NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Western Pacific Region

GPS TRACK EVALUATION

NTSB Accident: WPR17FA055
Accident Date: January 12, 2017

This document contains 26 embedded images
(Some courtesy Google)

A. ACCIDENT SUMMARY

On January 12, 2017, about 0905 Pacific Standard time, a Mooney M20J, N6201N, was destroyed when it impacted terrain near the Lake Hughes Very High Frequency Omnirange navigation beacon (LHS VOR) during a flight from Tehachapi Municipal Airport (TSP), Tehachapi, California to Zamperini Field Airport (TOA), Torrance, California. The private pilot/owner was fatally injured. The personal flight was conducted under the provisions of Title 14 Code of Federal Regulations Part 91. No flight plan was filed for the flight.

Evidence supports the existence of instrument meteorological conditions at the accident site at the time of the accident. All evidence was consistent with a controlled flight into terrain event, and no evidence of any pre-impact mechanical malfunctions, in-flight fire, or in-flight structural failure was observed.

B. GPS INFORMATION

A Garmin GPSMap 796 was recovered from the wreckage and sent to the NTSB Recorders Laboratory in Washington DC, and about 35 'trips' were successfully downloaded from the device memory. This report documents the evaluation of the trips with regard to the pilot's flight habits between TSP and TOA. A separate report documents the download process and results.

For clarification purposes, the number of trips is somewhat arbitrary. The GPS device catalogs 'sessions,' which are separated by device power on/power off cycles, and usually a session corresponds to a single trip. Normally, pilots, including this accident pilot, turn their GPS device on before the beginning of a particular flight, and turn it off at the completion of the flight, which results in a discrete data set, and one session per trip. However, sometimes the pilot fails to turn the device off after a flight, and the device remains in a fixed location or on the ground for hours or days before flying again, which can yield multiple trips or flights per session.

For this analysis, a 'trip' is typically determined as a discrete data set bounded by clear/obvious start and end dates, times, and locations. The trip division and trip counts assigned by the IIC for this analysis differed slightly from those created and used by the Recorders Laboratory personnel; this report catalogs and cross references both to minimize confusion.

C. TRIP SUMMARY

1.0 All Trips

The following two tables list all the sessions/trips that were downloaded from the GPS device. The tables list the sessions in chronological order, and include date, time, and origination and termination locations (typically designated by the airport identifiers). The 'Remarks' column includes observations of interest regarding the depicted flight tracks.

Recorders Lab Session or Trip #	IIC Trip #	Date	Time (UTC)	Start Location Intermediate Location(s) End Location	OBSERVATIONS / REMARKS
	1	12/17/2016	17:58:01	2 SE of TSP	
	1	12/17/2016	18:08:37	TSP	
1	2	12/20/2016	16:58:21	TSP	
1	2	12/20/2016	17:52:26	TOA	
2	3	12/21/2016	1:15:25	TOA	A few minor route deviations
2	3	12/21/2016	2:15:21	TSP	
3	4	12/21/2016	16:12:50	TSP	Significant circling just SE of TSP
3	4	12/21/2016	17:21:22	TOA	
4	5	12/22/2016	1:17:01	TOA	
4	5	12/22/2016	1:25:44	TOA	
4	5	12/22/2016	2:19:23	TSP	
5	6	12/22/2016	16:30:32	TSP	Flew South to mtn range and returned to TSP
5	6	12/22/2016	17:14:50	TSP	
6	7	12/27/2016	16:12:51	TSP	
6	7	12/27/2016	17:10:26	TOA	
7	8	12/28/2016	1:07:31	TOA	Large lateral deviation plus approx 3 circles just N of mtn range
7	8	12/28/2016	2:26:32	TSP	
	9	12/28/2016	16:21:01	TSP	
	9	12/28/2016	17:00:52	WHP	
	9	12/28/2016	17:33:06	AJO	
	9	12/28/2016	17:59:56	TOA	
9	10	12/29/2016	1:11:32	TOA	
9	10	12/29/2016	2:12:21	TSP	
10	11	12/29/2016	16:53:02	TSP	
10	11	12/29/2016	17:50:57	TOA	
11	12	12/30/2016	1:15:56	TOA	Slight deviation at mtn range
11	12	12/30/2016	2:18:39	TSP	
12	13	12/30/2016	16:31:01	TSP	
12	13	12/30/2016	16:58:41	WJF	
	14	12/30/2016	18:31:29	WJF	
	14	12/30/2016	18:52:59	TSP	
	15	1/2/2017	19:29:02	3 SSE of TSP	
	15	1/2/2017	19:45:52	WJF	
	15	1/2/2017	20:29:05	WJF	
	15	1/2/2017	21:00:46	TSP	
	16	1/2/2017	22:14:15	Grnd Veh TSP	
	17	1/3/2017	1:43:50	Grnd Veh TSP	
19	18	1/3/2017	16:52:32	7 SSE of TSP	One circle out of TSP plus some deviations at Mtns
19	18	1/3/2017	17:41:29	TOA	
	19	1/4/2017	0:52:55	TOA	

NOTES

AJO = Corona
TOA = Torrance
TSP = Tehachapi
WHP = Whiteman
WJP = Wm J. Fox

"Mtns" refers to NW-SE mountain range S of TSP and N of TOA

Figure 1 - GPS Trip Synopsis (1 of 2)

Recorders Lab Session or Trip #	IIC Trip #	Date	Time (UTC)	Start Location Intermediate Location(s) End Location	OBSERVATIONS / REMARKS
	19	1/4/2017	1:46:01	WJF	
	19	1/4/2017	1:59:30	WJF	
	19	1/4/2017	2:23:07	TSP	
22	20	1/4/2017	16:37:01	TSP	
22	20	1/4/2017	17:30:44	TOA	
	21	1/5/2017	1:15:00	TOA	
	21	1/5/2017	1:57:48	WJF	
	22	1/5/2017	2:15:47	WJF	
	22	1/5/2017	2:58:37	L 71 (Cal City)	
25	23	1/6/2017	18:05:32	L71 (Cal City)	Circling, climb/descent at L71
25	23	1/6/2017	18:39:55	WHP	
	24	1/6/2017	22:58:53	WHP	
	24	1/7/2017	1:10:51	MEV (Minden NV)	
	24A	1/7/2017	1:16:10	MEV (Minden NV)	
	24A	1/7/2017	3:31:16	TSP	
	25	1/7/2017	23:42:31	WJF	
	25	1/8/2017	0:04:03	TSP	
	26	1/8/2017	0:25:15	TSP	
	26	1/8/2017	0:54:28	WJF	
	27	1/8/2017	0:56:35	WJF	
	27	1/8/2017	1:19:29	TSP	
	28	1/9/2017	0:49:31	TSP	
	28	1/9/2017	1:21:25	WHP	
31	29	1/9/2017	5:55:58	WHP	Circling & descent/climb at TSP
31	29	1/9/2017	6:31:51	TSP	
32	30	1/10/2017	16:48:26	TSP	
32	30	1/10/2017	17:57:20	TOA	
33	31	1/11/2017	1:27:01	TOA	
33	31	1/11/2017	2:20:06	TSP	Circle at TSP
34	32	1/11/2017	16:16:21	TSP	
34	32	1/11/2017	17:13:50	TOA	
	33	1/12/2017	1:16:02	TOA	
	33	1/12/2017	1:46:42	WHP	
	34	1/12/2017	3:29:14	WHP	
	34	1/12/2017	4:07:06	TSP	
	ACC	1/12/2017	16:45:31	TSP	Accident Flight
	ACC	1/12/2017	17:03:26	ACC	

NOTES

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"Mtns" refers to NW-SE mountain range S of TSP and N of TOA

Figure 2 - GPS Trip Synopsis (2 of 2)

Collectively, the data confirms witness accounts that the pilot used the airplane to regularly commute for his job, between his home airport (TSP) and TOA. The recovered data contained about 17 trips (not including the accident flight) between those two airports in the period from December 20, 2016 to January 11, 2017 (the day before the accident).

TOA is approximately 80 miles south of TSP, but the flight routing is complicated by topography, weather patterns, and multiple airspace restrictions. TSP is situated north of the Mojave desert at an elevation of about 4,000 feet, while TOA is situated in the Los Angeles Basin, near the Pacific Ocean, and approximately sea level in elevation. A large mountain chain, with some peaks near 8,000 feet, extends SE to NW, and bounds the south edge of the Mojave flatlands. This mountain range also tends to generate or be obscured by clouds, even when the areas to the north and south are clear. Edwards Air Force Base (EAFB) and Palmdale airport (PMD) are located in the Mojave, and result in airspace restrictions. The Los Angeles (LAX) Class B airspace is just south of the Mojave, and TOA is situated under the LAX Class B.

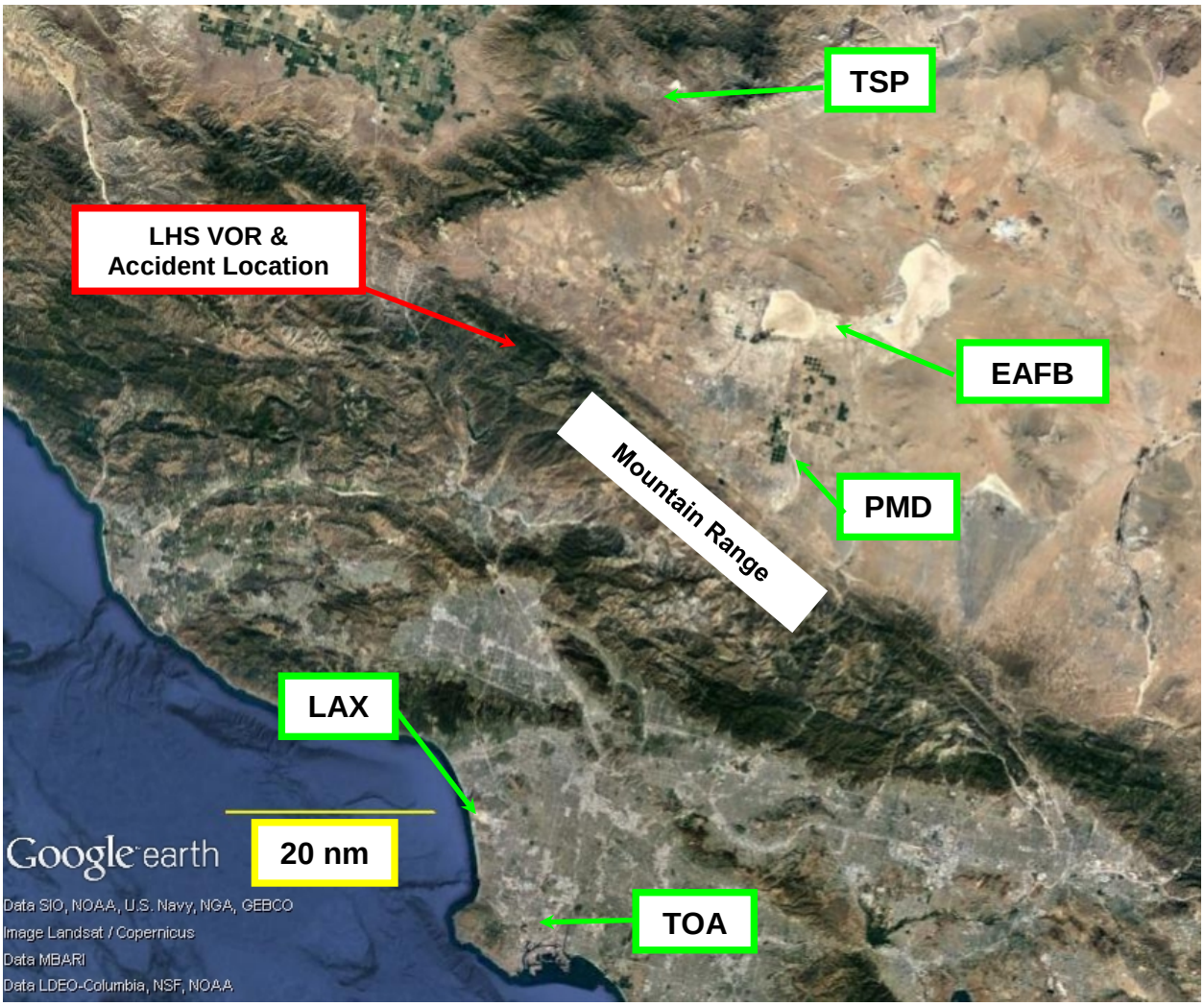

Figure 3 - Geographic Overview (Terrain view)

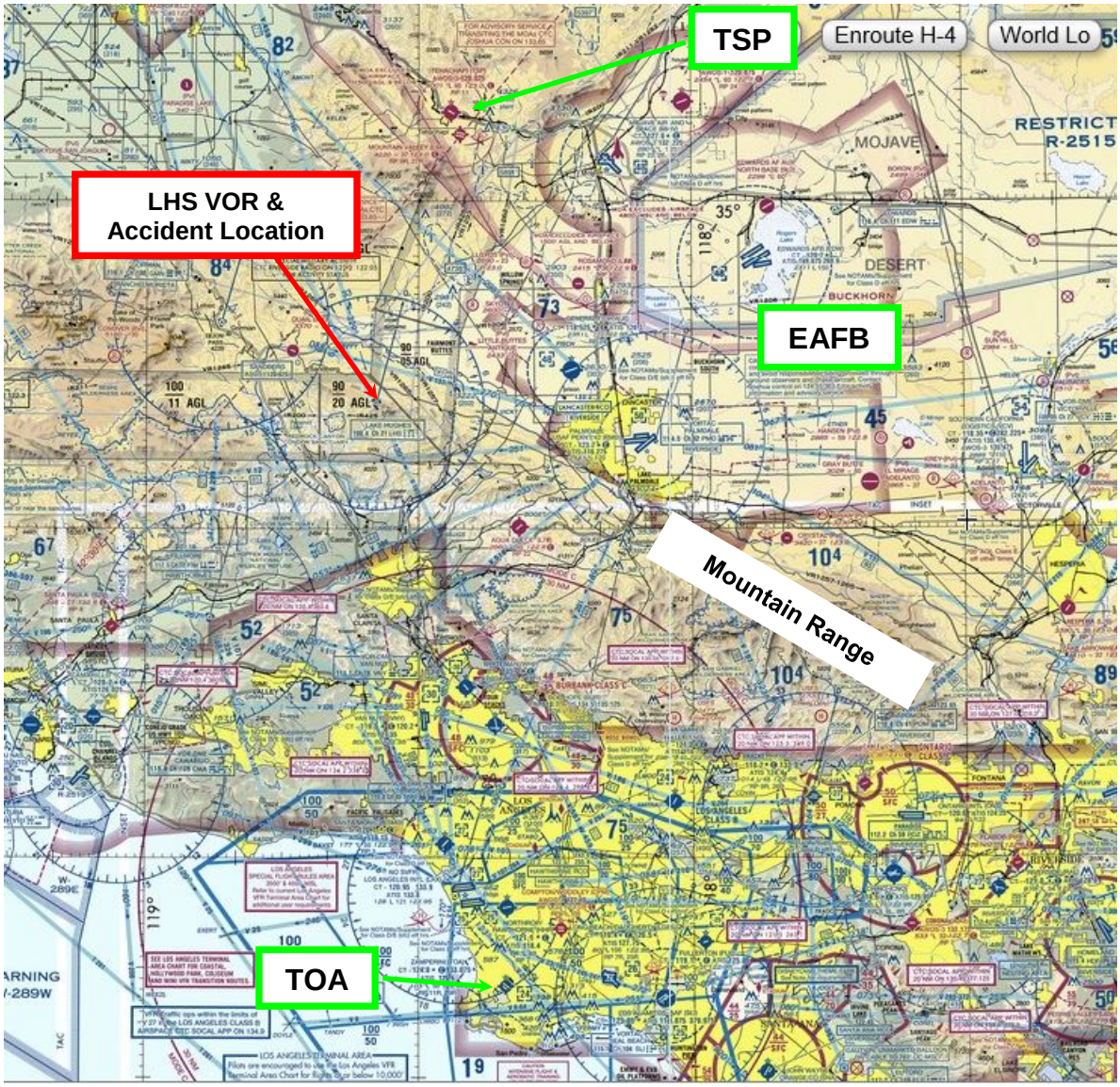

Figure 4 - Geographic Overview (Sectional chart)

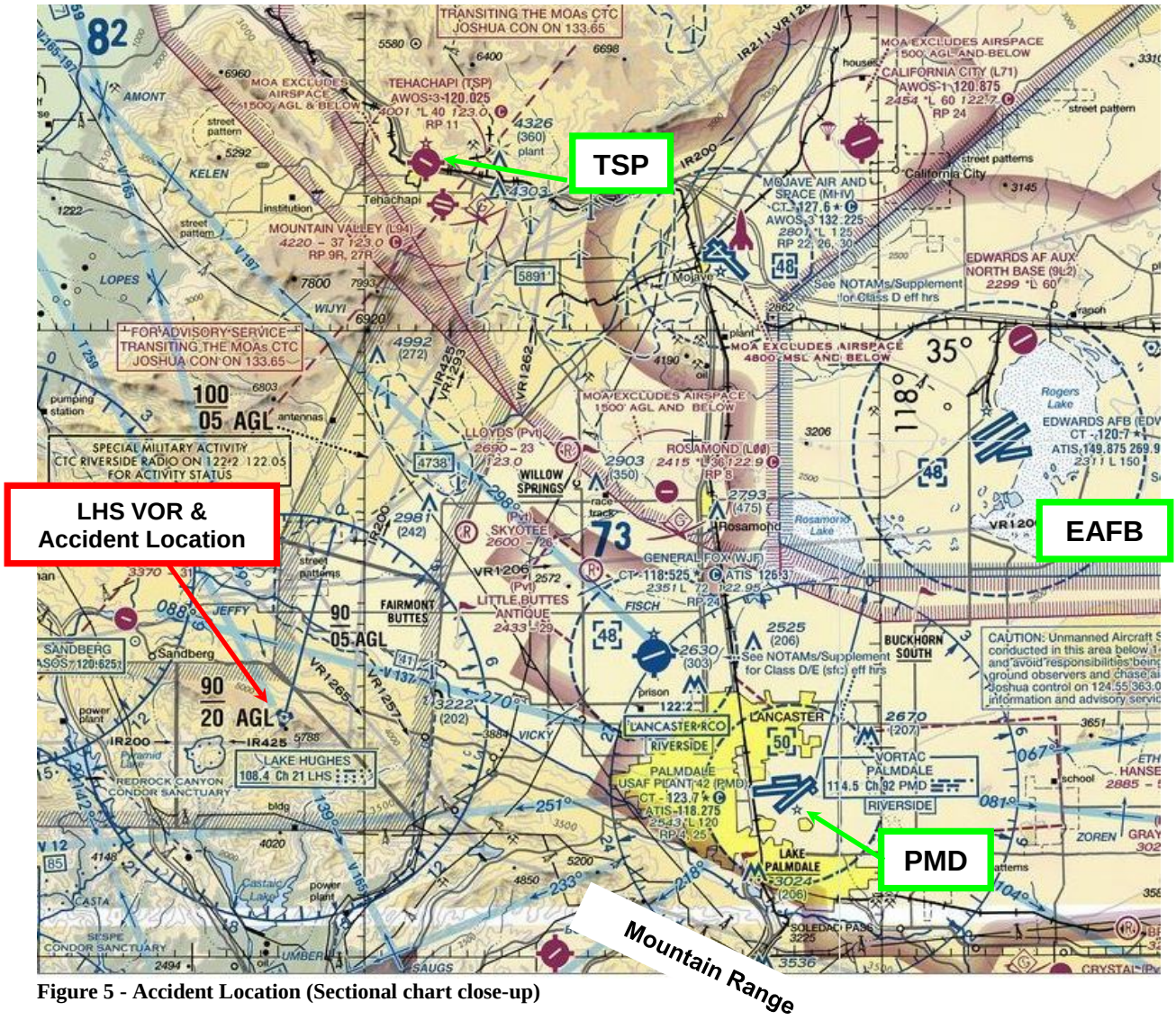

Figure 5 - Accident Location (Sectional chart close-up)

Eight of the 17 flights (some with intermediate stops) between TSP and TOA (either leg direction) depicted track deviations or circling, consistent with the pilot maneuvering the airplane to find a way between/around clouds. Five of those were on the TSP to TOA leg, while three were on the TOA to TSP leg. These events were clustered at two different locations; near TSP, or near the mountain range. One trip (Rec Lab #5) departed from TSP, flew south to the mountain range, and then returned to TSP. Although the reason for this cannot be known, it was consistent with the flight being blocked by clouds at the mountain range. Five examples are presented in Figures 6 through 15.

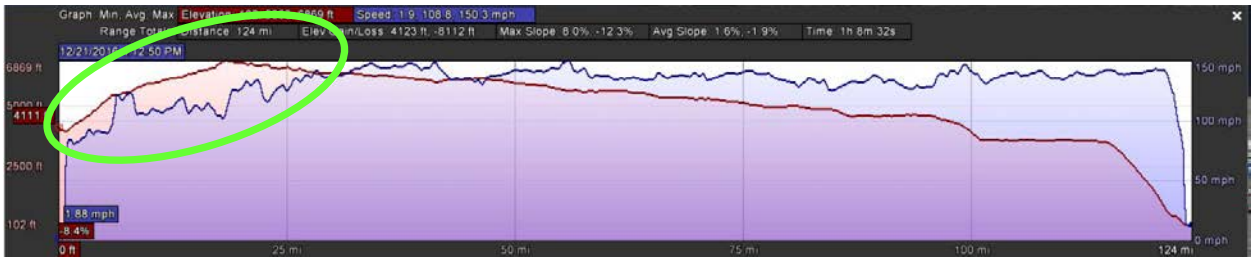

Figure 6 - Flight Altitude (red) & Speed (blue) (Rec Lab #3, deviation region circled)

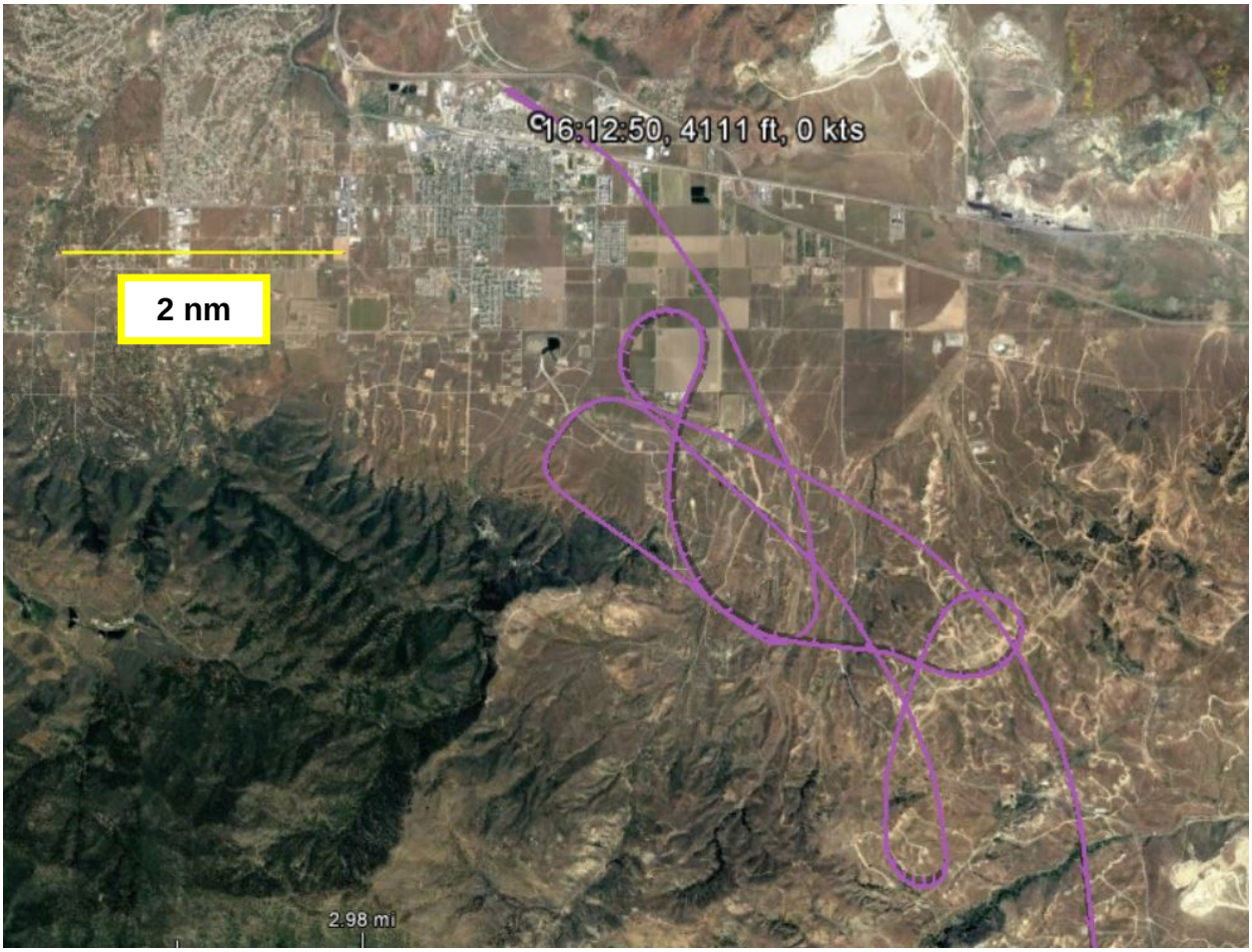

Figure 7 - Ground Track Deviations Departing TSP (Rec Lab #3)

Figure 8 - Flight Altitude (red) & Speed (blue) (Rec Lab #5)

Figure 9 - Ground Track (TSP departure & return, Rec Lab #5)

Figure 10 - Flight Altitude (red) & Speed (blue) (Rec Lab #7)

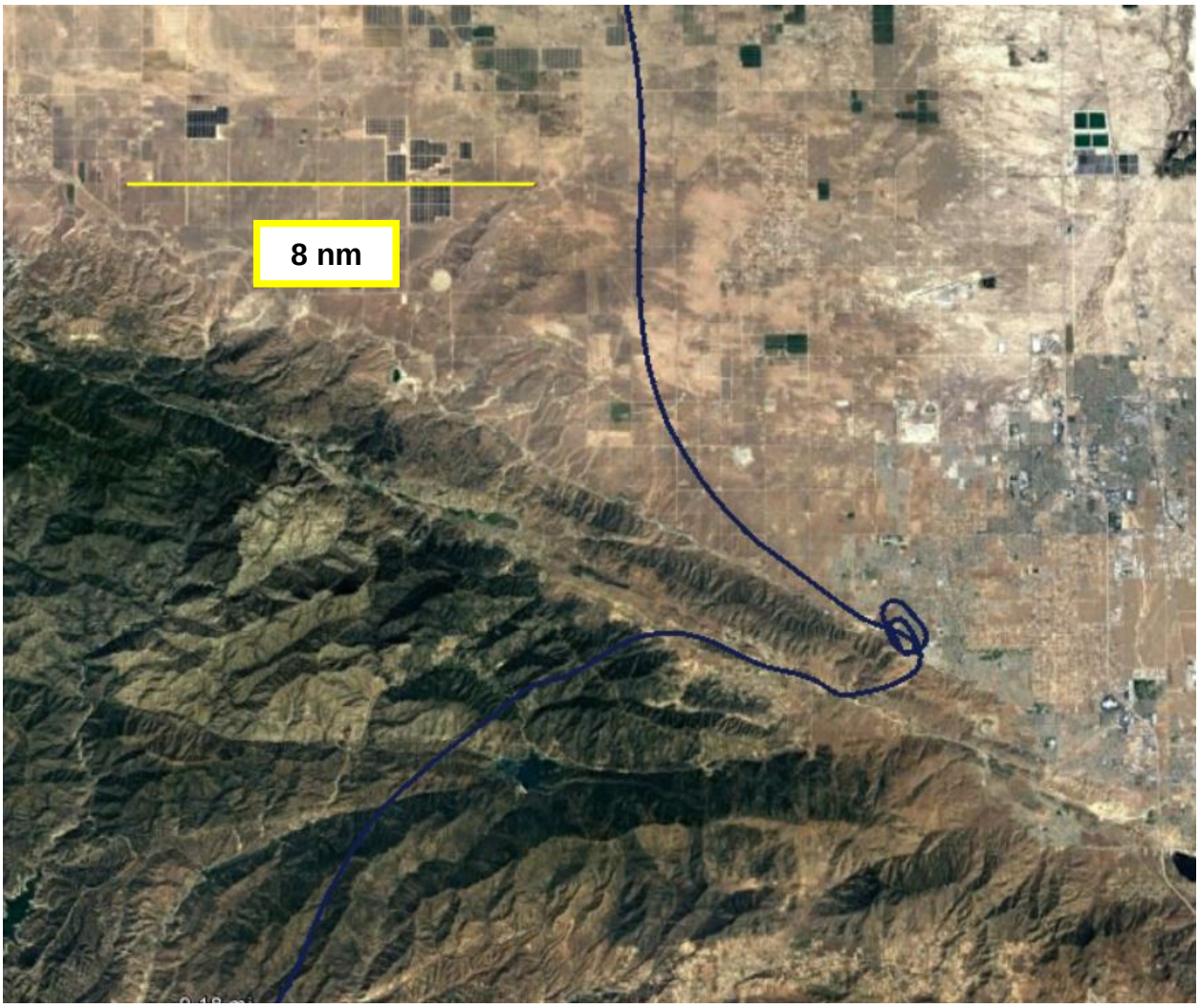

Figure 11 - Ground Track Deviations (TOA-TSP, Rec Lab #7)

Figure 12 - Flight Altitude (red) & Speed (blue) (TOA-TSP, Rec Lab #11)

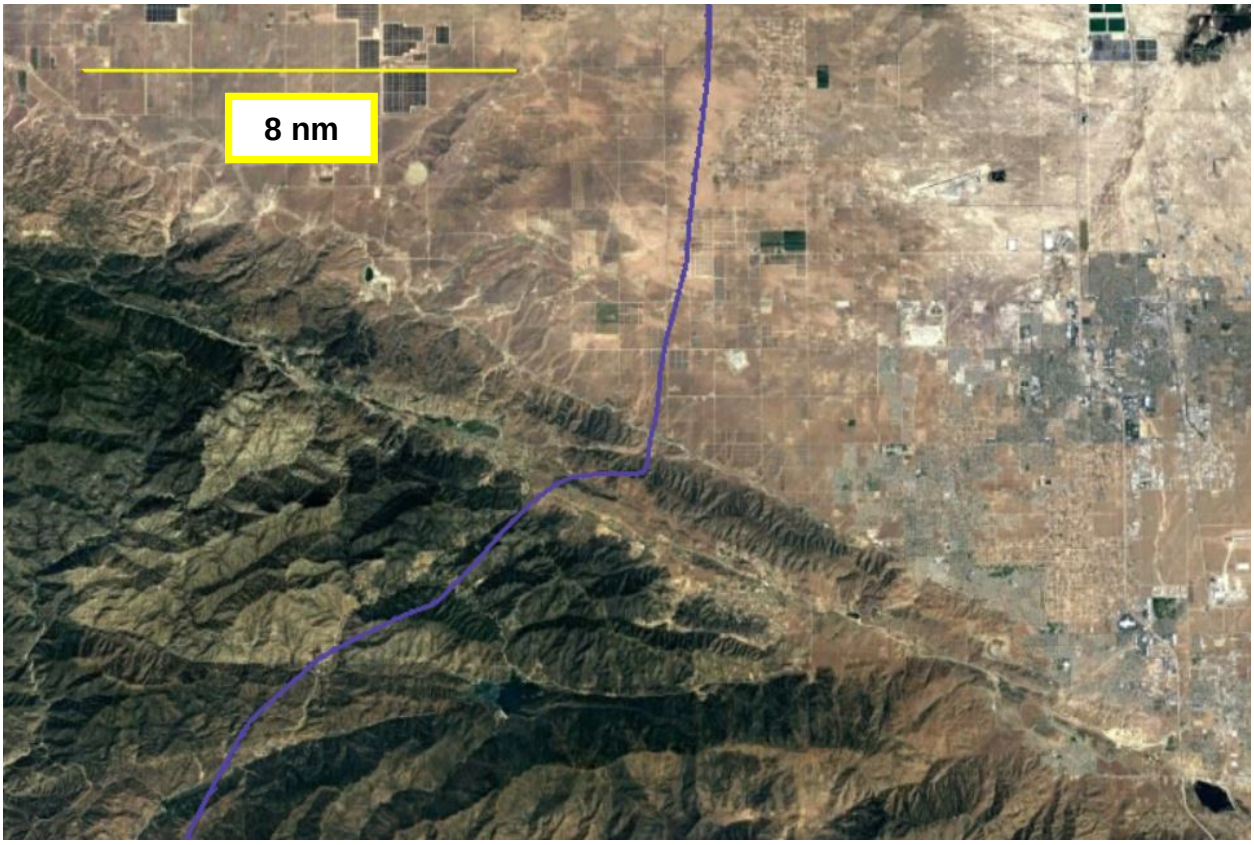

Figure 13 - Ground Track Deviations (Rec Lab #11)

Figure 14 - Flight Altitude (red) & Speed (blue) (TOA-TSP, Rec Lab #31)

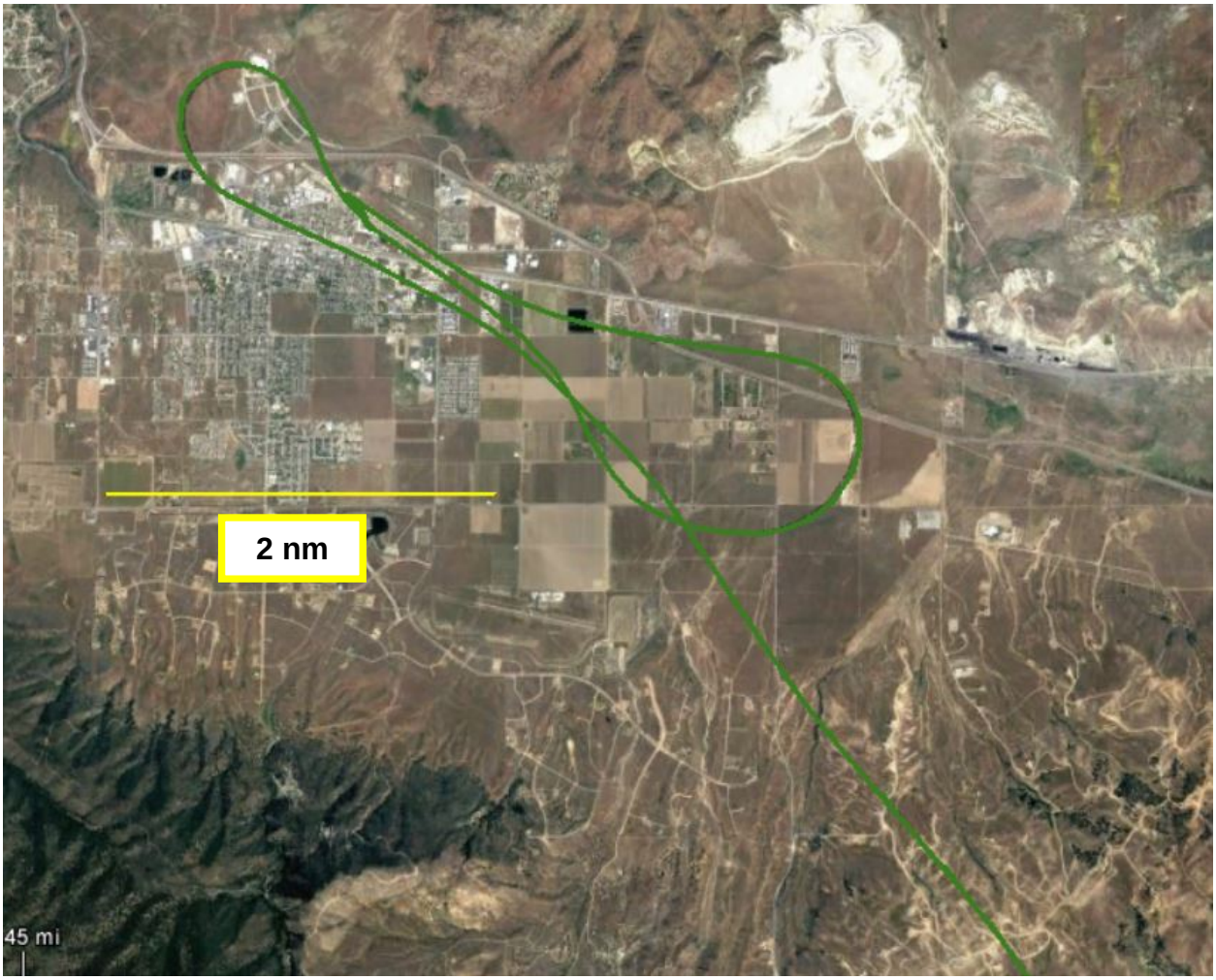

Figure 15 - Ground Track Deviations (TSP arrival, Rec Lab #31)

The recovered data contained 9 non-stop flights from TSP to TOA (including the accident flight), and 6 from TOA to TSP. Virtually all of those 15 flights were along different ground tracks, sometimes differing by several miles. With the exception of the accident flight, which tracked directly towards the LHS VOR, none of the flight tracks appeared to be aligned with any charted navigation facilities or waypoints. Therefore, the track path data did not provide any insights into the pilot's route selection methods.

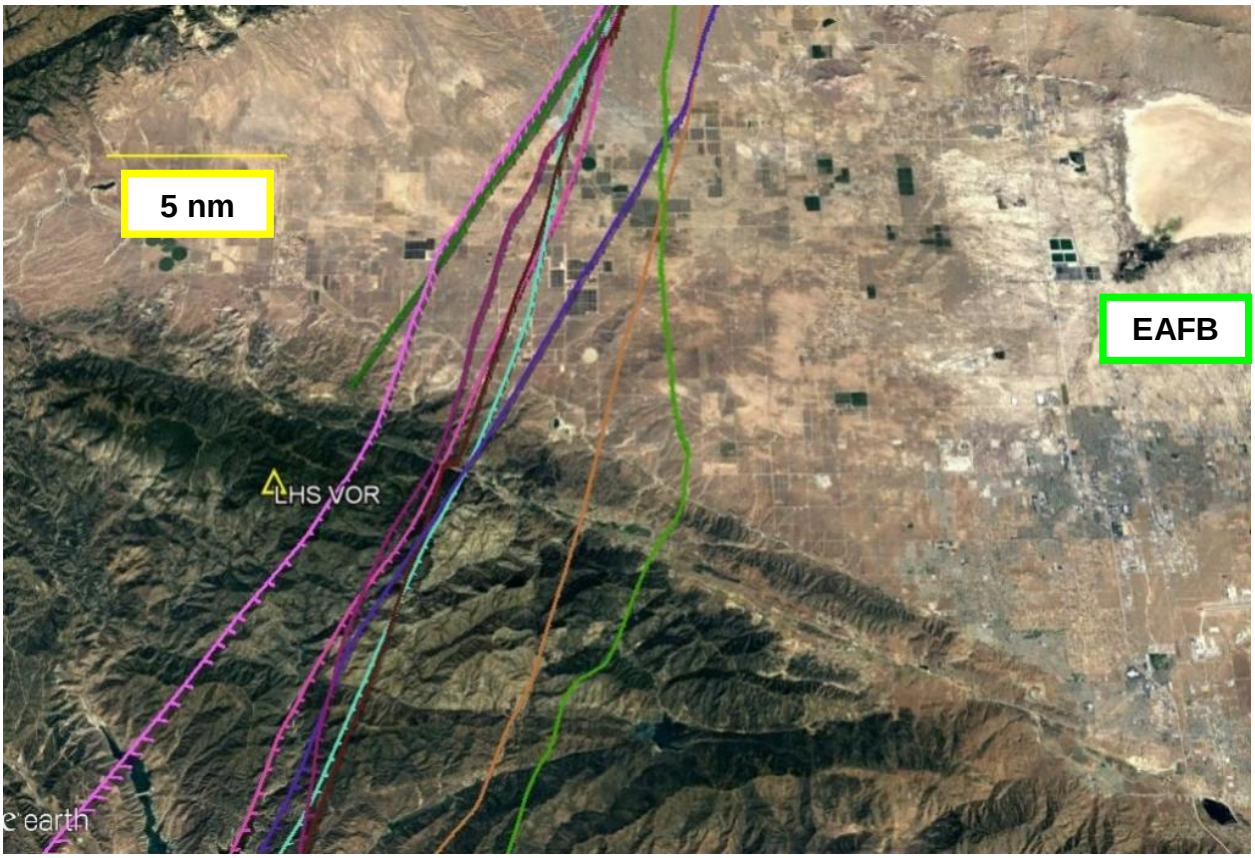

Figure 16 - TSP to TOA Legs

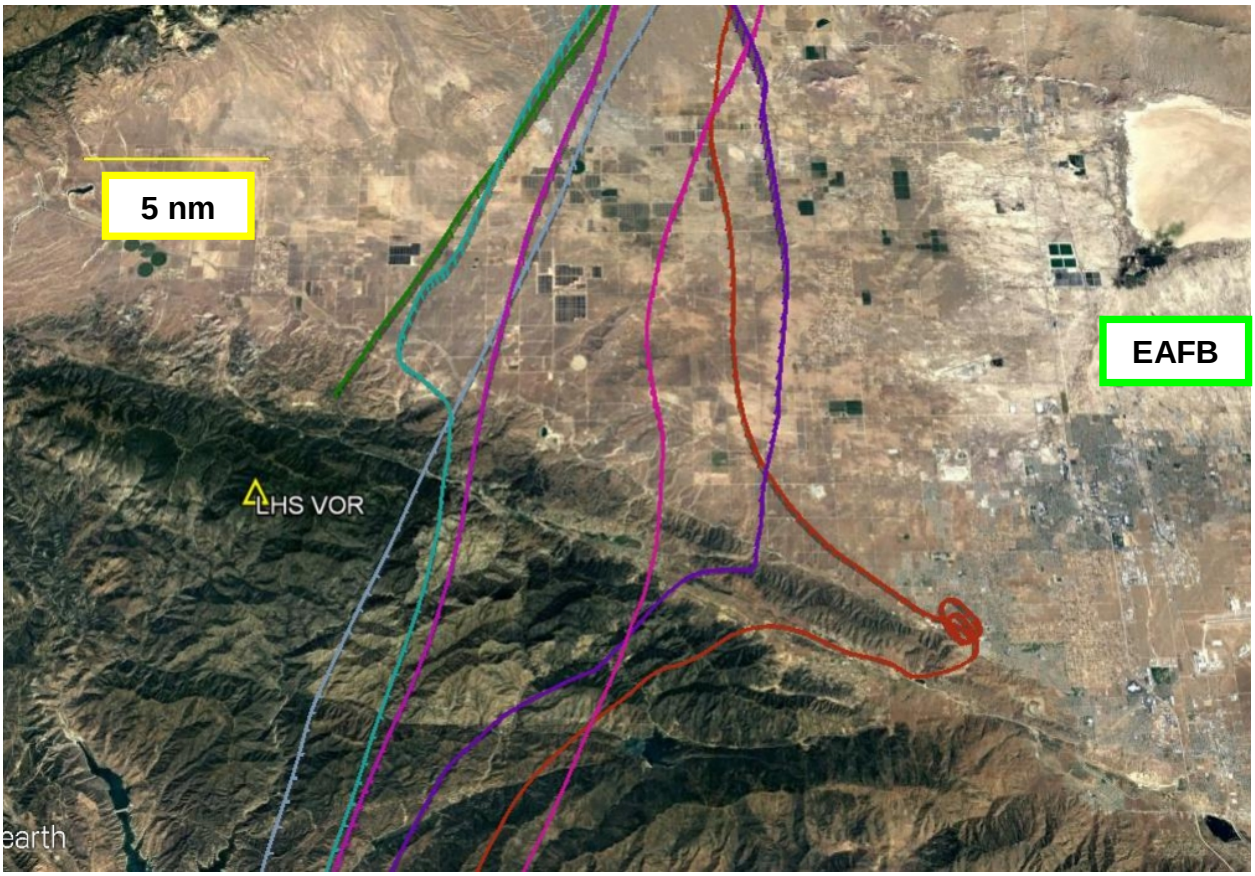

Figure 17 - TOA to TSP legs

The 15 non-stop flights (including the accident flight) were evaluated in terms of where the pilot crossed the mountain range relative to the LHS VOR, and his minimum terrain clearance for those crossings. The 14 non-accident flights all crossed east of the LHS VOR, and with the exception of the accident flight, cleared the underlying terrain by at least 1,000 feet. These data were compiled and plotted in an effort to detect any patterns, but again the data did not suggest any regular pilot habits or patterns regarding route or altitude selections.

Recorders Lab Trip #	IIC Trip #	Leg Direction	Offset from VOR (nm E)	Cruise Altitude (GPS ft)		Terrain Elevation (ft)	Crossing Altitude (ft)	Terrain Clearance (ft)
1	2	TSP - TOA	3.2	6800		4600	6700	2100
3	4	TSP - TOA	4.2	5600		4600	5600	1000
6	7	TSP - TOA	4.2	6300		4500	6300	1800
10	11	TSP - TOA	3.4	5700		4600	5700	1100
19	18	TSP - TOA	9.3	6400		4300	6500	2200
22	20	TSP - TOA	7.6	5900		3900	5900	2000
32	30	TSP - TOA	4.3	6500		4600	6600	2000
34	32	TSP - TOA	1.6	7000		5100	6900	1800
Accident	**Accident**	**TSP - TOA**	**0**	**5700**		**5790**	**5700**	**-90**
2	3	TOA - TSP	4.5	6200		4600	6200	1600
4	5	TOA - TSP	9.8	7200		3900	7100	3200
7	8	TOA - TSP	11.1	6000		4300	6000	1700
9	10	TOA - TSP	5	6000		4300	5700	1400
11	12	TOA - TSP	9.8	6200		4100	6200	2100
33	31	TOA - TSP	3.6	5700		4600	5600	1000

Figure 18 - Non-Stop Flights TSP/TOA

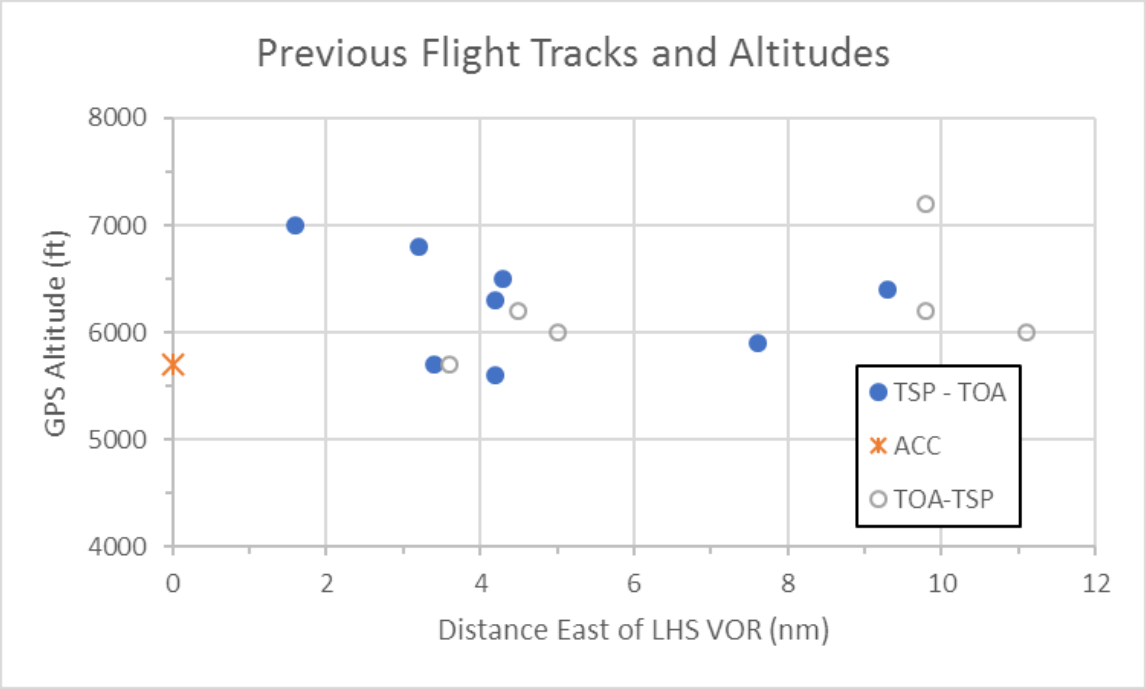

Figure 19 – Non-Stop TSP/TOA Flight Altitudes

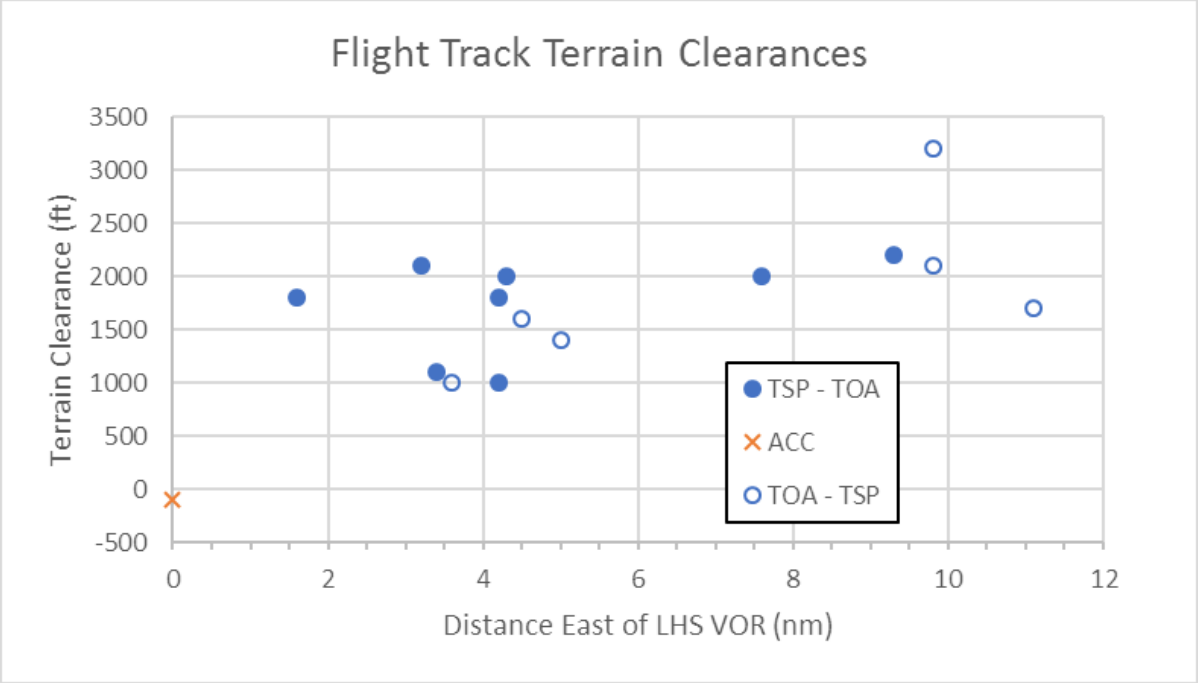

Figure 20 – Non-Stop TSP/TOA Terrain Clearances

D. ACCIDENT FLIGHT

The GPS data session from the accident flight began at 0845:31 PST on January 12, 2017, and the last session data point had a time tag of 0903:26. The session began with the airplane taxiing southeast on the parallel taxiway near the threshold of TSP runway 29. The airplane stopped near the approach end of runway 29 (likely for an engine run-up), and then began its takeoff roll from that runway at about 0848:50. About 0849:44, at an altitude of about 400 ft above ground level (agl), and about 0.4 nm beyond the runway 11 threshold, the airplane began an approximate 100° left turn to the southwest. About 50 seconds later, the airplane began a 90° left turn to the southeast (approximating the downwind leg of an airport traffic pattern), while continuing its climb. The airplane maintained that downwind leg track for about 4nm before beginning a slow arcing turn to the right (south). About 0854:20, when it was climbing through about 7,300 ft msl, the airplane began a 45° (heading) normal rate right turn to its final on-course heading of about 210° true, on which it remained until it struck the mountainside about 10 minutes later. As the airplane entered the 45° turn, it ceased climbing, and began a descent to about 6,500 ft msl, where it leveled off.

The 6,500 ft altitude was consistent with the FAA 'hemispheric rule' for VFR flight altitudes. However, after about 2 minutes of level flight, the airplane began a descent to about 5,750 feet, where it leveled off and remained for the rest of the recovered GPS dataset. The descent profile was smooth, with a rate of about 600 to700 feet per minute (fpm), consistent with a commanded, controlled descent. The 5,750 ft altitude was not consistent with the hemispheric rule for that segments of the flight. The reason(s) for the descent from 6,500 to 5,750 ft could not be determined, but it was possible the descent was to keep the airplane clear of clouds.

The GPS flight track ended 3.2 miles prior to the accident/impact location. This is likely due to the user-defined data capture settings, and the non-volatile memory buffering characteristics, of the GPS device. Straight-line extrapolation of the ground track leads directly to the impact site.

Figure 21 - Accident Flight GPS Altitude & Speed

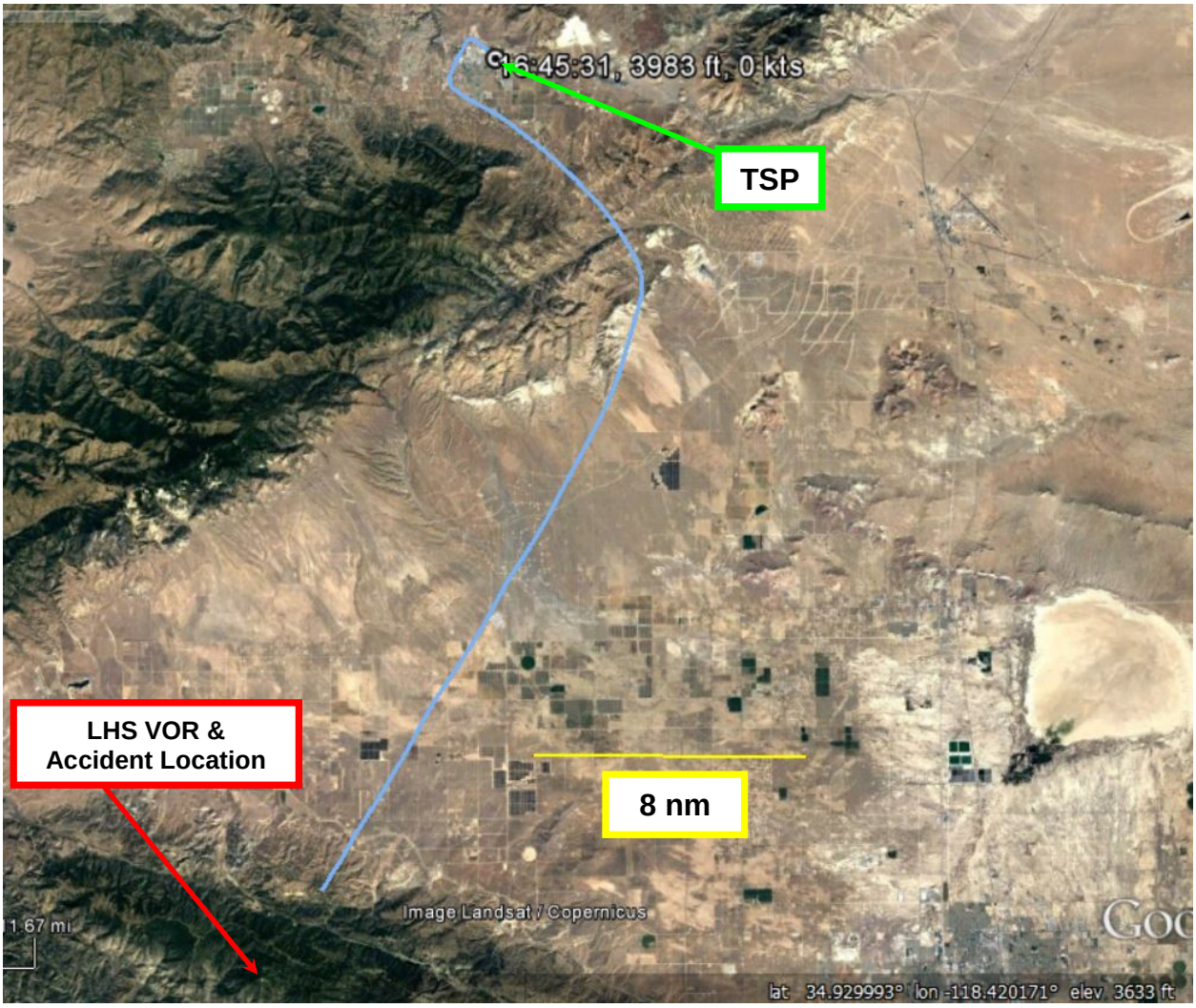

Figure 22 - Accident Flight GPS Ground Track

E. GPS vs ATC RADAR TRACK

The bulk of the accident flight was captured by FAA air traffic control (ATC) ground-based tracking radar, even though the flight was not being controlled by, or in communication with, ATC. The first ATC radar return from the airplane was at 0851:36, when the airplane was climbing through an altitude of 5,675 ft, on the downwind leg about 1.7 nm south of TSP. The GPS and ATC ground tracks and altitudes remain congruent (within the respective uncertainty ranges of the two datasets) for the entirety of time period that they have in common. The final ATC radar return was received at 0904:59, which is about 90 seconds later than the final GPS data point. At that time (0904:59), the airplane was still on the track that it had maintained for the previous 8 minutes, and which was directly towards the accident impact location.

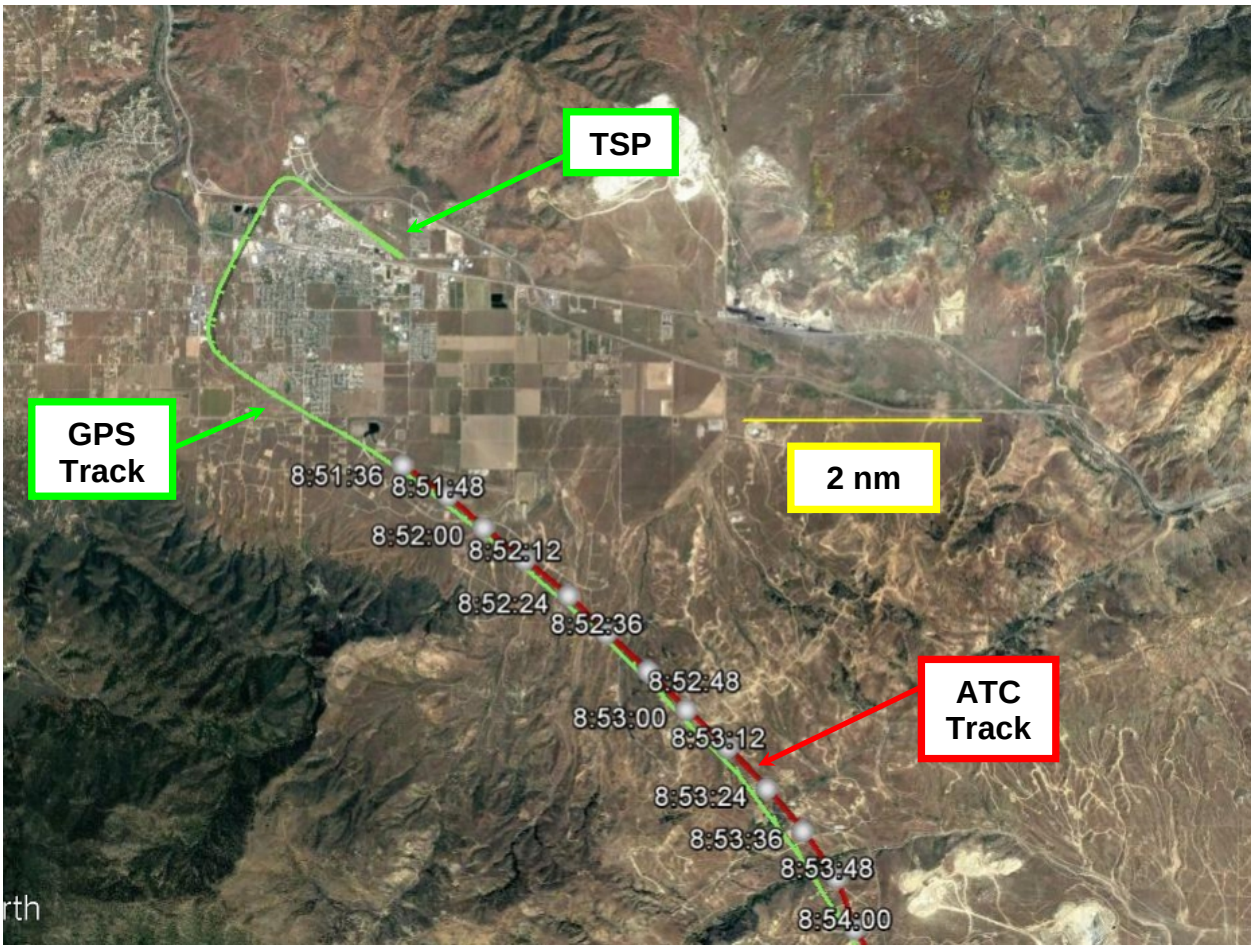

Figure 23 - GPS & ATC Tracks (Accident flight start)

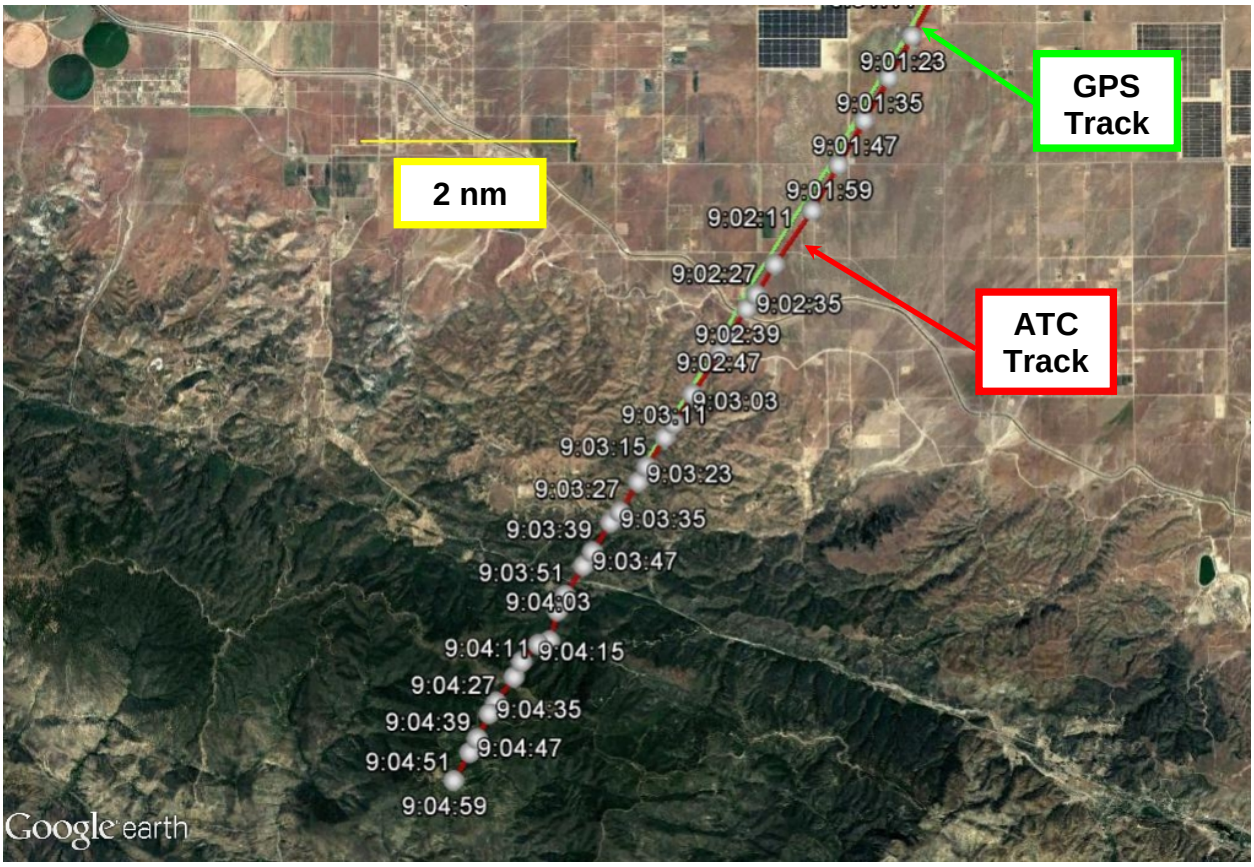

Figure 24 - GPS & ATC Tracks (Accident flight end)

The final ATC radar return indicates that the airplane was at an ATC-indicated altitude of 6,000 ft, and was within 700 feet laterally of the LHS VOR. The GPS and ATC altitude data differed slightly from one another, but these differences were within the expected uncertainty bands of the two separate systems, and were not significant with regard to any reason(s) for the accident.

The fact that the GPS and ATC flight tracks both depicted the airplane in steady state flight for at least 8 minutes, with both tracks extrapolating to the impact point, is completely consistent with a CFIT (controlled flight into terrain) accident. However, the underlying reason(s) for such a CFIT cannot be discerned from the GPS or ATC track data.

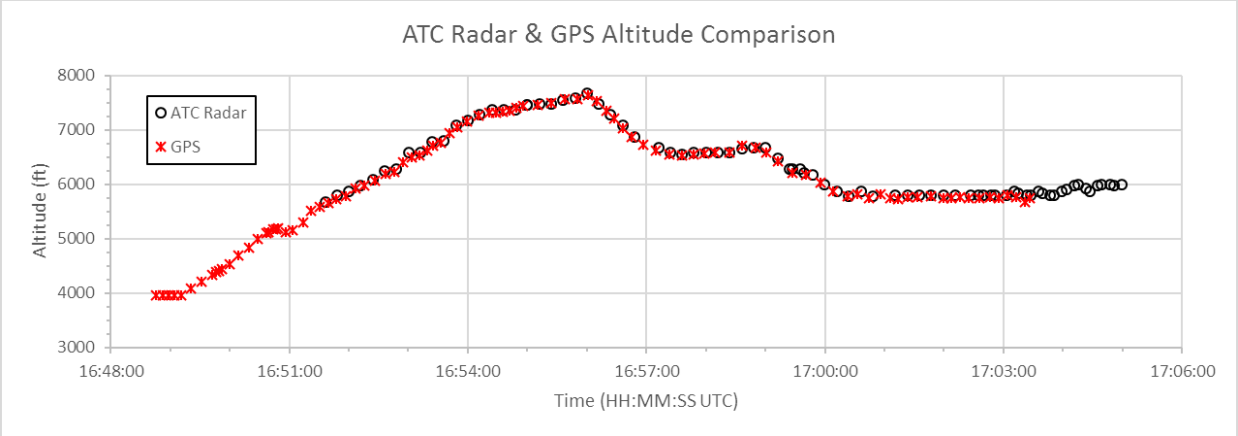

Figure 25 - GPS & ATC Track Altitudes (Entire flight)

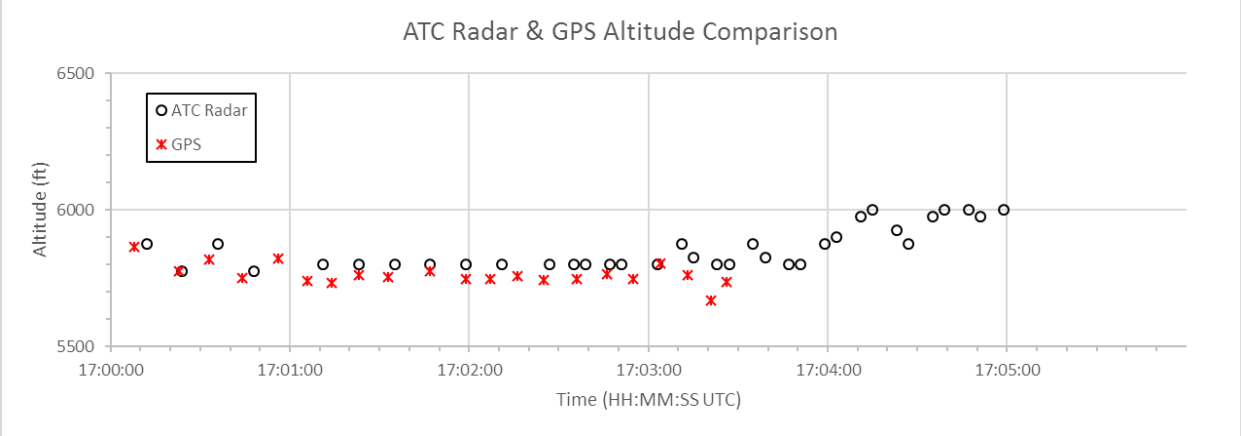

Figure 26 - GPS & ATC Track Altitudes (end of data)