

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

Radar Performance Study

Specialist Report
Timothy Burtch

A. ACCIDENT

Location: Sparks, Nevada (NV)
Date: August 30, 2016
Time: 0101 GMT (18:01 pm PDT)
Airplane: Beechcraft A-36, N985CA
NTSB Number: WPR16FA172

B. GROUP

No vehicle performance group was formed.

C. SUMMARY

On August 30, 2016, about 1801 pacific daylight time (PDT), a Beechcraft A-36 Bonanza, N985CA, was destroyed when it impacted the ground in a recreational vehicle park about a half mile north of the threshold of runway 16L at Reno/Tahoe International Airport (RNO), Sparks, NV. Both persons on board received fatal injuries; there were no ground injuries. The flight was conducted under the provisions of Title 14 Code of Federal Regulations Part 91. Visual meteorological conditions prevailed.

[Note: Times in the report are quoted in PDT as well as Greenwich Mean Time (GMT or “Z”):
PDT = GMT – 7 hr.)]

D. THE AIRPLANE

A picture of the accident airplane, a Beechcraft A-36, is shown in Figure 1. The accident airplane was manufactured by Beechcraft in 1981 and was owned by Venture Aviation Services of Reno Nevada. The airplane was on leaseback to, and operated by, Flying Start Aero, a flight school based at RNO.

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E. WEATHER OBSERVATION

METAR KRNO 310055Z 29017G20KT 10SM FEW100 FEW200 31/M05 A3001

At 0055 GMT on August 31st (1755 PDT on August 30th), the surface weather observation at RNO was reporting wind 290° at 17 knots (kt) with gusts to 20 kt; 10 statute miles visibility; a few clouds at 10,000 feet (ft) and 20,000 ft above the ground (agl); temperature 31° Celsius (C); dew point -5° C; altimeter 30.01" mercury. (See the Meteorology Group Chairman's Factual Report for more details.)

F. RADAR STUDY

The accident airplane was not equipped with a flight data recorder. As a result, the airplane performance study is based largely on radar data. The specific radar data used in the study are secondary returns (transponder code 6752) from the short-range Airport Surveillance Radar (ASR-8) located at RNO. Short-range radar data have approximately a 60 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.

The accident airplane was cleared to land on RNO runway 16L approximately 154 seconds behind a UPS Boeing 757 (UPS9706) and 24 seconds behind a FedEx Boeing 757 (FDX1359), both landing on the parallel runway 16R.

Figures 2 and 3 highlight the ground tracks into the Reno terminal area of the accident airplane N985CA and the two preceding Boeing 757's. Time and altitude are also included in the figures.

Figures 4 thru 6 show airplane performance parameters for N985CA derived from radar. Airspeeds in Figure 4 were estimated from radar using winds reported at RNO in a special weather observation at 1834 PDT.

The airplane attitude time histories shown in Figure 5 are also based on the RNO short-range radar. Because ASR-8 radar returns are only recorded every four to five seconds, the attitude estimates are less accurate during dynamic flight (high-rate turns, stalls, etc.). However, N985CA's approach into the Reno area appears relative smooth with bank angles less than 20°.

The Pilot Operating Handbook for the airplane indicates that the stall speed was less than 90 kt, even up to 45° bank. Figures 4 and 6 thus indicate that the airplane had sufficient airspeed and stall margin. As a result, an aerodynamic stall appears unlikely in the accident.

Figure 7, on the other hand, suggests that wake turbulence from FDX1359 may have been a factor in the accident. The figure begins at 1757 PDT as N985CA is starting a left turn for a left base to runway 16L; FDX1359 is about at N98CA's 11 o'clock position and 10.5 nm away. Four minutes later (at N98CA's last radar return), FDX1359 is upwind of and at N98CA's 12 o'clock position. N98CA is less than a mile from FDX1359. N98CA impacted the ground in a recreational vehicle park 0.5 nm north of the airport shortly after the last radar return.

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G. Wake Vortex Encounter Possibility

Wake vortices from an airplane exist any time that the airplane is producing lift. The vortices are a result of the pressure difference between the upper and lower surfaces of the (finite) wings. The left wing generates a trailing clockwise vortex and the right wing produces a counter-clockwise vortex as viewed from behind. See Figure 8.

According to FAA Advisory Circular (AC) 90-23G, “Aircraft Wake Turbulence”, the vortices typically descend at a rate of 300 to 500 feet per minute, moving with the local air mass, and stop sinking by the time they reach 500 to 900 ft below their origination point.

Figures 10 and 11 show the approach path for N985CA as well as that for FDX1359 in three dimensions. The figures include the wake vortex trajectories as estimated by NASA’s Aircraft Vortex Spacing System Prediction Algorithm (APA) program¹. The vortex time histories shown in Figures 10 and 11 were shed from FDX1359 approximately where the dashed blue circle is shown in Figure 11 or about 26 seconds before N985CA’s last radar hit which is shown as a dashed red circle in the figure. The NASA APA program accounts for airplane weight, wing span, vertical wind profile², and atmospheric turbulence³.

The APA program estimated that the flight path for N985CA was in the vicinity of both wake vortices generated by the FDX1359 just prior to the impact site. N985CA’s last radar hit (dashed red circle in Figure 11) was approximately 0.1 NM east-northeast of the impact site at 18:00:59.95 and 4,600 ft msl.

H. SUMMARY AND CONCLUSIONS

Based on radar data, weather observations, and wreckage, it is likely that N985CA encountered wake turbulence from FedEx FDX1359 which landed seconds before the accident. Aerodynamic stall does not appear to be a factor.

According to AC 90-23G, the wake of larger aircraft can impose rolling moments that induce a roll that exceeds the roll control authority of smaller encountering aircraft. In addition, AC 90-23G states that the greatest vortex strength occurs when the generating aircraft is heavy and slow as with landing and warns pilots to be alert for larger aircraft upwind from their approach (as was the case with FDX1359 and shown in Figures 9, 10, and 11).

Timothy Burtch
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National Transportation Safety Board

¹ Proctor, F.H., and Hamilton, D.W., “Evaluation of Fast-Time Wake Vortex Prediction Methods”, NASA Langley Research Center, Hampton, VA. January 5, 2009.

² The vertical wind profile used came from the 1700 MDT (0000Z) upper air sounding for Reno. The winds out of the west pushed both wing tip vortices from FDX1359 east of its flight path and closer to N985CA.

³ An Eddy Dissipation Rate of 0.005 m²/s³ associated with “moderately turbulent” air was used.

I. FIGURES



Figure 1: Accident Airplane, a 1981 Beechcraft A-36

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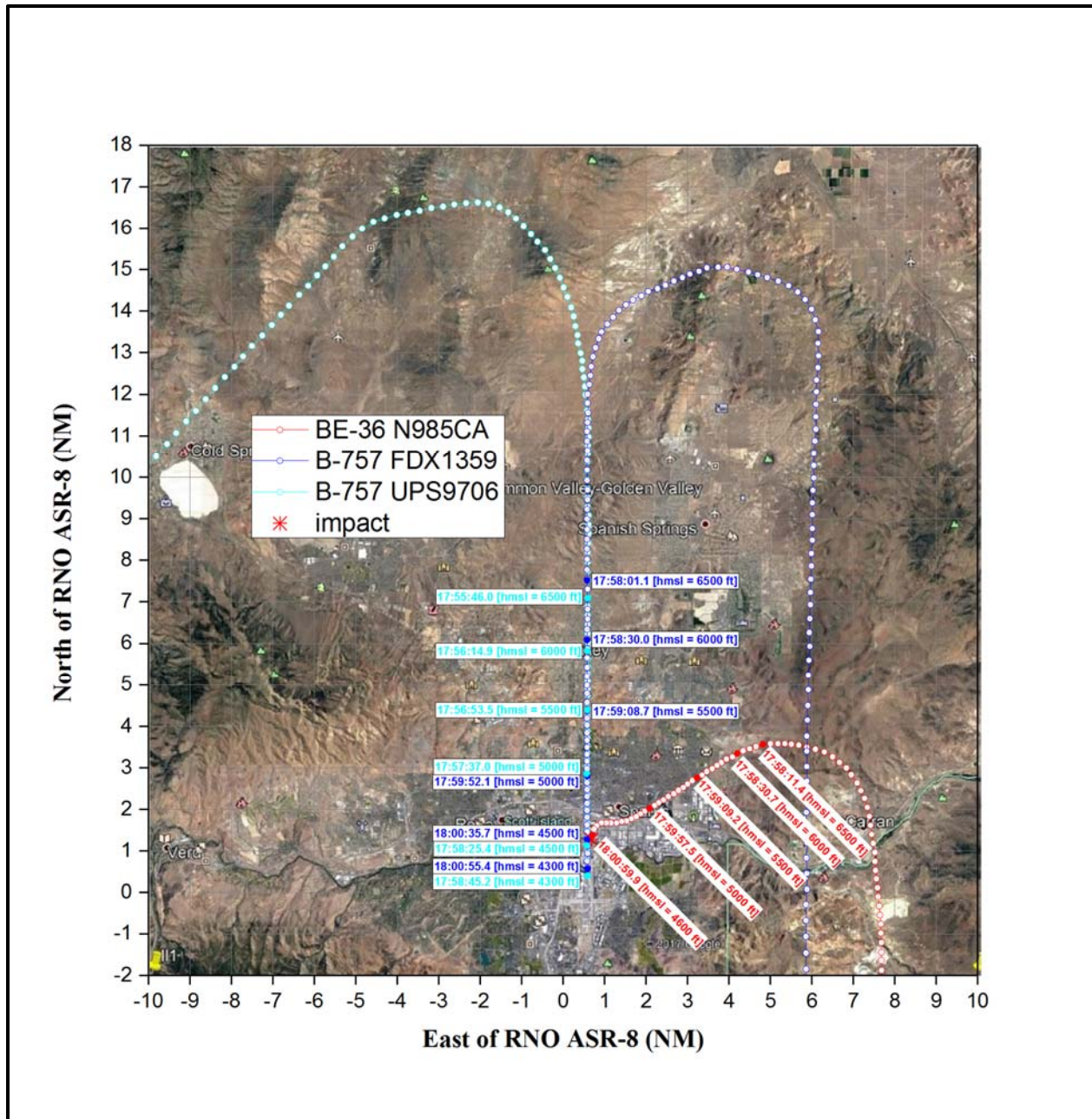


Figure 2: Ground Track with Radar Time and Altitude

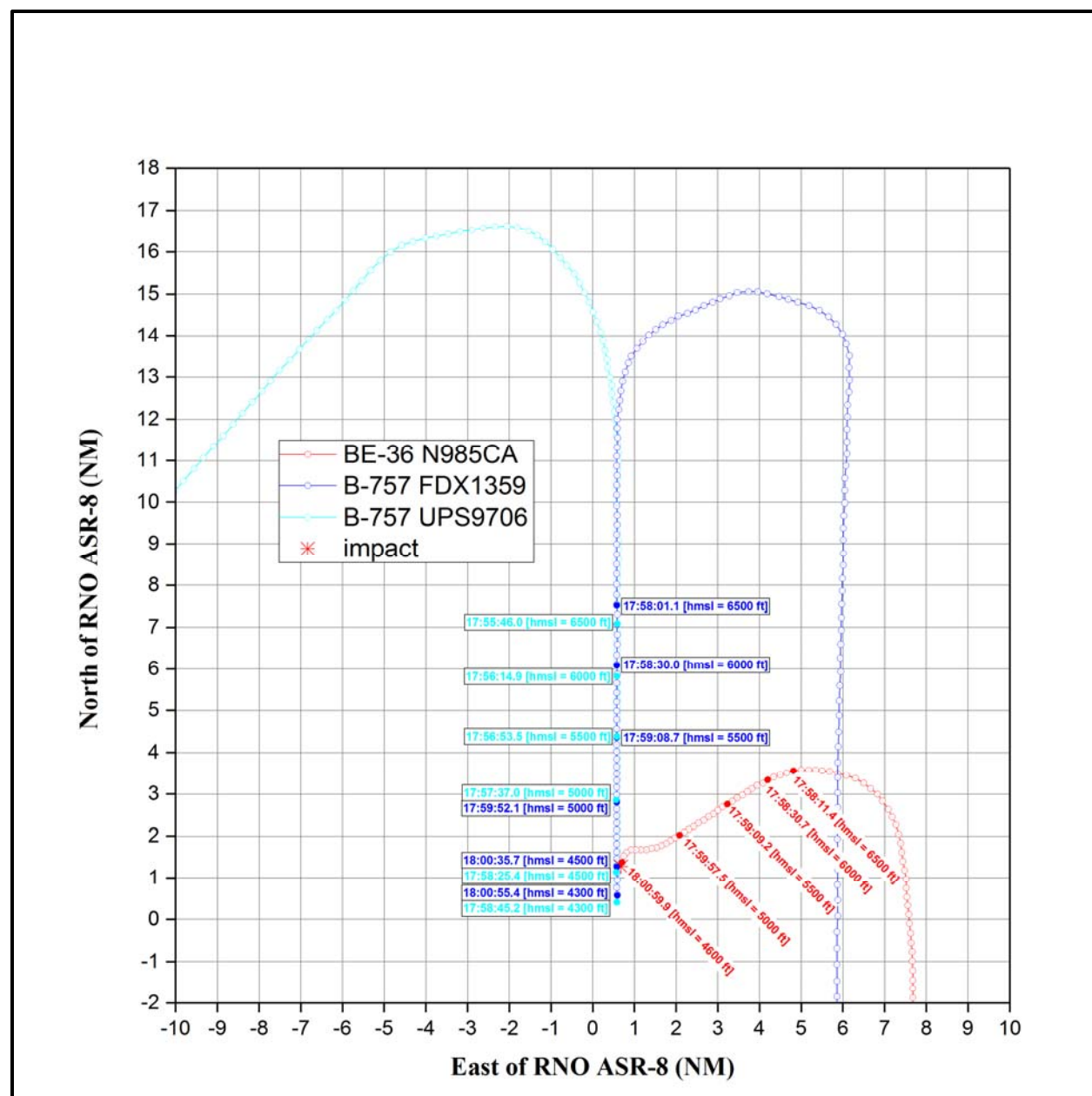


Figure 3: Ground Track without Map Background

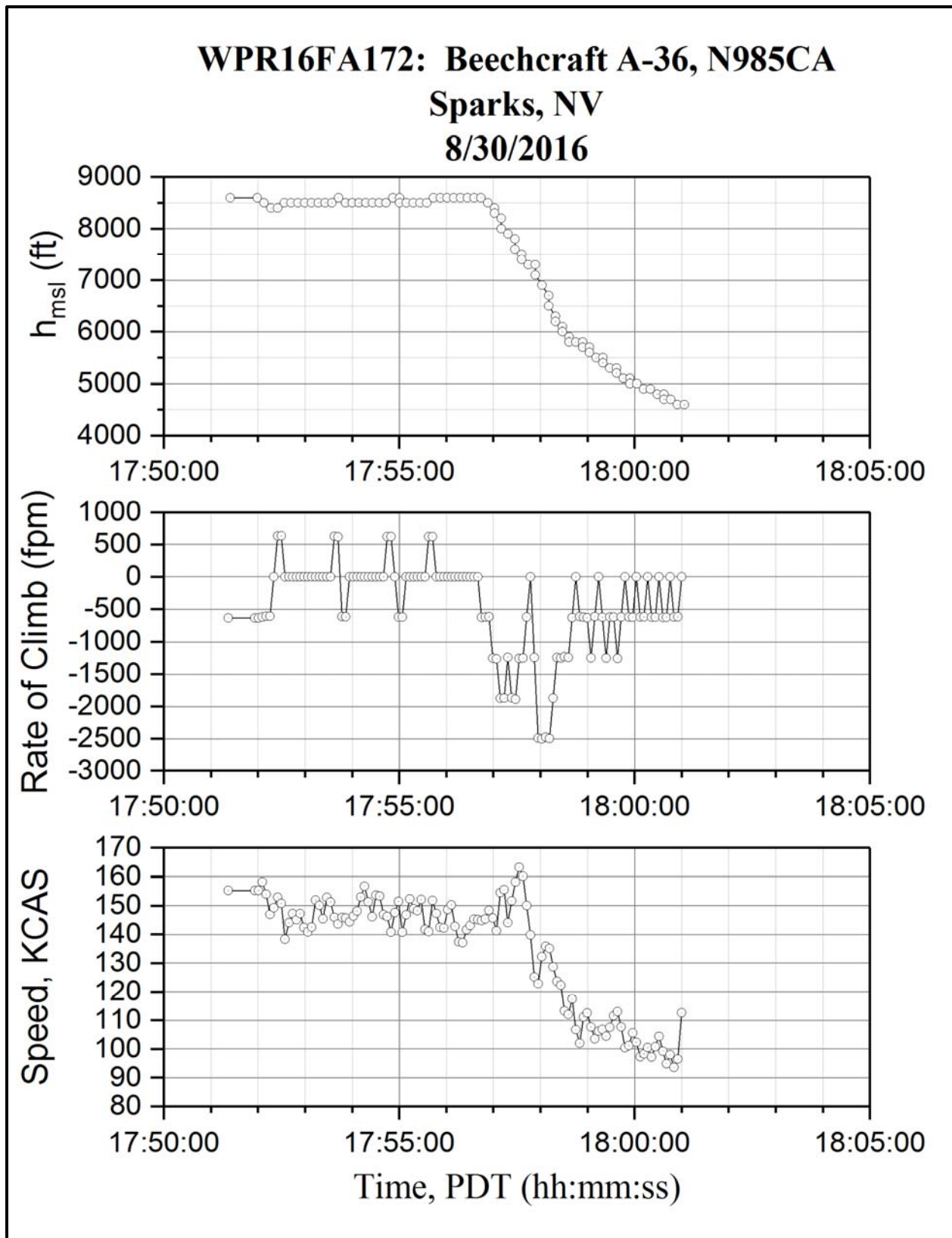


Figure 4: Altitude and Airspeed

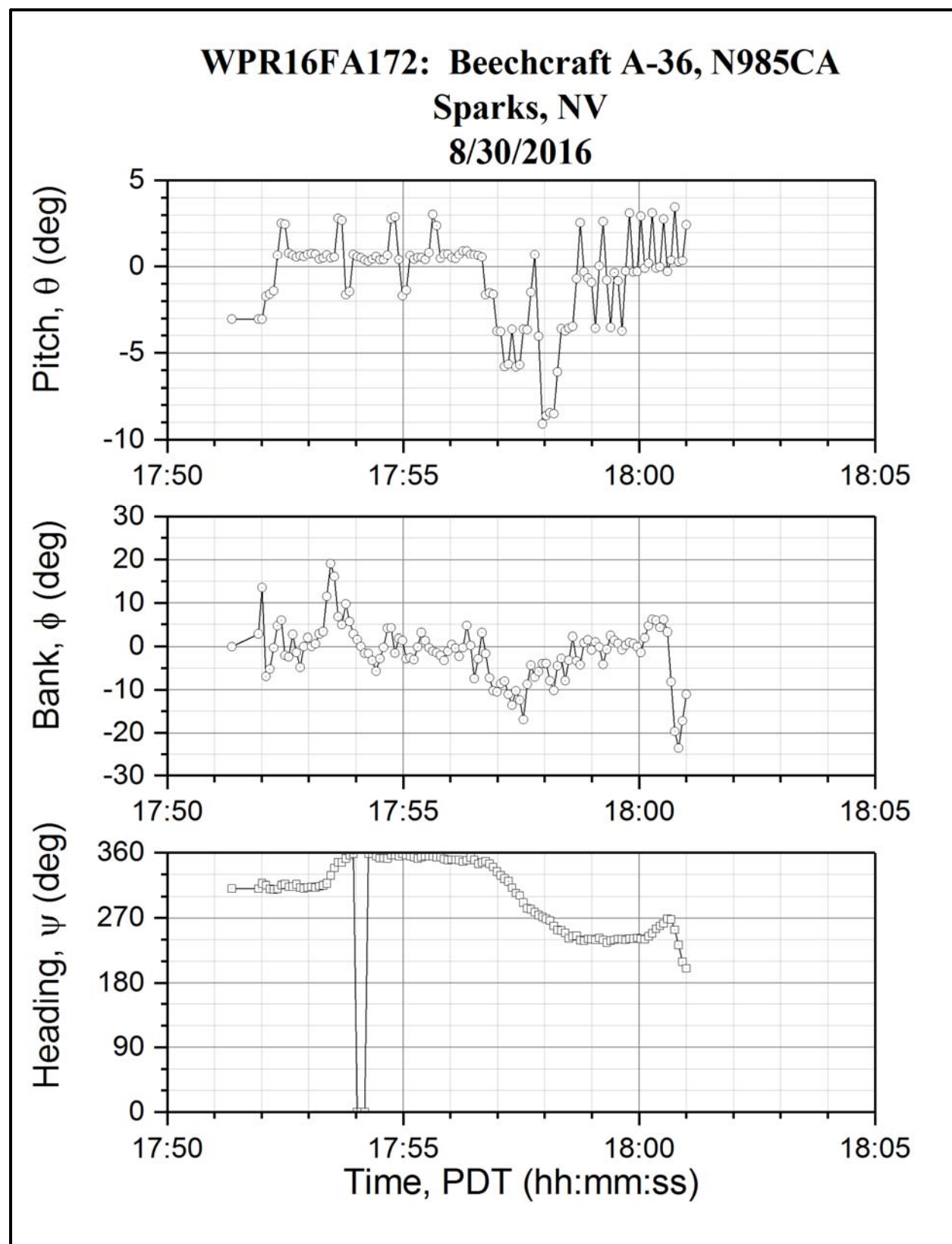


Figure 5: Pitch, Bank, and Heading

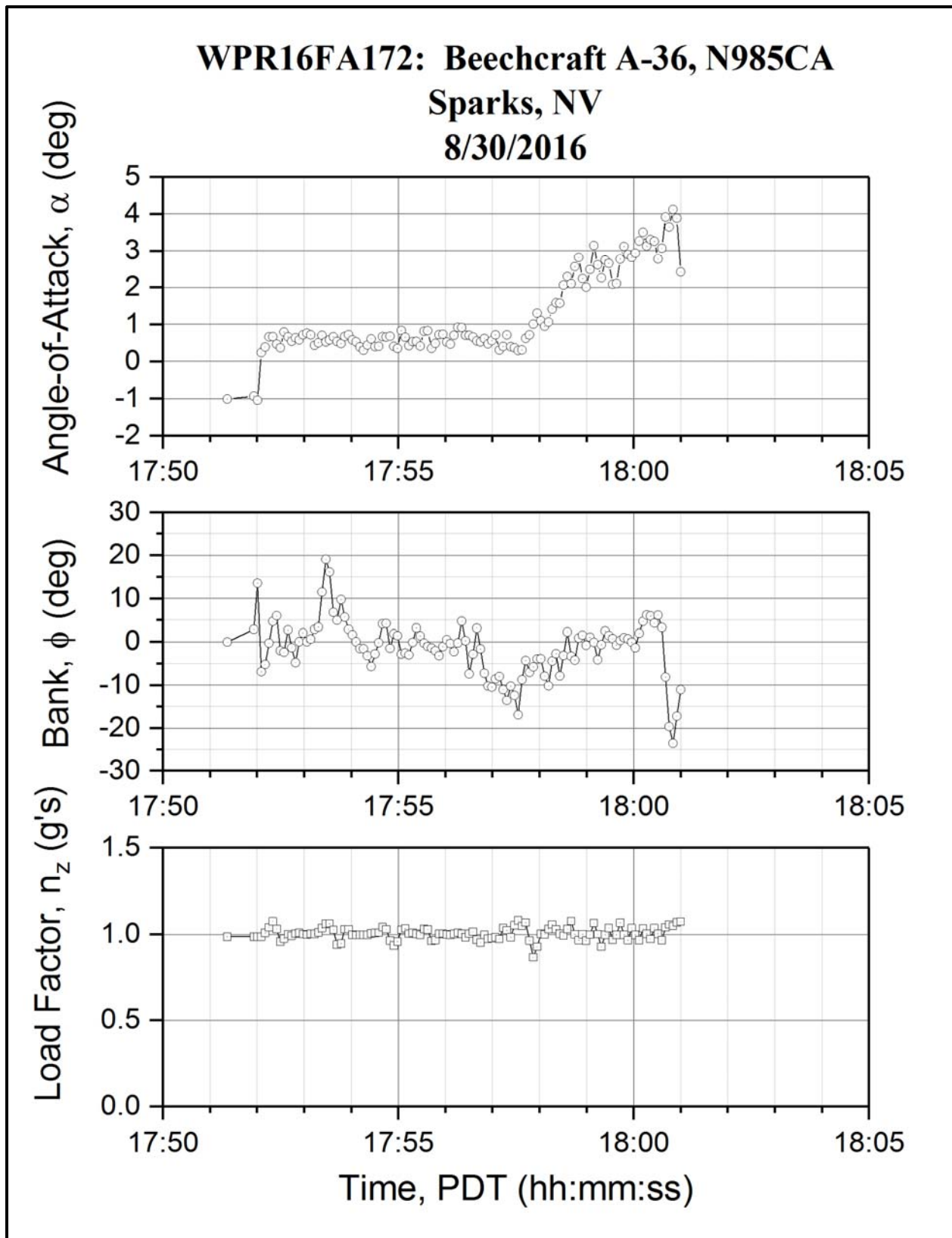


Figure 6: Estimated Angle-of-Attack and Load Factor

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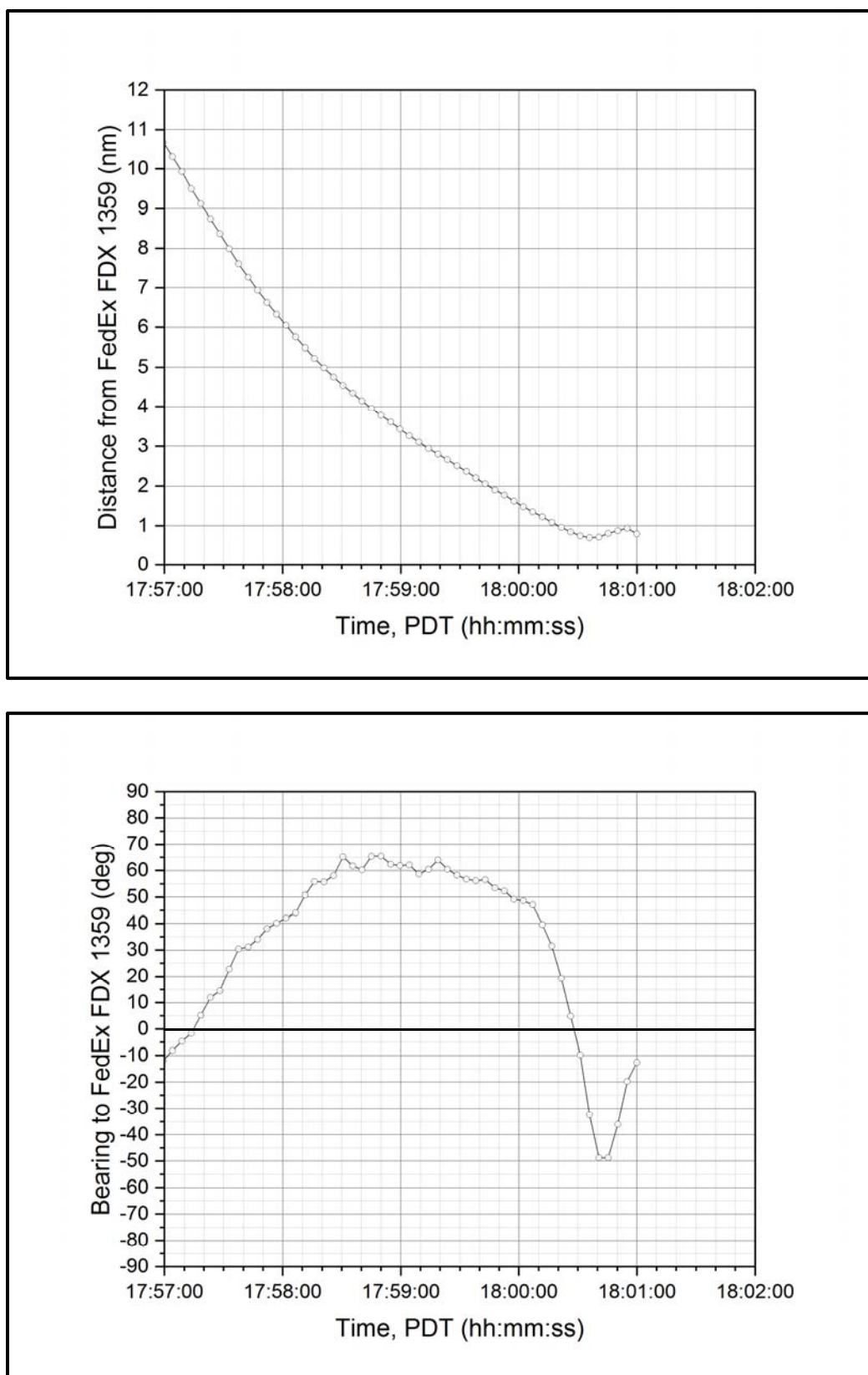


Figure 7: Distance and Bearing from N985CA to FDX1389

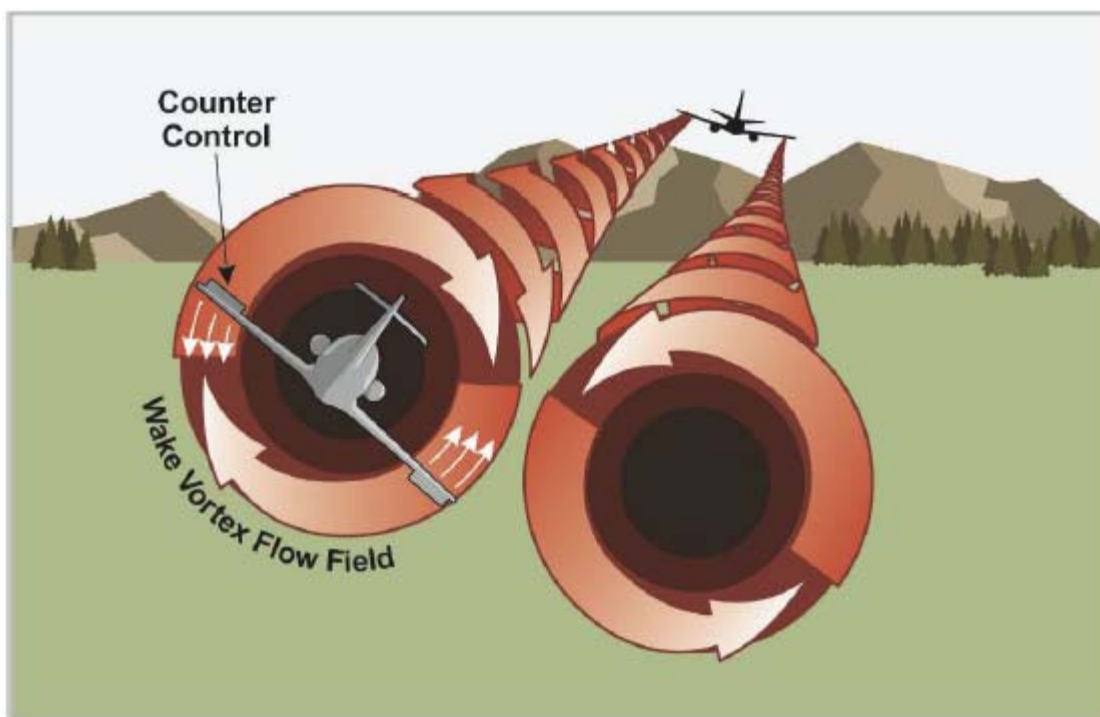


Figure 8: Induced Roll
(from FAA AC 90-23G)

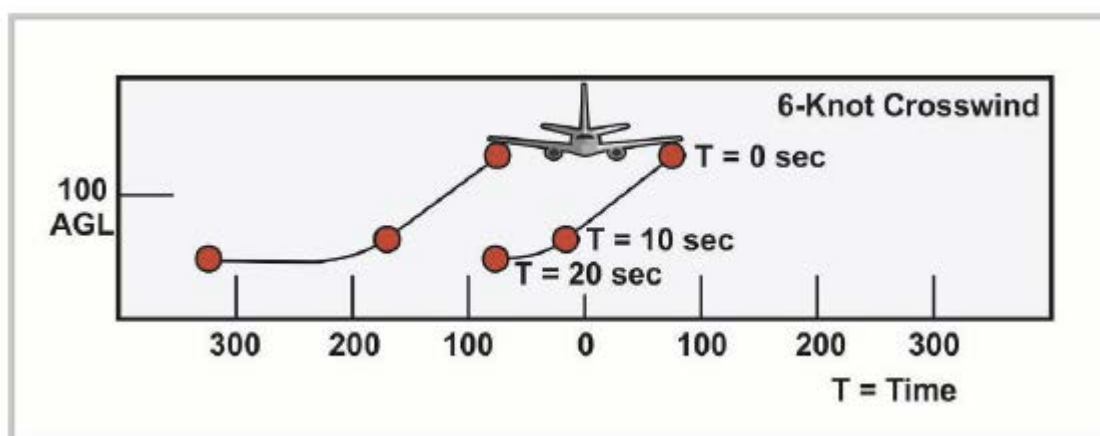


Figure 9: Effect of 6-Knot Crosswind on Vortices from Low Flying Aircraft
(from FAA AC 90-23G)

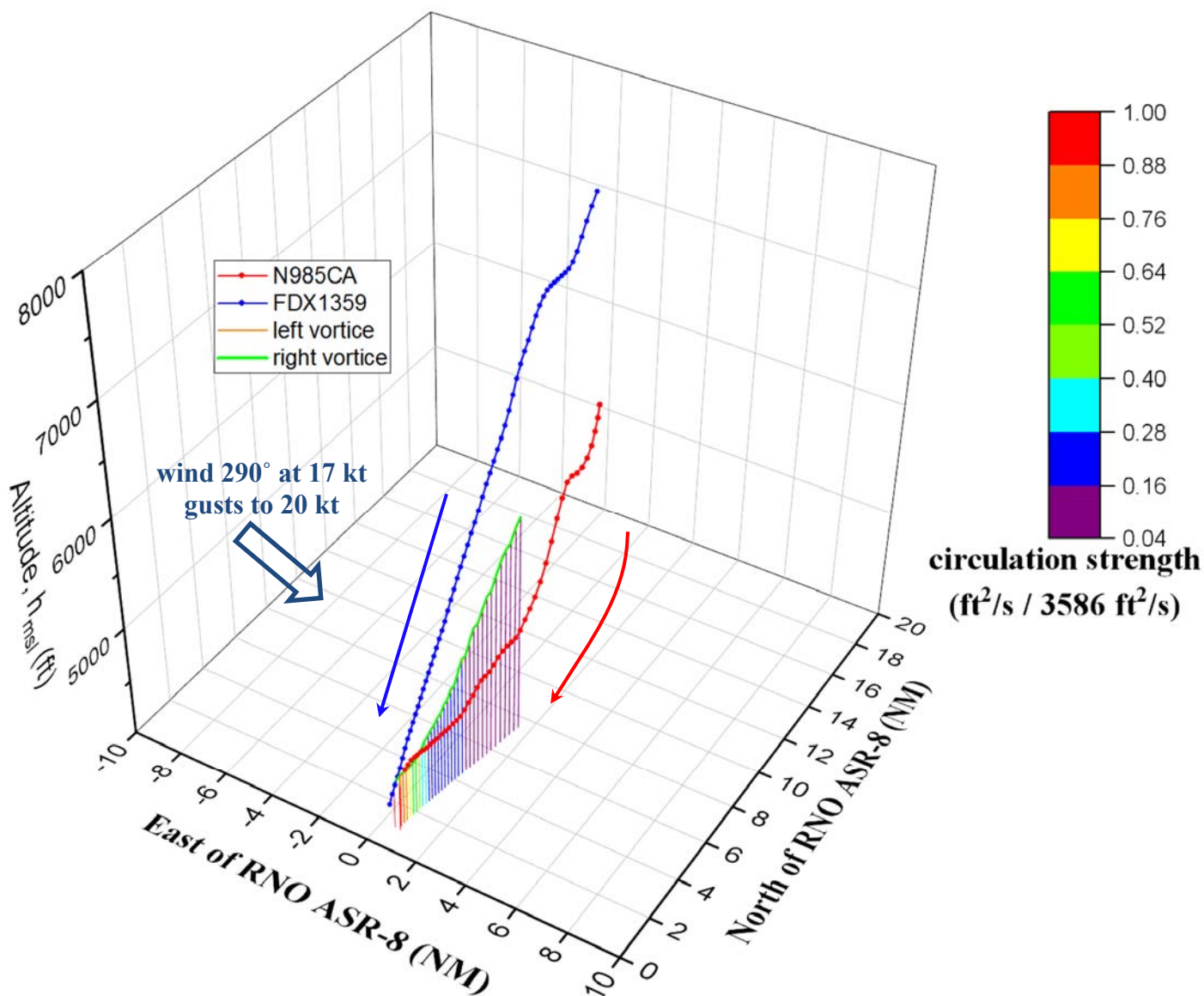


Figure 10: Three-Dimensional Approach Path for N985CA and FDX1359 with Wake Vortex Trajectories as Estimated by NASA APA Program

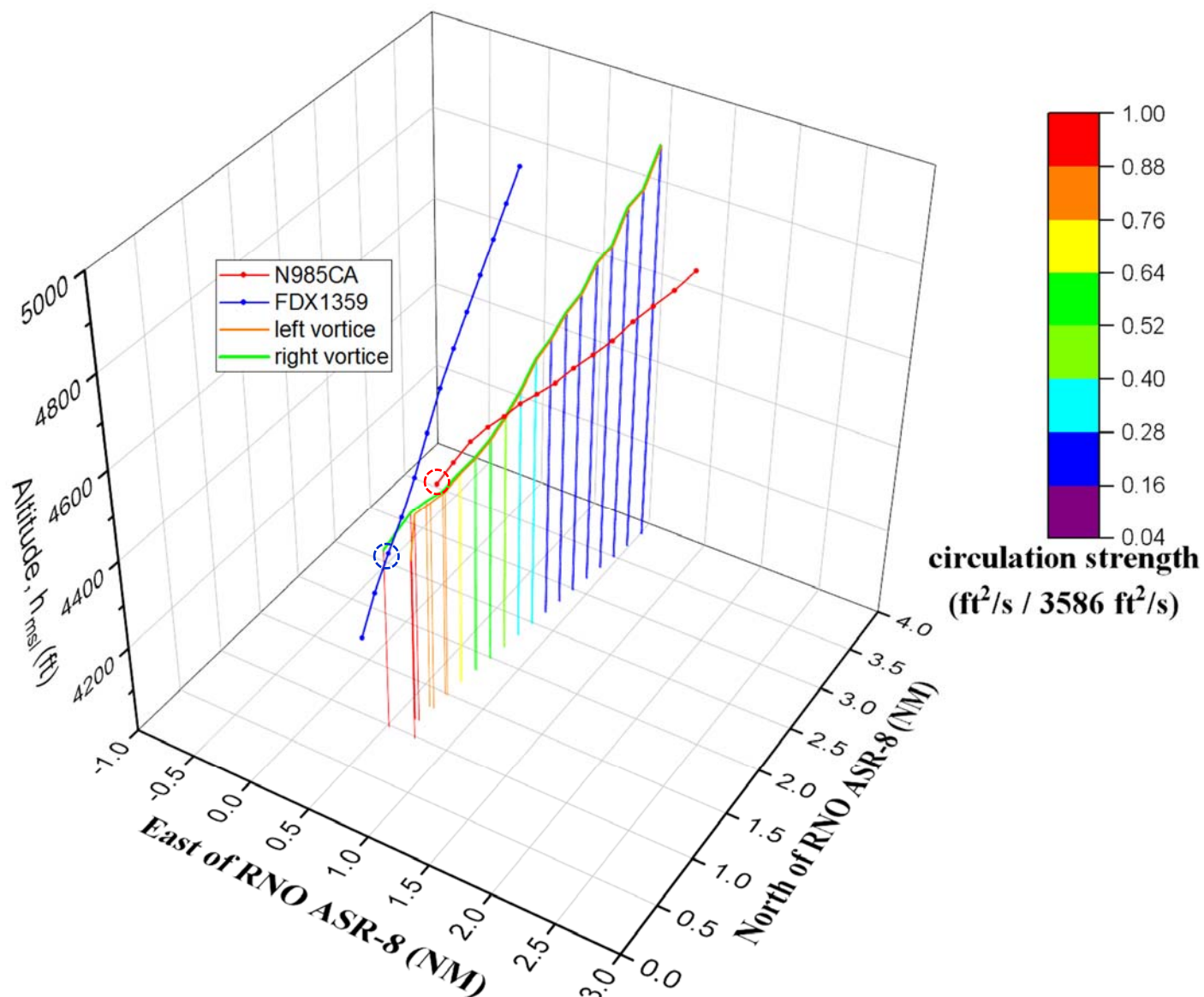


Figure 11: Three-Dimensional Approach Path for N985CA and FDX1359 with Wake Vortex Trajectories as Estimated by NASA APA Program (Increased Scale)