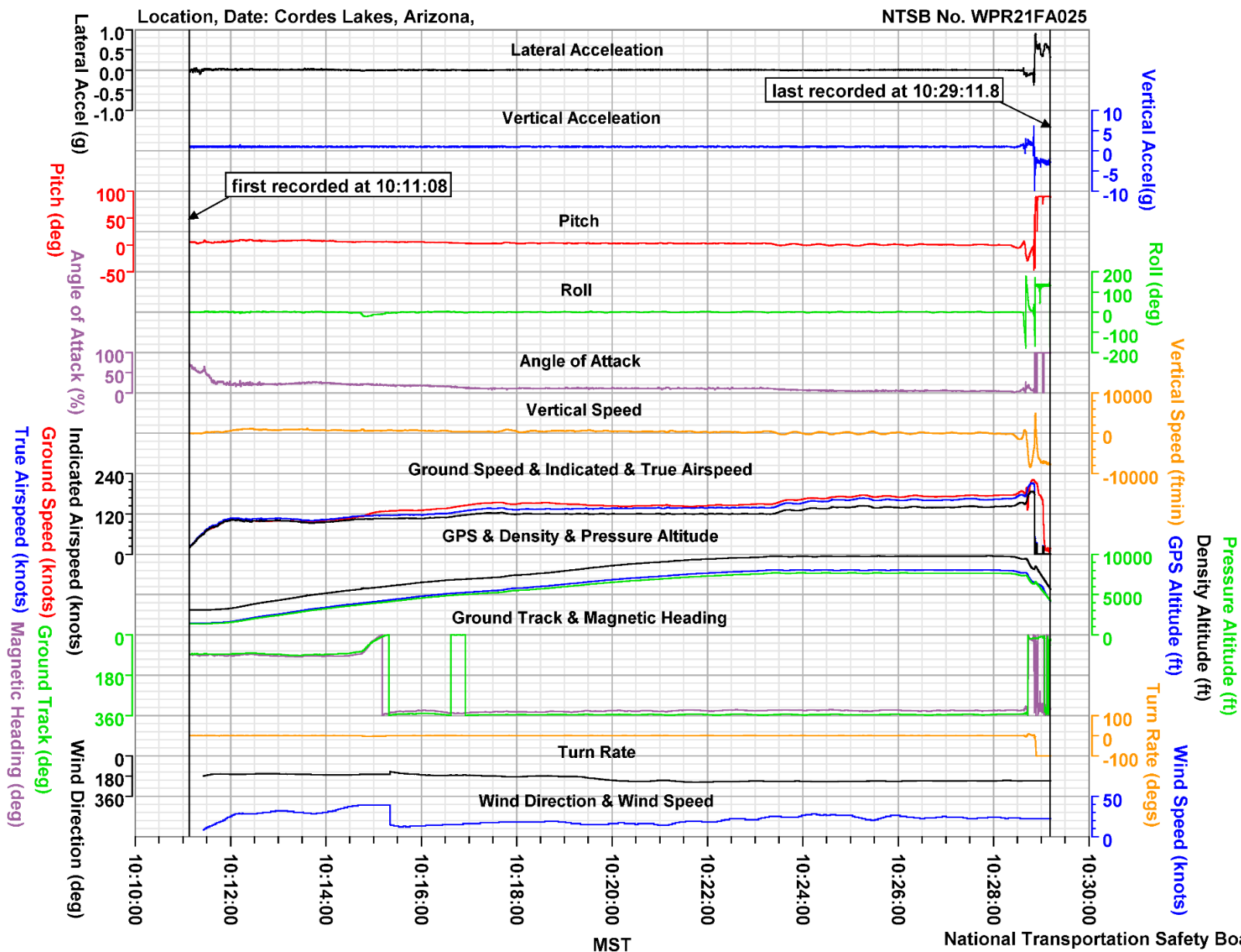


Figure 6: Plot of operational parameters for the entire accident flight recorded on October 24, 2020.

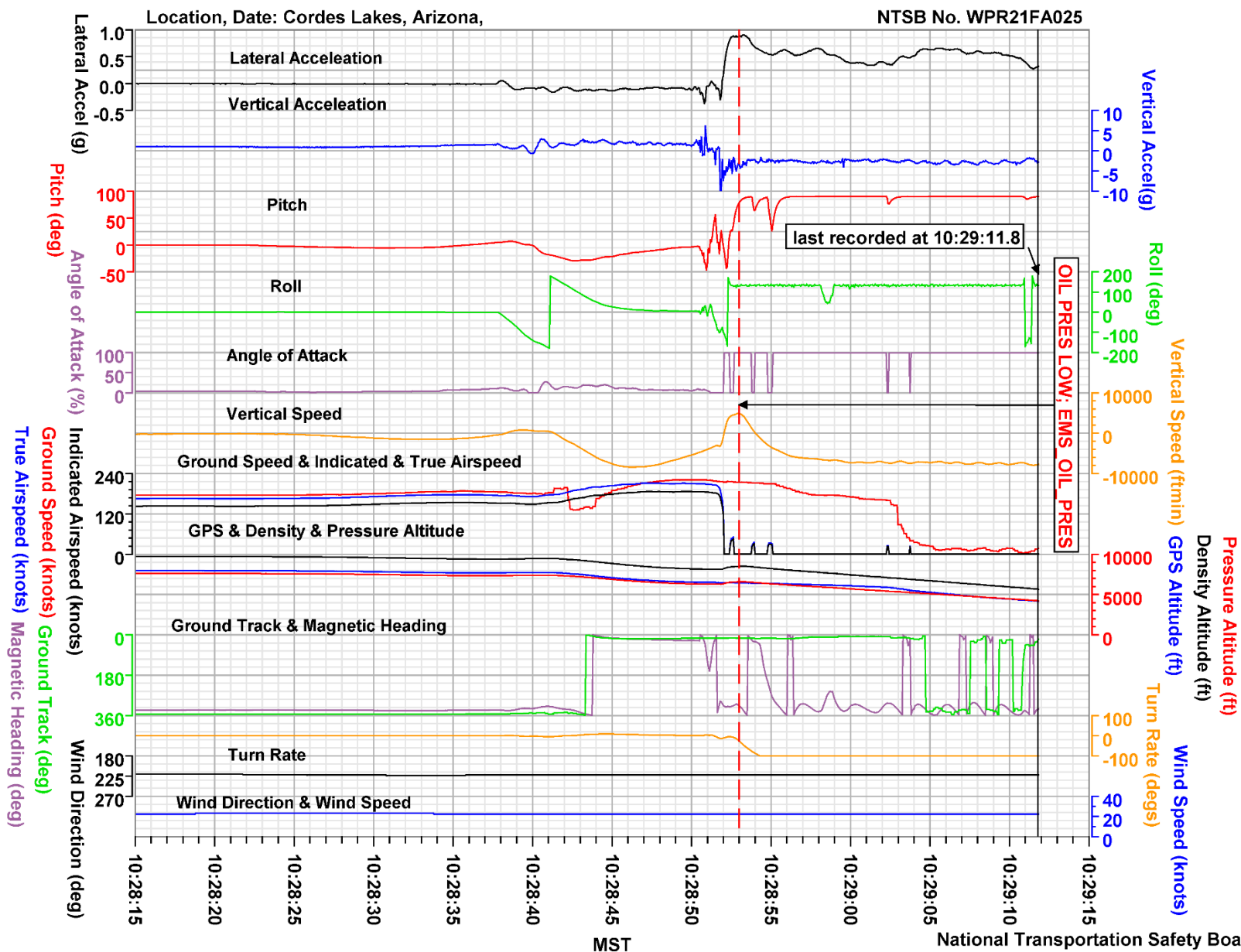


Figure 7: Plot of operational parameters for the final portion of the accident flight.

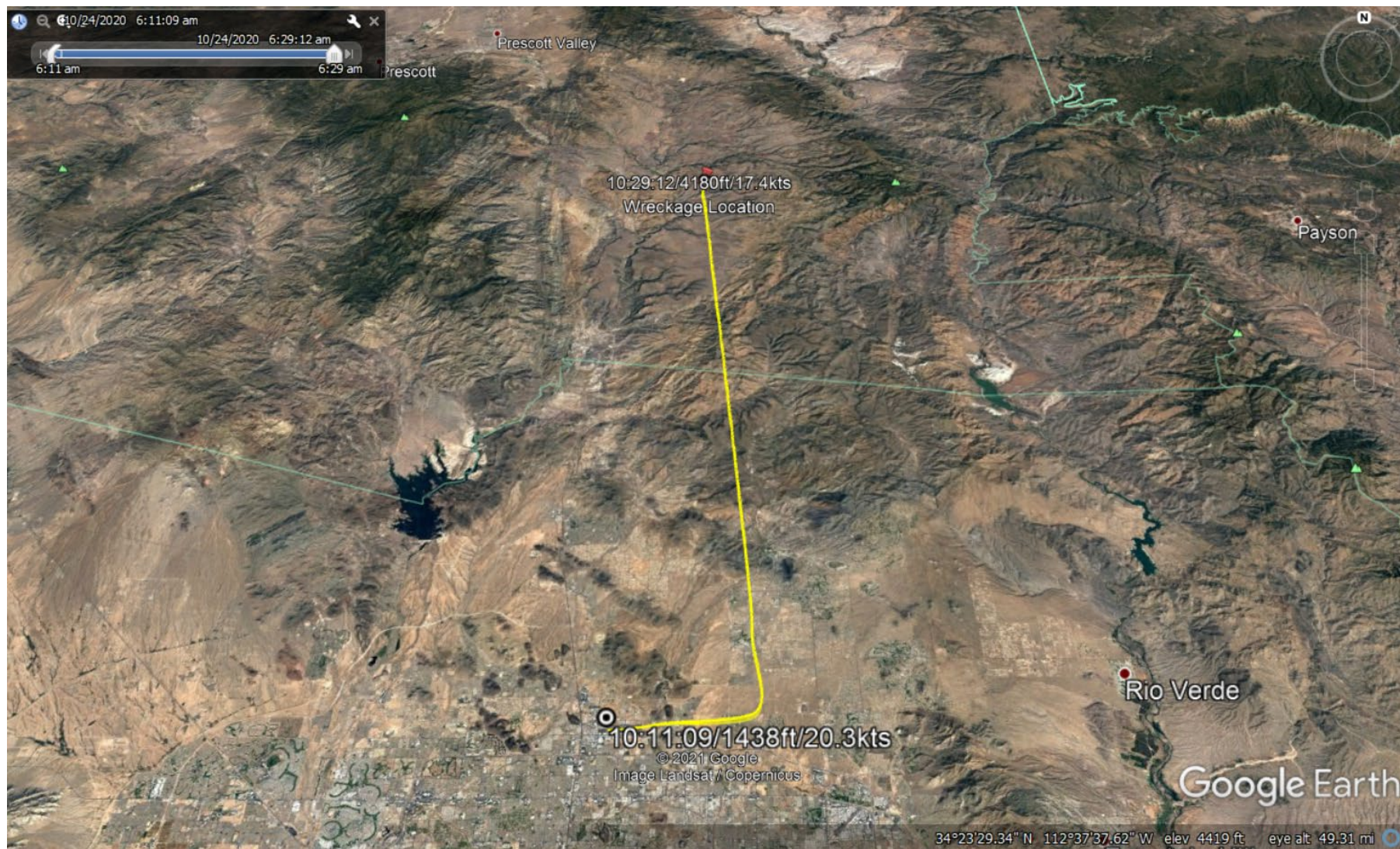


Figure 8: Google Earth overlay of the entire accident flight.



Figure 9: Google Earth overlay of the beginning of the accident flight.

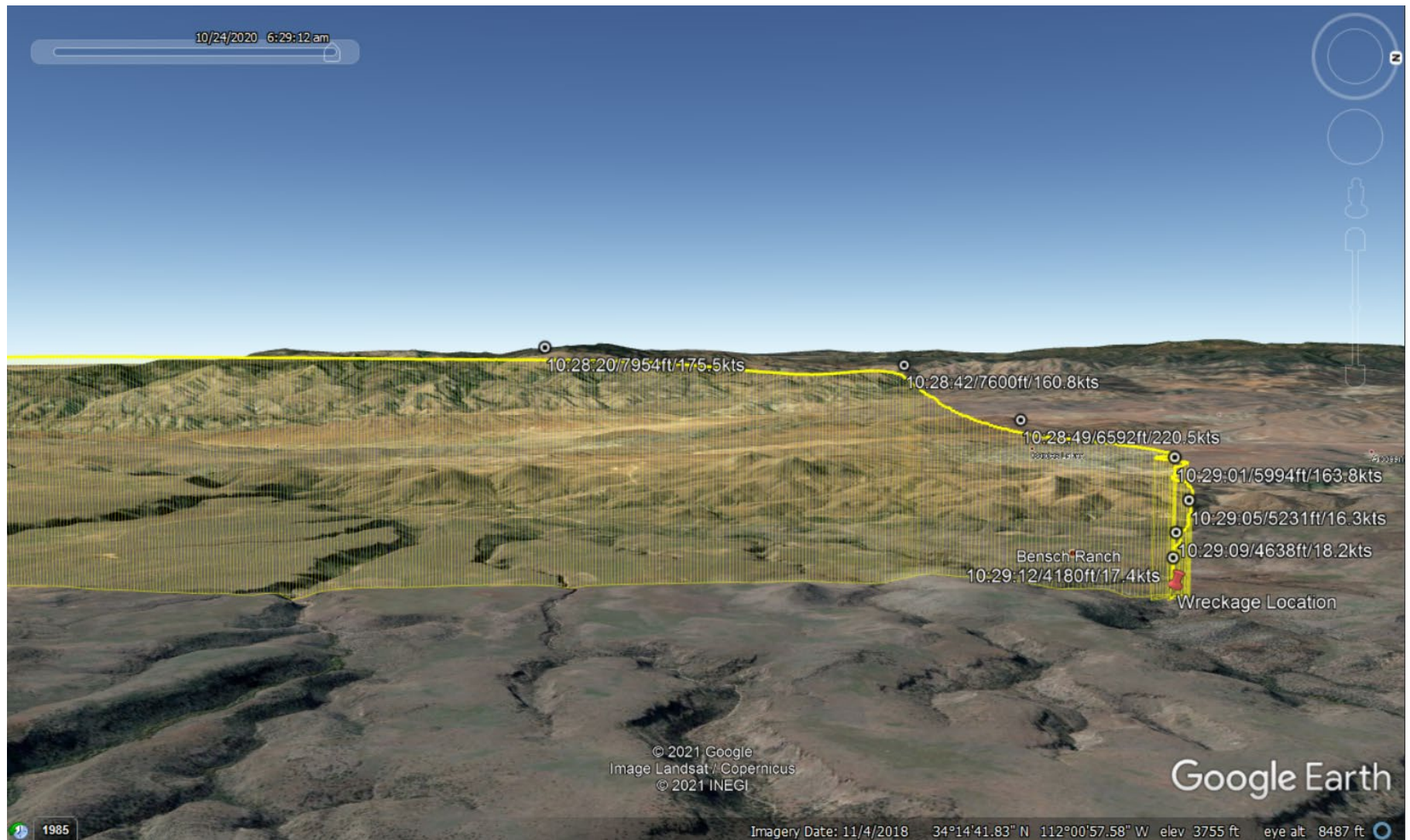


Figure 10: Google Earth overlay of the final portion of the accident flight.

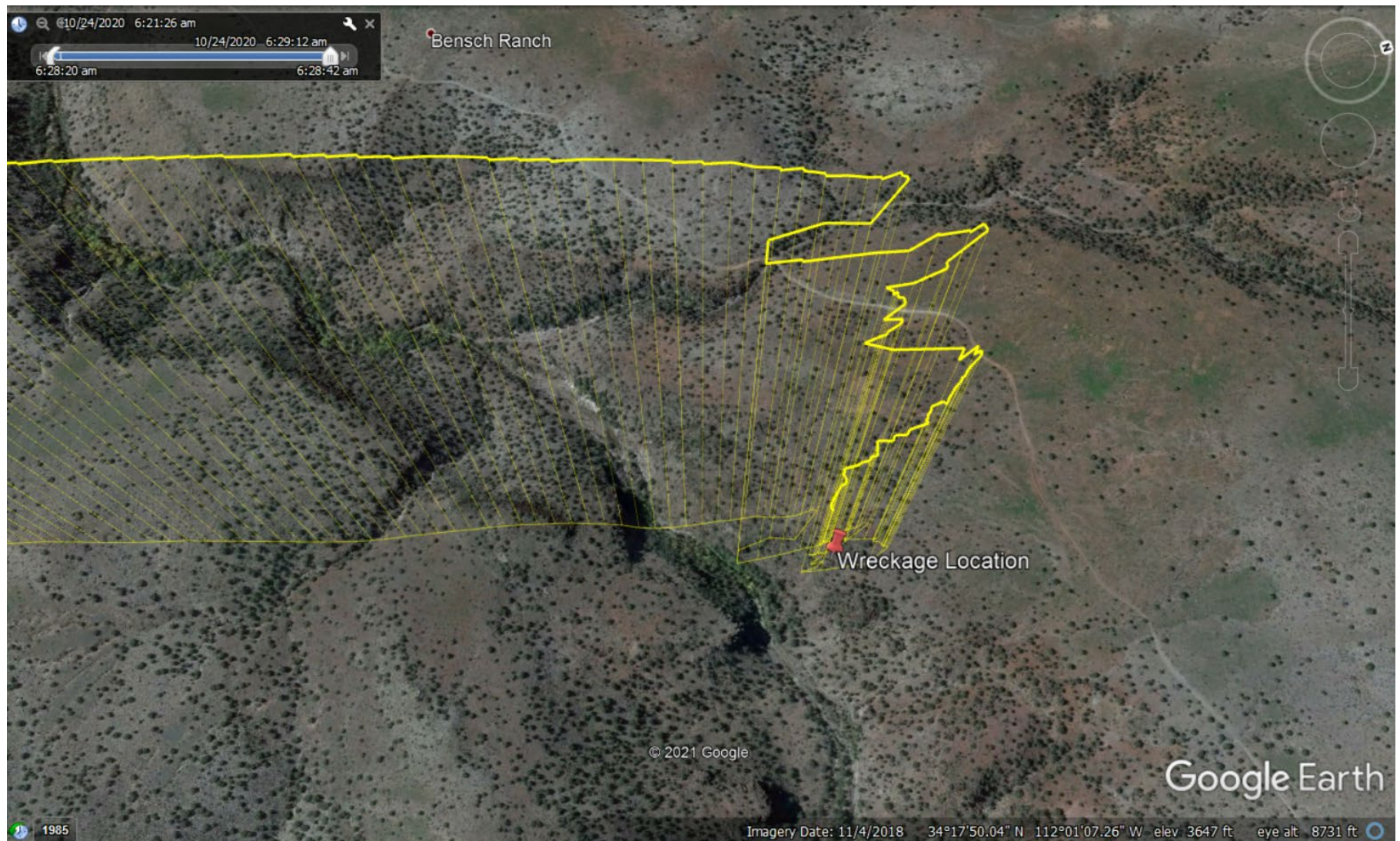


Figure 11: Google Earth overlay of the final portion of the accident flight.