

# National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



ERA24FA104

## **ELECTRONIC DEVICE**

Specialist's Factual Report

September 16, 2024

## TABLE OF CONTENTS

|                                                        |   |
|--------------------------------------------------------|---|
| A. ACCIDENT.....                                       | 3 |
| B. ELECTRONIC DEVICE SPECIALIST .....                  | 3 |
| C. DETAILS OF THE INVESTIGATION .....                  | 3 |
| 1.0 Appareo Stratus PRX V2 Description .....           | 3 |
| 1.1 Appareo Stratus PRX V2 Data Recovery .....         | 4 |
| 1.2 Appareo Stratus PRX V2 Recording Description ..... | 5 |
| 1.2.1 Appareo Stratus PRX V2 Parameters Provided.....  | 6 |
| 1.3 Appareo Startus PRX V2 Time Correlation .....      | 6 |
| D. FIGURES AND TABULAR DATA.....                       | 7 |

## **A. ACCIDENT**

Location: Clearwater, Florida  
Date: February 1, 2024  
Time: 1907 eastern standard time (EST)  
0007 coordinated universal time (UTC) on February 2, 2024  
Airplane: Beech V35B, private operator, N6659L

## **B. ELECTRONIC DEVICE SPECIALIST**

Specialist: Steven Smith  
Mechanical Engineer (Recorder Specialist)  
National Transportation Safety Board (NTSB)

## **C. DETAILS OF THE INVESTIGATION**

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

Recorder Manufacturer/Model: Appareo Stratus PRX V2  
Part Number: 150500-000003  
Recorder Serial Number: 202733

### **1.0 Appareo Stratus PRX V2 Description**

The Appareo Stratus PRX V2 device is a self-contained battery-powered unit that contains an internal AHRS, GPS/WAAS receiver, and ADS-B receiver in one compact unit.<sup>1, 2, 3</sup> The unit communicates wirelessly with compatible devices 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 flash memory chip (NVM).<sup>4</sup>

---

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

<sup>2</sup> 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.

<sup>3</sup> 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).

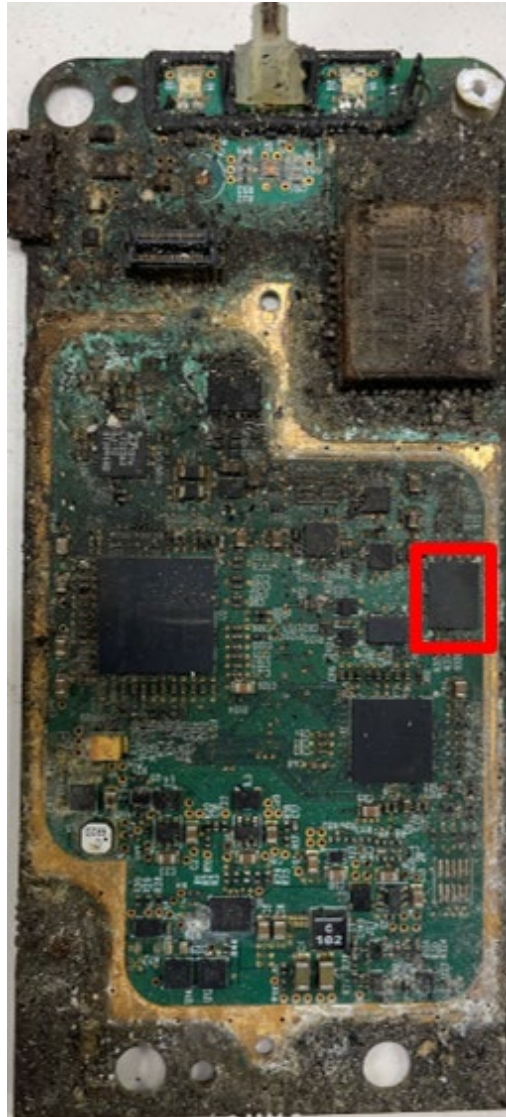
<sup>4</sup> Non-volatile memory is semiconductor memory that does not require external power for data retention.

## 1.1 Appareo Stratus PRX V2 Data Recovery

Upon arrival at the NTSB Vehicle Recorder Laboratory, an examination revealed the unit had sustained both impact and fire damage, as shown in figure 1. Due to the significant damage to the Appareo Stratus PRX V2, there was no attempt to power on the device. Instead, the Appareo Stratus PRX V2 was taken apart. The memory chip was identified, cleaned, and removed from the unit, as shown in figure 2. The raw binary data was extracted from the memory chip and was converted into engineering units using laboratory tools.



**Figure 1.** Appareo Stratus PRX V2 front (left) and back (right) as received by the Vehicle Recorder Lab.



**Figure 2.** Appareo Stratus circuit board removed from the unit. The red box in the image indicates location of removed chip.

## **1.2 Appareo Stratus PRX V2 Recording Description**

The recorded data included 11 sessions from November 24, 2023, through February 2, 2024, UTC. The session containing the accident event started on Thursday February 1, 2024, at 23:02:59 UTC and ended on Friday February 2, 2024, at 00:07:16 UTC. The data were sampled at 5 Hertz. Accuracy of gyroscopic parameters such as pitch angle and bank angle are dependent on the orientation of the device in the aircraft and proper calibration of the device.

The Appareo Stratus PRX V2 is an externally mounted device and is not necessarily fixed to the aircraft instrument panel in a rigid mounted position. As such, the device is subject to movement under extreme pitch and roll conditions. In such cases where the device is detached from its resting location, the device will continue

to record. This means that in an extreme pitch, roll or acceleration scenario, the device may move out of correlation with the aircraft, and the device will continue to record data based on the orientation of the unit itself, which is not necessarily reflective of the aircraft pitch, roll or acceleration condition. AHRS data is considered unreliable after 19:06:49.4 EST.

### 1.2.1 Appareo Stratus PRX V2 Parameters Provided

Table 1 lists the Appareo Stratus PRX V2 parameters verified and provided in this report.

**Table 1.** Appareo Stratus PRX V2 data parameters provided.

| Parameter Name (unit) | Parameter Description (unit)                          |
|-----------------------|-------------------------------------------------------|
| Accel Lat (g)         | Lateral Load Factor (gravitational acceleration)      |
| Accel Long (g)        | Longitudinal Load Factor (gravitational acceleration) |
| Accel Vert (g)        | Vertical Load Factor (gravitational acceleration)     |
| Alt MSL (ft)          | Altitude Mean Sea Level (feet)                        |
| Date (mm/dd/yyyy)     | Date (month/day/year)                                 |
| Ground Track (deg)    | Magnetic Ground Track (degrees)                       |
| Groundspeed (kts)     | Groundspeed (knots)                                   |
| Heading (deg)         | Magnetic Heading (degrees)                            |
| Latitude (deg)        | Latitude (degrees)                                    |
| Longitude (deg)       | Longitude (degrees)                                   |
| Pitch (deg)           | Pitch Attitude (degrees)                              |
| Roll (deg)            | Roll Attitude (degrees)                               |
| Slip (g)              | Slip (gravitational acceleration)                     |
| Time (HH:MM:SS)       | Time UTC (hours:minutes:seconds)                      |
| Turn Rate (deg/s)     | Turn Rate (degrees per second)                        |
| Vertical Speed (fpm)  | Vertical Speed (feet per minute)                      |

### 1.3 Appareo Stratus PRX V2 Time Correlation

The Appareo Stratus PRX V2 data was recorded in UTC. The difference between EST and UTC is 5 hours, or 18,000 seconds. The accident flight data was offset from the recorded device time to EST by subtracting 18,000 seconds.

An additional offset of 18 seconds was applied to correlate the device time to the Automatic Dependent Surveillance – Broadcast (ADS-B) data. The offset was determined by correlating the altitude, latitude, and longitude parameters from the Appareo Stratus PRX V2 to the same ADS-B parameters during takeoff and the final minutes of the flight. For the remainder of the report, all time will be referenced in EST.

## D. FIGURES AND TABULAR DATA

Figures 3 to 7 contain Appareo Stratus PRX V2 data recorded during the event on February 1, 2024. All the parameters listed in table 1 are plotted except Date, Time, Latitude, and Longitude.

Figures 3 and 4 are time history plots presenting the same parameters for the entire accident and the final 5 minutes of the recording, respectively.

These figures are configured such that right turns 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.

The electronic device data indicated the following sequence of events:

- **18:08:12 EST:** The aircraft began takeoff roll at Vero Beach Regional Airport (KVRB) from runway 30L.
- **18:16:03 EST:** The aircraft climbed to a maximum altitude of 6,264 ft.
- **18:16:13 EST - 18:48:12 EST:** The aircraft maintained a cruise altitude of approximately 6,100 ft.
- **18:48:13 EST:** The aircraft began to descend from 6,149 ft. Groundspeed was 166 kts.
- **18:50:20 EST:** The aircraft leveled at 3,990 ft.
- **18:56:34 EST:** The aircraft began to descend from 3,990 ft. Groundspeed was 166 kts.
- **18:57:59 EST:** The aircraft was descending through 2,840 ft. Groundspeed was 154 kts.
- **18:59:16 EST:** Altitude was 1,603 ft and groundspeed was 148 kts.
- **19:02:22 EST:** Altitude was 932 ft and groundspeed was 86 kts.
- **19:04:54 EST:** The aircraft was climbing through 1,148 ft and the groundspeed was 114 kts.
- **19:06:04 EST:** The aircraft was climbing through 1,520 ft and the groundspeed was 137 kts.
- **19:06:37 EST:** Altitude was 1,708 ft and descending, groundspeed was 79 kts and increasing, and vertical speed was -297 fpm.
- **19:06:39 EST:** Altitude was 1,692 ft and descending, groundspeed was 80 kts and reducing, and vertical speed was -453 fpm.
- **19:06:41 EST:** Altitude was 1,639 ft and descending, groundspeed was 80 kts and increasing, and vertical speed was -1220 fpm.
- **19:06:43 EST:** Altitude was 1,549 ft and descending, groundspeed was 86 kts and slightly reducing, and vertical speed was -2177 fpm.

- **19:06:45 EST:** Altitude was 1,440 ft and descending, groundspeed was 91 kts and increasing, and vertical speed was -2795 fpm.
- **19:06:47 EST:** Altitude was 1,309 ft and descending, groundspeed was 101 kts and increasing, and vertical speed was -3411 fpm.
- **19:06:49.4 EST:** End of apparent reliable AHRS data. The GPS data showed the altitude was 1,124 ft and descending, groundspeed was 106 kts, and vertical speed was -4199 fpm.
- **19:06:51 EST:** Altitude was 976 ft and descending, groundspeed was 108 kts and reducing, and vertical speed was -4781 fpm.
- **19:06:53 EST:** Altitude was 797 ft and descending, groundspeed was 112 kts and increasing, and vertical speed was -5083 fpm.
- **19:06:55 EST:** Altitude was 612 ft and descending, groundspeed was 114 kts and increasing, and vertical speed was -5301 fpm.
- **19:06:57 EST:** Altitude was 406 ft and descending, groundspeed was 118 kts and increasing, and vertical speed was -5628 fpm.
- **19:06:58.4 EST:** Last recorded valid GPS data point. Altitude was 255 ft and descending, groundspeed was 120 kts and increasing, and vertical speed was -5836 fpm. The distance from the last valid GPS data point and the reported accident site location was approximately 224 ft.

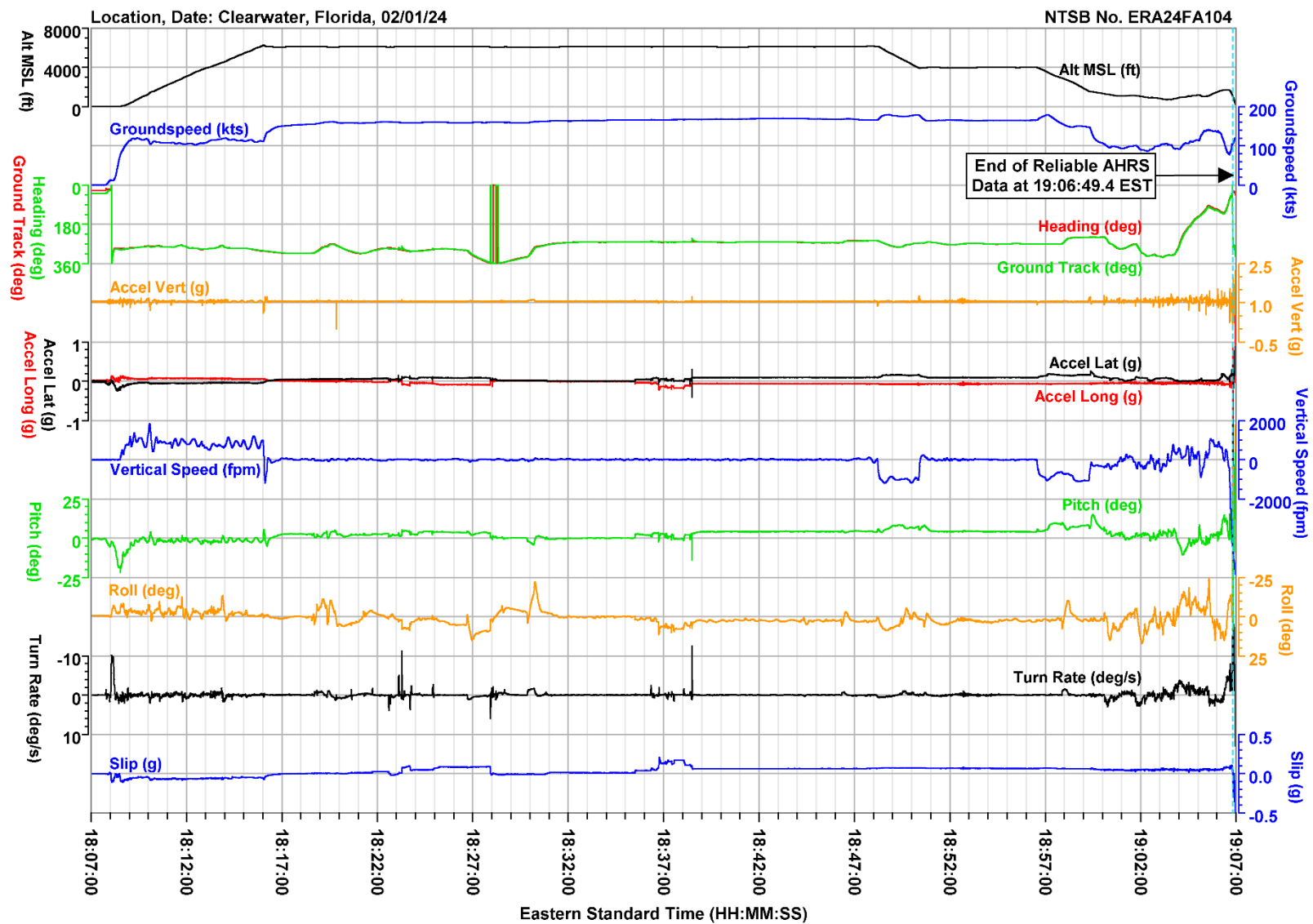
Figures 5 through 7 are graphical overlays derived from the Appareo Stratus data and generated using Google Earth presenting the entire accident flight from KVRB, the final 6 minutes of the recorded data, and the final 23.4 seconds of the recorded data, respectively. Weather and lighting conditions in Google Earth are not necessarily the weather and lighting conditions present at the time of the recording.

The corresponding tabular data used to create figures 3 to 7, including Date, Time, Latitude, and Longitude, are provided in electronic comma-separated value (CSV) format as attachment 1 to this report.

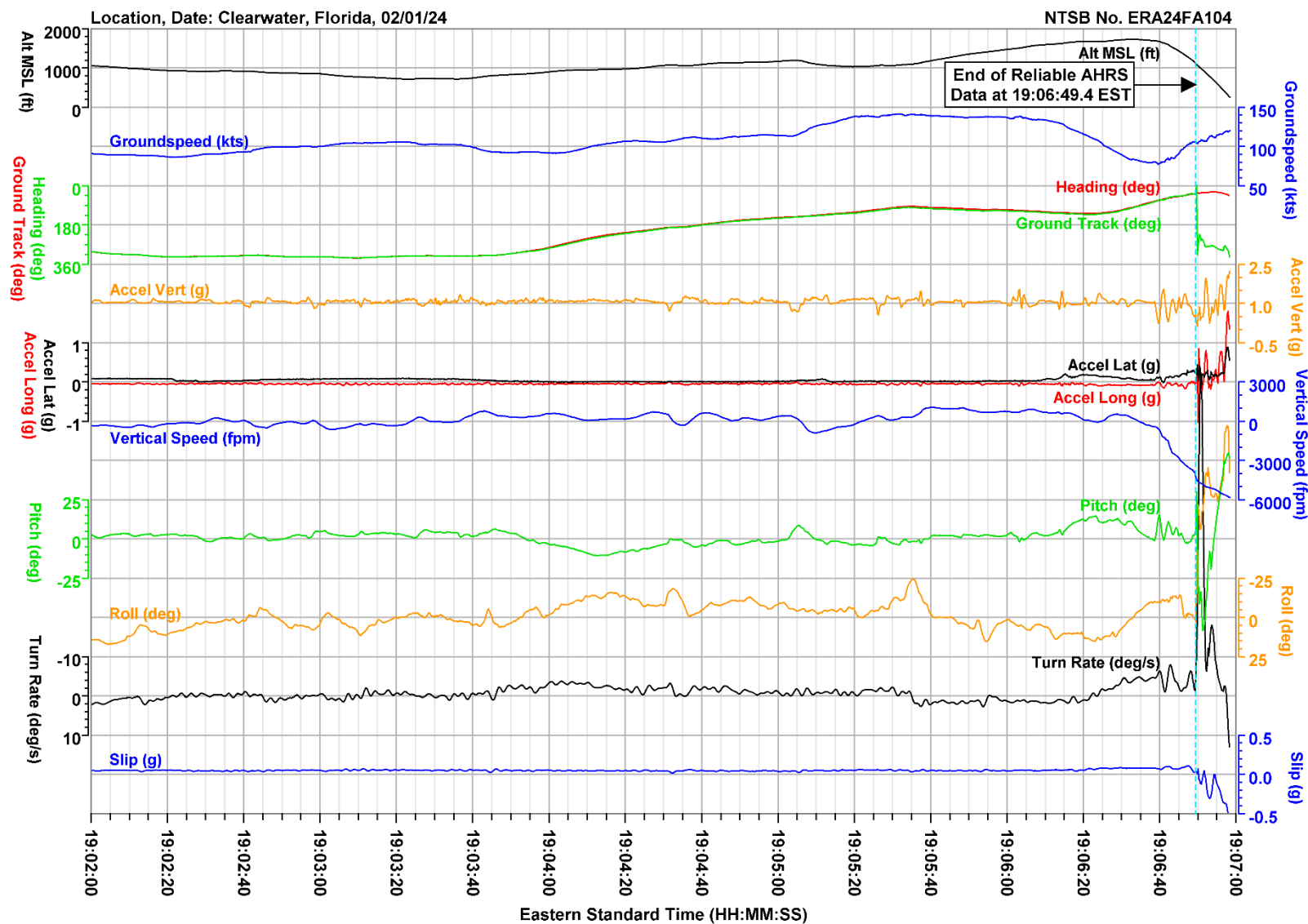
The corresponding ADS-B tabular data used for time correlation is provided in electronic CSV format as attachment 2 to this report.

Submitted by:

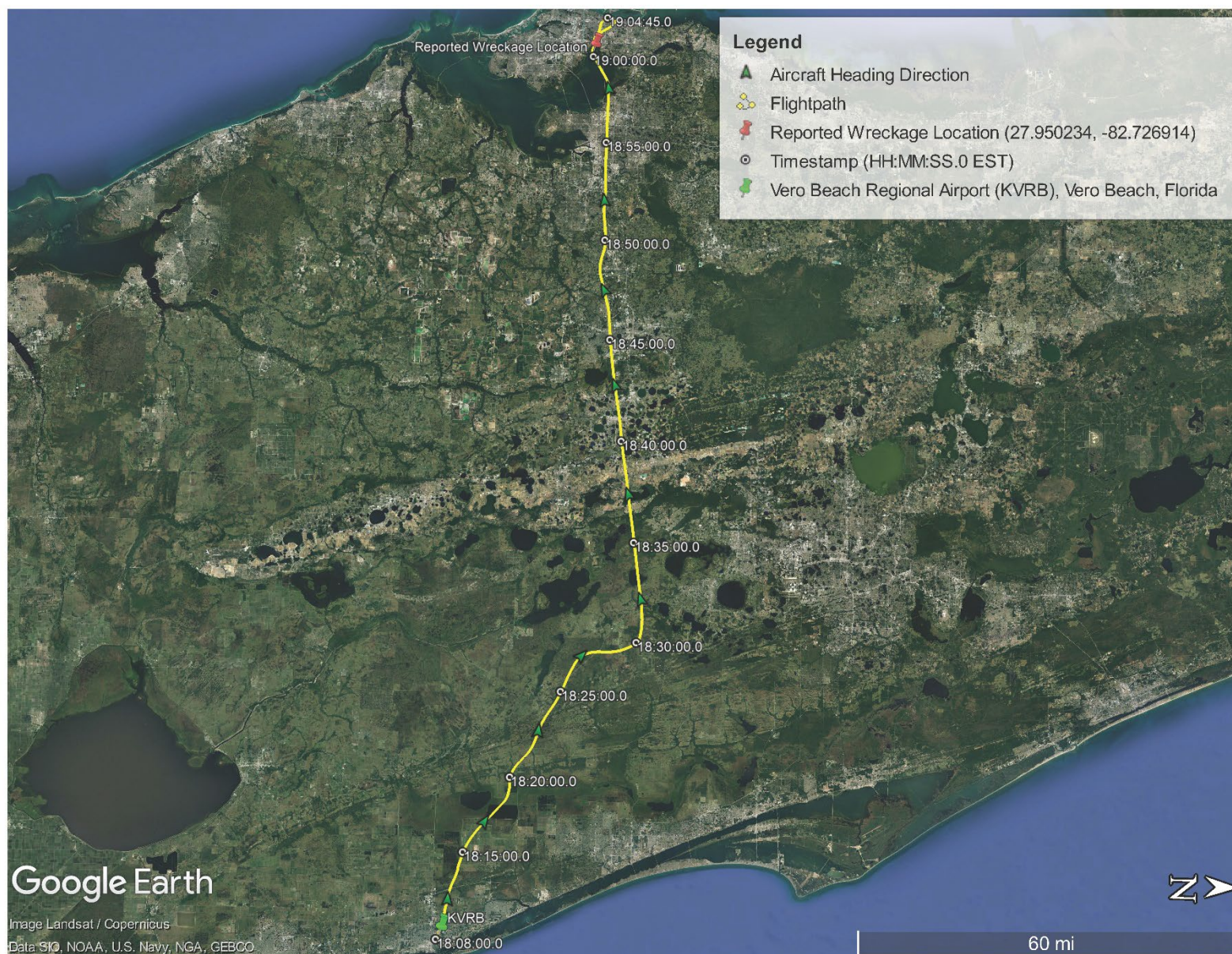
Steven Smith  
Mechanical Engineer (Recorder Specialist)



**Figure 3.** Time history plot of Appareo Stratus PRX V2 parameters for the entire accident flight.



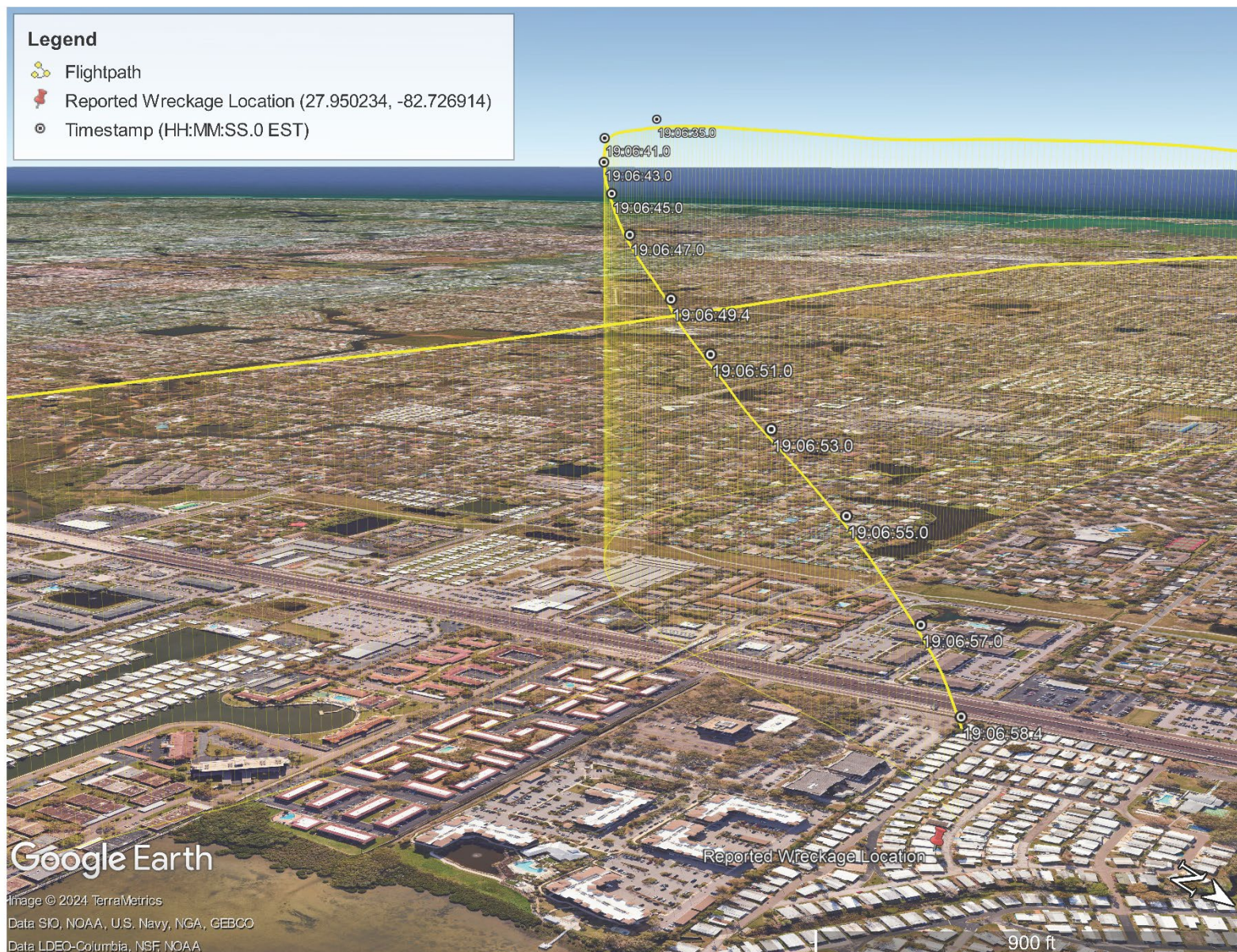
**Figure 4.** Time history plot of Appareo Stratus PRX V2 parameters for the final 5 minutes of the recording.



**Figure 5.** Google Earth overlay of the entire accident flight. Time displayed is 18:08:00 EST to 19:04:45 EST.



**Figure 6.** Google Earth overlay of the last 6 minutes of the recording. Time displayed is 19:00:45 EST to 19:06:45 EST.



**Figure 7.** Google Earth overlay of the last 23.4 seconds of the recording. Time displayed is 19:06:35 EST to 19:06:58.4 EST.