

# **National Transportation Safety Board**

Office of Research and Engineering  
Washington, D.C. 20594

## **Radar Performance Study**

**Specialist Report**  
**Timothy Burtch**

### **A. ACCIDENT**

Location:	Bellevue, TN
Date:	February 3, 2014
Time:	1655 CST
Airplane:	Gulfstream Commander 690C, Registration N840V
NTSB Number:	ERA14FA112

### **B. GROUP**

No vehicle performance group was formed.

### **C. SUMMARY**

On February 3, 2014, at about 1655 central standard time (CST), a Gulfstream Commander 690C, N840V<sup>1</sup>, operated by a private pilot, was destroyed when it impacted the ground near Bellevue, Tennessee, while on approach to the John C. Tune Airport (KJWN), Nashville, Tennessee. The private pilot and three passengers were fatally injured. Instrument meteorological conditions prevailed and an instrument flight rules (IFR) flight plan had been filed for the flight that departed Great Bend Municipal Airport (KGBD), Great Bend, Kansas. The personal flight was conducted under the provisions of 14 Code of Federal Regulations (CFR) Part 91.

According to initial information obtained from the Federal Aviation Administration (FAA), the airplane was based at GBD. On the date of the accident, the pilot flew the airplane from the Clarence E. Page Municipal Airport (KRCE), Oklahoma City, Oklahoma, where it had been undergoing maintenance, which included a 150-hour periodic inspection, to GBD. The pilot and three passengers then departed for KJWN about 1445 CST and planned to attend a convention and trade show that was being held in the Nashville area.

The flight progressed toward Nashville without incident, and the pilot was cleared for the GPS approach to runway 2 at KJWN. During the approach, air traffic control (ATC) informed the pilot that the airplane was about 1/2 mile east of the final approach course, and

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<sup>1</sup> See Figure 1 for a picture of the accident airplane.

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the pilot reported that he was correcting. The pilot subsequently performed a missed approach and was cleared for a second GPS approach to runway 2. During the second attempt, the airplane was on the final approach course when it veered to the left and began a descent. The airplane had turned to a heading of about 210 degrees before radar contact was lost. There were no distress calls received from the pilot prior to the accident.

**D. PERFORMANCE STUDY**

The performance study describes the accident airplane ground track, altitude, and speed, as well as the timing of select radio communication between ATC and N840V. Estimates of airplane pitch, roll, and heading derived from radar data are also presented.

The radar data used in the study are secondary returns (transponder code 1166) from the short-range Airport Surveillance Radar (ASR-9) located at Nashville International airport (KBNA), Nashville, TN. Figure 2 shows the radar site location (labeled “KBNA ASR-9 Radar” in the figure) relative to KJWN and the accident site. The radar data have approximately a 60 nautical mile (NM) range and an inherent uncertainty of  $\pm 2$  Azimuth Change Pulses (ACP) =  $\pm (2 \text{ ACP}) \times (360^\circ/4096 \text{ ACP}) = \pm 0.176^\circ$  in azimuth,  $\pm 50$  ft in altitude, and  $\pm 1/16$  NM in range.

Times in the study are reported in CST as well as Greenwich Mean Time (GMT or “Z”):  
CST = GMT – 6 hr.

**Weather Observation**

The Automated Surface Observing System (ASOS) report at KJWN around the time of the accident is as follows:

***KJWN 032255Z 36005KT 5SM OVC008 05/M04 A3029***

KJWN weather on the 3<sup>rd</sup> at 2255 GMT/1655 CST, wind 360° at 5 knots, visibility 5 statute miles, an overcast ceiling at 800 ft above ground level (agl), temperature of 5° C, dew point of minus 4° C, altimeter setting 30.29 inches of mercury.

***Accident at 2255Z/1655 CST***

There were several indications that icing was possible during N840V’s approach into KJWN. First, the Meteorological Factual report includes 27 pilot reports, or PIREPS, where light to moderate ice was reported by pilots operating airplanes ranging from a Cessna 182 up to a Boeing 737. All were operating in the vicinity of KJWN around the time of the accident, and most were flying around 3000 ft mean sea level (msl).

Second, the Current Icing Potential (CIP) produced by the National Weather Service indicated a 60 to 85 percent probability of icing at 3000 ft msl at 1700 CST, approximately five minutes after the accident.

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Finally, upper air soundings for KBNA indicated a cold and relatively moist vertical air mass from the surface up through 4500 ft msl. The air mass was close to saturation which would have likely supported the growth of supercooled large water droplets.

See the Meteorological Factual report for more detailed weather.

#### **Airplane Ground Track, Altitude, and Airspeed**

Figures 3 and 4 highlight the radar ground track for N840V as the airplane approached John Tune airport. Each radar point<sup>2</sup> in the figures has an associated GMT time, estimated calibrated airspeed in knots (kt), and altitude above mean sea level  $\pm$  50 feet (ft).

The estimated airspeed and altitude for the final 30 sec of flight are highlighted in Figure 4. From 22:56:3.3 until 22:56:21.7, the radar data indicate that the airplane was at the 2500 ft altitude prescribed for the RNAV (GPS) runway 2 approach procedure (as shown in Figure 7). However, the airplane was turning to the left. The airspeed decayed to approximately 108 kt<sup>3</sup> in the turn and, at 22:56:21.7, began increasing rapidly while the airplane descended at over 10,000 feet per minute. The airplane impacted the ground approximately 11 sec later.

Figure 5 shows select radio communications between N840V and Departure Radar West , Nashville Air Traffic Control Center (ATCC). Note that at no time was the possibility of ice in the vicinity of KJWN mentioned by either the pilot or ATC.

Figure 6 highlights the ground track during the first approach to the airport. Radar data indicate that the airplane descended to 640 ft msl  $\pm$  50 ft (145 ft  $\pm$  50 ft agl) over the threshold of runway 2 or approximately 655 ft below the reported 800 ft agl overcast ceiling. In addition, Figure 6 shows that the airplane was likely not aligned with runway 2 during the first approach until sometime after reaching the threshold. Both the weather and the runway alignment could explain the pilot's decision to abort the first landing attempt.

The published missed approach procedure for the approach calls for a climb to 3000 ft and a route that proceeds directly to the HUDGA waypoint, 12 NM along the runway 2 extended centerline. See Figures 2 and 7. The accident flight climbed to approximately 3000 ft after declaring a missed approach and was given radar vectors by ATC for a second attempt at the GPS approach to runway 2. The airplane crashed in between the initial approach fix (IAF) and final approach fix (FAF) for the GPS runway 2 approach in about a 25° left bank turn. This is shown in Figures 2-5.

Figures 8 thru 11 highlight other radar data and flight parameters that were estimated from radar assuming that the airplane was in coordinated flight with little or no sideslip. The

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<sup>2</sup> The radar "points" are actually boxes as shown in red in Figures 3 and 6. This is because of the uncertainty associated with the radar data mentioned earlier.

<sup>3</sup> The published stall speed for the Gulfstream Commander 690C for straight and level flight with the flaps and gear retracted is 77 kt. However, the stall speed would increase to approximately 108 kt in a 60° level turn. All speeds assume a clean wing with no ice accretion.

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airspeed was nominally 150 kt during the first approach and showed good acceleration after the pilot declared a missed approach. The altitude was approximately that called for in the approach until the final 11 sec. Finally, the estimated heading angles support the ground track data that show the airplane was not aligned with runway 2 during the first approach.

In summary, the radar data indicate that the accident flight flew over the threshold of runway 2 at John C. Tune airport at approximately 145 ft agl during the first landing attempt. According to a weather report around the time of the accident, the pilot should have gotten below clouds and been able to see the runway during his first approach. It is likely that the airplane was not properly aligned with the runway centerline until sometime after crossing the threshold during the first attempt.

The pilot then made a second attempt to land. However, the airplane entered a 25° left bank turn after slowing to 111 kt and, 18 sec later, while still in the turn, the airplane slowed to 108 kt and descended at over 10,000 feet per minute until impacting the ground. While the published stall speed for the Gulfstream Commander 690C is 77 kt, both bank angle and ice accretion would increase this speed.

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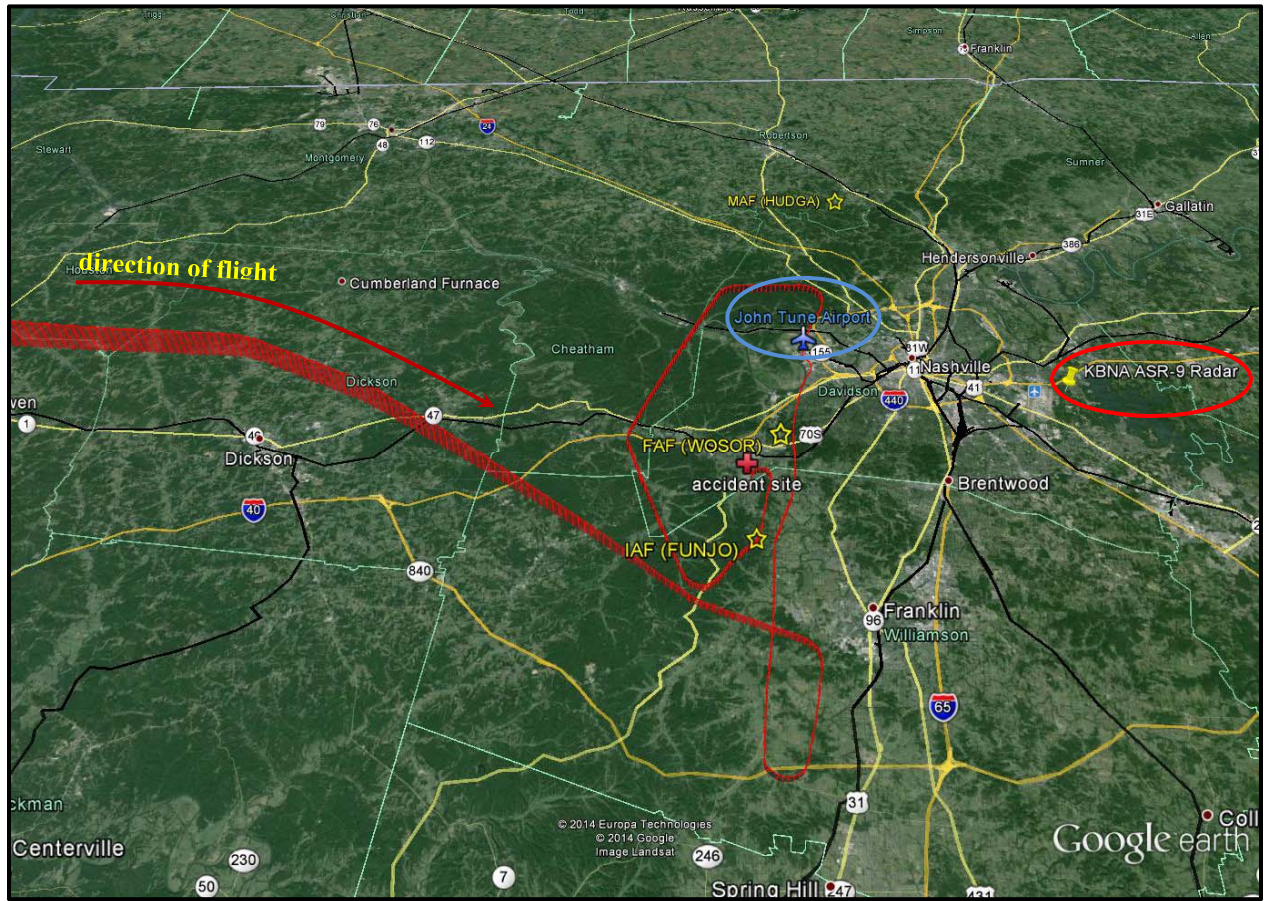
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**E. Figures**



**Figure 1: Accident Airplane N840V, a 1982 Gulfstream Commander 690C**

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**Figure 2: Study Based on Radar from Nashville International (KBNA ASR-9 Radar)**



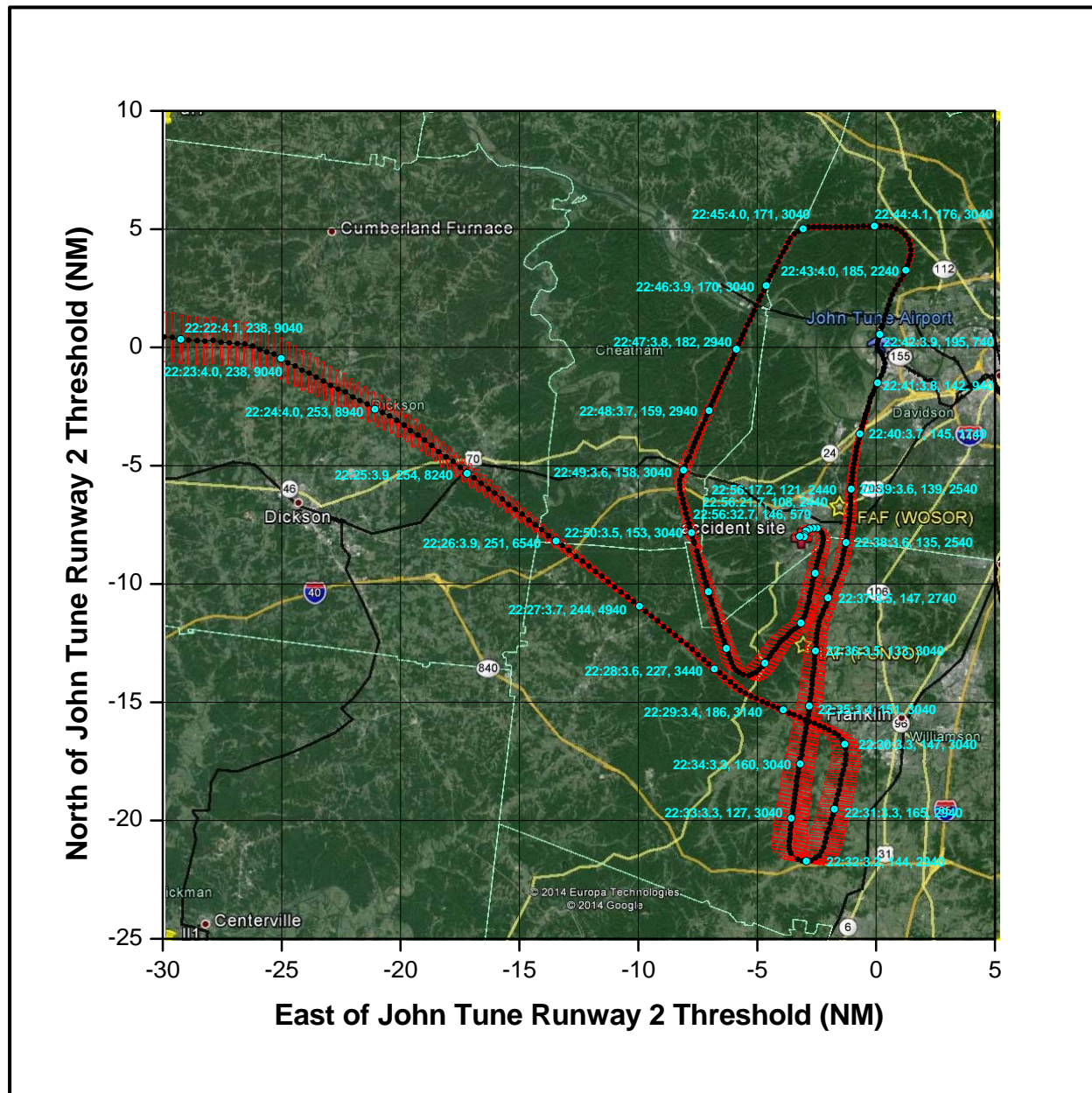
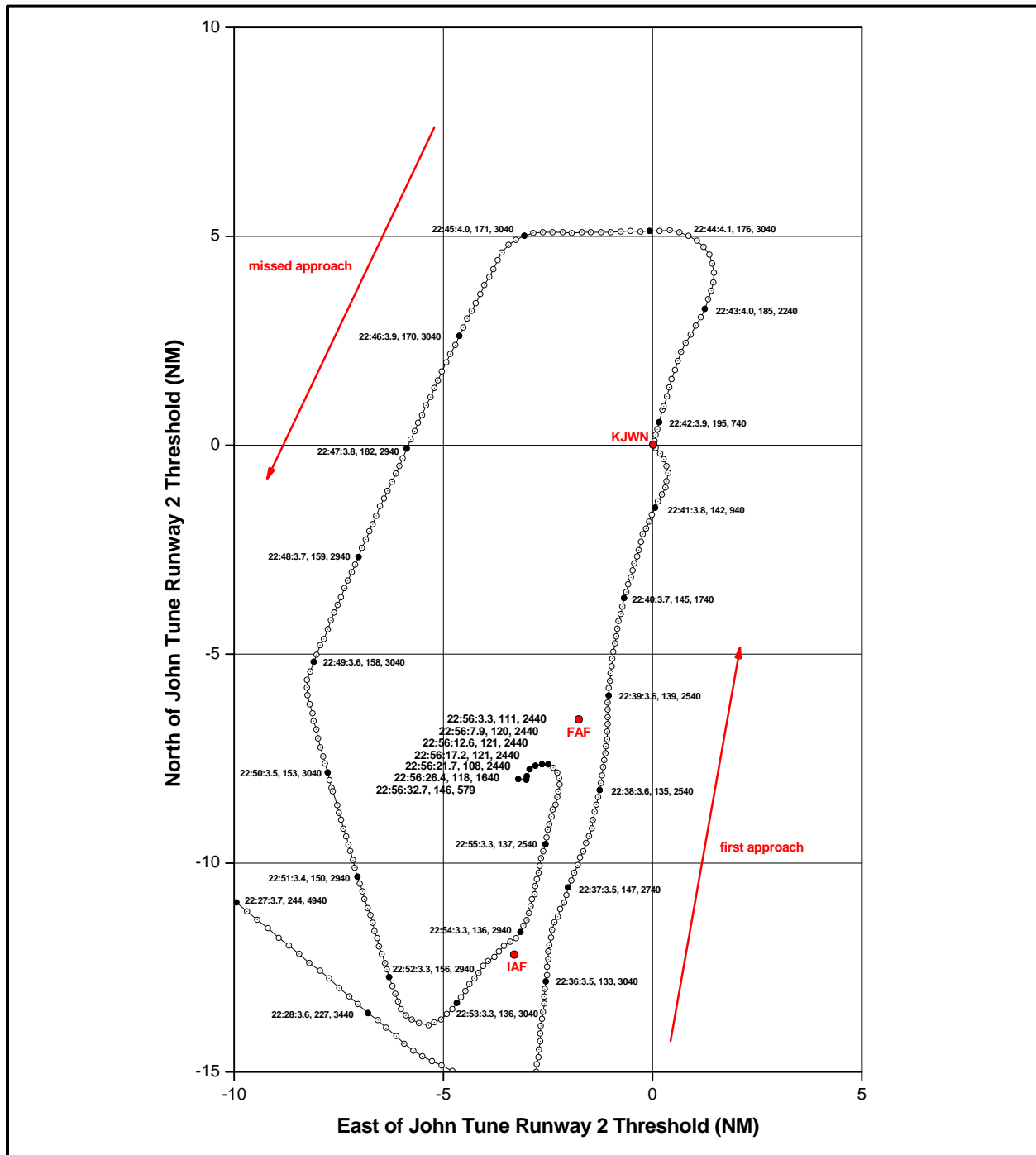


Figure 3: Radar Ground Track in Terminal Area  
hh:mm:ss (GMT) / Vc (kt) / hmsl (ft)

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**Figure 4: Radar Ground Track With Respect to GPS Runway 2 Approach**  
**hh:mm:ss (GMT) / Vc (kt) / hmsl (ft)**



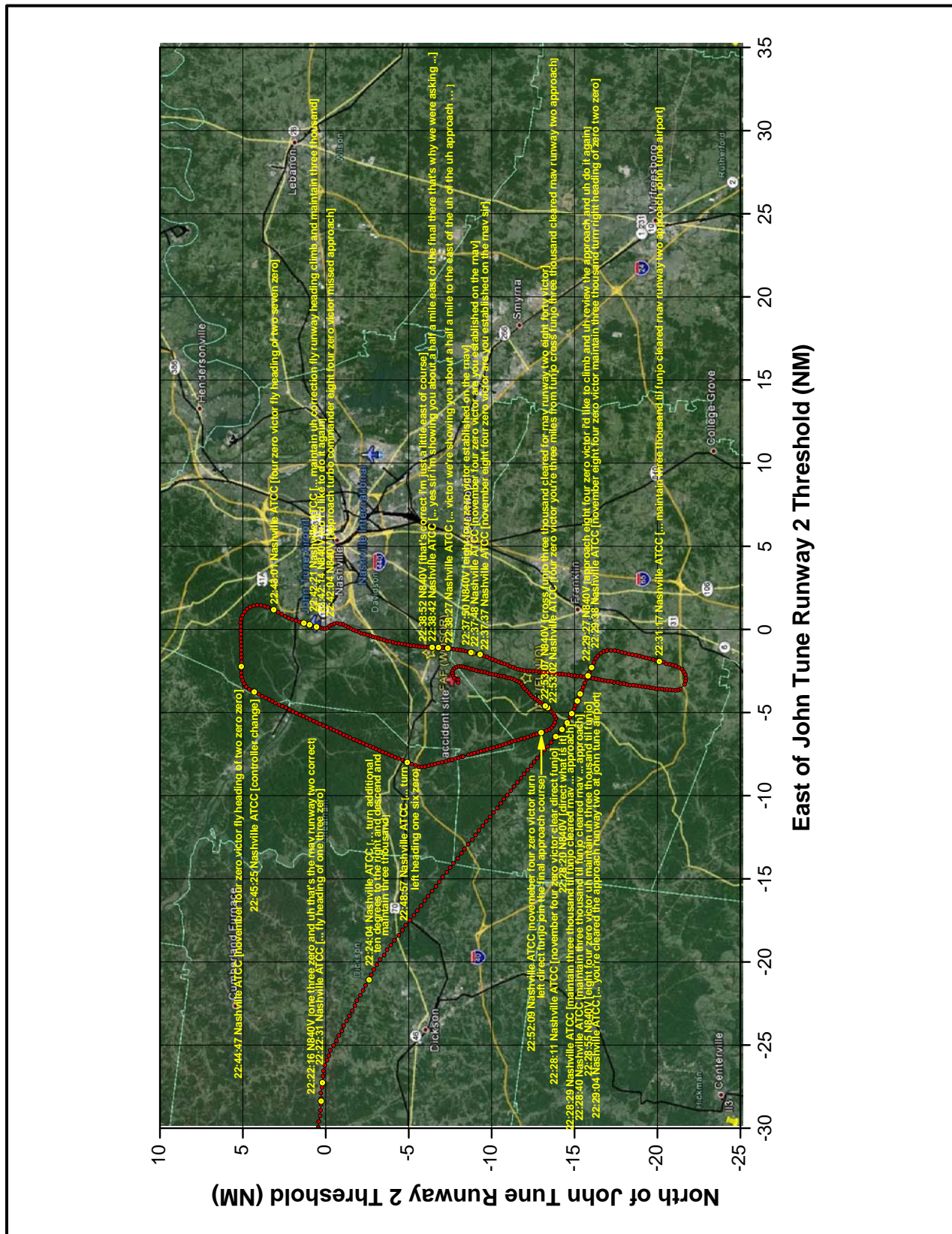
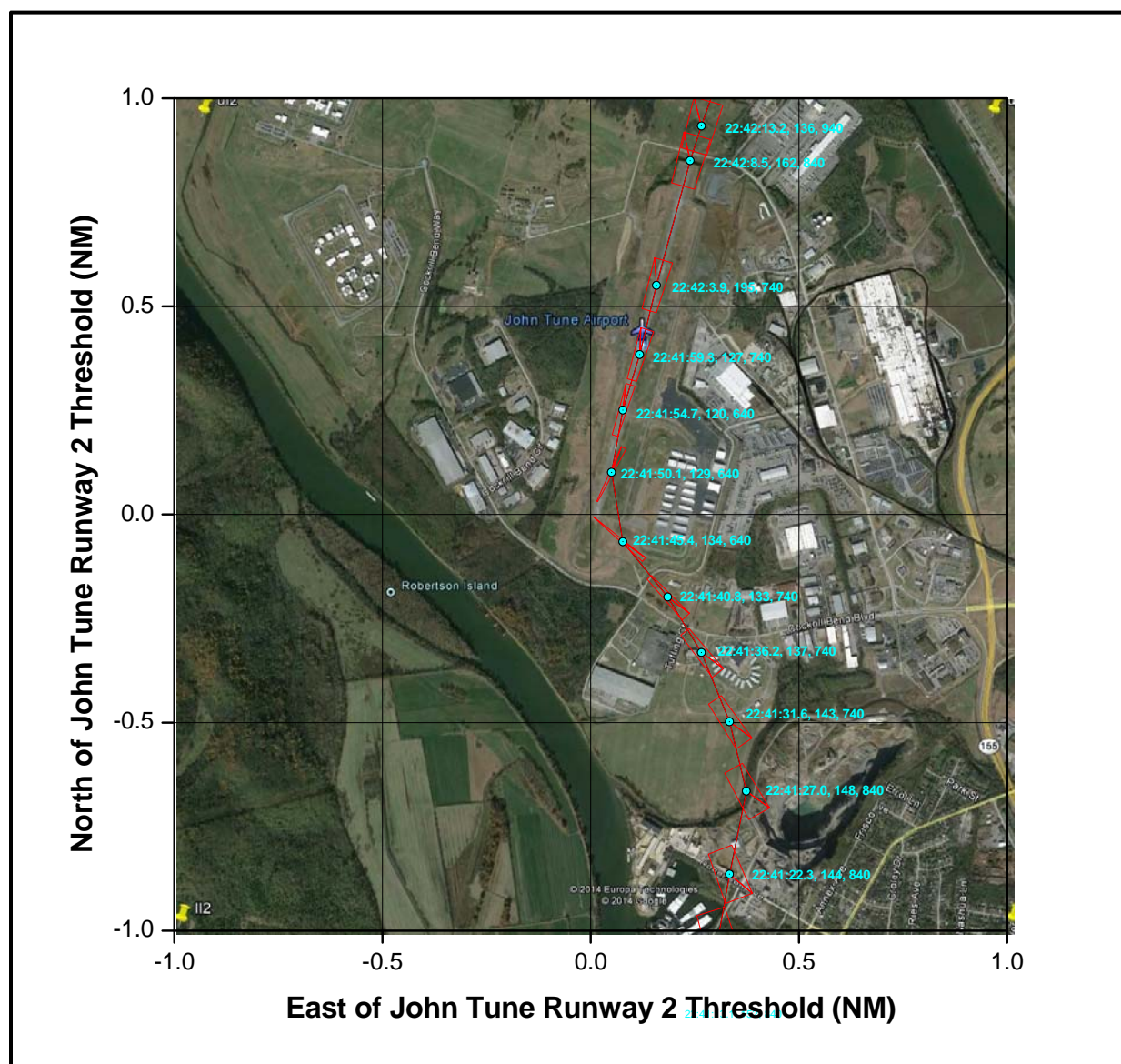
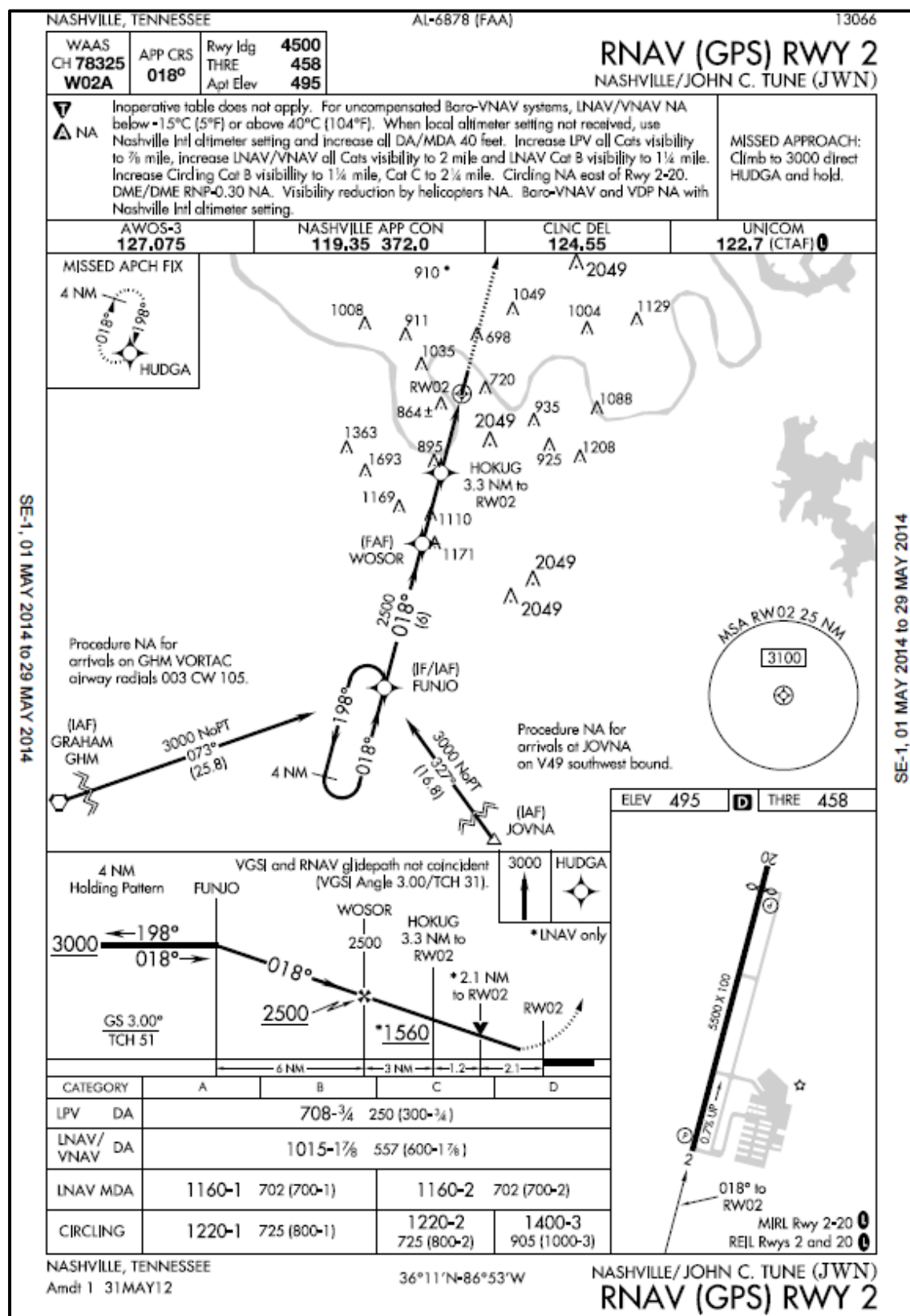


Figure 5: Radar Ground Track in Terminal Area with Select Radio Communications





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**Figure 7: Oakland County ILS 9R Approach Plate**

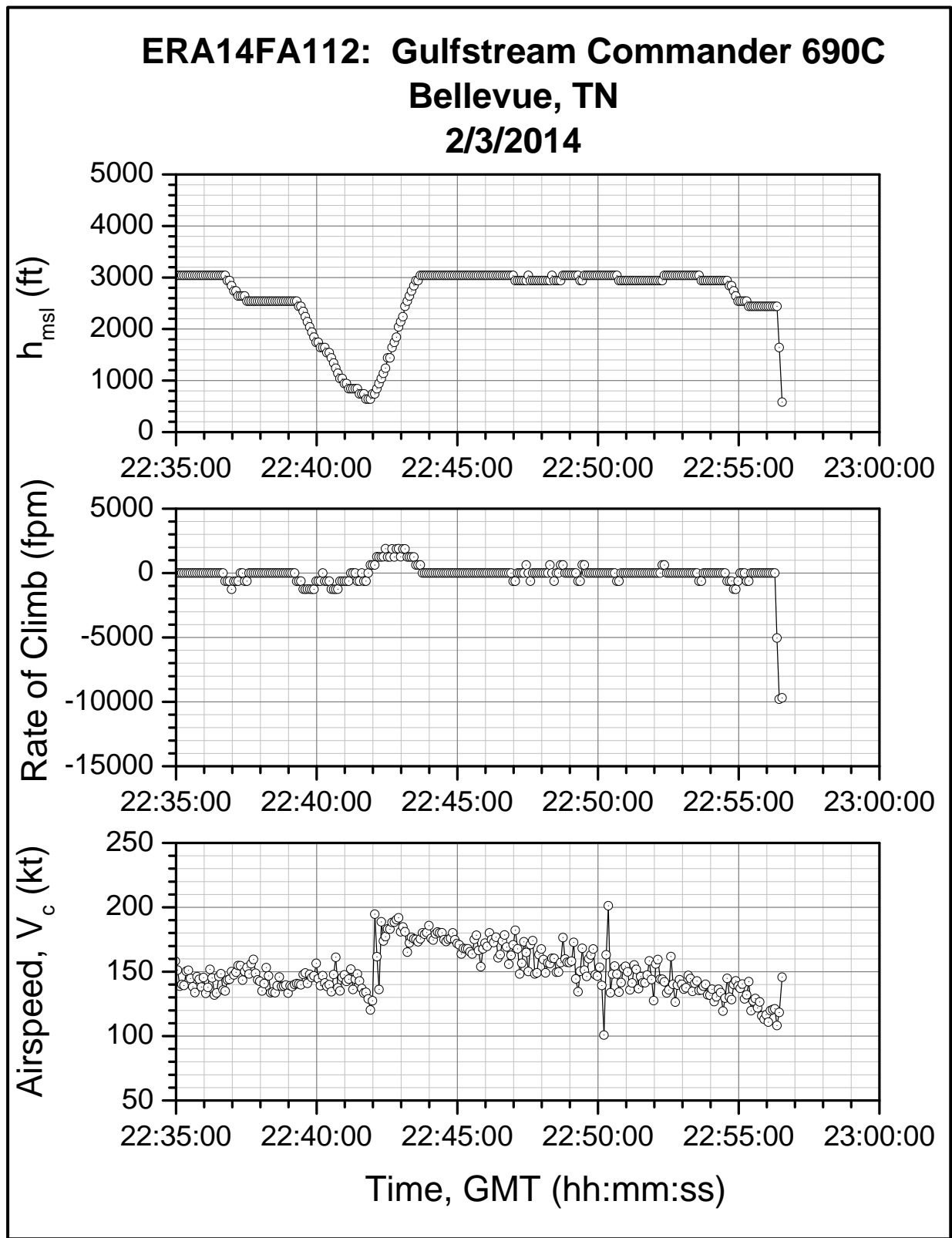


Figure 8: Altitude and Speed for Final Minutes of Flight

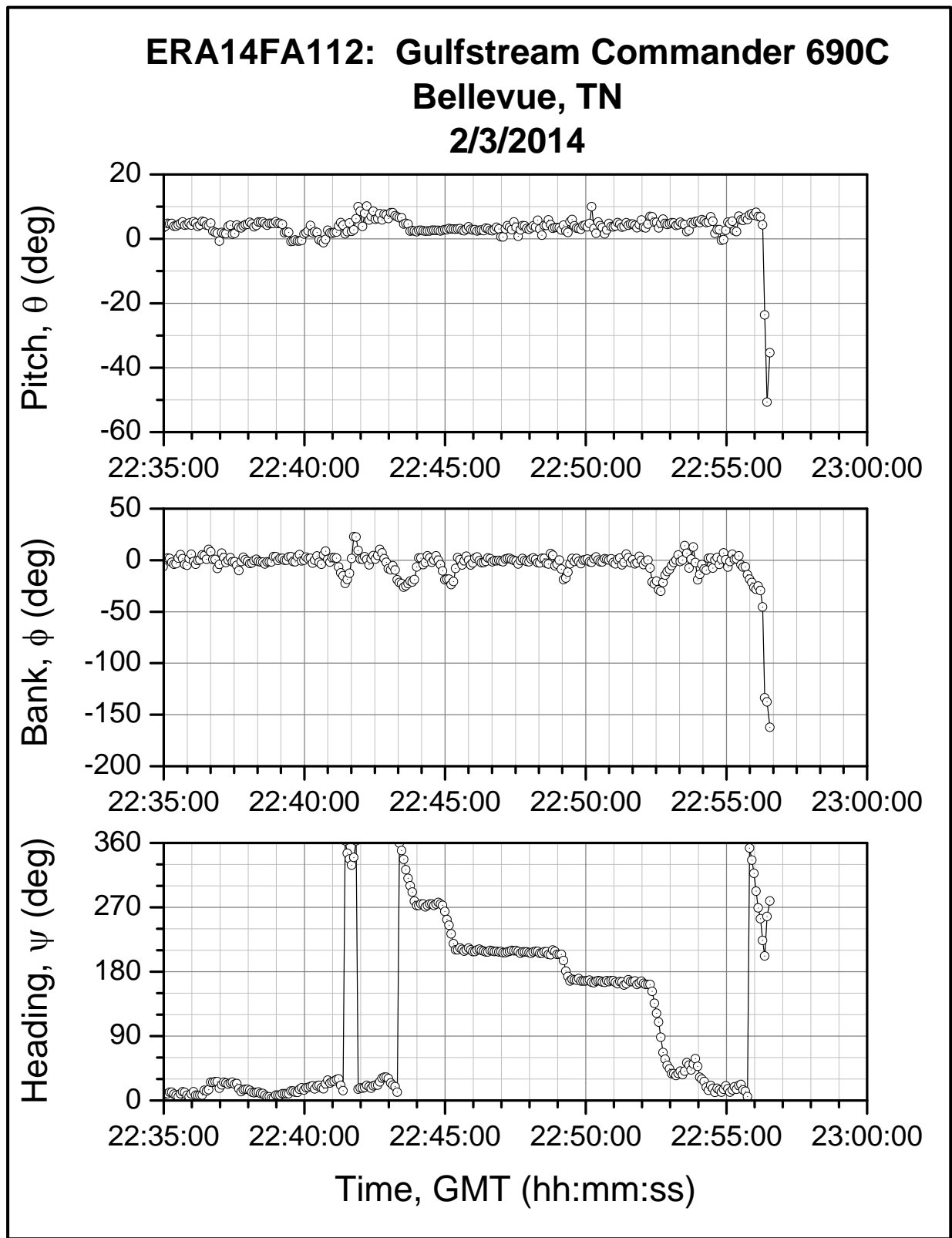


Figure 9: Pitch, Bank, and Heading for Final Minutes of Flight

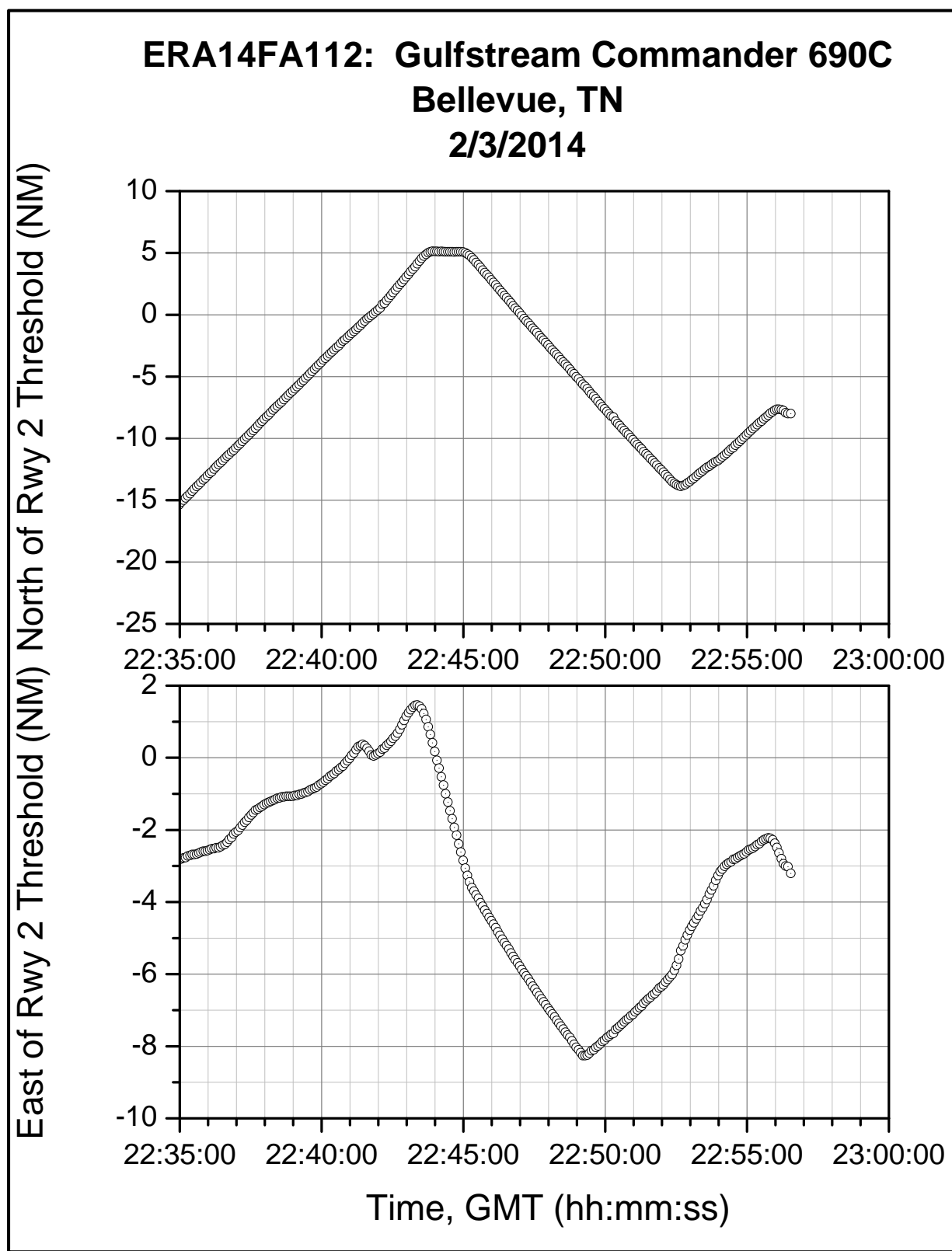


Figure 10: Position North and East of Runway 2 Threshold for Final Minutes of Flight



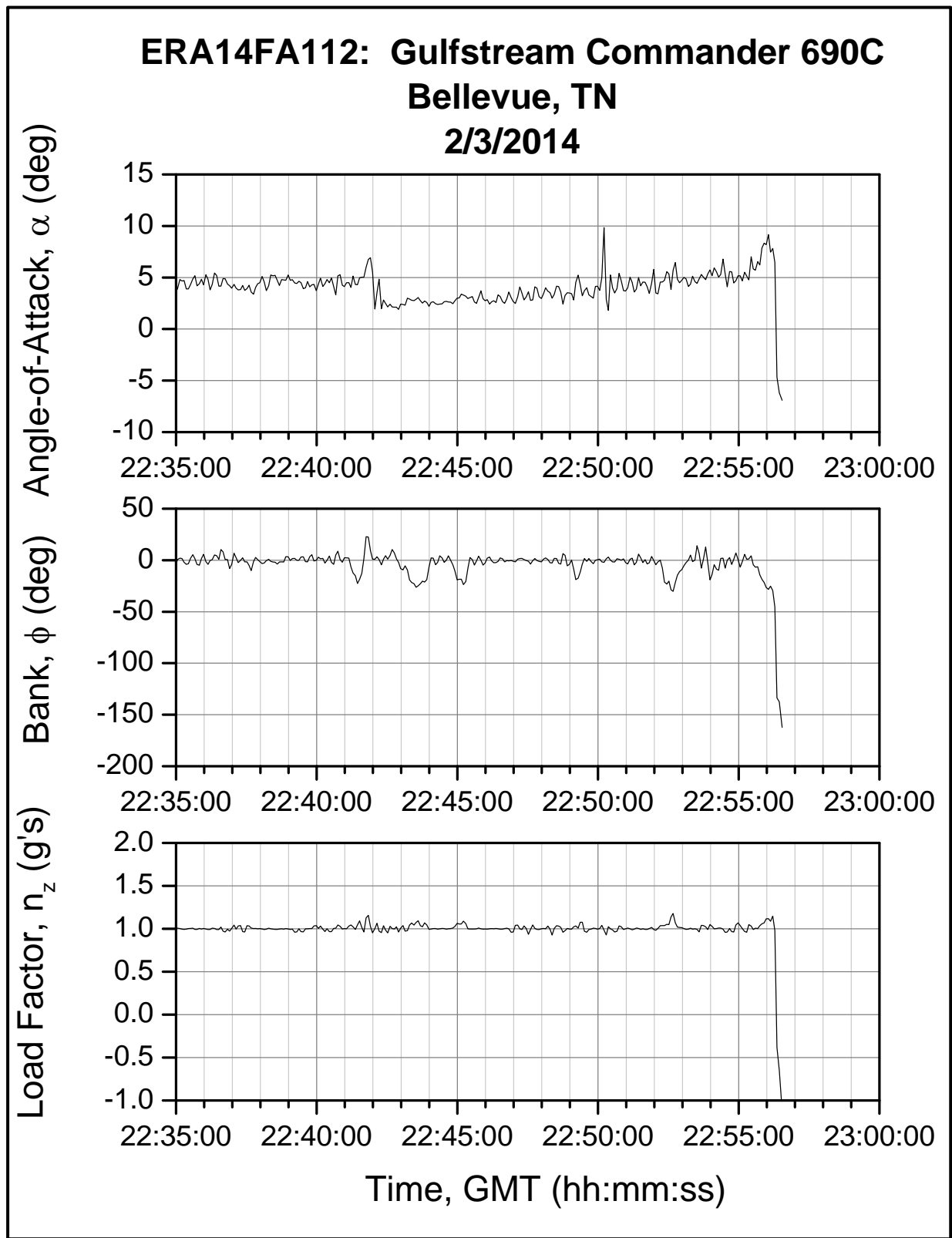


Figure 11: Angle-of-Attack and Load Factor for Final Minutes of Flight