

National Transportation Safety Board
Office of Research and Engineering
Washington, D.C. 20594

Airplane Performance Study

Specialist Report
Timothy Burtch

A. ACCIDENT

Location: Argyle, TX
Date: February 4, 2015
Time: 2109 CST (0309 GMT)
Airplane: Cessna Model 441 "Conquest II", Registration N441TG
NTSB Number: CEN15FA136

B. GROUP

No vehicle performance group was formed.

C. SUMMARY

On February 4, 2015, about 2109 central standard time (CST), a Cessna model 441 twin turbo-prop, N441TG, was substantially damaged when it collided with terrain following a loss of control during an instrument approach to Denton Municipal Airport (KDTO), Denton, Texas. The commercial pilot was fatally injured. See Figures 1 and 2 for pictures of the accident airplane and the accident site.

The airplane was registered to Del Air Enterprises II, LLC, and was operated by the pilot under the provisions of 14 Code of Federal Regulations Part 91 on an instrument flight rules (IFR) flight plan. Night instrument meteorological conditions (IMC) prevailed for the 2 hour and 40 minute cross-country flight that departed Willmar Municipal Airport (BDH), Willmar, Minnesota, about 1829 CST. See Figure 3 for the route filed and the radar ground track.

D. PERFORMANCE STUDY

The airplane performance study describes the accident airplane ground track, altitude, and speed, as well as the timing of select radio communications between ATC and N441TG. Airplane pitch, roll, and heading recorded by an Appareo Stratus 2 GPS and dual band receiver¹ that was recovered in the wreckage and estimates derived from radar data are also presented².

The radar data used in the study are secondary returns (transponder code 2601) from the short-range Airport Surveillance Radar (ASR-9) located at Dallas/Fort Worth International Airport (KDFW)³. The radar data have approximately a 60 nautical mile (NM) range and an inherent uncertainty of ± 2 Azimuth Change Pulses (ACP) = $\pm (2 \text{ ACP}) \times (360^\circ/4096 \text{ ACP}) = \pm 0.176^\circ$ in azimuth, ± 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 certified weather observer at KDTO issued the following reports around the time of the accident:

METAR KDTO 050253Z 35018G26KT 2SM -RA BR OVC010 03/03 A3025 RMK AO2 PK WND 35028/0230 RAB08 CIG 006V014

KDTO weather on the 5th at 0253 GMT/ 2053 CST, the wind is from 350° (true) at 18 knots (kt) with gusts to 26 kt, visibility 2 statute miles (SM), light rain and mist, ceiling overcast at 1,000 feet (ft) above ground level (agl), temperature 3° Celsius (C), dew point 3°C, altimeter 30.25 inches Hg. Remarks: Automated station with precipitation discriminator, peak wind 350° (true) at 28 kt, 30 minutes past the hour, rain began 8 minutes past the hour, ceiling variable between 600 feet agl and 1,400 feet agl.

SPECI KDTO 050303Z 35017G25KT 2SM -RA BR OVC009 03/03 A3026 RMK AO2 CIG 005V012

Special KDTO weather on the 5th at 0303 GMT/ 2103 CST, the wind is from 350° (true) at 17 kt with gusts to 25 kt, visibility 2 SM, light rain and mist, ceiling overcast at 900 ft agl, temperature 3°C, dew point 3°C, altimeter 30.26 inches Hg. Remarks: Automated station with precipitation discriminator, ceiling variable between 500 feet agl and 1,200 feet agl.

Accident at 0309Z/2109 CST

¹ The Appareo Stratus 2 receiver is a WAAS GPS that can also be used to view in-flight weather on an iPad, including NEXRAD radar, METARs, TAFs, TFRs, AIRMETs, SIGMETs, and NOTAMs. In addition, the Stratus 2 includes a built-in AHRS for displaying airplane attitude.

² Position data from a Honeywell Multi-Hazard Awareness System (MHAS) were also recovered from the wreckage. The MHAS position data corresponded with the data recorded by the Stratus 2 receiver. The MHAS was triggered by an obstacle alert. The obstacle was later identified as a tower located at 33.085827°N, 97.202152°W, and 258 ft agl or about 0.13 NM west-southwest, of the accident site.

³ The radar data used in the study were from the KDFW ASR-9 “B” or east antenna.

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***SPECI KDTO 050320Z 36017G28KT 2 1/2SM -RA BR BKN007 OVC012 03/02 A3026
RMK AO2 PK WND 36028/0312 CIG 005V011***

Special KDTO weather on the 5th at 0320 GMT/ 2120 CST, the wind is from 360° (true) at 17 kt with gusts to 28 kt, visibility 2.5 SM, light rain and mist, ceiling broken 700 ft agl, overcast at 1,200 ft agl, temperature 3°C, dew point 2°C, altimeter 30.26 inches Hg.

Remarks: Automated station with precipitation discriminator, peak wind 360° (true) at 28 kt, 12 minutes past the hour, ceiling variable between 500 feet agl and 1,100 feet agl.

At approximately 2010 CST or about an hour before the accident, a weak cold front moved through the Denton area. Following the passage of the cold front, KDTO experienced slightly lower visibilities and ceilings, higher surface winds, and slightly lower air temperatures. A second cold front went through the area at 2059 CST (ten minutes before the accident) and is depicted as a “fine line” (heading to the southeast) in Figures 4 and 5 .

An atmospheric sounding at 2100 CST as well as thermodynamic profiles retrieved from commercial aircraft arriving and departing from airports within the Dallas/Fort Worth area reported air temperatures that were above freezing below 10,000 ft mean sea level (msl). Considering the sounding and geostationary weather satellite data, cloud tops in the area were estimated to be above 10,000 ft msl.

Finally, a pilot report (PIREP) from the pilot of a Cessna C-172 landing just minutes before the accident airplane reported light-to-moderate turbulence with inflight visibility around 1.5 miles.

See the Meteorological summary for more detailed weather.

Airplane Ground Track, Altitude, and Airspeed

Figure 6 highlights the ground track recovered from the Appareo Stratus receiver with an overlay of the RNAV(GPS) Runway 36 approach procedure for which the accident flight had been cleared.

Similarly, the ground track from radar for the last 20 minutes of flight is shown in Figure 7. (The cyan line denotes the extended runway centerline.) The radar “points” are actually boxes in red in the figure; this is because of the uncertainty associated with the radar data mentioned earlier. Figure 7 also shows select air traffic control (ATC) communications between N441TG, the Dallas/Fort Worth Terminal Radar Approach Control (TRACON) facility (or “AR1” in the figure), and the Denton FAA Contract Tower (or “LC” in the figure). The communications included altitude warnings from ATC to the pilot as a result of ATC’s low altitude alert system.

Figure 8 shows the altitude and groundspeed recorded by the Appareo unit as well as estimates derived from radar and meteorological data. The altitudes and groundspeeds from

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the Appareo compare well with those from radar⁴. The wind corrections were applied only to radar. As a result, only an estimate of airspeed derived from radar are shown.

Based on the published approach procedure (shown in Figure 9), N441TG should not have descended below 2,000 ft msl before reaching the final approach fix (FAF), NULUX, shown in Figures 6, 7, and 9. N441TG never reached the FAF but instead crashed just over 2 NM south of NULUX.

Figure 10 compares the pitch, roll, and heading angles as recorded by the Appareo receiver for N441TG with those derived from radar during the final minutes of the flight. Figure 11 shows an estimate of angle-of-attack and load factor based on radar.

E. SUMMARY AND CONCLUSIONS

The flight parameters recorded by the Appareo receiver and the equivalent values derived from radar compare well for the final minutes of the flight. Some of the differences that exist between the two sets of data may be the result of winds that were assumed in the radar calculations⁵.

During the final five minutes of flight, the pilot of N441TG twice descended below the 2,000 ft msl “top of the approach” altitude required at the FAF for the GPS 36 approach into Denton Municipal Airport. N441TG never reached the FAF. The last communication received from the accident pilot at 0308:54 suggested that he intended to climb back up (to 2,000 ft) from his altitude of about 1,325 ft. The wreckage was found about two miles south of the FAF.

The pilot’s inputs based on airplane position and attitude appeared relatively normal and appropriate⁶ until the final seconds of the flight when, at 0309:00, the airplane slowed to the published stall speed⁷. Figure 12 shows a speed reduction was likely the result of a power reduction around 0306:38⁸ and an airplane-nose-up elevator input at 0308:52 (about two seconds before the pilot suggested that he was climbing back up). The power reduction set up a 25 kt/min deceleration which increased to a 168 kt/min deceleration with the nose up elevator input. Airspeed decreased from 162 kt calibrated airspeed (KCAS) at 0306:38 to 75 KCAS at 0309:00 while the estimated angle-of-attack increased from 2.7° to 14°⁹.

⁴ The rate of climb derived from the Appareo data was noisy. As a result, it is not shown for clarity.

⁵ The winds used in the radar calculations were reported by the pilot of an airplane climbing out from Dallas Love field (KDAL) 30 NM to the southeast at about 0320.

⁶ The rates of descent were approximately equal to the -1500 ft/min called for in the performance section (Section 5) of the Pilot’s Operating Handbook.

⁷ The published stall speed is approximately 80 KCAS with flaps retracted and 75 KCAS with flaps at 10°.

⁸ Airplane performance, or rate of descent in this case, is the product of attitude and power. The two vertical lines in Figure 12 mark two instances when the airplane’s pitch attitude and rate of descent are similar; however, the airplane is accelerating in the first instance and decelerating in the second. The difference is likely a power reduction sometime between the two points. Based on speed and altitude, the power reduction probably occurred around 0306:38, but the exact time could not be determined.

⁹ The flaps were likely retracted during most of the time for which radar data is available. However, the flap actuator was found in a flaps 10° position in the wreckage. The non-linear stall region of the lift curve begins at about 16° angle-of-attack with flaps retracted and at about 15° with flaps extended to 10°. C_{Lmax} is about 1.67° with flaps retracted and 2.18° with flaps 10°.

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A loss of control due to an aerodynamic stall is supported by security video camera footage as well as an eye witness account. The video shows the airplane first entering the camera's lateral field of view at 0308:48 in a wings-level descent and then, at 0309:00, entering a near-vertical left spiraling dive.

One witness (a captain for American Airlines) was about a mile east of the N441TG when the airplane passed traveling north. The witness reported that the airplane was “quite low and may have been trying to stay below the ceiling”. He also stated that the airplane “went from a straight and level flight attitude to an abrupt downward and almost near vertical attitude towards the ground, this occurring in about one to two seconds”. He also stated that it was his “impression from the way the lights changed position that the aircraft seemed to enter a steep left bank with the nose dropping down significantly.”

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F. Figures



Figure 1: Accident Airplane N441TG, a 1981 Cessna Model 441 “Conquest II”



Figure 2: Accident Site

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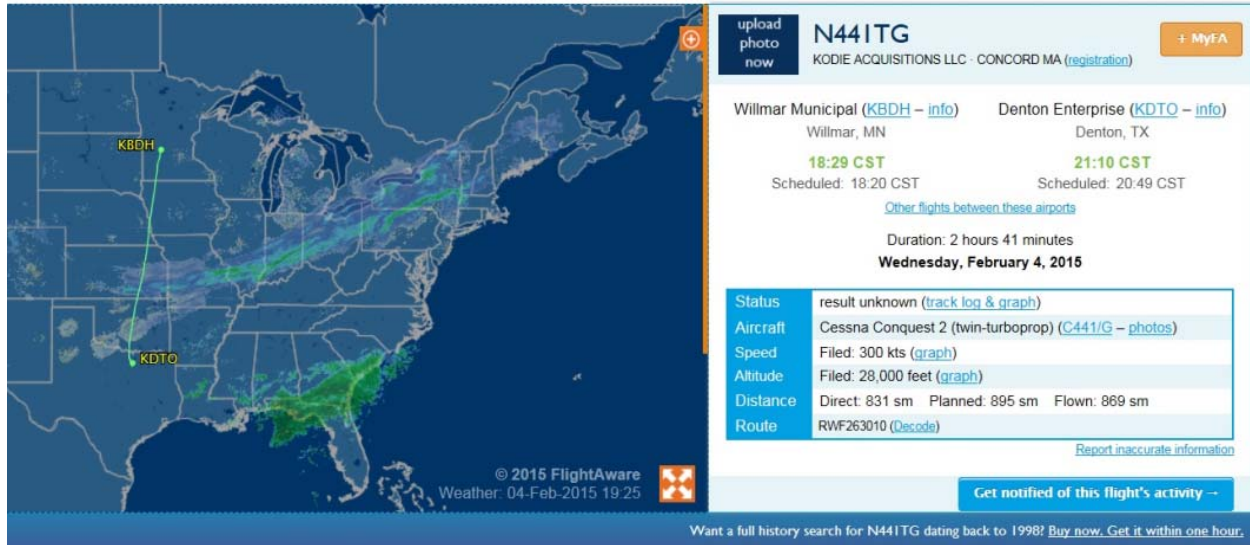


Figure 3: Route Filed on IFR Flight Plan and Radar Ground Track
(note: weather not representative of the accident)

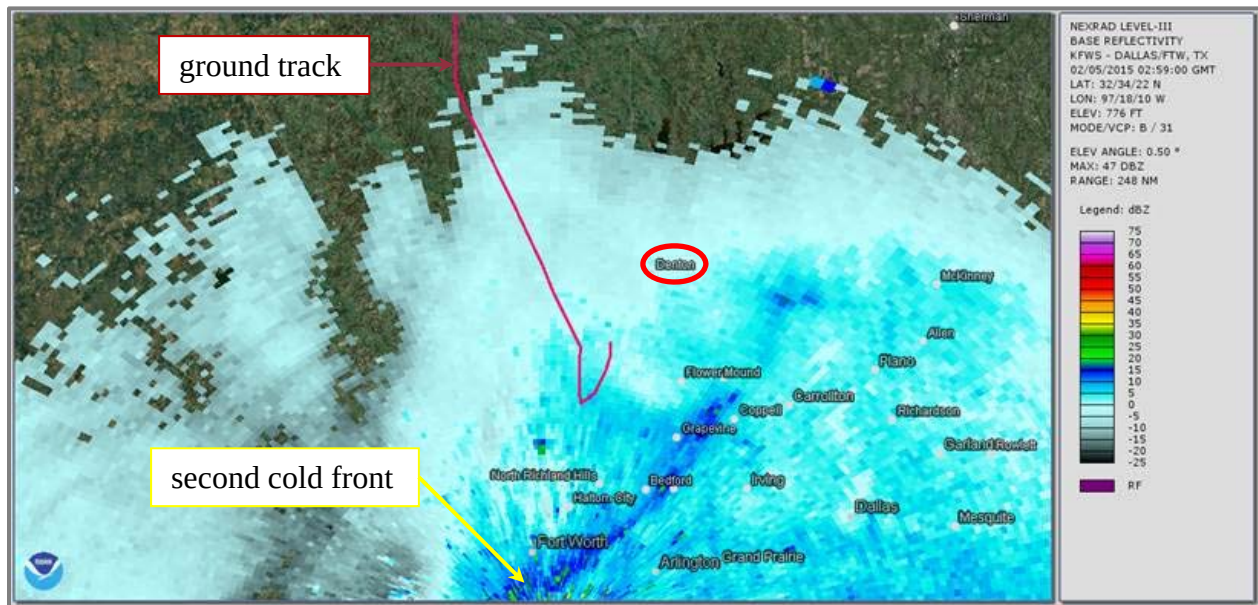


Figure 4: Doppler Radar Reflectivity Image at 0259 GMT / 2059 CST in dBZ

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Figure 5: Doppler Radar Radial Velocity Image at 0259 GMT / 2059 CST in Kt

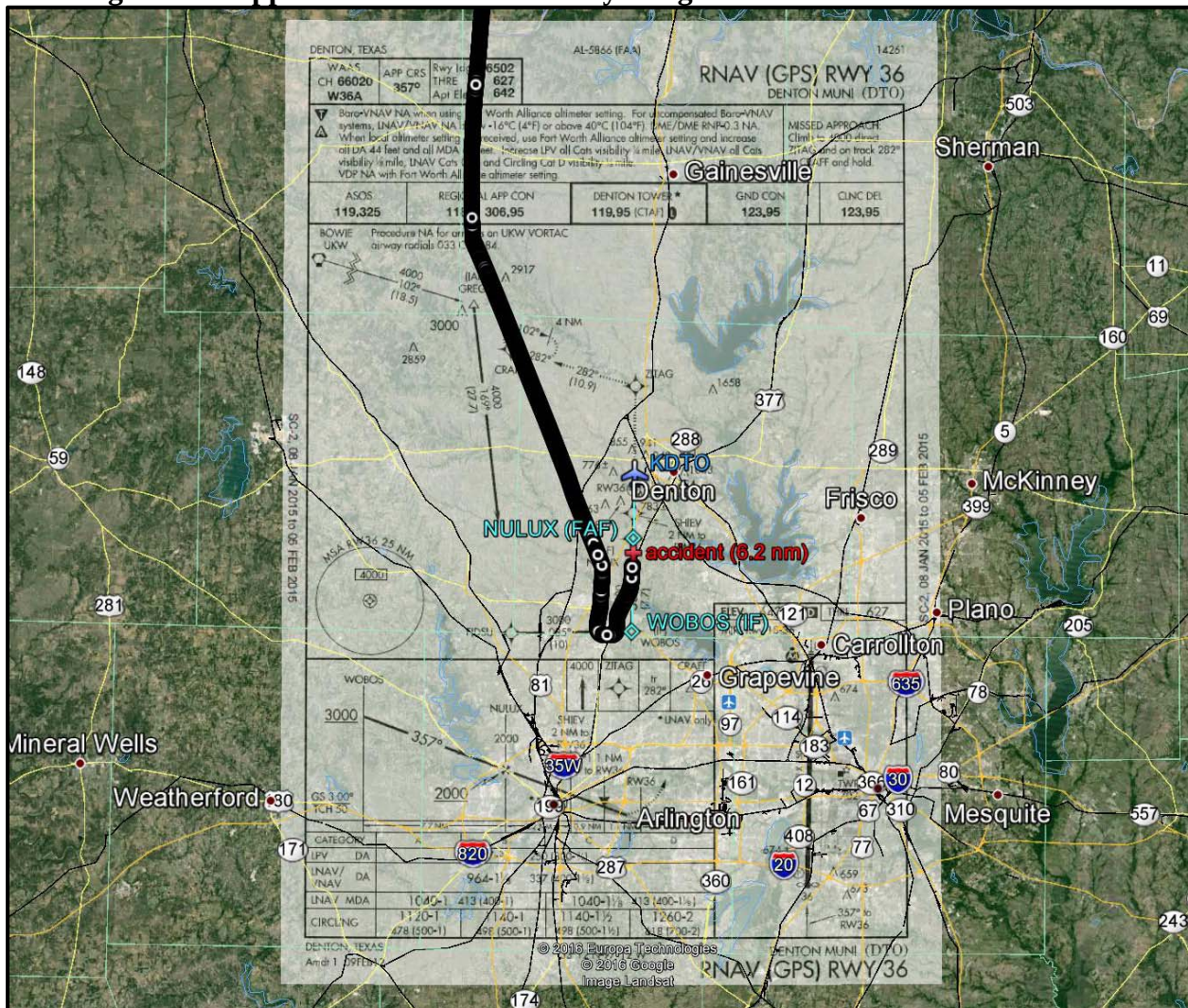


Figure 6: Appareo Stratus Ground Track and Approach Plate for KDTO GPS 36

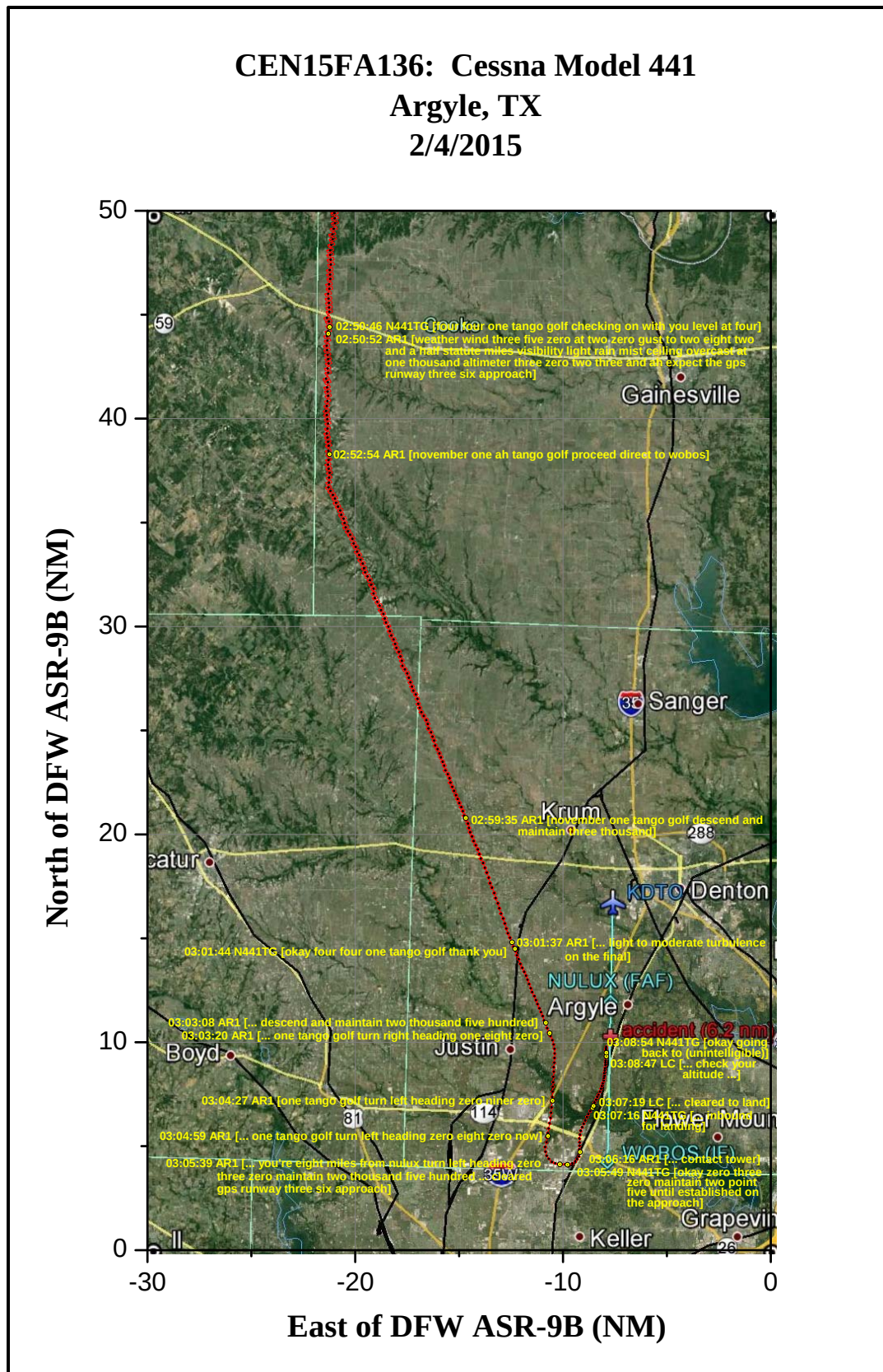


Figure 7: Radar Ground Track with Select Radio Communications Between N441TG and the KDFW TRACON (AR1) as well as the Denton Control Tower (LC)

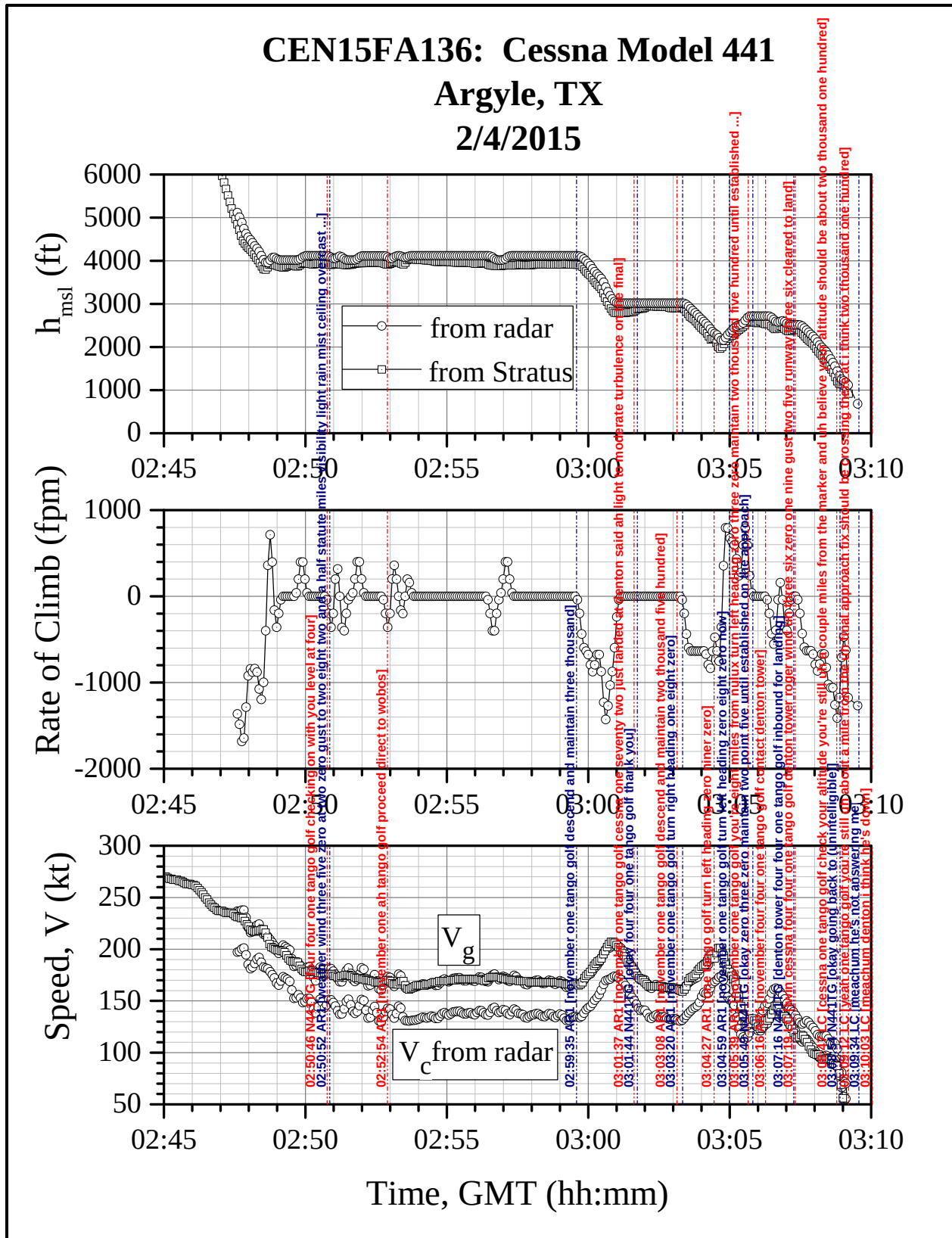


Figure 8: Altitude and Speed Based on Radar and Stratus
with Select Radio Communications

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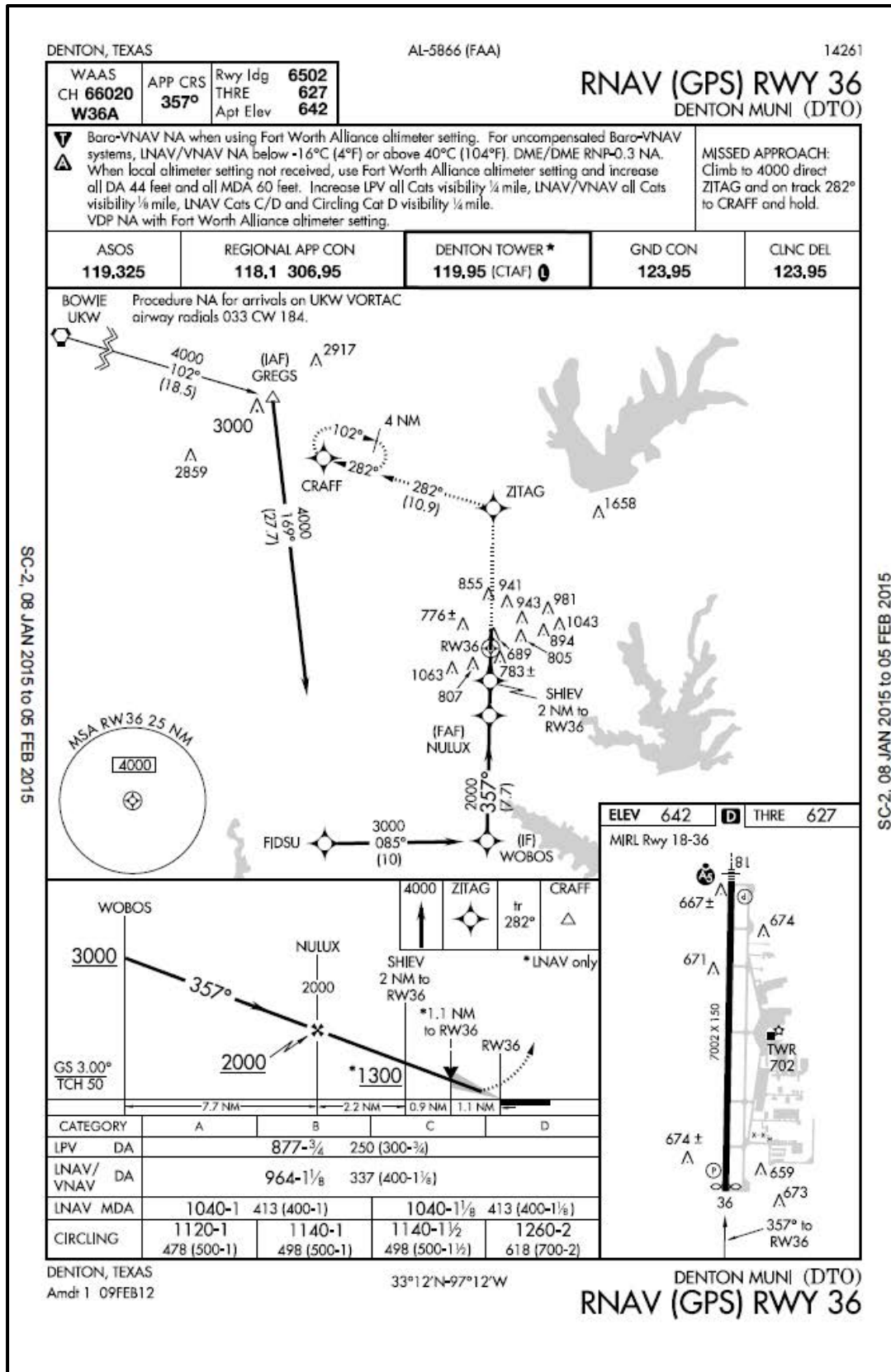


Figure 9: Published Approach for which N441TG had been Cleared

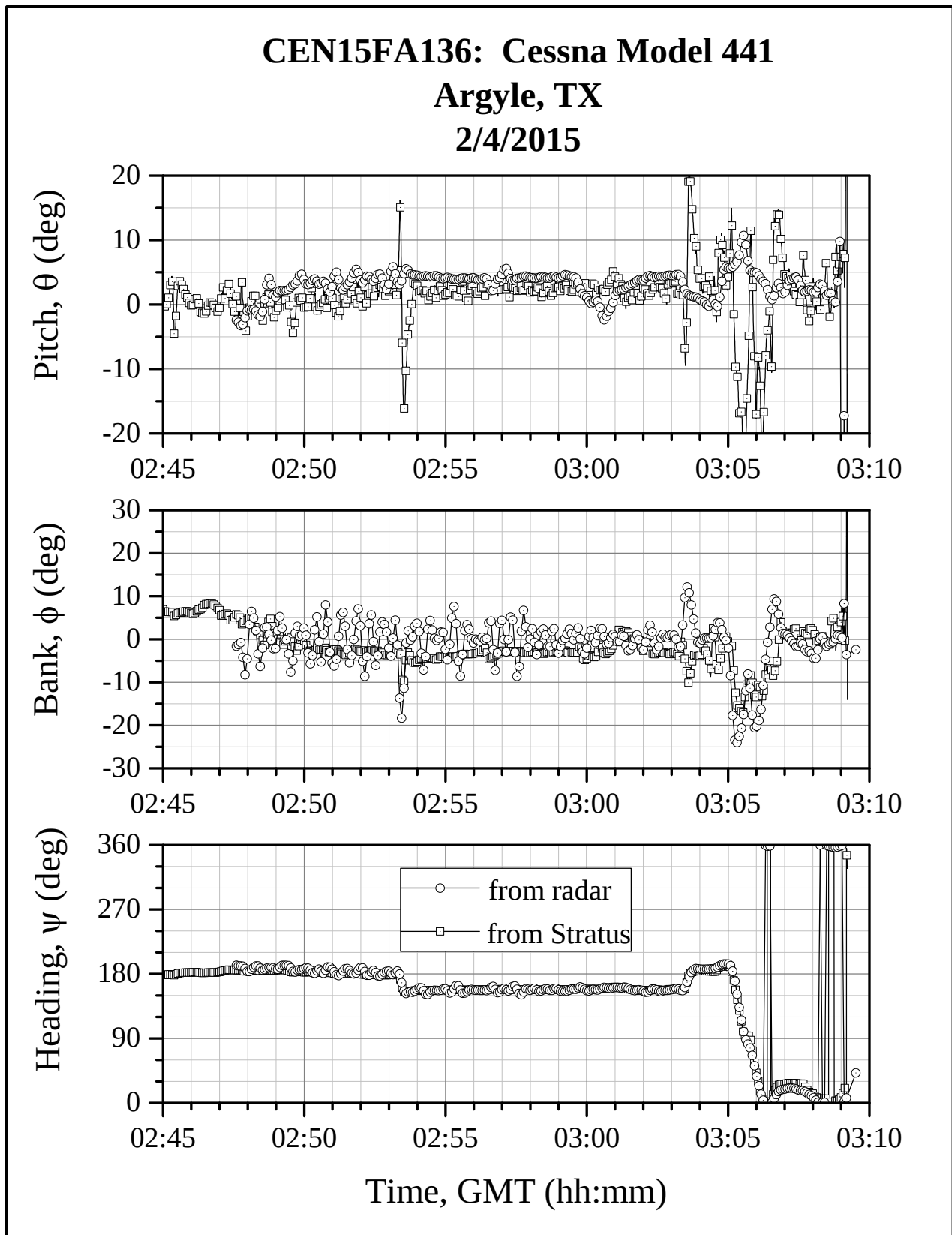


Figure 10: Pitch, Bank, and Heading Based on Radar and Stratus

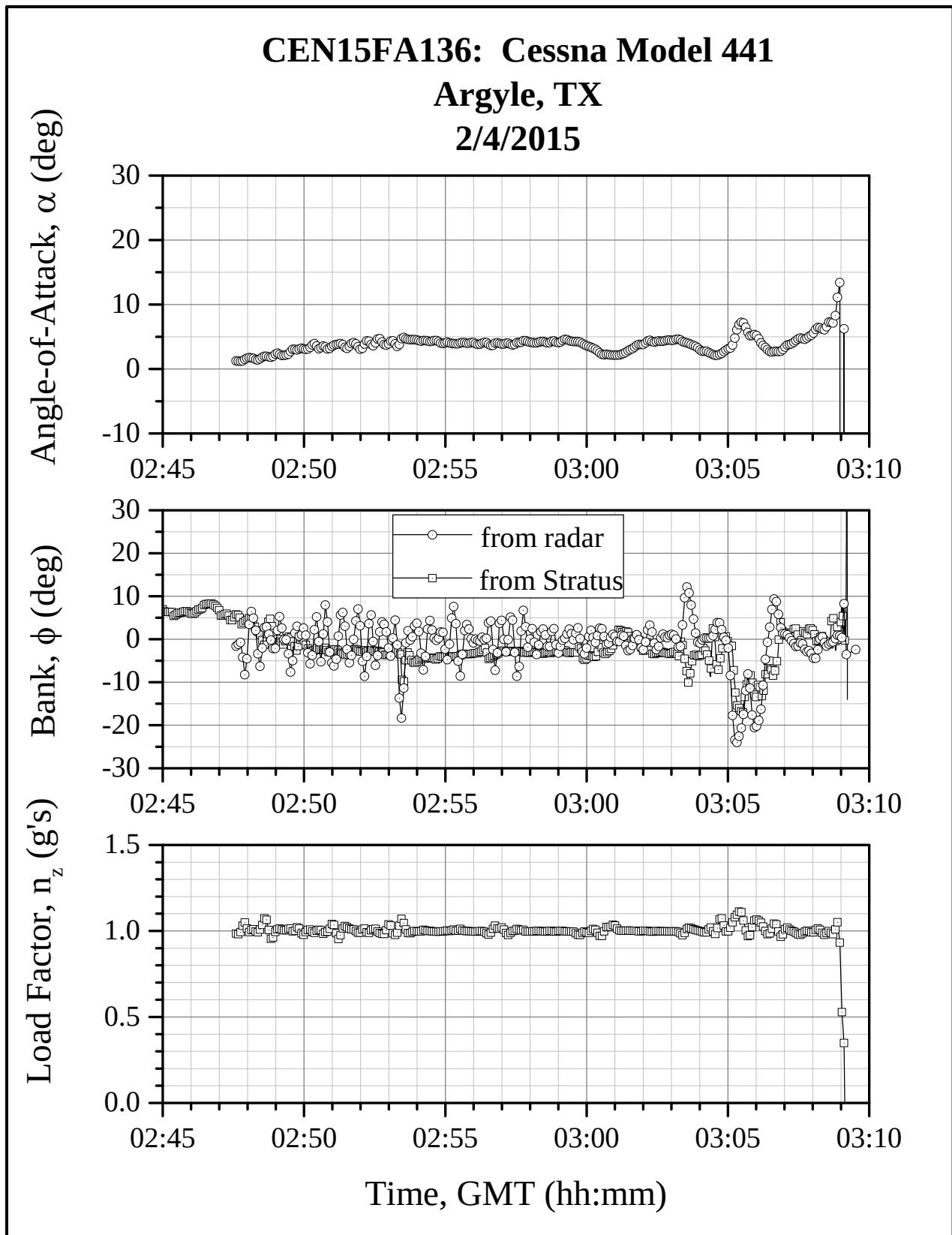


Figure 11: Estimated Angle-of-Attack and Load Factor Based on Radar and Stratus

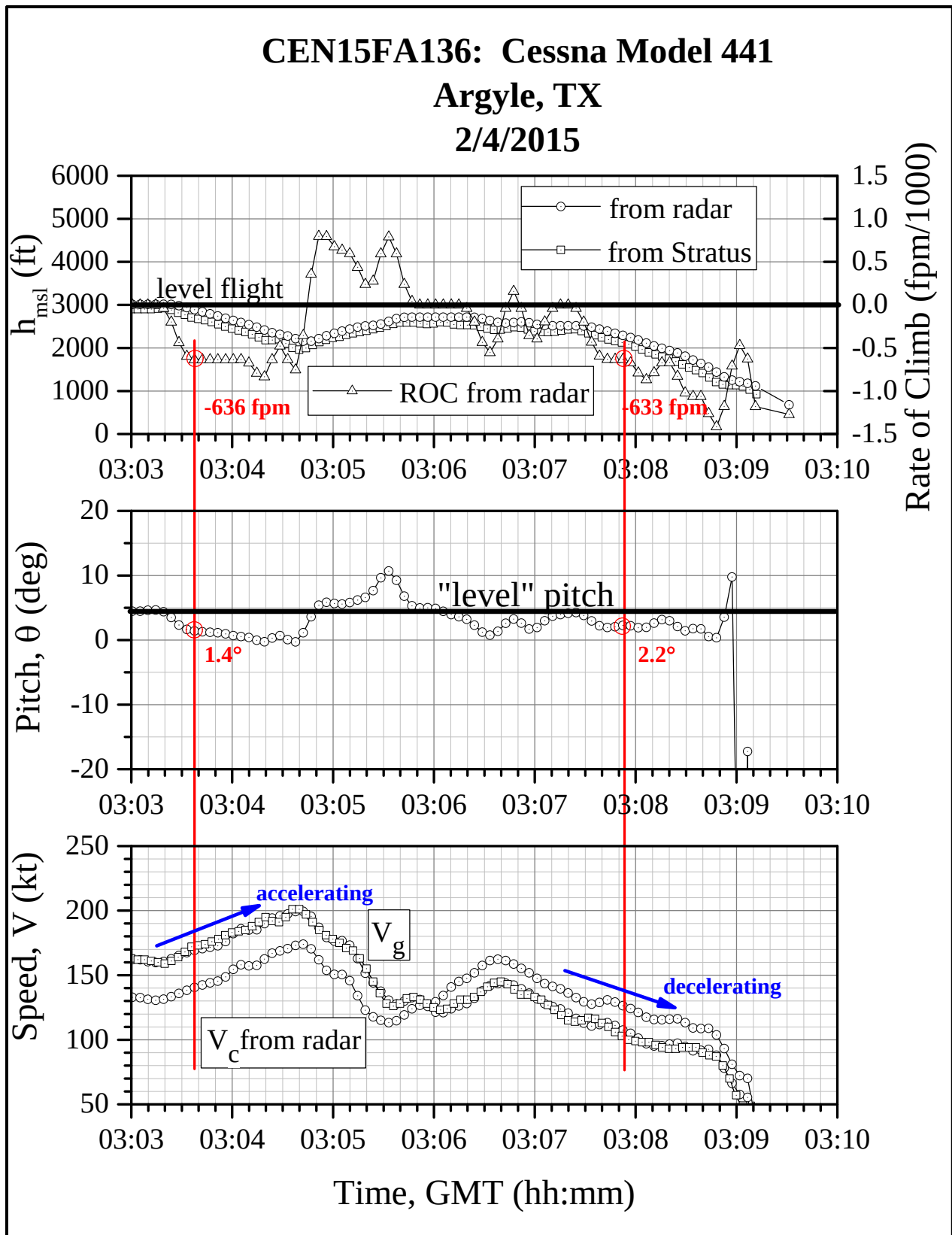


Figure 12: Altitude and Speed Based on Radar and Stratus