

**NATIONAL TRANSPORTATION SAFETY BOARD**  
Vehicle Recorder Division  
Washington, D.C. 20594

June 1, 2016

## **Multiple Electronic Devices**

**Specialist's Factual Report  
by Sean Payne**

### **1. EVENT**

Location: Linesville, Pennsylvania  
Date: December 7, 2015  
Aircraft: Cubcrafters CCK-1865  
Registration: N541TC  
Operator: Private  
NTSB Number: ERA16FA063

On December 7, 2015, about 1815 eastern standard time (EST), an experimental, amateur-built CCK-1865, N541TC, was substantially damaged when it impacted wooded terrain, while maneuvering near Merrys Pymatuning Airport (PA01), Linesville, Pennsylvania. The private pilot and passenger were fatally injured. The airplane was registered to Hartford Aviation LLC and operated by a private individual as a personal flight conducted under the provisions of 14 *Code of Federal Regulations* Part 91. Night Instrument meteorological conditions prevailed and no flight plan was filed for the planned flight to PA01. The flight originated from Greenville Municipal Airport (4G1), Greenville, Pennsylvania, about 1800.

### **2. DETAILS OF INVESTIGATION**

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following devices:

Device 1: Electronics International CGR-30P  
Device 1 Serial Number: 156170  
Device 2: Garmin Aera 796  
Device 2 Serial Number: 2cy007831  
Device 3: Contour+ Model 1500  
Device 3 Serial Number: Not Available

#### **2.1. Electronics International CGR-30P Device Description**

The Electronics International CGR-30P is a panel mounted instrument that can monitor and record up to 66 parameters related to engine operations. Depending on the installation engine parameters monitored can include:

- Exhaust Gas Temperature (EGT)
- Cylinder Head Temperature (CHT)
- Oil Pressure and Temperature
- Manifold Pressure
- Outside Air Temperature
- Engine Revolutions per Minute
- Fuel Pressure
- Battery Voltage
- Battery Amperage

The unit can also optionally be connected to an external GPS system to provide real time calculation of range and endurance. Additionally, when connected to an external GPS source, the device can calculate additional fuel management parameters such as Gallons Remaining to Destination and other estimations of fuel usage.

The unit contains an internal non-volatile<sup>1</sup> micro SD<sup>2</sup> card for data storage of the parameters recorded and calculated. The data is stored at a rate of 3 samples per second. The amount of data stored is dependant on the size of the micro SD card installed on the device's internal board. Additionally, the recording feature will only begin to overwrite older flight files when it has stored 1,500 flights. For a non-damaged unit, the data can then be downloaded by the operator using a USB flash drive and following the instructions on the unit when accessed from the "USB and Data Recording Screen."

### **2.1.1. Electronics International CGR-30P Data Recovery**

Upon arrival at the Vehicle Recorder Division, an exterior examination revealed the unit had not sustained any significant impact damage. Information was extracted by removing the device's internal microSD flash memory card and reading the device's contents in a forensic recovery program. The microSD card revealed a number of datafiles in .CSV format, one of which contained data captured during the accident flight. Figure 1 shows the device's condition upon arrival to the laboratory. Figure 2 shows the microSD card just prior to removal and read out.



**Figure 1. The device's condition upon arrival.**

<sup>1</sup> Non-volatile – electronic memory that does not require power to retain data.

<sup>2</sup> Micro SD – Secure Digital – a non-volatile memory card format.

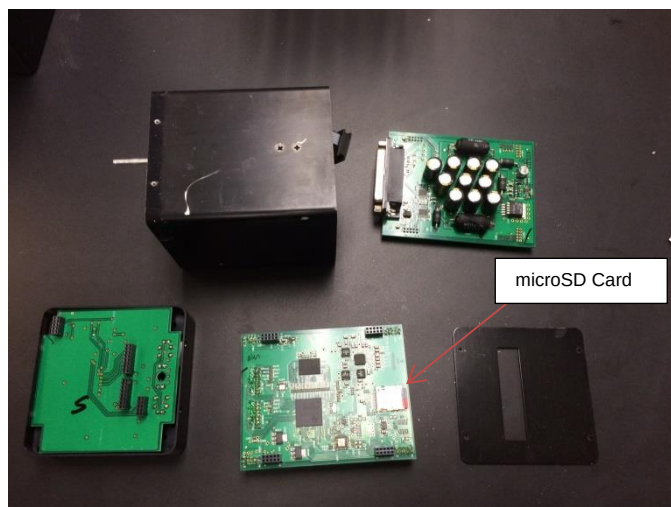


Figure 2. The microSD card seated in the device just prior to removal and readout.

### 2.1.2. Electronics International CGR-30P Data Description

The data extracted included 95 sessions from September 6, 2015<sup>3</sup> through December 7, 2016. The accident flight was the 94<sup>th</sup> session, recorded starting at 19:14:09 UTC and ending at 19:29:48 UTC on December 7, 2016 (2,790 total data points). The 95<sup>th</sup> and last recorded data log was approximately 6 seconds in length and contained data not consistent with operation of the aircraft in flight.

### 2.1.3. Electronics International CGR-30P Time Correlation

The EDM records time with the first data sample based on the unit's internal clock. This clock is set and updated by the operator. The final time sample shows a loss of data at 19:29:48. The timing of the accident could not be compared to final record of the Garmin Aera 796, as that device stopped logging data an unknown amount of time prior to impact (see section 2.2 for details). Instead, the time at which the aircraft showed take off power was applied was correlated to the timing information from the Garmin Aera 796 that showed the aircraft begin takeoff roll.

When comparing the above event, the corrected time correlation for this device is as follows:

$$\text{EST} = \text{GCR-30P Time} + 64,747 \text{ seconds}$$

For the rest of this report, all times are referenced as EST, not recorded time.

The manufacturer of the unit reports that the recording occurs at 3 Hz intervals. Reviewing the recorded data file found that records were mostly generated at 3 Hz, however, samples did not contain a value for decimal seconds. Decimal seconds for a 3 Hz sample rate were affixed to the recovered data file for use in plotting software.

<sup>3</sup> All dates and times are referenced to Coordinated Universal Time (UTC).

Previous flight files were also examined. The time correlation for previous flights was assumed to be the same in the absence of any other timing information.

#### **2.1.4. Electronics International CGR-30P Overlays and Tabular Data**

Tabular data used to generate figures 3 and 4 are included as Attachment 1. This attachment is provided in electronic comma-delimited (\*.CSV) format.

Figure 3 is a plot of selected parameters from the CGR-30P for the entire accident flight. The plot starts at 18:13 and ends at 18:30. EGT probes for cylinders 1, 3, and 4 show anomalous readings. Previous flights showed the same sensor issues for these parameters. Takeoff power was applied around 18:14:20. All engine parameters responded nominally to the engine power increase. The RPM values stabilized around 2,200 rpm for the first approximate 7 minutes of flight. During this time interval, other engine parameters showed nominal readings.

Around 18:21, engine rpm showed a decrease, other engine parameters responded normally. Rpm became around 1,700 rpm for the next few minutes until approximately 18:26 when rpm showed a reduction to about 1,350 rpm. About a minute later, rpm was shown in an increasing trend. Rpm increased slightly to about 2,400 rpm over the next few minutes. The recording ended at 18:28:56. At this time, all parameters appeared nominal.

Figure 4 is a condensed time interval plot of the same recording. The plotted time interval starts at 18:24 and ends at 18:30.

### **2.2. Garmin Aera 796 Device Description**

The Garmin Aera 796 is a battery-powered, portable, multi-function display and GPS receiver with a 7-inch diagonal, high resolution, LCD touch screen display. The unit includes a built-in Jeppesen database for flight information. The unit can also perform and store weight and balance calculations. A built-in AOPA Airport Directory and SafeTaxi airport diagrams are included for selected airfields. The device also has a “scratch pad” feature, allowing the user to hand write electronic notes.

The device stores date, route-of-flight, and flight-time information for up to 50 flights. A detailed track log – including latitude, longitude, date, time, and GPS altitude information – is stored within the unit whenever the receiver has a lock on the GPS navigation signal. Position is updated within the track log as a function of time or distance moved, depending on how the unit has been configured. Once the current track log memory becomes full, new information either overwrites the oldest information or recording stops, depending on how the unit is configured.

Track log storage may be activated or de-activated at user discretion. All recorded data is stored in non-volatile memory. The unit contains hardware and software permitting the download of recorded waypoint, route, and track log information to a PC via a built-in USB port.

### 2.2.1. Garmin Aera 796 Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed the unit had sustained some impact damage. The device's screen was no longer functioning. Power was applied to the device on the laboratory work bench and information was extracted using the manufacturer's software normally, without difficulty. Figure 5 shows the device's condition upon arrival to the laboratory.



Figure 5. The device's condition upon arrival.

### 2.2.2. Garmin Aera 796 Data Description

The data extracted included 54 sessions from October 26, 2015 through December 8, 2016 (9,999 total data points). The accident flight was the 53<sup>rd</sup> session, recorded starting at 23:13:27 UTC (18:13:27 EST) and ending at 23:27:18 UTC (18:27:18 EST) on December 7, 2016 (143 total data points). The last record taken on December 8, 2016, was a tracklog consistent with the device being used in an automobile.

### 2.2.3. Garmin Aera 796 Parameters Provided

Table 1 describes data parameters provided by the GPS device. Date, Time, Latitude, Longitude, and GPS Altitude are recorded by the device. Groundspeed and Track are derived from the recorded parameters.

Table 1. GPS Data Parameters

| Parameter Name | Parameter Description                         |
|----------------|-----------------------------------------------|
| Date           | Date for recorded data point (MM/DD/YYYY)     |
| Time           | Time (UTC) for recorded data point (HH:MM:SS) |
| Latitude       | Recorded Latitude (degrees)                   |
| Longitude      | Recorded Longitude (degrees)                  |
| GPS Alt        | Recorded GPS Altitude (feet)                  |
| Groundspeed    | Derived groundspeed (knots)                   |
| Track          | Derived course (degrees)                      |

## 2.2.4. Garmin Aera 796 Overlays and Tabular Data

The following overlay was created using Google Earth. The aircraft's flight path is shown in yellow. Times appear on the Google Earth overlays in EST.

Figure 6 is a north up oriented Google Earth overlay of the aircraft's track during the entire accident flight. The recording begins at Greenville Municipal Airport (4G1), Greenville, PA in the vicinity of the airport's ramp area. Around 1814:38 EST, the aircraft began a takeoff roll and departed runway 33 at 4G1. The aircraft departed and climbed straight ahead until 1817:25 EST, when the aircraft turned northbound at approximately 1,800 feet. The aircraft continued to climb northbound to approximately 2,900 feet at a groundspeed between 80 and 90 knots. Around 1821:31 EST, the aircraft began descending slowly as it continued northbound. By 1824:05 EST, the aircraft was over Ford Island on the Pymatuning Reservoir; the GPS device showed the aircraft's groundspeed as 66 knots and its altitude as 1,821 feet. The aircraft continued descending as it traveled northbound. At 1825:42 EST the aircraft deviated course shallowly to the right as it continued descending. At 1826:18 EST, the aircraft had descended to 1,358 feet and 42 knots of ground speed and began deviating course to the left. 14 seconds later, at 1826:32 EST, the aircraft began deviating course again to right and entered a climb from 1,430 feet at 52 knots groundspeed. GPS data ended at 1827:18 EST showing the aircraft in a climb trend, the last data point showed 1,555 feet and 68 knots groundspeed. The wreckage location is denoted as a yellow pin.

Figure 7 is a north up oriented view that shows the aircraft making a gradual descent as it continued northbound.

Figure 8 is detailed view of the final portion of the recording before the device terminated logging.

Tabular data used to generate figures 6 through 8 are included as Attachment 2. This attachment is provided in electronic comma-delimited (\*.CSV) format.

## 2.3. Contour+ Model 1500 Device Description

The Contour+ Model 1500 is a compact, lightweight, POV<sup>4</sup> digital camera. The camera contains a mount that allows the camera to be mounted in a variety of positions using an array of supported accessories. The camera supports 1080 HD<sup>5</sup> as well as other lower quality recording resolutions at higher frame rates. The camera can be set to record still images simultaneously or independently of a video stream at a resolution of up to 5 megapixels.<sup>6</sup> The camera includes a wide angle aspherical lens that provides a

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<sup>4</sup> POV – Point of View Shot – A photography technique that records the character's viewpoint from a singular camera location mounted in a manner that represents the character's field of view.

<sup>5</sup> HD – High Definition – A resolution generally consisting of greater than 480 lines of horizontal resolution.

<sup>6</sup> Megapixel – (MP) – A count of a million pixels in an image or used to express the number of individual image sensor elements on a digital camera image sensor.

maximum of 170 degrees viewing angle. The camera supports recording to micro SD<sup>7</sup> cards up to 64 GB in size. The camera also supports wireless control over Bluetooth through the use of an app on a separate portable electronic device (PED). This particular model of the camera is marketed under the “Nflightcam” brand name and contains a neutral density filter that permits the camera to record an aircraft propeller without the effects associated with the camera’s rolling shutter<sup>8</sup>.

### **2.3.1. Contour+ Model 1500 Data Recovery**

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed the unit had sustained significant impact damage. The device’s battery door was missing as well as the switch which turns the device on and off. The battery itself was also not present. The device’s microSD card was found seated in the device’s flash media slot. Upon further examination, the microSD card was found to have a crack running the width of the card. An examination of the edge of the card revealed the crack had penetrated through the card’s plastic casing. Figure 9 shows the device’s condition upon arrival to the laboratory. Figure 10 shows the device’s microSD card seated in the camera’s flash memory slot. Figure 11 shows the microSD card removed from the device under magnification. Figure 12 shows the underside of the microSD card under magnification.

The micro SD card was sent to the Integrated Electronics Engineering Center (IEEC) at Binghamton University for additional evaluation. Sonic imaging of the chip suggested that physical damage (crack) likely penetrated into the silicon die stack. As a result, the university concluded that data recovery was not likely. The IEEC report is available in the public docket as Attachment 3 to this report.



**Figure 9. The device’s condition upon arrival.**

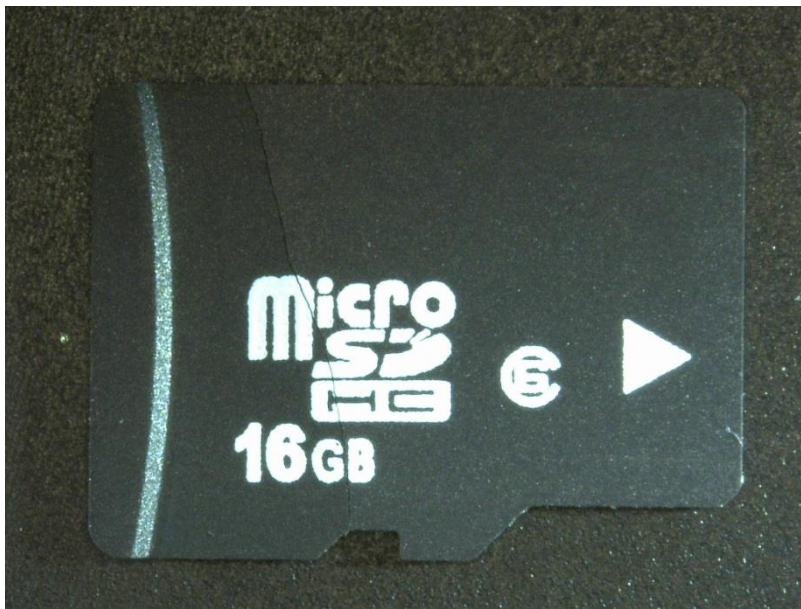
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<sup>7</sup> SD – Secure Digital – a standard for nonvolatile memory card used in portable devices.

<sup>8</sup> Rolling Shutter - A method of image capture in which a still picture (in a still camera) or each frame of a video (in a video camera) is captured not by taking a snapshot of the entire scene at single instant in time but rather by scanning across the scene rapidly, either vertically or horizontally.



**Figure 10. The microSD card shown seated in the device's memory slot.**



**Figure 11. The device's microSD card removed under magnification.**

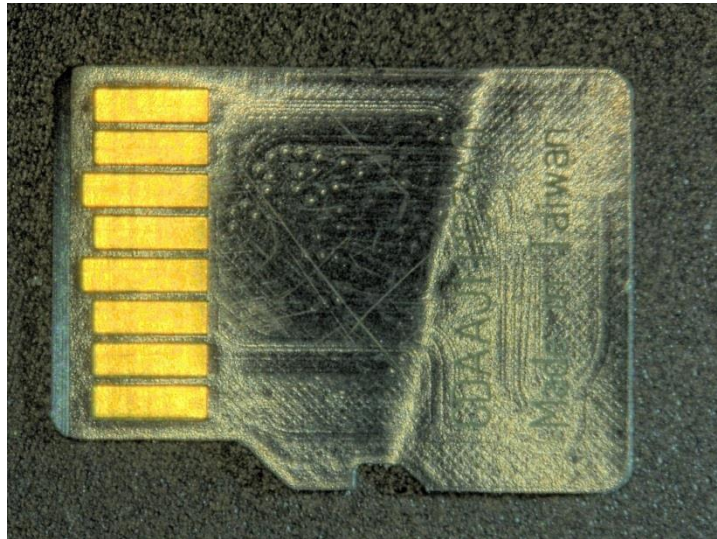


Figure 12. The underside of the microSD card under magnification.

### 2.3.2. Contour+ Model 1500 Data Description

No data was recovered from the device's microSD card.

Figure 3. A plot of selected recorded parameters from the CGR30P for the entire accident flight.

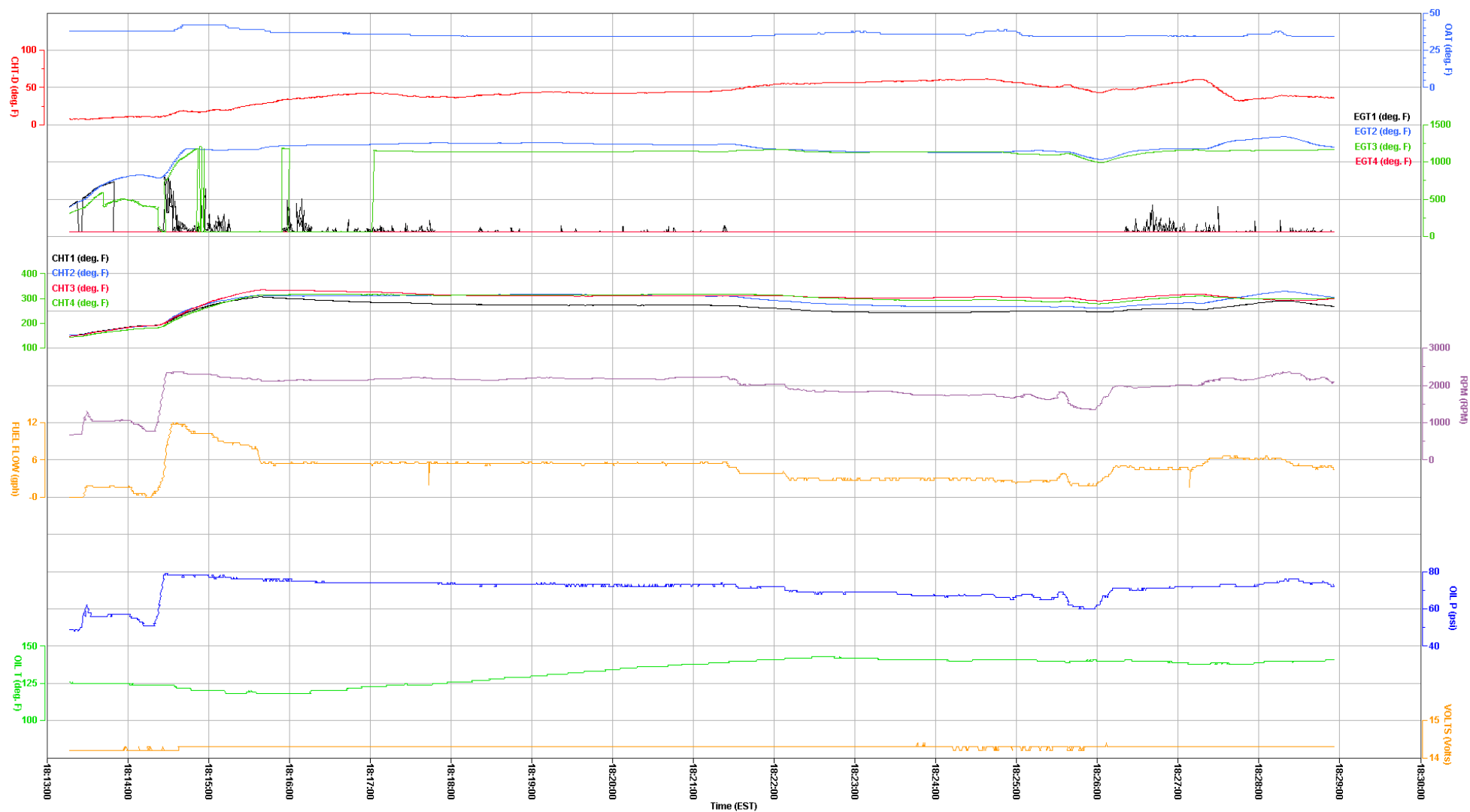


Figure 4. A plot of selected recorded parameters from the CGR30P for the final portion of the accident flight.

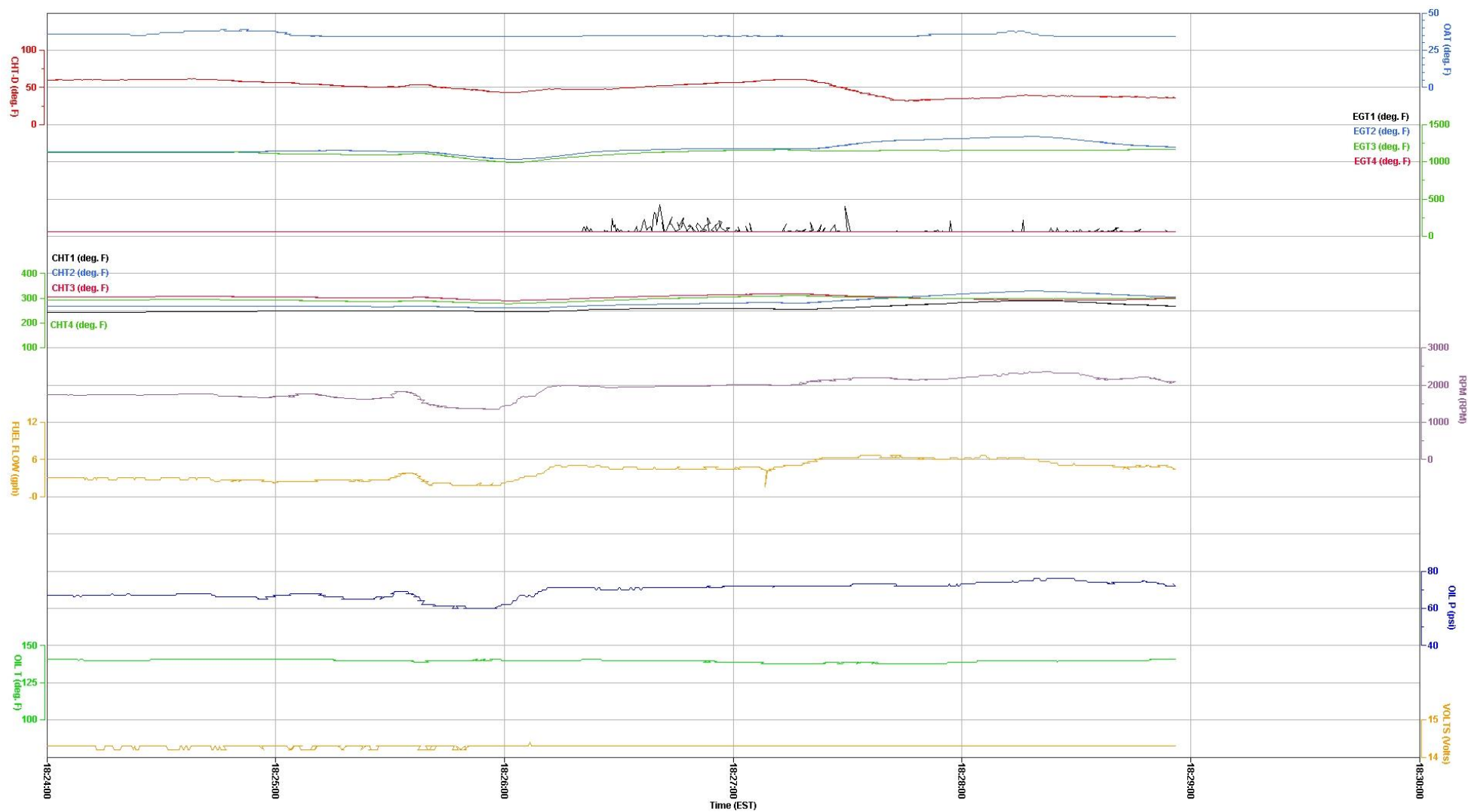


Figure 6. A north up view of GPS tracklogs from the entire accident flight recording.

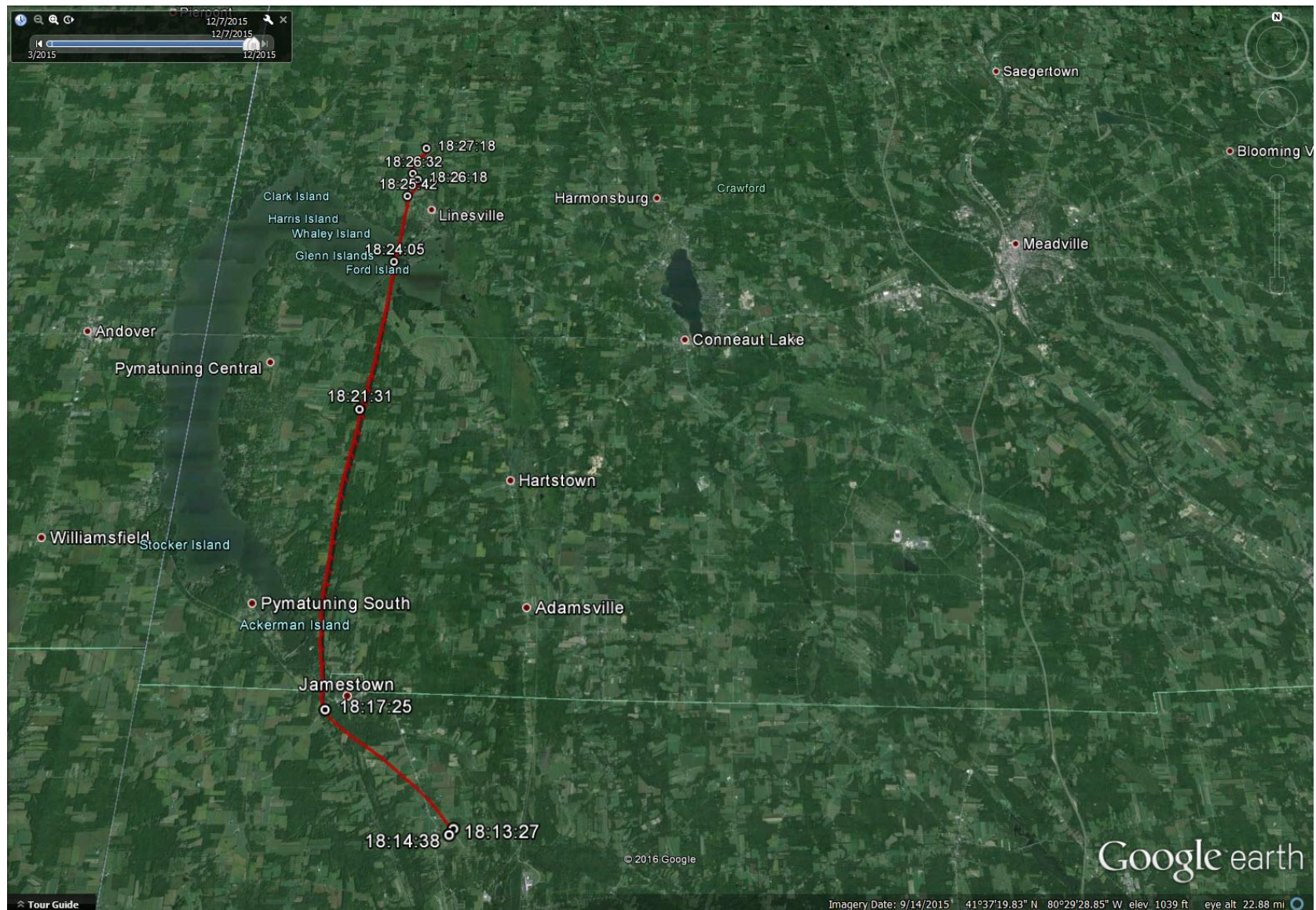


Figure 7. A north up view of GPS tracklogs that shows the aircraft's gradual descent as it continued northbound.

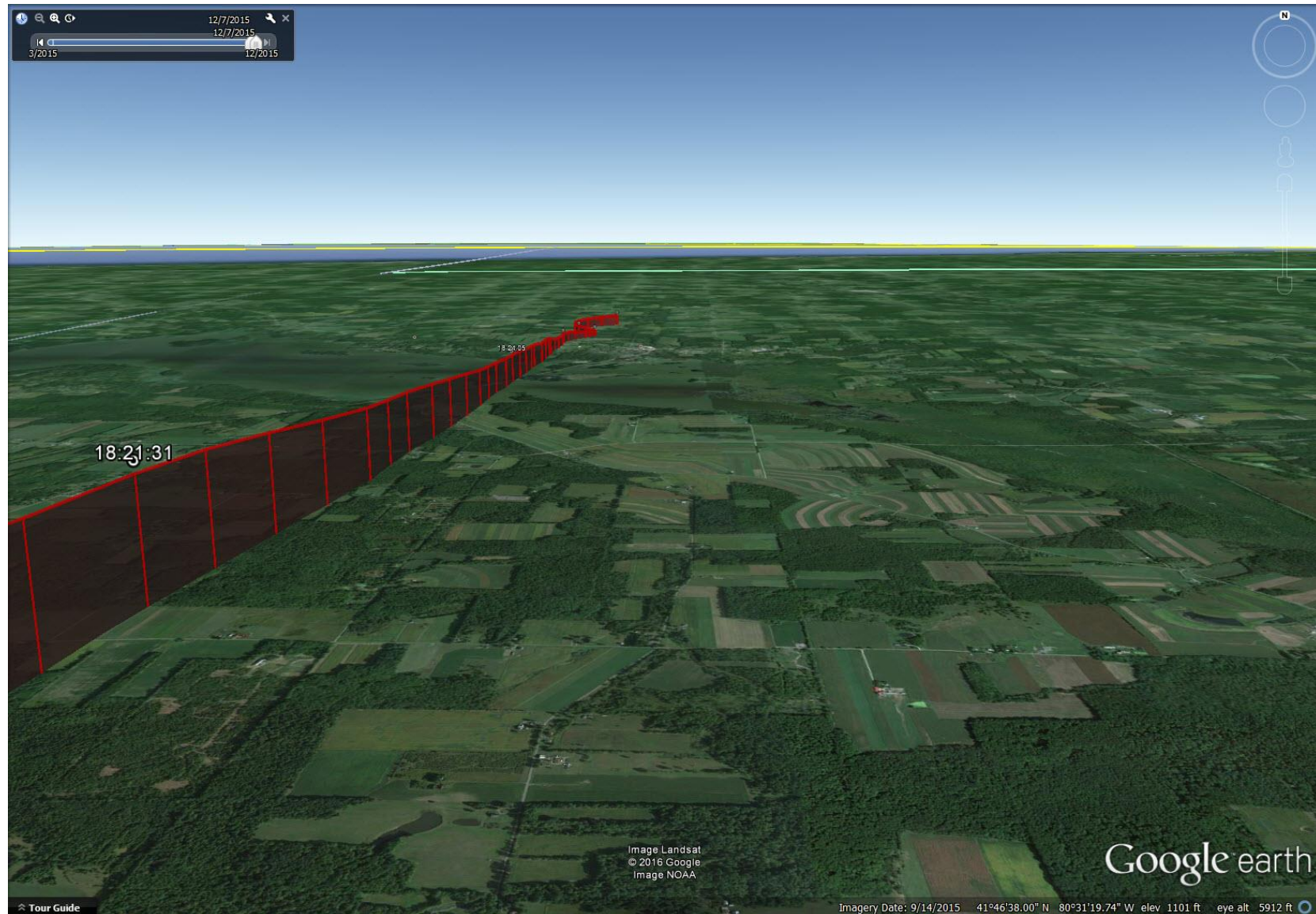
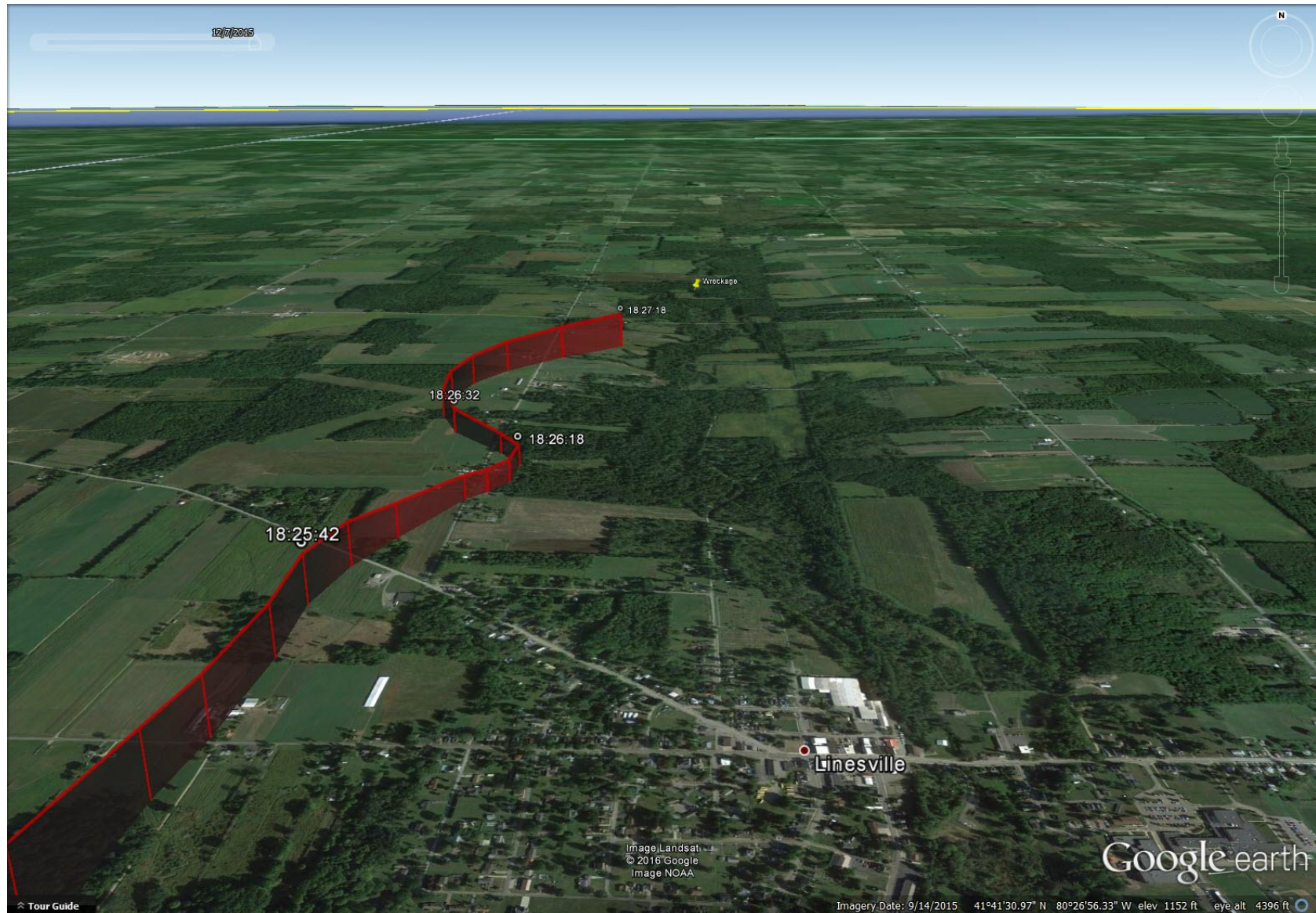


Figure 8. A north up view of GPS tracklogs that shows the aircraft's final portion of flight.



## APPENDIX A

This appendix describes the parameters provided and verified in this report. Table A-1 lists the parameters and table A-2 describes the unit abbreviations used in this report.

**Table A-1. Verified and provided parameters.**

| Parameter Name     | Parameter Description                                         |
|--------------------|---------------------------------------------------------------|
| 1. VOLTS (Volts)   | Battery System Voltage                                        |
| 2. CHT# (deg. F)   | Cylinder Head Temperature – Engine Cylinder # 1 - 4           |
| 3. CHT-D (deg. F)  | Cylinder Head Temperature – Delta Hottest to Coldest Cylinder |
| 4. EGT# (deg. F)   | Exhaust Gas Temperature – Engine Cylinder # 1- 4              |
| 5. FUEL FLOW (gph) | Fuel Flow                                                     |
| 6. OIL T (deg. F)  | Oil Temperature                                               |
| 7. OIL P (psi)     | Oil Pressure                                                  |
| 8. RPM (RPM)       | Engine RPM                                                    |
| 9. OAT (deg. F)    | Outside Air Temperature                                       |

**Table A-2. Unit abbreviations.**

| Units Abbreviation | Description            |
|--------------------|------------------------|
| RPM                | revolutions per minute |
| deg. F             | Degrees Fahrenheit     |
| gph                | Gallons per hour       |
| psi                | pounds per square inch |
| Volts              | Volts DC               |

NOTE: For parameters with a unit description of discrete, a discrete is typically a 1-bit parameter that is either a 0 state or a 1 state where each state is uniquely defined for each parameter.