

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



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ELECTRONIC DEVICE

Specialist's Factual Report

November 4, 2024

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A. ACCIDENT SUMMARY

Location: Anderson, Indiana
Date: September 6, 2024
Time: 0948 eastern daylight time (EDT)
1348 coordinated universal time (UTC)
Aircraft: Piper PA-46-350P, N629AG

B. ELECTRONIC DEVICE SPECIALIST

Specialist: W. Deven Chen
Electrical Engineer - Recorder Specialist
National Transportation Safety Board (NTSB)

C. DETAILS OF THE INVESTIGATION

A recorder group was not convened. The NTSB Vehicle Recorder Division received the following electronic device:

Recorder Manufacturer/Model:	Appareo Stratus 2S
Recorder Serial Number:	unknown due to damage

1.0 Appareo Stratus 2S Description

The Appareo Stratus 2S device is a self-contained battery-powered unit that contains an internal AHRS¹, GPS/WAAS receiver², and ADS-B³ receiver in one compact unit. The unit communicates wirelessly with compatible devices (iPad, iPhone, etc.) to display all the acquired information. In addition to communicating with compatible devices, the Stratus device records GPS position and AHRS information internally on a non-volatile memory chip.

¹ The Attitude Heading Reference System consists of a set of 3-axis gyroscope, accelerometers and heading reference sensors that enable the unit to compute pitch, roll, and yaw motions.

² The Wide Area Augmentation System (WAAS) is an air navigation aid to augment the Global Positioning System (GPS), by improving its accuracy, integrity, and availability.

³ Automatic Dependent Surveillance-Broadcast (ADS-B) is a surveillance technology deployed throughout the national airspace system. The ADS-B system is composed of aircraft avionics and a ground infrastructure. Onboard avionics determine the position of the aircraft by using the GPS and transmit its position along with additional information about the aircraft to ground stations for use by air traffic control (ATC) and other ADS-B services. This information is transmitted at a rate of approximately once per second. Operators equipped with ADS-B realize additional benefits from ADS-B broadcast services: Traffic Information Service - Broadcast (TIS-B) (traffic information) and Flight Information Service - Broadcast (FIS-B) (weather information).

1.1 Appareo Stratus 2S Condition and Data Recovery

The Appareo Stratus 2S had sustained impact damage. Figure 1 shows the condition of the device as received by NTSB Vehicle Recorder Division. The non-volatile memory chip of the device was removed, read out, and converted into engineering unit data using laboratory tools.



Figure 1. Front and back views of the Appareo Stratus 2S as received.

1.2 Appareo Stratus Recording Description

The data recovered from the Appareo Stratus 2S included numerous sessions. There were two sessions recorded on September 6, 2024. A session on this day from 11:42:07 UTC to 13:49:02 UTC, was identified to be associated with the accident flight. The other session from the accident date was identified as the previous flight to the accident and was recorded from 10:59:01 UTC to 11:28:00 UTC. The sampling rate of the recording was 5 Hz. Both sessions are included in this report.

1.2.1 Appareo Stratus Parameters Provided

Table 1 lists the Appareo Stratus 2S parameters verified and provided in this report.

Table 1. Appareo Stratus 2S data parameters provided.

Parameter Name (unit)	Parameter Description (unit)
Altitude HMSL (ft)	Altitude above Mean Sea Level (feet)
Bframe Acceleration X (gs)	Device body frame acceleration in X-axis (gs)
Bframe Acceleration Y (gs)	Device body frame acceleration in Y-axis (gs)
Bframe Acceleration Z (gs)	Device body frame acceleration in Z-axis (gs)
Bframe Rotation X (deg/s)	Device body frame rotation in X-axis (degrees per second)
Bframe Rotation Y (deg/s)	Device body frame rotation in Y-axis (degrees per second)
Bframe Rotation Z (deg/s)	Device body frame rotation in Z-axis (degrees per second)
Ground Speed (kts)	Average groundspeed between current and previous data point (knots)
Ground Track (deg)	Path on the surface of the Earth directly below aircraft (degrees)
Heading (deg)	Direction relative to true north (degrees)
Latitude (deg)	Geographic latitude (degrees)
Longitude (deg)	Geographic longitude (degrees)
Pitch (deg)	Pitch angle (degrees)
Roll (deg)	Roll angle (degrees)
Vertical Speed (fpm)	Vertical speed (feet per minute)

1.3 Appareo Stratus 2S Time Correlation

The Appareo Stratus 2S data contained GPS time parameters – GPS weeks (since January 6, 1980) and GPS ITOW (number of milliseconds from the beginning of the week), which were calculated into GPS time, and then offset to UTC by subtracting 18 seconds (current leap seconds between GPS time and UTC). The times are kept in UTC for the rest of the report. UTC is 4 hours ahead of EDT, the local time of the accident.

D. FIGURES AND TABULAR DATA

Figures 2 to 4 are data parameters plots of the accident flight recording with different time ranges. The plots are configured such that right turns of the aircraft are indicated by the trace moving toward the bottom of the page, left turns towards the top of the page, and nose up attitudes towards the top of the page.

Figures 5 to 8 are graphical overlays generated using Google Earth showing the accident flight. Figure 5 shows the entire flight recording, and figures 6 to 8 show the accident flight with focuses on different portions. 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 data parameters plot of the previous flight right before the accident flight recorded on the Appareo Stratus 2S on the same date. Figure 10 is a Google Earth overlay of this previous flight.

The corresponding tabular data used to create the above figures are provided in electronic comma-separated value (CSV) format as attachments to this report. Attachments 1 and 2 are GPS and AHRS data respectively from the accident flight, and attachment 3 and 4 are GPS and AHRS data respectively for the previous flight. Note that the attachments might contain additional parameters, however, not every parameter has been validated by the specialist.

Submitted by:

W. Deven Chen
Electrical Engineer – Recorder Specialist

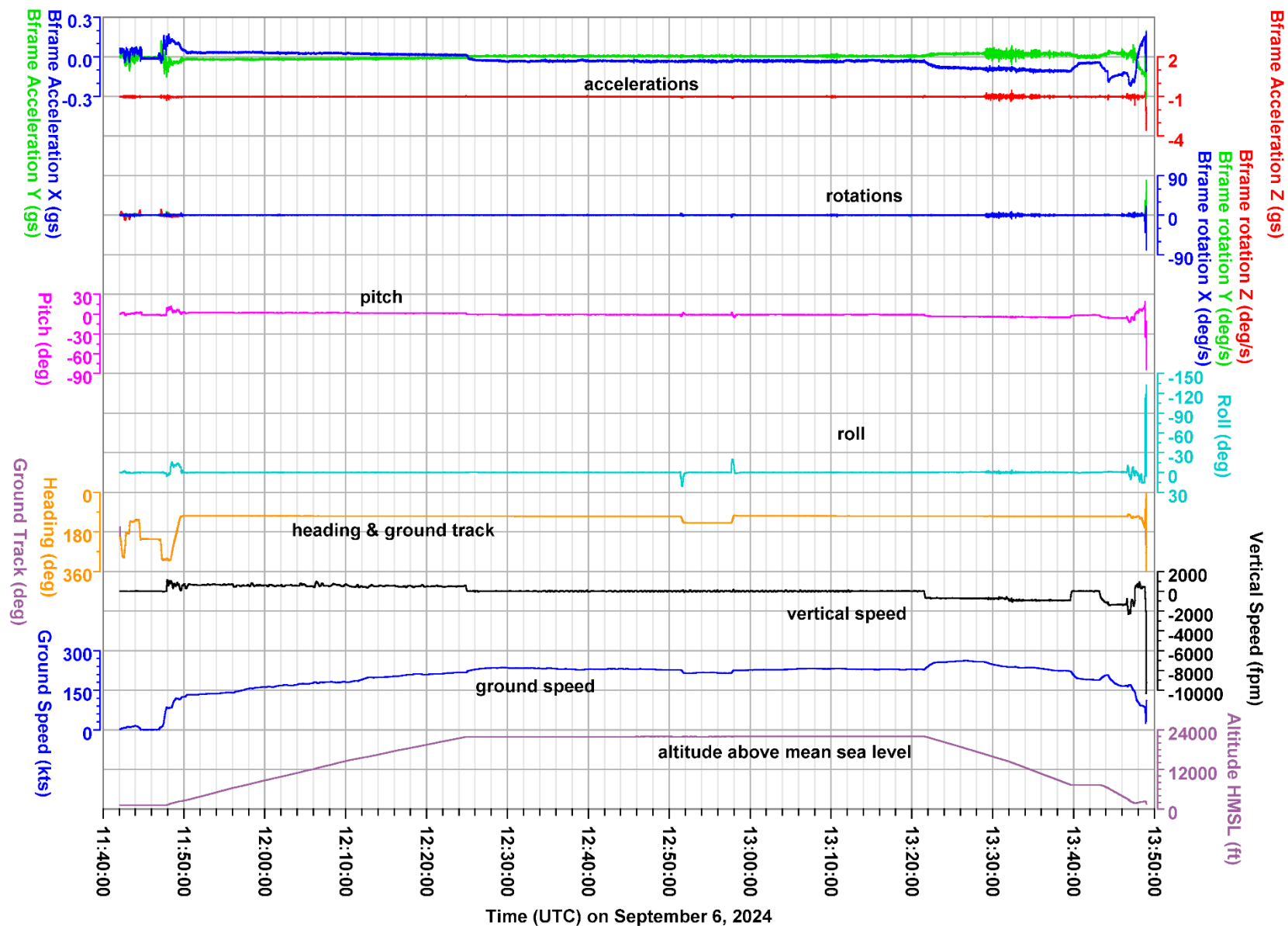


Figure 2. Plot of data parameters of the entire accident flight recordings.

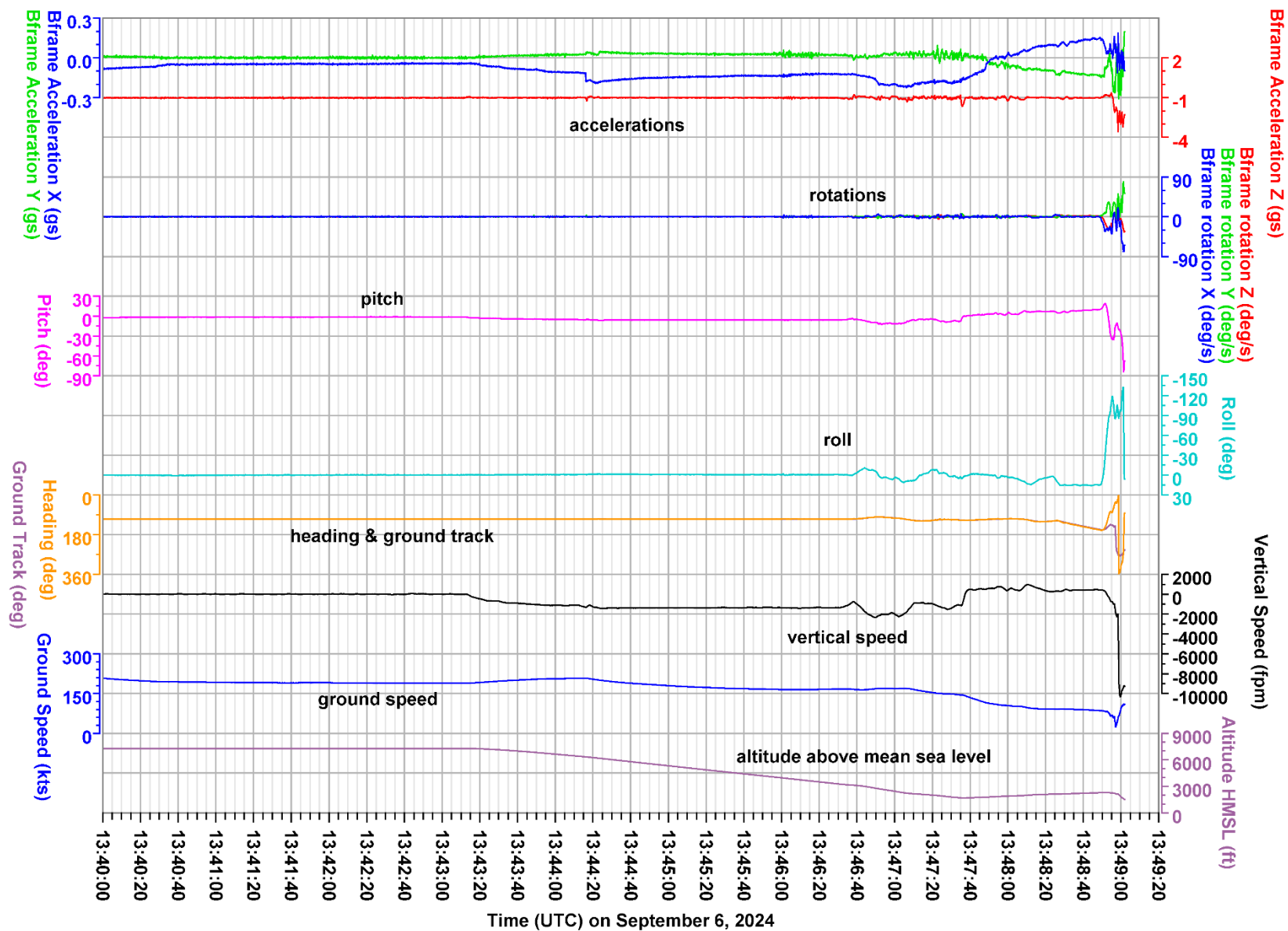


Figure 3. Plot of data parameters of the accident flight with time ranging from 13:40 UTC to the end of recording.

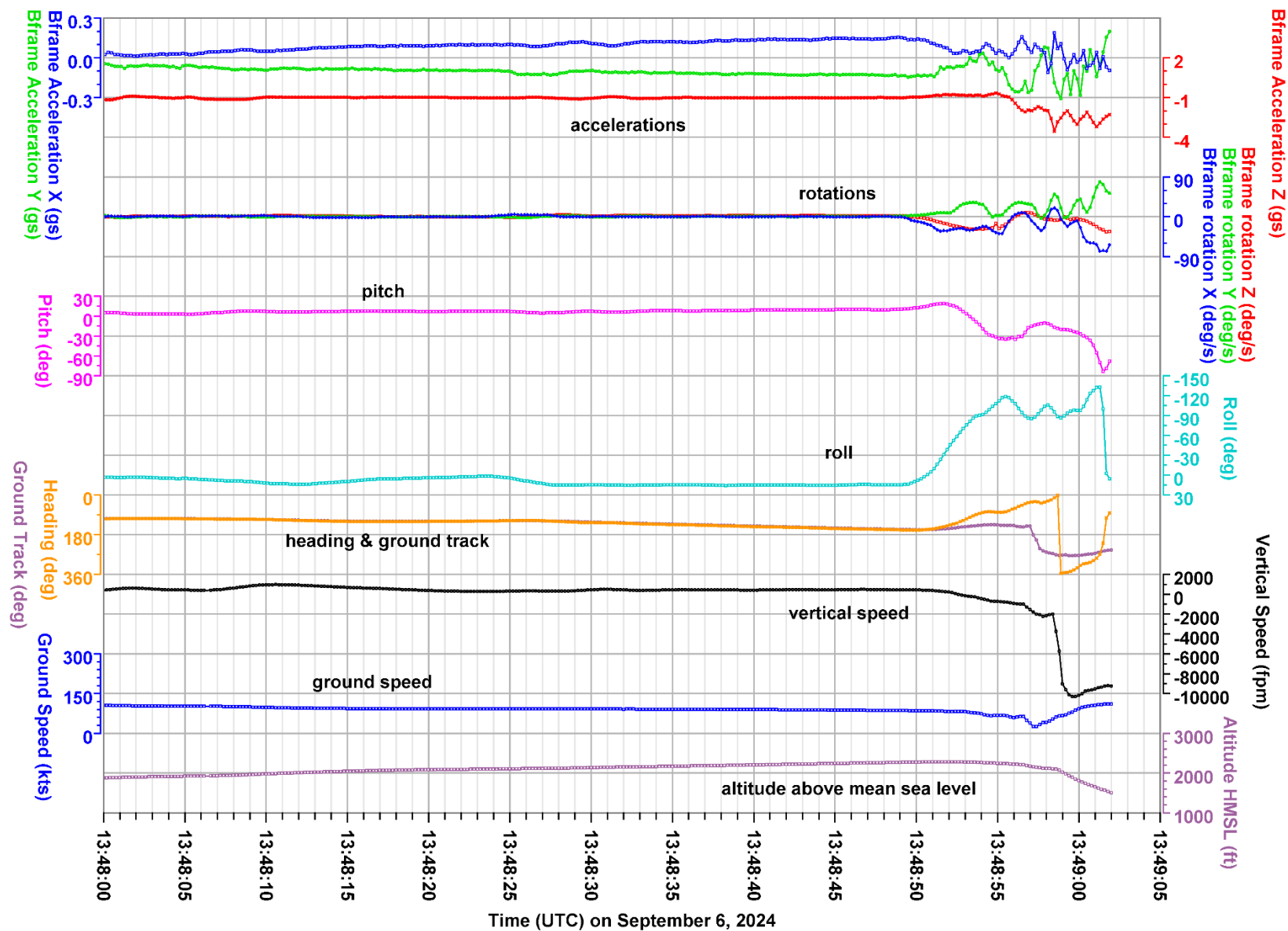


Figure 4. Plot of data parameters of the accident flight with a focus on the last 1 minute of the recording.

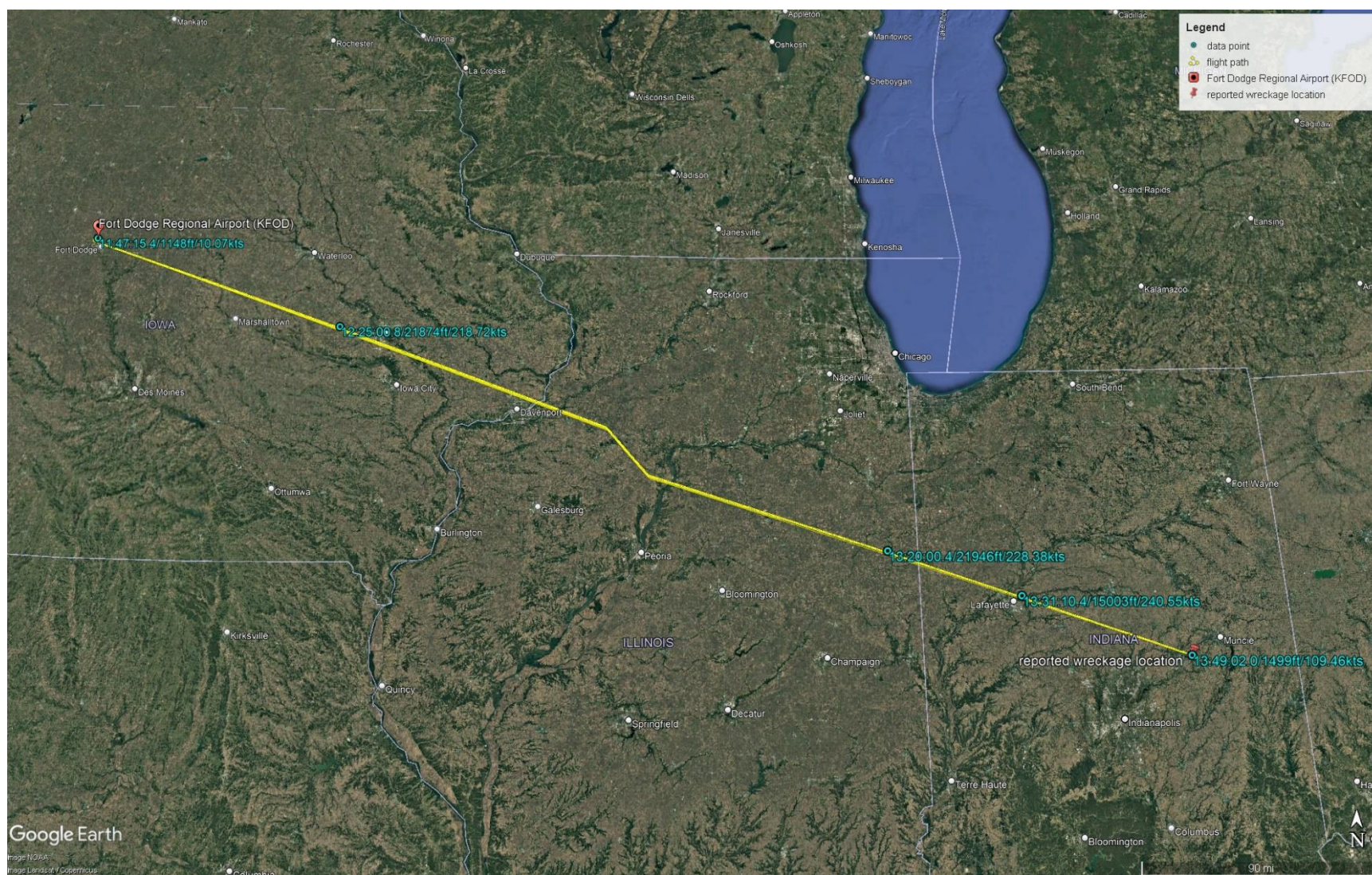


Figure 5. Google Earth overlay of the entire accident flight recording on September 6, 2024.

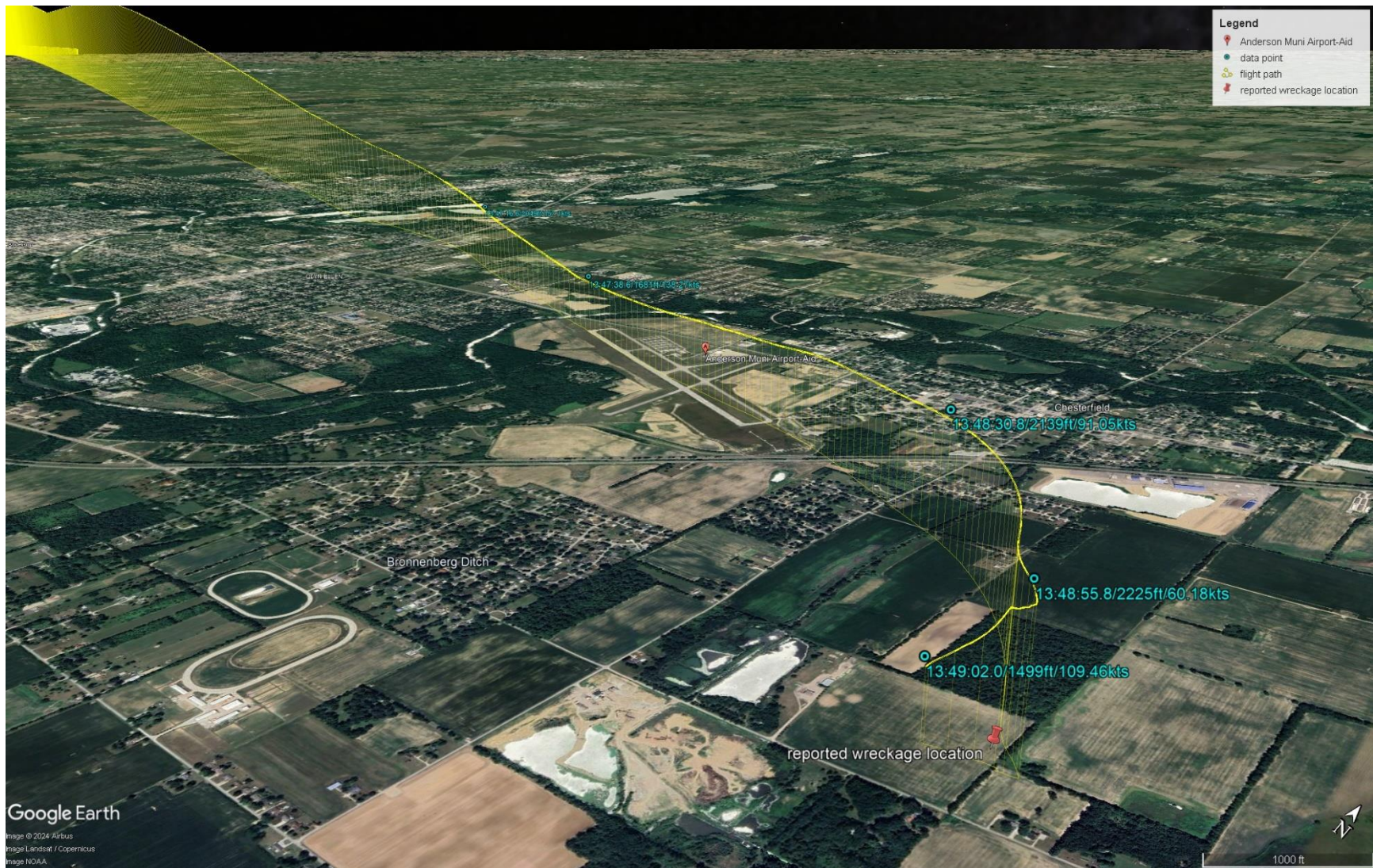


Figure 6. Google Earth overlay showing the last portion of the accident flight recording.

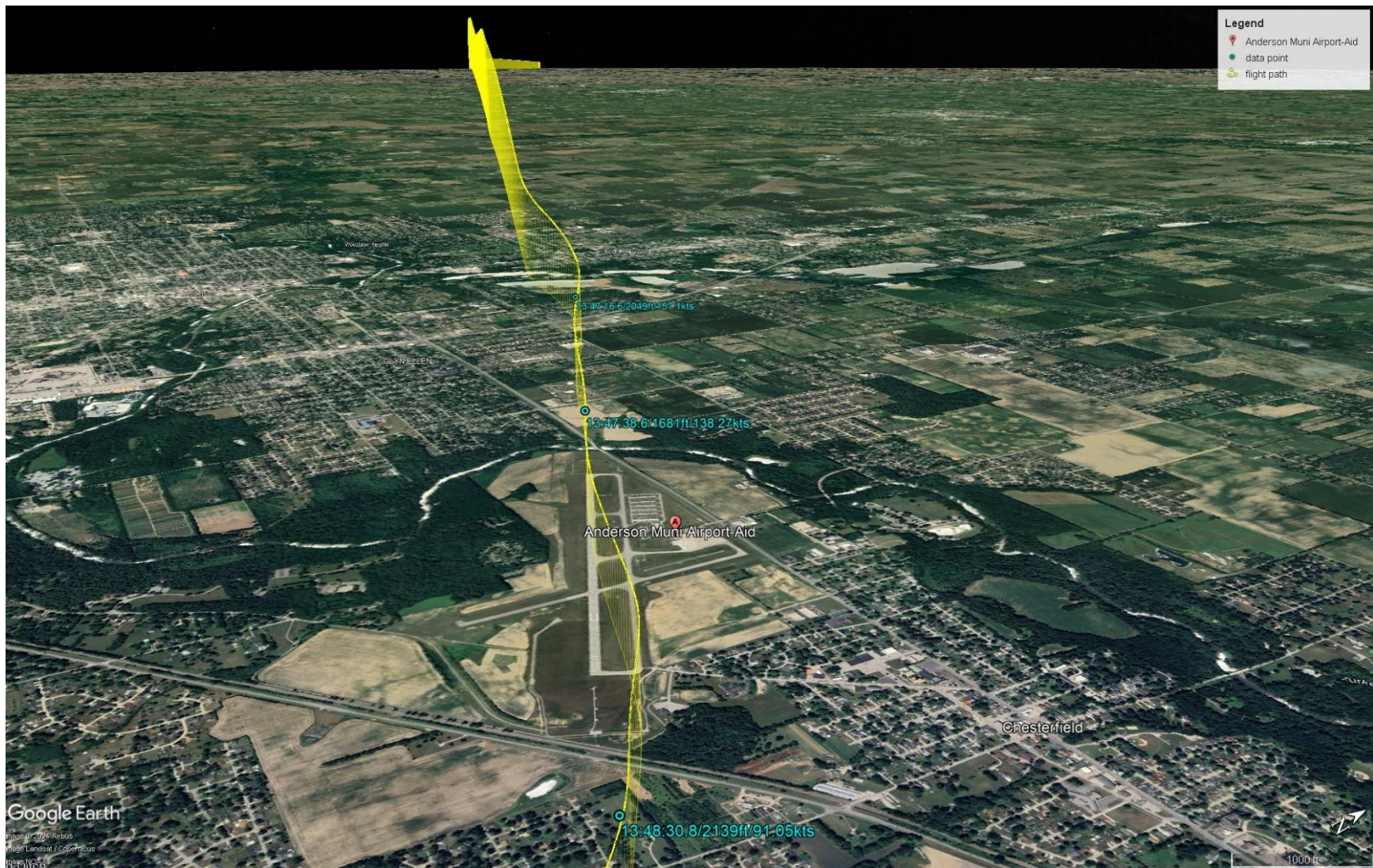


Figure 7. Google Earth overlay showing the accident flight path near the Anderson Municipal Airport.

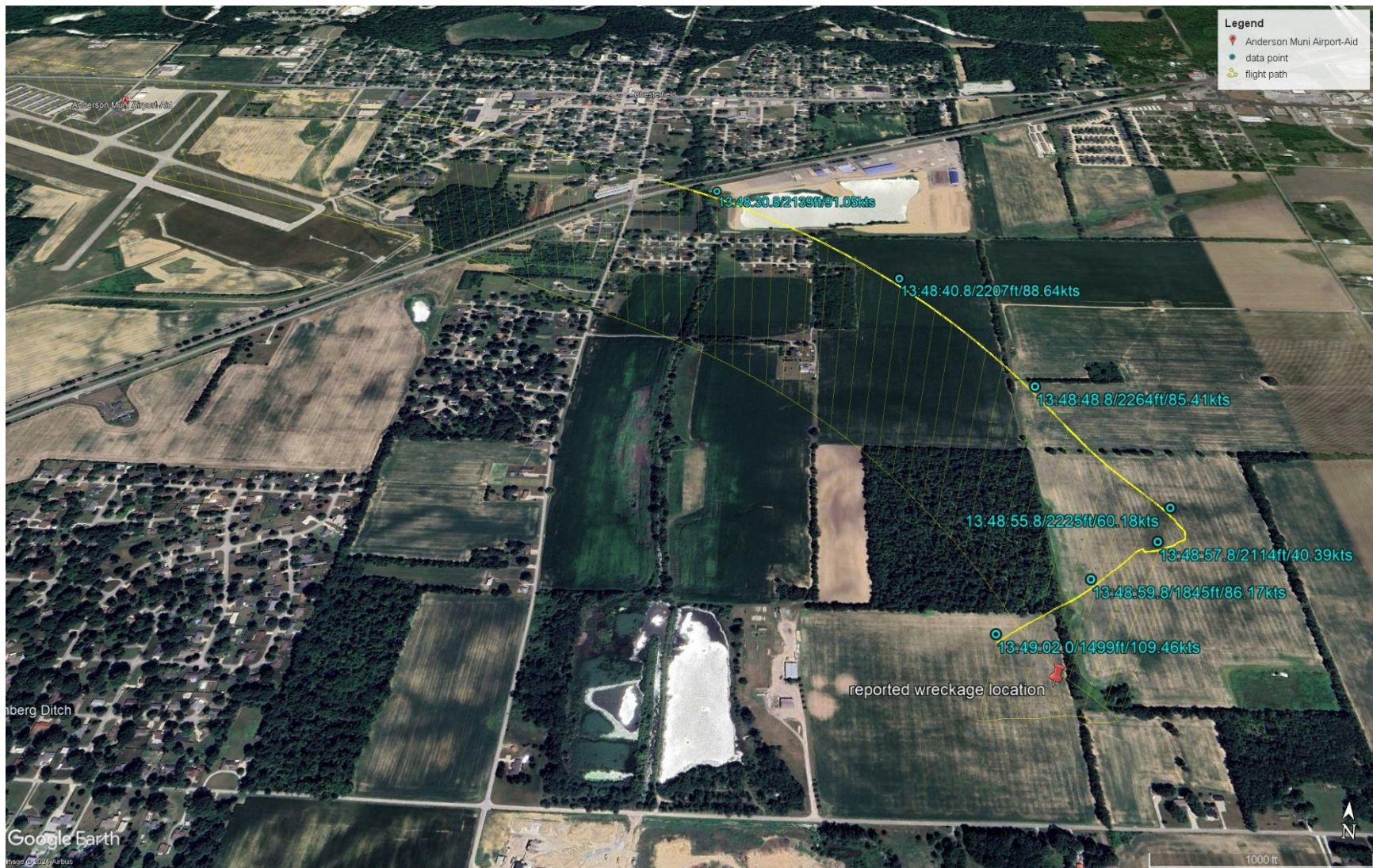


Figure 8. Google Earth overlay showing the last portion of the accident flight recording near the reported wreckage location.

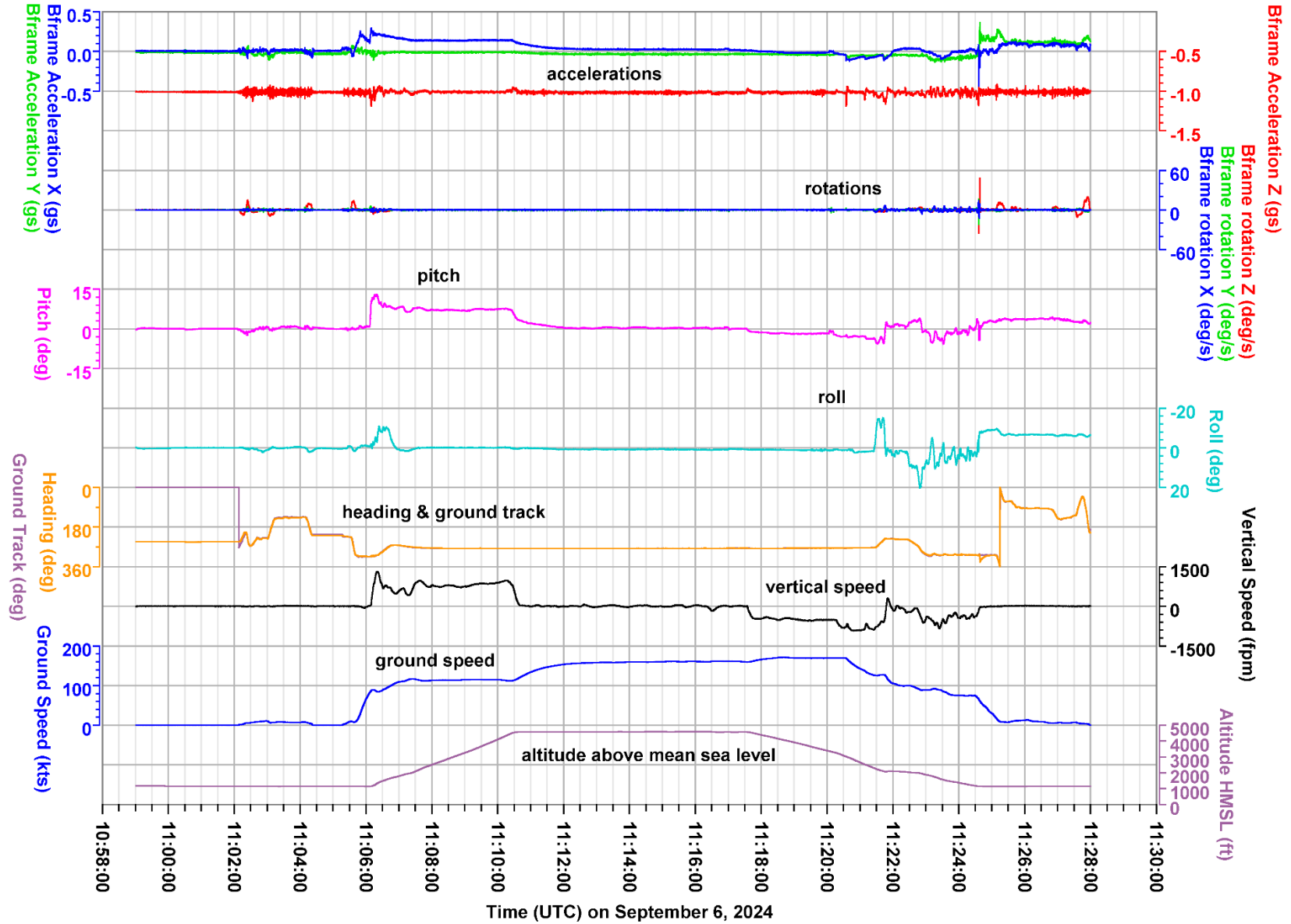


Figure 9. Plot of data parameters of the previous flight recording.

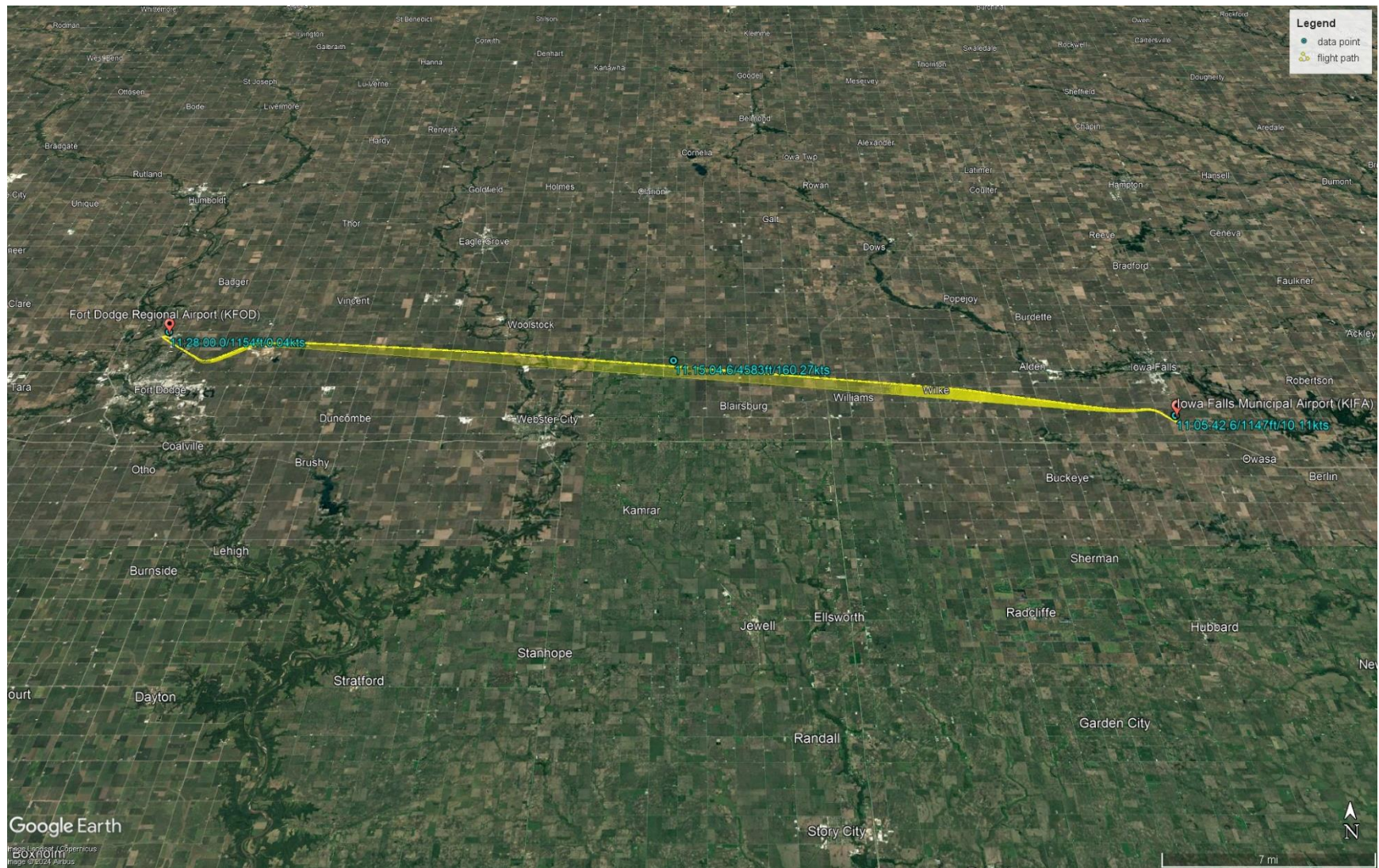


Figure 10. Google Earth overlay of the previous flight recording.