



NATIONAL TRANSPORTATION SAFETY BOARD

**Office of Aviation Safety
Western Pacific Region**

GPS DATA STUDY

**NTSB Accident: WPR17FA041
Accident Date: December 26, 2016**

This document contains 3 embedded images (courtesy Google Earth)

A. ACCIDENT

Location: Fresno, California
Date: December 26, 2016
Aircraft: Petrus Express S90, N176PA, Serial # 80842
NTSB IIC: Michael Huhn

B. ACCIDENT SUMMARY

On December 26, 2016, about 1318 Pacific standard time, an experimental amateur-built Express S-90, N176PA, was destroyed when it departed controlled flight and impacted terrain shortly after takeoff from runway 30 at Sierra Sky Park Airport (E79, Fresno, California). The private pilot/owner and his passenger received fatal injuries. Visual meteorological conditions prevailed at the time of the accident.

C. HARDWARE & DOWNLOAD INFORMATION

A panel-mounted (via "Air-Gizmo") Garmin GPSMap 496, SN 19787454, was recovered from the wreckage and sent to the NTSB Recorders Laboratory in Washington DC for possible data download.

The NTSB Recorders Laboratory was able to successfully download data from the recovered GPS device. This process is documented separately in a report in the NTSB public docket for this accident.

The extracted data included 59 track logs (referred to as "sessions"), that were dated from August 2, 2016 through December 26, 2016. The sessions included 35 flights (some with interim landings), including the accident flight. Because the GPS device was a handheld/portable unit, the possibility existed that, excluding the accident flight, the flights could have represented activity in other aircraft, and/or with other than the accident pilot. Correlation of the GPS flights with the pilot's logbook indicated that all but two of the GPS-recorded flights appeared to have been conducted in the accident airplane.

D. DATA EVALUATION

The data from the 59 sessions was examined to determine the session duration, start and end locations and altitudes for each session, in order to ascertain whether the session represented an actual flight. This evaluation indicated that the data contained 35 flights, including the accident flight. These results were then correlated with the pilot's logbook to determine whether each of the GPS flights were conducted by the pilot in the accident airplane; these results indicated that all but two of the GPS flights were by the pilot in the accident airplane (Figs 1 & 2).

GPS Session	Flight #	Pilot Log AC	Logbook Airports	Start Date	Start Time		End Date	End Time		Flight Duration	Start Line	End Line	Total Lines
0	1	N176PA	FFZ-E79	8/2/2016	5:10:58	PM	8/2/2016	6:32:33	PM	1:21:35	0	11137	11137
1				8/5/2016	2:24:20	AM	8/5/2016	2:25:32	AM	0:01:12	11174	11248	74
2				8/5/2016	4:12:02	AM	8/5/2016	4:19:20	AM	0:07:18	11285	11396	111
3	2			8/7/2016	7:43:20	PM	8/7/2016	8:58:22	PM	1:15:02	11433	28638	17205
4	3			8/7/2016	9:12:27	PM	8/7/2016	9:42:39	PM	0:30:12	28675	35446	6771
5				8/8/2016	8:36:02	PM	8/8/2016	8:40:26	PM	0:04:24	35483	35557	74
6				8/9/2016	3:14:02	AM	8/9/2016	3:19:25	AM	0:05:23	35594	35705	111
7	4	N176PA	E79-FCH-E79	8/10/2016	7:16:02	PM	8/10/2016	9:10:05	PM	1:54:03	35742	62567	26825
8				8/12/2016	3:45:50	PM	8/12/2016	3:46:21	PM	0:00:31	62604	62678	74
9	5	N176PA	E79-MAE-E79	8/13/2016	2:15:32	PM	8/13/2016	3:10:51	PM	0:55:19	62715	74333	11618
10	6	N176PA	E79-PTV	8/14/2016	2:39:02	PM	8/14/2016	3:23:46	PM	0:44:44	74370	81622	7252
11	7	N176PA	PTV-E79	8/14/2016	4:26:45	PM	8/14/2016	5:10:56	PM	0:44:11	81659	89947	8288
12				8/18/2016	4:11:32	PM	8/18/2016	4:15:29	PM	0:03:57	89984	90058	74
13	8	N176PA	E79 - MAE	8/19/2016	2:59:20	PM	8/19/2016	3:45:05	PM	0:45:45	90095	99826	9731
14	9	N176PA	MAE- E79	8/19/2016	4:24:45	PM	8/19/2016	4:45:02	PM	0:20:17	99863	103859	3996
15				8/22/2016	7:03:32	PM	8/22/2016	7:27:43	PM	0:24:11	103896	104673	777
16	10	N176PA	E79-PTV-E79?	8/23/2016	4:37:02	PM	8/23/2016	5:41:19	PM	1:04:17	104710	118400	13690
17				8/26/2016	4:26:32	PM	8/26/2016	4:41:45	PM	0:15:13	118437	118881	444
18	11	no		8/27/2016	3:23:32	PM	8/27/2016	4:05:21	PM	0:41:49	118918	126688	7770
19	12	no		8/27/2016	5:36:09	PM	8/27/2016	6:18:58	PM	0:42:49	126725	133237	6512
20				8/28/2016	6:27:50	PM	8/28/2016	7:24:54	PM	0:57:04	133274	134754	1480
21				8/30/2016	12:24:03	AM	8/30/2016	12:45:46	AM	0:21:43	134791	135642	851
22				8/30/2016	1:02:22	AM	8/30/2016	1:03:00	AM	0:00:38	135679	135716	37
23				9/5/2016	2:45:15	AM	9/5/2016	2:48:51	AM	0:03:36	135753	135901	148
24				9/5/2016	4:38:21	AM	9/5/2016	4:53:51	AM	0:15:30	135938	136419	481
25	13	N176PA	E79-MAE-E79	9/5/2016	5:32:02	PM	9/5/2016	6:25:16	PM	0:53:14	136456	147445	10989
26	14	N176PA	E79-MAE-FCH-E79	9/8/2016	2:33:50	PM	9/8/2016	2:51:42	PM	0:17:52	147482	150109	2627
27				9/8/2016	5:04:51	PM	9/8/2016	5:05:50	PM	0:00:59	150146	150183	37
28	15	N176PA	E79-MAE-FCH-E79	9/8/2016	6:56:03	PM	9/8/2016	7:38:48	PM	0:42:45	150220	157879	7659
29				9/10/2016	4:09:02	AM	9/10/2016	4:14:21	AM	0:05:19	157916	158064	148
30	16	N176PA	E79-RNO	9/10/2016	1:36:50	PM	9/10/2016	2:58:03	PM	1:21:13	158101	170718	12617
31	17	N176PA	RNO-E79	9/10/2016	6:01:32	PM	9/10/2016	7:33:24	PM	1:31:52	170755	184371	13616
32				9/11/2016	11:46:20	PM	9/11/2016	11:46:20	PM	0:00:00	184408	184408	0
33	18	N176PA	E79-MAE-E79	9/12/2016	3:29:20	PM	9/12/2016	4:48:24	PM	1:19:04	184445	201650	17205
34	19	N176PA	E79-MAE	9/15/2016	4:40:02	PM	9/15/2016	5:20:26	PM	0:40:24	201687	212158	10471
35	20	N176PA	MAE-E79	9/15/2016	5:38:39	PM	9/15/2016	6:05:42	PM	0:27:03	212195	216265	4070
36	21	N176PA	E79-SNS	9/24/2016	2:03:32	PM	9/24/2016	3:03:16	PM	0:59:44	216302	223554	7252
37	22	N176PA	SNS-E79	9/24/2016	11:36:02	PM	9/25/2016	12:29:44	AM	0:53:42	223591	232064	8473
38				9/27/2016	8:39:32	PM	9/27/2016	8:41:03	PM	0:01:31	232101	232138	37
39				10/1/2016	9:48:02	PM	10/1/2016	9:51:43	PM	0:03:41	232175	232360	185
40				10/3/2016	1:38:02	AM	10/3/2016	1:41:51	AM	0:03:49	232397	232582	185

Figure 1 - Session & Flight Roster (1 of 2)

GPS Session	Flight #	Pilot Log AC	Logbook Airports	Start Date	Start Time		End Date	End Time		Flight Duration	Start Line	End Line	Total Lines
41				10/6/2016	2:50:32	AM	10/6/2016	2:52:44	AM	0:02:12	232619	232656	37
42	23	N176PA	E79-FCH-E79	10/13/2016	6:22:03	PM	10/13/2016	7:23:43	PM	1:01:40	232693	247234	14541
43				10/16/2016	11:56:50	PM	10/17/2016	12:00:47	AM	0:03:57	247271	247382	111
44				10/18/2016	5:56:32	PM	10/18/2016	6:04:33	PM	0:08:01	247419	247715	296
45				10/18/2016	8:10:34	PM	10/18/2016	8:16:17	PM	0:05:43	247752	247900	148
46	24	N176PA	E79-O42?	10/23/2016	6:19:32	PM	10/23/2016	6:55:34	PM	0:36:02	247937	254079	6142
47	25	N176PA	O42-E79?	10/23/2016	7:56:52	PM	10/23/2016	8:25:31	PM	0:28:39	254116	260110	5994
48				10/29/2016	9:08:56	PM	10/29/2016	9:12:56	PM	0:04:00	260147	260332	185
49	26	N176PA	E79-O42	11/5/2016	7:12:32	PM	11/5/2016	7:43:34	PM	0:31:02	260369	265956	5587
50	27	N176PA	O42-E79	11/5/2016	8:36:50	PM	11/5/2016	9:05:21	PM	0:28:31	265993	270766	4773
51	28	N176PA	E79-MAE	11/8/2016	8:00:33	PM	11/8/2016	8:19:15	PM	0:18:42	270803	275021	4218
52	29	N176PA	MAE-E79	11/8/2016	8:31:45	PM	11/8/2016	8:51:28	PM	0:19:43	275058	278573	3515
53	30	N176PA	E79	11/12/2016	7:27:28	PM	11/12/2016	8:56:16	PM	1:28:48	278610	293743	15133
54	31	N176PA	E79-MAE	11/25/2016	8:55:32	PM	11/25/2016	9:17:21	PM	0:21:49	293780	298627	4847
55	32	N176PA	MAE-E79	11/25/2016	9:35:39	PM	11/25/2016	9:53:27	PM	0:17:48	298664	302327	3663
56				12/3/2016	4:14:16	AM	12/3/2016	4:19:52	AM	0:05:36	302364	302438	74
57	33	N176PA	E79	12/13/2016	9:46:32	PM	12/13/2016	10:18:36	PM	0:32:04	302475	309320	6845
58	34	N176PA	E79-MAE-E79	12/21/2016	10:25:01	PM	12/21/2016	11:20:39	PM	0:55:38	309357	323602	14245
59	35	N176PA	ACCIDENT	12/26/2016	9:10:55	PM	12/26/2016	9:17:48	PM	0:06:53	323639	324638	999

Figure 2 - Session & Flight Roster (2 of 2)

E. ACCIDENT FLIGHT

The data for the accident flight began at 1310:55 PST, and ended at 1317:48 PST on December 26, 2016. Due to data buffering on the GPS unit, the recorded data ended before the accident impact.

The data file contained a total of 29 discrete points (Fig 3). Each data 'point' consisted of the following parameters:

- Date
- Time (PST)
- GPS Altitude (ft)
- GPS-derived Groundspeed (kts)
- GPS-derived Track Heading (degrees true)
- Latitude
- Longitude

The data indicated that the takeoff roll began about 1317:10, and that the airplane was airborne by about 1317:33. The GPS recorded a total of 5 in-flight data points. The maximum recorded GPS altitude was 631 feet (Figs 4 & 5). The last recorded parameter was for time 1317:48. That final data point altitude was 434 feet, which was approximately 200 feet above the impact elevation.

Point-to-point rate of climb (ROC) calculations indicated that the airplane initially achieved a maximum ROC of 3,075 fpm. The airplane then arced over into a descent, reaching a maximum calculated descent rate of 1,924 fpm.

The GPS data was converted to a kml file in order to view it in Google Earth. Portions of the accident flight taxi-out and takeoff roll had GPS altitudes a few feet below the Google Earth elevations for the same locations; these GPS altitudes were adjusted to a fixed value of 327 feet in order to render the path visible in Google Earth.

The GPS derived ground track (Figs 6 - 8) indicated that the airplane began translating right of the runway centerline when it was about 2/3 of the way down the runway. The flight path became perpendicular to the runway alignment before the airplane reached the end of the runway, and continued to arc to the airplane right. The final GPS data point indicated that the airplane was positioned about 250 feet, on a true bearing of about 240°, from the impact location.

Time PST	Alt ft GPS	GPS GS kts	GPS Track- True	Latitude	Longitude		ROC fpm		Speed Del from vert kts	Still air speed
13:10:55	325	0.1	180	36.84177	-119.867					
13:10:55	327	0	0	36.8419	-119.867		#DIV/0!			
13:11:13	327	0.3	252.6	36.8419	-119.867		0.0		0.0	0.3
13:11:30	327	3.9	263	36.84186	-119.868		0.0		0.0	3.9
13:11:47	327	8.4	261.7	36.84176	-119.869		0.0		0.0	8.4
13:12:10	327	11.8	271.6	36.8418	-119.87		0.0		0.0	11.8
13:12:15	327	13.8	262	36.84176	-119.87		0.0		0.0	13.8
13:12:20	327	11.5	235.5	36.8416	-119.871		0.0		0.0	11.5
13:12:39	327	7.8	219.4	36.84107	-119.871		0.0		0.0	7.8
13:12:40	327	5.7	204.2	36.84105	-119.871		0.0		0.0	5.7
13:12:44	327	6.1	144.6	36.84095	-119.871		0.0		0.0	6.1
13:13:03	327	8.2	132.2	36.84047	-119.871		0.0		0.0	8.2
13:13:24	327	12.5	132.3	36.83965	-119.869		0.0		0.0	12.5
13:13:41	327	13.7	132.2	36.83893	-119.868		0.0		0.0	13.7
13:14:05	327	12.1	132.1	36.83803	-119.867		0.0		0.0	12.1
13:14:22	327	7.8	139.9	36.83756	-119.867		0.0		0.0	7.8
13:14:33	327	2.4	126.1	36.83749	-119.867		0.0		0.0	2.4
13:16:35	327	0	141.7	36.83748	-119.867		0.0		0.0	0.0
13:16:40	327	1.1	58	36.83749	-119.867		0.0		0.0	1.1
13:16:59	327	3.9	91.2	36.83749	-119.866		0.0		0.0	3.9
13:17:10	327	4.7	55.2	36.83762	-119.866		0.0		0.0	4.7
13:17:17	327	10.7	313.6	36.83786	-119.866		0.0		0.0	10.7
13:17:22	327	36.1	311.8	36.83842	-119.867		0.0		0.0	36.1
13:17:27	327	57.6	311.7	36.83931	-119.868		0.0		0.0	57.6
13:17:33	353.6	74.1	312.4	36.84069	-119.87		266.0		2.6	76.7
13:17:37	558.6	59.4	319	36.84152	-119.871		3075.0		30.4	89.8
13:17:41	631.2	47.5	325.1	36.84224	-119.872		1089.0		10.8	58.3
13:17:45	530.2	60.4	347.6	36.84334	-119.872		-1515.0		-15.0	75.4
13:17:48	434	66.4	38.9	36.84405	-119.871		-1924.0		-19.0	85.4

Figure 3 - Accident Flight Data Tab

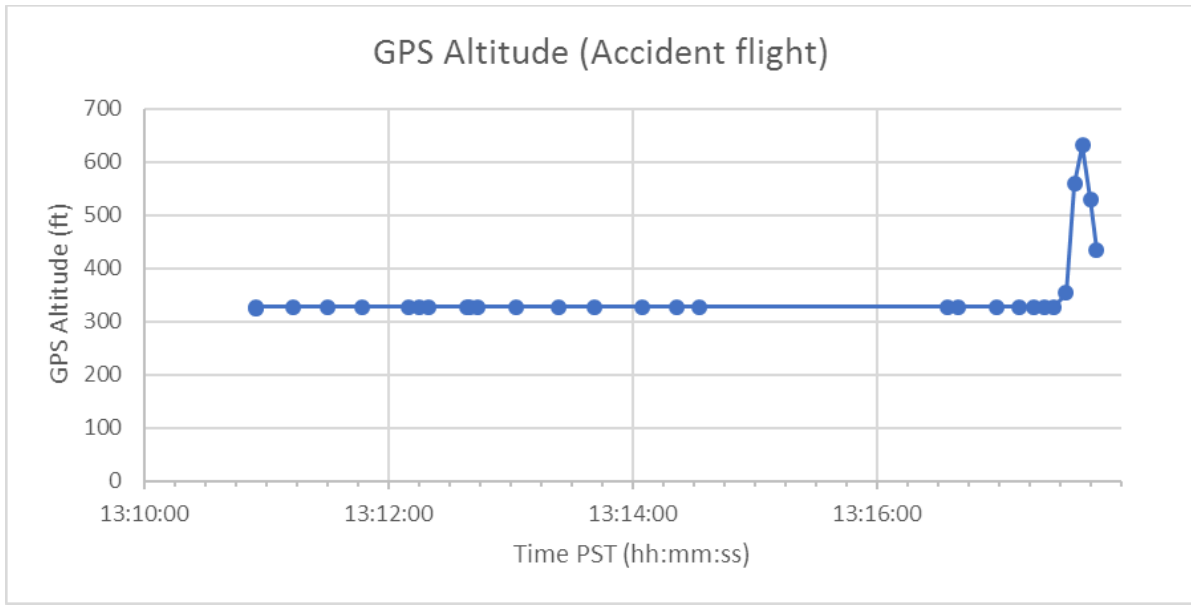


Figure 4 - Accident Flight Altitude Time History

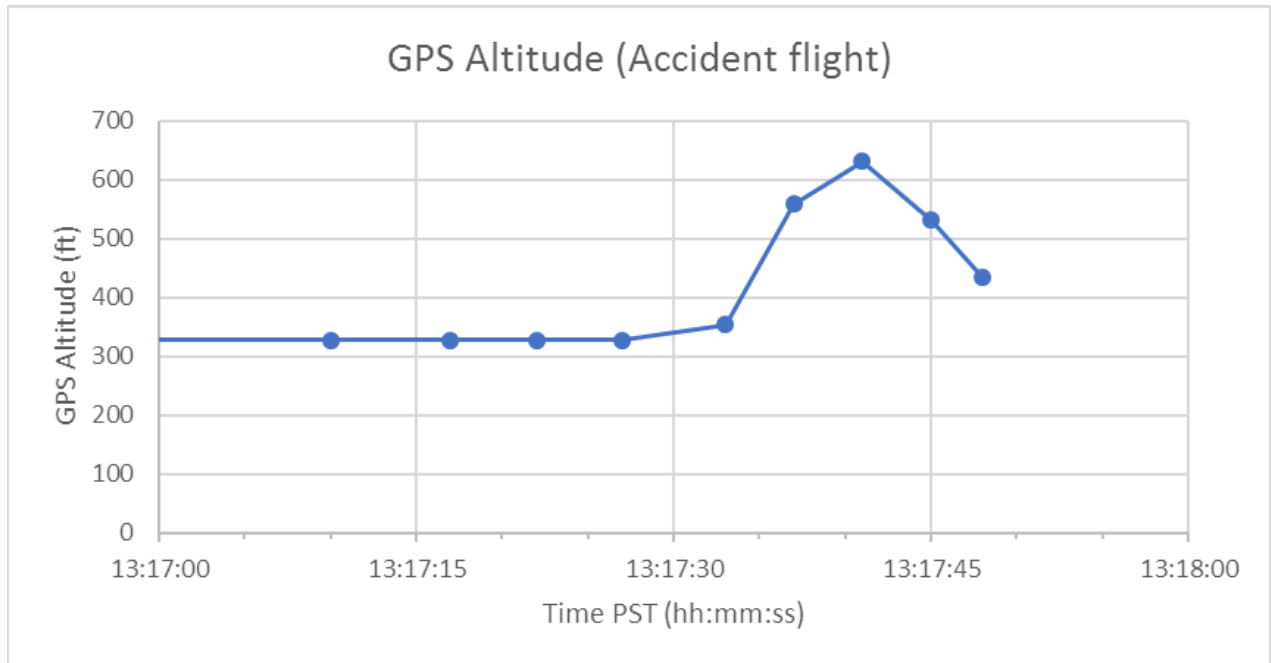


Figure 5 - Accident Flight Altitude Time History



Figure 6 - Overhead View of Flight Path



Figure 7 - Oblique View of Entire Flight Path



Figure 8 - Oblique View of Flight Path

F. TAKEOFF COMPARISONS

Most witnesses, some of whom were pilots, reported that the airplane climbed unusually rapidly and steeply. In an effort to explore this possibility, the accident takeoff was plotted (as altitude vs time from beginning of takeoff roll) against seven other takeoffs from E79 (Figs 9 – 20). Although variables that would affect takeoff performance (such as flap setting, weight, ambient temperature, and wind) for the takeoff could not be known or accounted for, the accident takeoff profile was markedly different from the other seven takeoffs. For the accident flight, the airplane remained on or near the ground for about 52 seconds, and then began a very steep climb. In contrast, five of the previous takeoffs indicated that the airplane was airborne in less than 30 seconds, with consistent, yet much lower, climb rates. The other two takeoffs indicated that the airplane began its climbout at about 40 seconds, and climbed at a rate between those of the other five flights and the accident flight.

Chronologically, three of the five 'flatter' takeoffs were on flights 4, 5, & 6, which took place in August, about 4 months prior to the accident flight. The other two of those five 'flatter' takeoffs were for flights 30 and 34A, which took place in early November and December, respectively. The two 'intermediate' takeoffs were on flights 33 and 34B, which both took place in December. Although not definitive, this pattern is consistent with the pilot's increased familiarity with the airplane, and his resulting increased aggressiveness in some of the latter takeoff profiles.

Session	Flight	Date	Time UTC hh:mm:ss	Time from Start of T/O	Latitude Deg	Longitude Deg	GPS Alt ft	Delta H ft	Ground Speed kts	Track Deg T
3	2	8/7/2016	19:43:20		36.8419	-119.8673	432		0	0
3	2	8/7/2016	19:44:07		36.84187	-119.8673	357		0	201.4
3	2	8/7/2016	19:44:21		36.84186	-119.8678	343		6	267.8
3	2	8/7/2016	19:44:39		36.84177	-119.8688	328		10	264.1
3	2	8/7/2016	19:45:02		36.84178	-119.87	319		9	270.4
3	2	8/7/2016	19:45:18		36.84175	-119.8705	314		5	265.2
3	2	8/7/2016	19:45:22		36.84172	-119.8706	313		2	233.9
3	2	8/7/2016	19:45:34		36.84155	-119.8708	316		5	226.3
3	2	8/7/2016	19:45:48		36.8413	-119.8711	316		5	222.4
3	2	8/7/2016	19:46:04		36.84103	-119.8713	313		5	215.1
3	2	8/7/2016	19:46:18		36.84082	-119.8711	311		4	136.6
3	2	8/7/2016	19:46:41		36.84029	-119.8703	313		7	131.5
3	2	8/7/2016	19:47:06		36.83972	-119.8695	313		7	132.1
3	2	8/7/2016	19:47:25		36.83917	-119.8688	313		9	131.6
3	2	8/7/2016	19:47:48		36.83856	-119.8679	313		8	132.3
3	2	8/7/2016	19:48:13		36.83781	-119.8669	314		10	131.9
3	2	8/7/2016	19:48:29		36.83753	-119.8667	314		5	145.2
3	2	8/7/2016	19:48:41		36.83752	-119.8666	313		1	103.2
3	2	8/7/2016	19:52:27		36.83753	-119.8666	313		0	72.7
3	2	8/7/2016	19:52:48		36.83748	-119.8661	313		4	98.1
3	2	8/7/2016	19:53:01		36.8376	-119.8658	313		4	60.7
3	2	8/7/2016	19:53:12		36.83762	-119.8659	314	0	1	313
3	2	8/7/2016	19:53:18	0:00:06	36.83793	-119.8663	314	0	17	311.3
3	2	8/7/2016	19:53:23	0:00:11	36.83861	-119.8673	314	0	44	312.2
3	2	8/7/2016	19:53:28	0:00:16	36.83963	-119.8687	316	2	66	311.8
3	2	8/7/2016	19:53:32	0:00:20	36.84062	-119.87	349	35	80	312.3
3	2	8/7/2016	19:53:36	0:00:24	36.84172	-119.8714	406	92	84	314.7
3	2	8/7/2016	19:53:45	0:00:33	36.84444	-119.8742	609	295	85	320.4
3	2	8/7/2016	19:53:51	0:00:39	36.84657	-119.8757	740	426	87	331.5
3	2	8/7/2016	19:54:04	0:00:52	36.85152	-119.8782	1006	692	89	338.2
3	2	8/7/2016	19:54:16	0:01:04	36.85622	-119.8807	1208	894	92	336.4
3	2	8/7/2016	19:54:29	0:01:17	36.8615	-119.8835	1461	1147	95	337.2
3	2	8/7/2016	19:54:36	0:01:24	36.86472	-119.8852	1491	1177	107	337.5
3	2	8/7/2016	19:54:44	0:01:32	36.86888	-119.8872	1549	1235	121	338.5
3	2	8/7/2016	19:54:49	0:01:37	36.87144	-119.889	1588	1274	127	330.5
3	2	8/7/2016	19:54:50	0:01:38	36.87189	-119.8895	1593	1279	130	319.1
3	2	8/7/2016	19:54:54	0:01:42	36.87331	-119.892	1626	1312	130	305.9
3	2	8/7/2016	19:54:58	0:01:46	36.87404	-119.895	1677	1363	135	287
3	2	8/7/2016	19:55:05	0:01:53	36.87443	-119.9006	1724	1410	140	274.9
3	2	8/7/2016	19:55:14	0:02:02	36.87469	-119.9083	1722	1408	148	272.4
3	2	8/7/2016	19:55:27	0:02:15	36.87497	-119.9197	1834	1520	152	271.7
3	2	8/7/2016	19:55:38	0:02:26	36.87533	-119.9291	1938	1624	148	272.8
3	2	8/7/2016	19:55:54	0:02:42	36.87628	-119.9424	2066	1752	144	275.1
3	2	8/7/2016	19:56:02	0:02:50	36.87679	-119.9488	2277	1963	138	275.8
3	2	8/7/2016	19:56:10	0:02:58	36.87724	-119.9545	2512	2198	123	275.7
3	2	8/7/2016	19:56:23		36.87806	-119.9633	2691		118	276.6
4	3	8/7/2016	21:12:27		36.99026	-120.111	303		0	0

Figure 9 - Data Tab (1 of 11)

Session	Flight	Date	Time UTC hh:mm:ss	Time from Start of T/O	Latitude Deg	Longitude Deg	GPS Alt ft	Delta H ft	Ground Speed kts	Track Deg T
4	3	8/7/2016	21:14:10		36.99022	-120.111	238		0	180
4	3	8/7/2016	21:14:15		36.99016	-120.111	238		3	170
4	3	8/7/2016	21:14:30		36.98991	-120.1112	235		4	210.3
4	3	8/7/2016	21:14:44		36.98965	-120.1113	237		4	196
4	3	8/7/2016	21:15:12		36.98964	-120.1113	237		0	122.1
4	3	8/7/2016	21:16:05		36.98948	-120.1111	240		1	141.4
4	3	8/7/2016	21:16:20		36.98905	-120.1106	238		8	136.8
4	3	8/7/2016	21:16:36		36.98828	-120.1096	238		15	134.6
4	3	8/7/2016	21:16:52		36.98721	-120.1083	240		20	136
4	3	8/7/2016	21:17:09		36.98591	-120.1067	242		23	135
4	3	8/7/2016	21:17:25		36.98472	-120.1052	243		23	135.2
4	3	8/7/2016	21:17:32		36.98431	-120.1048	243		16	140.7
4	3	8/7/2016	21:17:40		36.98392	-120.1046	242		11	162.6
4	3	8/7/2016	21:17:48		36.98378	-120.1048	243		5	217.3
4	3	8/7/2016	21:18:19		36.98378	-120.1048	245		0	287.3
4	3	8/7/2016	21:20:18		36.98379	-120.1051	246	0	0	270.9
4	3	8/7/2016	21:20:32	0:00:14	36.98352	-120.1055	246	0	7	231.8
4	3	8/7/2016	21:20:34	0:00:16	36.98345	-120.1056	246	0	11	226.8
4	3	8/7/2016	21:20:43	0:00:25	36.98351	-120.1062	245	-1	11	276.8
4	3	8/7/2016	21:20:45	0:00:27	36.9836	-120.1063	245	-1	14	316.6
4	3	8/7/2016	21:20:54	0:00:36	36.98423	-120.1071	243	-3	22	314.8
4	3	8/7/2016	21:20:59	0:00:41	36.98502	-120.1081	243	-3	49	314.2
4	3	8/7/2016	21:21:04	0:00:46	36.98613	-120.1095	243	-3	68	314.9
4	3	8/7/2016	21:21:11	0:00:53	36.98799	-120.1119	298	52	84	313.3
4	3	8/7/2016	21:21:21	0:01:03	36.99085	-120.1153	544	298	85	316.5
4	3	8/7/2016	21:21:32	0:01:14	36.99401	-120.1187	803	557	82	319.5
4	3	8/7/2016	21:21:39	0:01:21	36.99605	-120.1213	838	592	89	315.1
4	3	8/7/2016	21:21:44	0:01:26	36.99738	-120.1235	902	656	95	307.2
4	3	8/7/2016	21:21:48	0:01:30	36.99798	-120.1256	954	708	98	289.6
4	3	8/7/2016	21:21:49	0:01:31	36.99805	-120.1262	969	723	102	277.9
4	3	8/7/2016	21:21:54	0:01:36	36.99775	-120.1291	1055	809	102	262.8
4	3	8/7/2016	21:21:58	0:01:40	36.99675	-120.1312	1142	896	104	238.5
4	3	8/7/2016	21:22:01	0:01:43	36.99554	-120.1323	1193	947	108	217
4	3	8/7/2016	21:22:05	0:01:47	36.99354	-120.1331	1246	1000	114	197.8
4	3	8/7/2016	21:22:08	0:01:50	36.99187	-120.1332	1290	1044	120	181.9
4	3	8/7/2016	21:22:19	0:02:01	36.9855	-120.1323	1443	1197	126	173.6
4	3	8/7/2016	21:22:32	0:02:14	36.97799	-120.1314	1748	1502	126	174.4
4	3	8/7/2016	21:22:47	0:02:29	36.96975	-120.1301	1957	1711	120	172.9
4	3	8/7/2016	21:22:55	0:02:37	36.96515	-120.1291	1956	1710	126	170.3
4	3	8/7/2016	21:23:03	0:02:45	36.96019	-120.1284	1967	1721	135	173.3
4	3	8/7/2016	21:23:11	0:02:53	36.95492	-120.1279	1949	1703	143	176.1
4	3	8/7/2016	21:23:21	0:03:03	36.94795	-120.1276	1894	1648	151	177.8
4	3	8/7/2016	21:23:30	0:03:12	36.94149	-120.1274	1825	1579	155	178.8
4	3	8/7/2016	21:23:42	0:03:24	36.93266	-120.127	1754	1508	159	177.7
4	3	8/7/2016	21:23:46	0:03:28	36.9297	-120.1269	1744	1498	160	178.9
4	3	8/7/2016	21:23:50	0:03:32	36.92675	-120.1266	1754	1508	160	176
4	3	8/7/2016	21:23:55	0:03:37	36.9231	-120.1264	1793	1547	157	177.4
4	3	8/7/2016	21:24:00	0:03:42	36.9195	-120.1259	1781	1535	157	173.1
4	3	8/7/2016	21:24:06	0:03:48	36.91517	-120.1251	1793	1547	158	171.7

Figure 10 - Data Tab (2 of 11)

Session	Flight	Date	Time UTC hh:mm:ss	Time from Start of T/O	Latitude Deg	Longitude Deg	GPS Alt ft	Delta H ft	Ground Speed kts	Track Deg T
4	3	8/7/2016	21:24:13	0:03:55	36.91013	-120.1248	1790	1544	156	177.6
4	3	8/7/2016	21:24:19	0:04:01	36.90578	-120.1249	1770	1524	157	180.6
4	3	8/7/2016	21:24:24		36.90216	-120.1251	1754		156	182.1
4	3	8/7/2016	21:24:30		36.89776	-120.1249	1711		158	178.7
4	3	8/7/2016	21:24:35		36.89409	-120.1242	1678		161	170.2
4	3	8/7/2016	21:24:42		36.88891	-120.1234	1648		161	173
4	3	8/7/2016	21:24:49		36.88371	-120.1233	1650		161	179.2
4	3	8/7/2016	21:24:55		36.87933	-120.1227	1658		159	174.3
7	4	8/10/2016	19:16:02		36.84187	-119.8673	388		0	0
7	4	8/10/2016	19:18:10		36.84189	-119.8673	317		0	46.9
7	4	8/10/2016	19:18:28		36.84189	-119.8674	316		1	267.8
7	4	8/10/2016	19:18:47		36.84185	-119.8677	317		3	262.1
7	4	8/10/2016	19:19:04		36.84177	-119.8684	313		7	262.3
7	4	8/10/2016	19:19:24		36.84179	-119.8696	311		10	270.6
7	4	8/10/2016	19:19:39		36.84177	-119.8704	308		9	268.7
7	4	8/10/2016	19:19:52		36.84163	-119.8707	309		5	238.6
7	4	8/10/2016	19:20:08		36.84138	-119.871	313		5	223.4
7	4	8/10/2016	19:20:22		36.841	-119.8713	311		7	209.8
7	4	8/10/2016	19:20:43		36.84073	-119.8709	311		4	134.3
7	4	8/10/2016	19:21:13		36.84025	-119.8703	311		5	131.6
7	4	8/10/2016	19:21:49		36.83952	-119.8692	309		7	131.8
7	4	8/10/2016	19:22:23		36.83874	-119.8682	313		7	131.9
7	4	8/10/2016	19:22:54		36.83793	-119.867	311		8	132.1
7	4	8/10/2016	19:23:09		36.83761	-119.8667	309		6	140.7
7	4	8/10/2016	19:23:23		36.83752	-119.8666	309		2	133.1
7	4	8/10/2016	19:26:31		36.83752	-119.8666	306		0	7.1
7	4	8/10/2016	19:26:51		36.8375	-119.8662	308	0	3	94.8
7	4	8/10/2016	19:27:06	0:00:15	36.83762	-119.8659	309	1	4	67.8
7	4	8/10/2016	19:27:16	0:00:25	36.83782	-119.8662	311	3	7	311.7
7	4	8/10/2016	19:27:21	0:00:30	36.83828	-119.8668	311	3	30	312.1
7	4	8/10/2016	19:27:26	0:00:35	36.83908	-119.8679	313	5	52	311.6
7	4	8/10/2016	19:27:31	0:00:40	36.8402	-119.8695	314	6	72	312.2
7	4	8/10/2016	19:27:38	0:00:47	36.84206	-119.872	412	104	85	312.1
7	4	8/10/2016	19:27:47	0:00:56	36.84482	-119.8748	628	320	85	321.1
7	4	8/10/2016	19:27:54	0:01:03	36.84721	-119.8766	779	471	86	329.5
7	4	8/10/2016	19:28:05	0:01:14	36.85139	-119.8788	953	645	89	337.2
7	4	8/10/2016	19:28:15	0:01:24	36.85517	-119.8814	1142	834	94	330.8
7	4	8/10/2016	19:28:26	0:01:35	36.85934	-119.8849	1366	1058	99	326
7	4	8/10/2016	19:28:36	0:01:45	36.863	-119.8888	1562	1254	103	320.1
7	4	8/10/2016	19:28:44	0:01:53	36.86604	-119.8923	1582	1274	112	317.1
7	4	8/10/2016	19:28:52	0:02:01	36.86943	-119.8962	1642	1334	125	316.9
7	4	8/10/2016	19:29:01	0:02:10	36.87355	-119.9008	1726	1418	132	318.8
7	4	8/10/2016	19:29:13	0:02:22	36.87908	-119.9069	1825	1517	133	318.4
7	4	8/10/2016	19:29:18	0:02:27	36.88107	-119.9099	1871	1563	134	309.7
7	4	8/10/2016	19:29:24	0:02:33	36.88304	-119.9138	1927	1619	133	302.2
7	4	8/10/2016	19:29:30	0:02:39	36.88456	-119.918	1994	1686	133	294.3
7	4	8/10/2016	19:29:35	0:02:44	36.88531	-119.9217	2060	1752	130	284.5
7	4	8/10/2016	19:29:39	0:02:48	36.8854	-119.9246	2121	1813	128	272.1

Figure 11 - Data Tab (3 of 11)

Session	Flight	Date	Time UTC hh:mm:ss	Time from Start of T/O	Latitude Deg	Longitude Deg	GPS Alt ft	Delta H ft	Ground Speed kts	Track Deg T
7	4	8/10/2016	19:29:44	0:02:53	36.88493	-119.9282	2181	1873	126	260.8
7	4	8/10/2016	19:29:49	0:02:58	36.88394	-119.9317	2202	1894	128	250.4
7	4	8/10/2016	19:29:56		36.88198	-119.9365	2189		133	242.9
7	4	8/10/2016	19:30:05		36.87892	-119.9426	2236		137	237.7
7	4	8/10/2016	19:30:18		36.87408	-119.951	2353		138	234.4
7	4	8/10/2016	19:30:28		36.87002	-119.9576	2301		145	232.6
7	4	8/10/2016	19:30:38		36.86554	-119.9645	2284		153	230.7
7	4	8/10/2016	19:30:44		36.86249	-119.9683	2289		156	225.1
7	4	8/10/2016	19:30:49		36.85949	-119.971	2274		158	215.3
7	4	8/10/2016	19:30:54		36.85612	-119.973	2252		162	205.6
7	4	8/10/2016	19:30:59		36.8525	-119.9744	2255		164	196.9
7	4	8/10/2016	19:31:05		36.84805	-119.9754	2306		163	190.2
7	4	8/10/2016	19:31:10		36.84433	-119.9756	2352		161	183.2
7	4	8/10/2016	19:31:16		36.83991	-119.9753	2393		159	176.5
7	4	8/10/2016	19:31:23		36.8348	-119.9742	2408		160	170.3
7	4	8/10/2016	19:31:30		36.82976	-119.9724	2399		162	164.3
7	4	8/10/2016	19:31:42		36.82097	-119.9688	2323		167	161.8
7	4	8/10/2016	19:31:59		36.80839	-119.9632	2298		170	160.3
7	4	8/10/2016	19:32:11		36.79976	-119.9597	2227		163	162.2
7	4	8/10/2016	19:32:28		36.78787	-119.9553	2038		158	163.3
9	5	8/13/2016	14:22:13		36.83751	-119.8666	308		0	81.1
9	5	8/13/2016	14:22:34		36.83747	-119.8661	309		4	95.9
9	5	8/13/2016	14:22:46		36.83758	-119.8659	311	0	4	63.4
9	5	8/13/2016	14:22:57	0:00:11	36.83786	-119.8662	311	0	8	316
9	5	8/13/2016	14:23:02	0:00:16	36.83847	-119.8671	313	2	40	311.6
9	5	8/13/2016	14:23:07	0:00:21	36.83942	-119.8684	313	2	61	312
9	5	8/13/2016	14:23:14	0:00:28	36.84116	-119.8707	376	65	79	313
9	5	8/13/2016	14:23:24	0:00:38	36.84406	-119.8739	566	255	83	318.9
9	5	8/13/2016	14:23:31	0:00:45	36.84643	-119.8755	715	404	84	331.1
9	5	8/13/2016	14:23:41	0:00:55	36.85011	-119.8779	883	572	90	332.2
9	5	8/13/2016	14:23:55	0:01:09	36.8552	-119.8817	1118	807	91	329.5
9	5	8/13/2016	14:24:03	0:01:17	36.85833	-119.8842	1125	814	101	327.1
9	5	8/13/2016	14:24:13	0:01:27	36.86274	-119.8878	1180	869	114	326.9
9	5	8/13/2016	14:24:19	0:01:33	36.86539	-119.8904	1221	910	120	322.3
9	5	8/13/2016	14:24:24	0:01:38	36.86728	-119.893	1273	962	123	311.8
9	5	8/13/2016	14:24:29	0:01:43	36.86868	-119.8962	1305	994	125	299
9	5	8/13/2016	14:24:34	0:01:48	36.86951	-119.8996	1399	1088	124	286.9
9	5	8/13/2016	14:24:45	0:01:59	36.87066	-119.9072	1554	1243	121	280.7
9	5	8/13/2016	14:25:00	0:02:14	36.87192	-119.9177	1729	1418	123	278.5
9	5	8/13/2016	14:25:13	0:02:27	36.87259	-119.9271	1826	1515	125	275.1
9	5	8/13/2016	14:25:32	0:02:46	36.87343	-119.941	2072	1761	127	274.3
9	5	8/13/2016	14:25:57		36.87438	-119.9594	2347		128	273.7
9	5	8/13/2016	14:26:18		36.87493	-119.9751	2536		129	272.5
9	5	8/13/2016	14:26:39		36.87528	-119.9914	2710		134	271.5
9	5	8/13/2016	14:26:51		36.87534	-120.001	2706		138	270.5
9	5	8/13/2016	14:27:06		36.87504	-120.0134	2798		144	268.3
10	6	8/14/2016	14:49:04		36.83764	-119.8659	309	0	1	313.6

Figure 12 - Data Tab (4 of 11)

Session	Flight	Date	Time UTC hh:mm:ss	Time from Start of T/O	Latitude Deg	Longitude Deg	GPS Alt ft	Delta H ft	Ground Speed kts	Track Deg T
10	6	8/14/2016	14:49:10	0:00:06	36.83787	-119.8662	309	0	13	309.5
10	6	8/14/2016	14:49:15	0:00:11	36.83849	-119.8671	311	2	40	312.1
10	6	8/14/2016	14:49:20	0:00:16	36.83945	-119.8684	313	4	62	312.3
10	6	8/14/2016	14:49:25	0:00:21	36.84056	-119.8701	385	76	74	310.3
10	6	8/14/2016	14:49:31	0:00:27	36.8422	-119.8719	494	185	79	318.1
10	6	8/14/2016	14:49:38	0:00:34	36.84459	-119.8739	554	245	89	325.5
10	6	8/14/2016	14:49:49	0:00:45	36.84887	-119.8768	760	451	95	332
10	6	8/14/2016	14:50:03	0:00:59	36.85403	-119.8805	1062	753	92	330.2
10	6	8/14/2016	14:50:18	0:01:14	36.85919	-119.8849	1257	948	90	325.5
10	6	8/14/2016	14:50:25	0:01:21	36.86127	-119.8874	1339	1030	90	315.7
10	6	8/14/2016	14:50:29	0:01:25	36.86225	-119.8892	1383	1074	92	305.1
10	6	8/14/2016	14:50:34	0:01:30	36.86277	-119.8917	1424	1115	91	284.3
10	6	8/14/2016	14:50:35	0:01:31	36.86278	-119.8923	1428	1119	94	271.3
10	6	8/14/2016	14:50:42	0:01:38	36.86241	-119.8962	1446	1137	97	263.2
10	6	8/14/2016	14:50:49	0:01:45	36.86163	-119.9004	1437	1128	108	257.1
10	6	8/14/2016	14:50:58	0:01:54	36.86031	-119.9064	1467	1158	119	254.5
10	6	8/14/2016	14:51:08	0:02:04	36.85862	-119.9135	1475	1166	128	253.5
10	6	8/14/2016	14:51:19	0:02:15	36.85633	-119.9216	1536	1227	135	250.6
10	6	8/14/2016	14:51:28	0:02:24	36.85397	-119.9282	1555	1246	138	245.8
10	6	8/14/2016	14:51:34	0:02:30	36.85195	-119.9324	1574	1265	141	238.9
10	6	8/14/2016	14:51:39	0:02:35	36.8499	-119.9355	1603	1294	141	230.8
10	6	8/14/2016	14:51:44	0:02:40	36.84751	-119.9383	1636	1327	140	222.5
10	6	8/14/2016	14:51:49	0:02:45	36.84483	-119.9405	1666	1357	139	213.3
10	6	8/14/2016	14:51:54	0:02:50	36.84188	-119.942	1689	1380	138	202.9
10	6	8/14/2016	14:51:59	0:02:55	36.83875	-119.9429	1703	1394	139	192.4
10	6	8/14/2016	14:52:04	0:03:00	36.83552	-119.9431	1716	1407	139	182.5
53	30	11/12/2016	19:27:28		36.84186	-119.8678	314		0	0
53	30	11/12/2016	19:27:45		36.84175	-119.8686	311		9	261.3
53	30	11/12/2016	19:28:01		36.84177	-119.8699	313		14	271
53	30	11/12/2016	19:28:08		36.84172	-119.8705	311		15	264.4
53	30	11/12/2016	19:28:12		36.84157	-119.8708	314		13	232.6
53	30	11/12/2016	19:28:28		36.84118	-119.8712	316		7	222.6
53	30	11/12/2016	19:28:32		36.84105	-119.8713	316		8	211.2
53	30	11/12/2016	19:28:36		36.84093	-119.8712	316		7	155.4
53	30	11/12/2016	19:28:58		36.84032	-119.8704	314		9	131.9
53	30	11/12/2016	19:29:19		36.83948	-119.8692	314		13	131.5
53	30	11/12/2016	19:29:38		36.8387	-119.8681	314		13	131.9
53	30	11/12/2016	19:30:02		36.83784	-119.8669	311		11	132.5
53	30	11/12/2016	19:30:14		36.83749	-119.8666	311		8	144.4
53	30	11/12/2016	19:30:15		36.83748	-119.8666	311		5	107.4
53	30	11/12/2016	19:30:38		36.83749	-119.8666	311		0	38.3
53	30	11/12/2016	19:32:37		36.83751	-119.8666	316		0	46.9
53	30	11/12/2016	19:32:57		36.83752	-119.8665	314		1	86.4
53	30	11/12/2016	19:33:12		36.8375	-119.866	314		6	92.5
53	30	11/12/2016	19:33:17		36.83757	-119.8659	314		6	56.7
53	30	11/12/2016	19:33:25		36.83765	-119.8659	314	0	2	343.8
53	30	11/12/2016	19:33:31	0:00:06	36.83791	-119.8663	313	-1	14	312.4
53	30	11/12/2016	19:33:36	0:00:11	36.83854	-119.8671	311	-3	41	311.8

Figure 13 - Data Tab (5 of 11)

Session	Flight	Date	Time UTC hh:mm:ss	Time from Start of T/O	Latitude Deg	Longitude Deg	GPS Alt ft	Delta H ft	Ground Speed kts	Track Deg T
53	30	11/12/2016	19:33:41	0:00:16	36.8395	-119.8685	311	-3	62	312
53	30	11/12/2016	19:33:48	0:00:23	36.84123	-119.8709	357	43	80	312.1
53	30	11/12/2016	19:33:58	0:00:33	36.84414	-119.8742	522	208	86	317.1
53	30	11/12/2016	19:34:01	0:00:36	36.84525	-119.875	571	257	91	331.6
53	30	11/12/2016	19:34:05	0:00:40	36.84697	-119.8753	630	316	94	351.3
53	30	11/12/2016	19:34:08	0:00:43	36.84827	-119.8747	669	355	100	20.8
53	30	11/12/2016	19:34:11	0:00:46	36.8493	-119.8735	742	428	102	43
53	30	11/12/2016	19:34:13	0:00:48	36.84983	-119.8725	798	484	101	55
53	30	11/12/2016	19:34:22	0:00:57	36.85191	-119.8682	988	674	97	59.2
53	30	11/12/2016	19:34:27	0:01:02	36.85382	-119.8665	1021	707	102	35.7
53	30	11/12/2016	19:34:30	0:01:05	36.85529	-119.8661	1051	737	107	10.6
53	30	11/12/2016	19:34:34	0:01:09	36.8573	-119.8665	1092	778	110	352.3
53	30	11/12/2016	19:34:37	0:01:12	36.85872	-119.8672	1133	819	111	336.6
53	30	11/12/2016	19:34:43	0:01:18	36.86125	-119.8695	1204	890	113	323.7
53	30	11/12/2016	19:34:52	0:01:27	36.8647	-119.8738	1346	1032	116	315.5
53	30	11/12/2016	19:35:08	0:01:43	36.87094	-119.8816	1517	1203	119	315
53	30	11/12/2016	19:35:18	0:01:53	36.87489	-119.8868	1599	1285	124	313.3
53	30	11/12/2016	19:35:23	0:01:58	36.87644	-119.8899	1659	1345	125	302.3
53	30	11/12/2016	19:35:28	0:02:03	36.87736	-119.8933	1707	1393	126	288.4
53	30	11/12/2016	19:35:32	0:02:07	36.8776	-119.8962	1727	1413	127	276
53	30	11/12/2016	19:35:37	0:02:12	36.87728	-119.9	1748	1434	130	263.8
53	30	11/12/2016	19:35:42	0:02:17	36.87637	-119.9037	1754	1440	133	252.9
53	30	11/12/2016	19:35:48	0:02:23	36.87466	-119.908	1708	1394	139	243.8
53	30	11/12/2016	19:36:00	0:02:35	36.87077	-119.9168	1738	1424	145	241.1
53	30	11/12/2016	19:36:08	0:02:43	36.86784	-119.9225	1784	1470	146	237
53	30	11/12/2016	19:36:13	0:02:48	36.86631	-119.9262	1812	1498	145	242.9
53	30	11/12/2016	19:36:21	0:02:56	36.86439	-119.9324	1905	1591	143	248.8
53	30	11/12/2016	19:36:35		36.86139	-119.943	2074		139	250.5
53	30	11/12/2016	19:36:46		36.85945	-119.9512	2210		134	253.4
53	30	11/12/2016	19:37:01		36.85721	-119.9623	2397		132	255.8
53	30	11/12/2016	19:37:12		36.85531	-119.97	2523		128	253
53	30	11/12/2016	19:37:29		36.85186	-119.9819	2694		128	249.9
53	30	11/12/2016	19:37:45		36.84886	-119.9933	2902		130	251.9
53	30	11/12/2016	19:38:04		36.84579	-120.0067	3113		127	254
53	30	11/12/2016	19:38:19		36.84358	-120.0177	3249		131	255.9
53	30	11/12/2016	19:38:35		36.84135	-120.0292	3473		128	256.5
53	30	11/12/2016	19:38:51		36.83897	-120.0406	3630		127	255.3
53	30	11/12/2016	19:39:02		36.8367	-120.0481	3780		127	249.5
53	30	11/12/2016	19:39:14		36.83411	-120.0563	3902		127	248.5
53	30	11/12/2016	19:39:26		36.83192	-120.065	4014		131	252.5
53	30	11/12/2016	19:39:40		36.82938	-120.0754	4105		134	253
53	30	11/12/2016	19:39:54		36.82695	-120.0863	4212		140	254.4
53	30	11/12/2016	19:40:02		36.82514	-120.0924	4323		140	249.5
53	30	11/12/2016	19:40:08		36.82338	-120.0966	4406		137	242.6
53	30	11/12/2016	19:40:15		36.82092	-120.1012	4473		136	236.1
53	30	11/12/2016	19:40:24		36.81789	-120.1074	4515		139	238.4
53	30	11/12/2016	19:40:34		36.81492	-120.1146	4626		141	243.1
57	33	12/13/2016	21:46:32		36.84185	-119.8672	388		0	0

Figure 14 - Data Tab (6 of 11)

Session	Flight	Date	Time UTC hh:mm:ss	Time from Start of T/O	Latitude Deg	Longitude Deg	GPS Alt ft	Delta H ft	Ground Speed kts	Track Deg T
57	33	12/13/2016	21:46:53		36.84184	-119.8673	319		0	252.6
57	33	12/13/2016	21:47:10		36.8418	-119.8678	311		6	265.1
57	33	12/13/2016	21:47:26		36.84173	-119.8689	303		11	265.1
57	33	12/13/2016	21:47:45		36.84176	-119.8702	298		12	271.6
57	33	12/13/2016	21:47:54		36.84168	-119.8706	298		8	256.5
57	33	12/13/2016	21:48:07		36.84138	-119.871	305		7	224.2
57	33	12/13/2016	21:48:20		36.84109	-119.8715	302		8	233.9
57	33	12/13/2016	21:48:33		36.84145	-119.872	298		9	312.3
57	33	12/13/2016	21:48:50		36.84213	-119.8729	297		13	312.4
57	33	12/13/2016	21:49:02		36.84249	-119.8734	295		10	312.9
57	33	12/13/2016	21:49:16		36.84266	-119.8736	294		4	308.9
57	33	12/13/2016	21:50:23		36.84268	-119.8736	300		0	0
57	33	12/13/2016	21:50:27		36.84265	-119.8736	308		2	162.7
57	33	12/13/2016	21:51:32		36.84274	-119.8736	303		0	353.6
57	33	12/13/2016	21:51:45		36.84275	-119.8736	303	0	0	58.3
57	33	12/13/2016	21:51:55	0:00:10	36.8428	-119.8734	303	0	4	76.6
57	33	12/13/2016	21:52:13	0:00:28	36.84274	-119.873	303	0	4	98.6
57	33	12/13/2016	21:52:18	0:00:33	36.84241	-119.8725	306	3	22	132.3
57	33	12/13/2016	21:52:23	0:00:38	36.84173	-119.8716	309	6	44	131.9
57	33	12/13/2016	21:52:29	0:00:44	36.84052	-119.8699	314	11	65	131.9
57	33	12/13/2016	21:52:36	0:00:51	36.83873	-119.8675	390	87	80	133.7
57	33	12/13/2016	21:52:45	0:01:00	36.8363	-119.8649	612	309	78	139
57	33	12/13/2016	21:52:53	0:01:08	36.83396	-119.8628	689	386	78	143.9
57	33	12/13/2016	21:52:58	0:01:13	36.83193	-119.8622	716	413	90	168.1
57	33	12/13/2016	21:53:01	0:01:16	36.83067	-119.8627	754	451	94	195.1
57	33	12/13/2016	21:53:04	0:01:19	36.82964	-119.8637	797	494	95	218.9
57	33	12/13/2016	21:53:08	0:01:23	36.82877	-119.8657	872	569	97	240.9
57	33	12/13/2016	21:53:12	0:01:27	36.82842	-119.8678	954	651	96	258.8
57	33	12/13/2016	21:53:15	0:01:30	36.82866	-119.8695	969	666	98	279.9
57	33	12/13/2016	21:53:17	0:01:32	36.82908	-119.8706	984	681	103	296.6
57	33	12/13/2016	21:53:24	0:01:39	36.8312	-119.8742	980	677	110	306.3
57	33	12/13/2016	21:53:31	0:01:46	36.83376	-119.8781	947	644	124	309.4
57	33	12/13/2016	21:53:40	0:01:55	36.83743	-119.8835	964	661	137	310
57	33	12/13/2016	21:53:56	0:02:11	36.84421	-119.8933	1074	771	140	310.8
57	33	12/13/2016	21:54:09	0:02:24	36.84971	-119.901	1141	838	137	311.8
57	33	12/13/2016	21:54:19	0:02:34	36.85437	-119.9067	1199	896	140	315.9
57	33	12/13/2016	21:54:36	0:02:51	36.86253	-119.9162	1262	959	142	317.1
57	33	12/13/2016	21:54:46	0:03:01	36.86761	-119.9215	1309	1006	144	319.9
57	33	12/13/2016	21:54:55	0:03:10	36.87257	-119.9259	1328	1025	145	324.9
57	33	12/13/2016	21:55:07	0:03:22	36.87949	-119.9313	1336	1033	147	328
57	33	12/13/2016	21:55:10	0:03:25	36.88144	-119.9316	1336	1033	142	352.7
57	33	12/13/2016	21:55:12	0:03:27	36.88245	-119.9306	1325	1022	138	37.9
57	33	12/13/2016	21:55:14	0:03:29	36.8829	-119.9292	1369	1066	133	68.7
57	33	12/13/2016	21:55:20	0:03:35	36.88333	-119.9246	1379	1076	133	83.2
57	33	12/13/2016	21:55:29	0:03:44	36.88353	-119.9173	1327	1024	140	88.1
57	33	12/13/2016	21:55:41	0:03:56	36.88373	-119.9072	1360	1057	145	88.6
57	33	12/13/2016	21:55:44		36.8844	-119.9049	1360		142	70
57	33	12/13/2016	21:55:46		36.88544	-119.9039	1330		143	38.2
57	33	12/13/2016	21:55:48		36.88677	-119.9036	1300		145	8.4

Figure 15 - Data Tab (7 of 11)

Session	Flight	Date	Time UTC hh:mm:ss	Time from Start of T/O	Latitude Deg	Longitude Deg	GPS Alt ft	Delta H ft	Ground Speed kts	Track Deg T
57	33	12/13/2016	21:55:50		36.8881	-119.904	1278		147	347.5
57	33	12/13/2016	21:55:56		36.89207	-119.9053	1316		148	345.2
57	33	12/13/2016	21:56:05		36.8979	-119.9064	1442		142	351.3
57	33	12/13/2016	21:56:10		36.90105	-119.9066	1472		136	357.4
57	33	12/13/2016	21:56:12		36.90226	-119.9063	1497		133	11.3
57	33	12/13/2016	21:56:16		36.90438	-119.905	1535		127	26.1
57	33	12/13/2016	21:56:19		36.90556	-119.9035	1554		124	46.4
57	33	12/13/2016	21:56:22		36.9063	-119.9016	1574		120	63.9
57	33	12/13/2016	21:56:26		36.90662	-119.8989	1595		116	81.2
57	33	12/13/2016	21:56:35		36.90628	-119.8929	1565		115	94.1
57	33	12/13/2016	21:56:43		36.90611	-119.8876	1543		116	92.3
57	33	12/13/2016	21:56:48		36.90689	-119.8844	1492		116	73
57	33	12/13/2016	21:56:56		36.90927	-119.8796	1410		121	58.2
57	33	12/13/2016	21:57:08		36.91282	-119.8721	1342		125	59.3
57	33	12/13/2016	21:57:24		36.91723	-119.862	1204		124	61.4
57	33	12/13/2016	21:57:35		36.92019	-119.855	1163		124	62.1
57	33	12/13/2016	21:57:42		36.92178	-119.8505	1170		121	66.1
57	33	12/13/2016	21:57:54		36.92437	-119.8429	1104		119	66.9
57	33	12/13/2016	21:58:04		36.9263	-119.8366	1066		117	69
58	34	12/21/2016	22:25:01		36.84189	-119.8672	358		0	0
58	34	12/21/2016	22:26:37		36.84191	-119.8673	297		0	327.8
58	34	12/21/2016	22:26:49		36.84192	-119.8674	302		2	273.6
58	34	12/21/2016	22:27:10		36.84185	-119.8678	306		4	259.3
58	34	12/21/2016	22:27:28		36.84177	-119.8687	308		8	263.7
58	34	12/21/2016	22:27:46		36.84179	-119.8698	305		11	271.3
58	34	12/21/2016	22:27:55		36.84178	-119.8704	305		11	268.3
58	34	12/21/2016	22:28:01		36.84164	-119.8707	306		9	237.4
58	34	12/21/2016	22:28:19		36.84117	-119.8712	309		8	222.3
58	34	12/21/2016	22:28:28		36.84095	-119.8712	309		5	179.6
58	34	12/21/2016	22:28:48		36.84052	-119.8706	311		7	131.4
58	34	12/21/2016	22:29:06		36.83982	-119.8697	311		13	132.2
58	34	12/21/2016	22:29:26		36.83878	-119.8682	313		17	131.9
58	34	12/21/2016	22:29:39		36.83815	-119.8673	313		16	131.8
58	34	12/21/2016	22:29:55		36.83761	-119.8667	313		10	137.5
58	34	12/21/2016	22:30:05		36.83747	-119.8666	311		4	141.3
58	34	12/21/2016	22:30:27		36.83749	-119.8666	309		0	65
58	34	12/21/2016	22:32:38		36.8375	-119.8665	306		0	32.7
58	34	12/21/2016	22:32:46		36.83751	-119.8664	306		4	85.9
58	34	12/21/2016	22:33:03		36.83758	-119.8658	308		5	81.1
58	34	12/21/2016	22:33:15		36.83764	-119.8659	308		1	339.3
58	34	12/21/2016	22:33:21		36.83764	-119.8659	308	0	0	0
58	34	12/21/2016	22:33:27	0:00:06	36.83789	-119.8662	309	1	13	312.4
58	34	12/21/2016	22:33:32	0:00:11	36.83848	-119.867	311	3	39	311.7
58	34	12/21/2016	22:33:38	0:00:17	36.83958	-119.8686	313	5	60	311.5
58	34	12/21/2016	22:33:44	0:00:23	36.84106	-119.8706	336	28	78	313.1
58	34	12/21/2016	22:33:53	0:00:32	36.84358	-119.8739	437	129	88	313.1
58	34	12/21/2016	22:34:05	0:00:44	36.84736	-119.8786	609	301	96	315.3
58	34	12/21/2016	22:34:16	0:00:55	36.85106	-119.8832	800	492	102	315.3

Figure 16 - Data Tab (8 of 11)

Session	Flight	Date	Time UTC hh:mm:ss	Time from Start of T/O	Latitude Deg	Longitude Deg	GPS Alt ft	Delta H ft	Ground Speed kts	Track Deg T
58	34	12/21/2016	22:34:27	0:01:06	36.85463	-119.8883	1059	751	106	311.3
58	34	12/21/2016	22:34:38	0:01:17	36.85806	-119.8938	1169	861	111	307.5
58	34	12/21/2016	22:34:45	0:01:24	36.86049	-119.8981	1112	804	129	305.3
58	34	12/21/2016	22:34:52	0:01:31	36.86314	-119.903	1054	746	145	304.4
58	34	12/21/2016	22:35:02	0:01:41	36.86735	-119.9103	1059	751	156	305.6
58	34	12/21/2016	22:35:14	0:01:53	36.87276	-119.919	1196	888	158	308
58	34	12/21/2016	22:35:25	0:02:04	36.87757	-119.9265	1415	1107	151	308.6
58	34	12/21/2016	22:35:34	0:02:13	36.88131	-119.932	1615	1307	138	310.5
58	34	12/21/2016	22:35:40	0:02:19	36.88401	-119.9352	1692	1384	134	316.6
58	34	12/21/2016	22:35:55	0:02:34	36.89119	-119.9426	1819	1511	134	320.6
58	34	12/21/2016	22:36:11	0:02:50	36.89875	-119.9507	2003	1695	134	319.5
58	34	12/21/2016	22:36:24	0:03:03	36.90466	-119.9575	2118	1810	134	317.2
58	34	12/21/2016	22:36:33	0:03:12	36.90892	-119.9622	2129	1821	137	318.4
58	34	12/21/2016	22:36:37	0:03:16	36.91125	-119.9638	2112	1804	142	332
58	34	12/21/2016	22:36:42	0:03:21	36.91445	-119.965	2137	1829	145	342.9
58	34	12/21/2016	22:36:46	0:03:25	36.91687	-119.9664	2178	1870	144	335.2
58	34	12/21/2016	22:36:50	0:03:29	36.91895	-119.9684	2225	1917	142	322.2
58	34	12/21/2016	22:36:55	0:03:34	36.92117	-119.9715	2252	1944	143	312.2
58	34	12/21/2016	22:37:03	0:03:42	36.92484	-119.9765	2249	1941	146	312.9
58	34	12/21/2016	22:37:13	0:03:52	36.92983	-119.9829	2147	1839	154	314.2
58	34	12/21/2016	22:37:24		36.93572	-119.99	2140		161	316.1
58	34	12/21/2016	22:37:33		36.94071	-119.9953	2255		157	319.5
58	34	12/21/2016	22:37:46		36.94805	-120.0023	2304		153	322.7
58	34	12/21/2016	22:37:53		36.95229	-120.0058	2243		157	326.4
58	34	12/21/2016	22:37:57		36.95508	-120.0071	2202		161	339.4
58	34	12/21/2016	22:38:01		36.95806	-120.0077	2161		163	351
58	34	12/21/2016	22:38:05		36.96109	-120.0075	2142		164	3.5
58	34	12/21/2016	22:38:09		36.96395	-120.0064	2161		162	16.7
58	34	12/21/2016	22:38:15		36.96791	-120.0041	2227		158	25.2
58	34	12/21/2016	23:06:30		36.98436	-120.1048	238		14	135.5
58	34	12/21/2016	23:06:39		36.98402	-120.1049	237		8	189.1
58	34	12/21/2016	23:06:42		36.98395	-120.105	238		8	230.6
58	34	12/21/2016	23:06:56		36.98378	-120.1052	240		4	225
58	34	12/21/2016	23:07:45		36.98359	-120.1054	242	0	1	224.1
58	34	12/21/2016	23:07:49	0:00:04	36.98342	-120.1056	243	1	14	227.4
58	34	12/21/2016	23:07:56	0:00:11	36.98354	-120.1061	243	1	13	286
58	34	12/21/2016	23:08:02	0:00:17	36.98431	-120.1071	242	0	39	315.3
58	34	12/21/2016	23:08:07	0:00:22	36.98539	-120.1085	242	0	66	314.9
58	34	12/21/2016	23:08:13	0:00:28	36.98703	-120.1105	286	44	84	314.5
58	34	12/21/2016	23:08:23	0:00:38	36.99021	-120.1142	513	271	94	317.2
58	34	12/21/2016	23:08:32	0:00:47	36.99338	-120.1176	644	402	100	319.5
58	34	12/21/2016	23:08:40	0:00:55	36.99664	-120.1207	764	522	110	322.8
58	34	12/21/2016	23:08:49	0:01:04	37.00076	-120.124	915	673	117	327.7
58	34	12/21/2016	23:08:50	0:01:05	37.00119	-120.1244	940	698	118	321.8
58	34	12/21/2016	23:08:54	0:01:09	37.00249	-120.1265	1071	829	115	307.6
58	34	12/21/2016	23:08:57	0:01:12	37.0028	-120.1284	1177	935	110	281.6
58	34	12/21/2016	23:09:00	0:01:15	37.00254	-120.1303	1246	1004	108	260.2
58	34	12/21/2016	23:09:03	0:01:18	37.00175	-120.1319	1270	1028	113	239.6
58	34	12/21/2016	23:09:06	0:01:21	37.00051	-120.1333	1278	1036	119	221.4

Figure 17 - Data Tab (9 of 11)

Session	Flight	Date	Time UTC hh:mm:ss	Time from Start of T/O	Latitude Deg	Longitude Deg	GPS Alt ft	Delta H ft	Ground Speed kts	Track Deg T
58	34	12/21/2016	23:09:10	0:01:25	36.9984	-120.1346	1265	1023	127	205.9
58	34	12/21/2016	23:09:15	0:01:30	36.99529	-120.1354	1235	993	137	192.3
58	34	12/21/2016	23:09:19	0:01:34	36.99258	-120.1355	1224	982	146	181.2
58	34	12/21/2016	23:09:24	0:01:39	36.98909	-120.1349	1229	987	153	172
58	34	12/21/2016	23:09:29	0:01:44	36.98557	-120.1336	1226	984	158	163.7
58	34	12/21/2016	23:09:38	0:01:53	36.97921	-120.1305	1251	1009	164	158.9
58	34	12/21/2016	23:09:47	0:02:02	36.97283	-120.127	1226	984	168	155.9
58	34	12/21/2016	23:09:53	0:02:08	36.96862	-120.124	1142	900	173	150.9
58	34	12/21/2016	23:09:57	0:02:12	36.96603	-120.1215	1111	869	177	142.2
58	34	12/21/2016	23:10:00	0:02:15	36.96441	-120.1191	1093	851	179	130.7
58	34	12/21/2016	23:10:03	0:02:18	36.96321	-120.1164	1085	843	179	119
58	34	12/21/2016	23:10:06	0:02:21	36.96246	-120.1135	1093	851	177	107.8
58	34	12/21/2016	23:10:10	0:02:25	36.96203	-120.1094	1101	859	177	97.4
58	34	12/21/2016	23:10:18	0:02:33	36.96133	-120.1013	1081	839	176	96.2
58	34	12/21/2016	23:10:23	0:02:38	36.96032	-120.0963	1059	817	178	104.2
58	34	12/21/2016	23:10:28	0:02:43	36.95876	-120.0916	1073	831	177	112.3
58	34	12/21/2016	23:10:37	0:02:52	36.9556	-120.0836	1107	865	171	116.4
58	34	12/21/2016	23:10:48	0:03:03	36.95185	-120.074	1123	881	168	116
58	34	12/21/2016	23:10:57		36.94947	-120.066	1153		163	110.5
58	34	12/21/2016	23:11:11		36.94564	-120.0539	1215		161	111.6
58	34	12/21/2016	23:11:25		36.94168	-120.042	1234		159	112.5
58	34	12/21/2016	23:11:32		36.93927	-120.0363	1248		160	117.7
58	34	12/21/2016	23:11:37		36.93698	-120.0326	1218		161	128
58	34	12/21/2016	23:11:45		36.93275	-120.027	1123		165	133.6
59	ACC	12/26/2016	21:10:55		36.8419	-119.8673	251		0	0
59	ACC	12/26/2016	21:11:13		36.8419	-119.8673	275		0	252.6
59	ACC	12/26/2016	21:11:30		36.84186	-119.8677	287		4	263
59	ACC	12/26/2016	21:11:47		36.84176	-119.8685	295		8	261.7
59	ACC	12/26/2016	21:12:10		36.8418	-119.8701	298		12	271.6
59	ACC	12/26/2016	21:12:15		36.84175	-119.8705	300		14	262
59	ACC	12/26/2016	21:12:20		36.8416	-119.8708	305		11	235.5
59	ACC	12/26/2016	21:12:39		36.84107	-119.8713	306		8	219.4
59	ACC	12/26/2016	21:12:40		36.84105	-119.8713	306		6	204.2
59	ACC	12/26/2016	21:12:44		36.84095	-119.8712	305		6	144.6
59	ACC	12/26/2016	21:13:03		36.84047	-119.8706	305		8	132.2
59	ACC	12/26/2016	21:13:24		36.83965	-119.8695	305		12	132.3
59	ACC	12/26/2016	21:13:41		36.83893	-119.8685	306		14	132.2
59	ACC	12/26/2016	21:14:05		36.83803	-119.8672	305		12	132.1
59	ACC	12/26/2016	21:14:22		36.83756	-119.8667	305		8	139.9
59	ACC	12/26/2016	21:14:33		36.83749	-119.8666	306		2	126.1
59	ACC	12/26/2016	21:16:35		36.83748	-119.8666	311		0	141.7
59	ACC	12/26/2016	21:16:40	0:00:05	36.83749	-119.8666	311	0	1	58
59	ACC	12/26/2016	21:16:59	0:00:24	36.83749	-119.8661	311	0	4	91.2
59	ACC	12/26/2016	21:17:10	0:00:35	36.83762	-119.8659	311	0	5	55.2
59	ACC	12/26/2016	21:17:17	0:00:42	36.83786	-119.8662	311	0	11	313.6
59	ACC	12/26/2016	21:17:22	0:00:47	36.83842	-119.867	311	0	36	311.8
59	ACC	12/26/2016	21:17:27	0:00:52	36.83931	-119.8682	311	0	58	311.7
59	ACC	12/26/2016	21:17:33	0:00:58	36.84069	-119.8701	354	43	74	312.4

Figure 18 - Data Tab (10 of 11)

Session	Flight	Date	Time UTC hh:mm:ss	Time from Start of T/O	Latitude Deg	Longitude Deg	GPS Alt ft	Delta H ft	Ground Speed kts	Track Deg T
59	ACC	12/26/2016	21:17:37	0:01:02	36.84152	-119.871	559	248	59	319
59	ACC	12/26/2016	21:17:41	0:01:06	36.84224	-119.8717	631	320	47	325.1
59	ACC	12/26/2016	21:17:45	0:01:10	36.84333	-119.8719	530	219	60	347.6
59	ACC	12/26/2016	21:17:48	0:01:13	36.84405	-119.8712	434	123	66	38.9

Figure 19 - Data Tab (11 of 11)

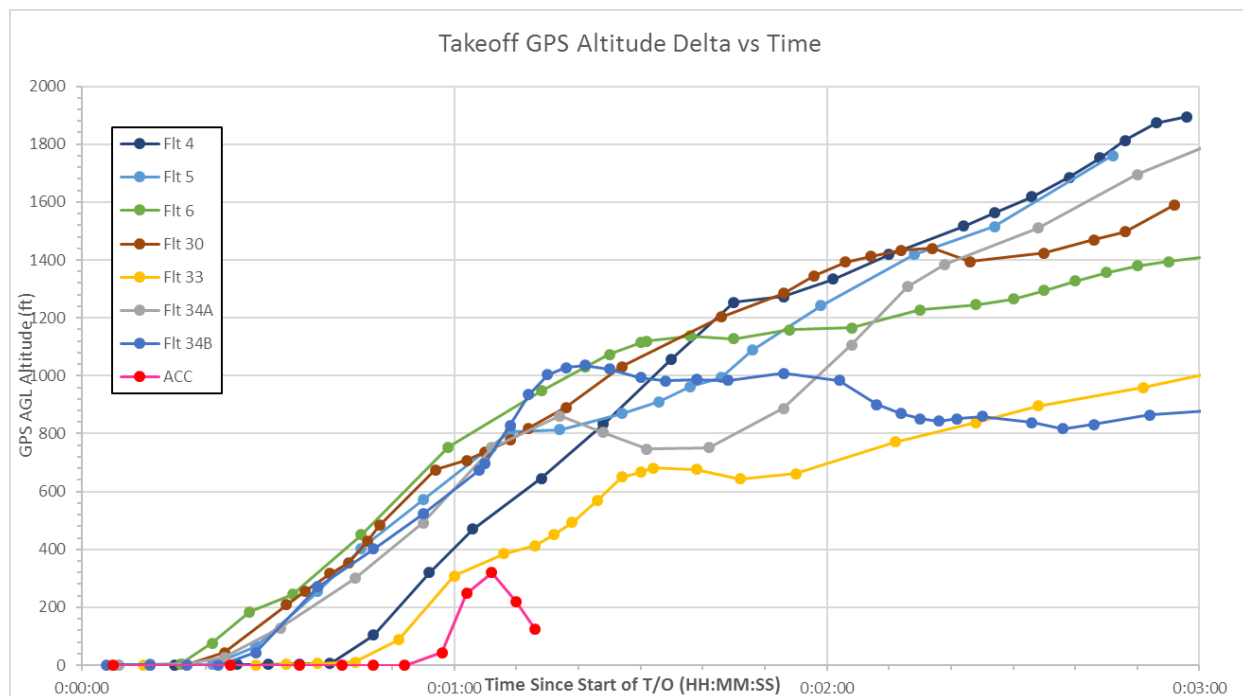


Figure 20 - Takeoff Comparison