



FUGRO GEOSPATIAL, INC.

Collection Report – USGS Lidar Acquisition (Fall 2017)

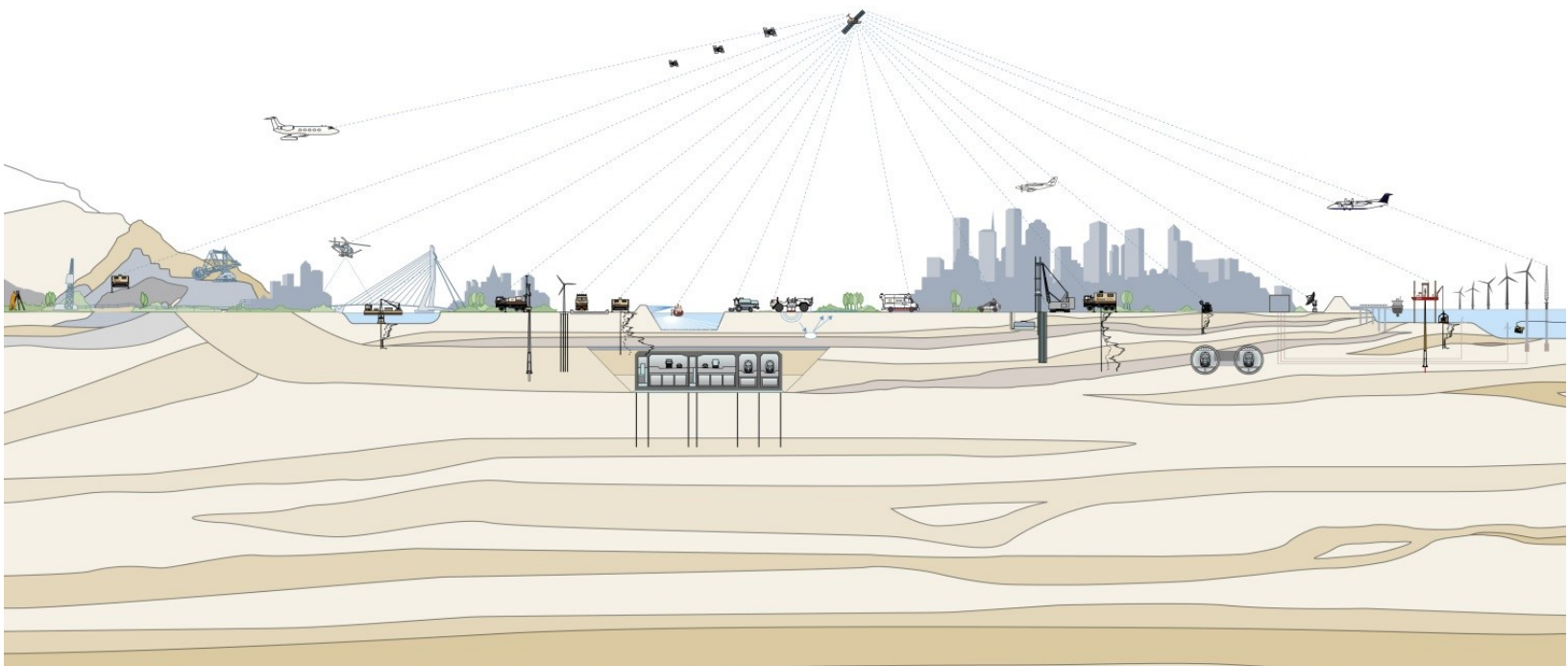
SD_FY17 NRCS Lidar FUGRO_2017_D17

Prepared for:

United States Geological Survey
1400 Independence Road
Rolla, MO 65401
(573) 308-3689

February 7, 2018

USGS Contract: G17PC00015
USGS Task Order: G17PD01311



Fugro was tasked with planning, acquiring, processing, and producing derivative products of high resolution lidar data (QL2+) collected at an aggregate nominal pulse spacing (ANPS) of 0.5 meters (4ppsm), including overlap, over portions of Butte, Lawrence, and Meade counties in South Dakota. The area of interest (AOI) covers approximately 3,916 square miles. A 100-meter buffer was added to the AOI covering approximately 3,927 square miles; all products will be generated to the limit of this buffered boundary.

Lidar data, and derivative products produced in compliance with the task order will be based on the “**U.S. Geological Survey National Geospatial Program Lidar Base Specification Version 1.2**”.

The **fall 2017** acquisition occurred during the acceptable collection windows that existed between October 27 and December 2, 2017.

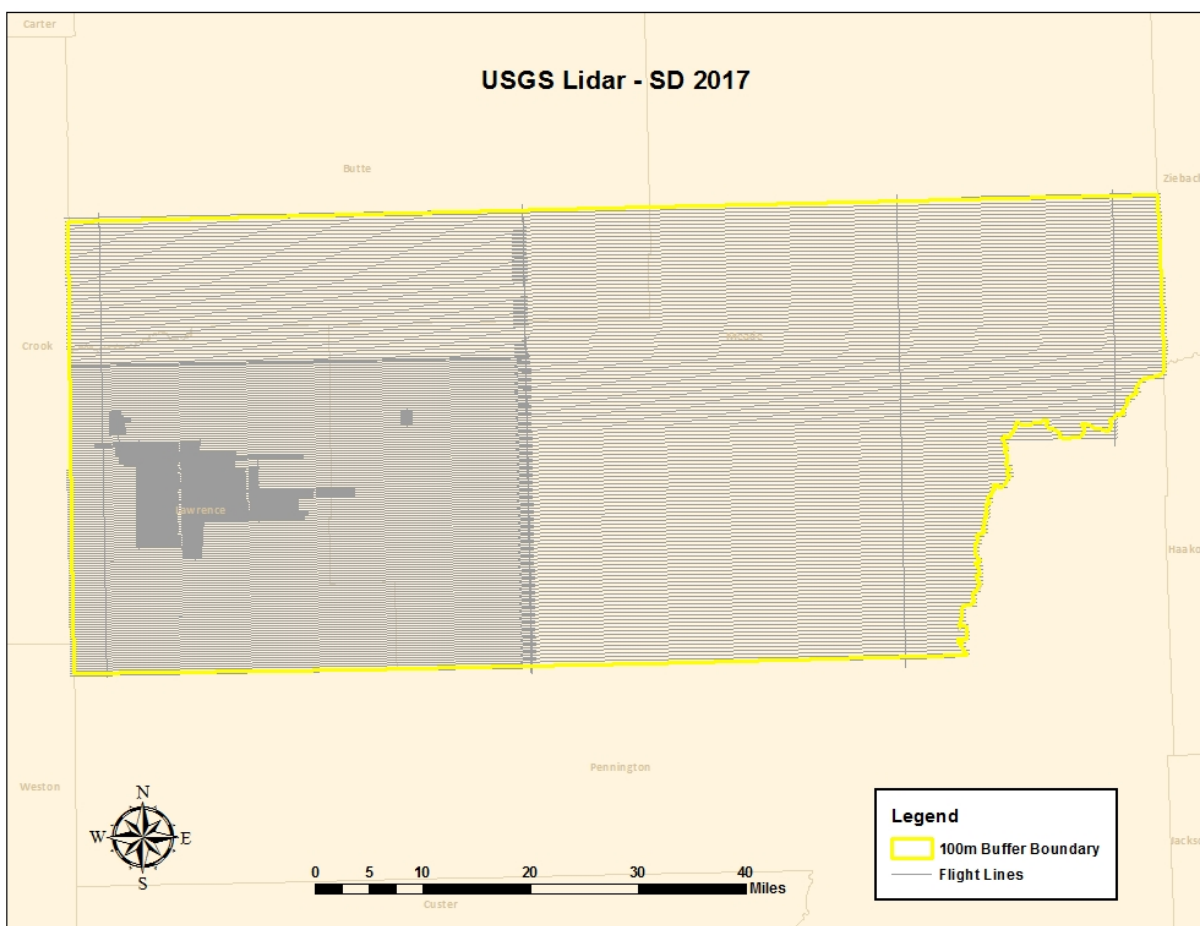


Figure 1: Flight plan

The following is detail on the **fall 2017** lidar acquisition covering the South Dakota FY17 NRCS Lidar buffered boundary.

Collections:	30
Collection Dates:	October 27 th – December 2 nd , 2017
Field of View (FOV):	60 degrees
Average Point Density (planned):	4 ppsm
Flight Level(s) AMT:	3250 ft, 2400 ft
Sensor Type(s):	Riegl LMS-Q680i, Riegl LMS-Q780
Sensor Serial Number(s):	216, 165, 421

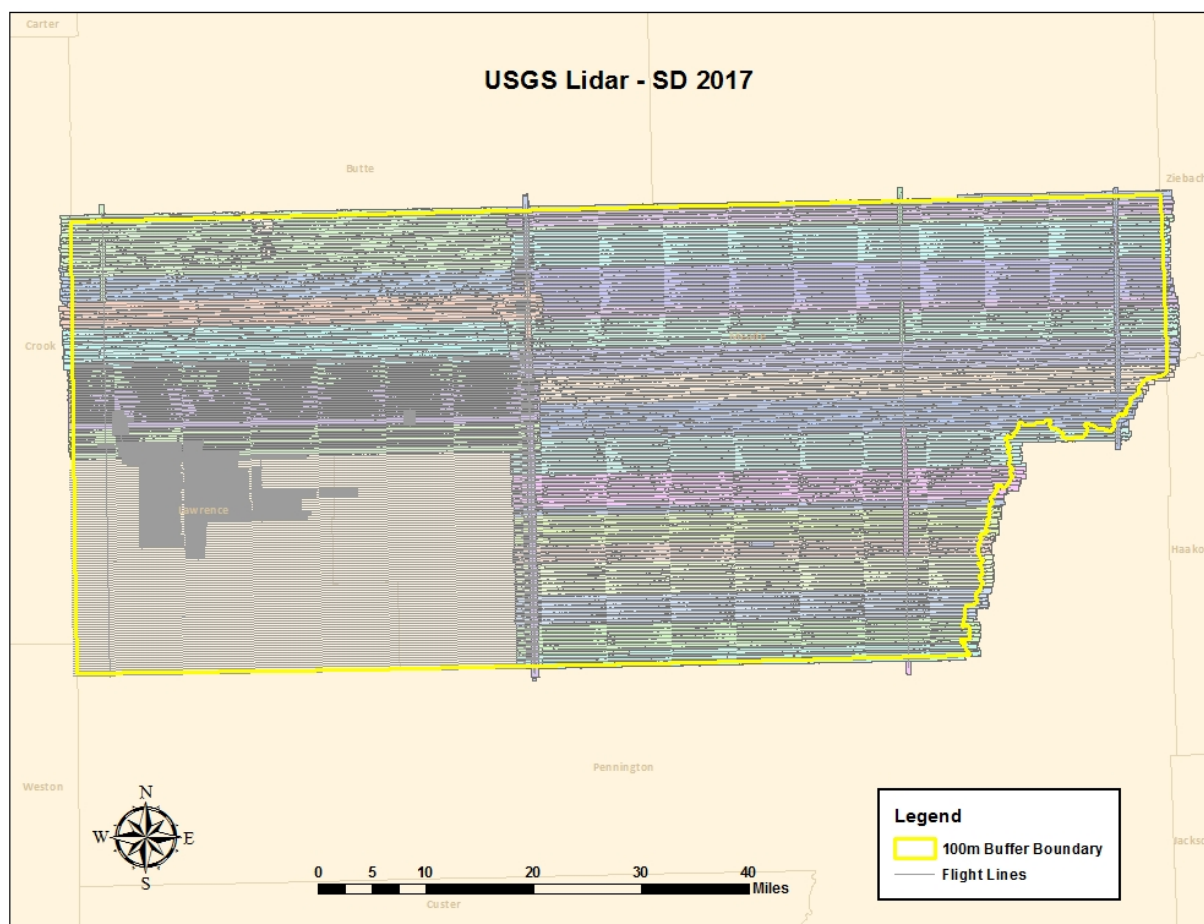


Figure 2: Executed Collection Footprints

All acquired lidar data was QC'd and accepted for processing.

Below are the acquisition logs and GPS plots from the **fall 2017** collections covering the South Dakota FY17 NRCS Lidar buffered boundary.

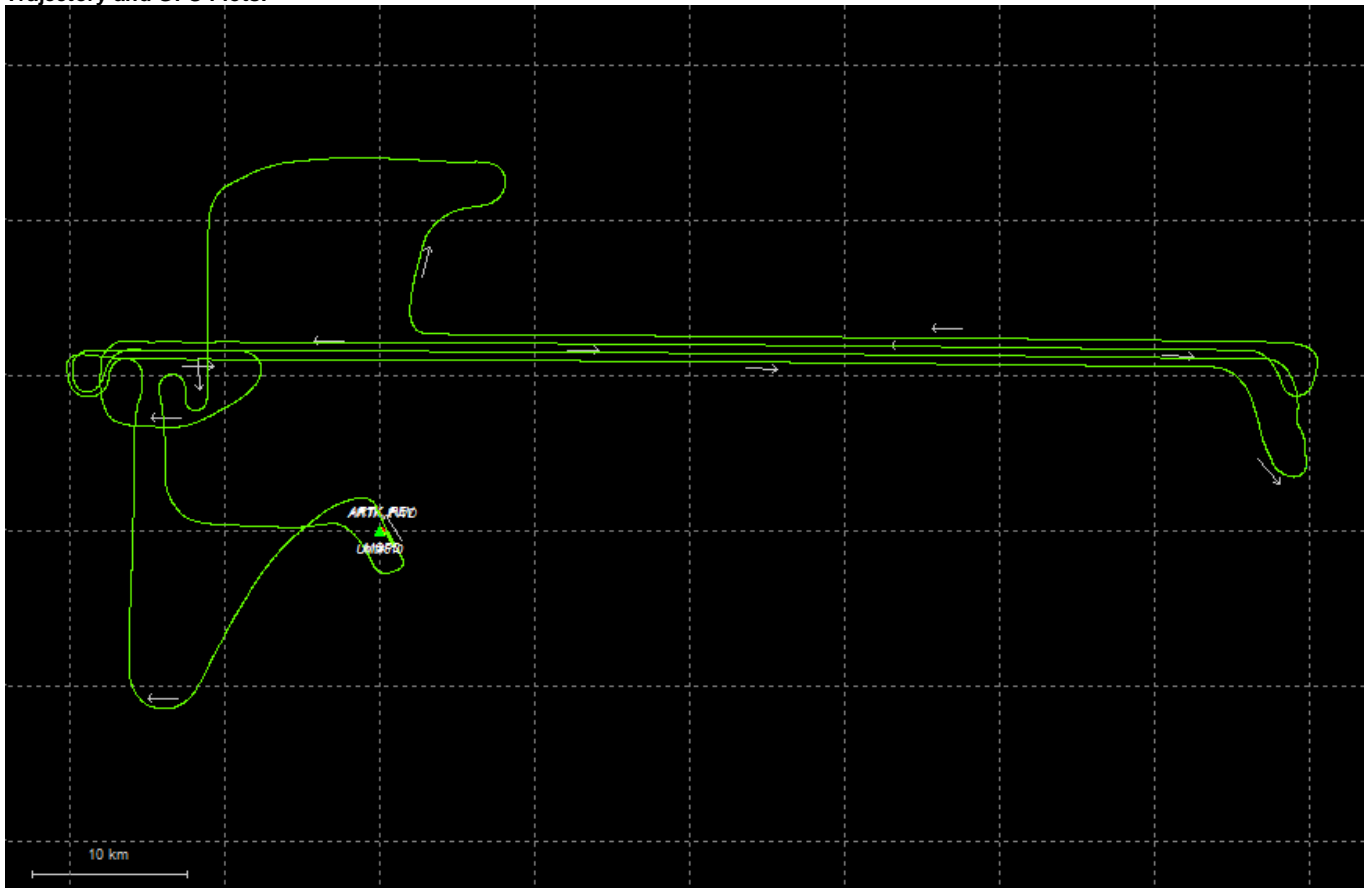


Acquisition and Processing details ----- Collection 1 (October 27, 2017)

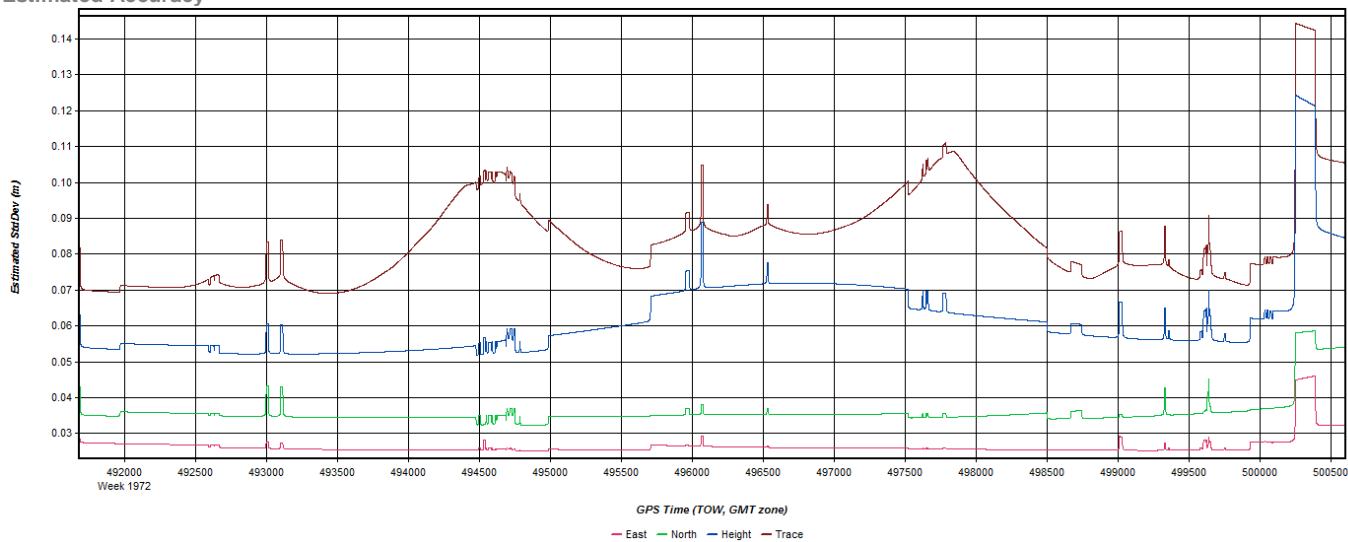
Log:

FUGRO		Fugro Geospatial, Inc.										Riegl				
17.06		Lift Begin			Lift End			Flt	Flt	Hobbs	Activity	Flight Log				
	Airport	Chocks	Hobbs	Airport	Chocks	Hobbs	Duration	Hrs	Hrs		AC80-50-00-02					
1	KRAP	16:16	428.8	KRAP	19:03	431.1	2:46	2.75	2.3	0900-Production						
2																
3																
FGI Job # 22.17003900		Project Name USGS SD Lidar 2017 D17			System 680i	Unit 216	IMU FMU-300			Ground Temp °C 2.0 4.0	Min Range' 1542	Data Logger Drives				
Flight Date 27-Oct-17	GPS Day 17-300	Lift 1				Sun° NA	Solar Times (UTC) NA	Pulse Rate 330 kHz	Flying Temp °C 0.0 3.0		Max Range' 2933	Download Drive				
Mission ID (yyymmdd_Sen_Job_Lift) 171027_216_17003900_01		Aircraft N3832K	Airport ID KRAP	FMS CCNS 6	UTC -6	AMT (ft) 2400	Speed 130	FOV	Scan Rate (Hz) 130	MTA 2	km/WPT 0.439	AltM Setting 30.29 30.24	Humidity @ Alt	Shipping Track		
Pilot #1 Wayne Manning		Pilot #2		Operator #1 Jonathan Spencer		Operator #2										
Base 1 ID FGI 081	Location KRAP		Rec ID GR3	Ant ID U5	ARP (m) 1.8	Start Time (UTC) 27-Oct-17 14:35		Stop Time (UTC) 28-Oct-17 00:03		GPS Filename Unit#51027o	Operator Jonathan Spencer	Data With AB				
Area	Flight #		Wpt		Distance		UTC		Flt	Altitude	Speed	Scan	Comments and Conditions		SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End	Dir	(GPS)	(knots)	Rate				
							16:26:43	16:31:43					5 min grd stc			
							16:55:51	16:57:42					S-turn			
EastSD_A	1		1	149	0	65	16:59:56	17:18:49	E	5,440	115	130.0			8	2.0
	2		154	1	67.2	0	17:25:02	17:44:53	W	5,390	115	130.0			8	2.0
	2		1	7	0	2.6	17:49:01	17:50:03	E	5,390	125	130.0	calibration line		8	2.0
	3		1	154	0	67.2	17:56:21	18:14:44	E	5,540	120	130.0			8	2.0
	4		153	36	66.7	15.4	18:18:35	18:33:08	W	5,540	115	130.0	called off by Ellsworth Control		8	2.0
EastSD_X	1		10	1	4	0	18:43:36	18:45:19	S	4,940	115	130.0	tie line		8	2.0
							18:45:32	18:47:14					S-turn			
							18:57:39	19:02:39					5 min grd stc			

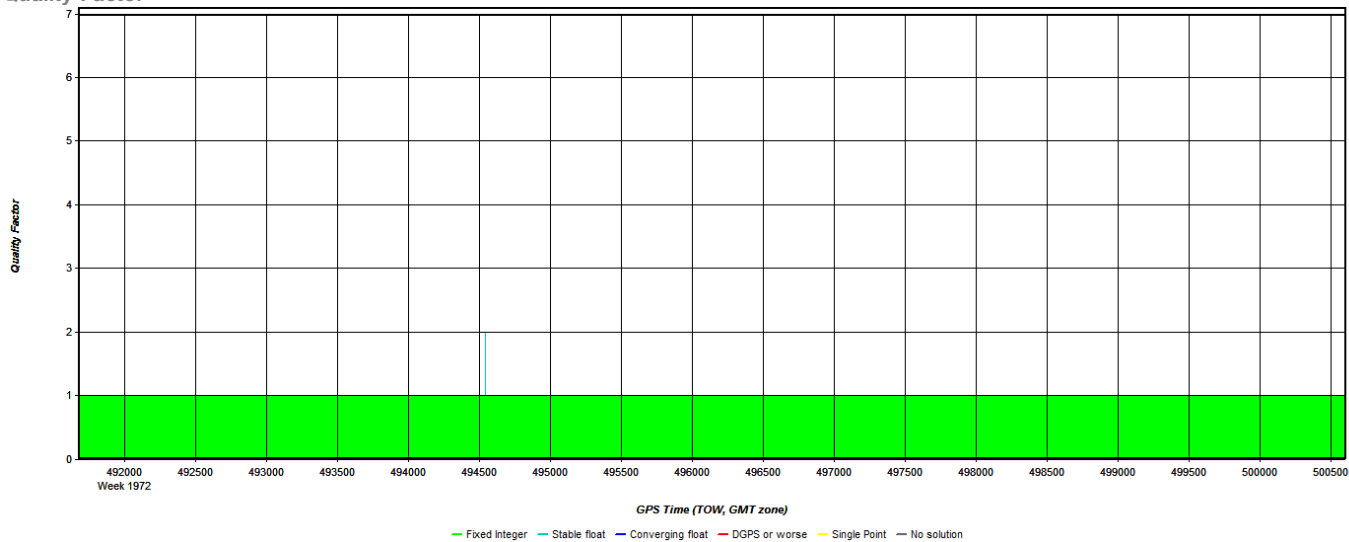
Trajectory and GPS Plots:



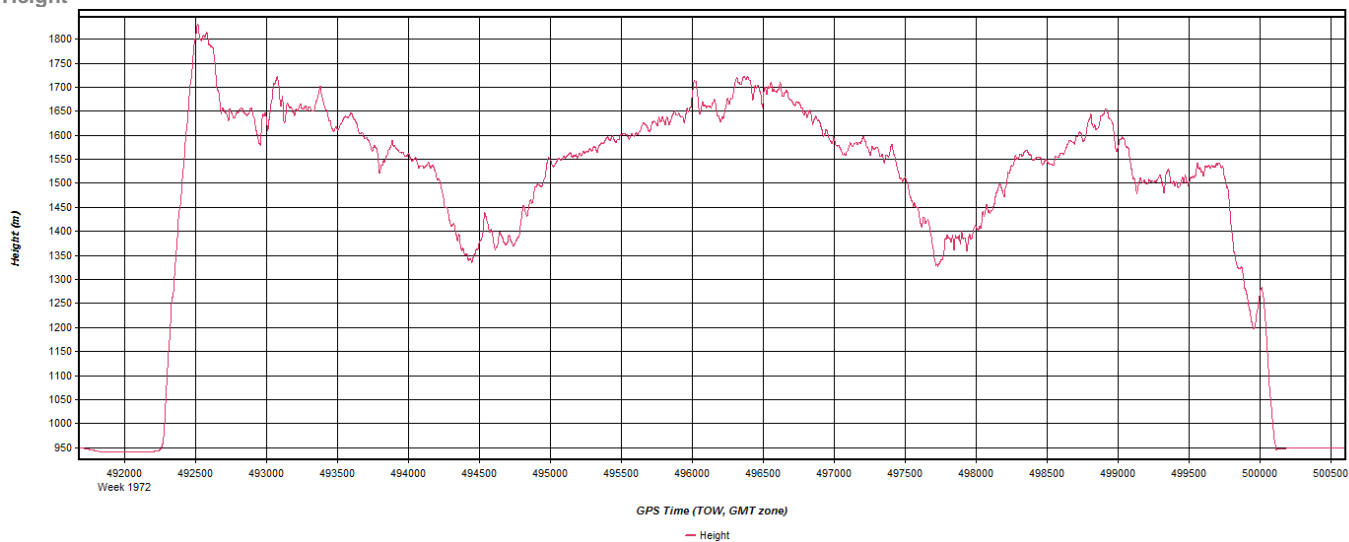
Estimated Accuracy



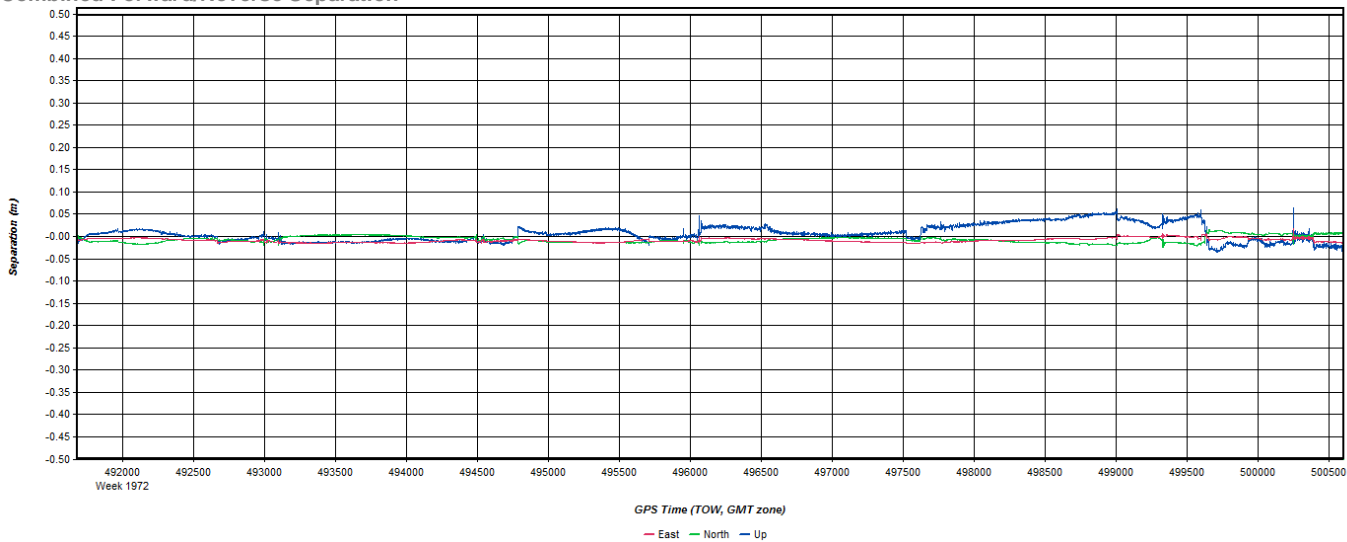
Quality Factor



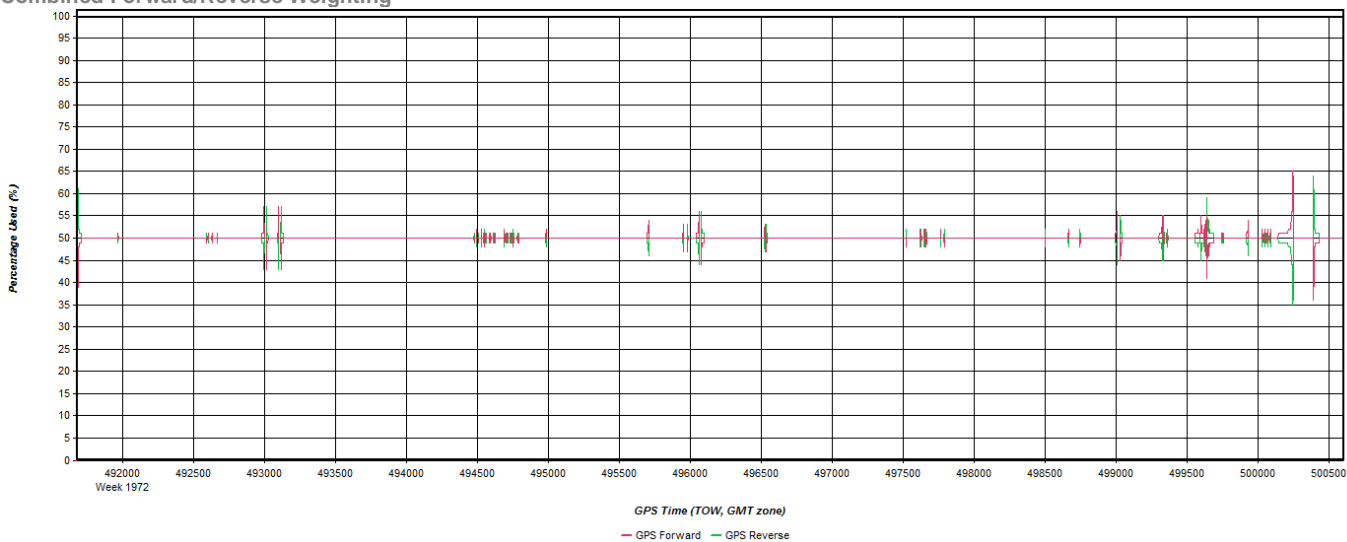
Height



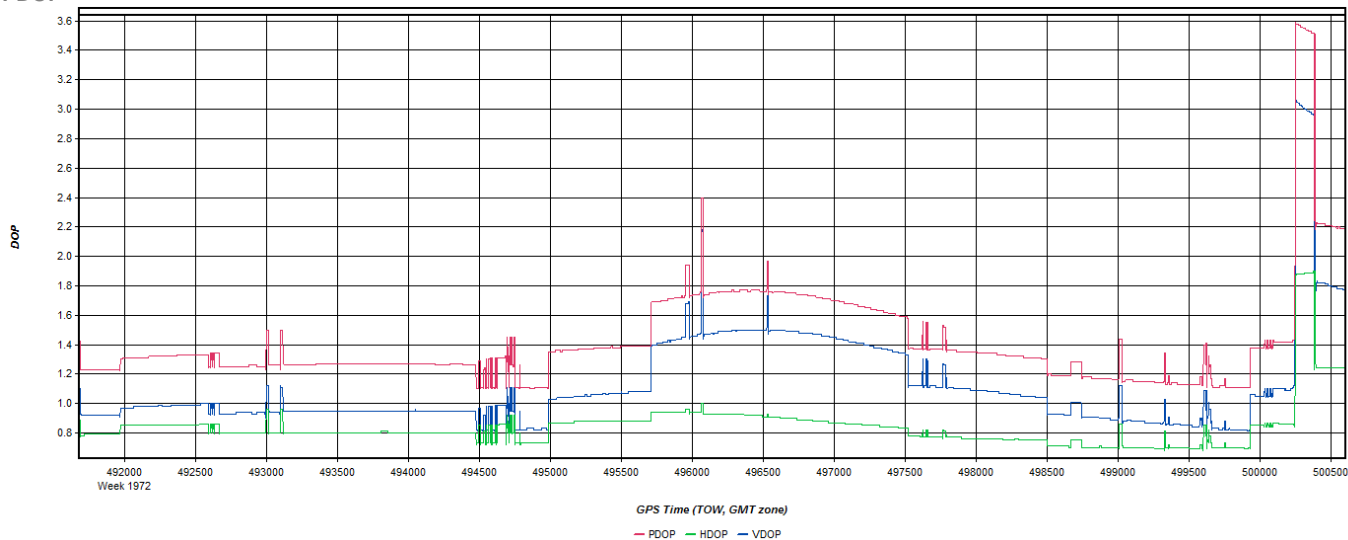
Combined Forward/Reverse Separation



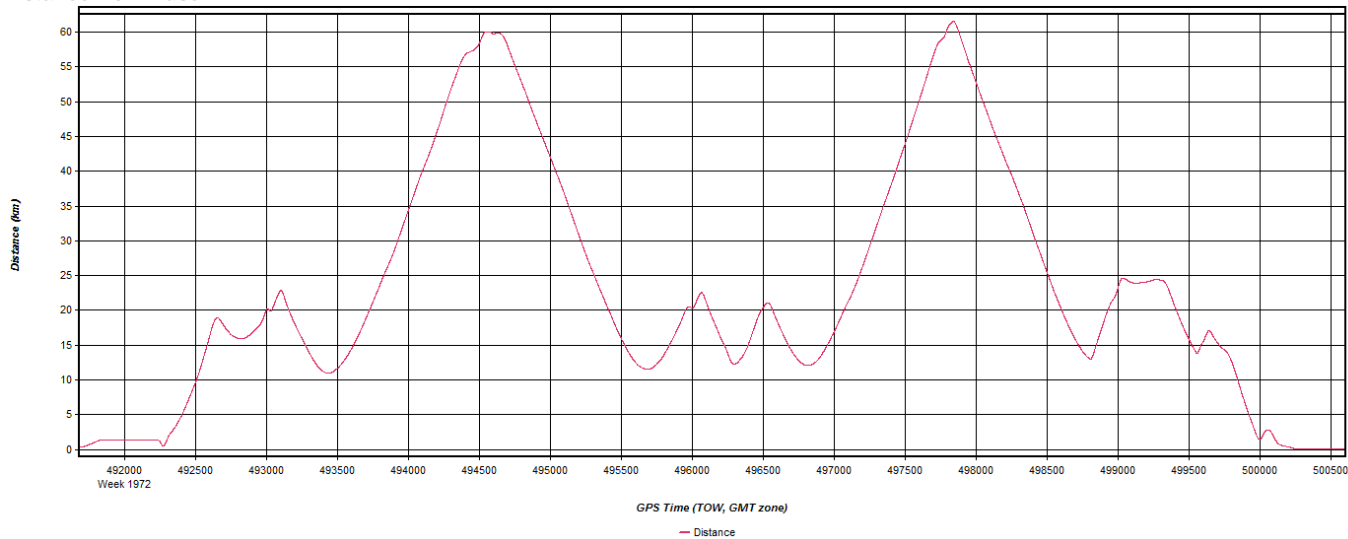
Combined Forward/Reverse Weighting



PDOP

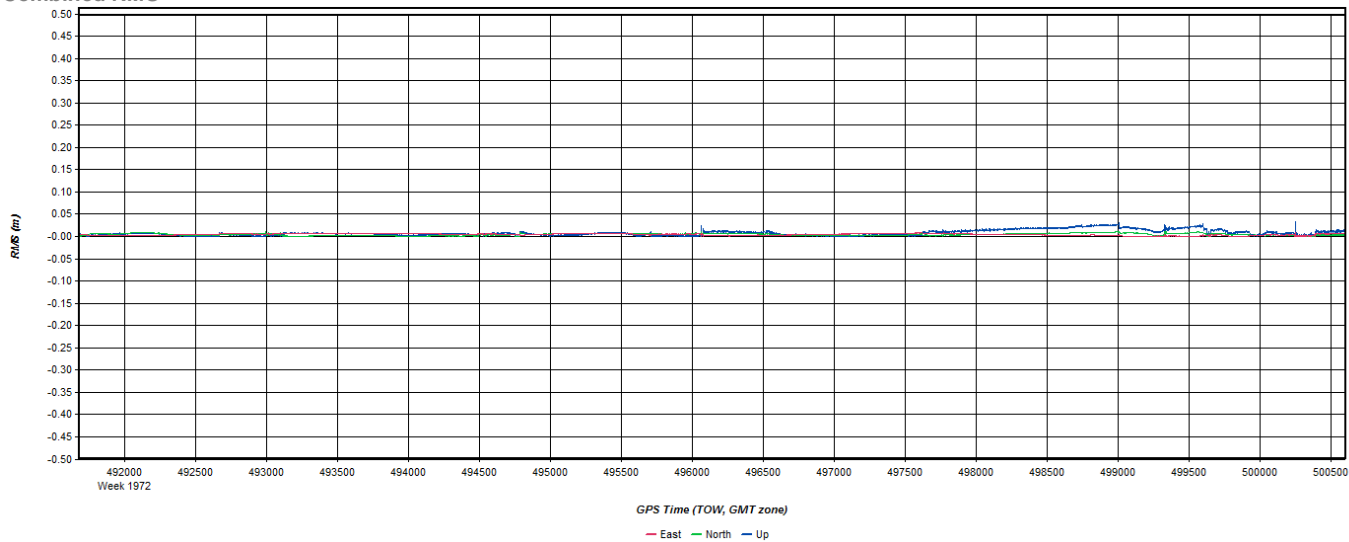


Distance from Base

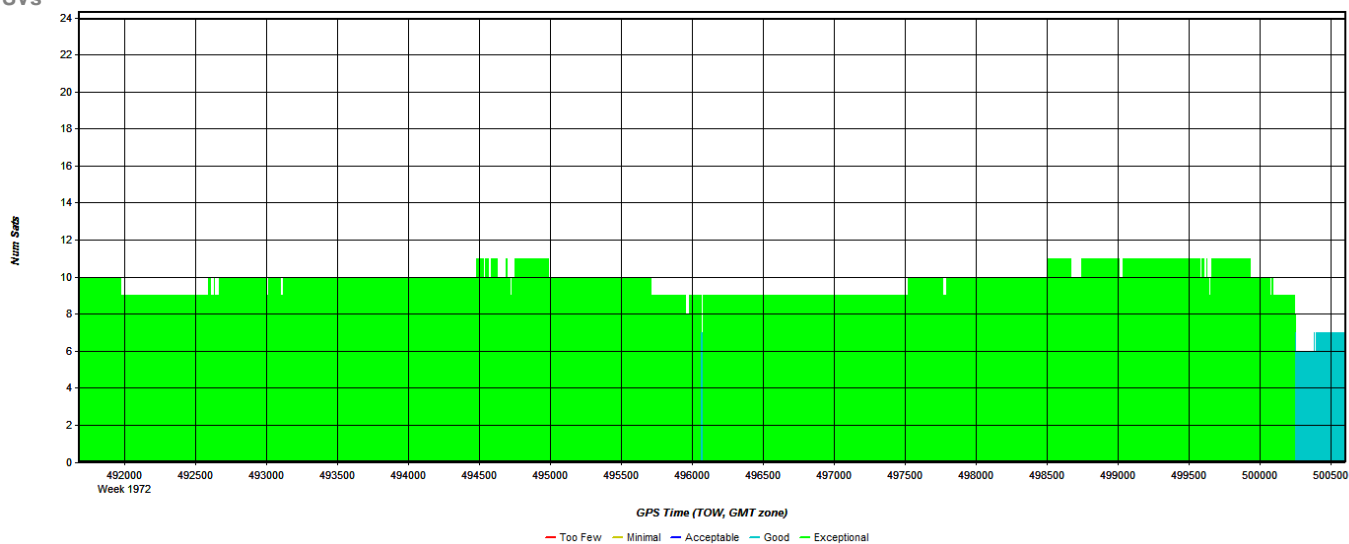




Combined RMS



SVs



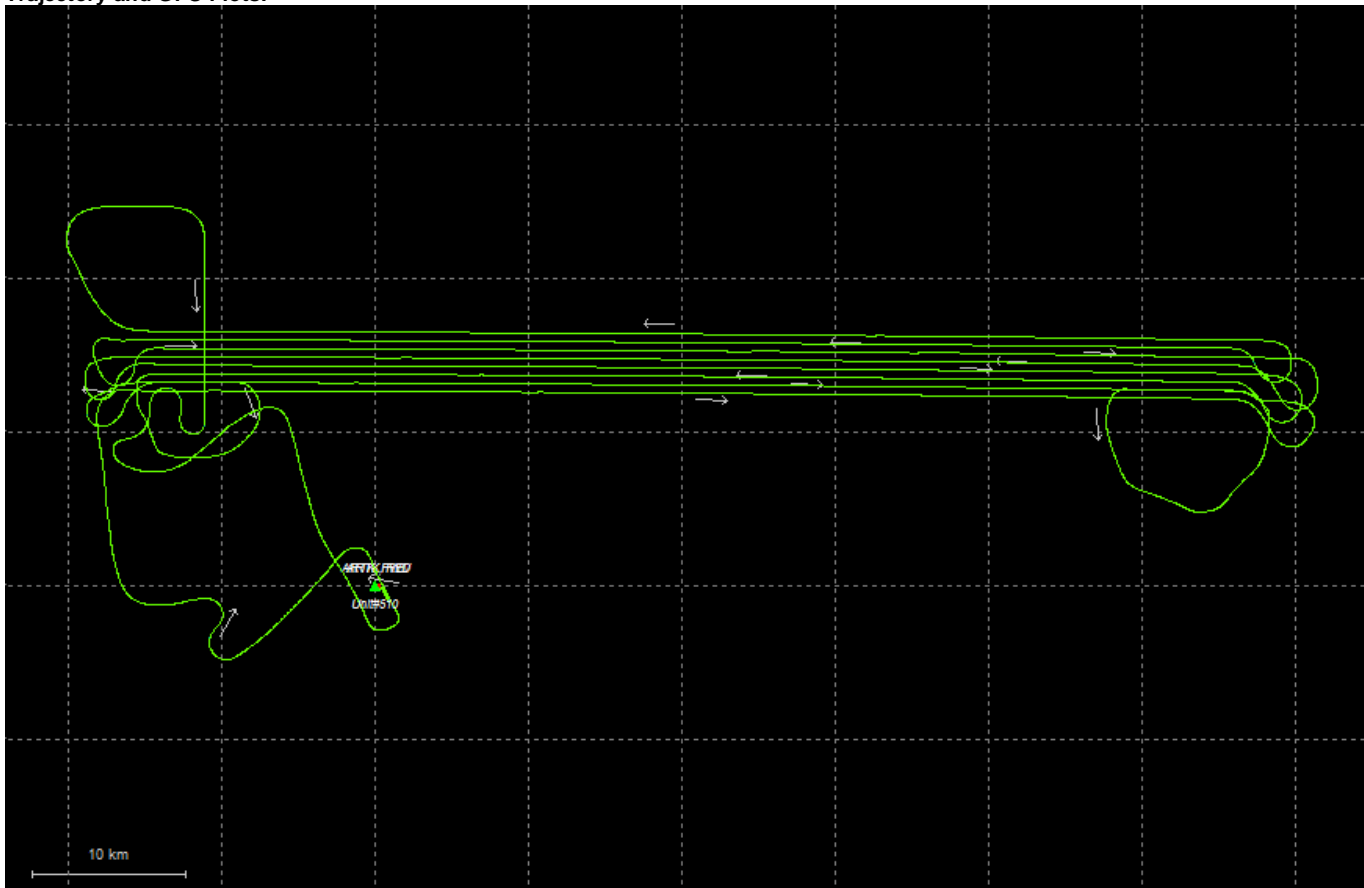


Acquisition and Processing details ----- Collection 2 (October 27, 2017)

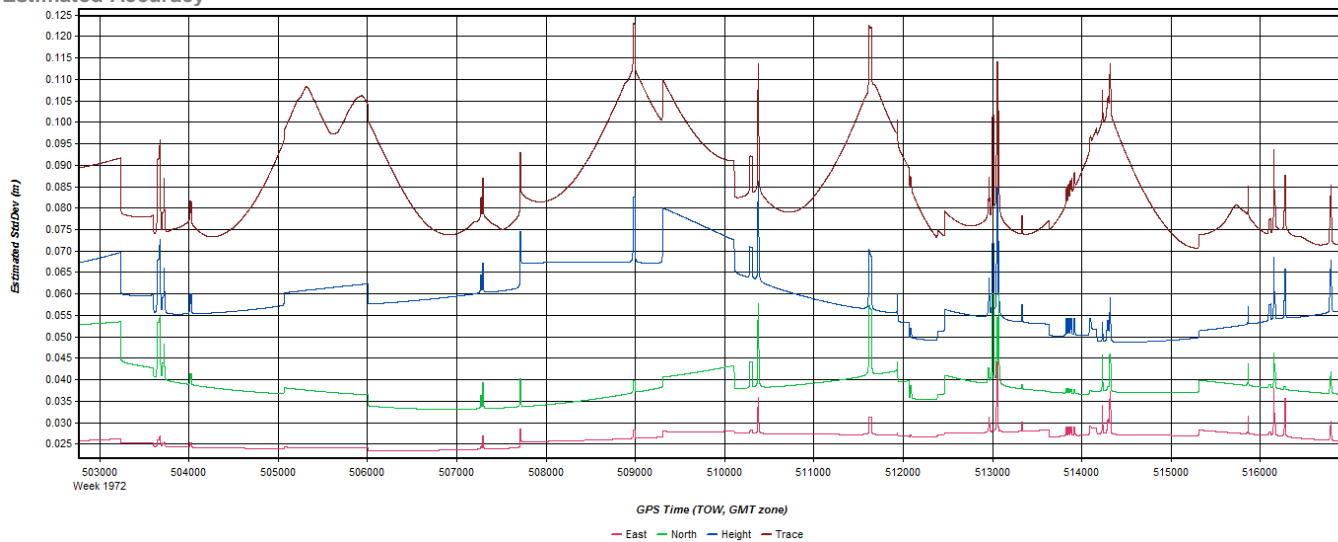
Log:

FUGRO		Fugro Geospatial, Inc.										Riegl Flight Log		AC80-50-00-02		
17.06		Lift Begin			Lift End			Flt	Flt	Hobbs	Activity					
		Airport	Chocks	Hobbs	Airport	Chocks	Hobbs	Duration	Hrs	Hrs						
1		KRAP	19:32	431.1	KRAP	23:43	434.9	4:10	4.25	3.8	0900-Production					
2																
3																
FGI Job #		Project Name				System	Unit	IMU			Ground Temp °C	Min Range'	Data Logger Drives			
22.17003900		USGS SD Lidar 2017 D17				680i	216	FMU-300			6.0 3.0	1542				
Flight Date		GPS Day	Lift				Sun°	Solar Times (UTC)		Pulse Rate	Flying Temp °C	Max Range'	Download Drive			
27-Oct-17		17-300	2				NA	NA		330 kHz	4.0 2.0	2933				
Mission ID (yyymmdd_Sen_Job_Lift)		Aircraft	Airport ID	FMS	UTC	AMT (ft)	Speed	FOV	Scan Rate (Hz)	MTA	km/WPT	AltM Setting	Humidity @ Alt	Shipping Track		
171027_216_17003900_02		N3832K	KRAP	CCNS 6	-6	2400	130		130	2	0.439	30.22 30.18				
Pilot #1		Pilot #2		Operator #1			Operator #2									
Wayne Manning				Jonathan Spencer												
Base 1 ID	Location		Rec ID	Ant ID	ARP (m)	Start Time (UTC)		Stop Time (UTC)		GPS Filename		Operator		Data		
FGI 081	KRAP		GR3	U5	1.8	27-Oct-17 14:35		28-Oct-17 00:03		Unit#51027o		Jonathan Spencer		With AB		
Area	Flight #		Wpt		Distance		UTC		Flt	Altitude	Speed	Scan	Comments and Conditions		SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End	Dir	(GPS)	(knots)	Rate				
							19:35:41	19:40:41					5 min grd stc			
							19:53:36	19:55:09					S-turn			
EastSD_A	4		1	154	0	67.2	20:00:46	20:19:18	E	5,540	120	130.0	re-flight		10	1.1
	5		153	1	66.7	0	20:33:10	20:52:30	W	5,540	115	130.0			10	1.1
	5		1	7	0	2.6	20:55:54	20:56:53	E	5,540	125	130.0	calibration line		10	1.2
	6		1	154	0	67.2	21:01:58	21:20:42	E	5,540	123	130.0			9	1.3
	7		154	1	67.2	0	21:24:24	21:43:50	W	5,540	112	130.0			9	1.3
	8		1	154	0	67.2	21:47:17	22:05:16	E	5,540	125	130.0			9	1.2
	9		154	1	67.2	0	22:09:22	22:28:26	W	5,440	117	130.0			9	1.1
	10		1	154	0	67.2	22:31:42	22:49:44	E	5,440	123	130.0			9	1.1
	11		153	1	66.7	0	22:52:57	23:12:15	W	5,440	115	130.0			11	1.2
EastSD_X	1		19	5	7.9	1.8	23:18:42	23:20:58	S	4,940	113	130.0	crossing tie line		10	1.1
							23:21:16	23:23:05					S-turn			
							23:36:47	23:41:47					5 min grd stc			
													Lift end			

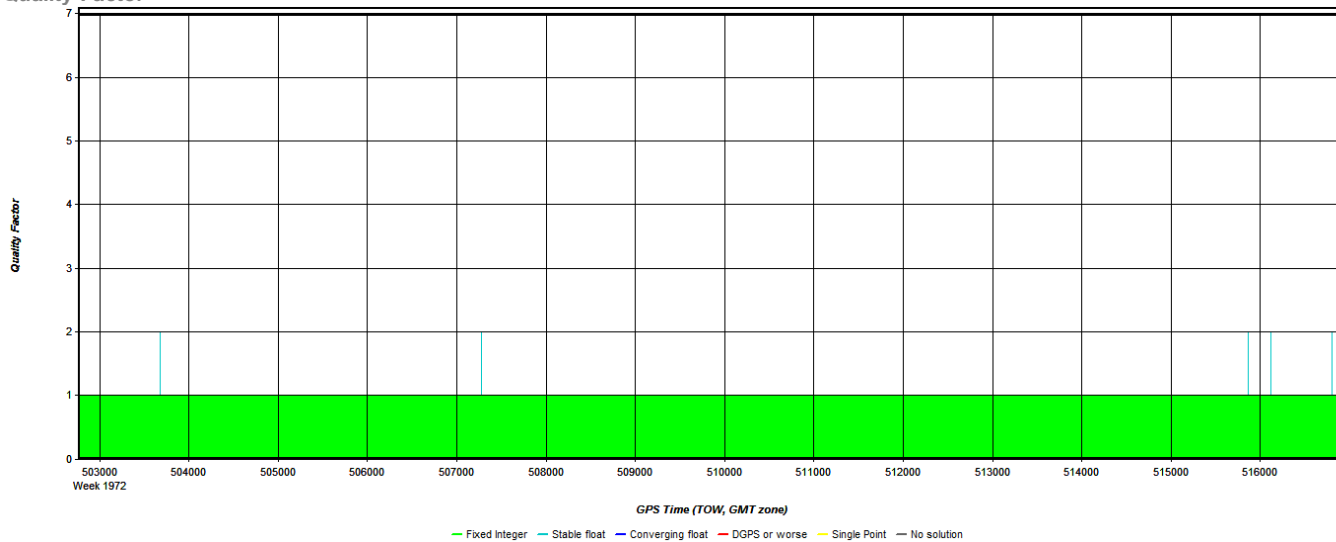
Trajectory and GPS Plots:



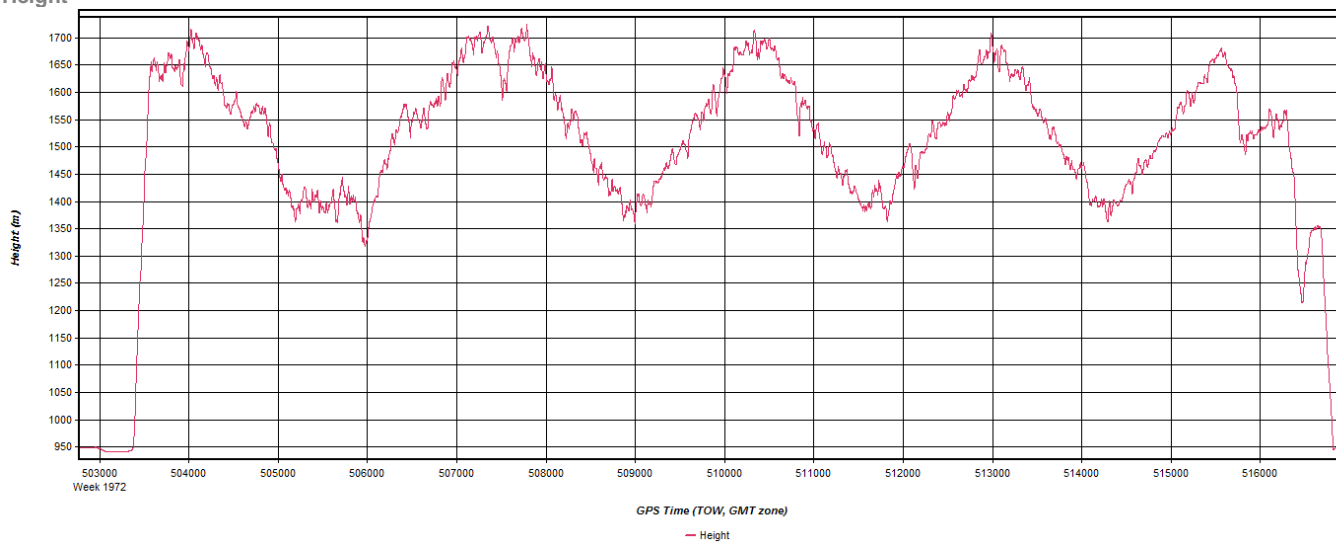
Estimated Accuracy



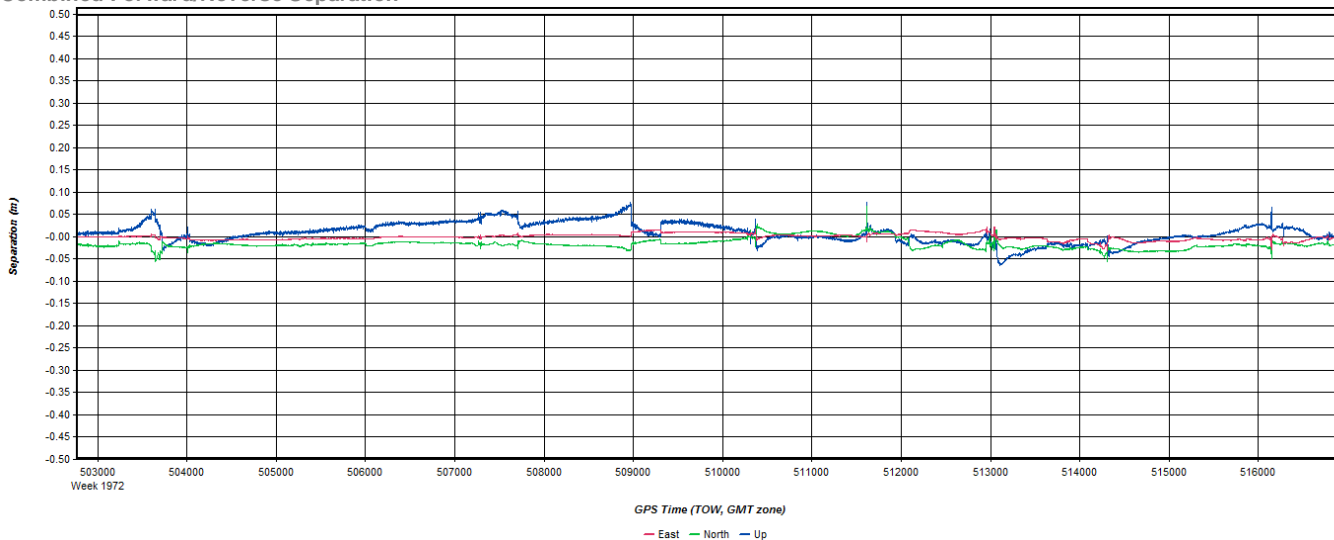
Quality Factor



Height



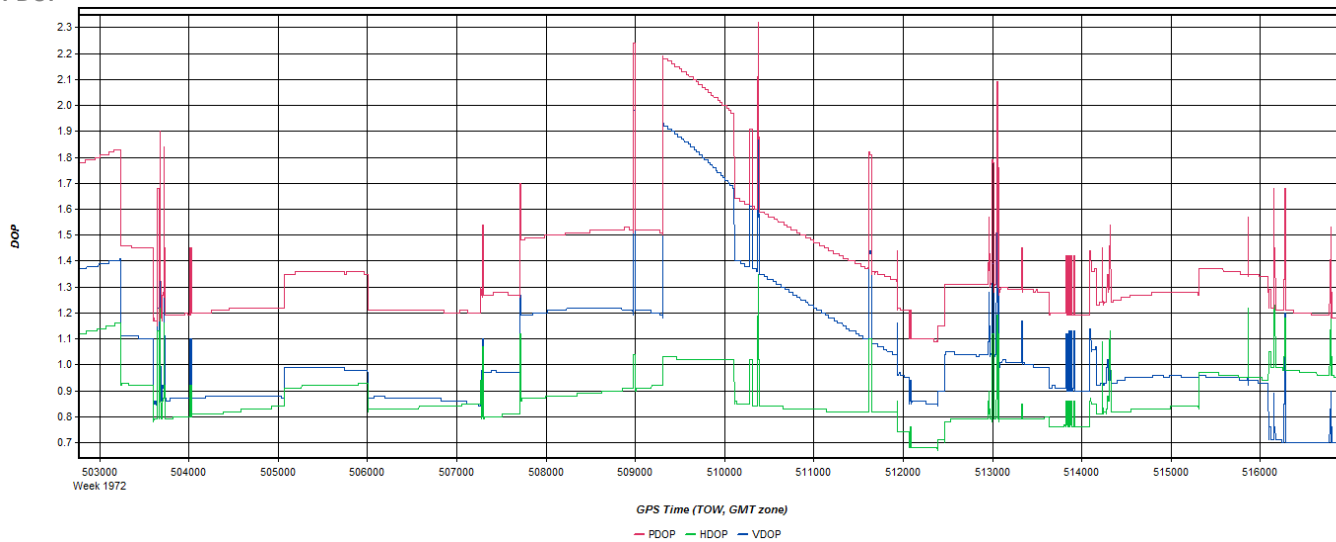
Combined Forward/Reverse Separation



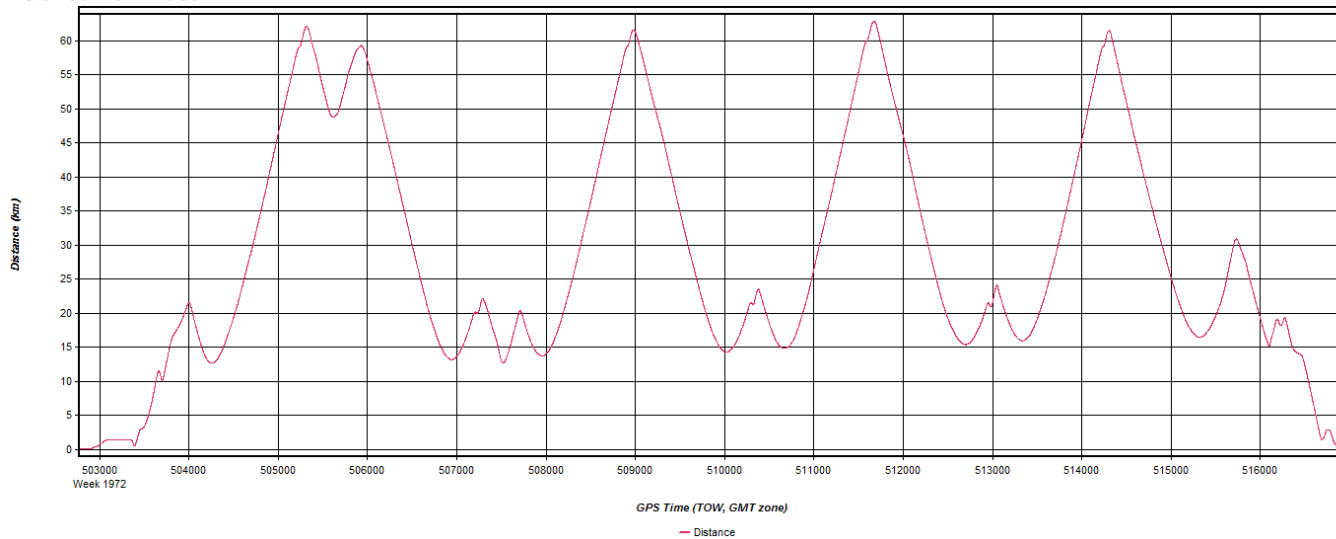
Combined Forward/Reverse Weighting



PDOP

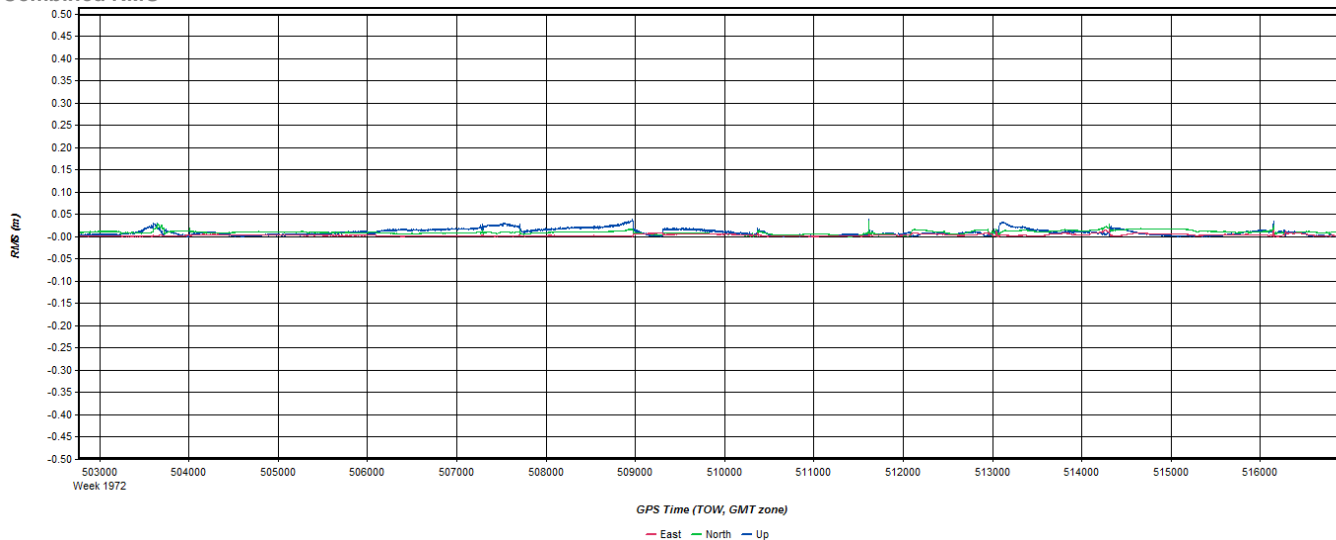


Distance from Base

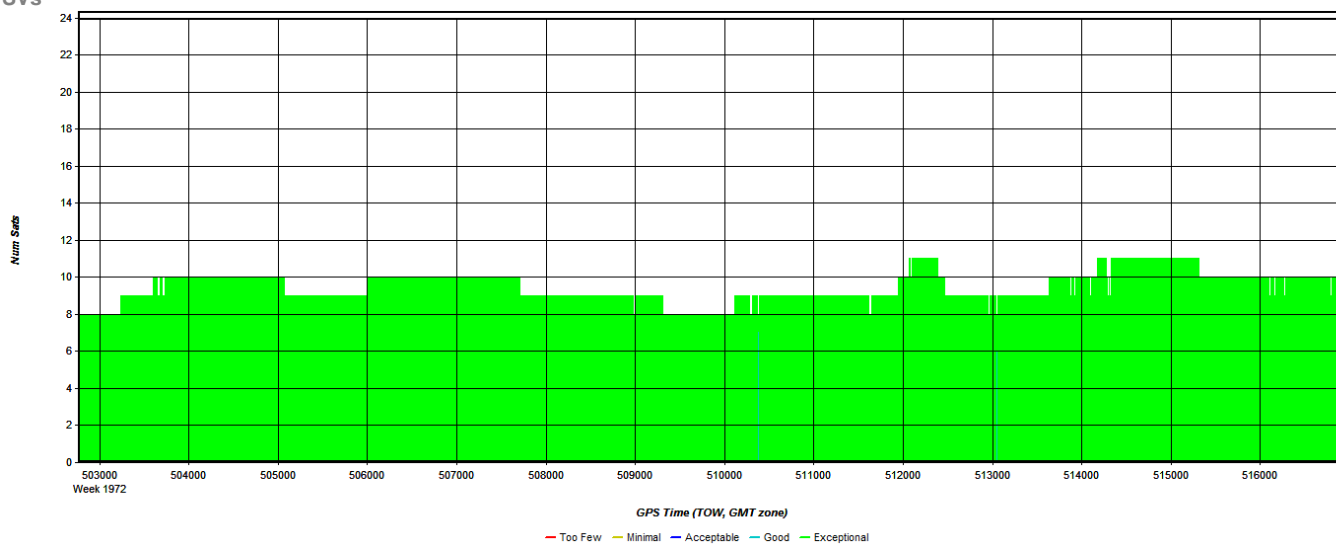




Combined RMS



SVs



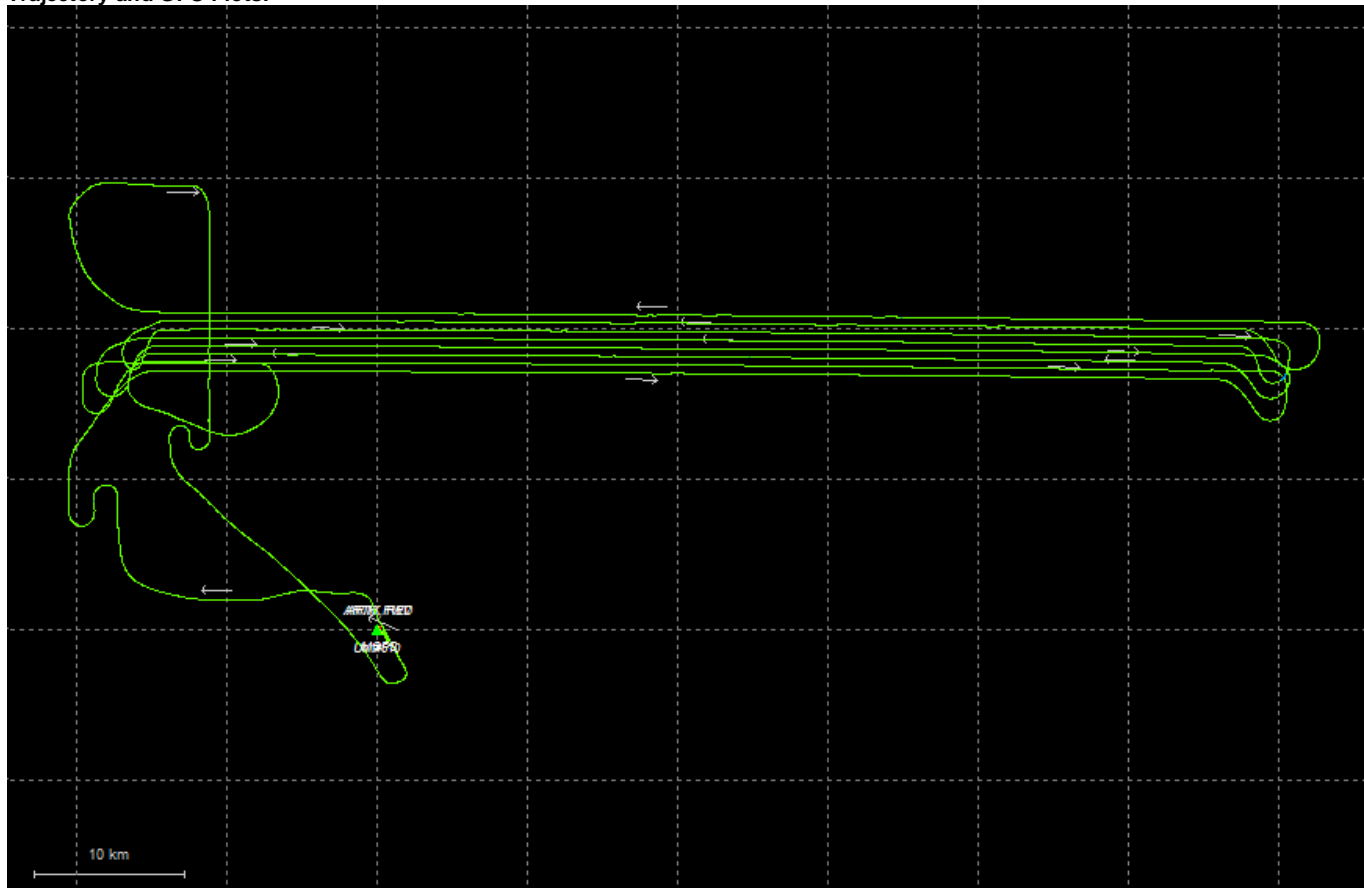


Acquisition and Processing details ----- Collection 3 (October 28, 2017)

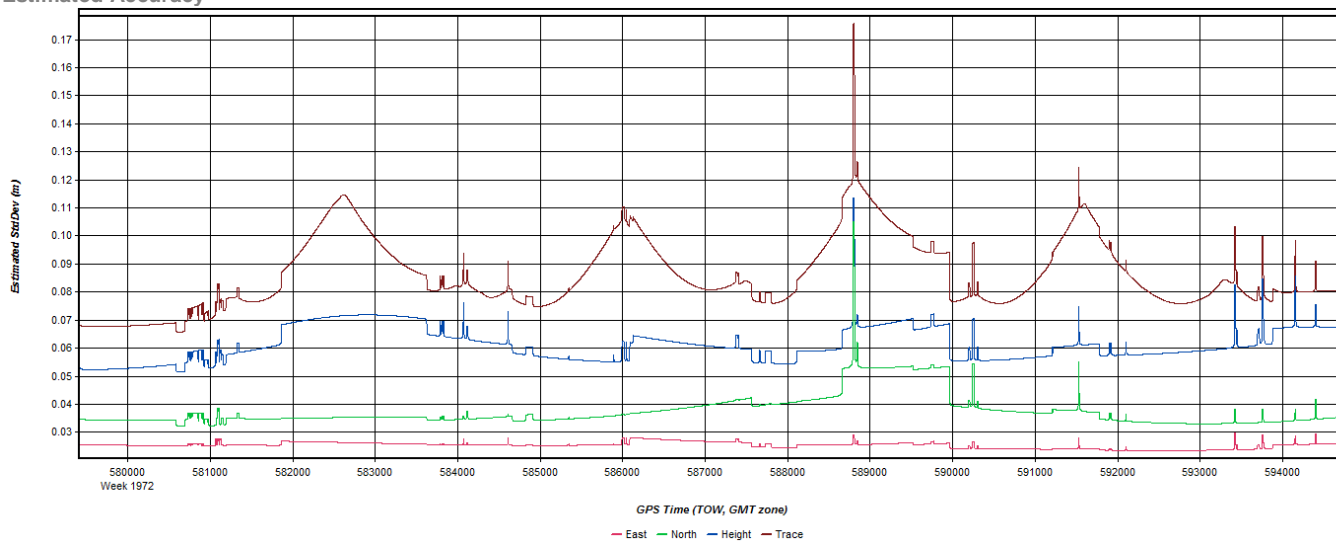
Log:

FUGRO		Fugro Geospatial, Inc.										Riegl Flight Log		AC80-50-00-02		
17.06		Lift Begin			Lift End			Flt	Flt	Hobbs	Activity					
		Airport	Chocks	Hobbs	Airport	Chocks	Hobbs	Duration	Hrs	Hrs						
1		KRAP	16:55	434.9	KRAP	21:13	438.7	4:17	4.25	3.8	0900-Production					
2																
3																
FGI Job #		Project Name				System	Unit	IMU	Ground Temp °C		Min Range'		Data Logger Drives			
22.17003900		USGS SD Lidar 2017 D17				680i	216	FMU-300	11.0 14.0		1542					
Flight Date		GPS Day	Lift	Sun°			Solar Times (UTC)		Pulse Rate	Flying Temp °C		Max Range'	Download Drive			
28-Oct-17		17-301	3	NA			NA		330kHz	6.0 10.0		2933				
Mission ID (yyymmdd_Sen_Job_Lift)		Aircraft	Airport ID	FMS	UTC	AMT (ft)	Speed	FOV	Scan Rate (Hz)	MTA	km/WPT	AltM Setting	Humidity @ Alt	Shipping Track		
171028_216_17003900_03		N3832K	KRAP	CCNS 6	-6	2400	130		130	2	0.439	30.02 29.91				
Pilot #1		Pilot #2		Operator #1			Operator #2									
Wayne Manning		Jonathan Spencer														
Base 1 ID	Location		Rec ID	Ant ID	ARP (m)	Start Time (UTC)		Stop Time (UTC)		GPS Filename		Operator	Data			
FGI 081	KRAP		GR3	U5	1.8					Unit#51028		Riley Forsyth	With AB			
Area	Flight #		Wpt		Distance		UTC		Flt	Altitude	Speed	Scan	Comments and Conditions		SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End	Dir	(GPS)	(knots)	Rate				
							16:58:34	17:03:34					5 min grd stc			
							17:23:56	17:25:42					S-turn			
EastSD_A	12		1	153	0	66.7	17:28:55	17:47:37	E	5,440	115	130.0			10	1.2
	13		153	1	66.7	0	17:51:39	18:11:34	W	5,390	110	130.0			9	1.3
	13		1	10	0	4	18:16:26	18:17:49	E	5,390	120	130.0	calibration line		10	1.3
	14		1	153	0	66.7	18:24:21	18:44:12	E	5,340	113	130.0			11	1.3
	15		157	1	68.5	0	18:47:37	19:08:25	W	5,340	114	130.0			11	1.1
	16		1	157	0	68.5	19:12:14	19:31:36	E	5,340	120	130.0			10	1.2
	17		157	1	68.5	0	19:34:53	19:55:56	W	5,340	110	130.0			8	1.4
	18		1	157	0	68.5	19:58:43	20:17:34	E	5,340	125	130.0			10	1.0
	19		157	1	68.5	0	20:21:02	20:44:08	W	5,340	107	130.0	Data recorder warning		10	1.1
EastSD_X	1		30	12	12.7	4.8	20:51:39	20:54:09	S	4,940	118	130.0	crossing tie line		10	1.1
							20:54:37	20:56:21					S-turn			
							21:06:40	21:11:40					5 min grd stc			

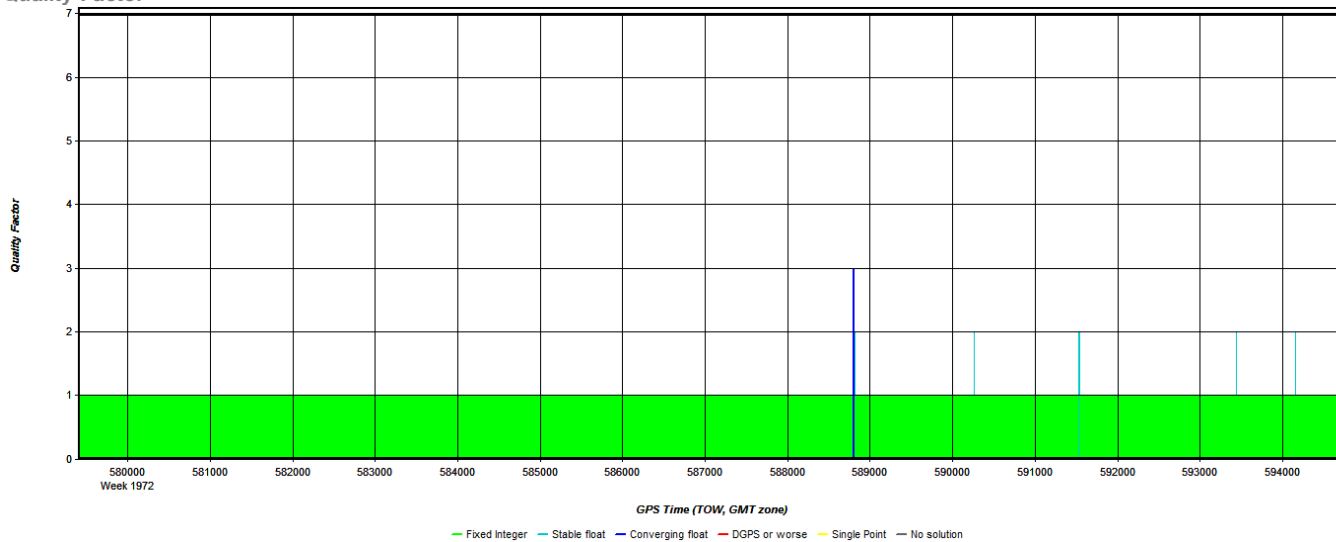
Trajectory and GPS Plots:



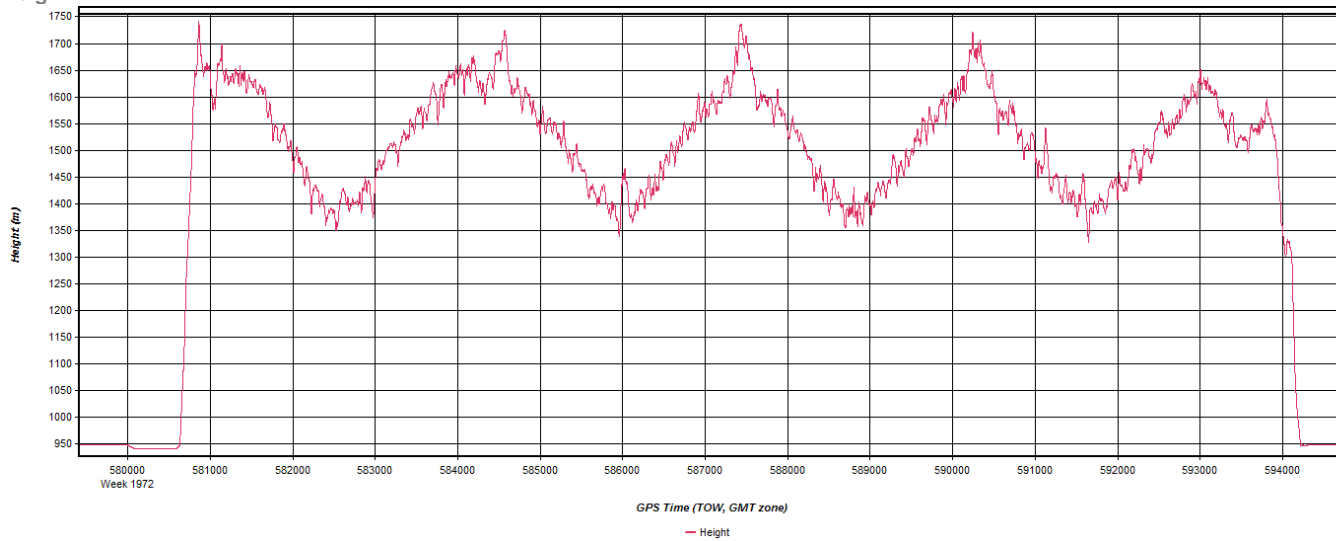
Estimated Accuracy



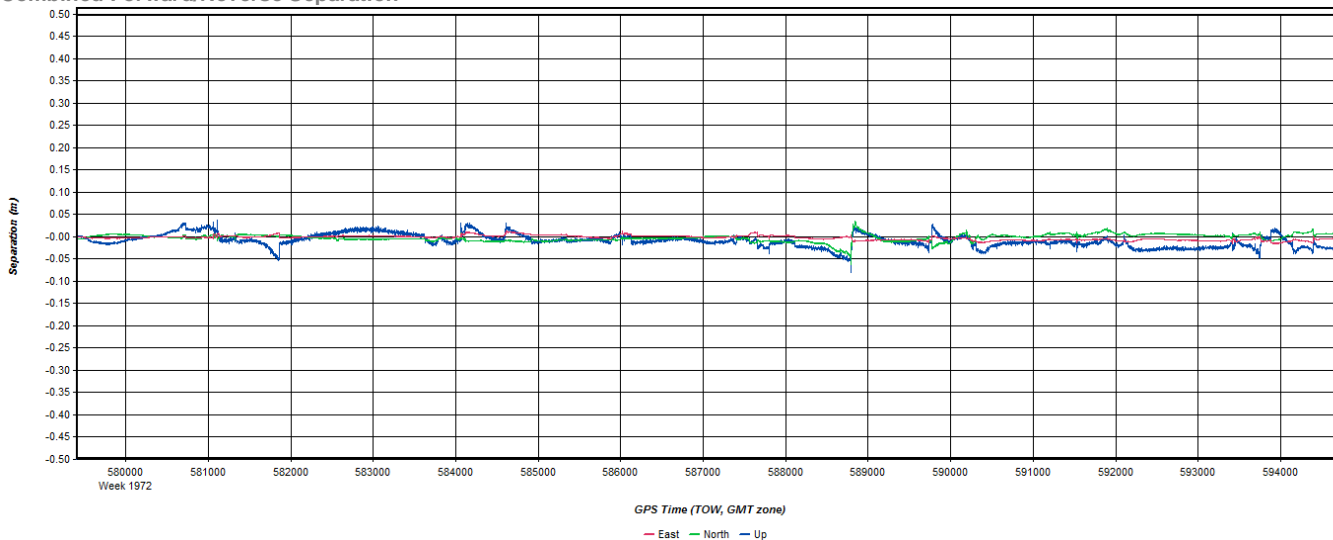
Quality Factor



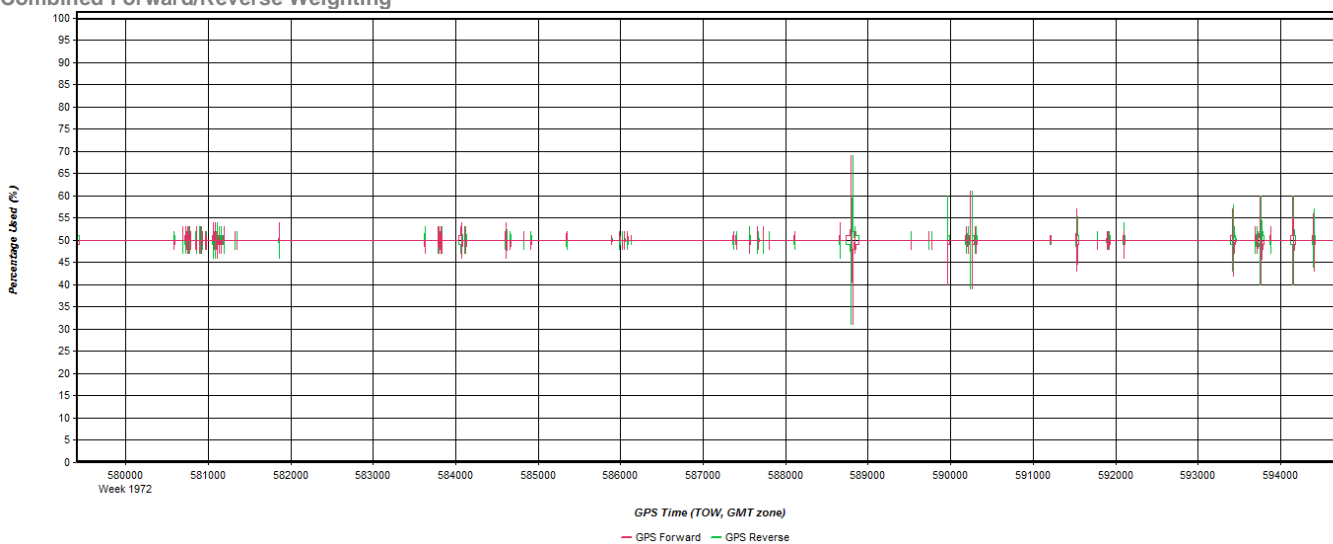
Height



Combined Forward/Reverse Separation

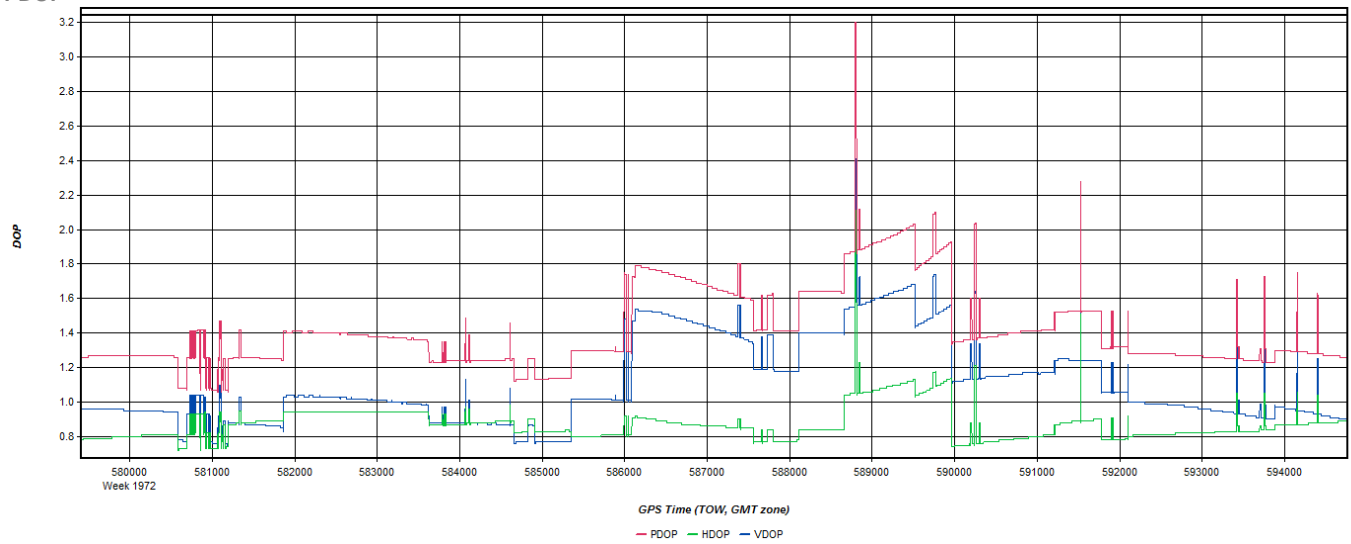


Combined Forward/Reverse Weighting

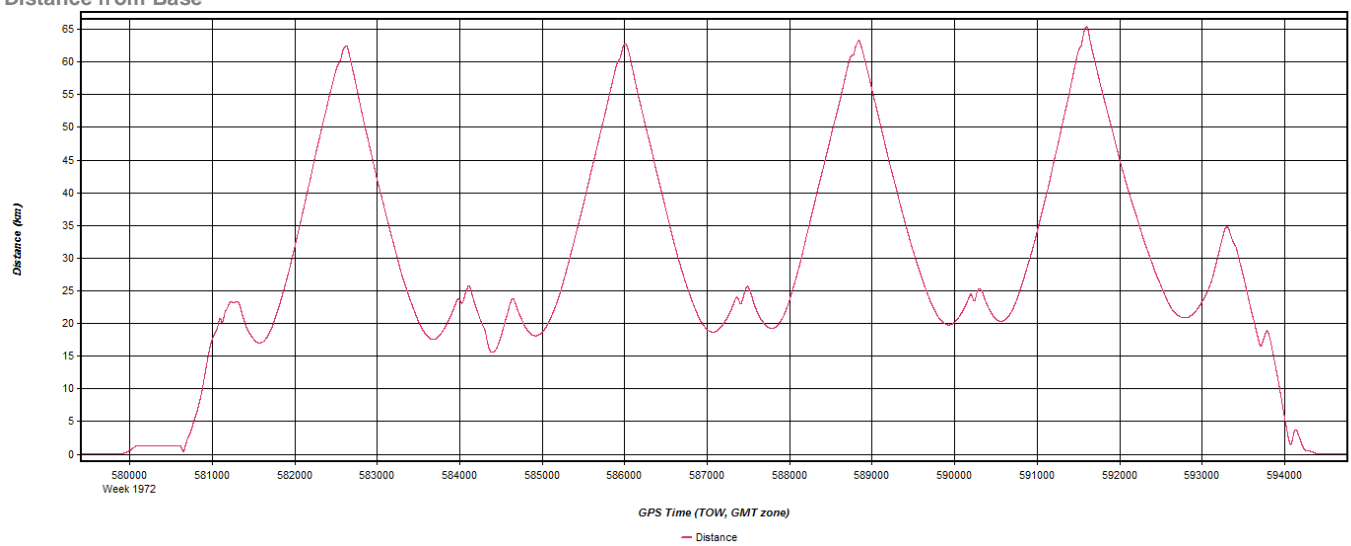


USGS COLLECTION REPORT

PDOP

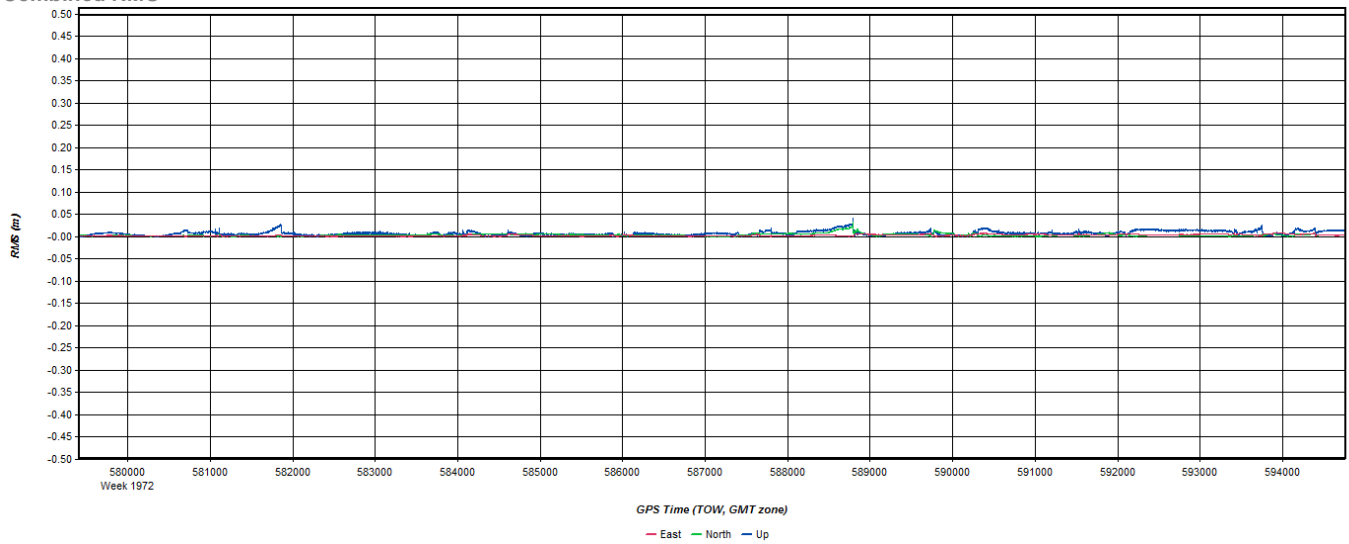


Distance from Base

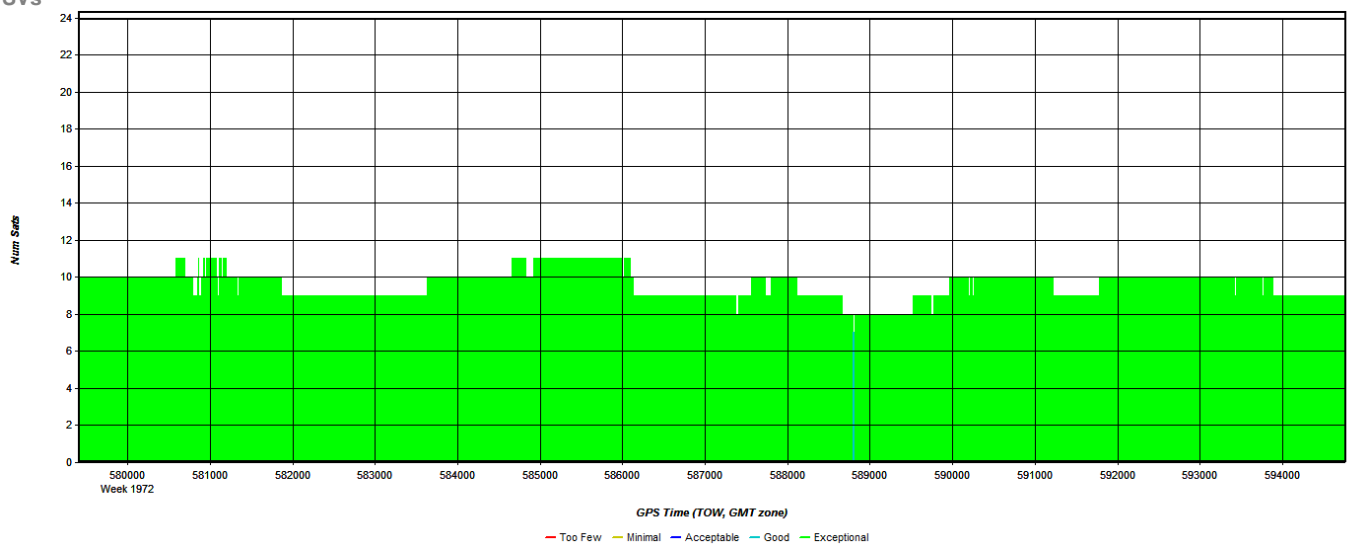


USGS COLLECTION REPORT

Combined RMS



SVs





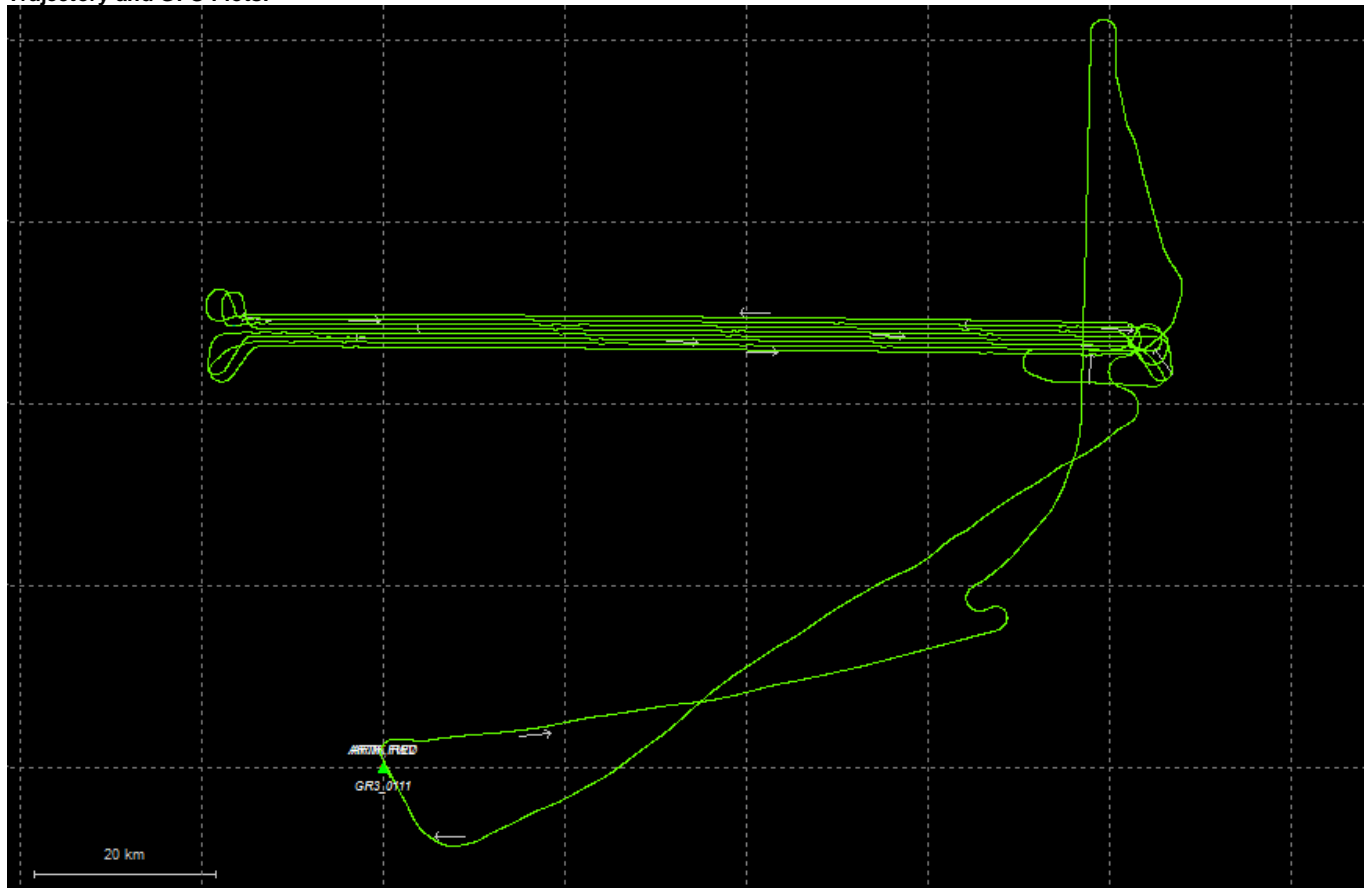
Acquisition and Processing details ----- Collection 4 (November 8, 2017)

Log:

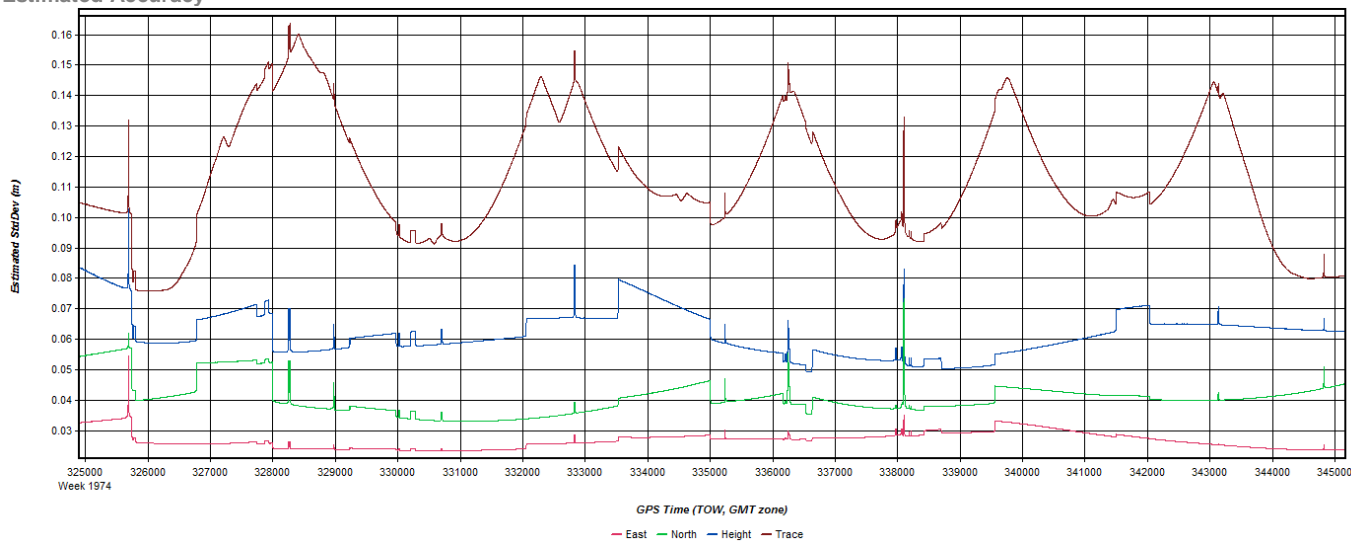
FUGRO		Fugro Geospatial, Inc.										Riegl Flight Log		AC80-50-00-02	
17.06		Lift Begin			Lift End			Flt	Flt	Hobbs	Activity				
		Airport	Chocks	Hobbs	Airport	Chocks	Hobbs	Duration	Hrs	Hrs					
1	KRAP	18:11	769.4	KRAP	23:53	774.5	5:42	5.75	5.1	0900-Production					
2															
3															

FGI Job # 17003900	Project Name USGS SD Lidar 2017 D17		System 680i	Unit 165	IMU						Ground Temp °C 4.0 1.0	Min Range' 1542	Data Logger Drives			
Flight Date 8-Nov-17	GPS Day 17-312	Lift 1			Sun°	Solar Times (UTC)	Pulse Rate 330			Flying Temp °C 6.0 -4.0	Max Range' 2933	Download Drive				
Mission ID (yyymmdd_Sen_Job_Lift) 171108_165_17003900_01		Aircraft N97HC	Airport ID KRAP	FMS CCNS 7	UTC -7	AMT (ft) 2400	Speed 130	FOV 56.2	Scan Rate (Hz) 120	MTA 2	km/WPT 0.439	AltM Setting 30.05 30.09	Humidity @ Alt 44	Shipping Track		
Pilot #1 Steve Hartman		Pilot #2		Operator #1 Riley Forsyth		Operator #2										
Base 1 ID FGI 081	Location Rapid City SD		Rec ID GR3-5	Ant ID GR3-5	ARP (m) 1.8	Start Time (UTC)		Stop Time (UTC)		GPS Filename Unit#5171108o		Operator Jonathan Spencer	Data			
Area	Flight #		Wpt		Distance		UTC		Flt	Altitude	Speed	Scan	Comments and Conditions		SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End	Dir	(GPS)	(knots)	Rate				
							18:21:00	18:26:00					Ground static at KRAP		14	1.3
							18:53:27						pre acquisition s turn		17	1.0
E-680-X	3		1	88	0	38.2	19:01:44	19:12:58	N	4,403	130		cross tie line		18	1.0
E-680-B	1		205	1	89.6	0	19:23:44	19:47:52	W	4,380	119				19	1.0
	2		1	208	0	90.9	19:51:53	20:15:41	E	4,966	130				18	1.2
	2		208	198	90.9	86.5	20:20:05	20:22:10	W	4,368	118		calibration line		19	1.2
	3		208	1	90.9	0	20:28:57	20:53:27	W	4,320	121				18	1.2
	4		1	209	0	91.3	20:57:58	21:21:43	E	4,982	130				17	1.2
	5		210	1	91.8	0	21:27:11	21:51:56	W	4,216	118				19	1.1
	6		1	211	0	92.2	21:55:46	22:19:32	E	4,747	120				21	1.0
	7		212	1	92.6	0	22:24:04	22:48:29	W	4,205	120				20	1.0
	8		1	213	0	93.1	22:52:49	23:16:48	E	4,944	126				20	1.0
							23:16:59						post acquisition s turn		18	1.2
							23:47:00	23:52:00					Ground static at KRAP		17	1.2

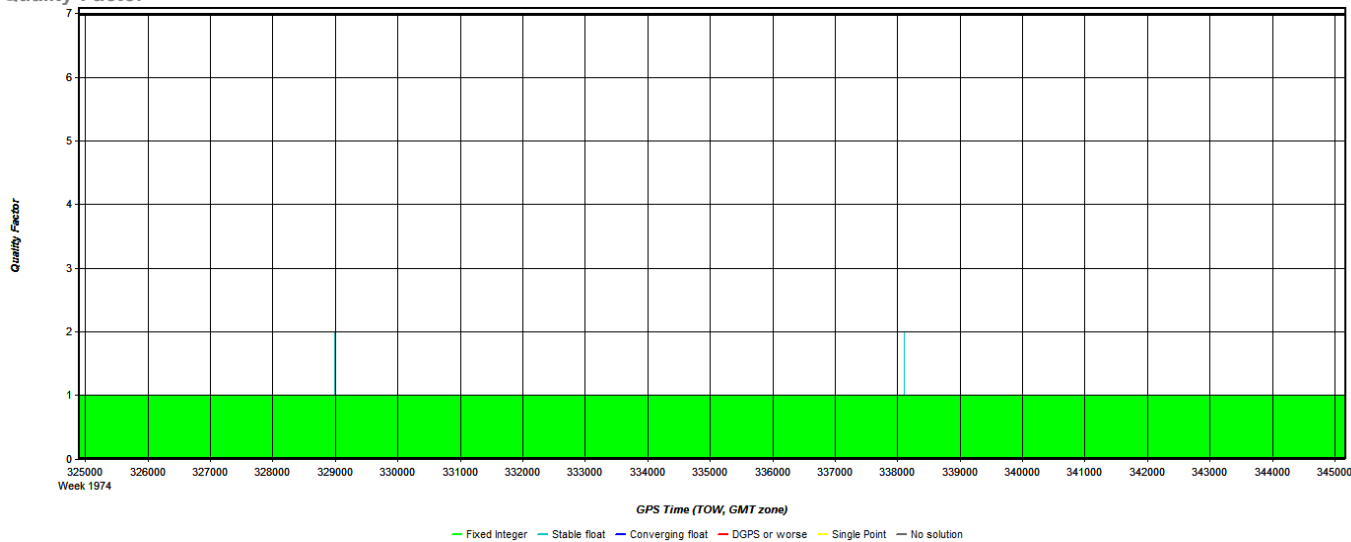
Trajectory and GPS Plots:



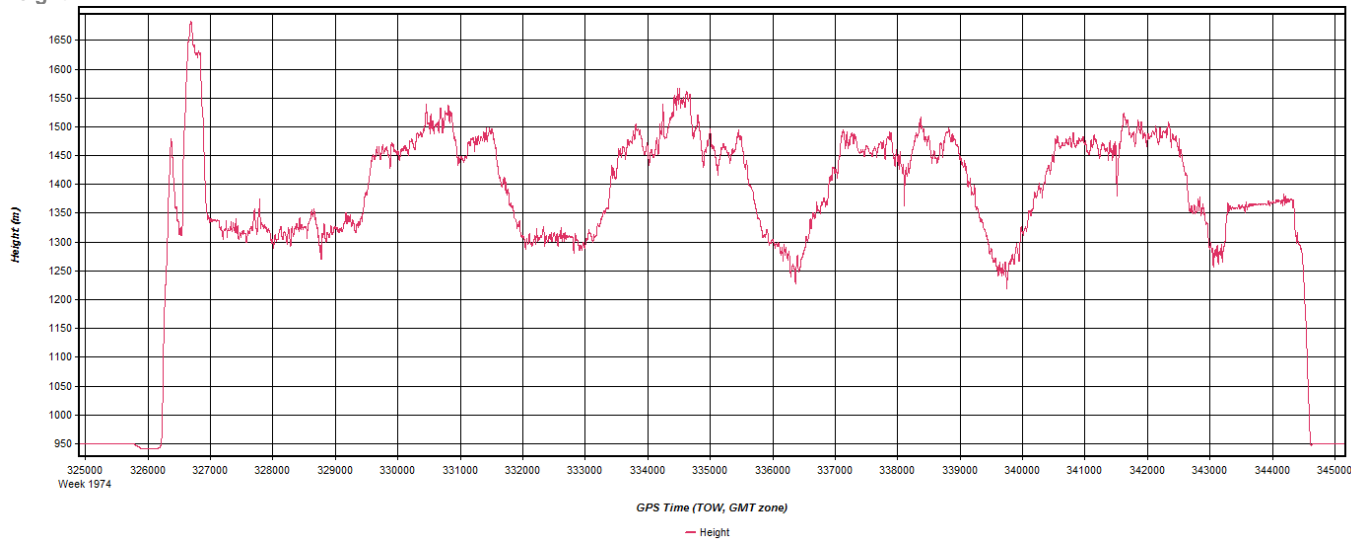
Estimated Accuracy



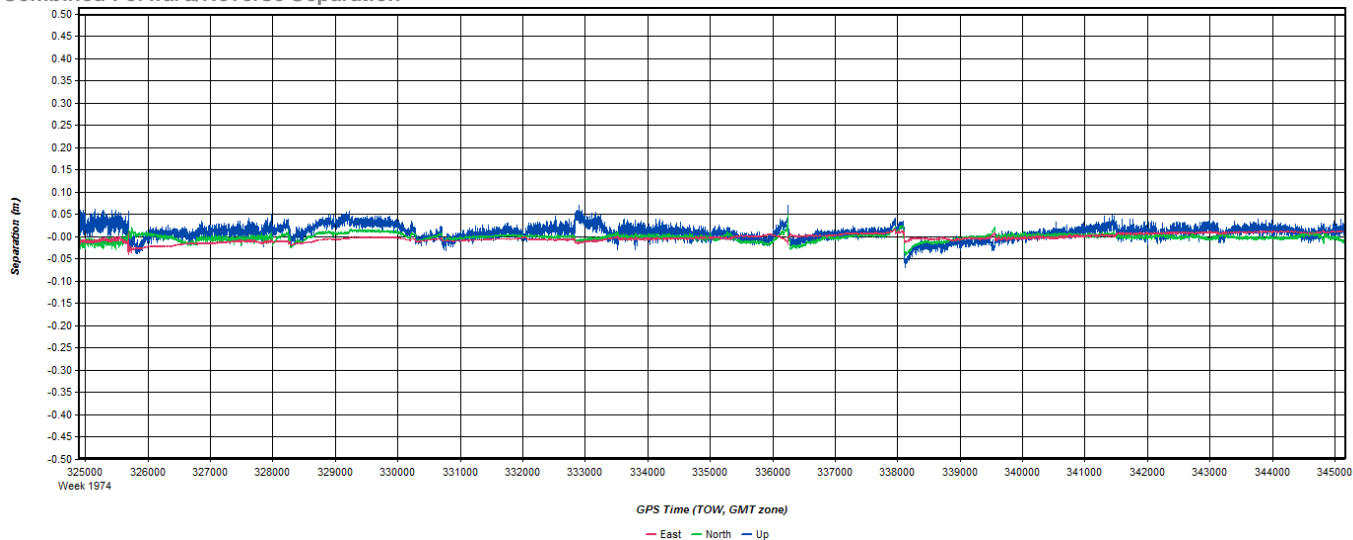
Quality Factor



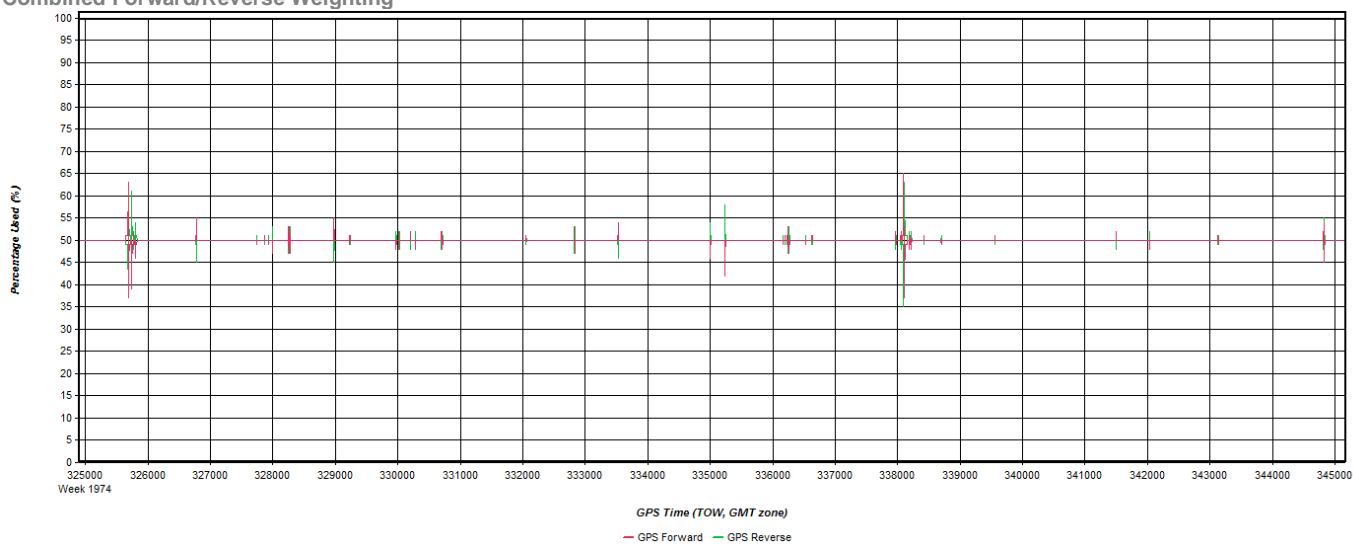
Height



Combined Forward/Reverse Separation



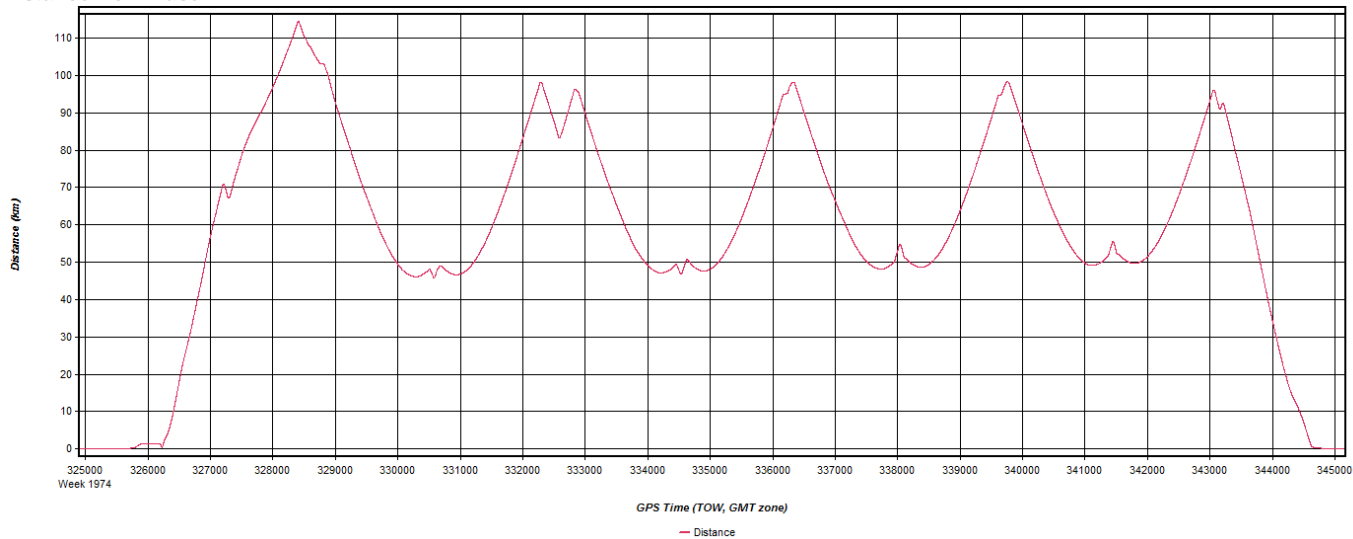
Combined Forward/Reverse Weighting



PDOP

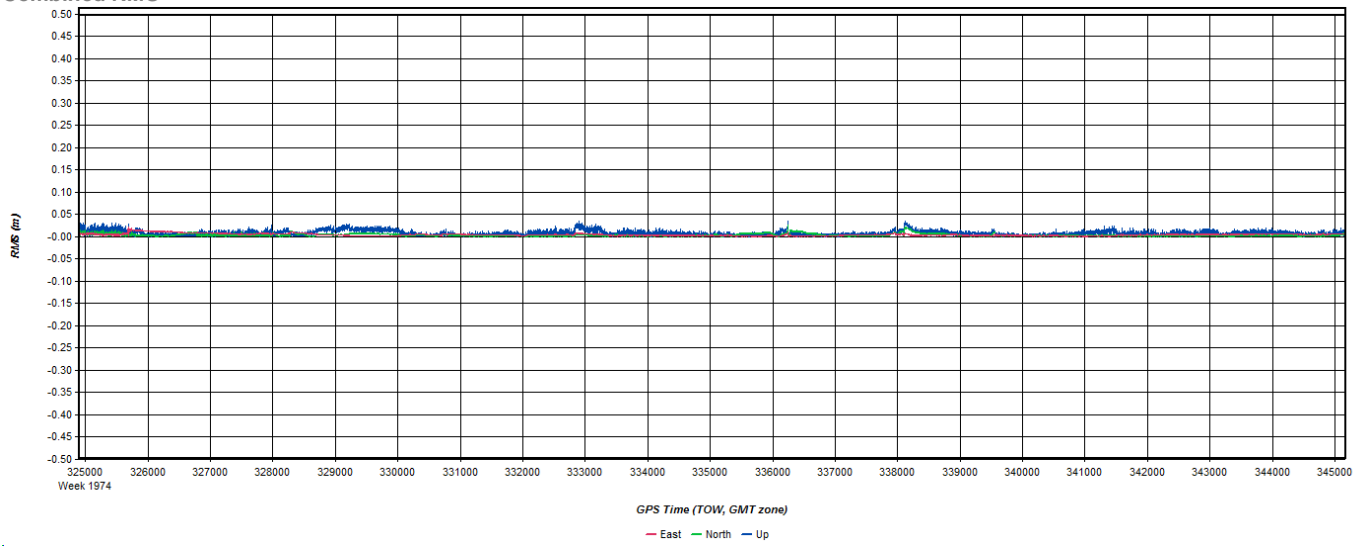


Distance from Base

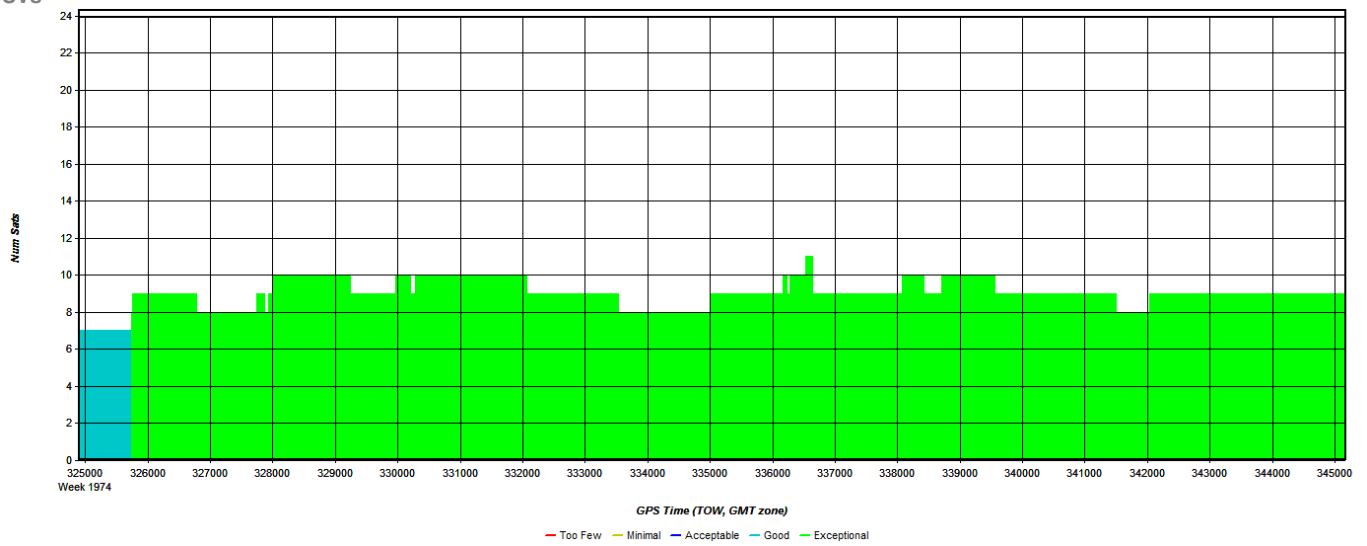


USGS COLLECTION REPORT

Combined RMS



SVs



**USGS
COLLECTION REPORT**



Acquisition and Processing details ----- Collection 5 (November 8, 2017)

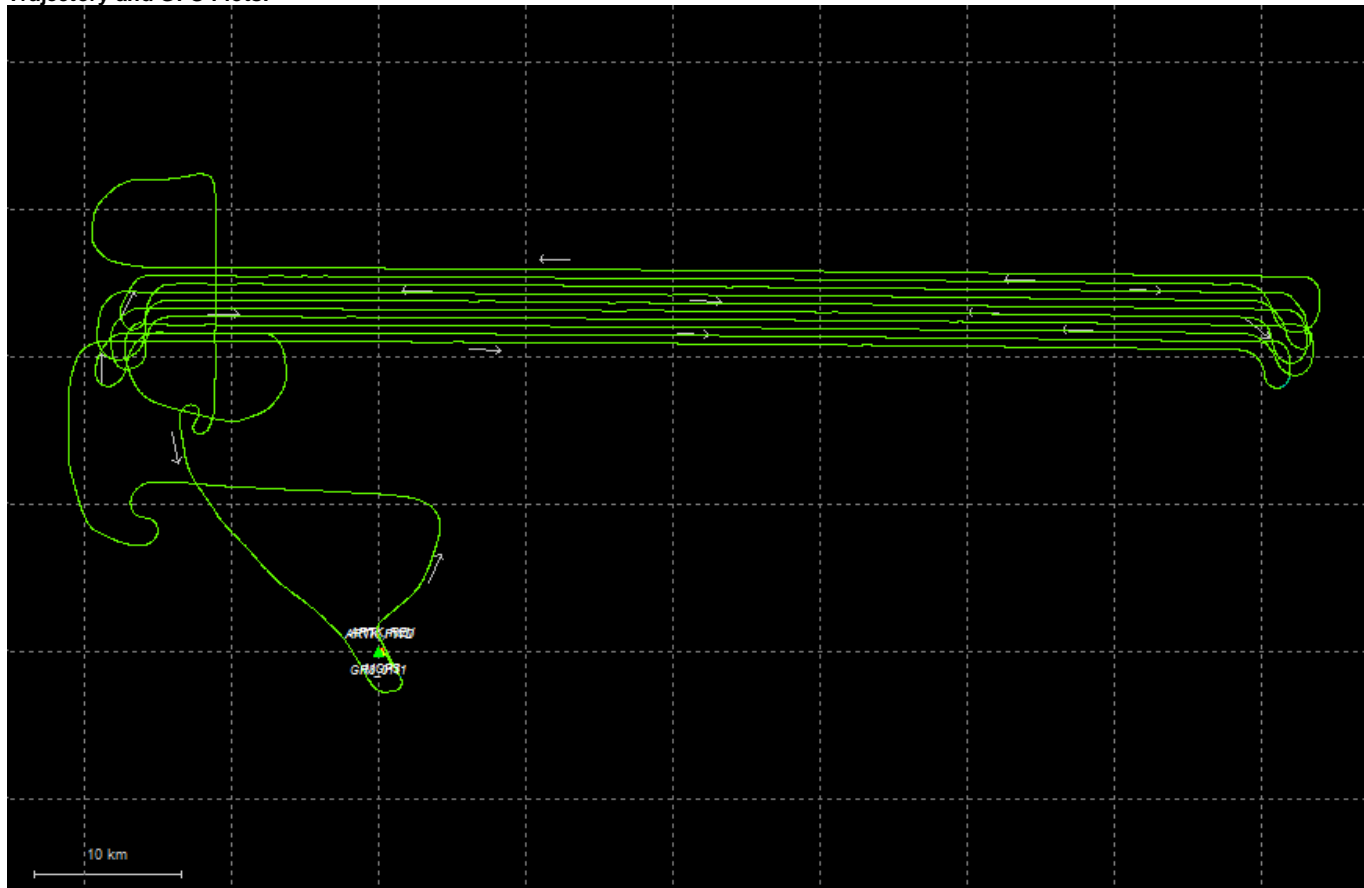
Log:

17.06	Lift Begin			Lift End			Flt Duration	Flt Hrs	Hobbs Hrs	Activity
	Airport	Chocks	Hobbs	Airport	Chocks	Hobbs				
	1	KRAP	16:52	439.1	KRAP	21:49	443.6	4:56	5.00	4.5
2										
3										

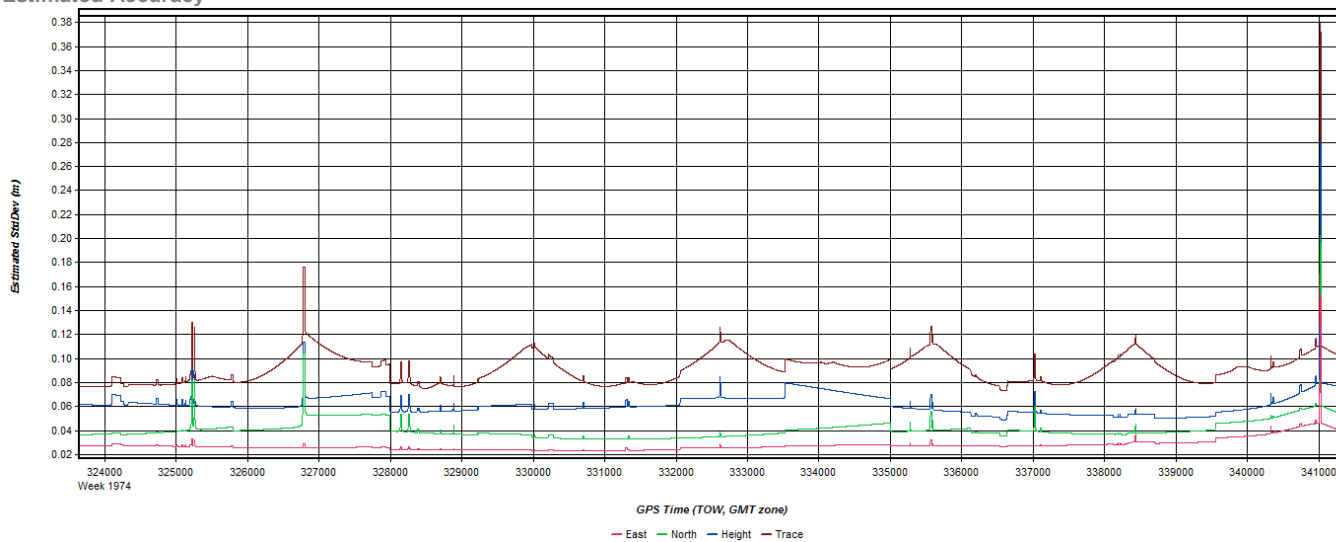
Fugro Geospatial, Inc.		Riegl Flight Log		AC80-50-00-02
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FGI Job # 22.17003900	Project Name USGS SD Lidar 2017 D17		System 680i	Unit 216	IMU FMU-300			Ground Temp °C 4.0 3.0	Min Range' 1542	Data Logger Drives					
Flight Date 8-Nov-17	GPS Day 17-312	Lift 4	Sun° NA		Solar Times (UTC) NA		Pulse Rate 330kHz	Flying Temp °C 6.0 2.0	Max Range' 2933	Download Drive					
Mission ID (yyymmdd_Sen_Job_Lift) 171108_216_17003900_04		Aircraft N3832K	Airport ID KRAP	FMS CCNS 6	UTC -6	AMT (ft) 2400	Speed 130	FOV	Scan Rate (Hz) 130	MTA 2	km/WPT 0.439	AltM Setting 30.05 30.08	Humidity @ Alt	Shipping Track	
Pilot #1 Wayne Manning		Pilot #2		Operator #1 Jonathan Spencer		Operator #2									
Base 1 ID FGI 081	Location KRAP		Rec ID GR3 U1	Ant ID U1	ARP (m) 1.8	Start Time (UTC) 08-Nov-17 15:09		Stop Time (UTC)	GPS Filename	Operator Jonathan Spencer	Data With AB				
Area	Flight #		Wpt		Distance		UTC		Flt Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions	SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End							
							16:57:11	17:02:11					5 min grd stc		
							17:19:16	17:20:48					S-turn		
EastSD_A	19		1	157	0	68.5	17:26:24	17:44:48	E	5,340	122	130.0	re-flight	10	1.2
	20		157	1	68.5	0	17:47:53	18:06:59	W	5,290	118	130.0		8	1.4
	20		1	10	0	4	18:11:01	18:12:28	E	5,290	116	130.0	calibration line	10	1.1
	21		1	159	0	69.4	18:18:40	18:37:31	E	5,290	124	130.0		10	1.0
	22		159	1	69.4	0	18:41:26	19:00:21	W	5,290	122	130.0		10	1.1
	23		1	159	0	69.4	19:03:50	19:22:37	E	5,290	124	130.0		10	1.2
	24		159	1	69.4	0	19:26:35	19:46:29	W	5,290	116	130.0		9	1.2
	25		1	159	0	69.4	19:50:51	20:10:41	E	5,290	118	130.0		9	1.2
	26		159	1	69.4	0	20:14:59	20:35:20	W	5,290	110	130.0		9	1.2
	27		1	159	0	69.4	20:38:41	20:57:33	E	5,290	123	130.0		9	1.1
	28		159	1	69.4	0	21:01:56	21:21:37	W	5,290	120	130.0		12	1.1
EastSD_X	1		43	20	18.4	8.3	21:27:03	21:30:04	S	4,940	121	130.0	crossing tie line	10	1.1
							21:30:51	21:32:45					S-turn		
							21:42:38	21:47:38					5 min grd stc		

Trajectory and GPS Plots:

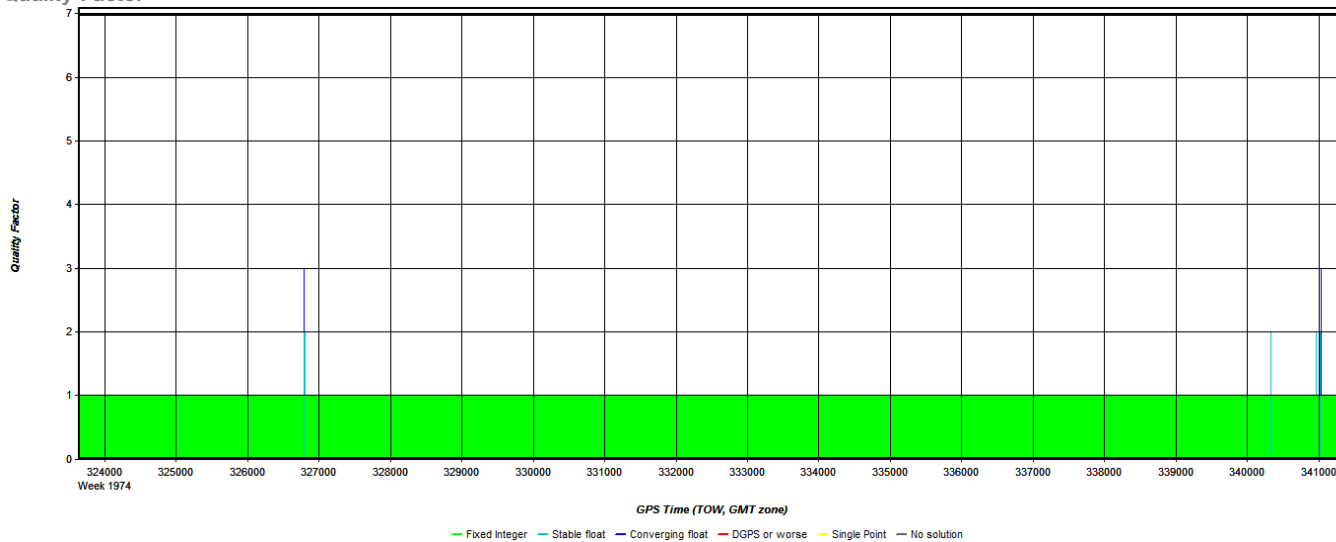


Estimated Accuracy

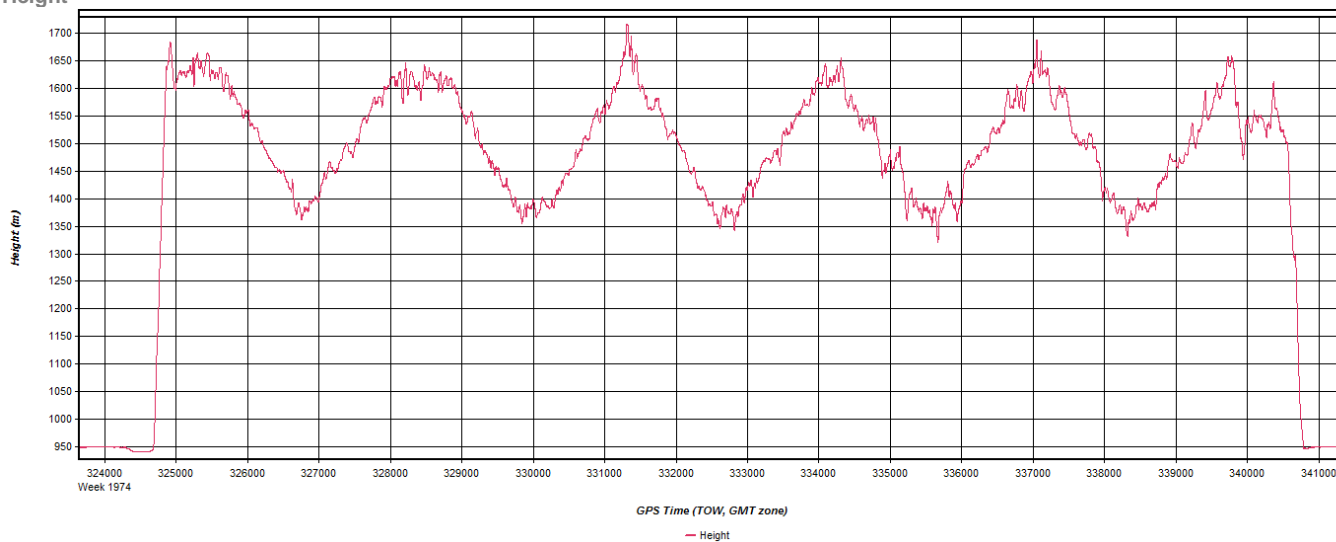




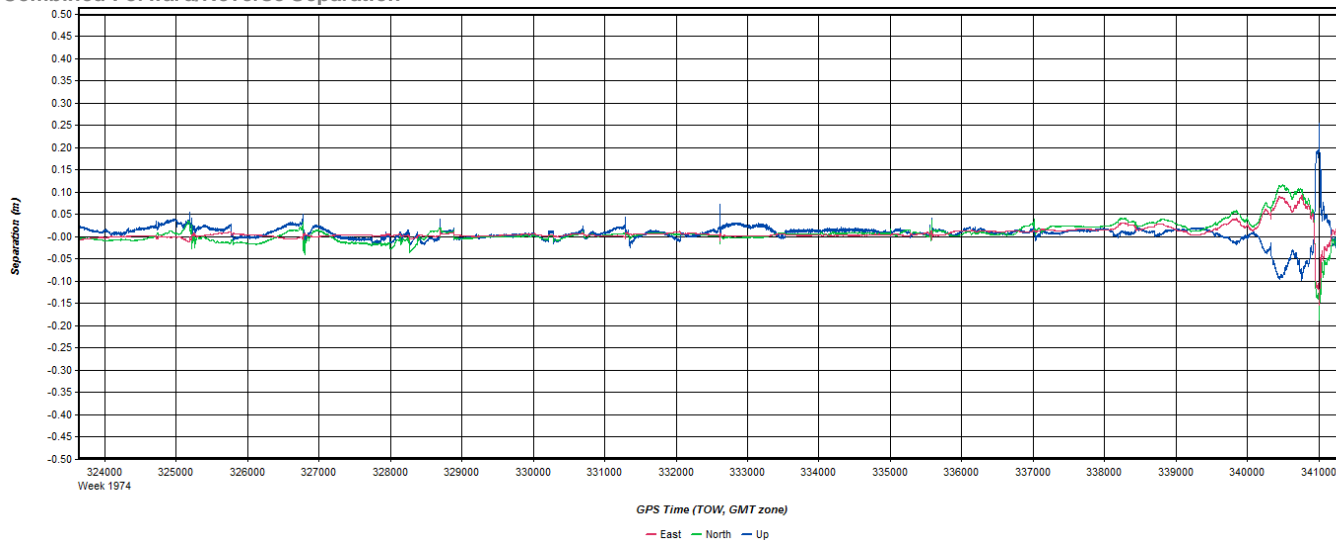
Quality Factor



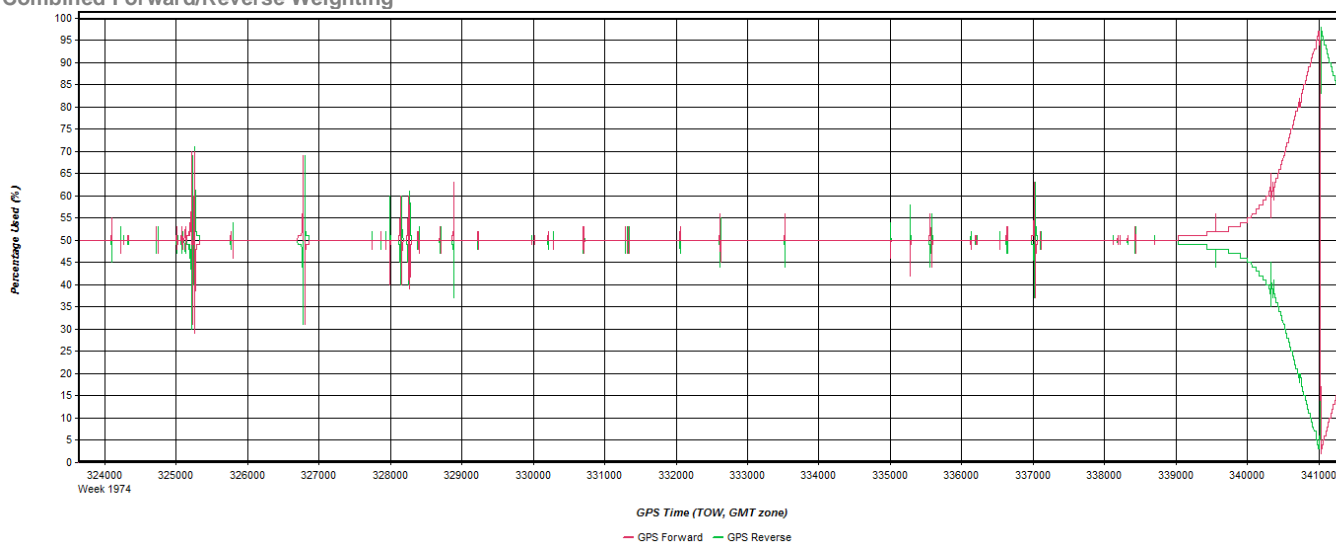
Height



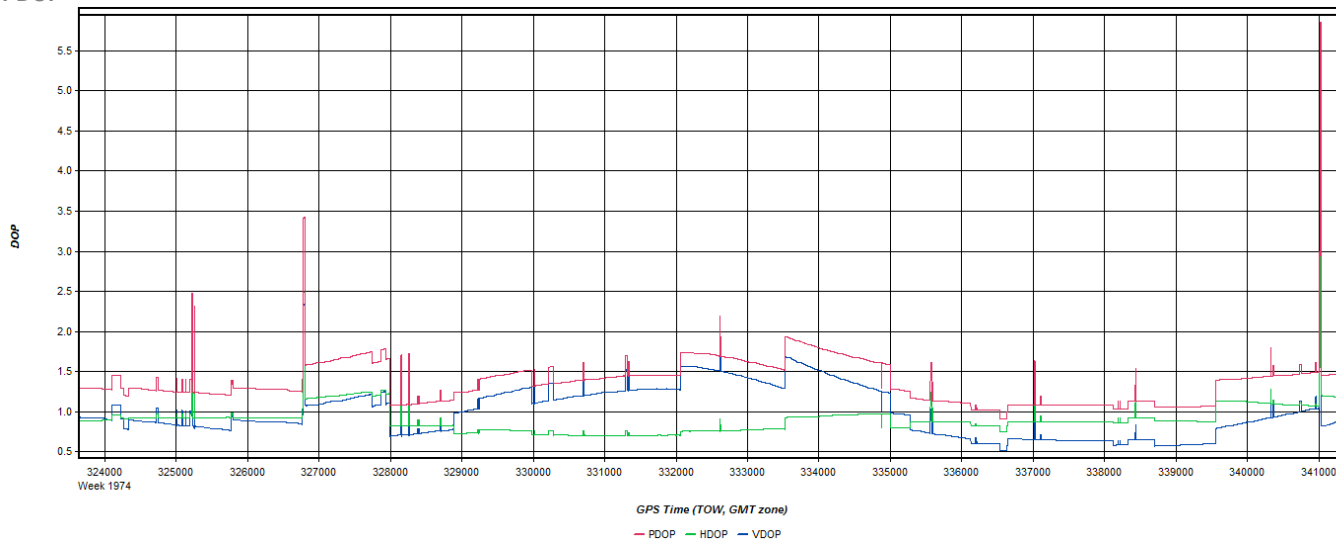
Combined Forward/Reverse Separation



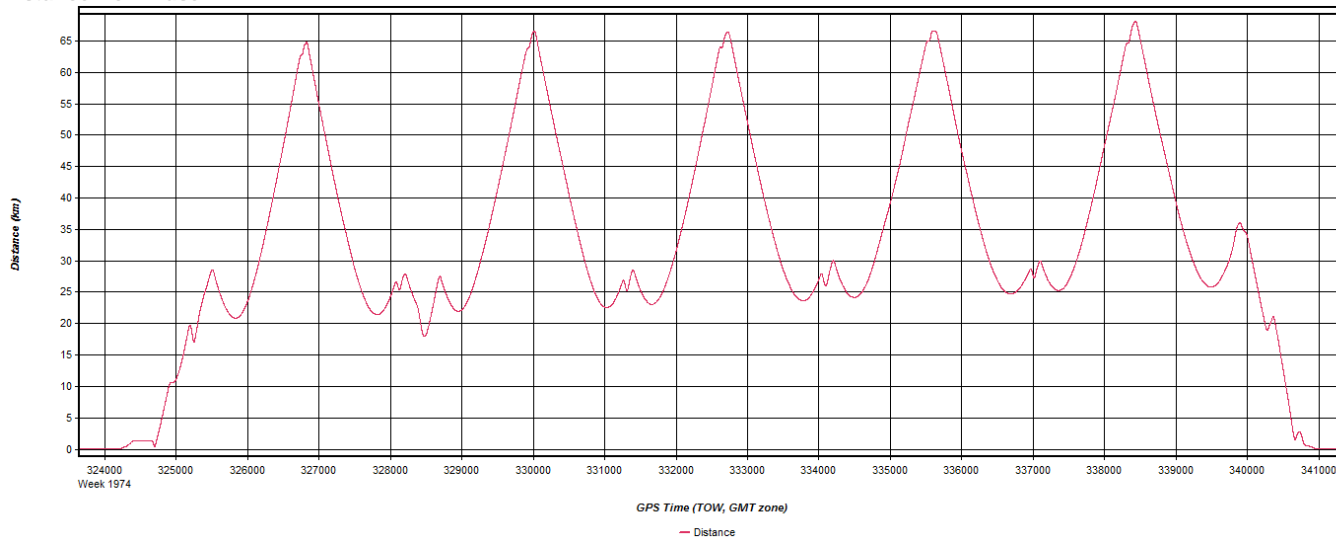
Combined Forward/Reverse Weighting



PDOP

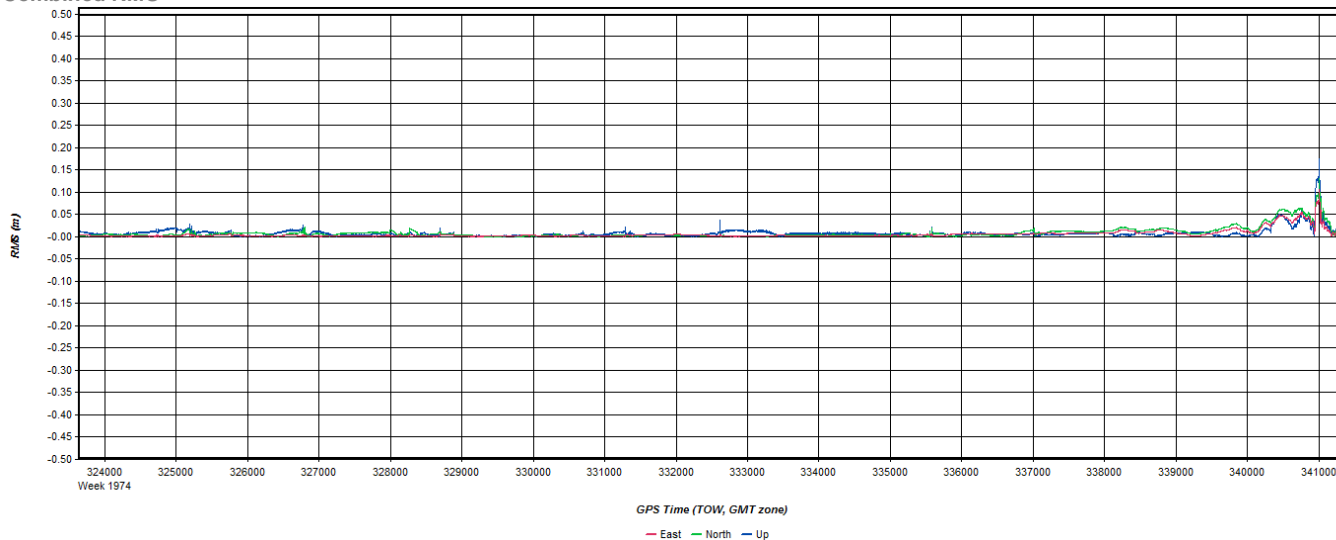


Distance from Base

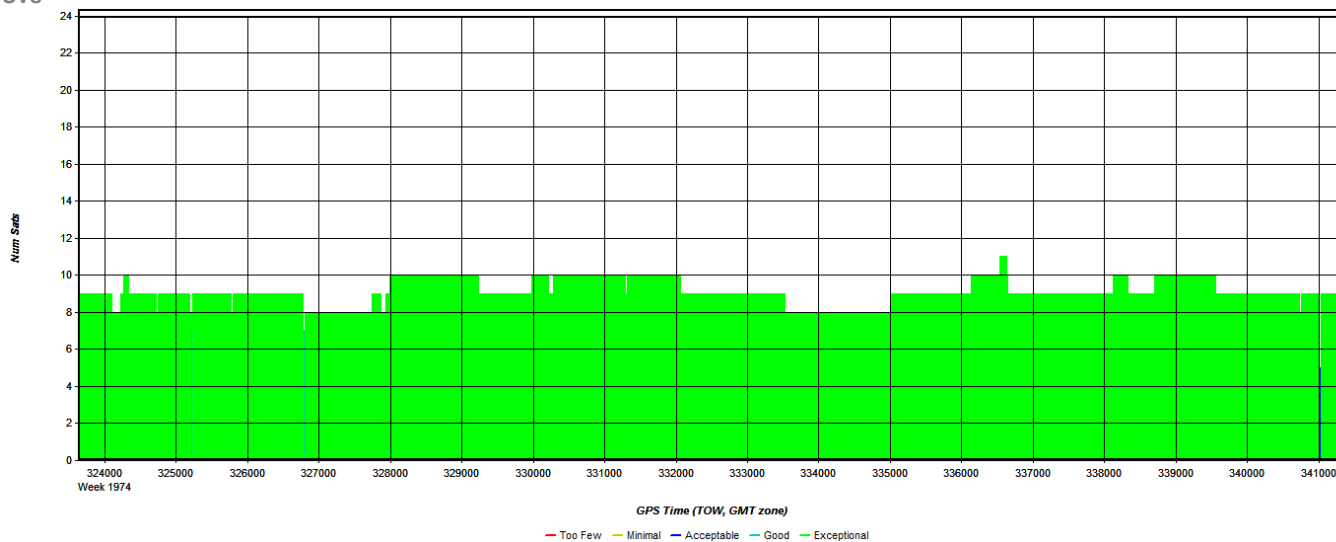




Combined RMS



SVs



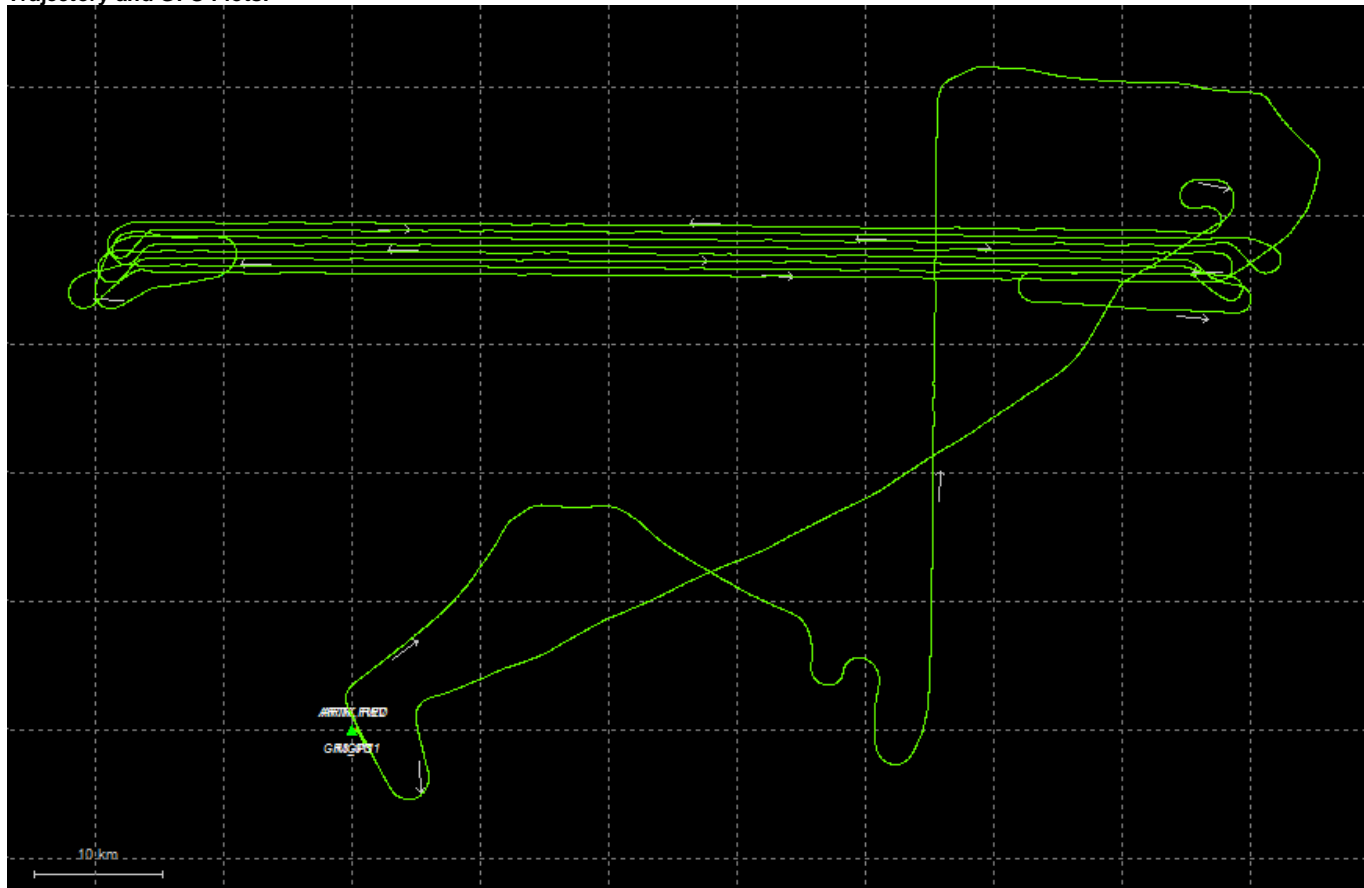


Acquisition and Processing details ----- Collection 6 (November 8, 2017)

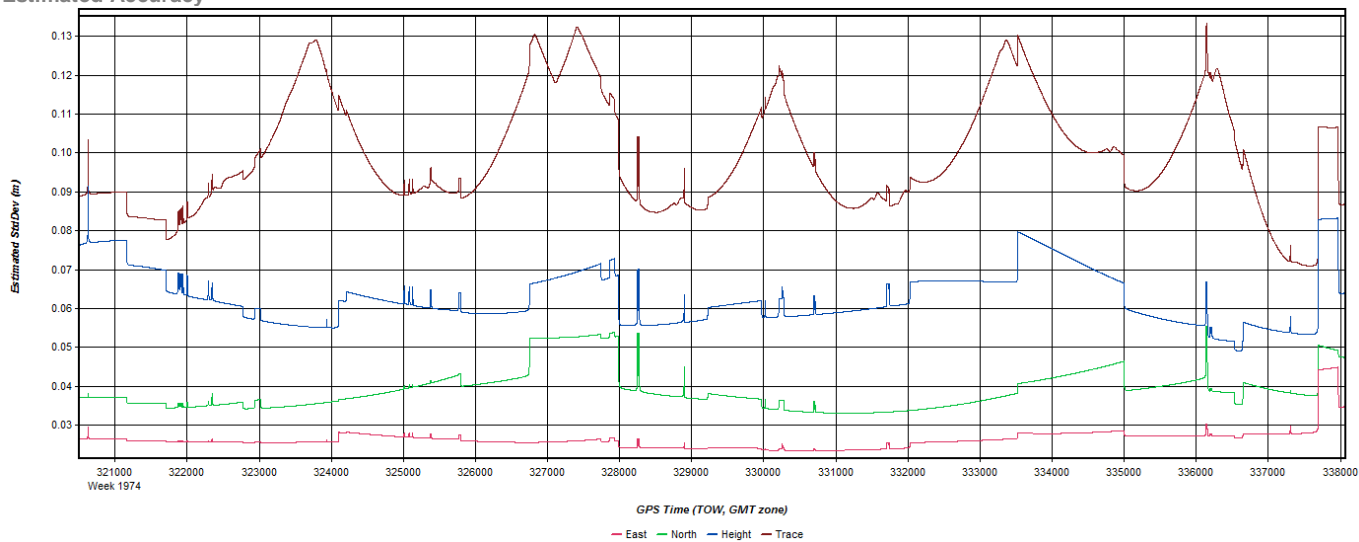
Log:

FUGRO Geospatial, Inc.												Riegl Flight Log		AC80-50-00-02							
16.92												Lift Begin		Lift End			Flt	Flt	Hobbs	Activity	
												Airport	Chocks	Hobbs	Airport	Chocks	Hobbs	Duration	Hrs	Hrs	
1												KRAP	16:58	7522.5	KRAP	21:54	7527.4	4:56	5.00	4.9	0900-Production
2																					
3																					
FGI Job #	Project Name				System	Unit	IMU					Ground Temp °C	Min Range'	Data Logger Drives							
17003900	USGS SD Lidar 2017 D17				780	421	AIMU					-6.0 4.0	1542	01/02/03							
Flight Date	GPS Day	Lift	CCNS8			Sun°	Solar Times (UTC)		Pulse Rate			Flying Temp °C	Max Range'	Download Drive							
8-Nov-17	17-312	1				N/A	N/A		330k			2.0 0.0	2933	NS2TB#2							
Mission ID (yyymmdd_Sen_Job_Lift)	Aircraft	Airport ID	FMS	UTC	AMT (ft)	Speed	FOV	Scan Rate (Hz)	MTA	km/WPT	AltM Setting	Humidity @ Alt	Shipping Track								
171108_421_17003900_01	N76JN	KRAP		-7	2400	130	60	130	2	0.440	30.05 30.05	51%									
Pilot #1		Pilot #2		Operator #1			Operator #2														
George Wilson		Fred Davis		Eric Mueller																	
Base 1 ID	Location		Rec ID	Ant ID	ARP (m)	Start Time (UTC)		Stop Time (UTC)		GPS Filename		Operator	Data								
FGI 081	KRAP		UNIT01	UNIT01	1.8M	171108 1509				GR3_011108q.tps		Jonathan Spencer	With AB								
Area	Flight #		Wpt		Distance		UTC		Flt	Altitude	Speed	Scan	Comments and Conditions		SVs	PDOP					
	FGI	Client	From	To	Begin	End	Start	End	Dir	(GPS)	(knots)	Rate									
							17:06:00	17:11:00					GROUND-STATIC @ KRAP		14	1.3					
							17:30:00	17:32:00		4,600	154		PRE ACQUISITION CALIBRATION		18	1.0					
EastSD_X	2		1	85	0	37	17:37:00	17:47:00	001	4,590	116		CROSS LINE		17	1.2					
EastSD_A	45		163	1	71.3	0	18:01:00	18:20:00	271	4,415	130				17	1.1					
	46		1	164	0	71.7	18:24:00	18:44:00	090	5,090	130				16	1.2					
	46		164	155	71.7	67.8	18:49:00	18:51:00	271	4,415	130				15	1.4					
	47		168	1	73.5	0	18:58:00	19:18:00	271	4,400	127				17	1.1					
	48		1	168	0	73.5	19:21:00	19:41:00	090	5,140	127				18	1.2					
	49		169	1	73.9	0	19:44:00	20:04:00	271	4,395	125				18	1.1					
	50		1	170	0	74.4	20:07:00		090	5,140			ABORTED DUE TO SPEED AND COURSE								
	50		1	170	0	74.4	20:13:00	20:33:00	090	5,140	125				19	1.2					
	51		170	1	74.4	0	20:38:00	20:58:00	271	4,395	123				17	1.3					
	52		1	170	0	74.4	21:01:00	21:21:00	090	5,140	127				17	1.2					
							21:22:00	21:24:00		4,400	134		POST ACQUISITION CALIBRATION		19	1.1					
							21:48:00	21:53:00					GROUND-STATIC @ KRAP		16	1.1					

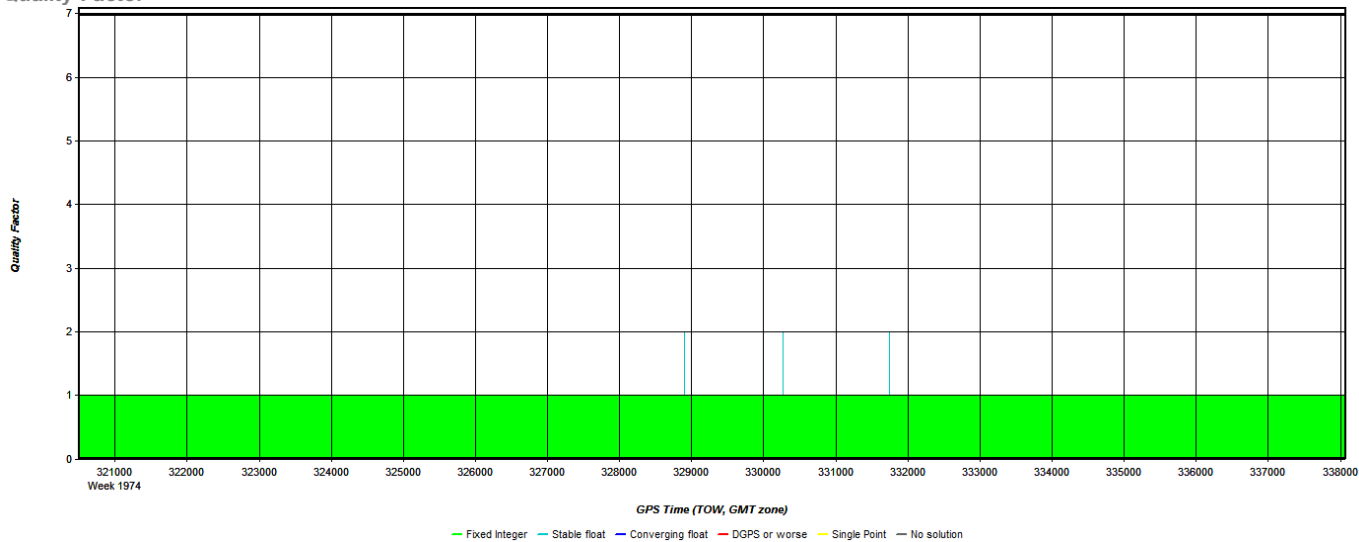
Trajectory and GPS Plots:



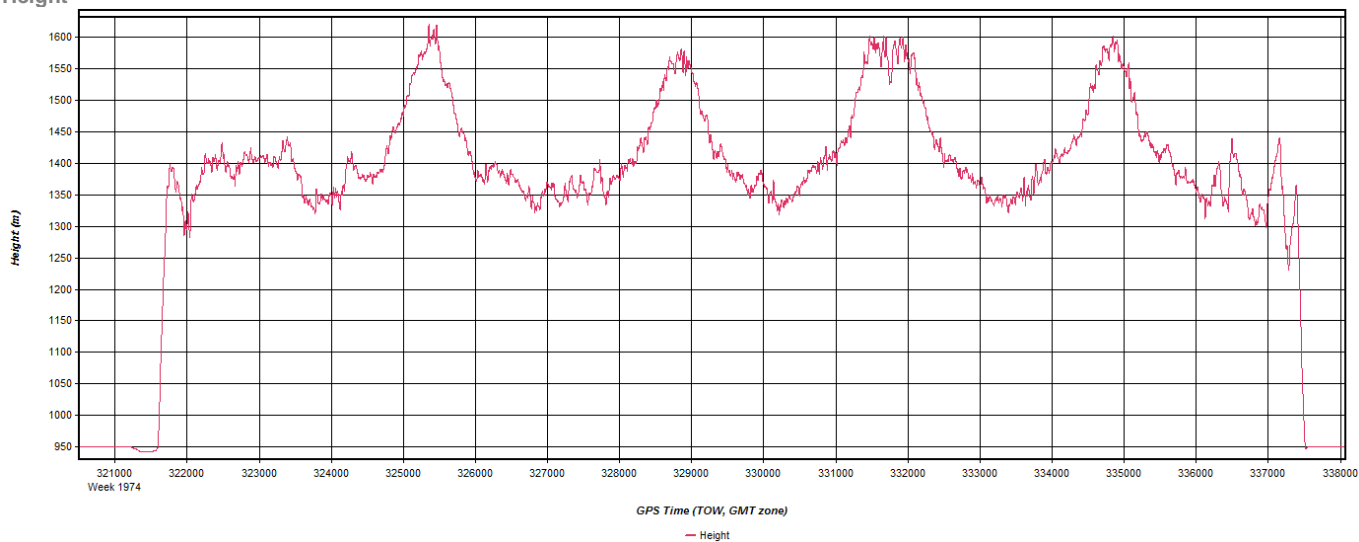
Estimated Accuracy



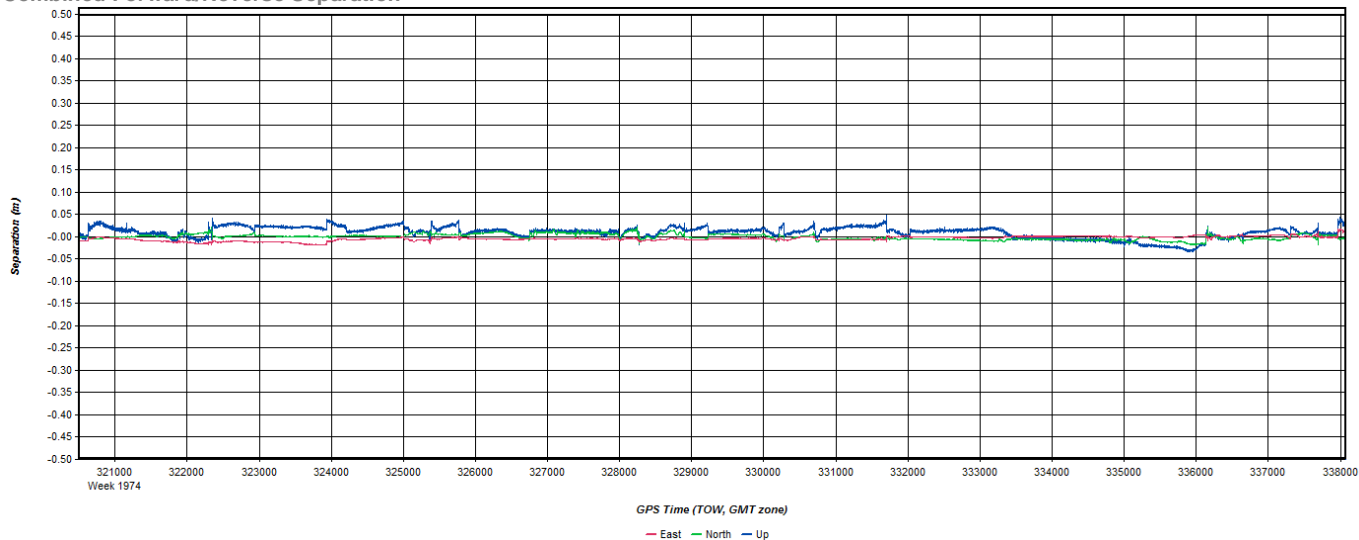
Quality Factor



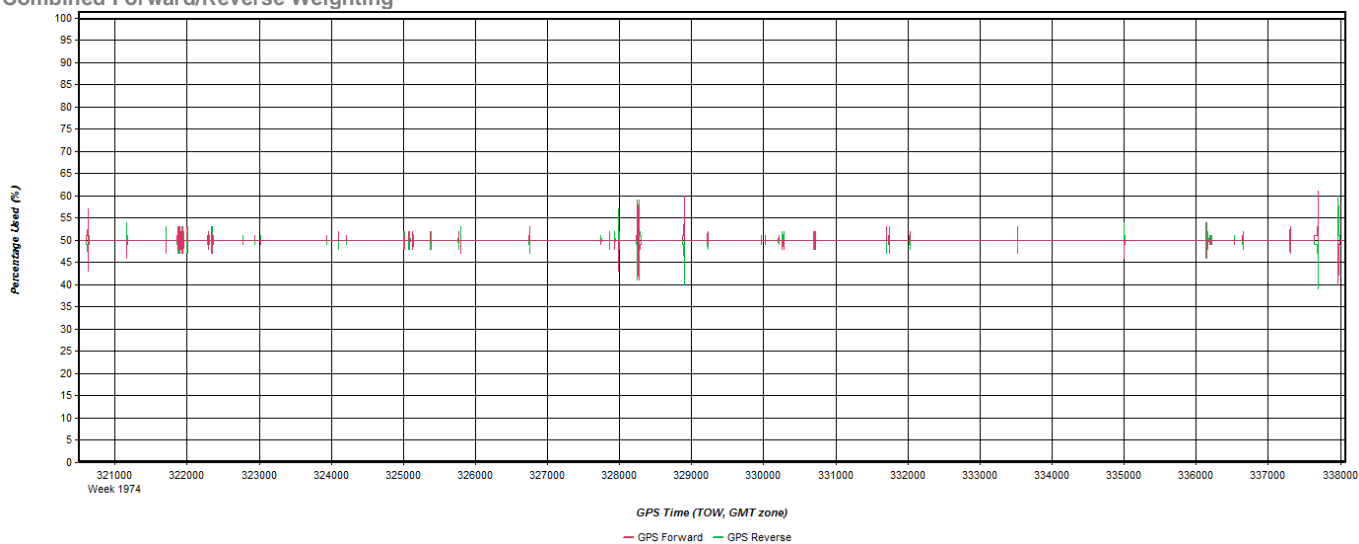
Height



Combined Forward/Reverse Separation

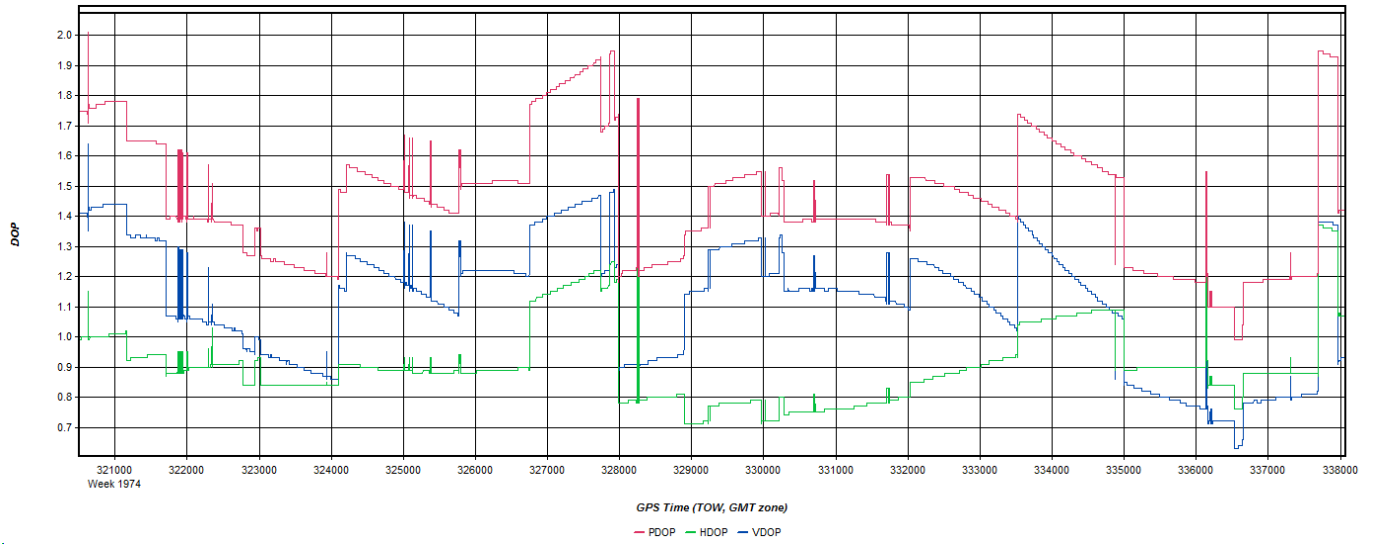


Combined Forward/Reverse Weighting

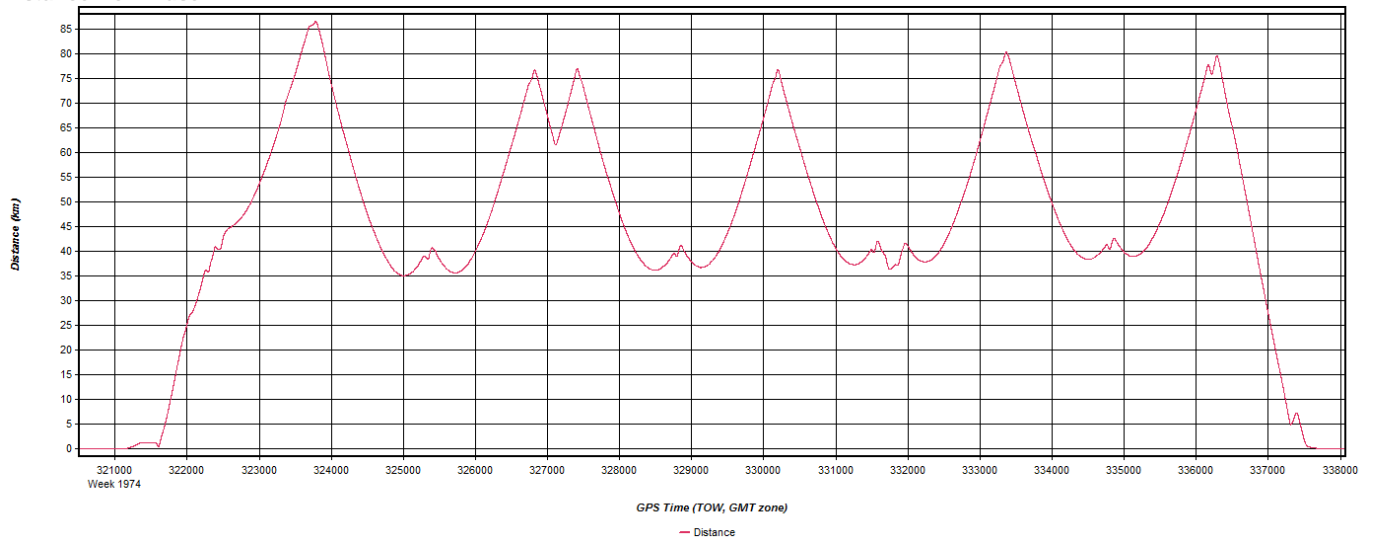


USGS COLLECTION REPORT

PDOP

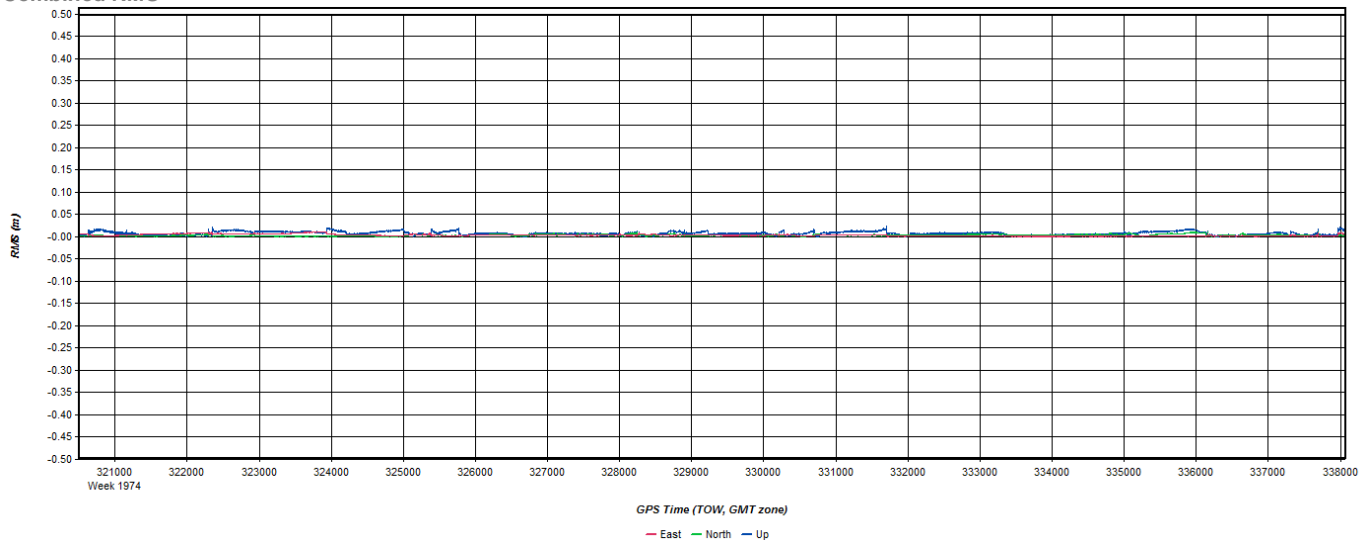


Distance from Base

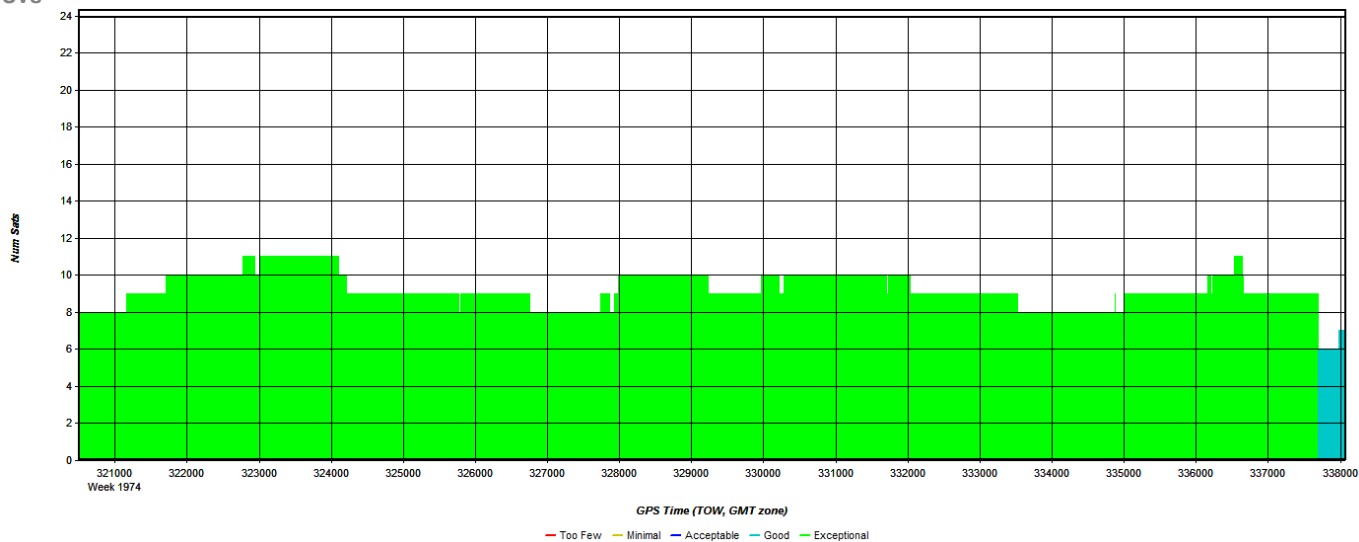




Combined RMS



SVs





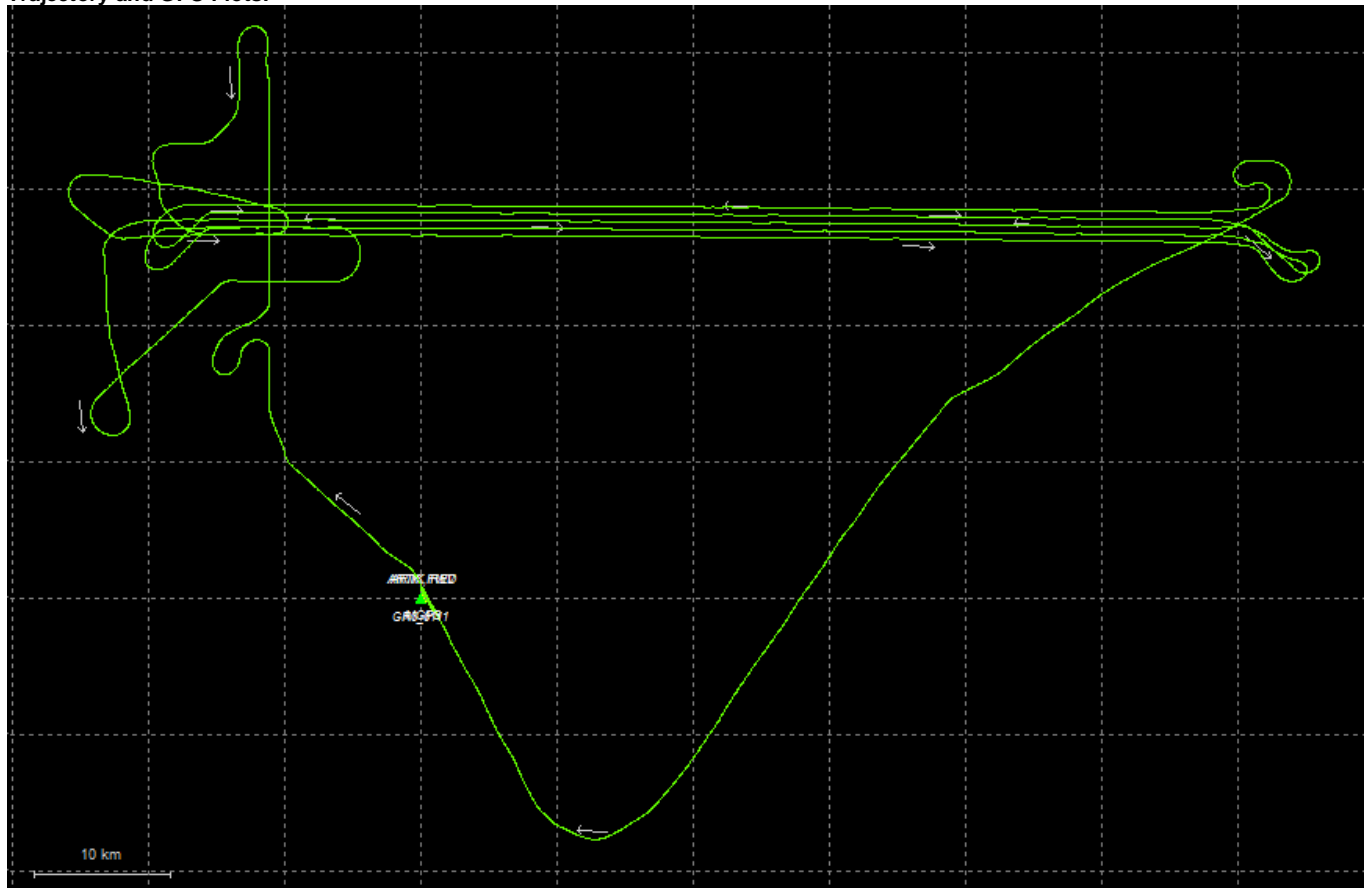
Acquisition and Processing details ----- Collection 7 (November 8, 2017)

Log:

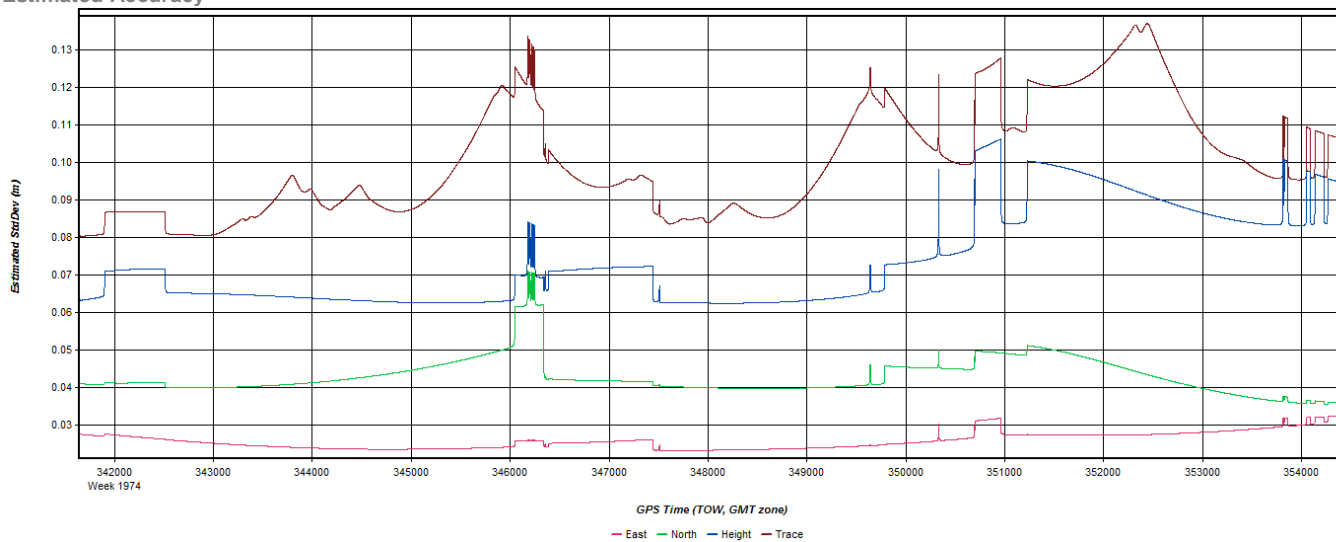
FUGRO Geospatial, Inc.												Riegl Flight Log AC80-50-00-02	
16.92													
			Lift Begin			Lift End			Flt	Flt	Hobbs	Activity	
Airport	Chocks	Hobbs	Airport	Chocks	Hobbs	Duration	Hrs	Hrs					
1	KRAP	22:50	7527.4	KRAP	2:28	7531.0	3:38	3.75	3.6	0900-Production			
2													
3													

FGI Job # 17003900	Project Name USGS SD Lidar 2017 D17		System 780	Unit 421	IMU AIMU			Ground Temp °C 3.0 0.0	Min Range' 1542	Data Logger Drives 02/03/EU02						
Flight Date 8-Nov-17	GPS Day 17-312	Lift 2	CCNS 8		Sun° N/A	Solar Times (UTC) N/A	Pulse Rate 330k	Flying Temp °C 0.0 -1.0	Max Range' 2933	Download Drive NS2TB#2						
Mission ID (yyymmdd_Sen_Job_Lift) 171108_421_17003900_02		Aircraft N76JN	Airport ID KRAP	FMS	UTC -7	AMT (ft) 2400	Speed 130	FOV 60	Scan Rate (Hz) 130	MTA 2	km/WPT 0.440	AltM Setting 30.09 30.17	Humidity @ Alt	Shipping Track		
Pilot #1 George Wilson		Pilot #2 Fred Davis		Operator #1 Eric Mueller		Operator #2										
Base 1 ID FGI 081	Location KRAP		Rec ID UNIT01	Ant ID UNIT01	ARP (m) 1.8M	Start Time (UTC) 171108 1509	Stop Time (UTC)	GPS Filename GR3_011108q.tps	Operator Jonathan Spencer	Data With AB						
Area	Flight #		Wpt		Distance		UTC		Flt	Altitude	Speed	Scan	Comments and Conditions		SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End	Dir	(GPS)	(knots)	Rate				
							23:02:20	23:07:20					GROUND-STATIC @ KRAP		16	1.4
							23:20:00	23:22:00		4,920	150		PRE ACQUISITION CALIBRATION		18	1.2
EastSD_X	1		35	55	15	23.8	23:24:00	23:28:00	360	4,940	107		CROSS LINE		18	1.2
EastSD_A	29		1	158	0	69.1	23:35:00		090	5,290	129		ABORTED DUE TO COURSE AND SPEED		20	1.0
	29		1	158	0	69.1	23:44:00	00:02:00	090	5,290	130				19	1.1
	30		158	1	69.1	0	00:07:00	00:25:00	271	4,510	115				19	1.1
	30		1	10	0	4	00:29:00	00:31:00	090	5,340	125		CALIBRATION LINE		17	1.3
	31		1	158	0	69.1	00:46:00	01:04:00	090	5,390	128				17	1.2
	32		159	1	69.5	0	01:09:00	01:28:00	271	4,505	113				16	1.3
	33		1	159	0	69.5	01:32:00	01:50:00	090	5,390	128				14	1.3
							01:51:00	01:53:00		4,400	138		POST ACQUISITION CALIBRATION		14	1.5
							02:21:20	02:26:20					GROUND-STATIC @ KRAP		15	1.3

Trajectory and GPS Plots:

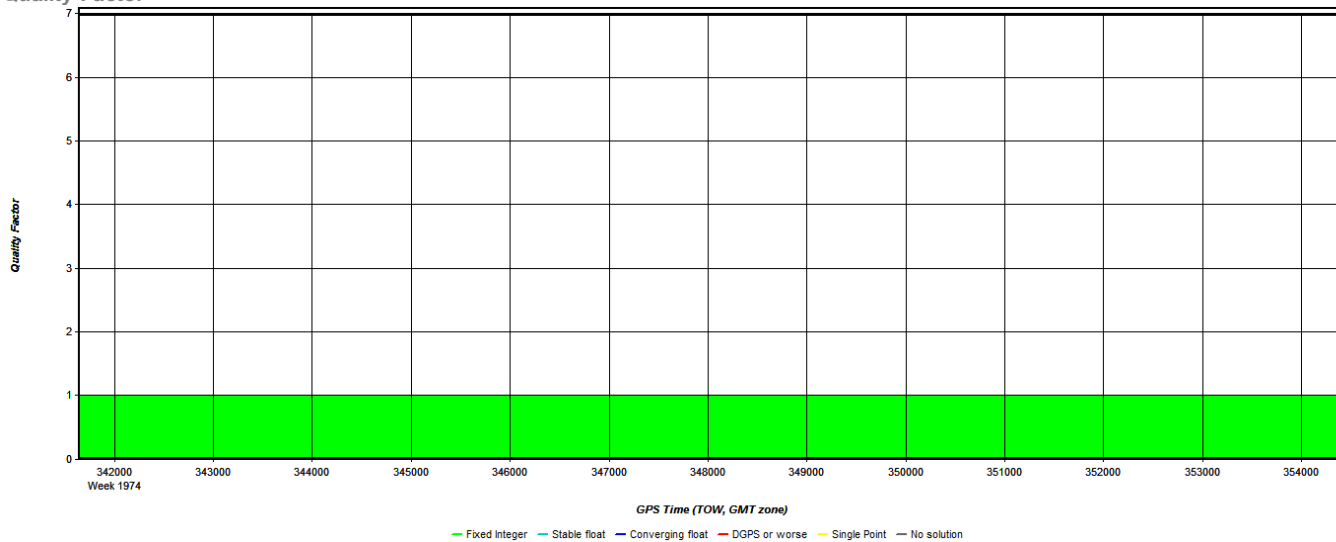


Estimated Accuracy

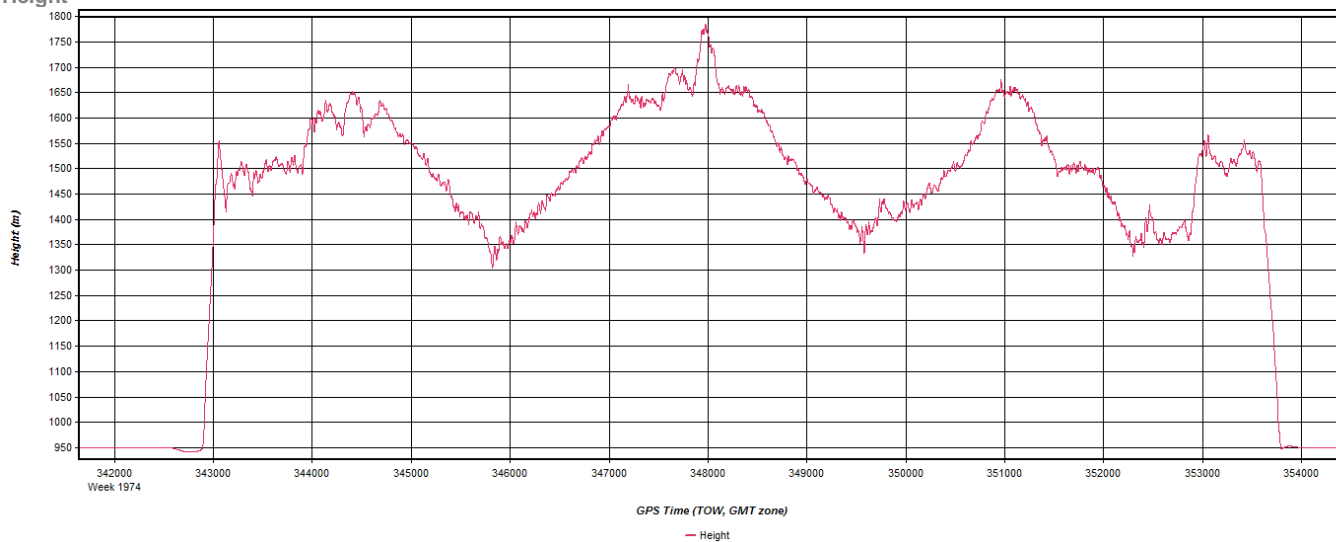




Quality Factor

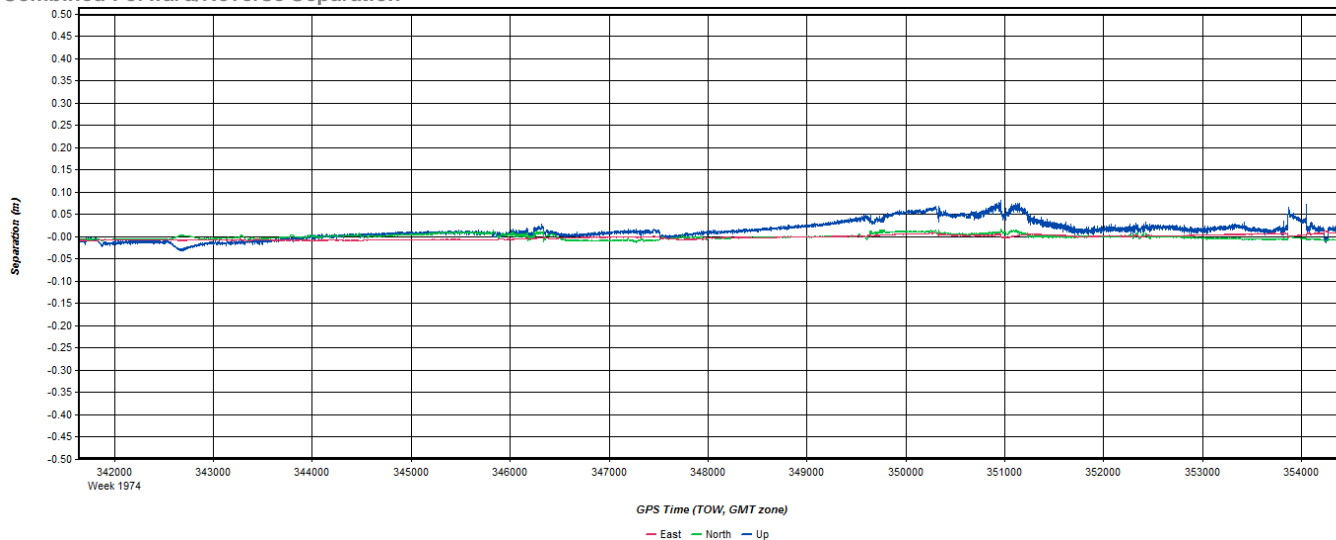


Height





Combined Forward/Reverse Separation

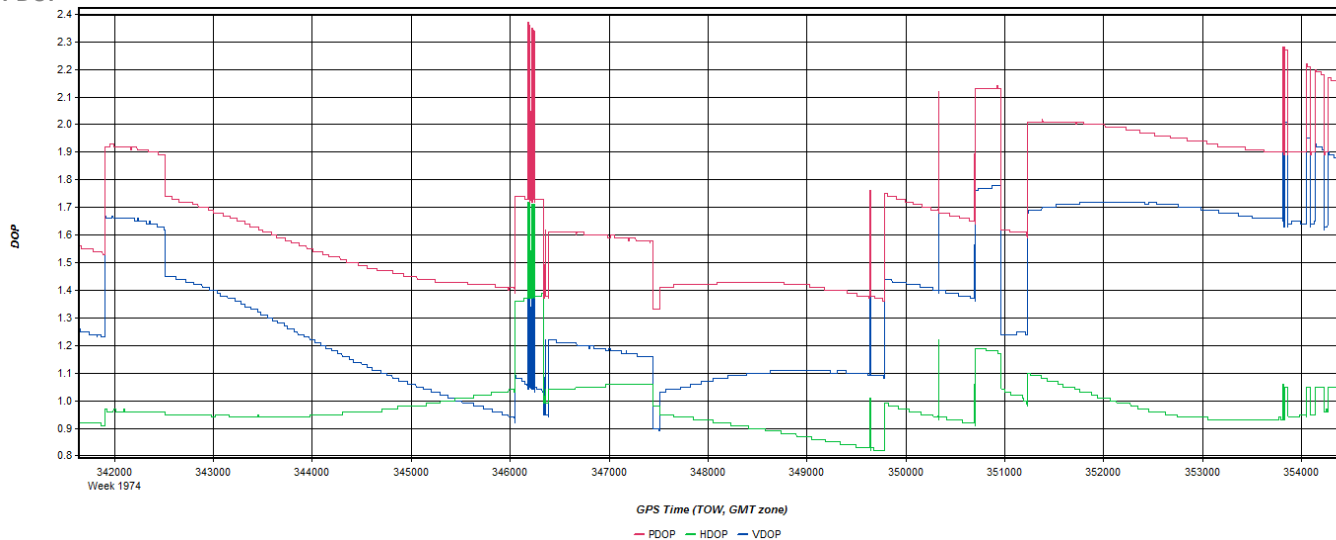


Combined Forward/Reverse Weighting

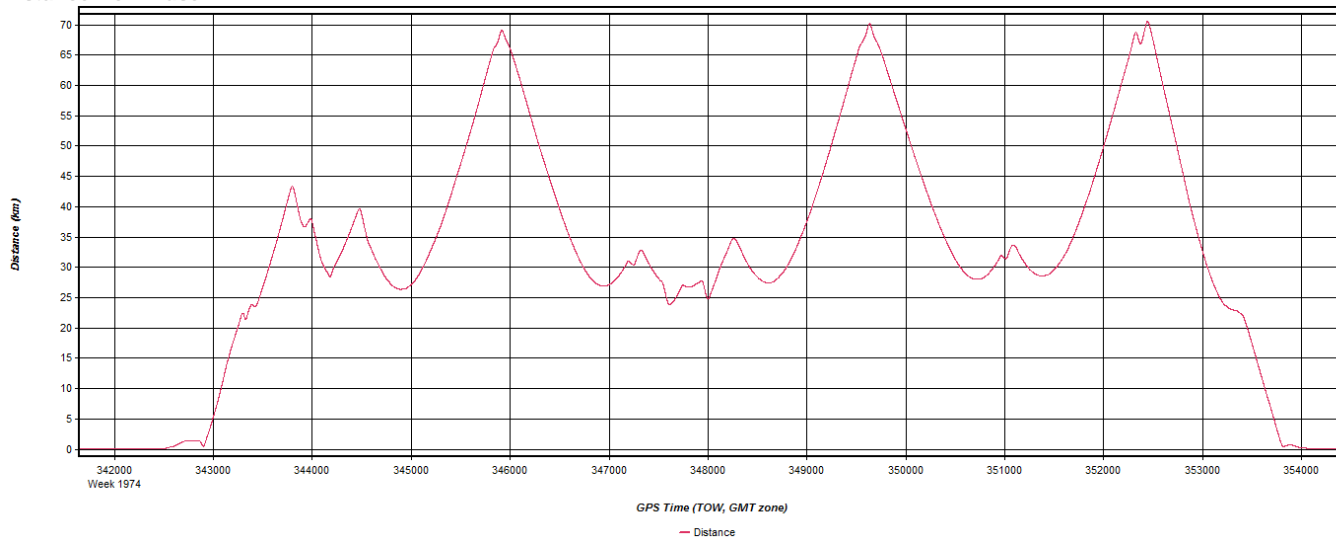




PDOP

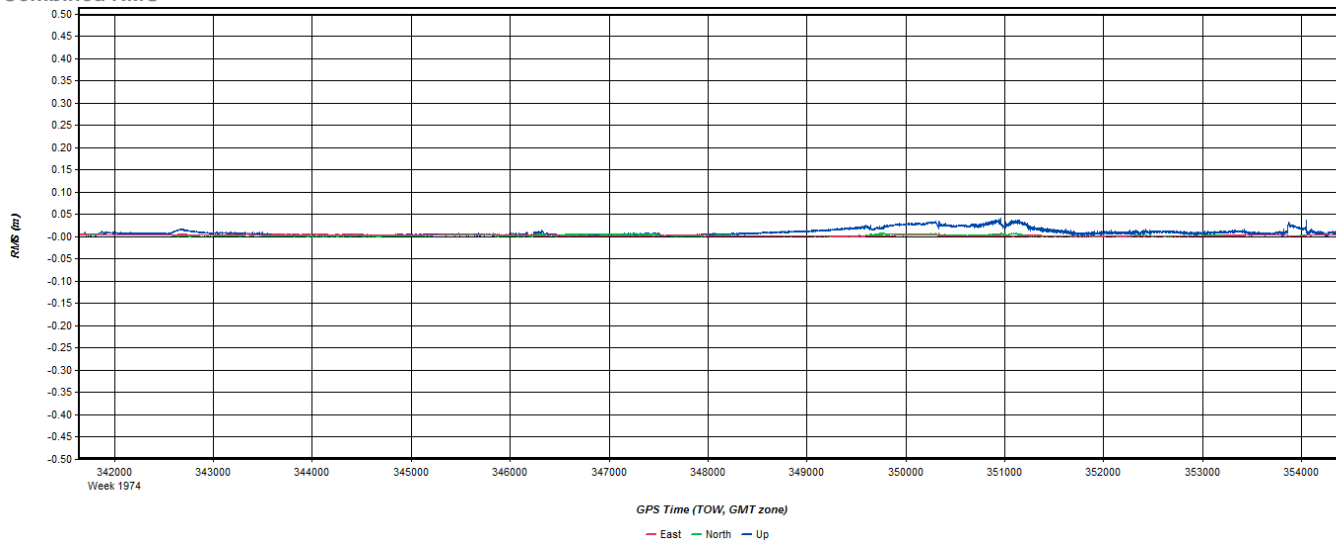


Distance from Base

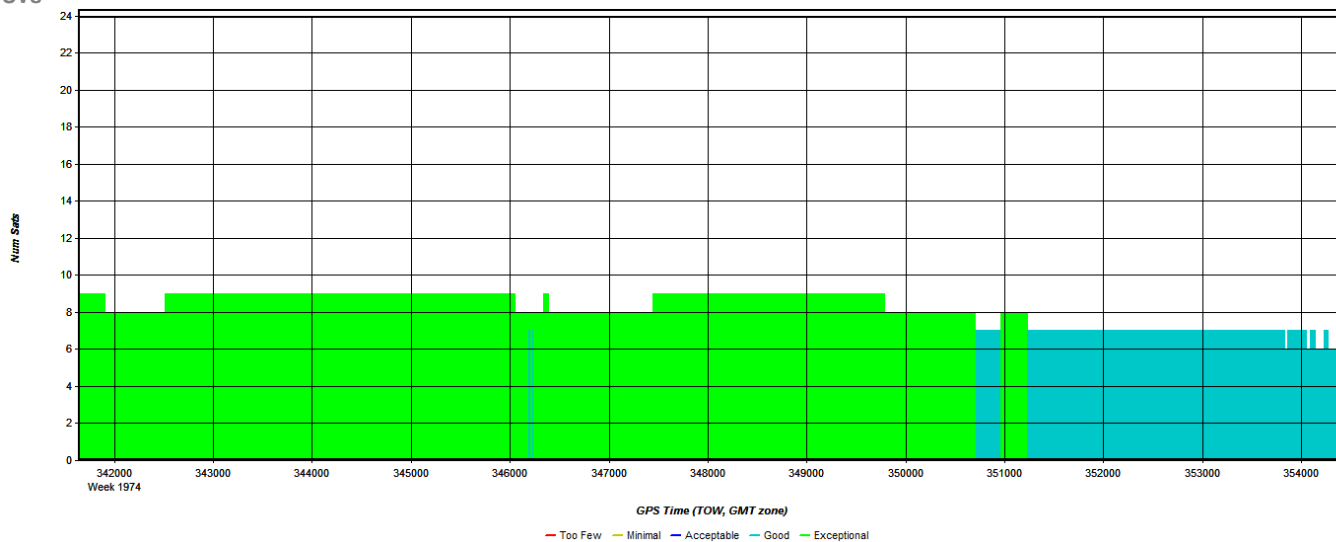




Combined RMS



SVs





Acquisition and Processing details ----- Collection 8 (November 10, 2017)

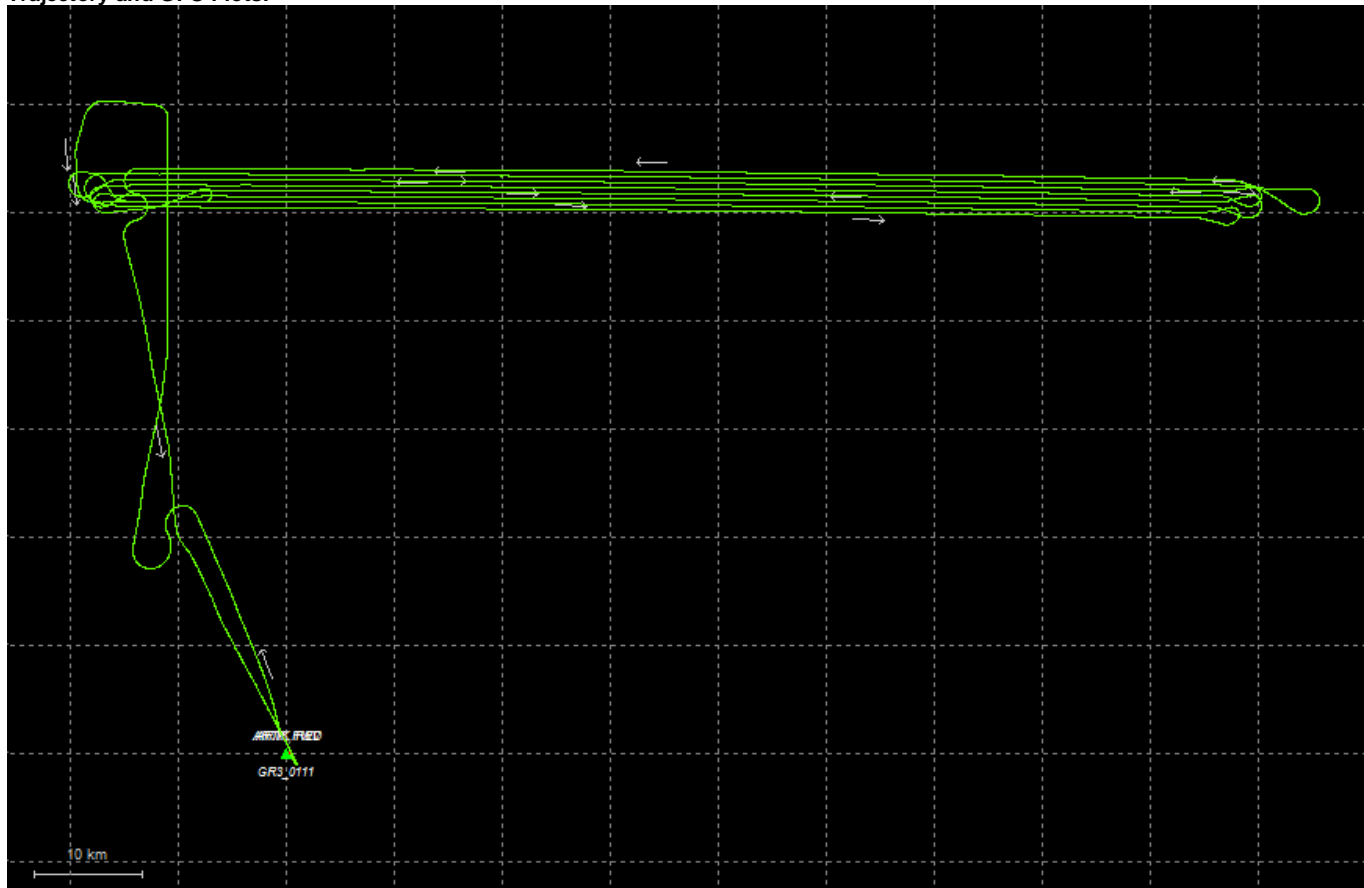
Log:

17.06	Lift Begin			Lift End			Flt Duration	Flt Hrs	Hobbs Hrs	Activity
	Airport	Chocks	Hobbs	Airport	Chocks	Hobbs				
1	KRAP	20:25	776.2	KRAP	1:28	780.7	5:03	5.00	4.5	0900-Production
2										
3										

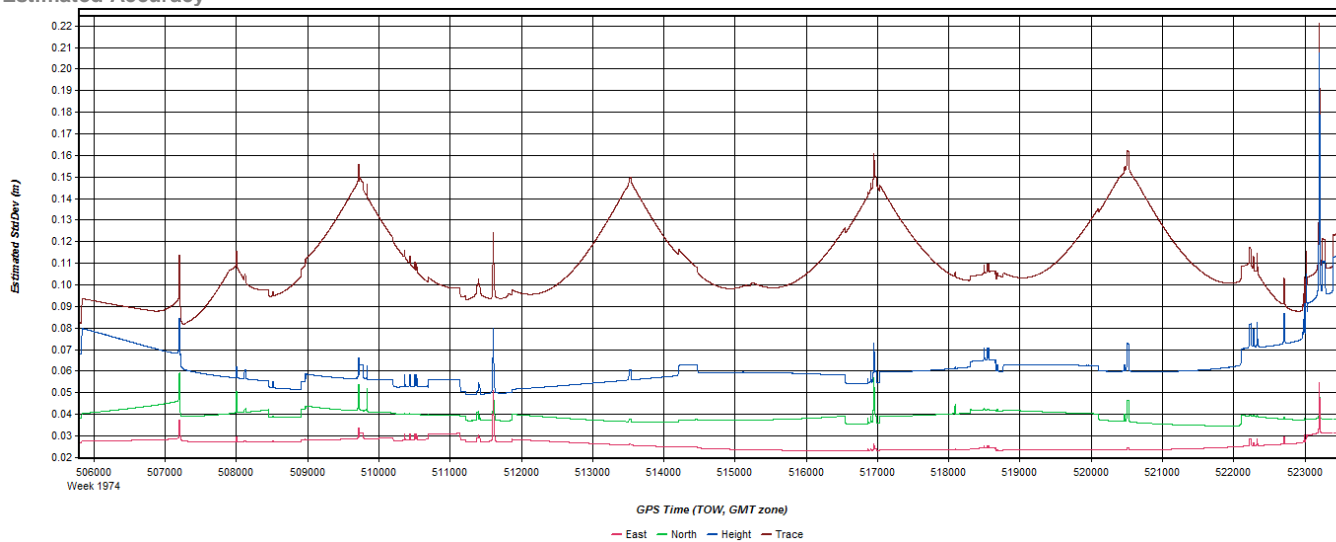
Fugro Geospatial, Inc.		Riegl Flight Log	
		AC80-50-00-02	

FGI Job # 17003900	Project Name USGS SD Lidar 2017 D17		System 680i	Unit 165	IMU					Ground Temp °C 8.0 1.0	Min Range' 1542	Data Logger Drives EU RIEGL 05			
Flight Date 10-Nov-17	GPS Day 17-314	Lift 2		Sun°	Solar Times (UTC)	Pulse Rate 330				Flying Temp °C 8.0 6.0	Max Range' 2933	Download Drive			
Mission ID (yyymmdd_Sen_Job_Lift) 171110_165_17003900_02		Aircraft N97HC	Airport ID KRAP	FMS CCNS 7	UTC -7	AMT (ft) 2400	Speed 130	FOV 56.2	Scan Rate (Hz) 120	MTA 2	km/WPT 0.439	AltM Setting 29.84 29.88	Humidity @ Alt 45.8	Shipping Track	
Pilot #1 Andy Weathers		Pilot #2		Operator #1 Chris Fought		Operator #2									
Base 1 ID FGI 081	Location Rapid City SD		Rec ID GR3-5	Ant ID GR3-5	ARP (m) 1.8	Start Time (UTC) 11/10/17 1905	Stop Time (UTC) 11/11/17 0204	GPS Filename GR3_011110t		Operator Chris Fought		Data With AB			
Area	Flight #		Wpt		Distance		UTC		Flt Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions	SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End							
						20:35:00	20:40:00						Ground static at KRAP	18	1.2
						20:52:00	20:55:00						pre acquisition s turn	18	1.2
E-680-X	1		90	105	39.1	45.7	21:01:00	21:04:10	N	5,005	121	120.0	cross tie line	18	1.2
E-680-B	9		1	214	0	93.5	21:09:44	21:33:05	E	4,840	130	120.0		20	1.1
	10		214	1	93.5	0	21:36:42	22:01:19	W	4,840	124	120.0		19	1.0
	10		1	10	0	4	22:04:49	22:05:54	E	4,840	125	120.0	calibration line	20	1.0
	11		1	214	0	93.5	22:11:20	22:36:04	E	4,840	130	120.0		19	1.1
	12		216	1	94.4	0	22:40:34	23:05:23	W	4,840	127	120.0		19	1.1
	13		1	222	0	97	23:08:14	23:34:36	E	4,840	128	120.0		18	1.2
	14		223	1	97.5	0	23:36:57	0:02:26	W	4,840	127	120.0		21	0.9
	15		1	223	0	97.5	0:06:37	0:31:43	E	4,840	129	120.0		19	1.0
	16		223	1	97.5	0	0:37:31	1:02:54	W	4,840	125	120.0		17	1.1
							1:03:00	1:06:00					post acquisition s turn	15	1.0
							1:20:00	1:25:00					Ground static at KRAP	15	1.1

Trajectory and GPS Plots:

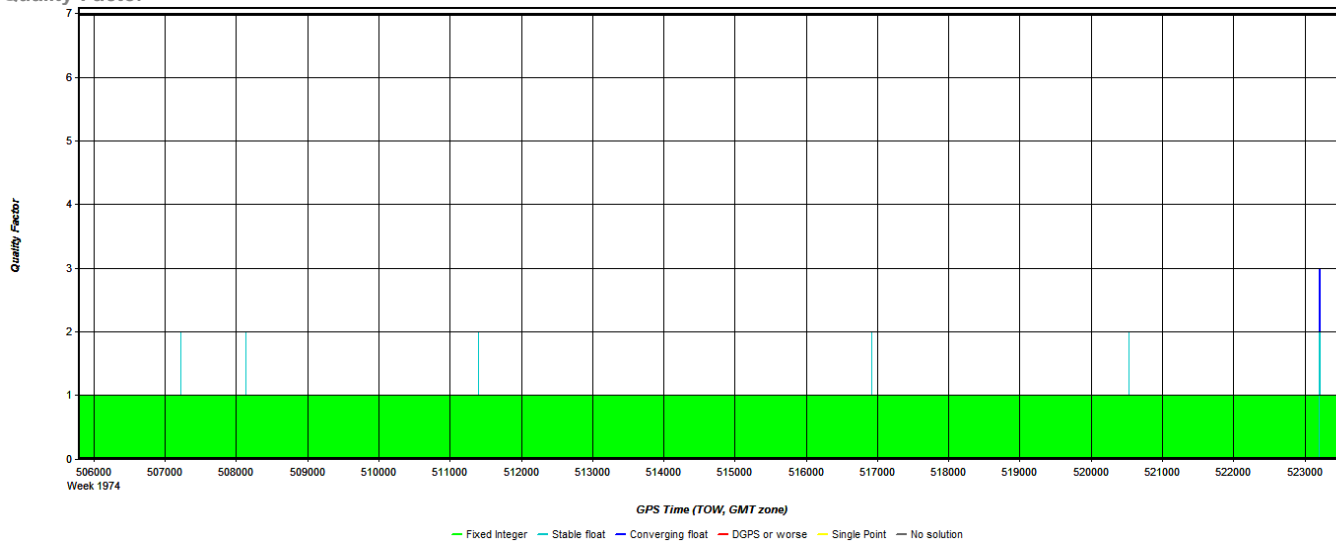


Estimated Accuracy

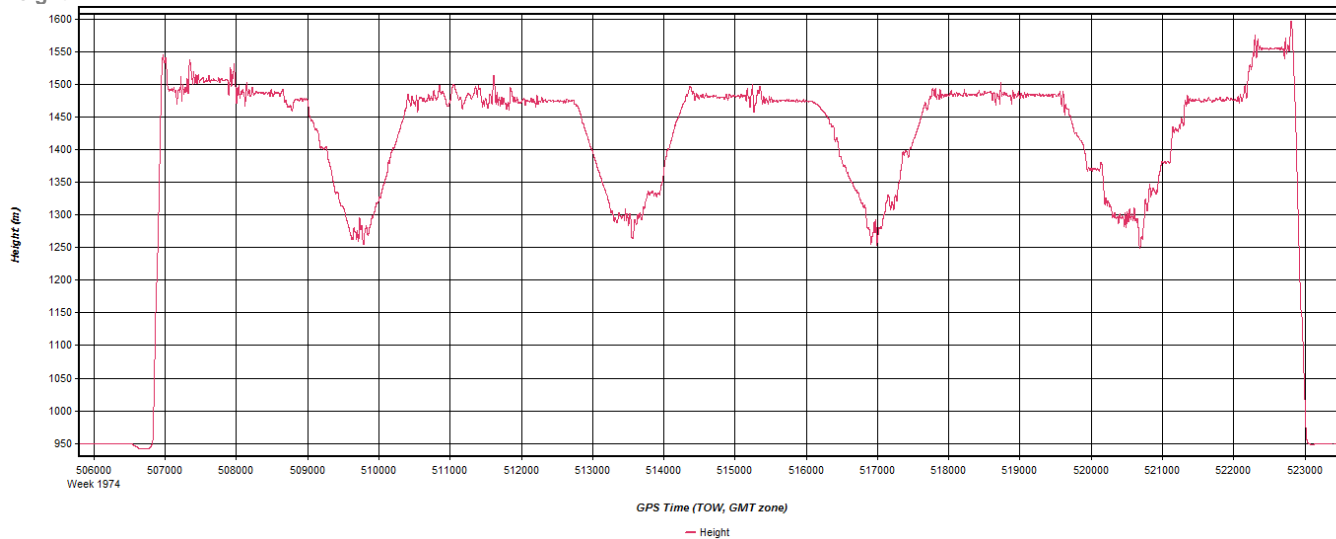




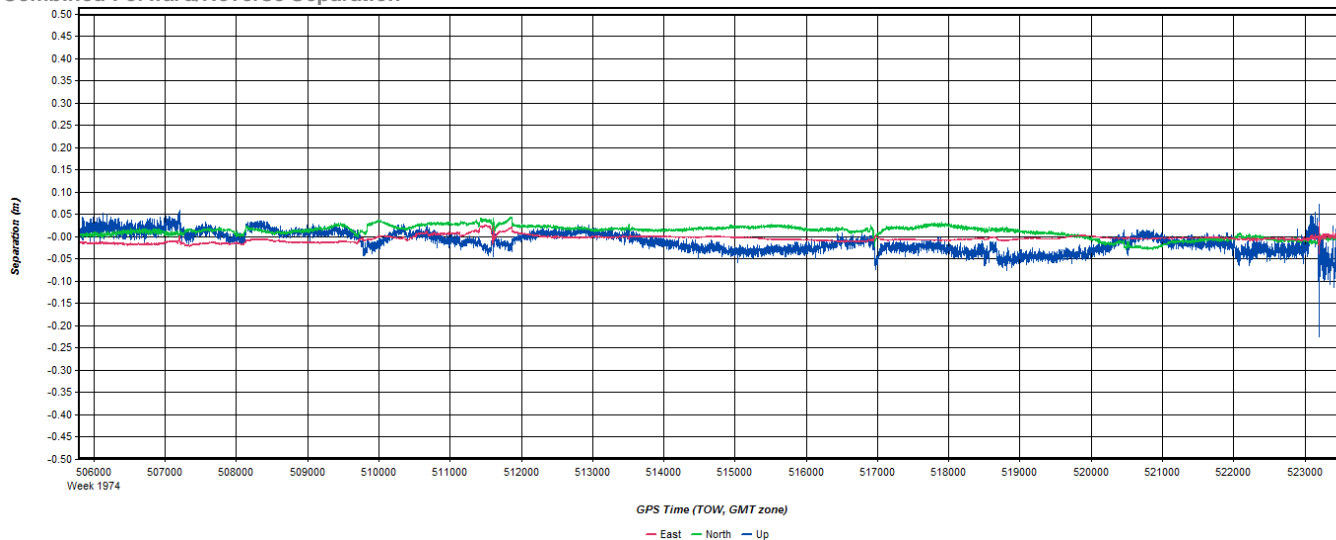
Quality Factor



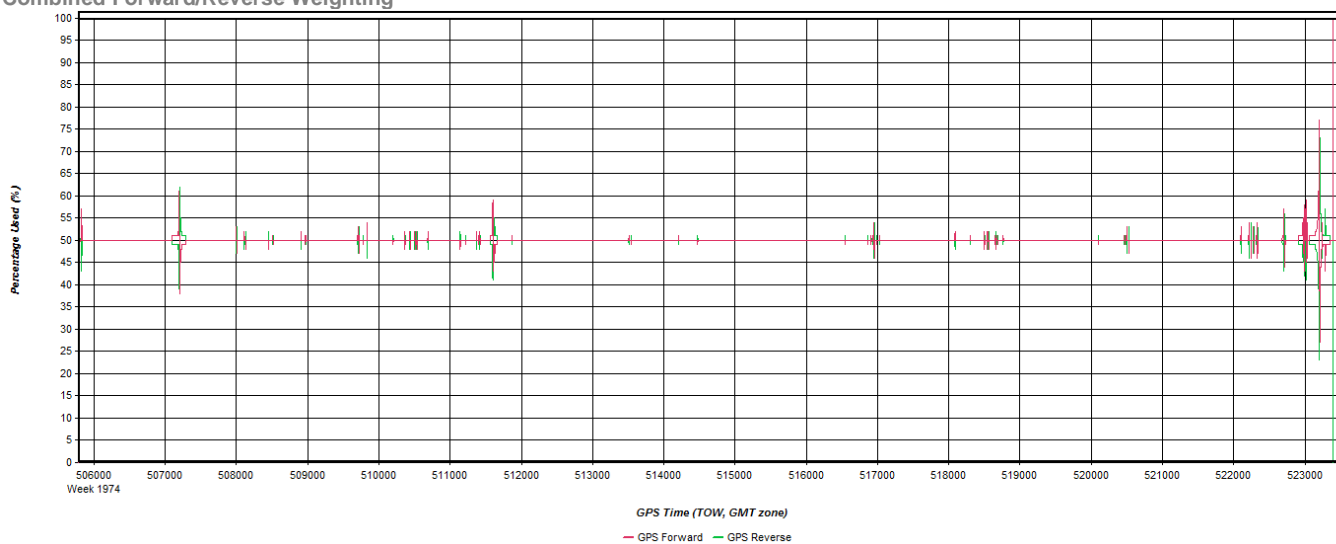
Height



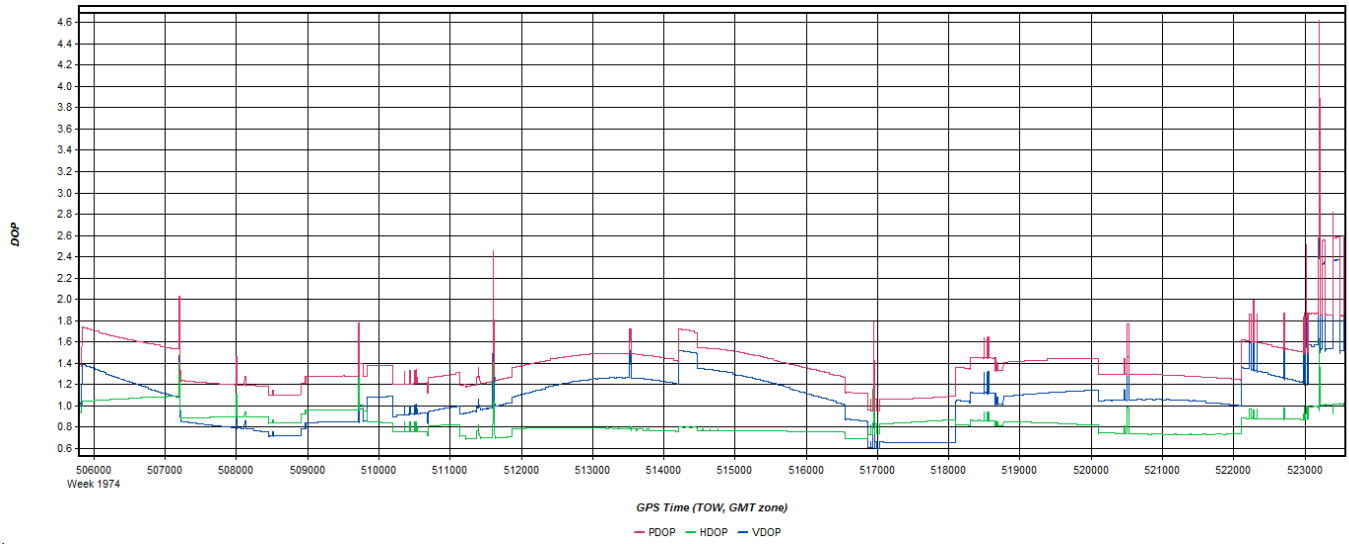
Combined Forward/Reverse Separation



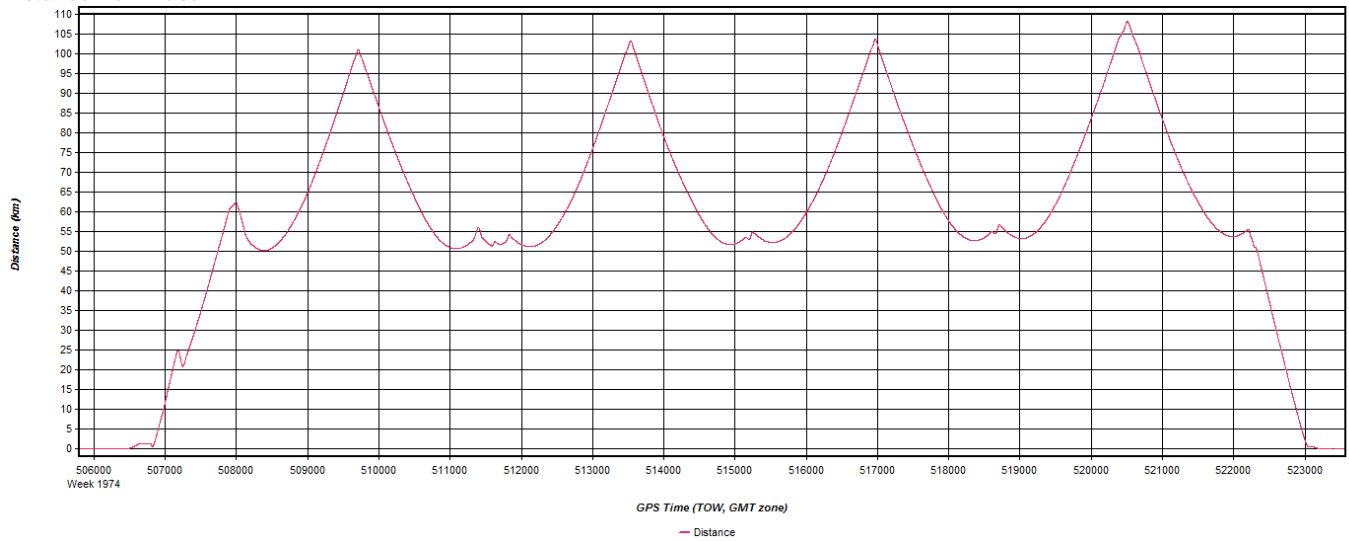
Combined Forward/Reverse Weighting



PDOP

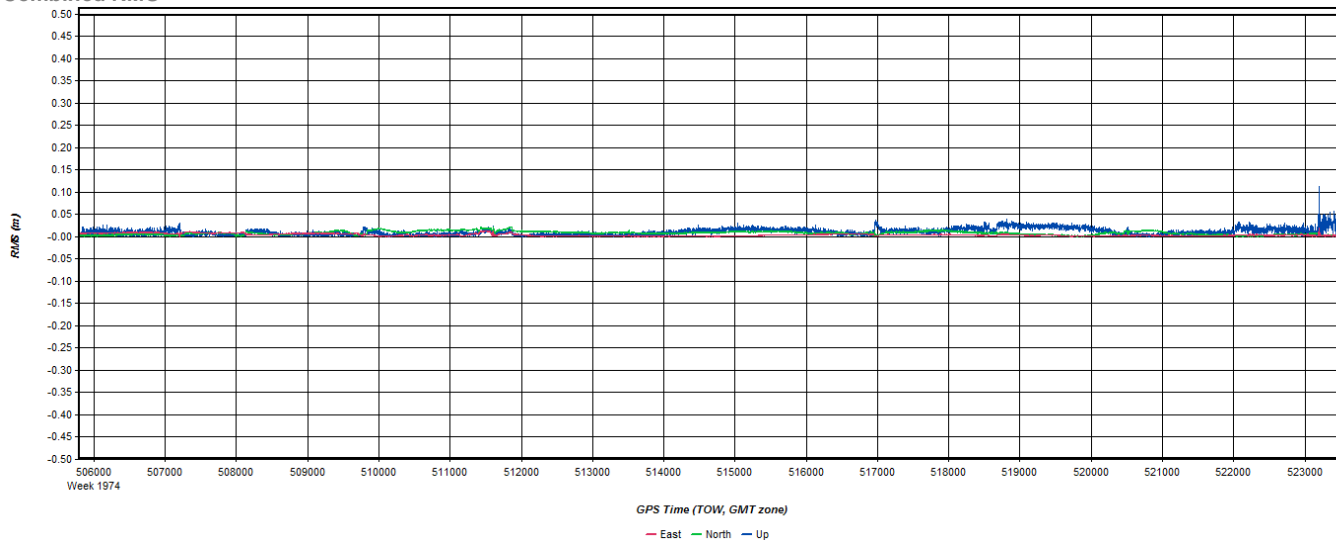


Distance from Base

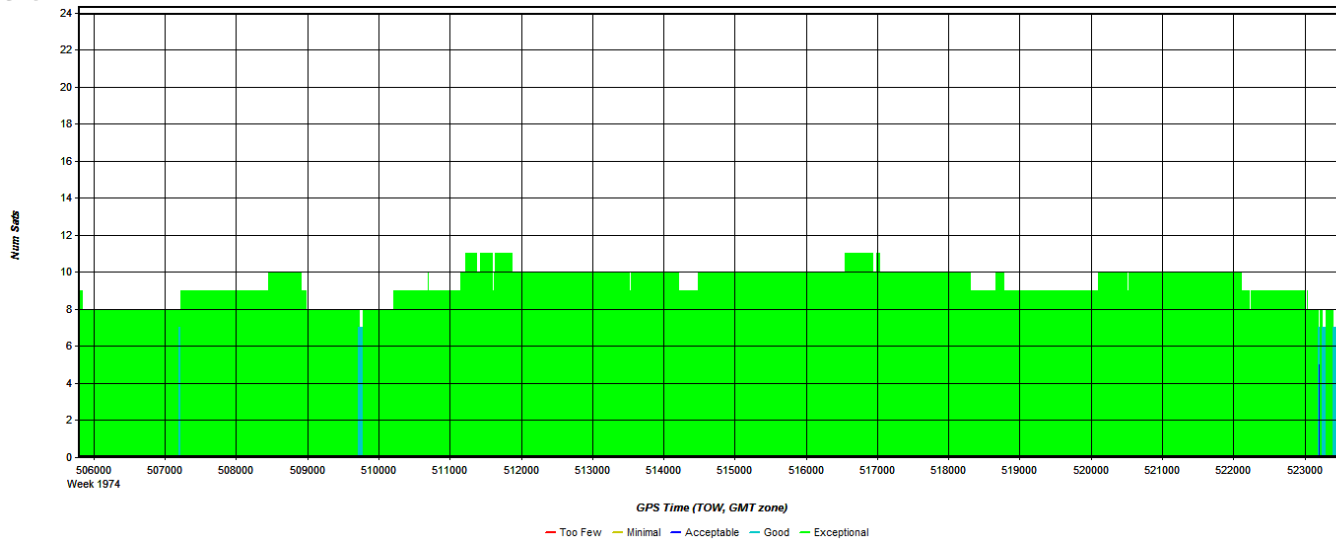




Combined RMS



SVs



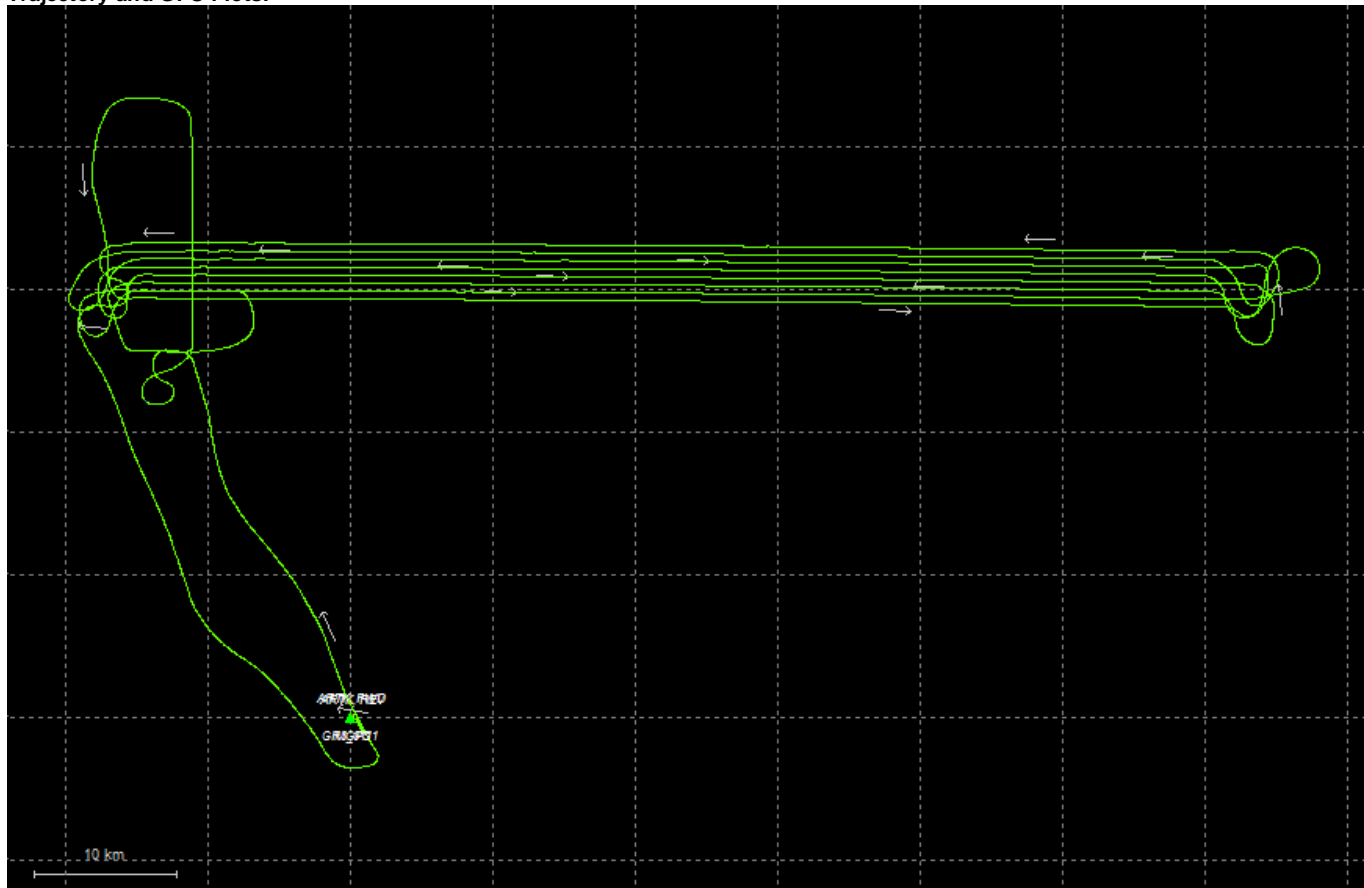


Acquisition and Processing details ----- Collection 9 (November 10, 2017)

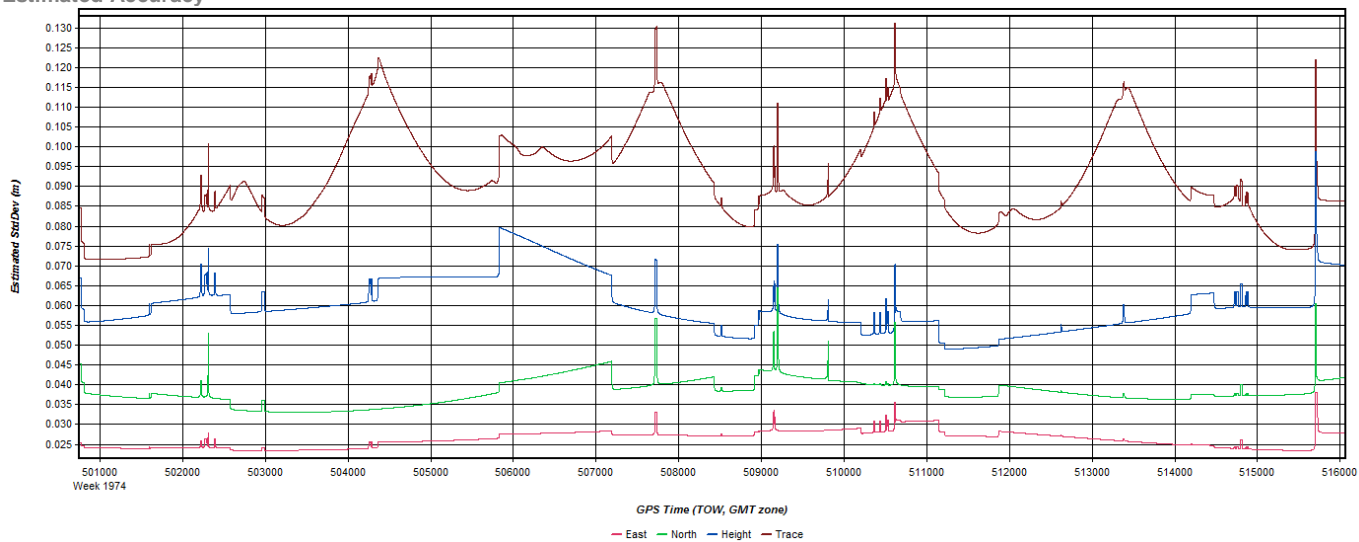
Log:

FUGRO		Fugro Geospatial, Inc.										Riegl			
FUGRO		Fugro Geospatial, Inc.										Riegl			
FUGRO		Fugro Geospatial, Inc.										Riegl			
17.06		Lift Begin			Lift End			Flt	Flt	Hobbs	Activity				
		Airport	Chocks	Hobbs	Airport	Chocks	Hobbs	Duration	Hrs	Hrs					
1		KRAP	17:56	443.9	KRAP	22:21	447.8	4:25	4.50	3.9	0900-Production				
2															
3															
FGI Job #		Project Name			System	Unit	IMU			Ground Temp °C	Min Range'	Data Logger Drives			
22.17003900		USGS SD Lidar 2017 D17			680i	216	AIMU			6.0 6.0	1542				
Flight Date		GPS Day	Lift			Sun°	Solar Times (UTC)	Pulse Rate	Flying Temp °C		Max Range'	Download Drive			
10-Nov-17		17-314	5			NA	NA	330kHz	12.0 9.0		2933				
Mission ID (yyymmdd_Sen_Job_Lift)		Aircraft	Airport ID	FMS	UTC	AMT (ft)	Speed	FOV	Scan Rate (Hz)	MTA	km/WPT	AltM Setting	Humidity @ Alt	Shipping Track	
171110_216_17003900_05		N3832K	KRAP	CCNS 6	-6	2400	130		130	2	0.439	29.84 29.84			
Pilot #1		Pilot #2		Operator #1		Operator #2									
Wayne Manning				Jonathan Spencer											
Base 1 ID	Location		Rec ID	Ant ID	ARP (m)	Start Time (UTC)		Stop Time (UTC)		GPS Filename		Operator	Data		
FGI 081	KRAP		GR3 U	U5	1.8							Chris Fought	With AB		
Area	Flight #		Wpt		Distance		UTC		Flt Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions	SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End							
							18:05:45	18:10:45					5 min grd stc		
							18:29:49	18:31:16					S-turn		
EastSD_X	1		41	64	17.6	27.7	18:33:07	18:36:09	N	4,940	120	130.0	crossing tie line	18	1.0
EastSD_A	34		1	160	0	69.8	18:43:10	19:02:23	E	5,390	125	130.0		18	1.0
	35		161	1	70.2	0	19:08:14	19:28:06	W	5,390	120	130.0		19	0.9
	35		1	10	0	4	19:31:54	19:33:22	E	5,390	118	130.0	calibration line	16	1.3
	36		1	161	0	70.2	19:39:40	19:59:47	E	5,390	115	130.0		18	1.0
	37		161	1	70.2	0	20:04:31	20:24:58	W	5,390	110	130.0		18	1.0
	38		1	161	0	70.2	20:28:16	20:47:23	E	5,390	127	130.0		18	1.0
	39		162	1	70.7	0	20:51:12	21:10:44	W	5,340	123	130.0		20	0.9
	40		1	162	0	70.7	21:14:50	21:34:12	E	5,290	125	130.0		18	1.1
	41		162	1	70.7	0	21:38:25	21:57:52	W	5,240	124	130.0		19	1.0
							21:58:41	22:00:15					S-turn		
							22:15:05	22:20:05					5 min grd stc		

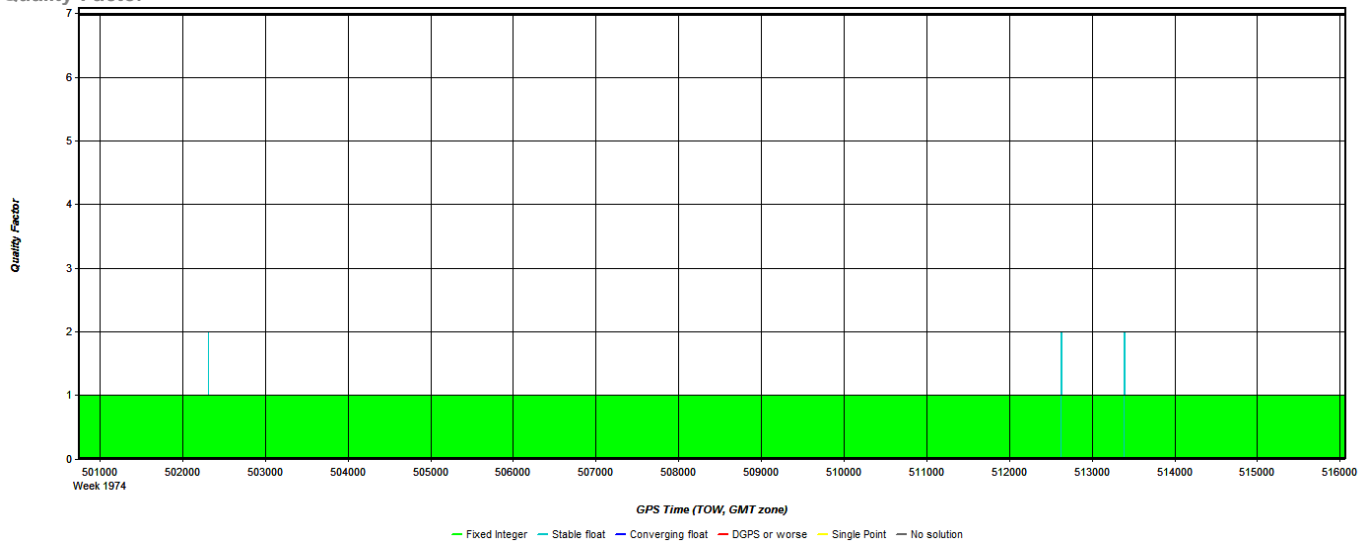
Trajectory and GPS Plots:



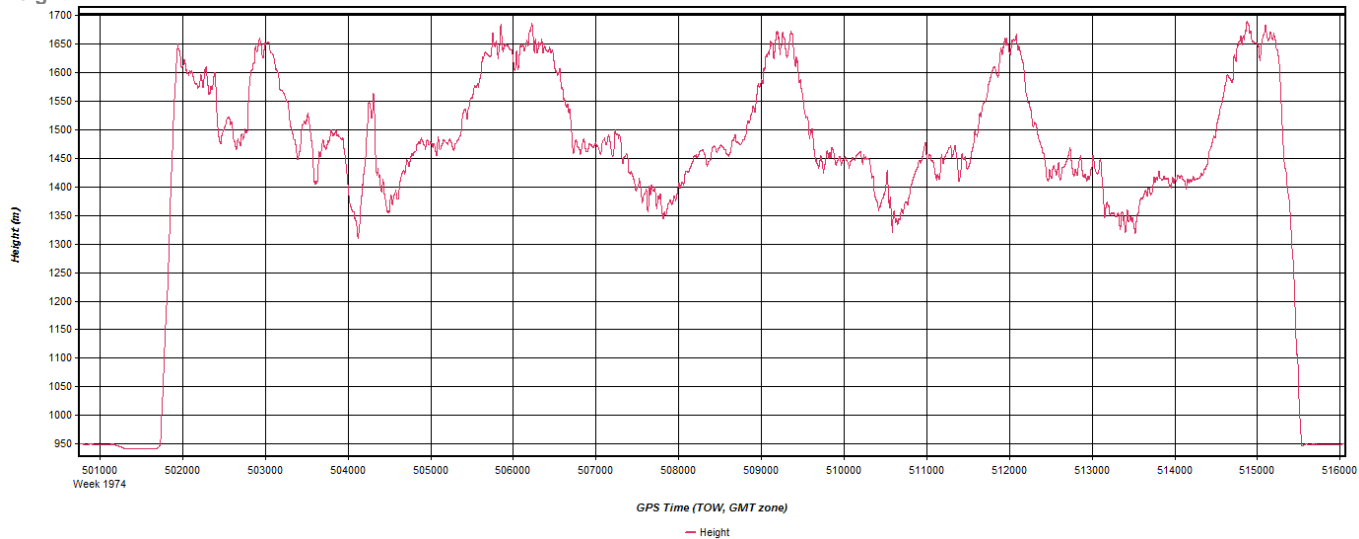
Estimated Accuracy



Quality Factor

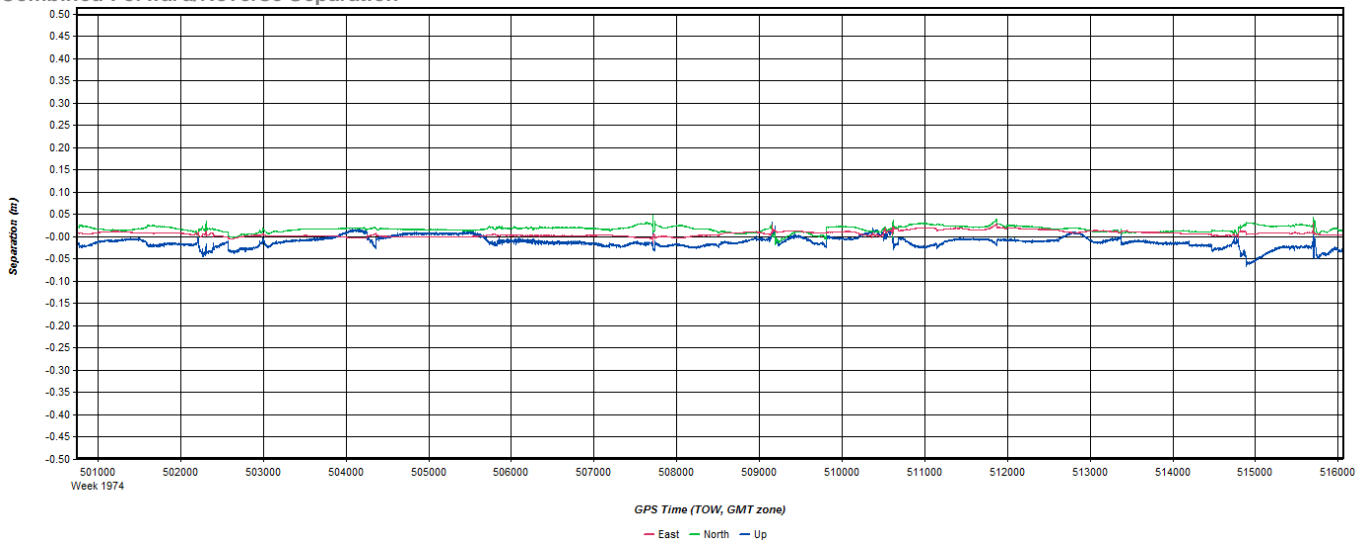


Height

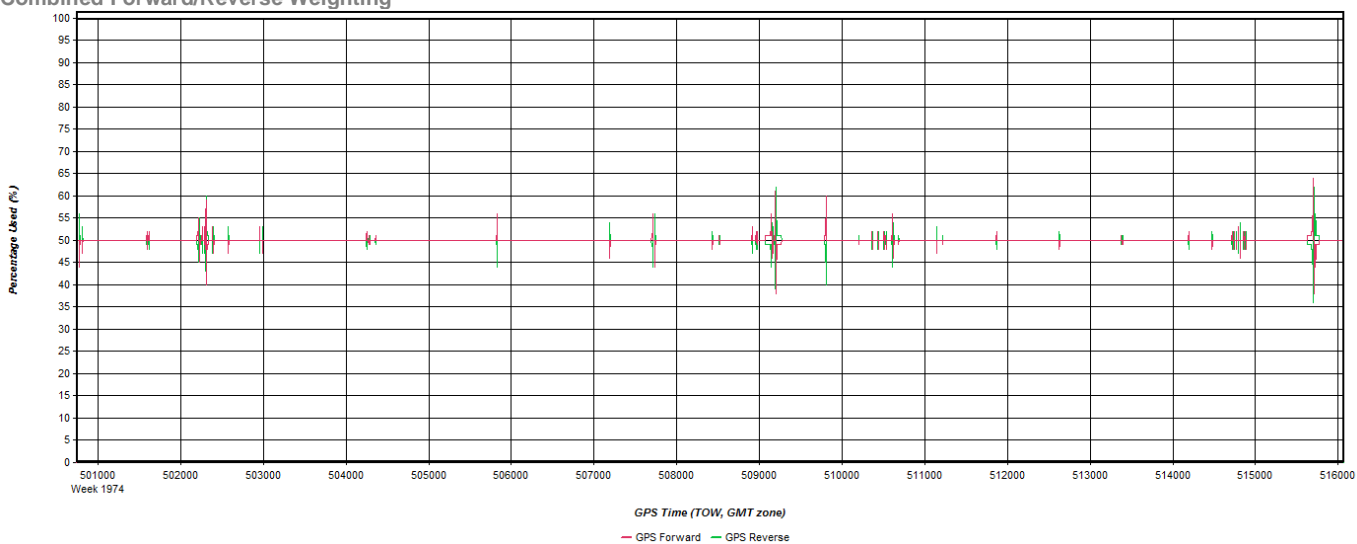




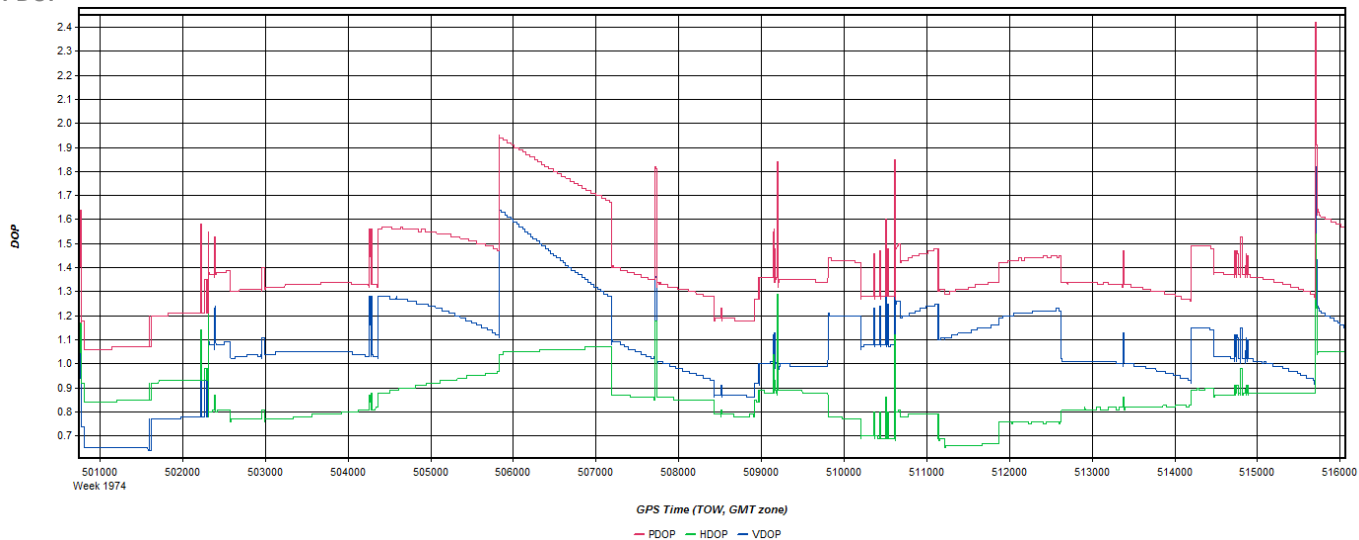
Combined Forward/Reverse Separation



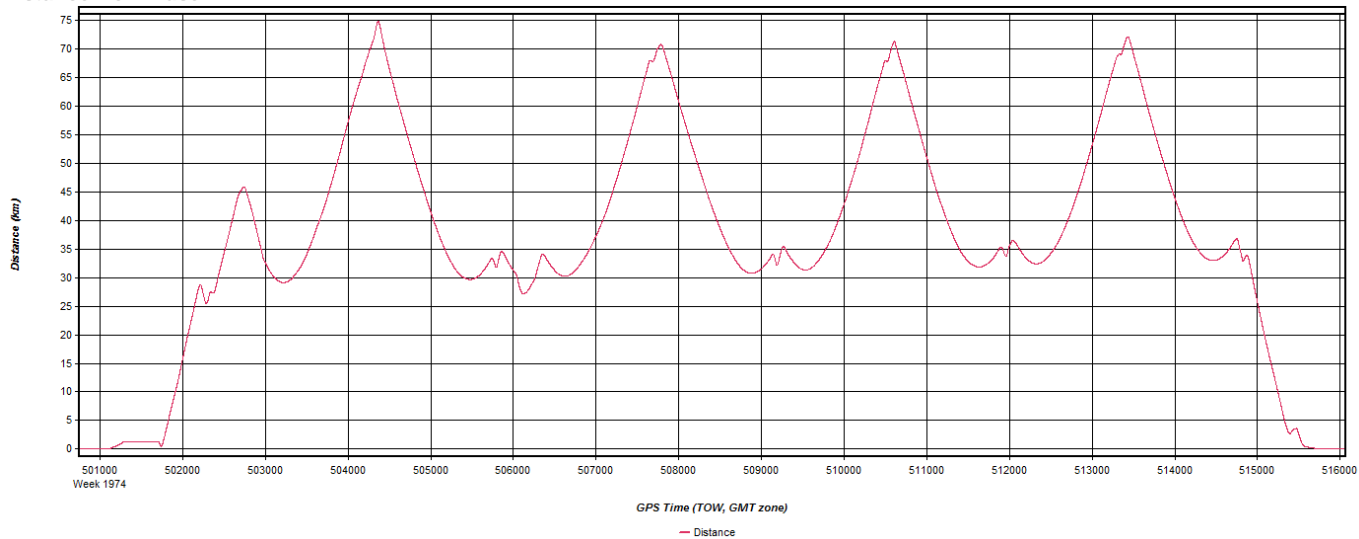
Combined Forward/Reverse Weighting



PDOP

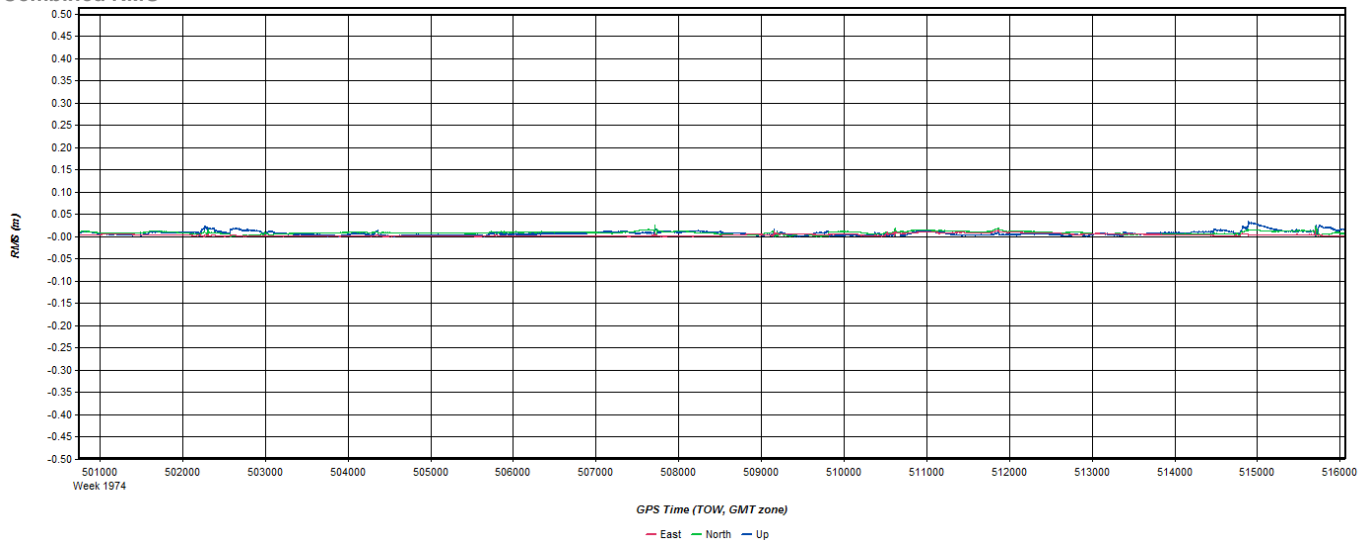


Distance from Base

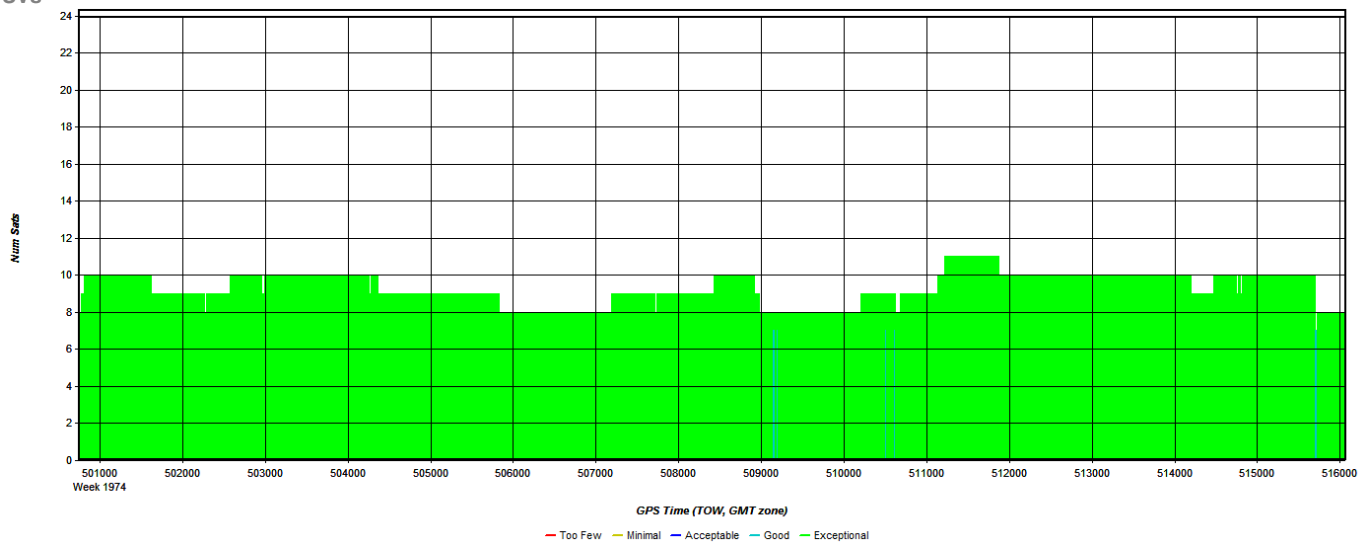




Combined RMS



SVs





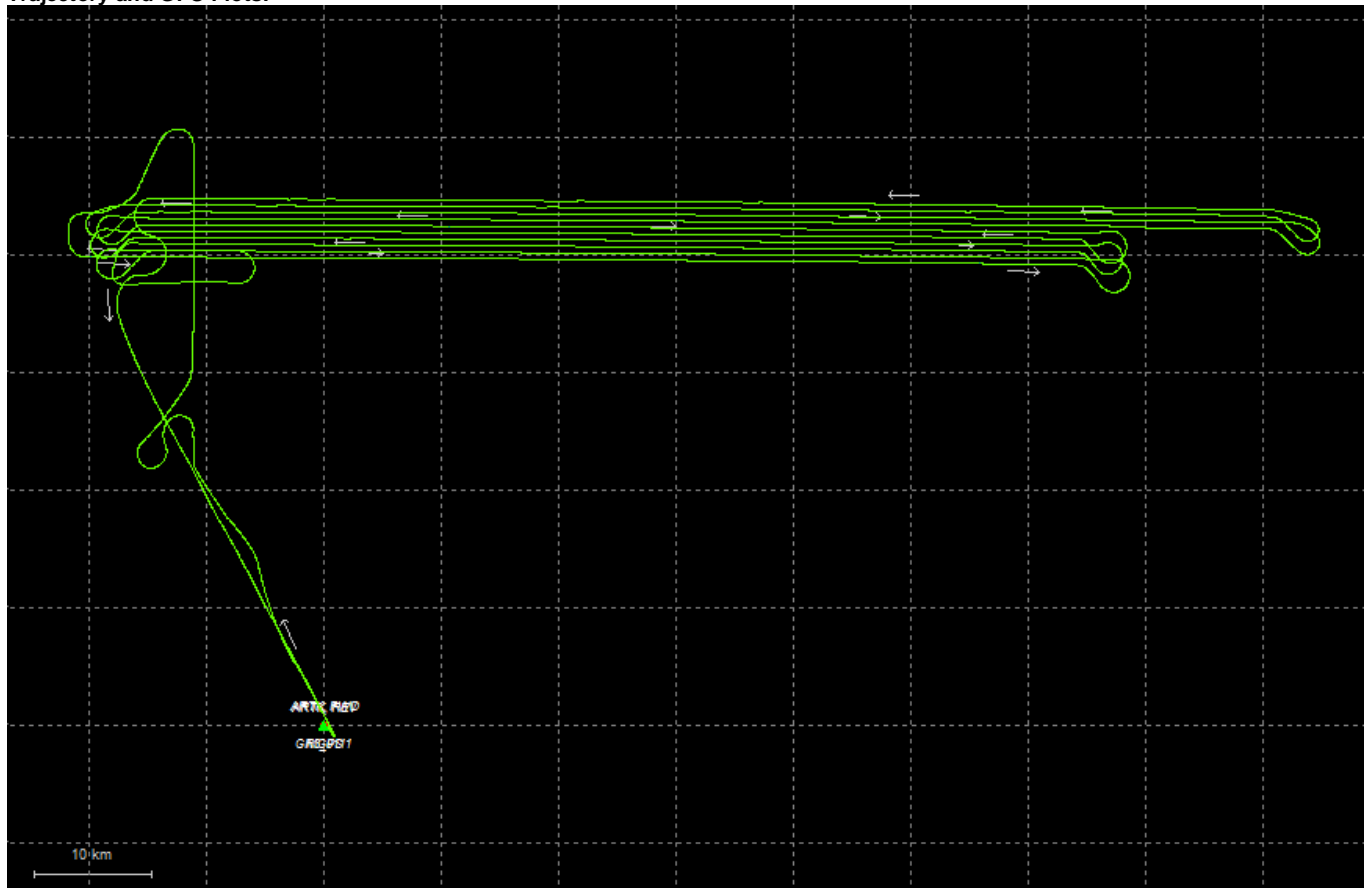
Acquisition and Processing details ----- Collection 10 (November 10, 2017)

Log:

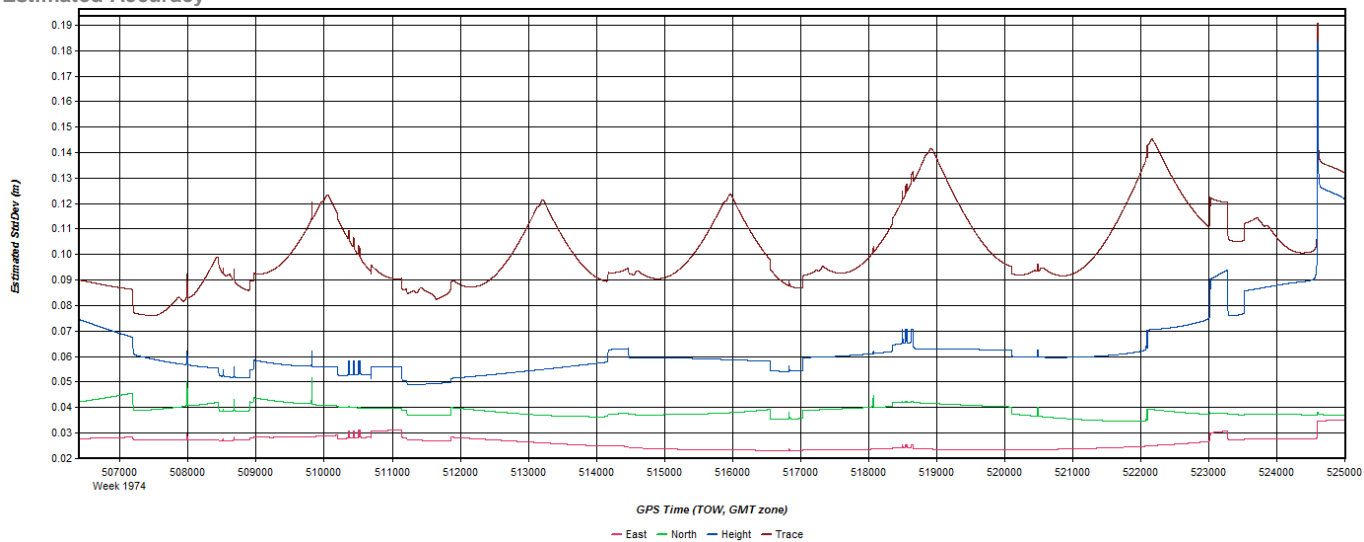
FUGRO		Fugro Geospatial, Inc.										Riegl Flight Log	
17.06		Lift Begin			Lift End			Flt	Flt	Hobbs	Activity		
		Airport	Chocks	Hobbs	Airport	Chocks	Hobbs	Duration	Hrs	Hrs			
1		KRAP	20:37	7532.4	KRAP	1:50	7537.5	5:12	5:25	5:1	0900-Production		
2													
3													

FGI Job #	Project Name			System	Unit	IMU				Ground Temp °C	Min Range'	Data Logger Drives				
22.17003900	USGS SD Lidar 2017 D17			780	421	AIMU				6.0 -1.0	1542	01/03/EU RIEGL 02				
Flight Date	GPS Day	Lift				Sun°	Solar Times (UTC)	Pulse Rate	Flying Temp °C		Max Range'	Download Drive				
10-Nov-17	17-314	3				-	-	330K	6.0 4.0		2933	NS1TB-57				
Mission ID (yyymmdd_Sen_Job_Lift)	Aircraft	Airport ID	FMS	UTC	AMT (ft)	Speed	FOV	Scan Rate (Hz)	MTA	km/WPT	AltM Setting	Humidity @ Alt	Shipping Track			
171110_421_17003900_03	N76JN	KRAP	CCNS 1	-7	2400	130	60	130	2	0.440	29.84 29.88	61%				
Pilot #1	Pilot #2		Operator #1			Operator #2										
Fred Davis			Jacob Amundson			Chris Acuña										
Base 1 ID	Location	Rec ID	Ant ID	ARP (m)	Start Time (UTC)	Stop Time (UTC)	GPS Filename	Operator		Data						
FGI 0493	KRAP	GR3 U1	Unit 1	1.8	10-Nov-17 12:05	11-Nov-17 02:04	GR2_011110t.tps	Riley Forsyth		With AB						
Area	Flight #		Wpt		Distance		UTC		Flt	Altitude	Speed	Scan	Comments and Conditions		SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End	Dir	(GPS)	(knots)	Rate				
							20:44:21	20:49:21					GROUND STATIC		17	1.3
							21:03:29						ALIGNMENT TURNS		18	1.2
EastSD_X	1		65	80	28.2	34.8	21:09:47	21:12:53	N	4,945	127	130.0	CROSSING LINE		18	1.2
EastSD_A	53		1	170	0	74.4	21:19:20	21:38:32	E	5,125	131	130.0			19	1.1
	54		169	1	73.9	0	21:42:04	###	W	###	130	130.0			18	1.1
	54		1	10	0	4	22:04:38	###	E	###	126	130.0	CALIBRATION LINE		18	1.2
	55		1	169	0	73.9	22:12:05	###	E	###	128	130.0			19	1.1
	56		169	1	73.9	0	22:34:42	22:54:14	W	4,335	130	130.0			19	1.1
	57		1	169	0	73.9	22:57:50	23:17:11	E	5,185	128	130.0			18	1.3
	58		169	1	73.9	0	23:20:37	23:39:54	W	4,320	127	130.0			18	1.1
	59		1	169	0	73.9	23:43:12	0:02:32	E	5,200	127	130.0			17	1.2
	60		206	1	90.2	0	0:09:55	0:33:14	W	4,340	129	130.0			17	1.2
	61		1	205	0	89.8	0:36:59	1:00:39	E	5,200	128	130.0			17	1.2
	62		205	1	89.8	0	1:04:02	1:27:55	W	4,305	126	130.0			15	1.2
							1:28:05						ALIGNMENT TURNS		14	1.3
							1:43:12	1:48:12					GROUND STATIC		12	1.5

Trajectory and GPS Plots:

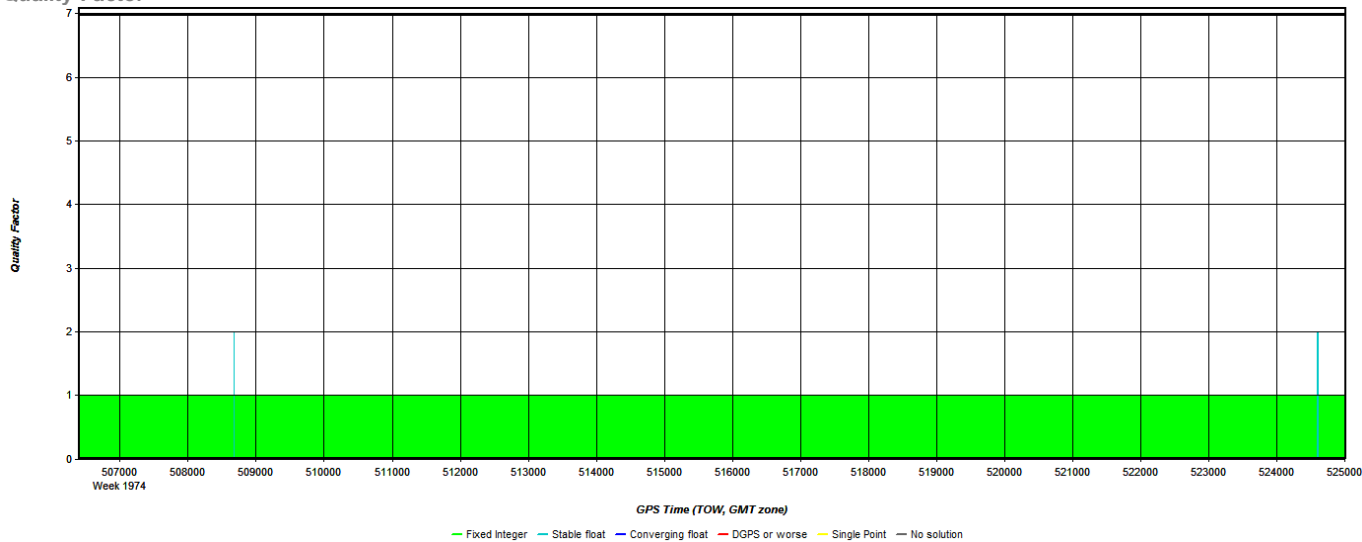


Estimated Accuracy

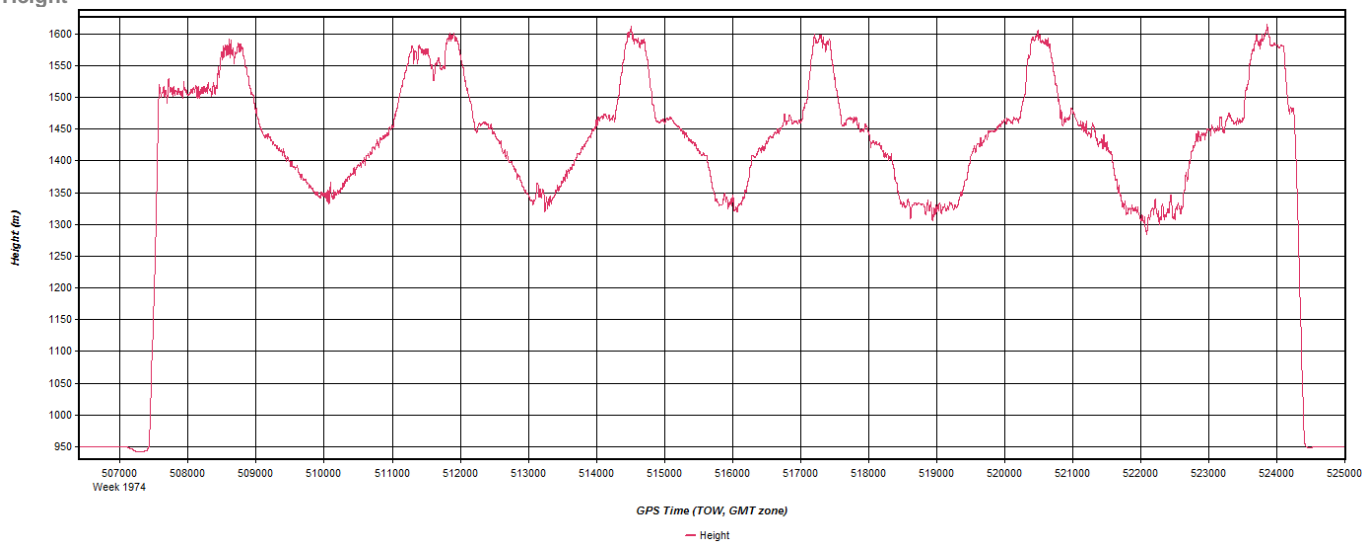




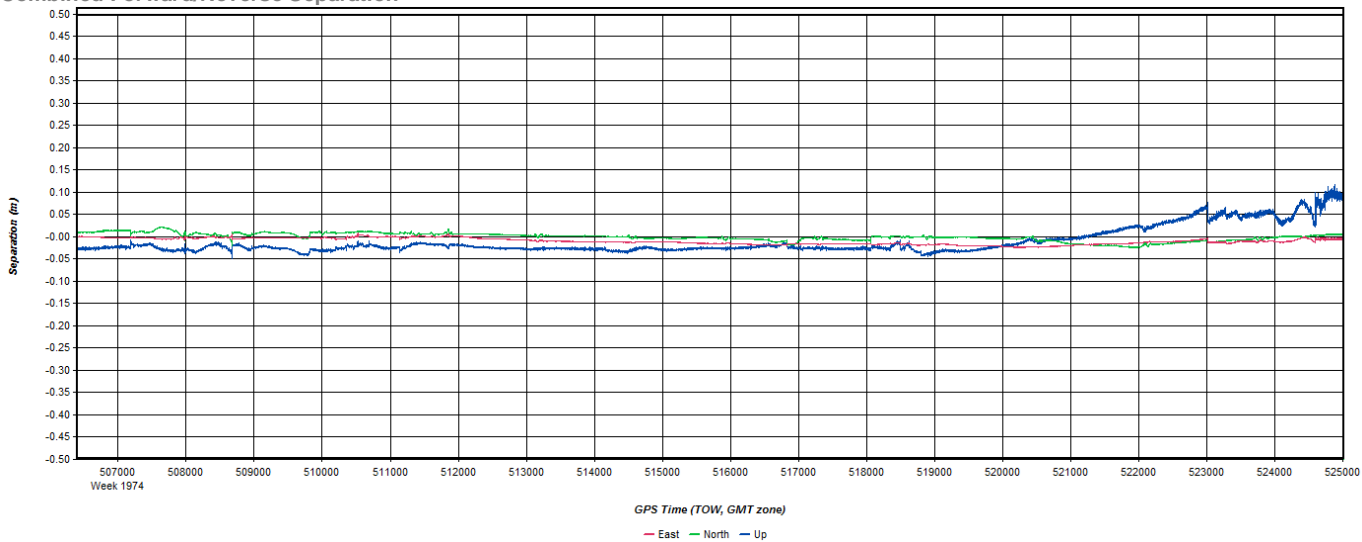
Quality Factor



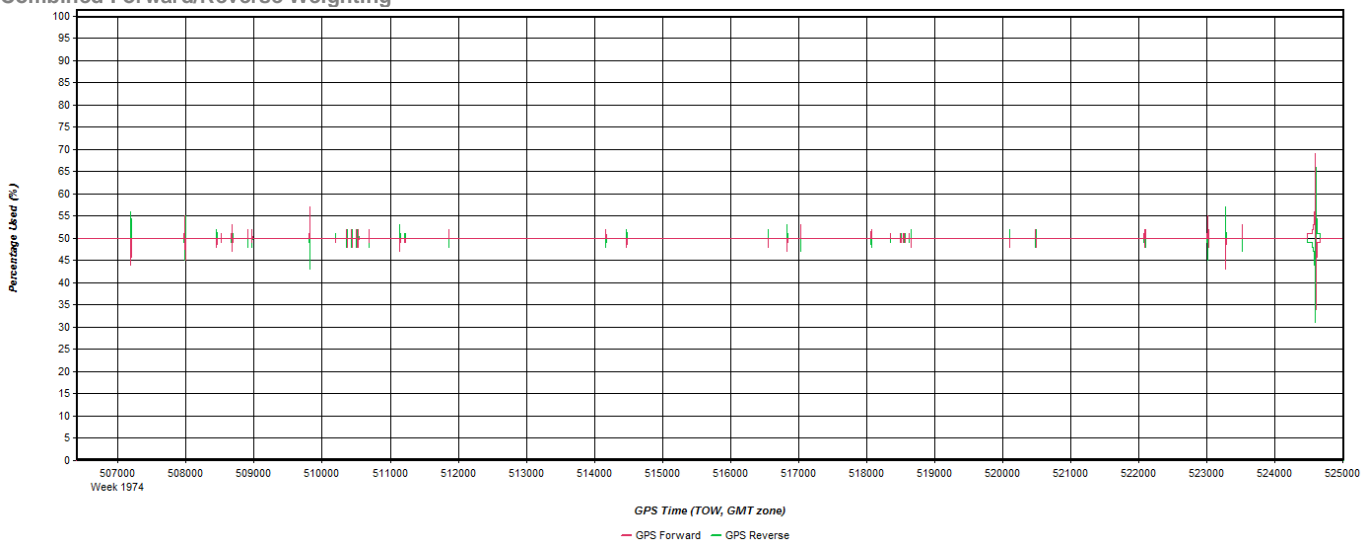
Height



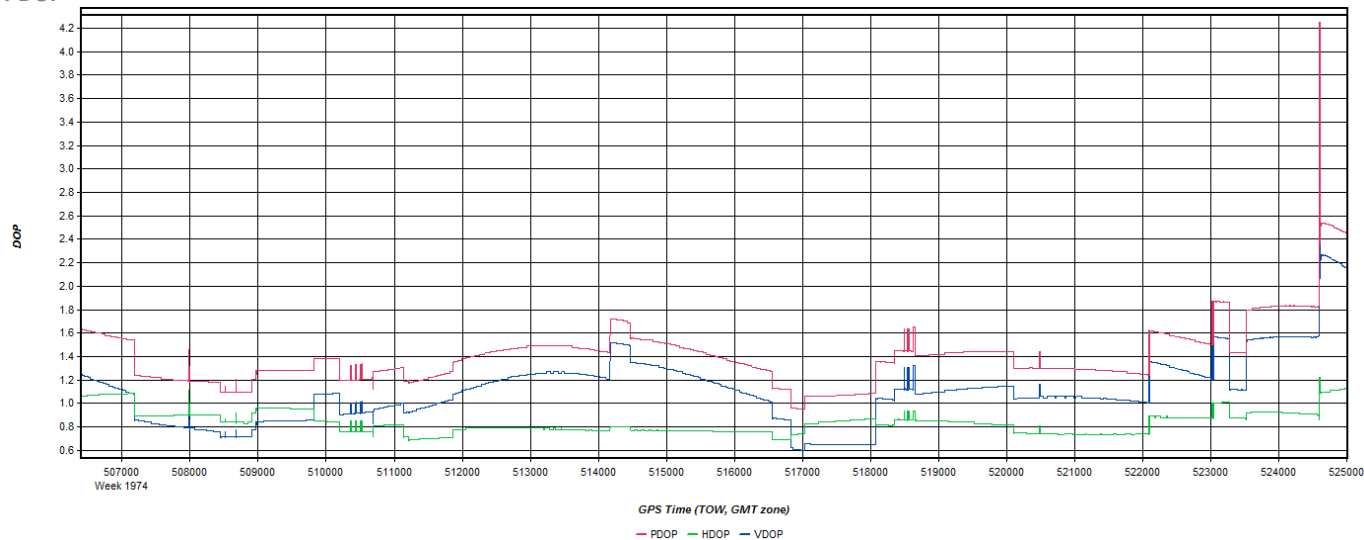
Combined Forward/Reverse Separation



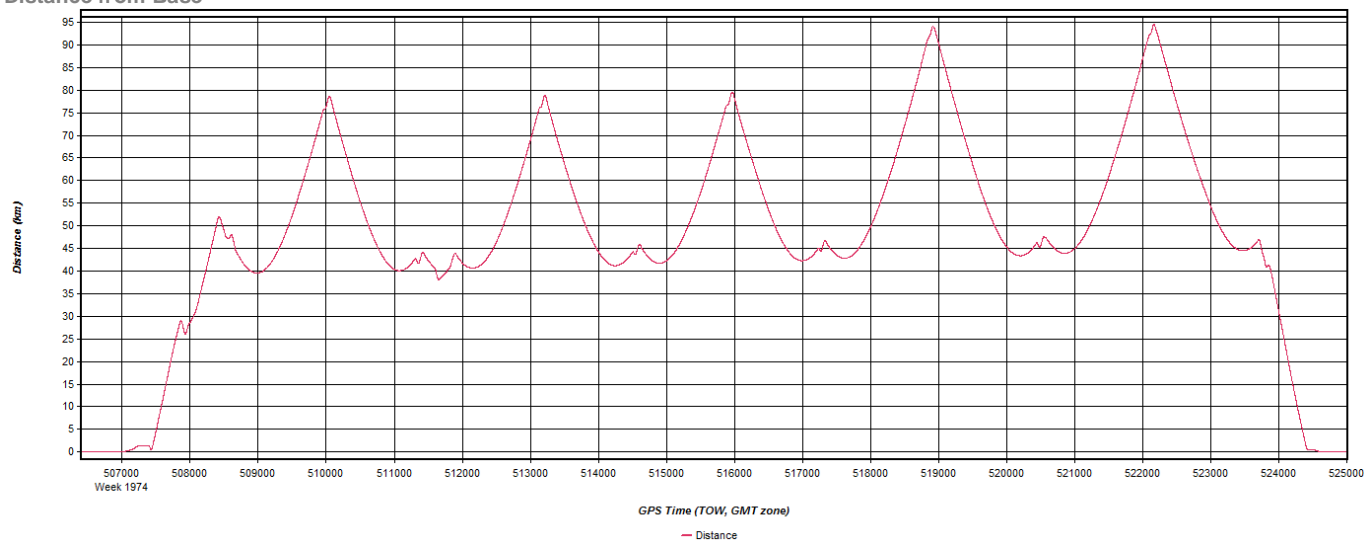
Combined Forward/Reverse Weighting



PDOP

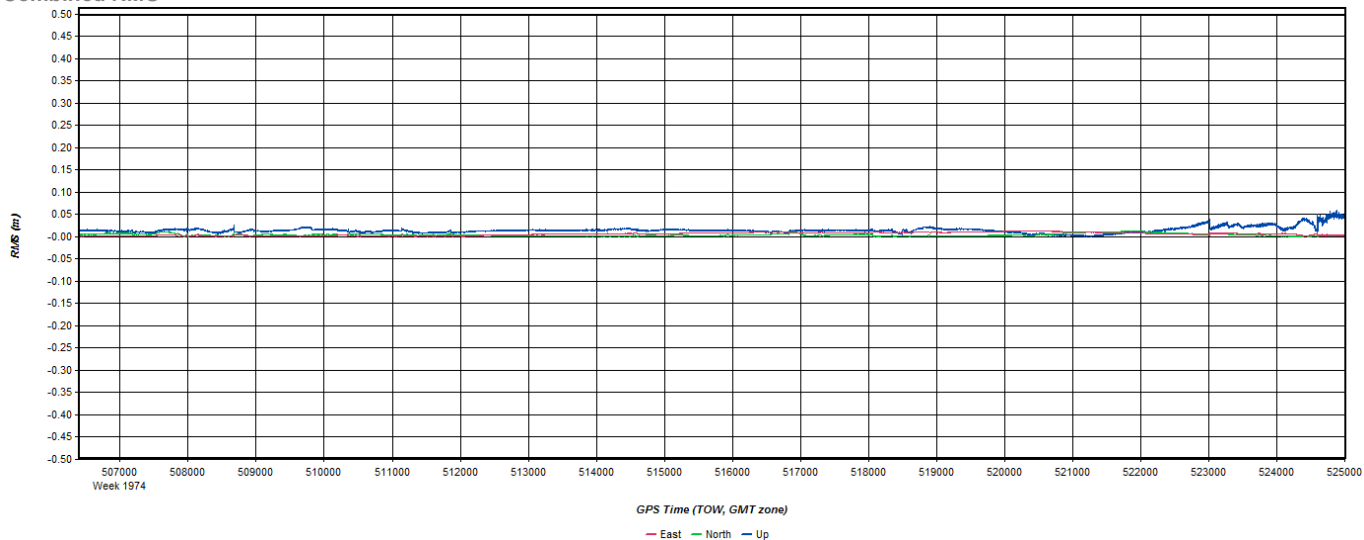


Distance from Base

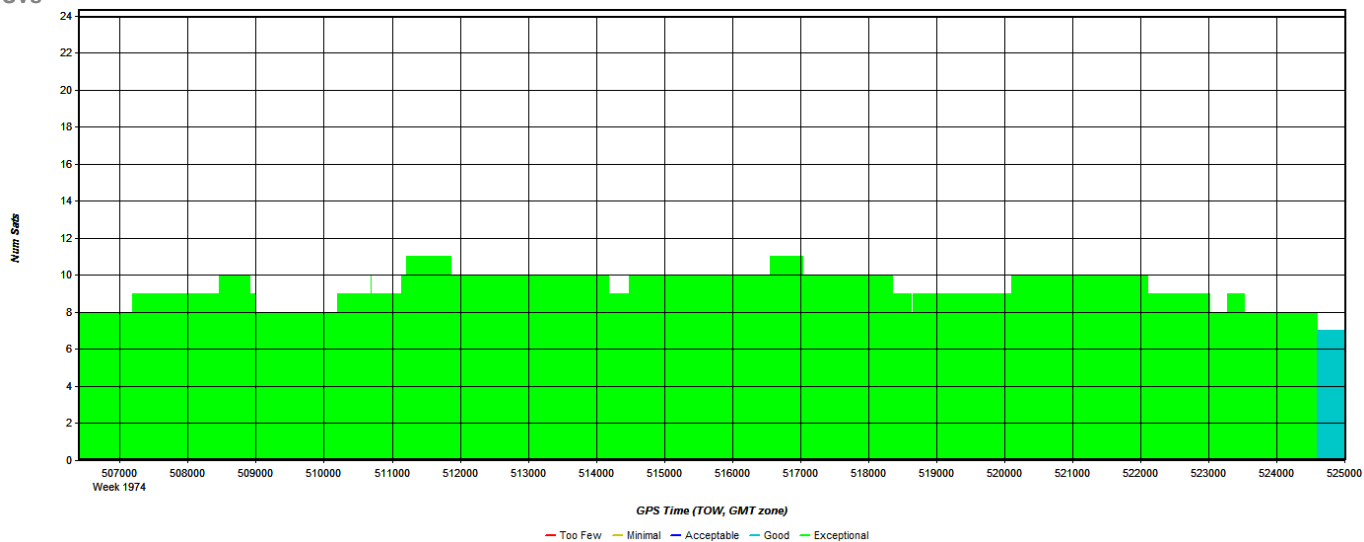




Combined RMS



SVs





Acquisition and Processing details ----- Collection 11 (November 11, 2017)

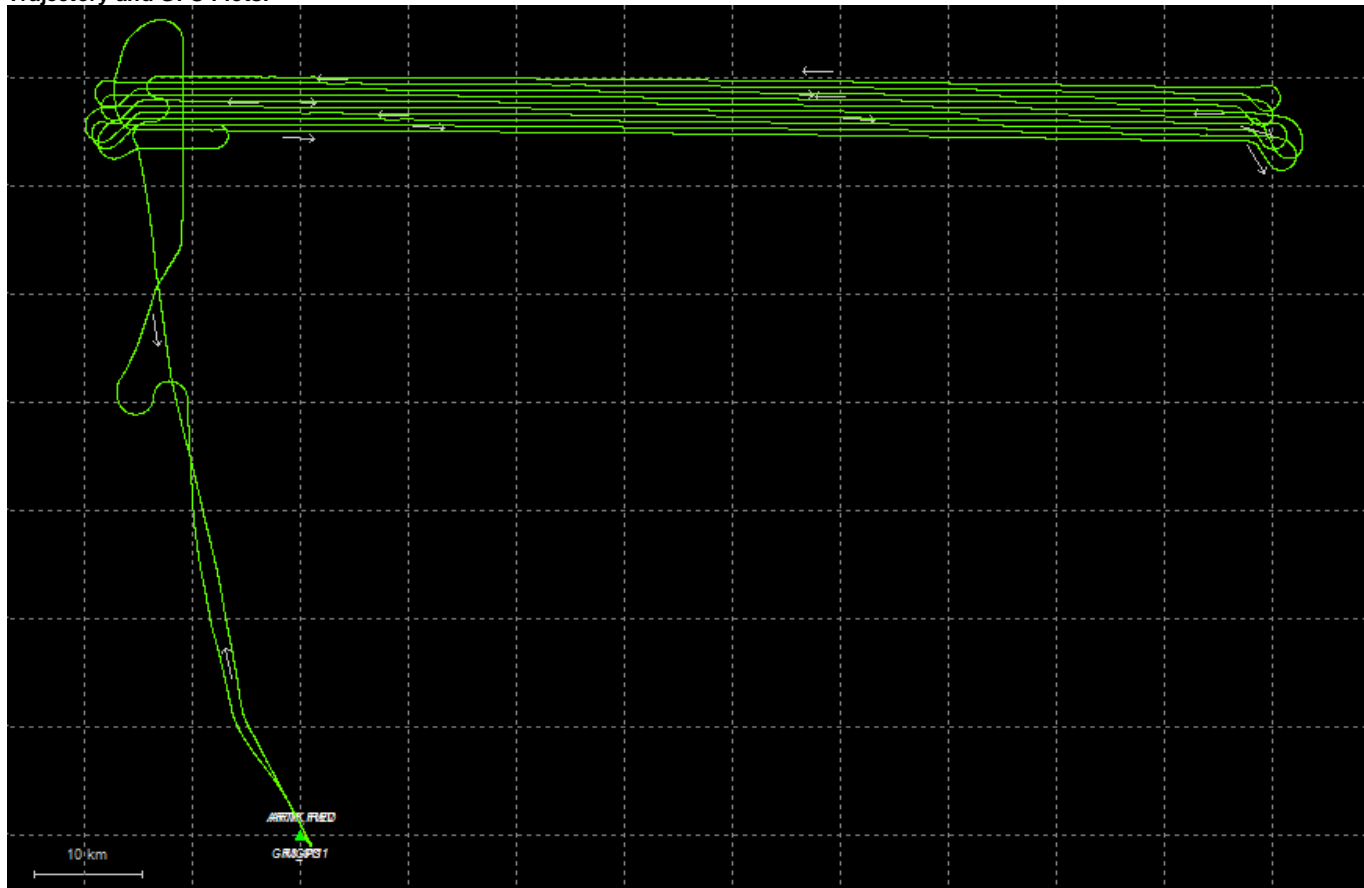
Log:

17.06	Lift Begin			Lift End			Fit Duration	Fit Hrs	Hobbs Hrs	Activity
	Airport	Chocks	Hobbs	Airport	Chocks	Hobbs				
1	KRAP	15:42	780.7	KRAP	21:44	786.3	6:02	6.00	5.6	0900-Production
2										
3										

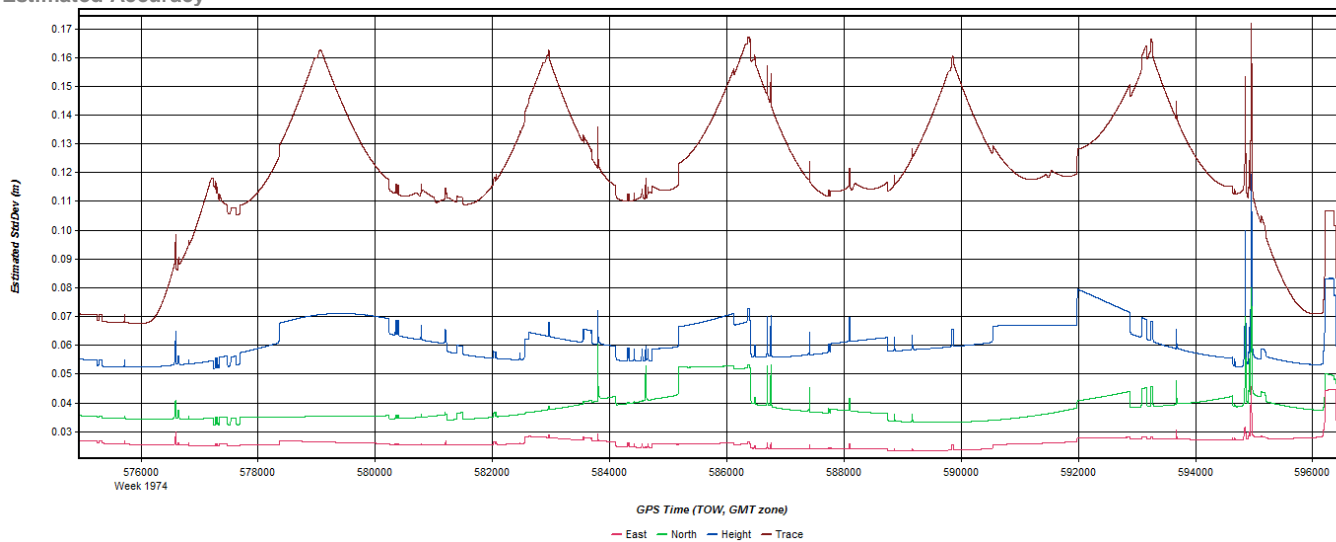
Fugro Geospatial, Inc.		Riegl Flight Log	
		AC80-50-00-02	

FGI Job # 17003900	Project Name USGS SD Lidar 2017 D17		System 680i	Unit 165	IMU					Ground Temp °C 6.0 8.0	Min Range' 1542	Data Logger Drives EU RIEGL 04			
Flight Date 11-Nov-17	GPS Day 17-315	Lift 3		Sun°	Solar Times (UTC)	Pulse Rate 330				Flying Temp °C 1.0 0.0	Max Range' 2933	Download Drive			
Mission ID (yyymmdd_Sen_Job_Lift) 171111_165_17003900_03	Aircraft N97HC	Airport ID KRAP	FMS CCNS 7	UTC -7	AMT (ft) 2400	Speed 130	FOV 56.2	Scan Rate (Hz) 120	MTA 2	km/WPT 0.439	AltM Setting 30.01 30.03	Humidity @ Alt 66	Shipping Track		
Pilot #1 Fred Davis		Pilot #2		Operator #1 Chris Fought		Operator #2									
Base 1 ID FGI 081	Location Rapid City SD		Rec ID GR3-5	Ant ID GR3-5	ARP (m) 1.8	Start Time (UTC) 11/11/17 1431	Stop Time (UTC) 11/11/17 2211	GPS Filename GR3_0111110.tps		Operator Jacob Amundson		Data With AB			
Area	Flight #		Wpt		Distance		UTC		Fit Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions	SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End							
						15:47:00	15:52:00						Ground static at KRAP	18	1.1
						16:08:30	16:10:30						pre acquisition s turn	19	1.1
E-680-X	1		123	143	53.6	62.3	16:16:29	16:18:47	N	5,000	125	120.0	cross tie line	19	1.1
E-680-B	37		1	223	0	97.5	16:23:26	16:48:25	E	5,000	128	120.0		19	1.0
	38		223	1	97.5	0	16:52:13	17:17:35	W	5,000	125	120.0		17	1.1
	38		1	10	0	4	17:21:25	17:22:34	E	5,000	125	120.0	calibration line	18	1.0
	39		1	223	0	97.5	17:28:11	17:53:27	E	5,000	129	120.0		17	1.2
	40		223	1	97.5	0	17:56:41	18:21:39	W	5,000	127	120.0		18	1.0
	41		1	223	0	97.5	18:25:52	18:50:57	E	5,000	126	120.0		17	1.1
	42		222	1	97	0	18:55:37	19:20:41	W	5,000	128	120.0		18	1.0
	43		1	222	0	97	19:24:02	19:48:59	E	5,000	127	120.0		19	1.0
	44		222	1	97	0	19:51:48	20:16:33	W	5,000	128	120.0		19	1.1
	45		1	222	0	97	20:20:11	20:45:02	E	5,000	127	120.0		18	1.2
	46		222	1	97	0	20:48:09	21:13:04	W	5,000	128	120.0		17	1.2
						21:13:10	21:16:00						post acquisition S turn	21	1.0
						21:36:40	21:41:40						Ground static at KRAP	16	1.2

Trajectory and GPS Plots:

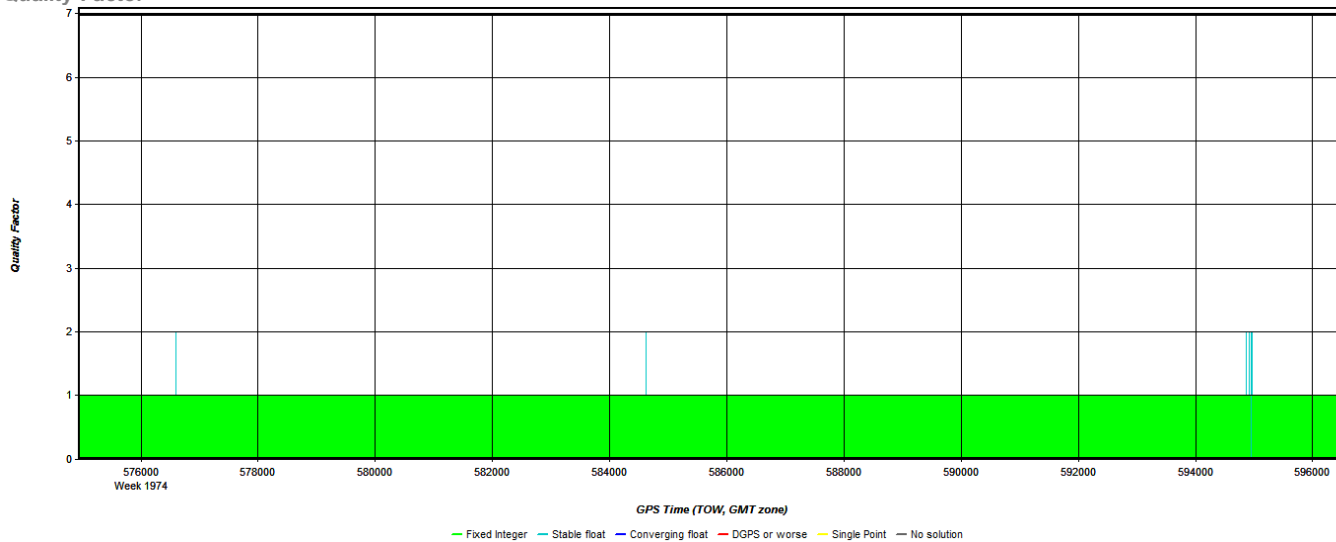


Estimated Accuracy

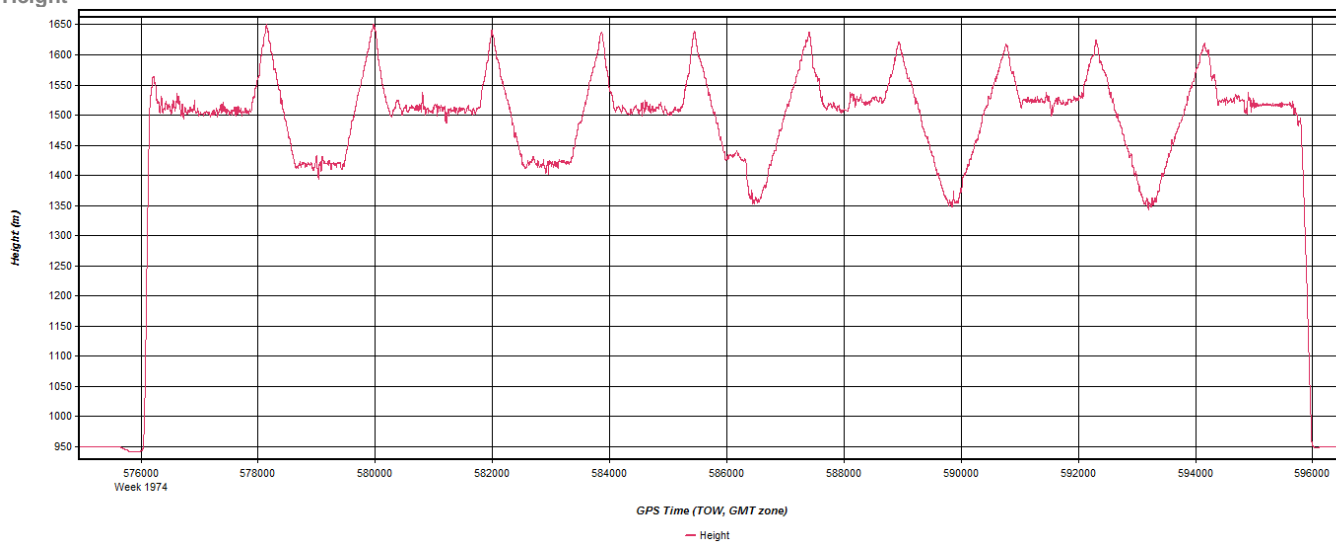




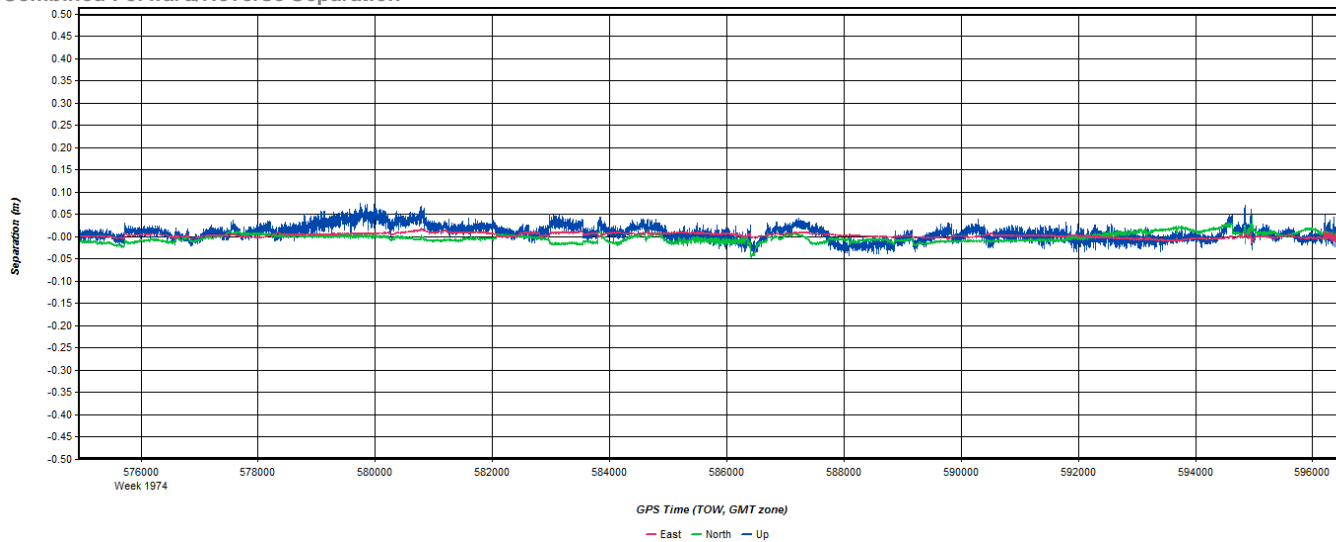
Quality Factor



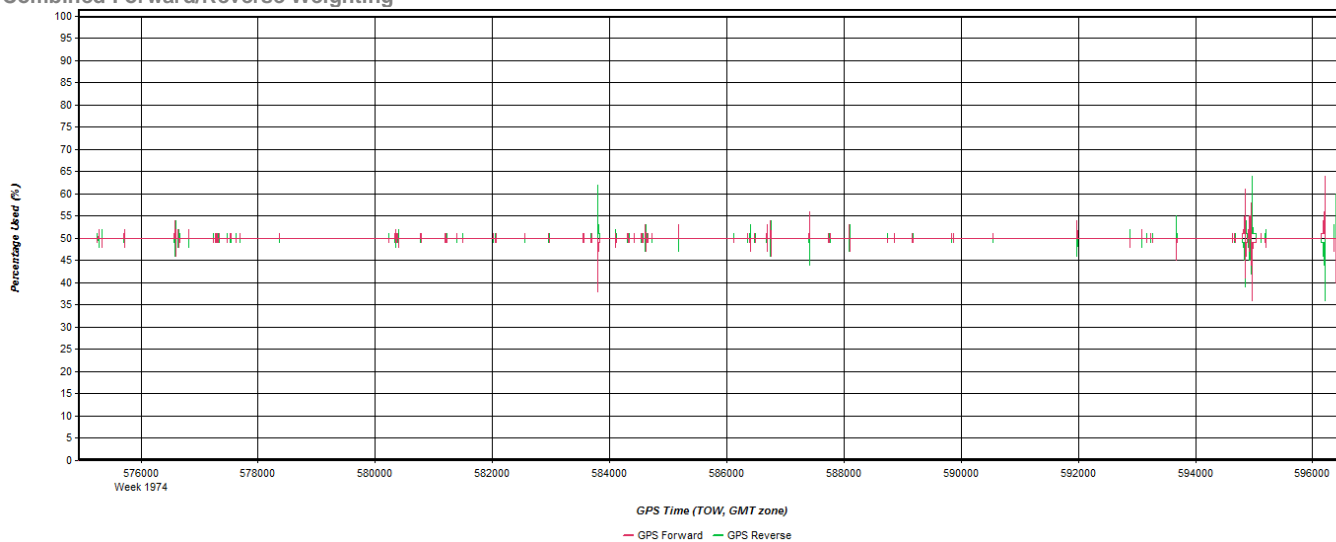
Height



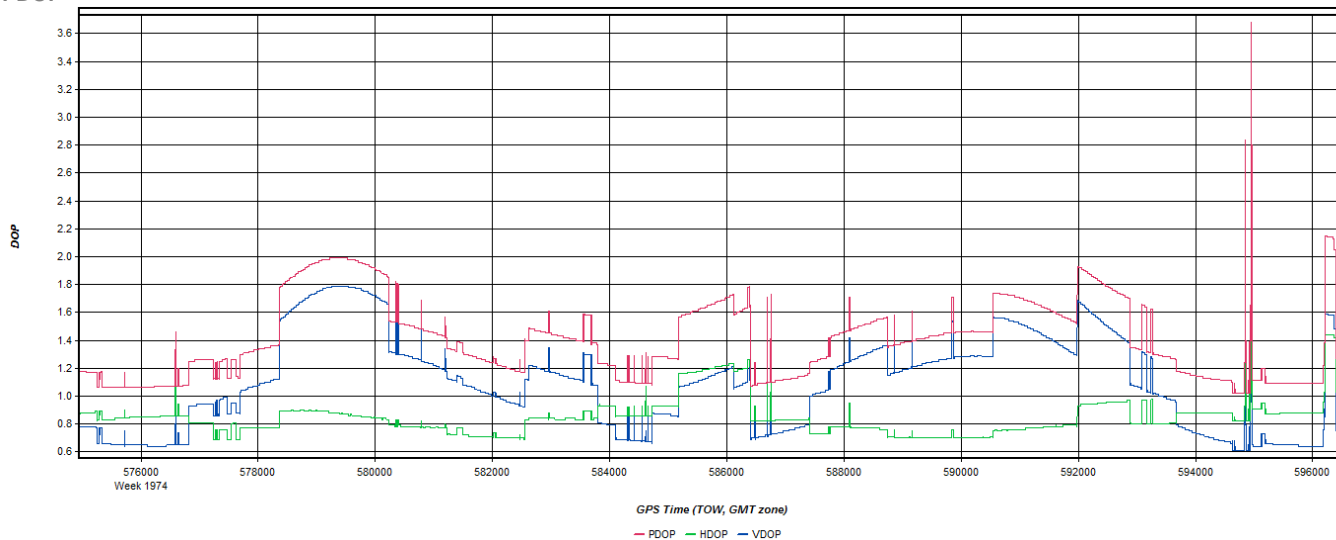
Combined Forward/Reverse Separation



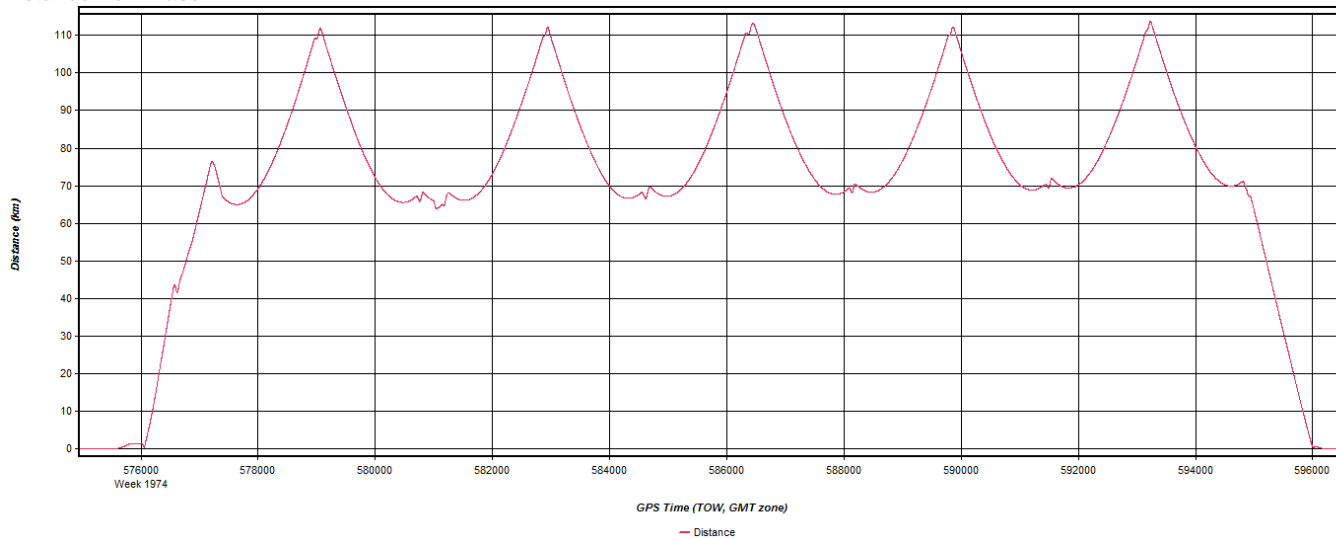
Combined Forward/Reverse Weighting



PDOP

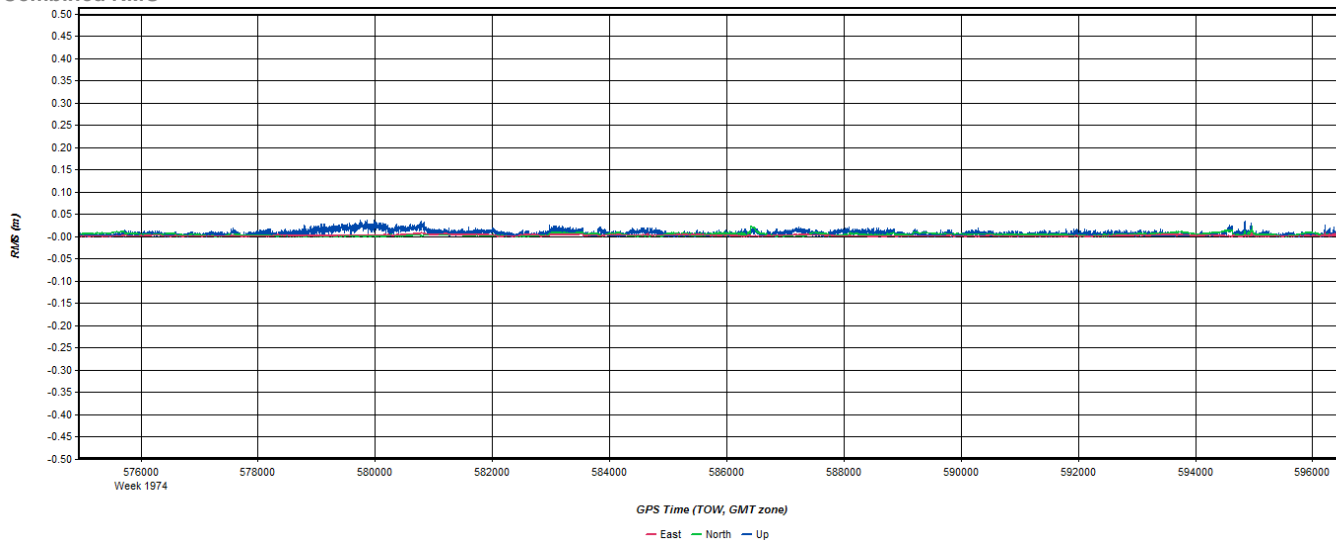


Distance from Base

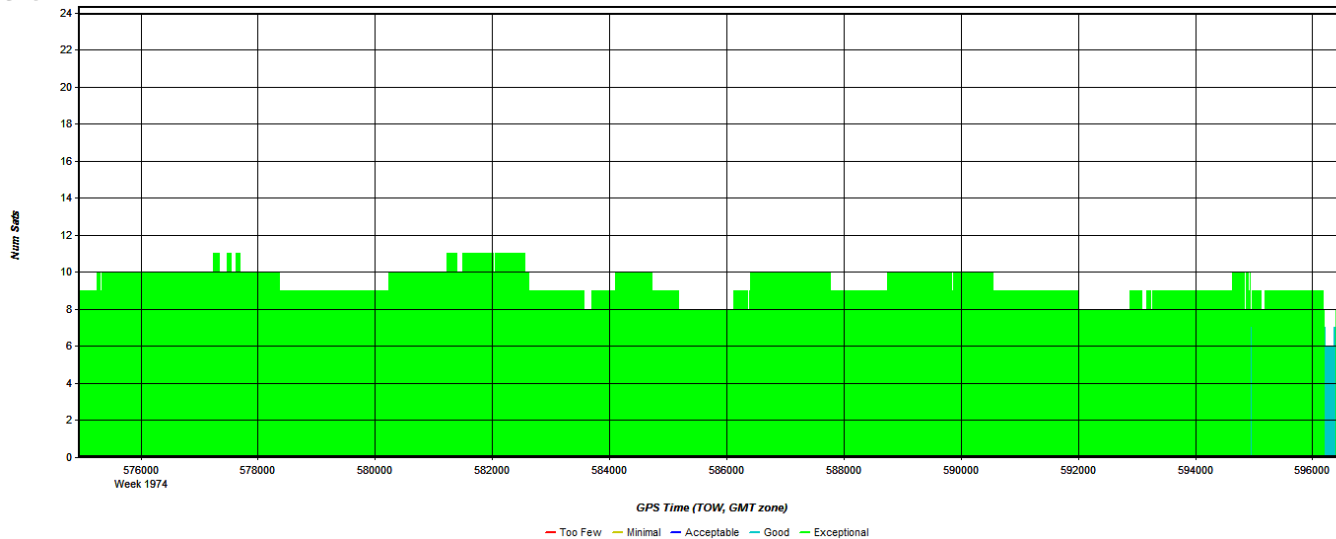




Combined RMS



SVs



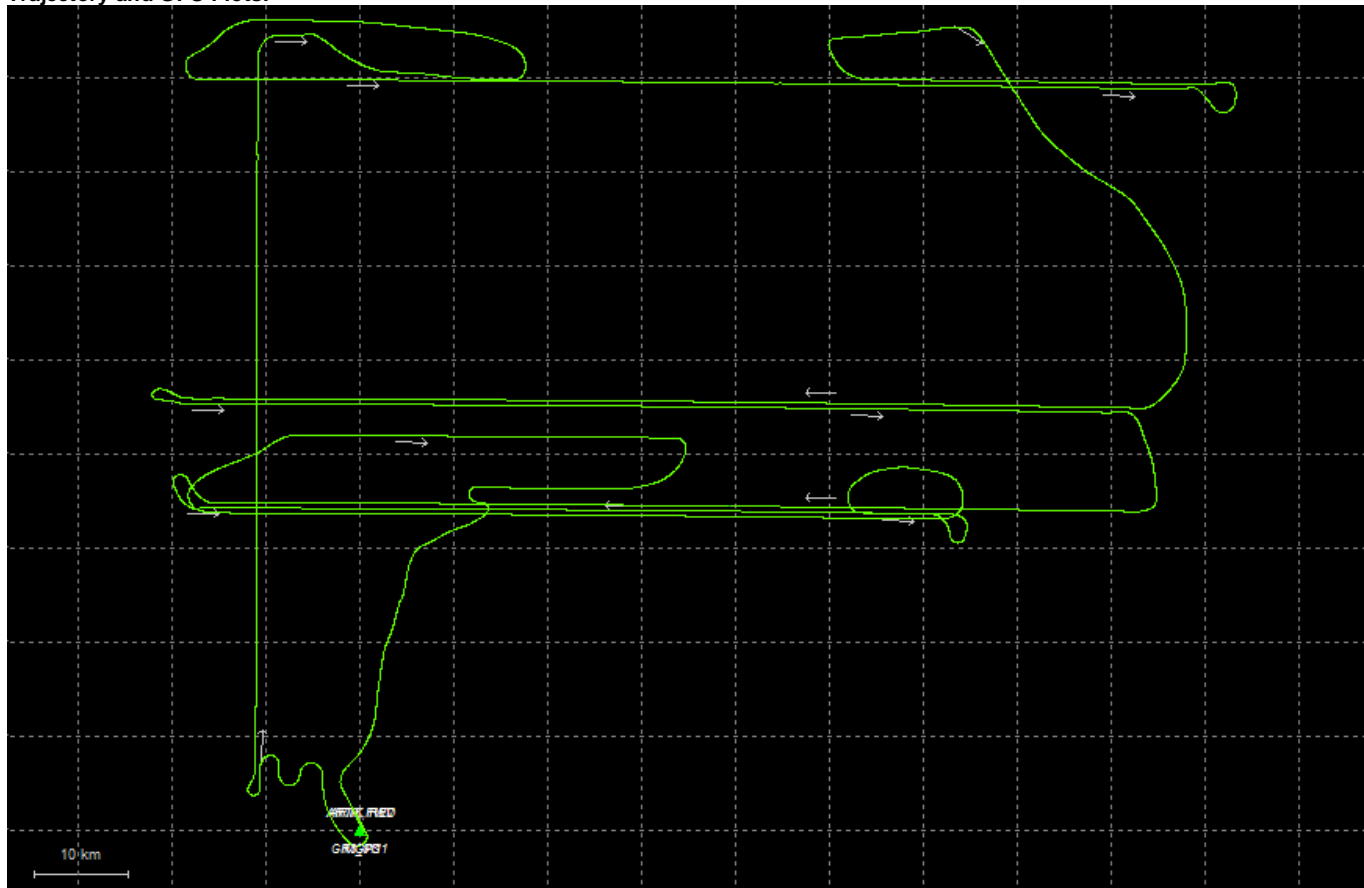


Acquisition and Processing details ----- Collection 12 (November 11, 2017)

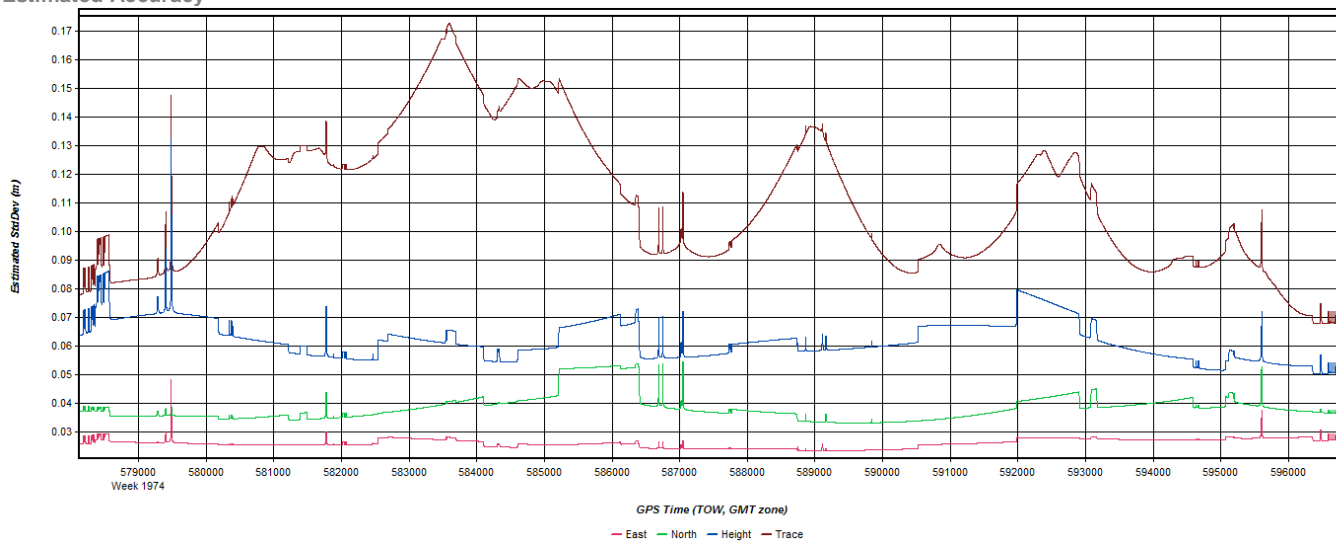
Log:

FUGRO		Fugro Geospatial, Inc.										Riegl				
17.06		Lift Begin			Lift End			Flt	Flt	Hobbs	Activity	Flight Log				
		Airport	Chocks	Hobbs	Airport	Chocks	Hobbs	Duration	Hrs	Hrs		AC80-50-00-02				
1	KRAP	15:08	447.8	KRAP	20:51	452.6	5:43	5.75	4.8	0900-Production						
2																
3																
FGI Job #		Project Name			System	Unit	IMU				Ground Temp °C	Min Range'	Data Logger Drives			
22.17003900		USGS SD Lidar 2017 D17			680i	216	AIMU				6.0 8.0	1542				
Flight Date		GPS Day	Lift				Sun°	Solar Times (UTC)		Pulse Rate	Flying Temp °C	Max Range'	Download Drive			
11-Nov-17		17-315	6				NA	NA		330kHz	8.0 6.0	2933				
Mission ID (yyymmdd_Sen_Job_Lift)		Aircraft	Airport ID	FMS	UTC	AMT (ft)	Speed	FOV	Scan Rate (Hz)	MTA	km/WPT	AltM Setting	Humidity @ Alt	Shipping Track		
171111_216_17003900_06		N3832K	KRAP	CCNS 6	-6	2400	130		130	2	0.439	30.02 30.04				
Pilot #1		Pilot #2		Operator #1			Operator #2									
Wayne Manning		Jonathan Spencer														
Base 1 ID	Location		Rec ID	Ant ID	ARP (m)	Start Time (UTC)		Stop Time (UTC)		GPS Filename		Operator		Data		
FGI 081	KRAP		GR3 U1	U1	1.8	11-Nov-17 14:31		11-Nov-17 22:11		GR3_0111110.tps		Jacob Amundson		With AB		
Area	Flight #		Wpt		Distance		UTC		Flt	Altitude	Speed	Scan	Comments and Conditions		SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End	Dir	(GPS)	(knots)	Rate				
							15:35:42	15:40:42					5 min grd stc			
							15:53:48	15:55:46					S-turn			
EastSD_X	1		1	161	0	70.2	15:58:51	16:18:26	N	4,940	128	130.0	crossing tie line		15	1.2
EastSD_B	63		1	222	0	97	16:37:27	17:03:37	E	5,040	125	130.0			17	1.0
	64		69	1	29.9	0	17:07:58	17:16:48	W	4,592	120	130.0			17	0.9
EastSD_A	64		205	1	89.6	0	17:36:12	18:01:10	W	5,190	120	130.0			15	1.1
	63		1	205	0	89.6	18:06:09	18:33:58	E	5,190	110	130.0			18	0.9
	44		163	1	71.1	0	18:44:46	19:04:57	W	5,190	120	130.0			19	1.0
	43		1	163	0	71.1	19:09:33	19:30:30	E	5,190	115	130.0			18	1.1
	43		163	153	71.1	66.7	19:34:10	19:35:38	W	5,190	128	130.0	calibration line		15	1.3
	42		162	1	70.7	0	19:42:29	20:02:53	W	5,190	115	130.0			17	1.1
	57		29	34	12.3	14.5	20:10:01	20:11:04	E	5,190	111	130.0	re-flight		20	0.8
	57		94	99	40.8	43	20:17:53	20:18:41	E	5,190	121	130.0	re-flight		19	0.9
	47		78	73	33.8	31.6	20:23:19	20:24:17	W	5,140	118	130.0	re-flight		19	0.9
							20:26:01	20:27:50					S-turn			
							20:41:25	20:46:25					5 min grd stc			

Trajectory and GPS Plots:

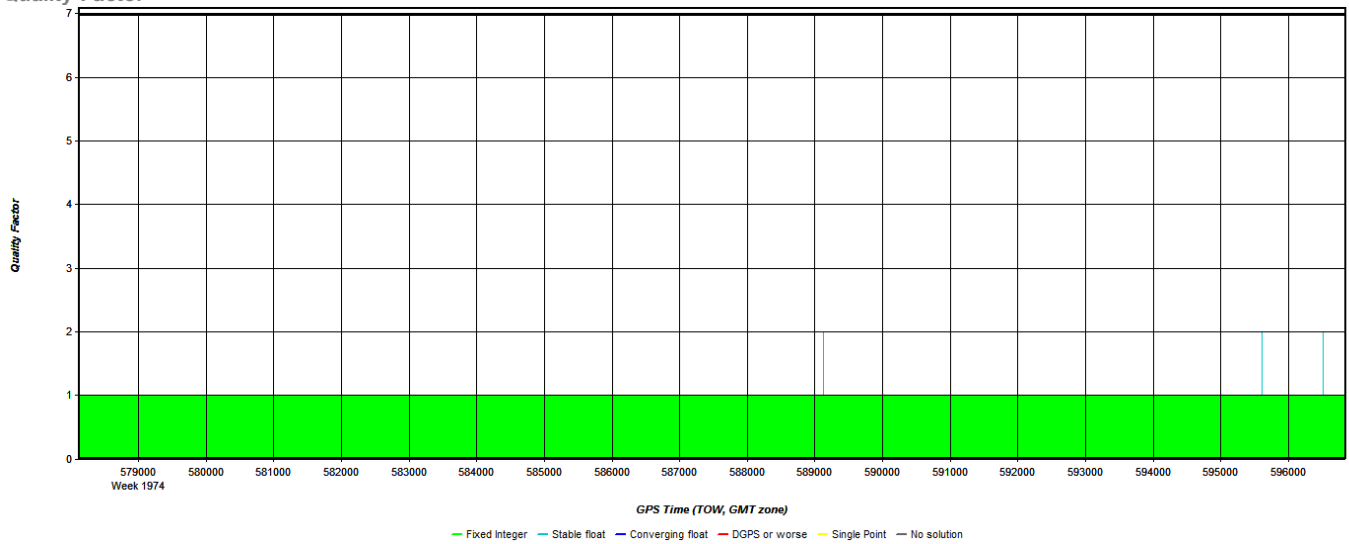


Estimated Accuracy

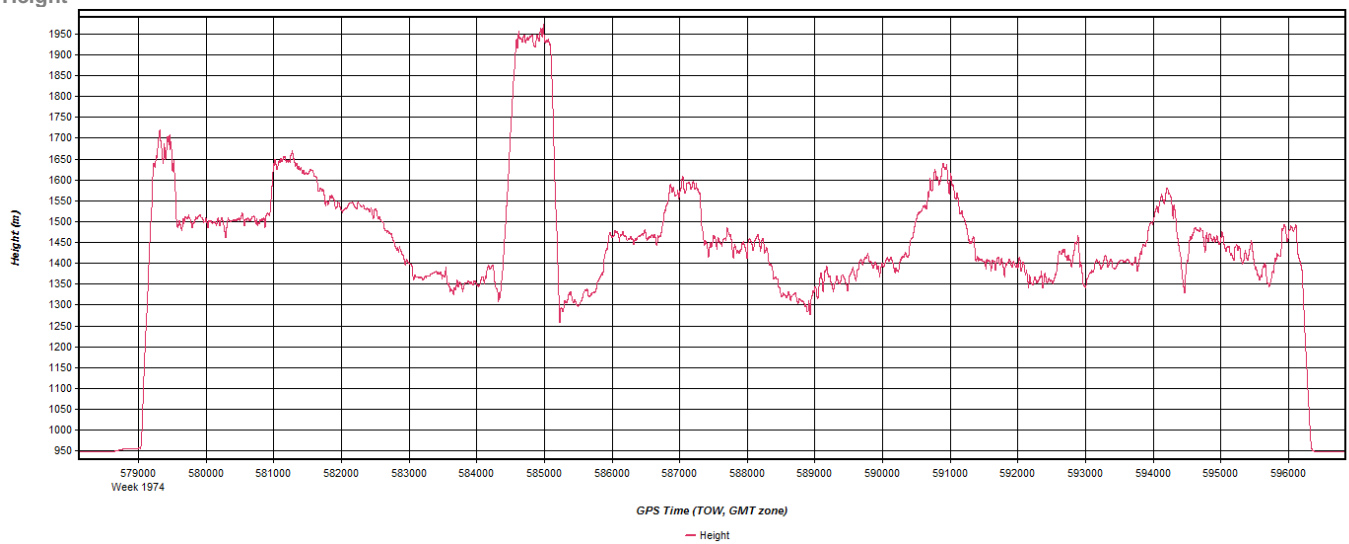


USGS COLLECTION REPORT

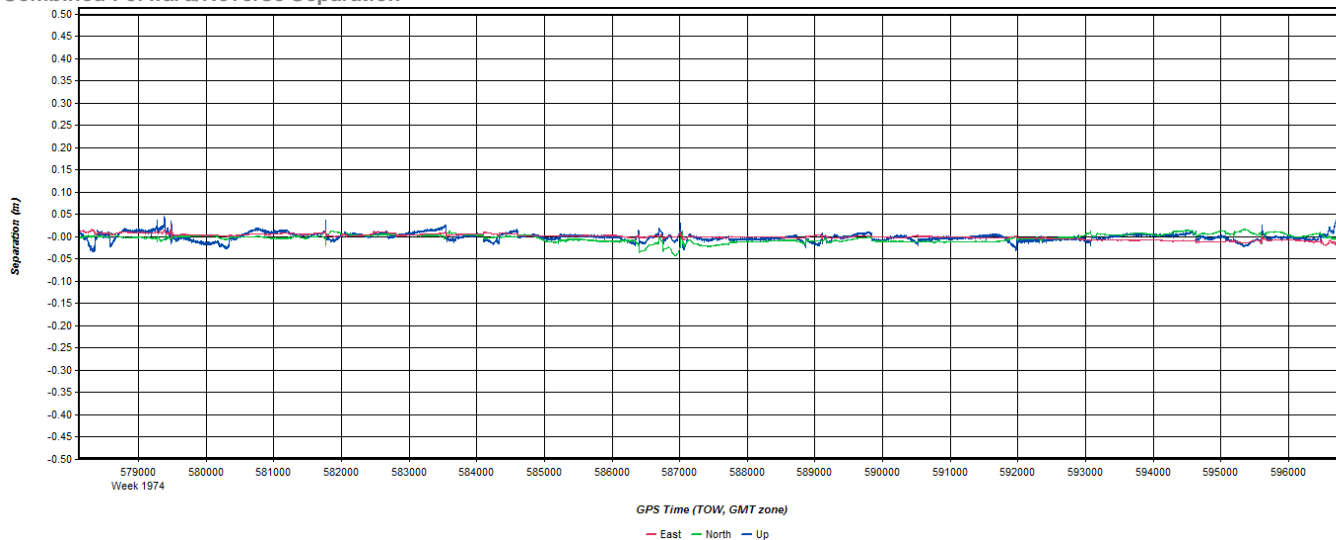
Quality Factor



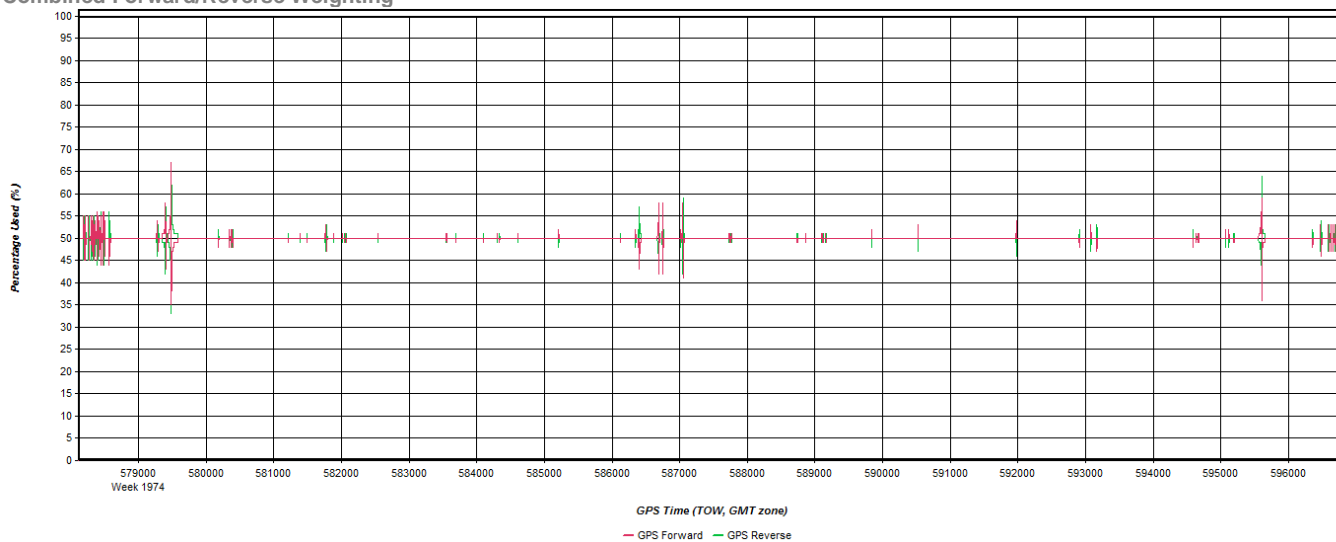
Height



Combined Forward/Reverse Separation

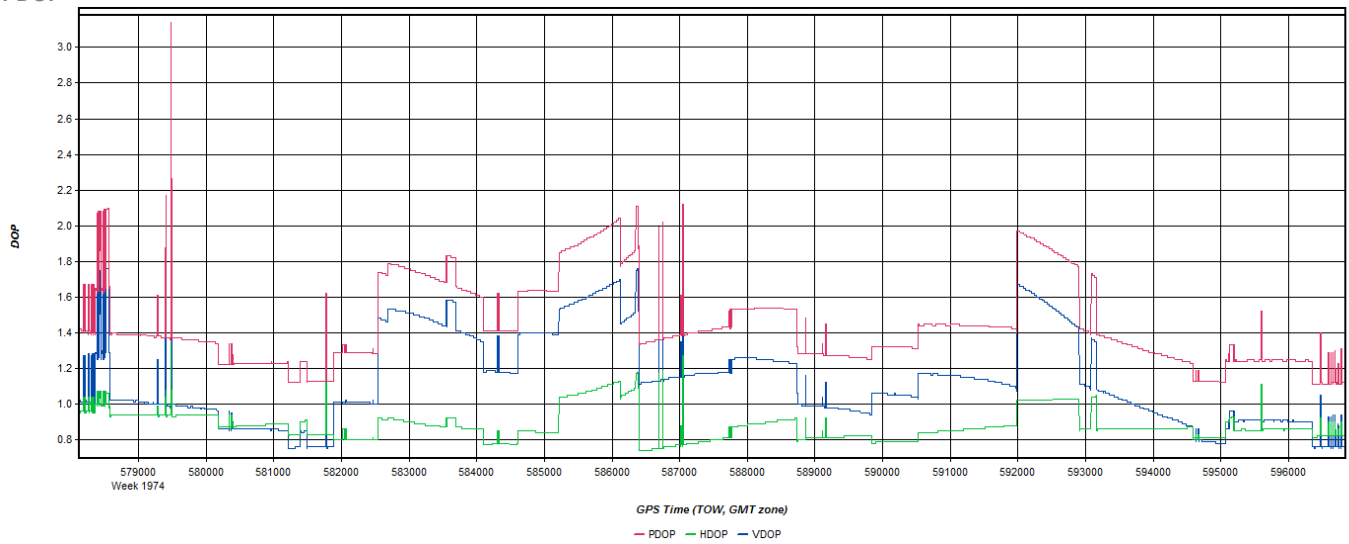


Combined Forward/Reverse Weighting

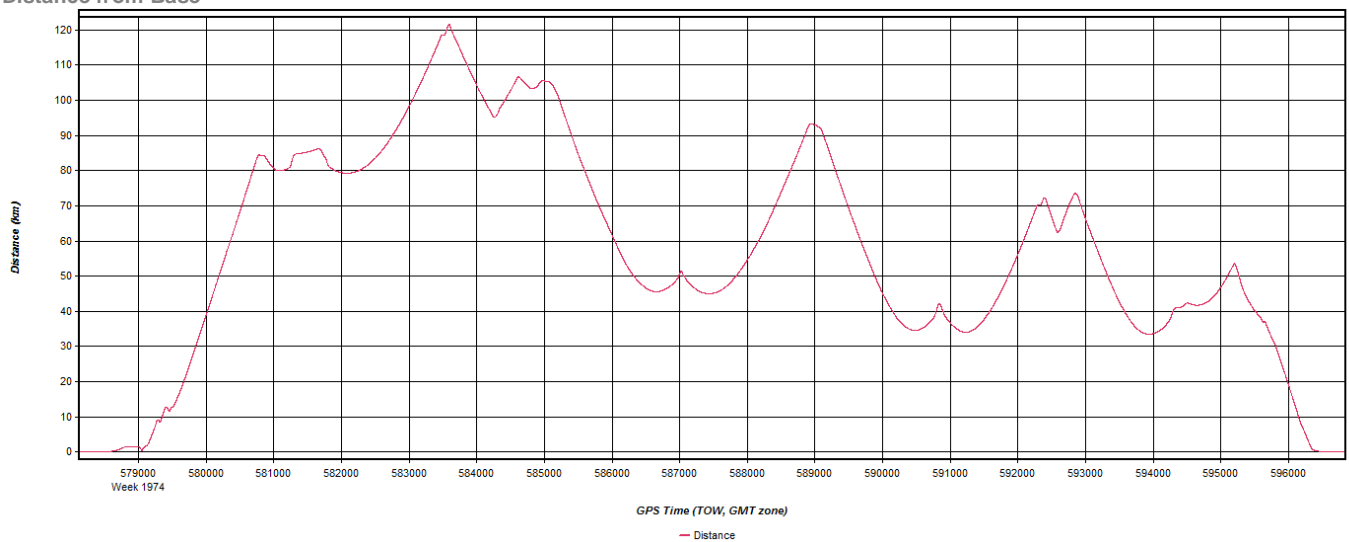


USGS COLLECTION REPORT

PDOP

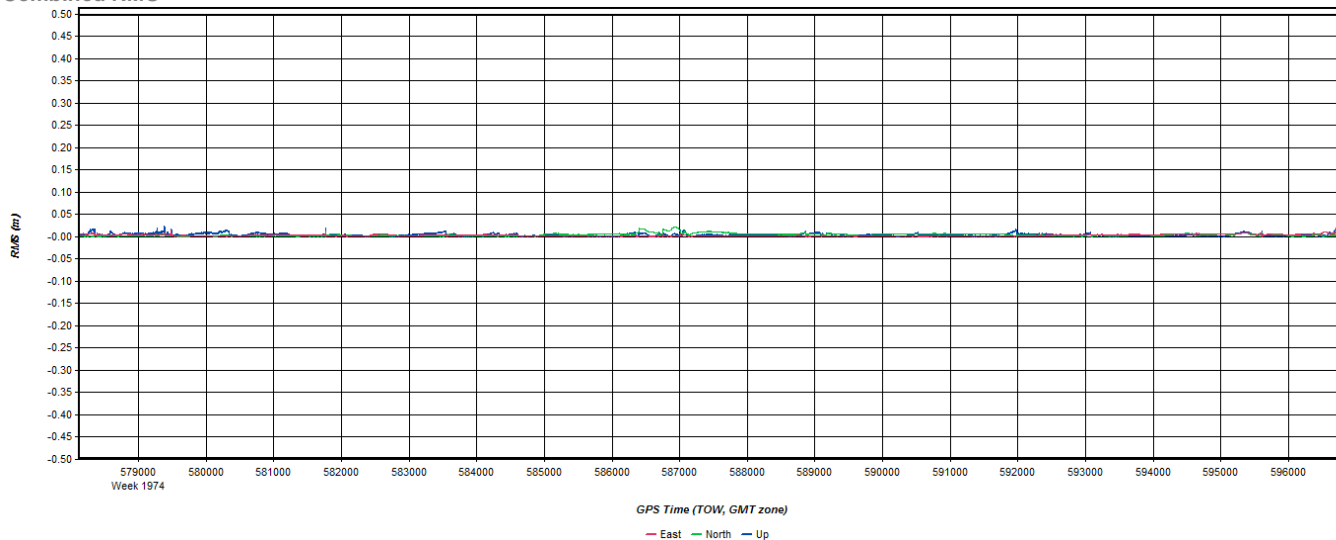


Distance from Base

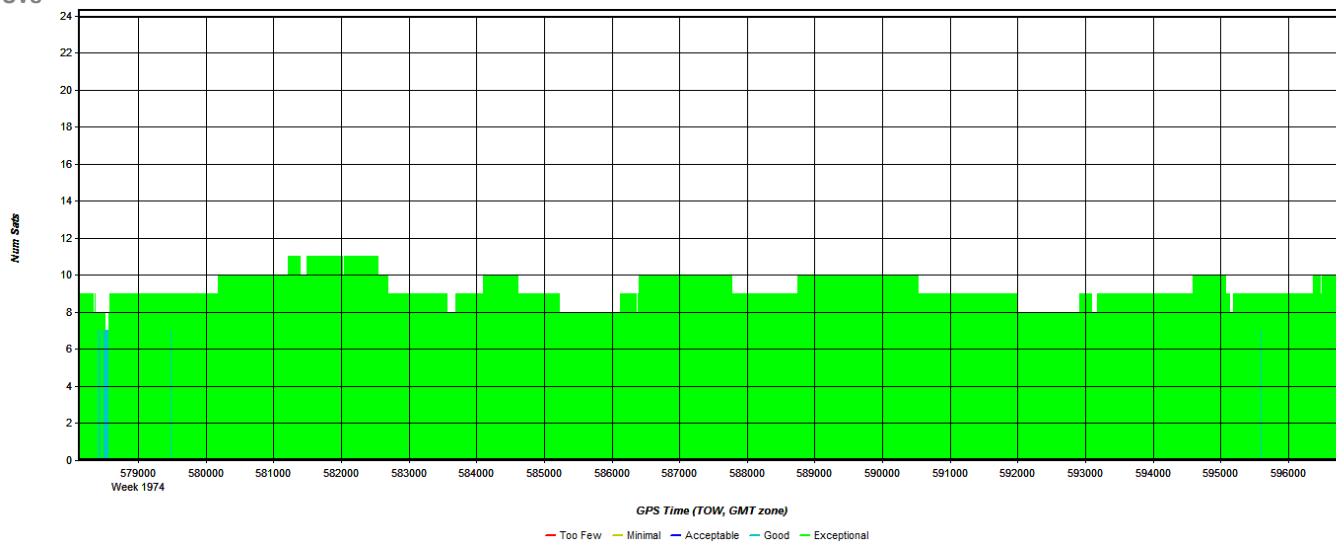




Combined RMS



SVs





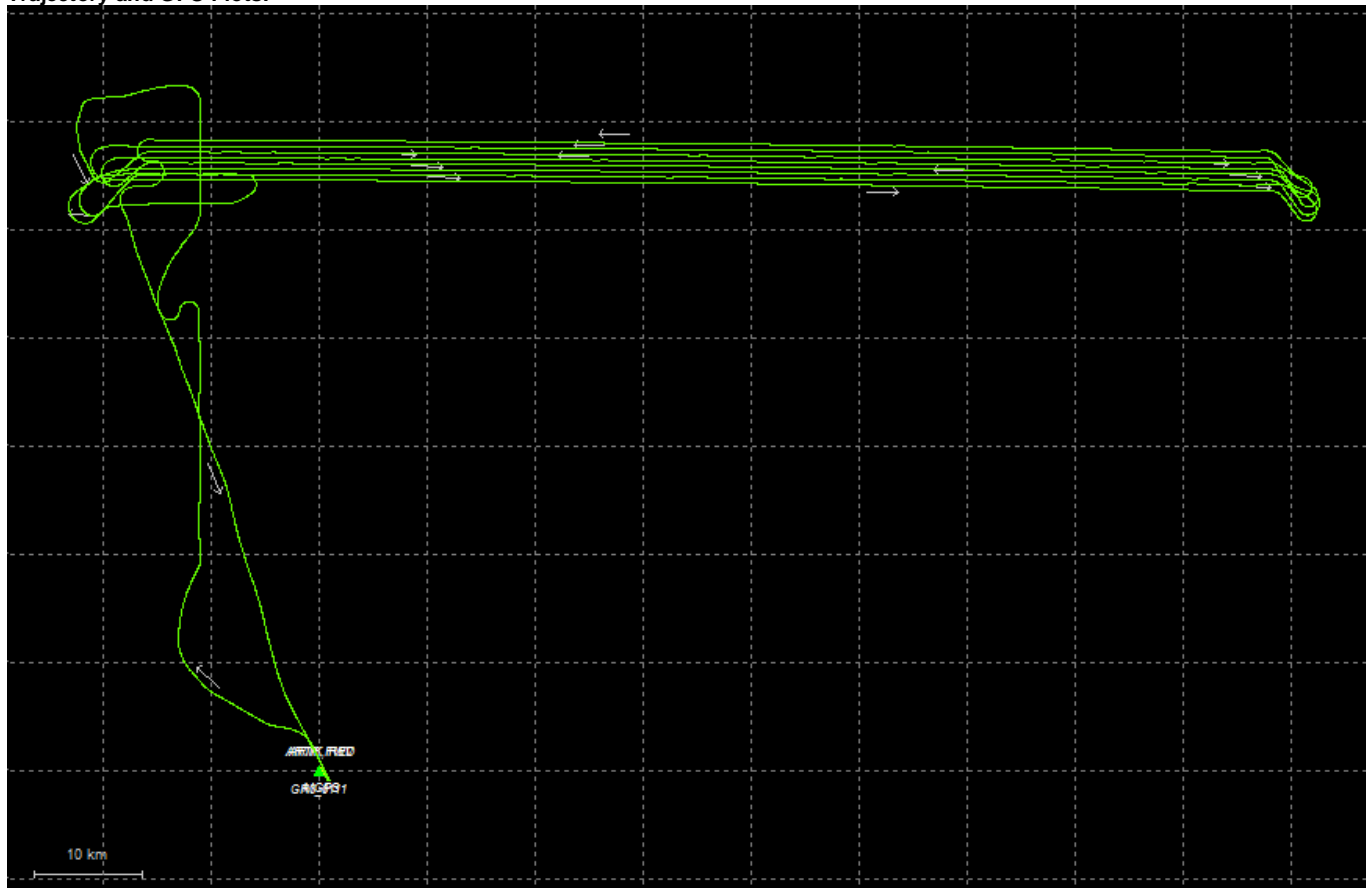
Acquisition and Processing details ----- Collection 13 (November 11, 2017)

Log:

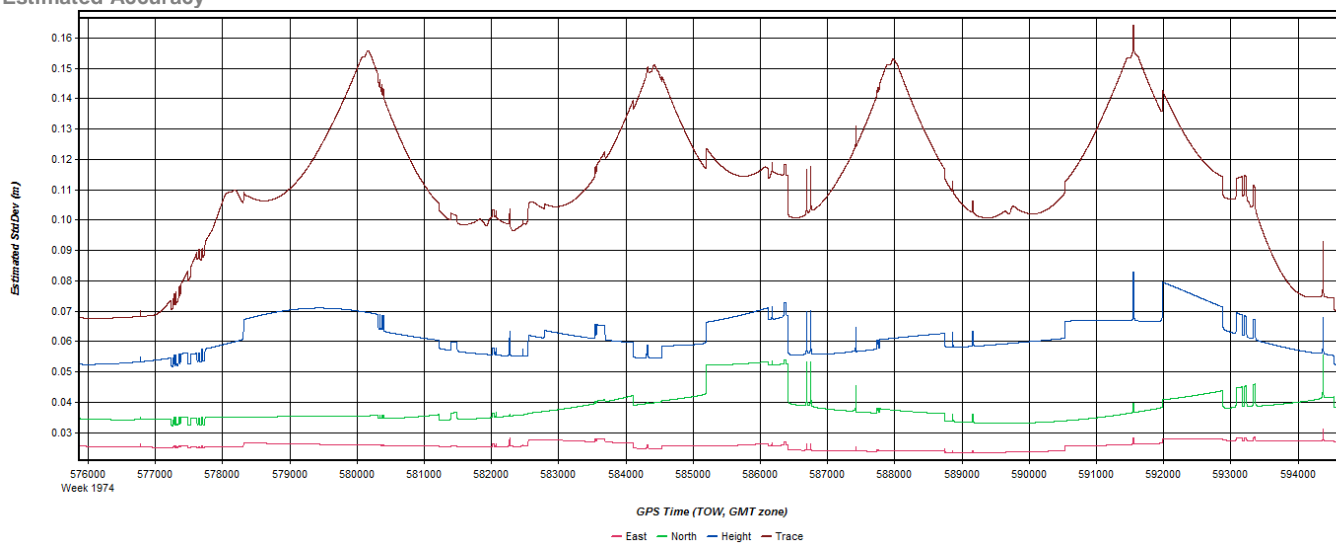
17.06	Lift Begin			Lift End			Fit Duration	Fit Hrs	Hobbs Hrs	Activity
	Airport	Chocks	Hobbs	Airport	Chocks	Hobbs				
1	KRAP	15:53	7537.5	KRAP	21:12	7542.8	5:19	5:25	5:3	0900-Production
2										
3										

Fugro Geospatial, Inc.		Riegl Flight Log		AC80-50-00-02											
FGI Job #	Project Name		System	Unit	IMU	Ground Temp °C	Min Range'	Data Logger Drives							
22.17003900	USGS SD Lidar 2017 D17		780	421	AIMU	6.0 9.0	1542	01/03/EU RIEGL 02							
Flight Date	GPS Day	Lift	Sun°	Solar Times (UTC)		Pulse Rate	Flying Temp °C	Max Range'	Download Drive						
11-Nov-17	17-315	4	-	-		330k	2.0 2.0	2933	NS1TB-61						
Mission ID (yyymmdd_Sen_Job_Lift)	Aircraft	Airport ID	FMS	UTC	AMT (ft)	Speed	FOV	Scan Rate (Hz)	MTA	km/WPT	AltM Setting	Humidity @ Alt	Shipping Track		
171111_421_17003900_04	N76JN	KRAP	CCNS 1	-7	2400	130	60	130	2	0.440	30.01 30.02	65%			
Pilot #1		Pilot #2		Operator #1		Operator #2									
George Wilson				Jacob Amundson											
Base 1 ID	Location		Rec ID	Ant ID	ARP (m)	Start Time (UTC)		Stop Time (UTC)		GPS Filename		Operator	Data		
FGI 0493	KRAP		GR3 U1	Unit 1	1.8	11-Nov-17 14:31		11-Nov-17 22:11		GR3_0111110.tps		Jacob Amundson	With AB		
Area	Flight #		Wpt		Distance		UTC		Fit Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions	SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End							
							16:01:55	16:06:55					GROUND STATIC	17	1.2
							16:26:36						ALIGNMENT TURNS	18	1.1
EastSD_X	1		99	115	43.1	50.2	16:30:57	16:32:55	N	4,930	130	130.0	CROSSING LINE	17	1.2
EastSD_B	17		1	223	0	97.7	16:40:43	17:06:54	E	4,815	125	130.0		17	1.2
	18		223	1	97.7	0	17:10:39	17:36:15	W	4,215	130	130.0		17	1.3
	18		1	10	0	4	17:42:07	17:43:33	E	4,840	117	130.0	CALIBRATION LINE	17	1.2
	19		1	223	0	97.7	17:51:26	18:17:53	E	4,805	115	130.0		17	1.2
	20		223	1	97.7	0	18:21:34	18:47:00	W	4,240	130	130.0		17	1.1
	21		1	223	0	97.7	18:51:02	19:17:11	E	4,815	123	130.0		17	1.1
	22		223	1	97.7	0	19:20:52	19:46:30	W	4,205	128	130.0		17	1.2
	23		1	223	0	97.7	19:50:44	20:16:57	E	4,770	120	130.0	POSSIBLE GAP AT KM 182	19	1.2
	24		223	1	97.7	0	20:20:22	20:46:00	W	4,370	127	130.0		16	1.3
							20:46:22						ALIGNMENT TURNS	17	1.3
							21:06:02	21:11:02					GROUND STATIC	18	1.1

Trajectory and GPS Plots:

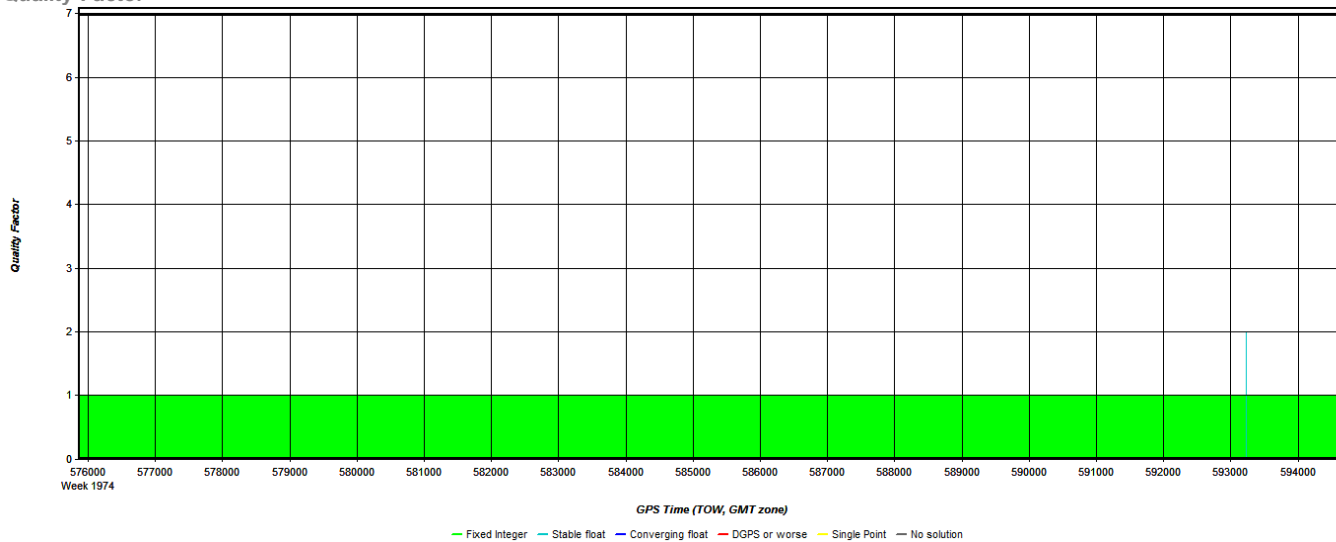


Estimated Accuracy

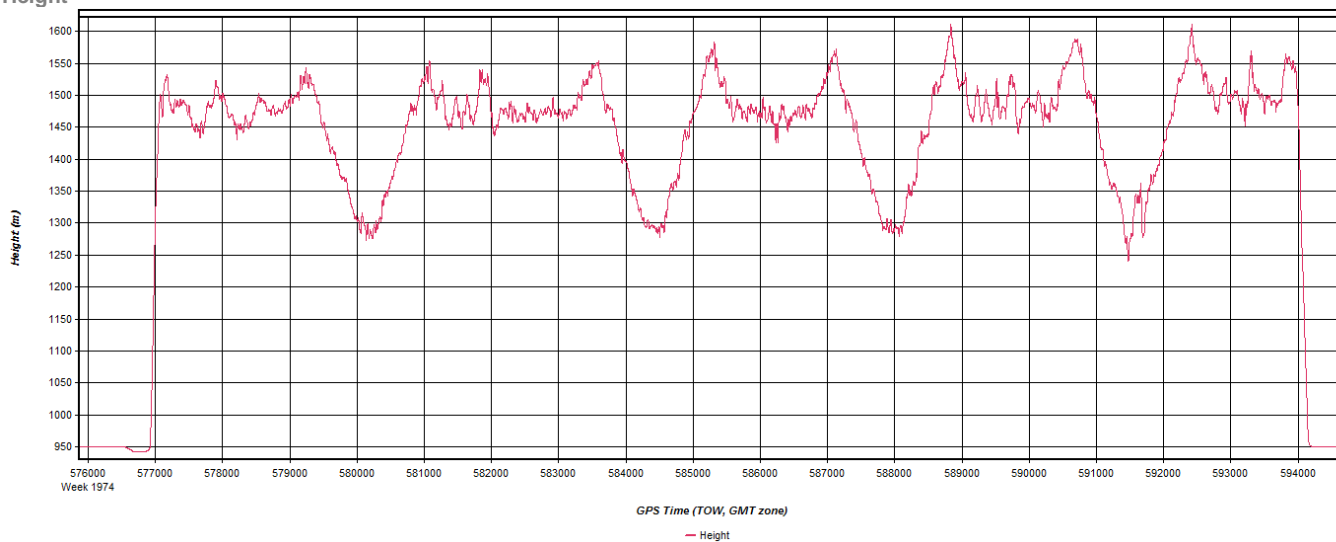




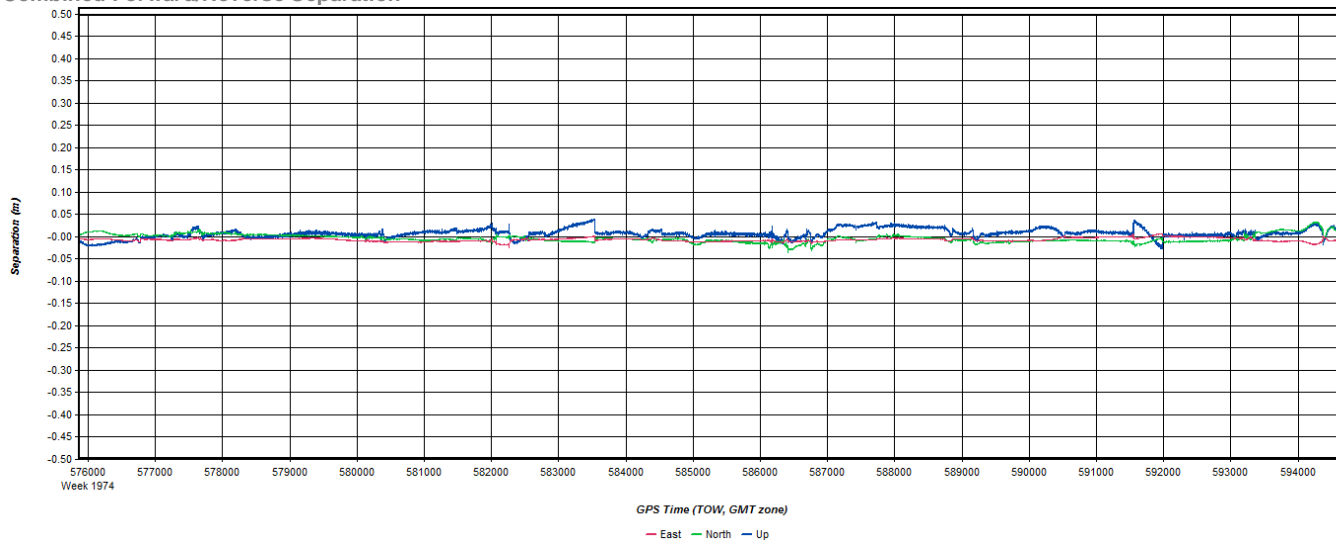
Quality Factor



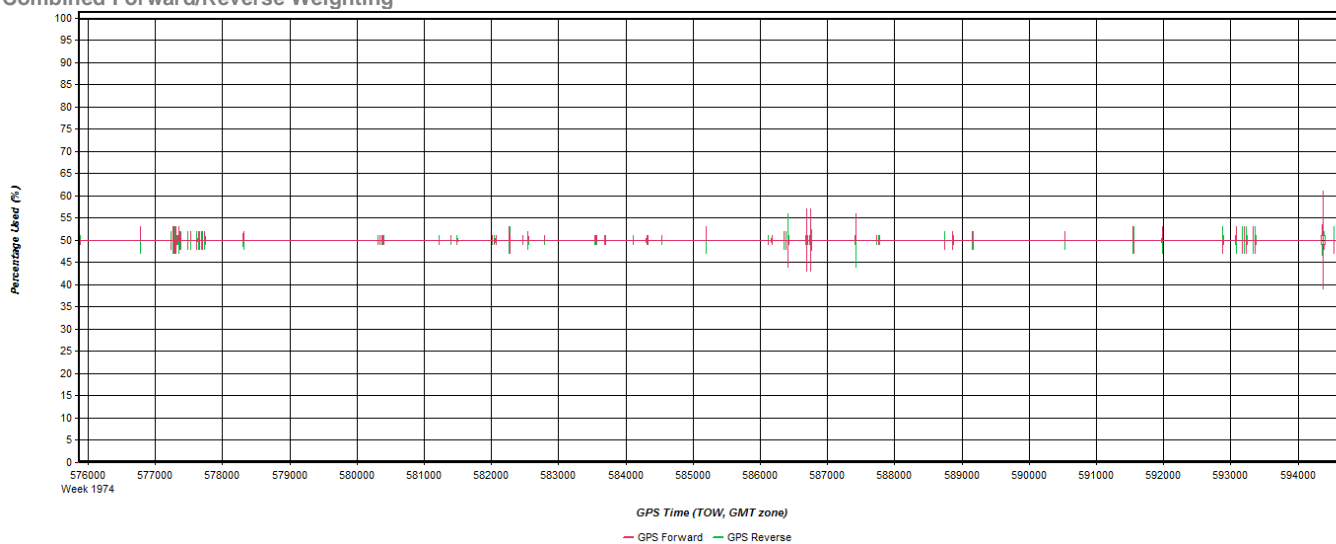
Height



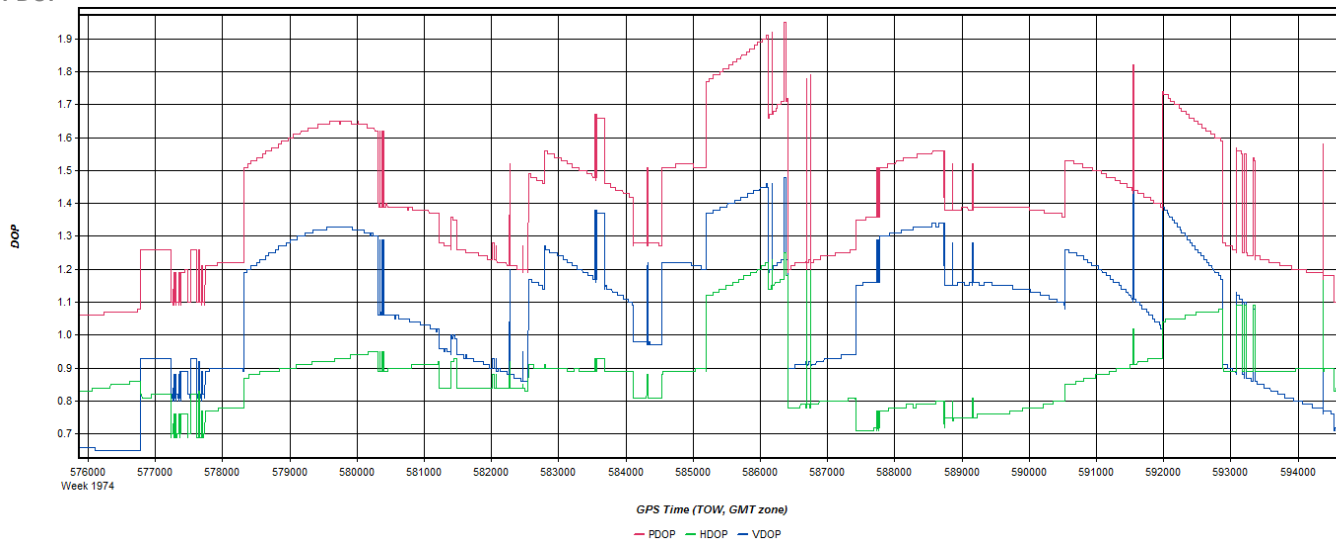
Combined Forward/Reverse Separation



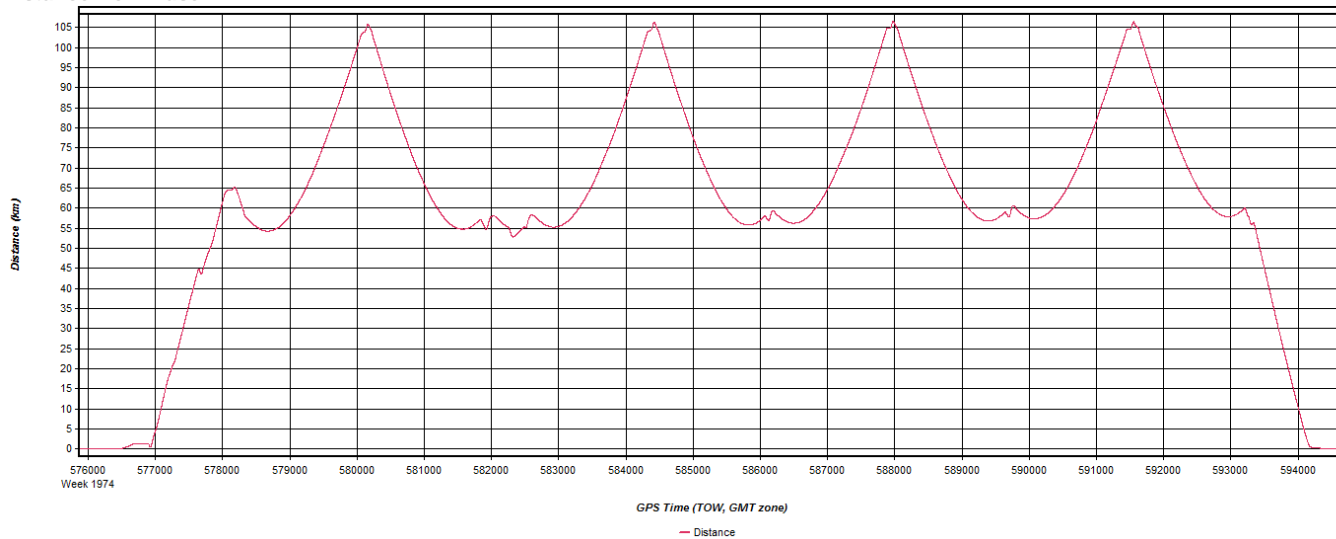
Combined Forward/Reverse Weighting



PDOP

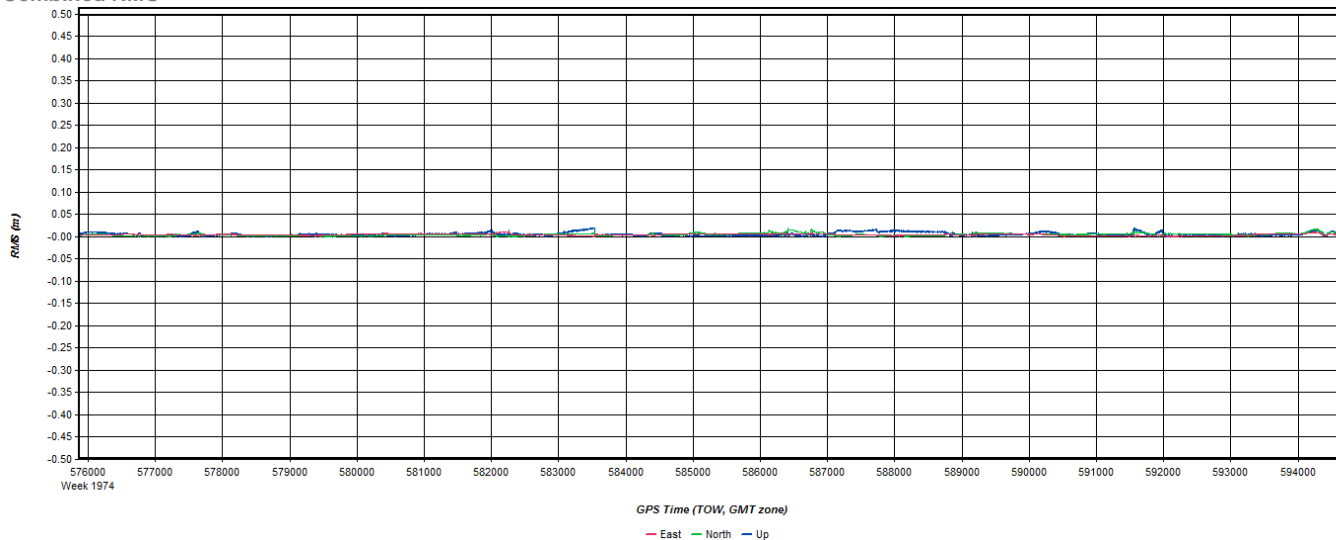


Distance from Base

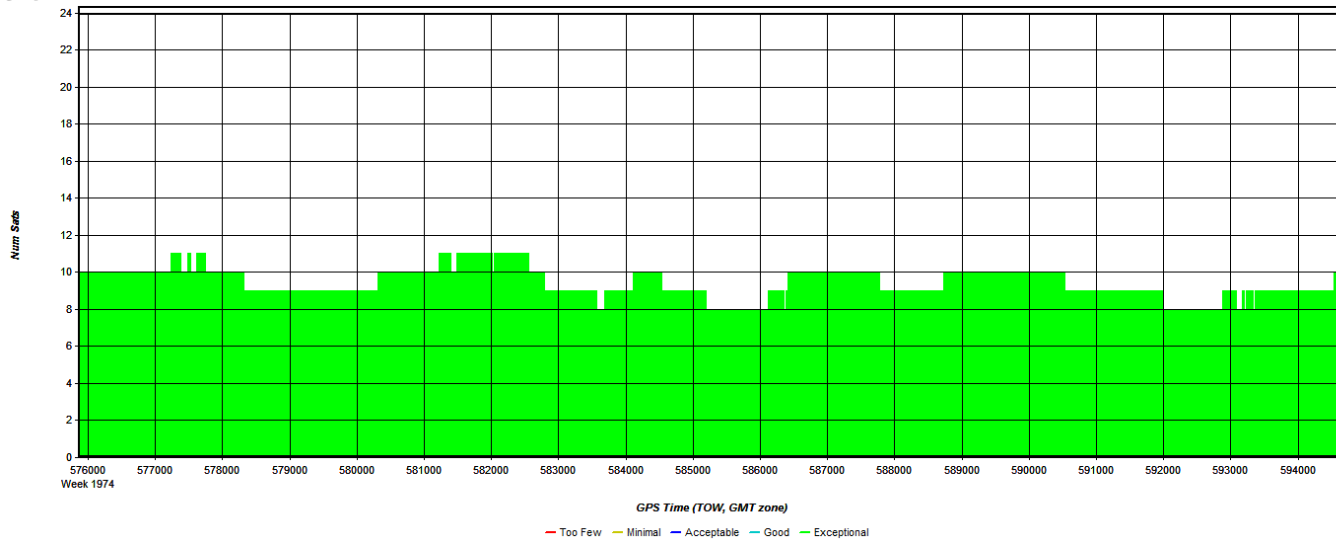




Combined RMS



SVs





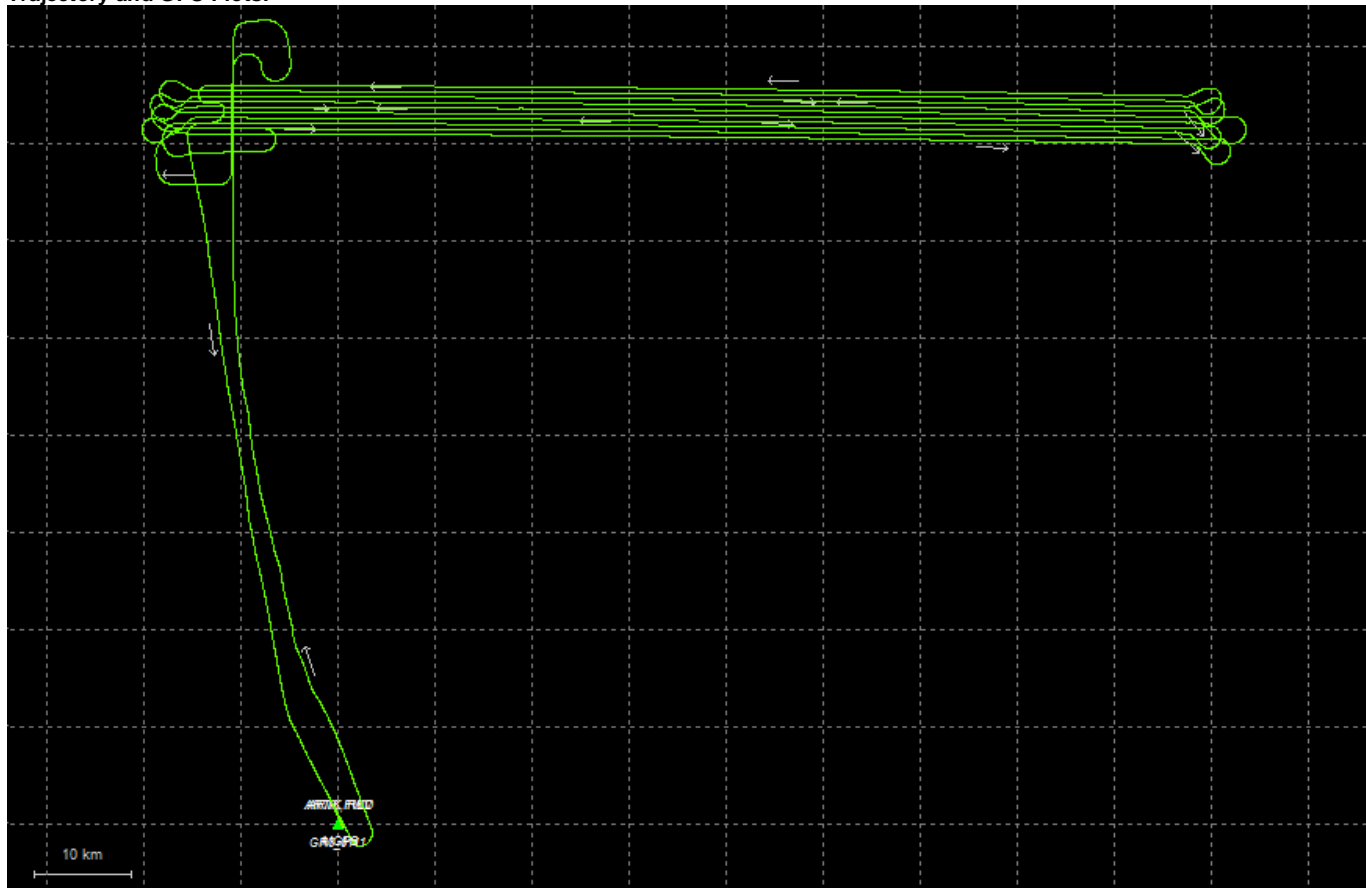
Acquisition and Processing details ----- Collection 14 (November 12, 2017)

Log:

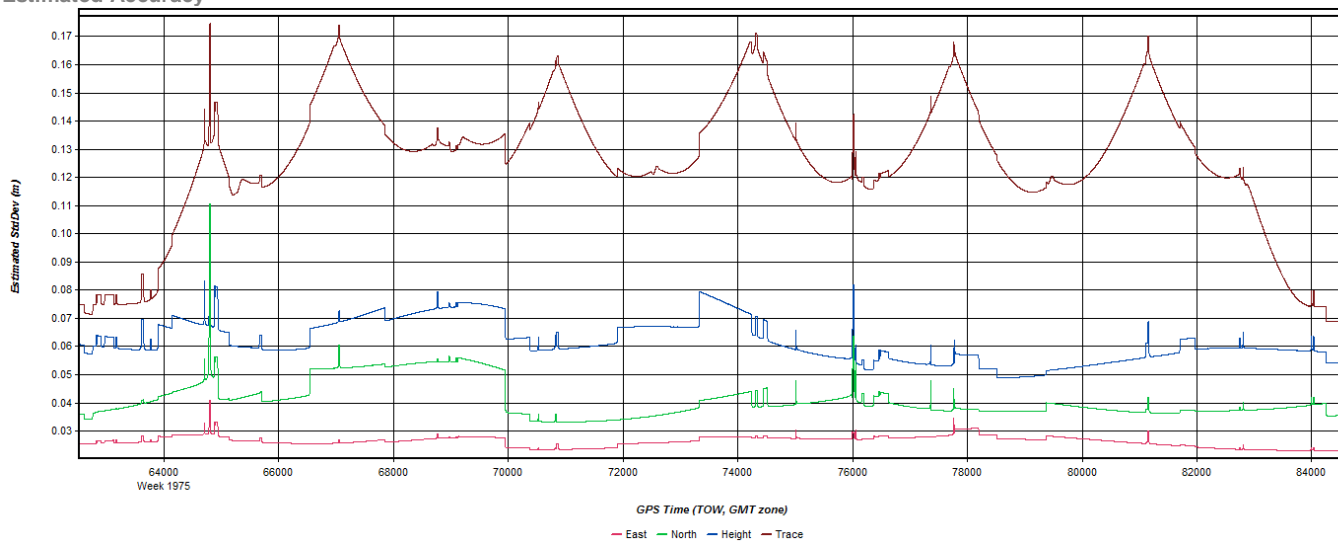
FUGRO		Fugro Geospatial, Inc.										Riegl Flight Log	
17.06		Lift Begin			Lift End			Flt Duration	Flt Hrs	Hobbs Hrs	Activity	AC80-50-00-02	
		Airport	Chocks	Hobbs	Airport	Chocks	Hobbs						
1		KRAP	17:18	786.7	KRAP	23:32	792.5	6:14	6:25	5:8	0900-Production		
2													
3													

FGI Job # 17003900	Project Name USGS SD Lidar 2017 D17		System 680i	Unit 165	IMU						Ground Temp °C 6.0 11.0	Min Range' 1542	Data Logger Drives EU RIEGL 04		
Flight Date 12-Nov-17	GPS Day 17-316	Lift 4		Sun°	Solar Times (UTC)	Pulse Rate 330				Flying Temp °C 2.0 5.0	Max Range' 2933	Download Drive NS1TB-70			
Mission ID (yyymmdd_Sen_Job_Lift) 171112_165_17003900_04		Aircraft N97HC	Airport ID KRAP	FMS CCNS 7	UTC -7	AMT (ft) 2400	Speed 130	FOV 56.2	Scan Rate (Hz) 120	MTA 2	km/WPT 0.439	AltM Setting 30.28 30.14	Humidity @ Alt 52	Shipping Track	
Pilot #1 Fred Davis		Pilot #2		Operator #1 Chris Fought		Operator #2									
Base 1 ID FGI 081	Location Rapid City SD		Rec ID GR3-5	Ant ID GR3-5	ARP (m) 1.8	Start Time (UTC) 11/12/17 0728	Stop Time (UTC) 11/12/17 2333	GPS Filename GR3_0111120.tps	Operator Jacob Amundson	Data With AB					
Area	Flight #		Wpt		Distance		UTC		Flt Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions	SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End							
							17:25:00	17:30:00					Ground static at KRAP	16	1.3
							17:58:00	18:01:00					pre acquisition s turn	17	1.1
E-680-X	1		155	135	67.6	58.8	18:02:56	18:05:20	S	5,000	125	120.0	cross tie line	17	1.1
E-680-B	47		1	222	0	97	18:10:11	18:34:58	E	5,000	128	120.0		17	1.1
	48		222	1	97	0	18:38:34	19:03:23	W	5,000	126	120.0		18	1.0
	48		1	10	0	4	19:07:34	19:08:45	E	5,000	128	120.0	calibration line	19	1.0
	49		1	222	0	97	19:14:10	19:38:51	E	5,000	127	120.0		19	1.1
	50		222	1	97	0	19:42:03	20:07:15	W	5,000	126	120.0		18	1.2
	51		1	222	0	97	20:10:57	20:35:39	E	5,000	127	120.0		18	1.2
	52		222	1	97	0	20:40:10	21:05:11	W	5,000	128	120.0		17	1.2
	53		1	222	0	97	21:08:55	21:33:44	E	5,000	129	120.0		20	1.0
	54		222	1	97	0	21:37:14	22:02:11	W	5,000	126	120.0		21	1.0
	55		1	222	0	97	22:05:27	22:30:22	E	5,000	129	120.0		20	1.0
	56		222	1	97	0	22:33:38	22:58:29	W	5,000	125	120.0		20	1.1
							22:59:00	23:01:00					post acquisition S turn	18	1.2
							23:24:00	23:29:00					Ground static at KRAP	20	1.0

Trajectory and GPS Plots:

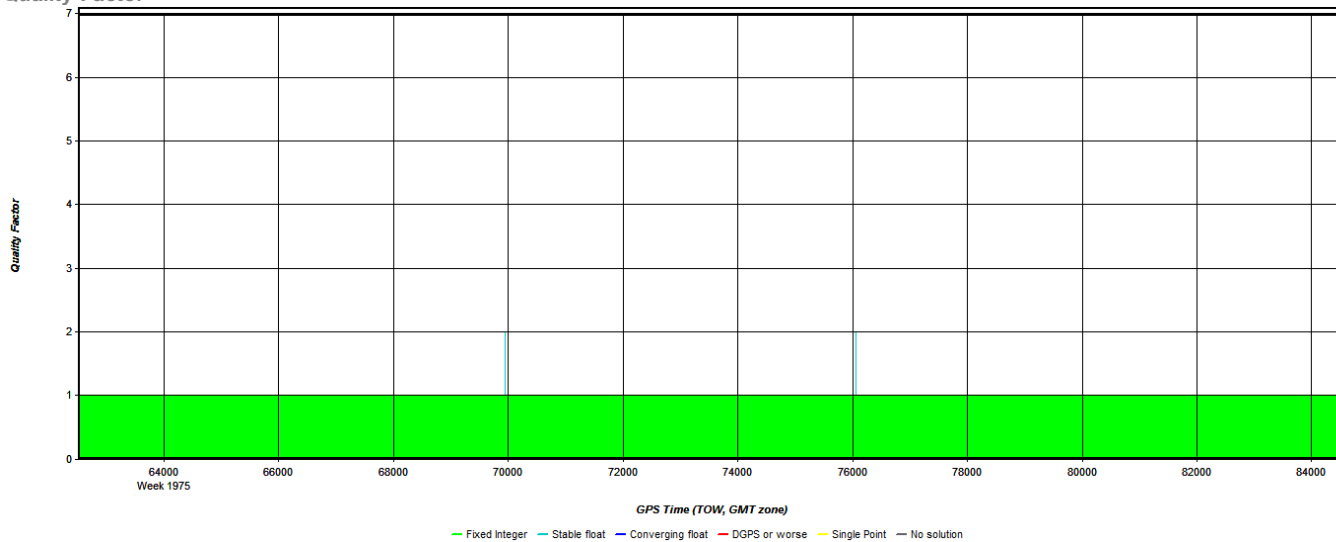


Estimated Accuracy

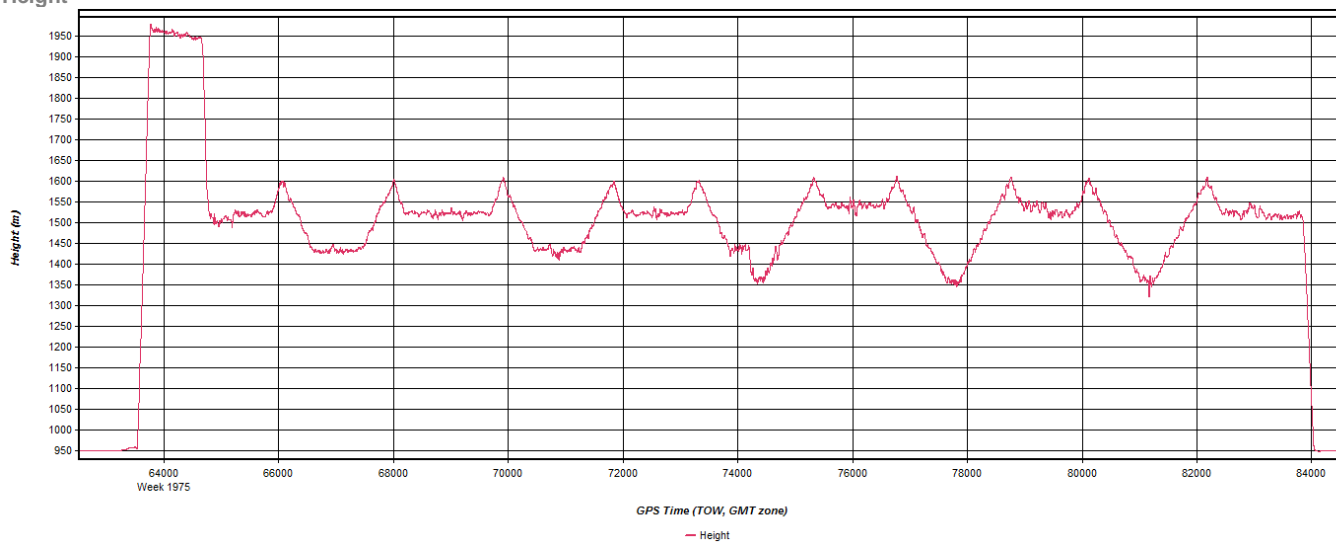




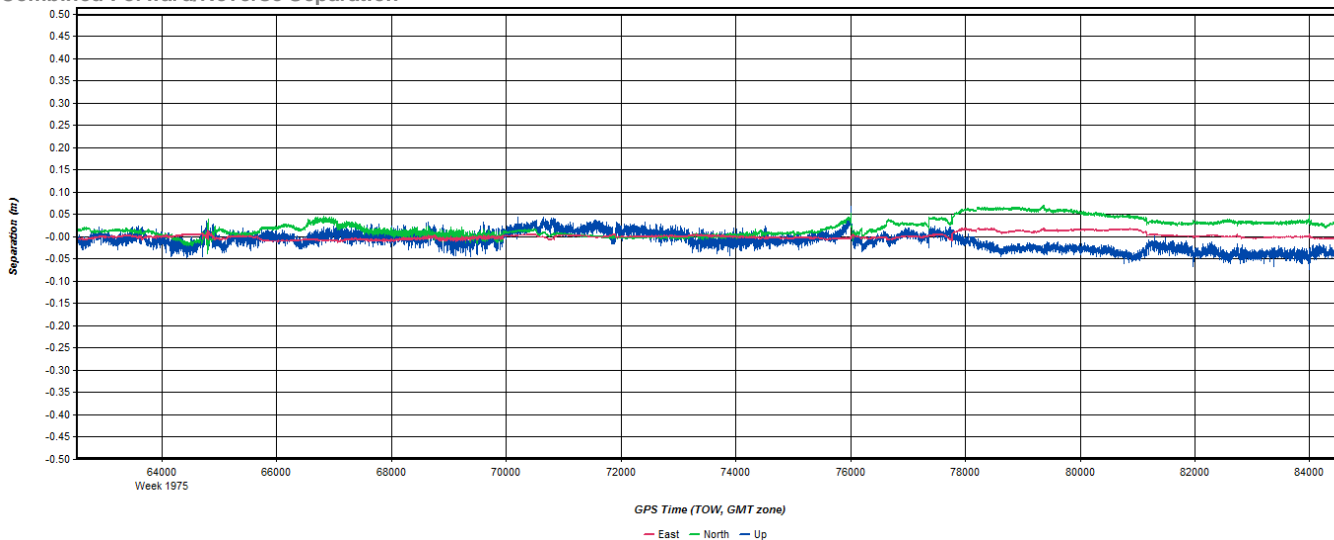
Quality Factor



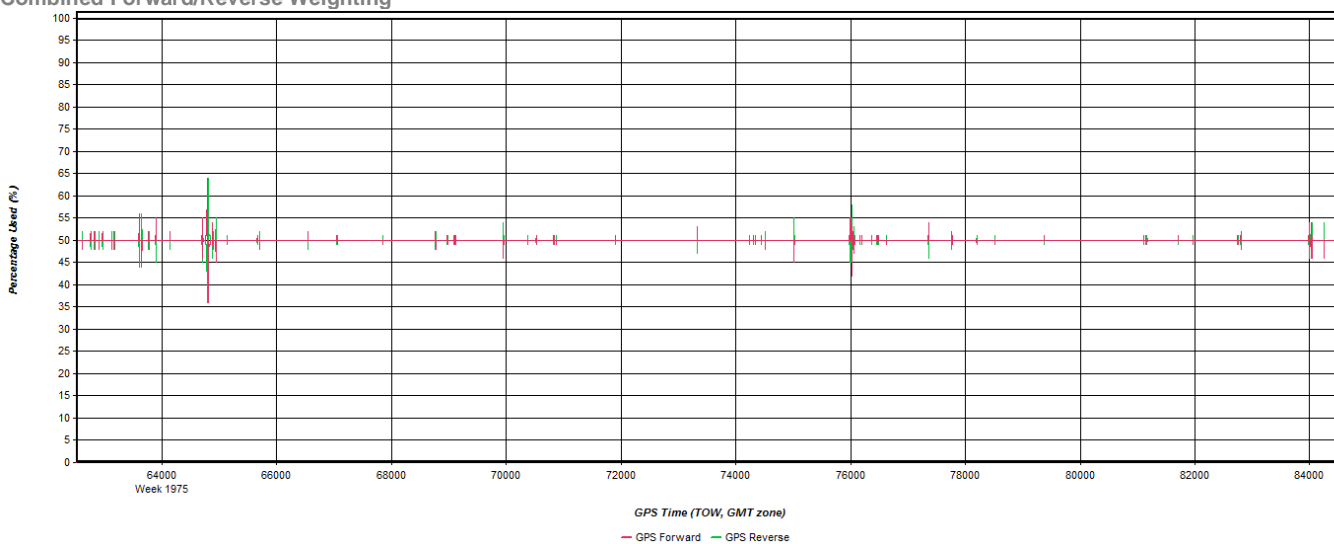
Height



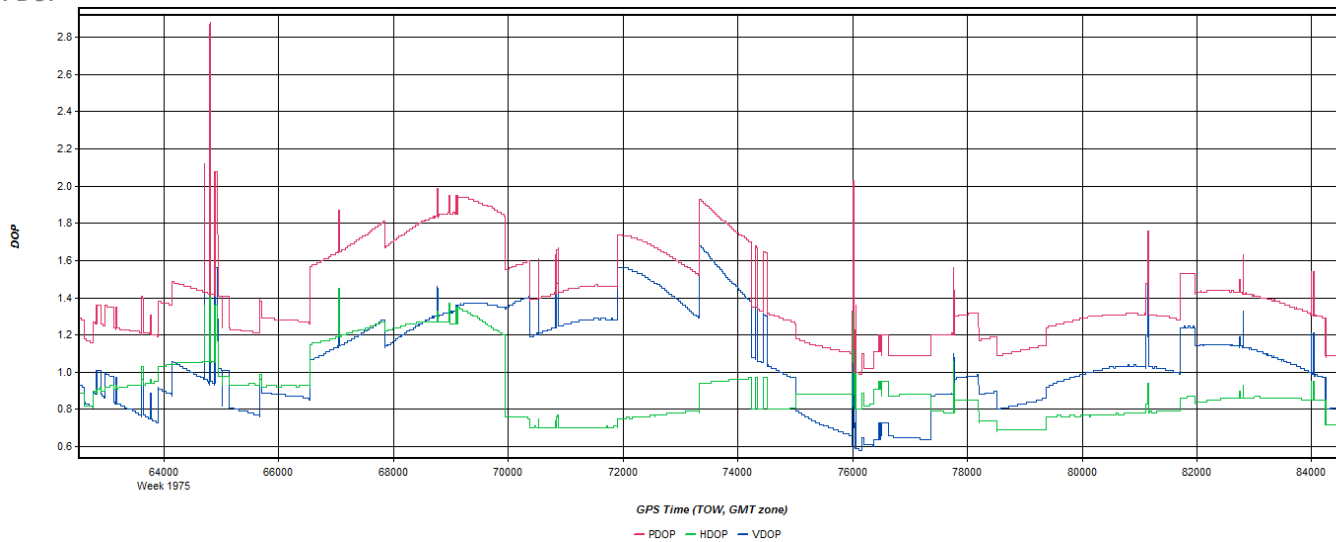
Combined Forward/Reverse Separation



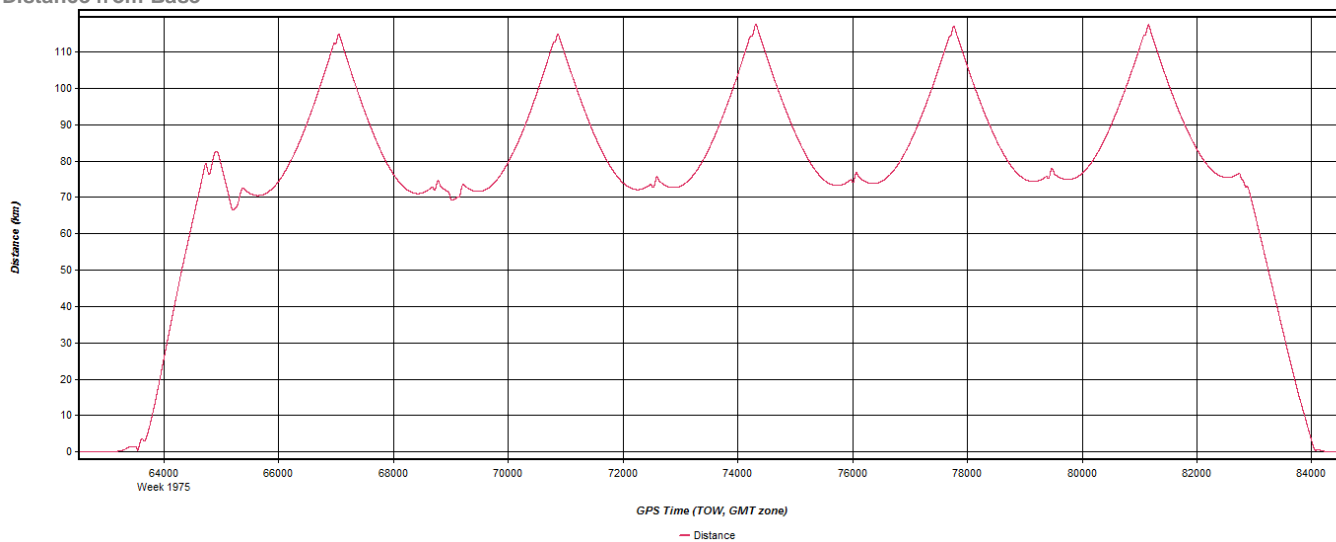
Combined Forward/Reverse Weighting



PDOP

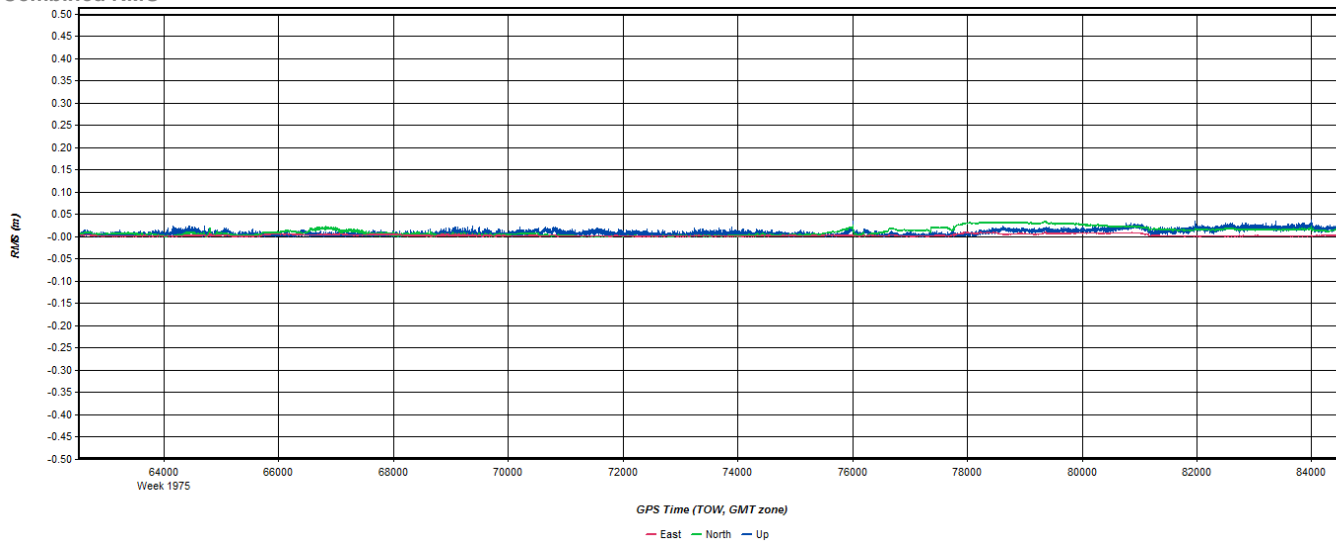


Distance from Base

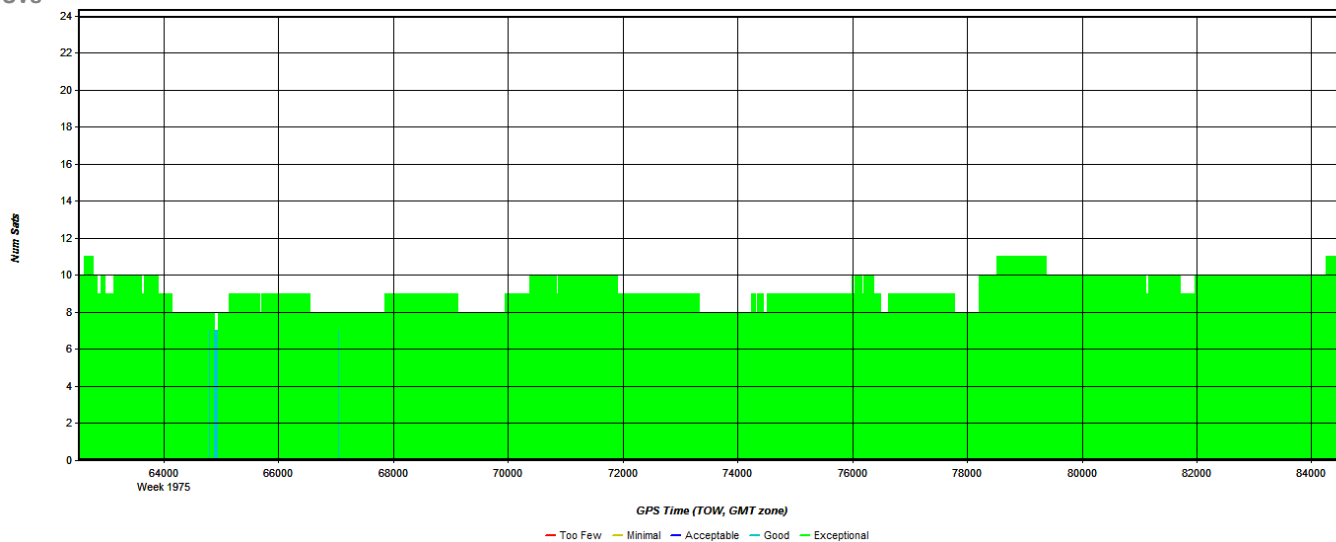




Combined RMS



SVs



**USGS
COLLECTION REPORT**



Acquisition and Processing details ----- Collection 15 (November 12, 2017)

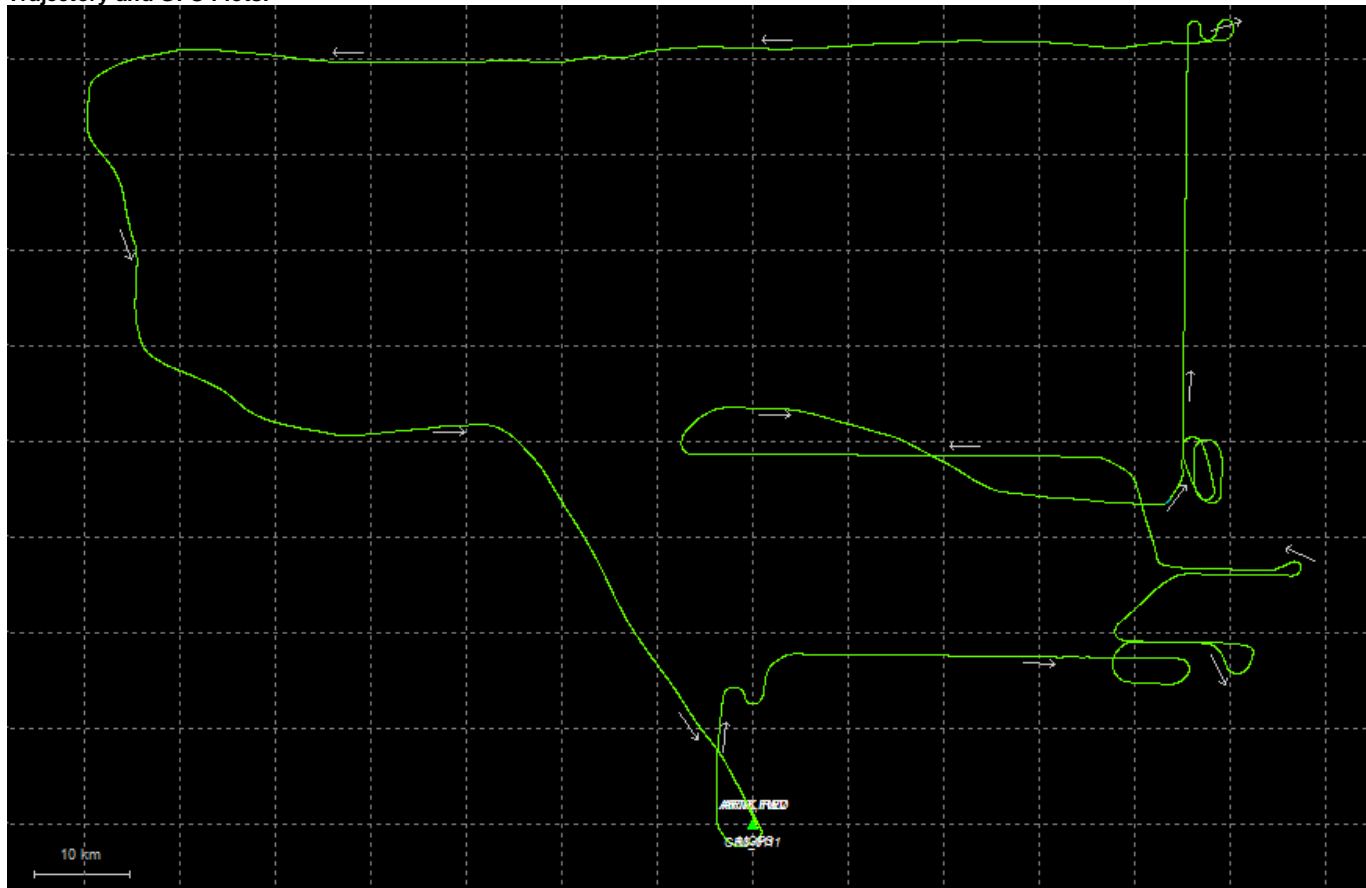
Log:

17.06	Lift Begin			Lift End			Flt Duration	Flt Hrs	Hobbs Hrs	Activity
	Airport	Chocks	Hobbs	Airport	Chocks	Hobbs				
1	KRAP	16:07	452.6	KRAP	19:15	455.3	3:07	3.25	2.7	0900-Production
2										
3										

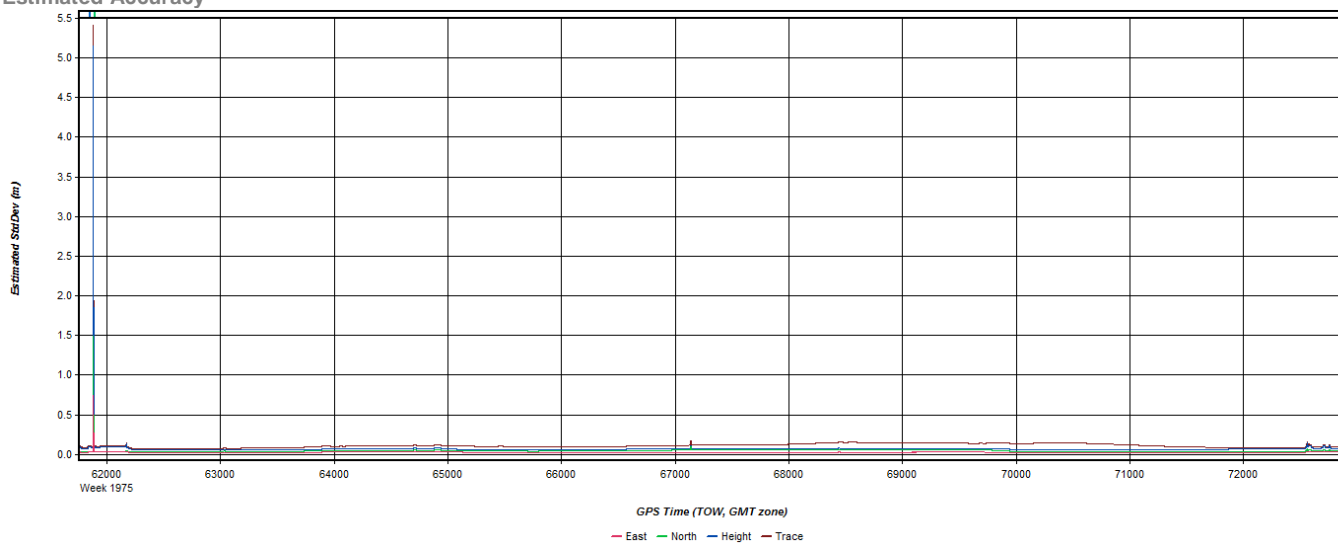
Fugro Geospatial, Inc.		Riegl Flight Log		AC80-50-00-02
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FGI Job # 22.17003900	Project Name USGS SD Lidar 2017 D17		System 680i	Unit 216	IMU AIMU			Ground Temp °C 6.0 8.0	Min Range' 1542	Data Logger Drives					
Flight Date 12-Nov-17	GPS Day 17-316	Lift 7	Sun° NA		Solar Times (UTC) NA		Pulse Rate 330kHz	Flying Temp °C 6.0 9.0	Max Range' 2933	Download Drive					
Mission ID (yyymmdd_Sen_Job_Lift) 171112_216_17003900_07		Aircraft N3832K	Airport ID KRAP	FMS CCNS 6	UTC -6	AMT (ft) 2400	Speed 130	FOV	Scan Rate (Hz) 130	MTA 2	km/WPT 0.439	AltM Setting 30.28 30.20	Humidity @ Alt	Shipping Track	
Pilot #1 Wayne Manning		Pilot #2		Operator #1 Jonathan Spencer		Operator #2									
Base 1 ID FGI 081	Location KRAP		Rec ID GR3 U1	Ant ID U1	ARP (m) 1.8	Start Time (UTC) 12-Nov-17 14:28		Stop Time (UTC)		GPS Filename GR3_011112	Operator Chris Fought		Data With AB		
Area	Flight #		Wpt		Distance		UTC		Flt Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions	SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End							
							16:10:05	16:15:05					5 min grd stc		
							16:30:05	16:31:57					S-turn		
EastSD_A	13		117	122	50.9	53.1	16:42:36	16:43:32	E	5,390	126	130.0	re-flight	17	1.0
	16		128	133	55.8	57.9	16:49:32	16:50:39	E	5,340	107	130.0	re-flight	17	1.0
	16		133	128	57.9	55.8	16:55:30	16:56:32	W	5,340	114	130.0	calibration line	15	1.2
	29		146	151	63.7	65.8	17:01:43	17:02:39	E	5,290	125	130.0	re-flight	16	1.1
	30		145	138	63.2	60.1	17:05:29	17:06:48	W	5,340	113	130.0	re-flight	16	1.1
	51		99	94	43	40.8	17:12:58	17:14:01	W	5,140	115	130.0	re-flight	17	1.0
	51		34	29	14.5	12.3	17:21:11	17:22:04	W	5,140	112	130.0	re-flight	17	1.0
EastSD_X	2		75	162	32.5	70.7	17:49:17	17:59:45	N	4,590	126	130.0	crossing tie line	16	1.1
							18:00:08	18:01:44					S-turn		
							19:09:15	19:14:15					5 min grd stc		

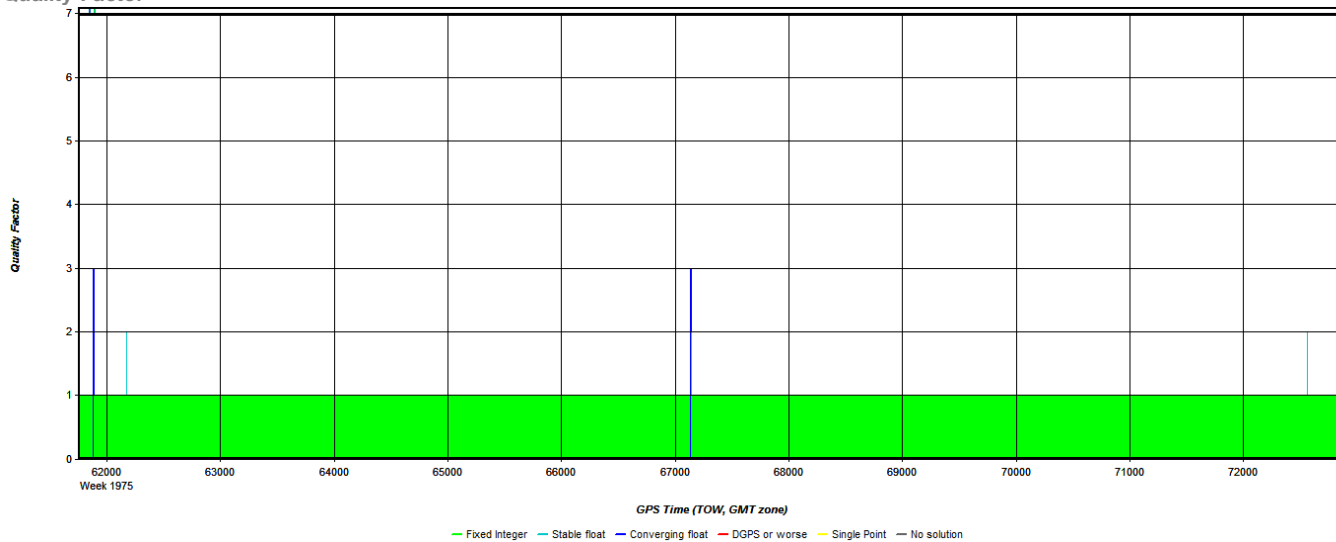
Trajectory and GPS Plots:



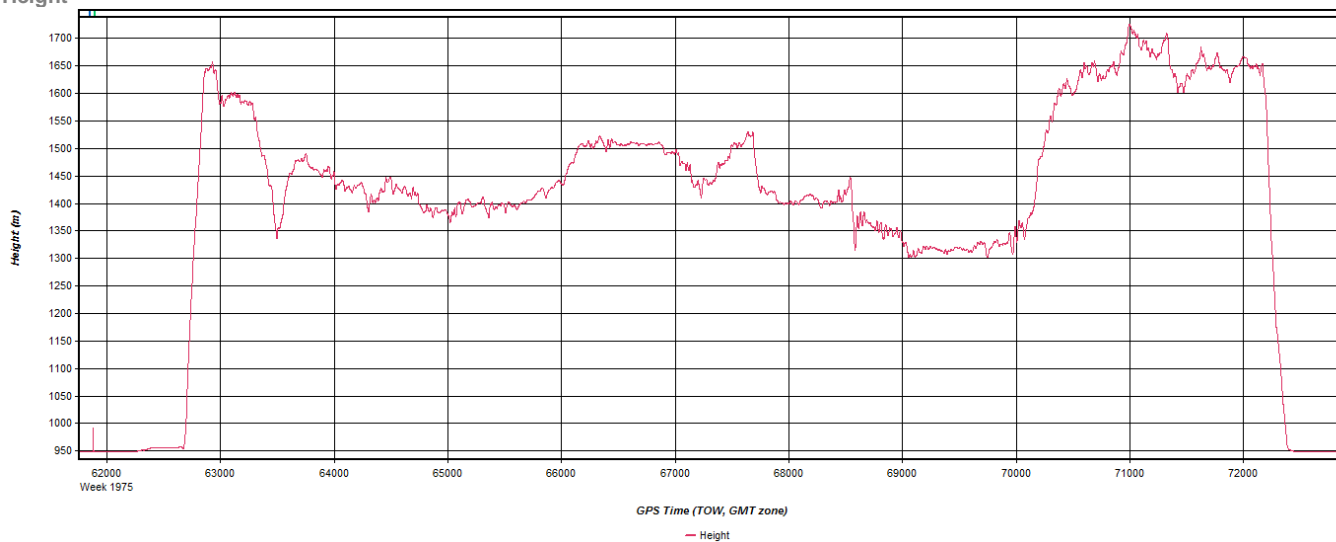
Estimated Accuracy



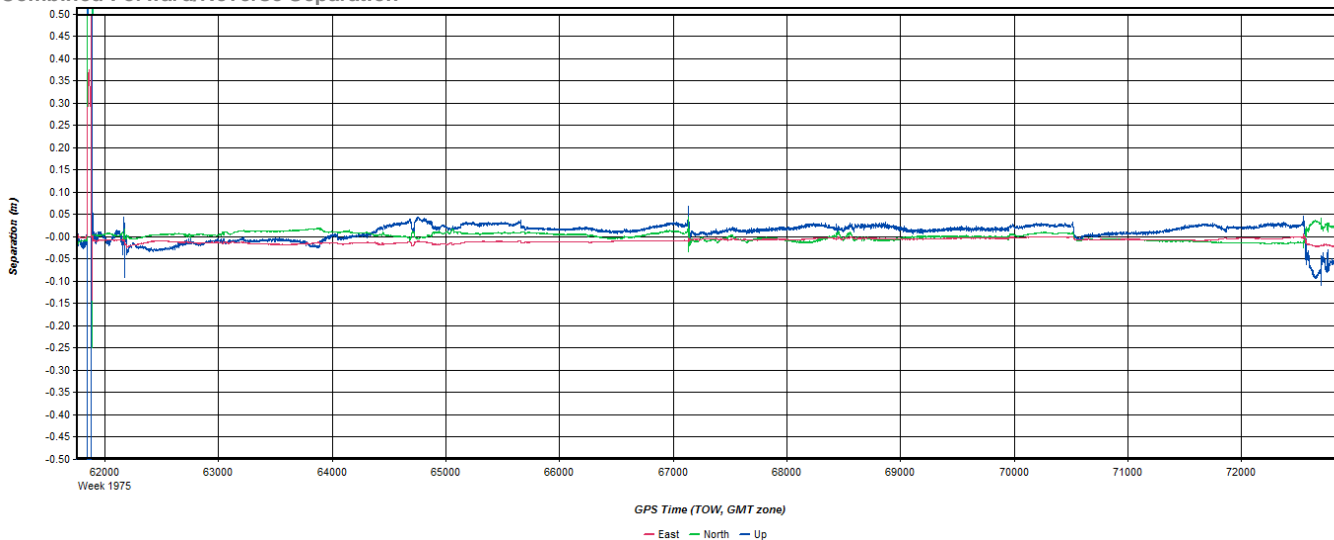
Quality Factor



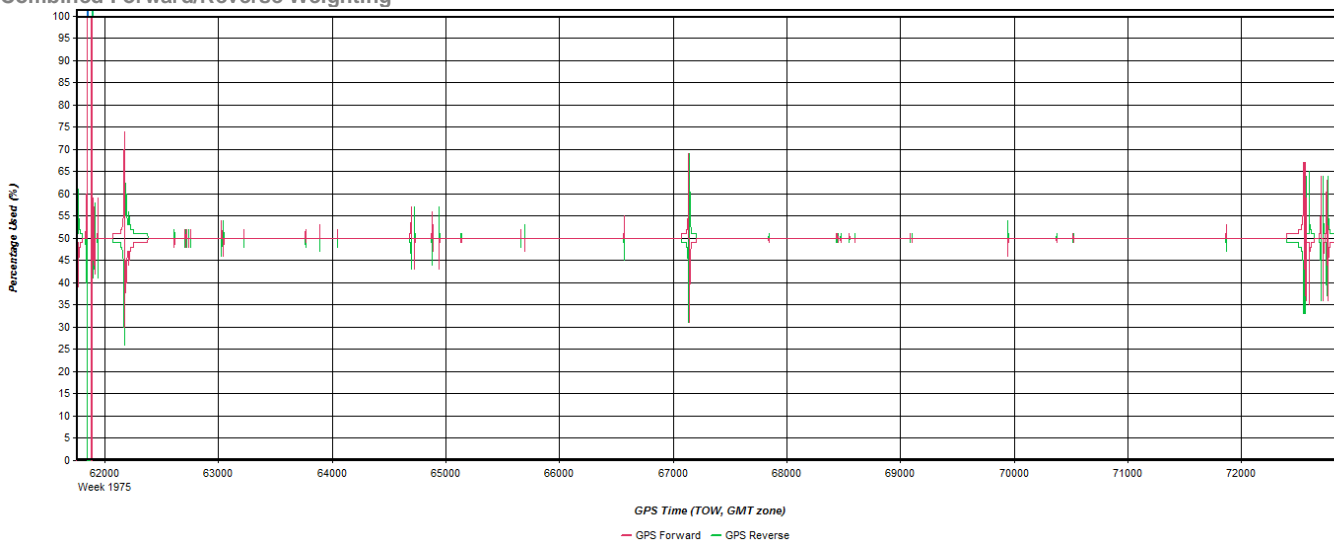
Height



Combined Forward/Reverse Separation



Combined Forward/Reverse Weighting



USGS COLLECTION REPORT

PDOP

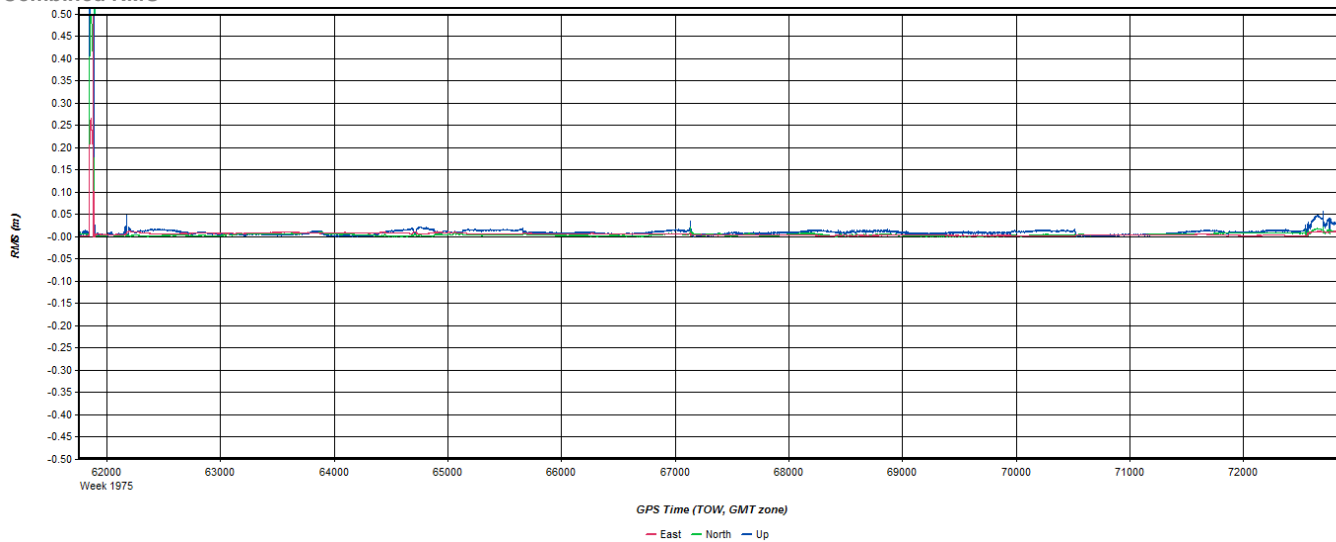


Distance from Base

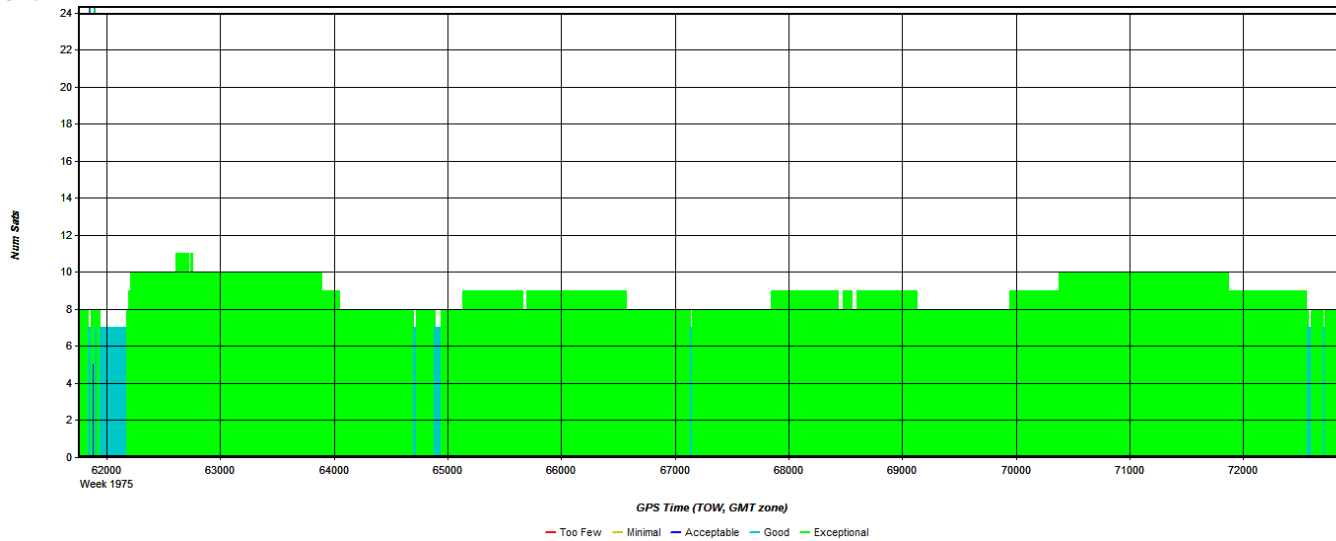




Combined RMS



SVs



**USGS
COLLECTION REPORT**

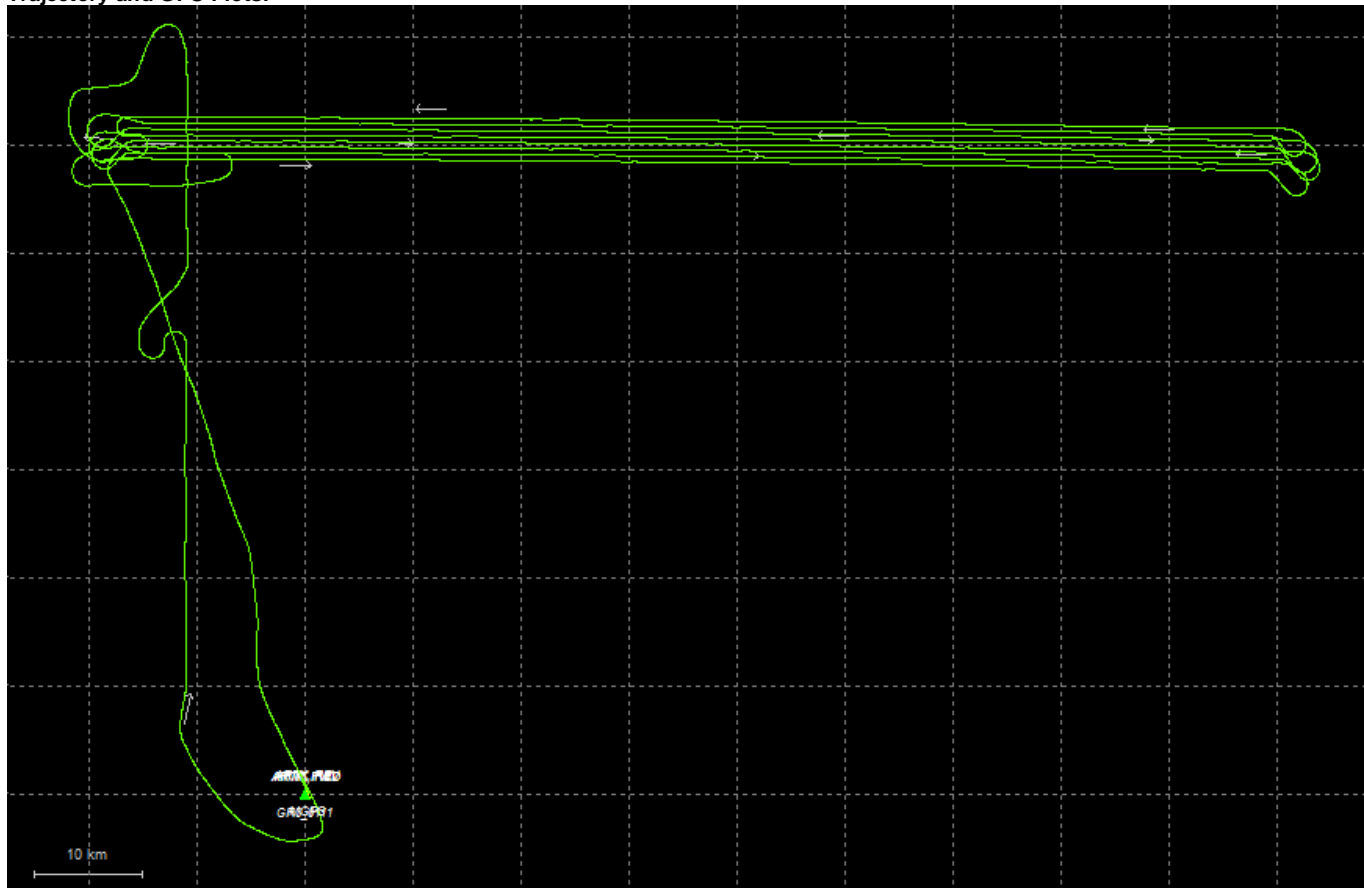


Acquisition and Processing details ----- Collection 16 (November 12, 2017)

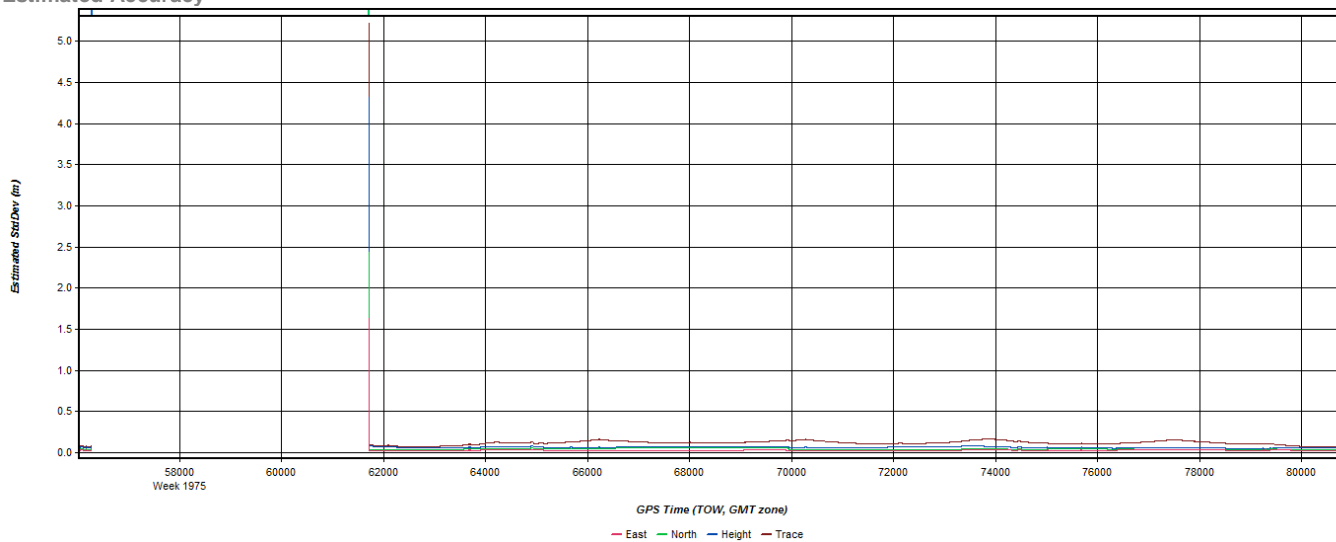
Log:

FUGRO		Fugro Geospatial, Inc.										Riegl				
												Flight Log				
												AC80-50-00-02				
17.06		Lift Begin			Lift End			Flt	Flt	Hobbs	Activity					
		Airport	Chocks	Hobbs	Airport	Chocks	Hobbs	Duration	Hrs	Hrs						
1		KRAP	17:06	7542.8	KRAP	22:28	7548.3	5:22	5:25	5:5	0900-Production					
2																
3																
FGI Job #		Project Name				System	Unit	IMU			Ground Temp °C	Min Range'	Data Logger Drives			
22.17003900		USGS SD Lidar 2017 D17				780	421	AIMU			6.0 12.0	1542	02/03/EU RIEGL 02			
Flight Date		GPS Day	Lift				Sun°	Solar Times (UTC)	Pulse Rate	Flying Temp °C		Max Range'	Download Drive			
12-Nov-17		17-316	5				-	-	330k	3.0 3.0		2933	NS1TB-83			
Mission ID (yyymmdd_Sen_Job_Lift)		Aircraft	Airport ID	FMS	UTC	AMT (ft)	Speed	FOV	Scan Rate (Hz)	MTA	km/WPT	AltM Setting	Humidity @ Alt	Shipping Track		
171112_421_17003900_05		N76JN	KRAP	CCNS 4	-7	2400	130	60	130	2	0.440	30.28 30.14	60%			
Pilot #1		Pilot #2		Operator #1			Operator #2									
George Wilson				Jacob Amundson												
Base 1 ID	Location		Rec ID	Ant ID	ARP (m)	Start Time (UTC)		Stop Time (UTC)		GPS Filename		Operator	Data			
FGI 0493	KRAP		GR3 U1	Unit 1	1.8	12-Nov-17 14:28		12-Nov-17 23:33		GR3_0111120.tps		Chris Fought	With AB			
Area	Flight #		Wpt		Distance		UTC		Flt	Altitude	Speed	Scan	Comments and Conditions		SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End	Dir	(GPS)	(knots)	Rate				
							17:11:35	17:16:35					GROUND STATIC		15	1.3
							17:40:42						ALIGNMENT TURNS		17	1.1
EastSD_X	1		108	125	47.1	54.6	17:46:13	17:48:07	N	4,875	130	130.0	CROSSING LINE		17	1.1
EastSD_B	25		1	223	0	97.7	17:56:15	18:22:00	W	4,855	126	130.0			15	1.4
	26		223	1	97.7	0	18:25:37	18:51:24	E	4,425	127	130.0			17	1.1
	26		1	10	0	4	18:55:18	18:56:27	W	4,855	124	130.0	CALIBRATION LINE		18	1.1
	27		1	223	0	97.7	19:03:28	19:29:01	W	4,930	130	130.0			18	1.2
	28		223	1	97.7	0	19:33:06	19:59:22	E	4,405	121	130.0			18	1.2
	29		1	223	0	97.7	20:03:10	20:28:53	W	4,845	121	130.0			18	1.2
	30		223	1	97.7	0	20:33:01	20:59:47	E	4,440	119	130.0			15	1.5
	31		1	223	0	97.7	21:03:48	21:29:40	W	4,825	128	130.0			20	1.0
	32		223	1	97.7	0	21:33:11	21:59:49	E	4,510	124	130.0			19	1.0
							22:00:19						ALIGNMENT TURNS		18	1.2
							22:21:46	22:26:46					GROUND STATIC		19	1.1

Trajectory and GPS Plots:

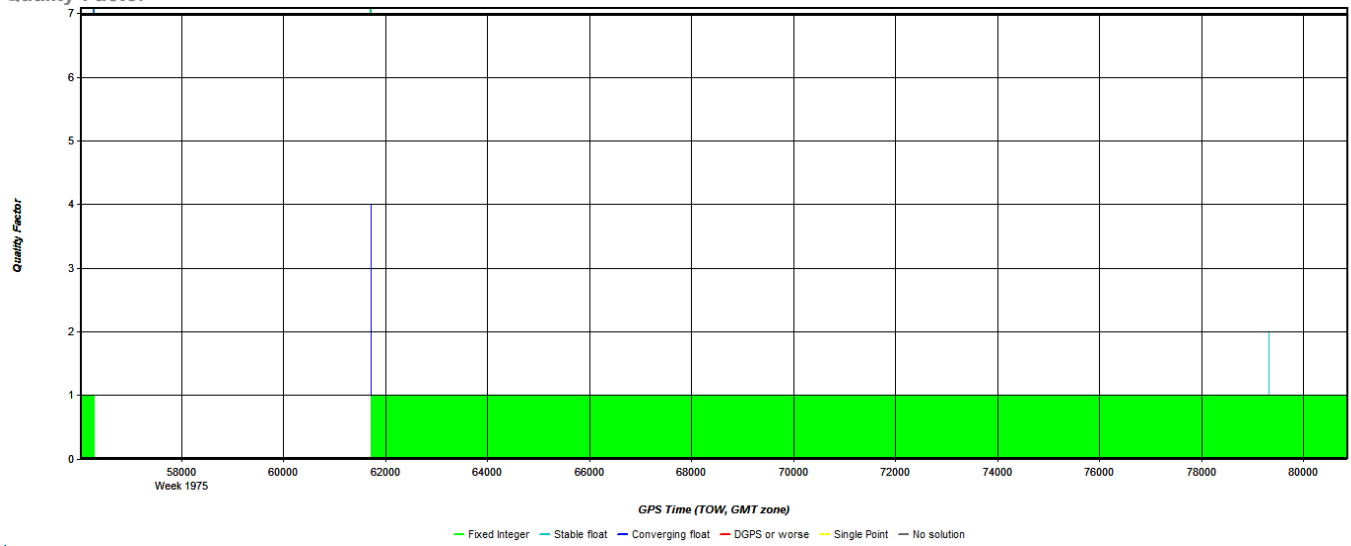


Estimated Accuracy

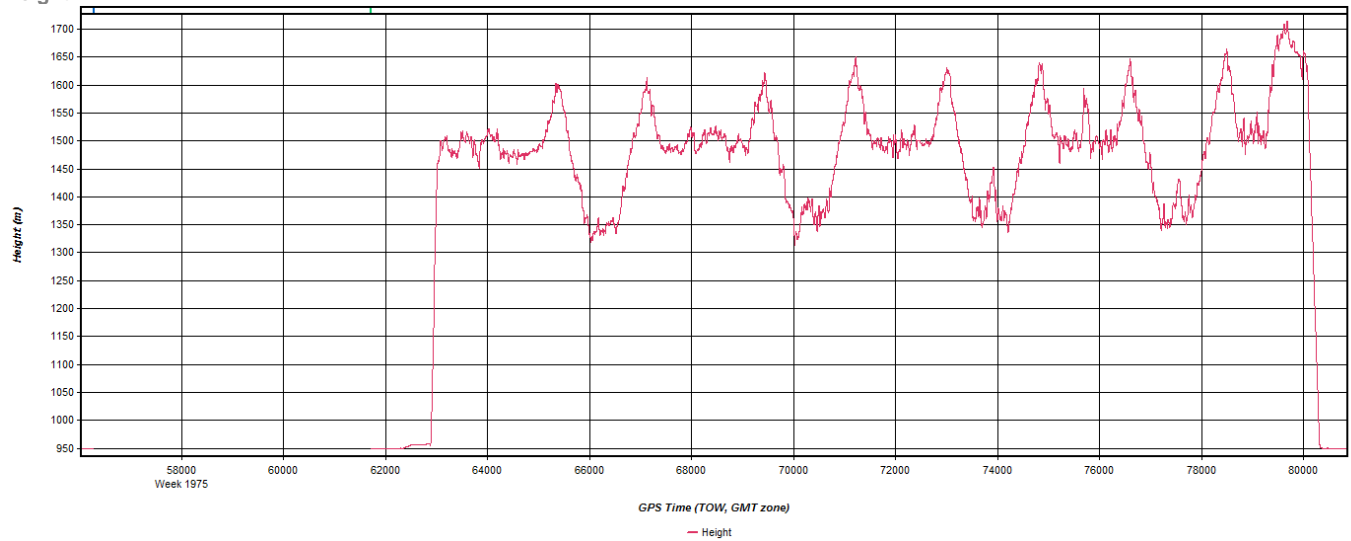


USGS COLLECTION REPORT

Quality Factor

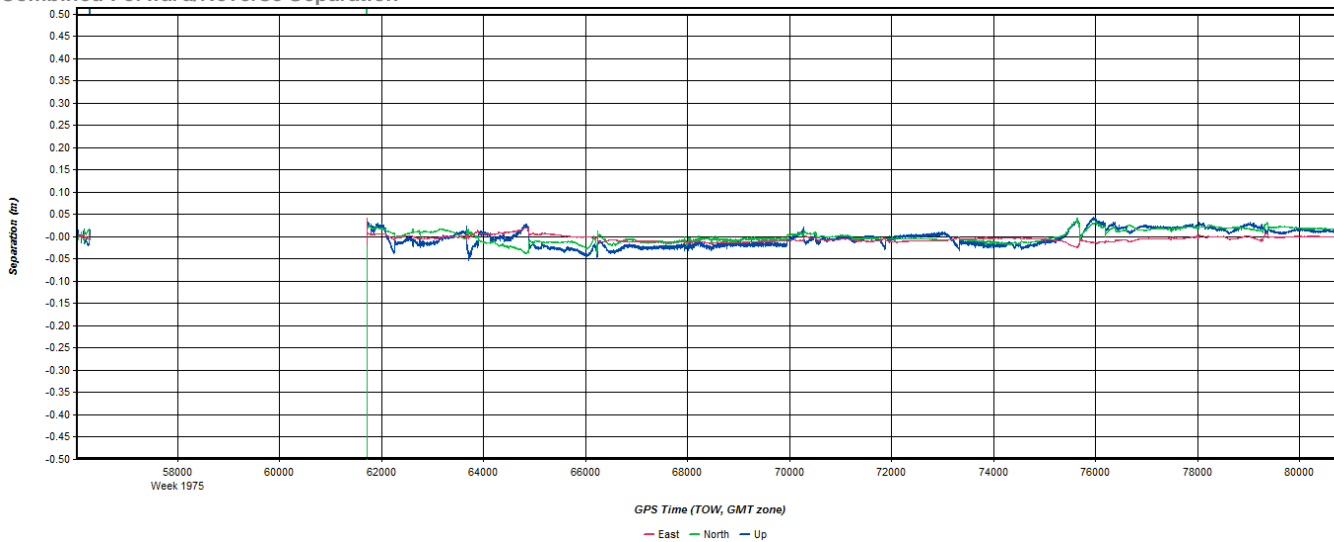


Height

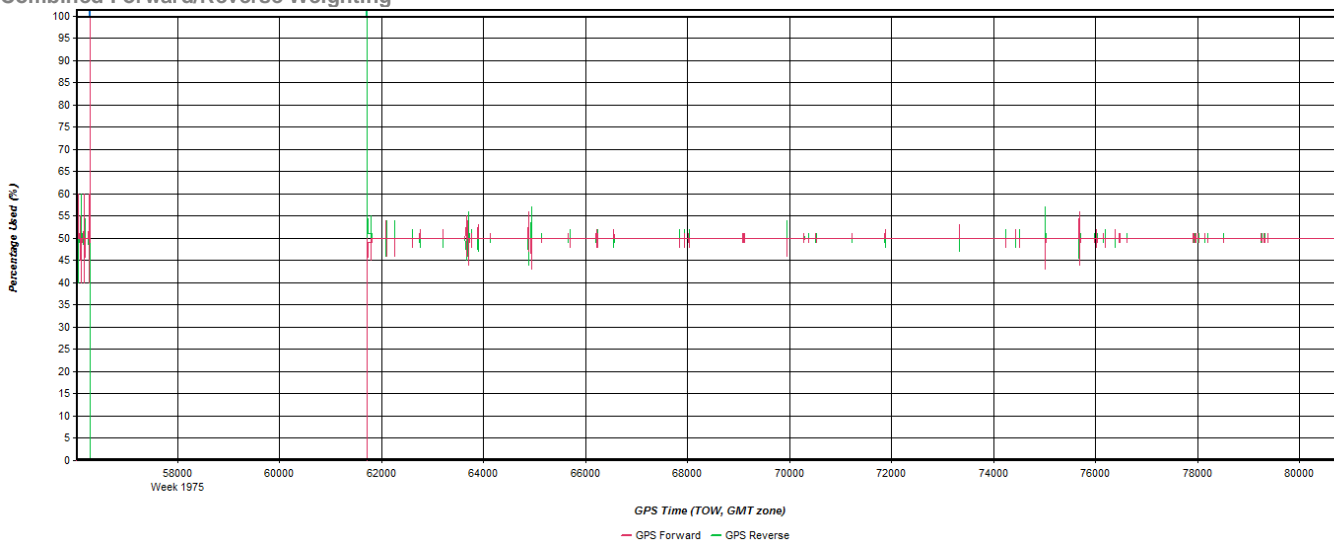




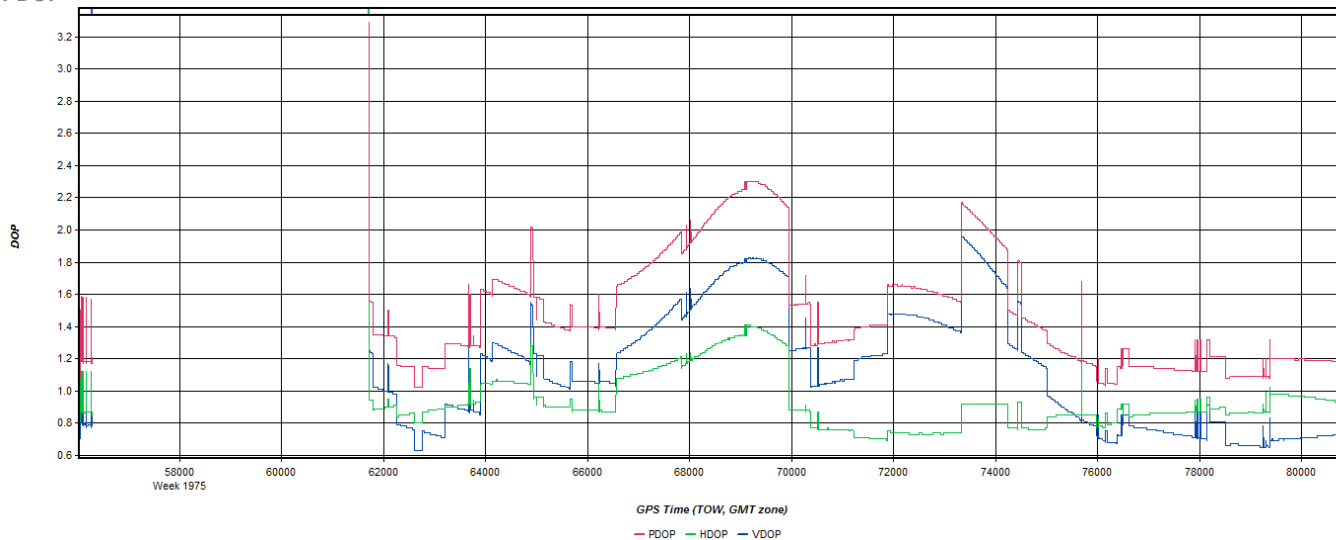
Combined Forward/Reverse Separation



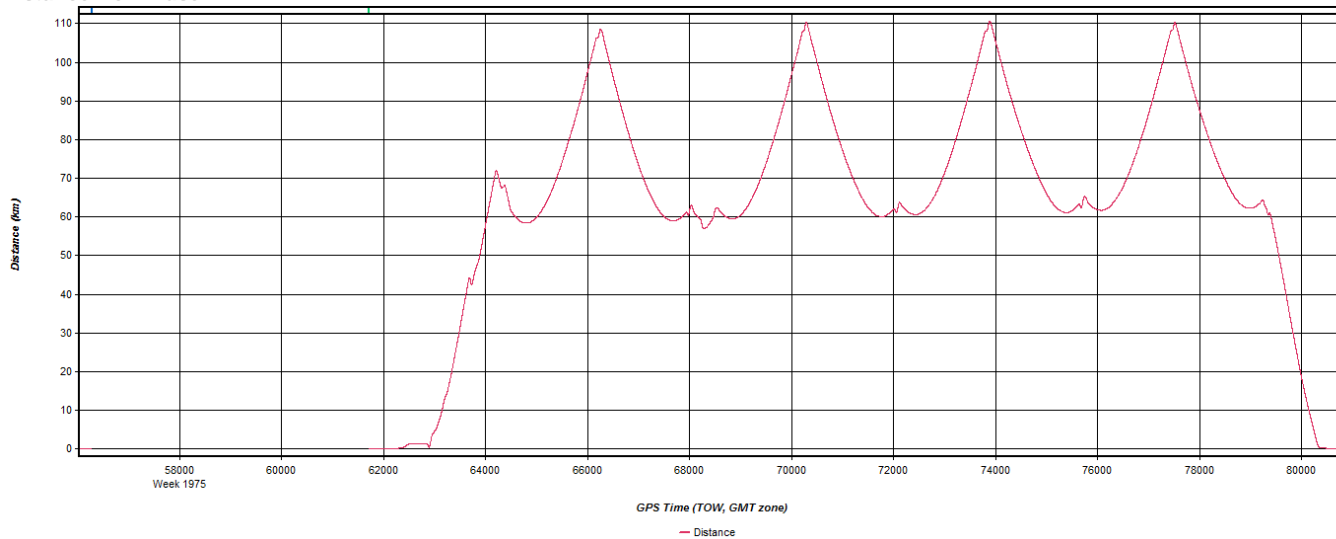
Combined Forward/Reverse Weighting



PDOP

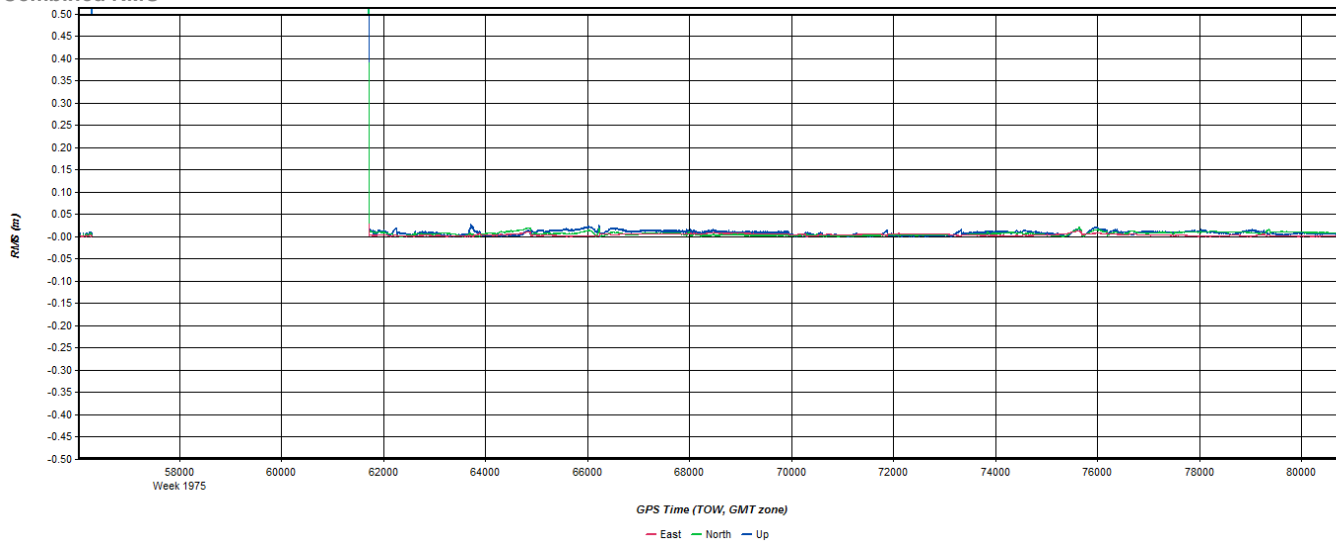


Distance from Base

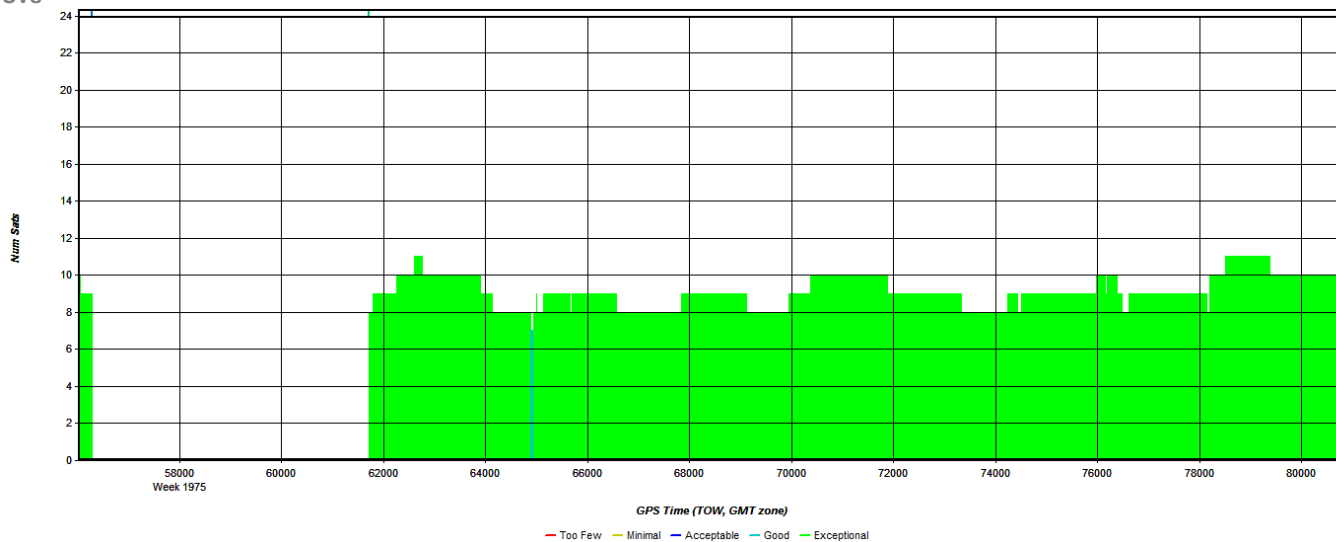




Combined RMS



SVs



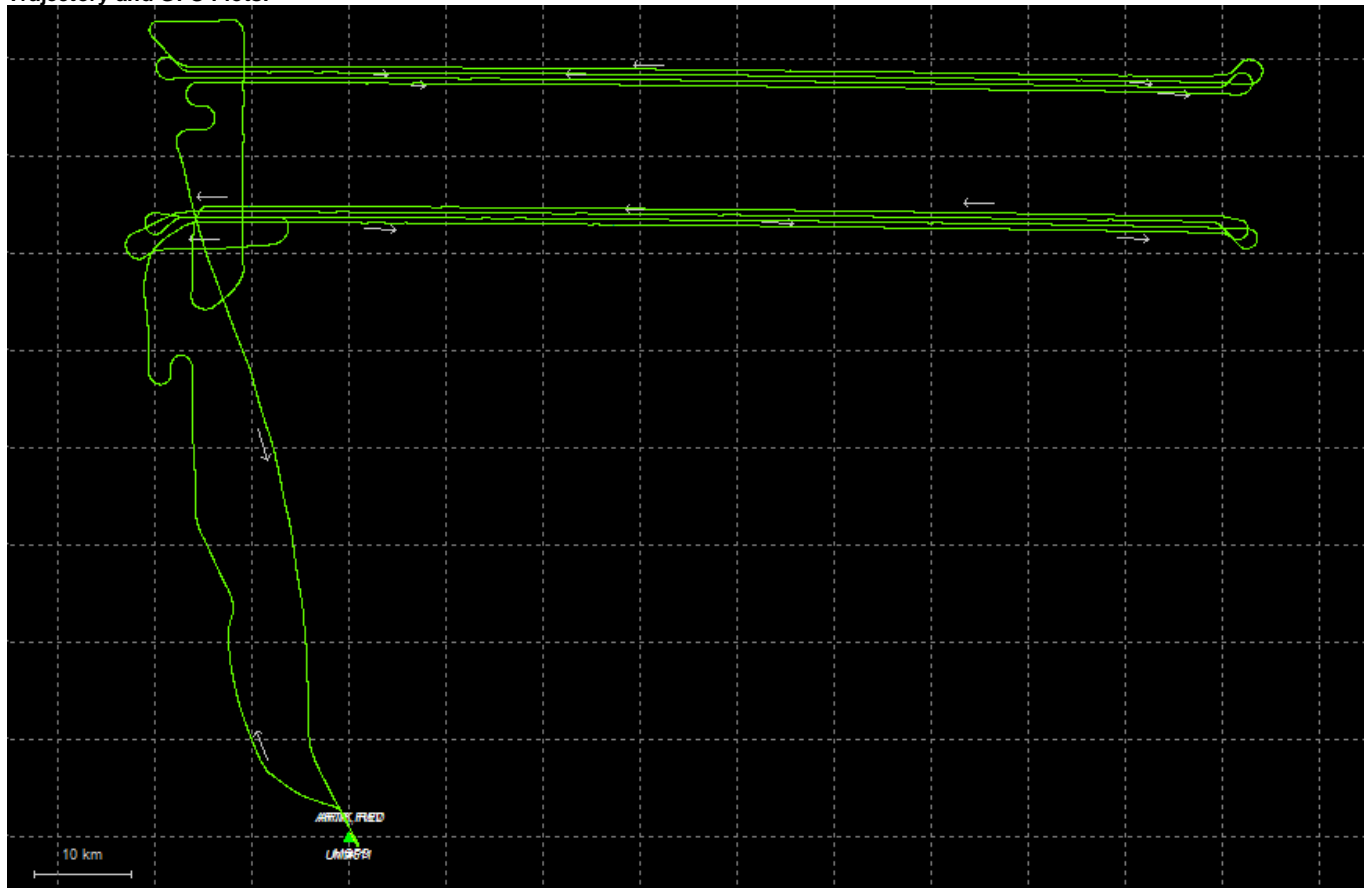


Acquisition and Processing details ----- Collection 17 (November 13, 2017)

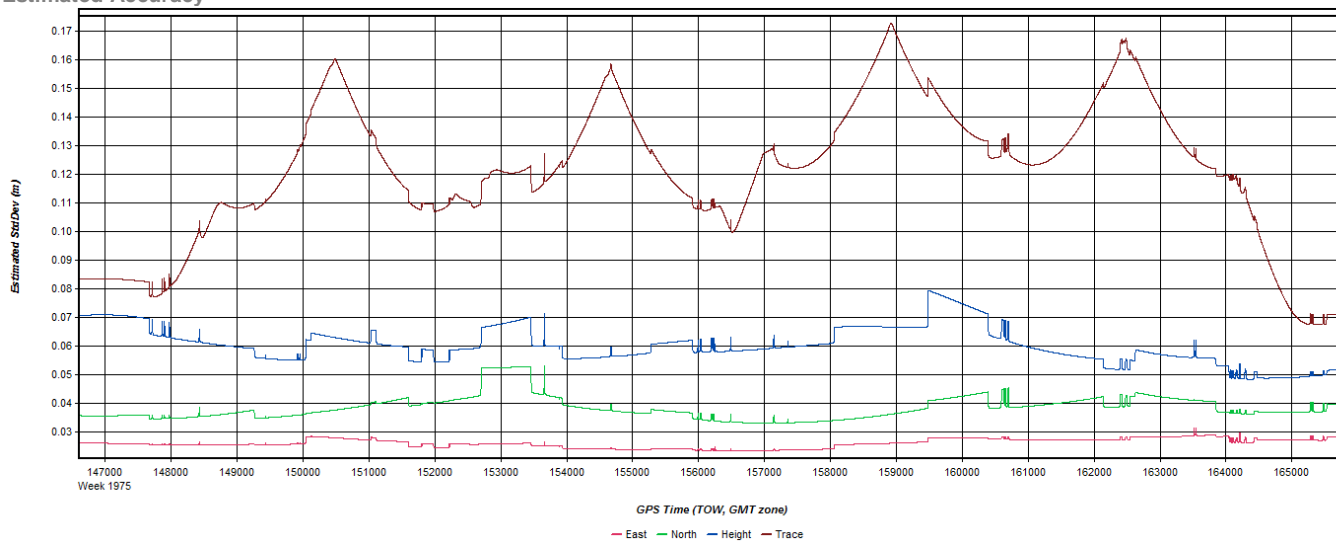
Log:

FUGRO		Fugro Geospatial, Inc.										Riegl				
17.06		Lift Begin			Lift End			Flt	Flt	Hobbs	Activity	Flight Log				
		Airport	Chocks	Hobbs	Airport	Chocks	Hobbs	Duration	Hrs	Hrs		AC80-50-00-02				
1	KRAP	16:40	7548.3	KRAP	22:03	7553.7	5:23	5:50	5:4	0900-Production						
2																
3																
FGI Job #		Project Name			System	Unit	IMU				Ground Temp °C	Min Range'	Data Logger Drives			
22.17003900		USGS SD Lidar 2017 D17			780	421	AIMU				12.0 15.0	1542	01/03/EU RIEGL 02			
Flight Date		GPS Day	Lift				Sun°	Solar Times (UTC)	Pulse Rate	Flying Temp °C		Max Range'	Download Drive			
13-Nov-17		17-317	6				-	-	330k	10.0 9.0		2933	-			
Mission ID (yyymmdd_Sen_Job_Lift)		Aircraft	Airport ID	FMS	UTC	AMT (ft)	Speed	FOV	Scan Rate (Hz)	MTA	km/WPT	AltM Setting	Humidity @ Alt	Shipping Track		
171113_421_17003900_06		N76JN	KRAP	CCNS 4	-7	2400	130	60	130	2	0.440	30.05 29.99	39%			
Pilot #1		Pilot #2		Operator #1			Operator #2									
George Wilson				Jacob Amundson												
Base 1 ID	Location		Rec ID	Ant ID	ARP (m)	Start Time (UTC)		Stop Time (UTC)		GPS Filename		Operator		Data		
FGI 081	KRAP		GR3 U1	Unit 1	1.8	13-Nov-17 14:52		-		Unit51113o.tps		Lee Scadden		With AB		
Area	Flight #		Wpt		Distance		UTC		Flt	Altitude	Speed	Scan	Comments and Conditions		SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End	Dir	(GPS)	(knots)	Rate				
							16:46:42	16:51:42					GROUND STATIC		15	1.3
							17:12:55						ALIGNMENT TURNS		16	1.2
EastSD_B	33		1	223	0	97.7	17:20:00	17:45:39	E	4,900	125	130.0			17	1.2
	34		223	1	97.7	0	17:49:40	18:15:47	W	4,545	122	130.0			15	1.4
	34		1	10	0	4	18:20:09	18:21:28	E	4,920	119	130.0	CALIBRATION LINE		17	1.1
	35		1	223	0	97.7	18:29:49	18:55:37	E	4,850	118	130.0			15	1.4
	36		223	1	97.7	0	18:59:06	19:24:51	W	4,510	121	130.0			19	1.0
EastSD_X	1		119	161	51.9	70.4	19:30:18	19:35:25	N	4,890	130	130.0	CROSSING LINE		18	1.2
EastSD_B	62		1	222	0	97.2	19:40:48	20:06:21	E	5,100	123	130.0			18	1.2
	61		222	1	97.2	0	20:10:43	20:36:24	W	4,490	127	130.0			17	1.3
	60		1	222	0	97.2	20:40:05	21:05:35	E	5,140	126	130.0			17	1.2
	59		222	1	97.2	0	21:09:20	21:34:51	W	4,455	126	130.0			21	1.0
							21:35:15						ALIGNMENT TURNS		20	1.1
							21:57:54	22:02:54					GROUND STATIC		18	1.3

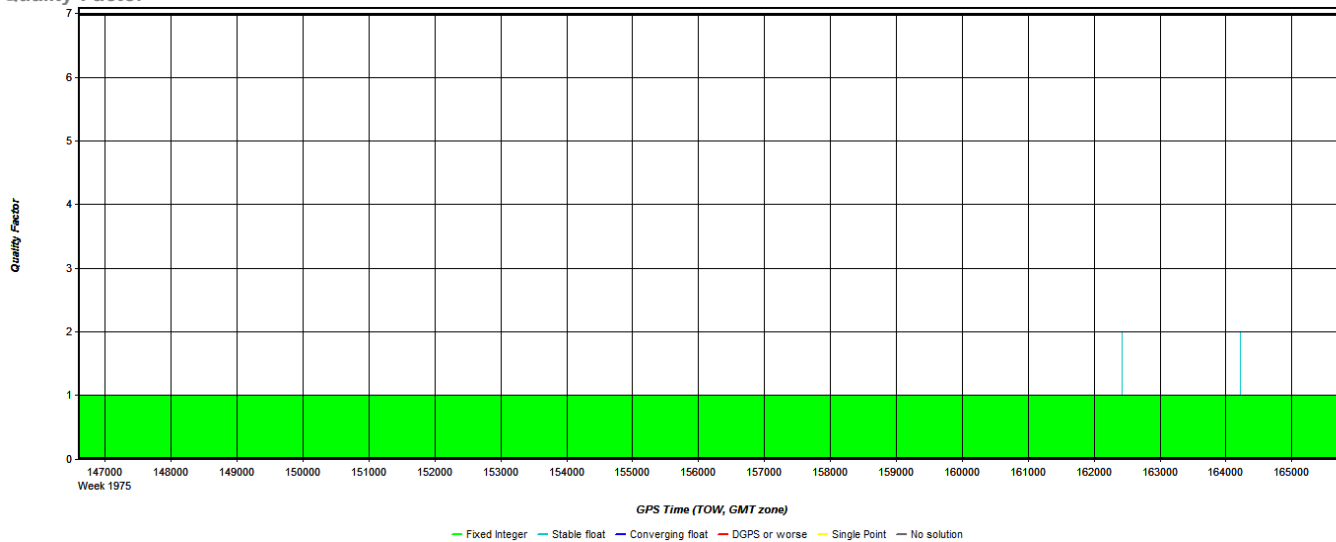
Trajectory and GPS Plots:



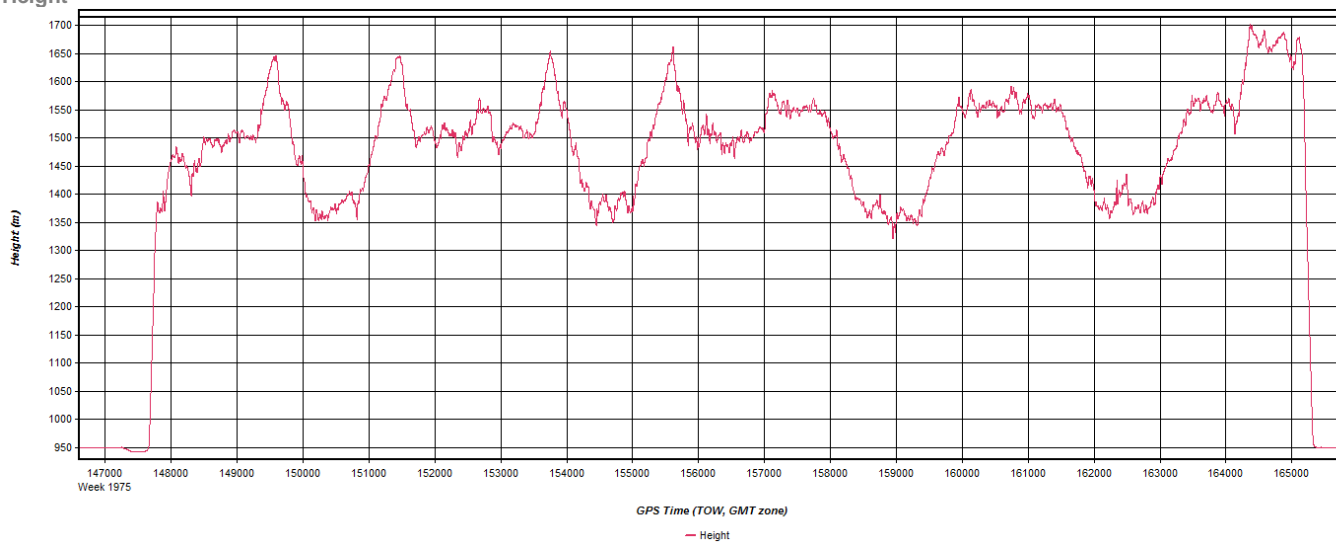
Estimated Accuracy



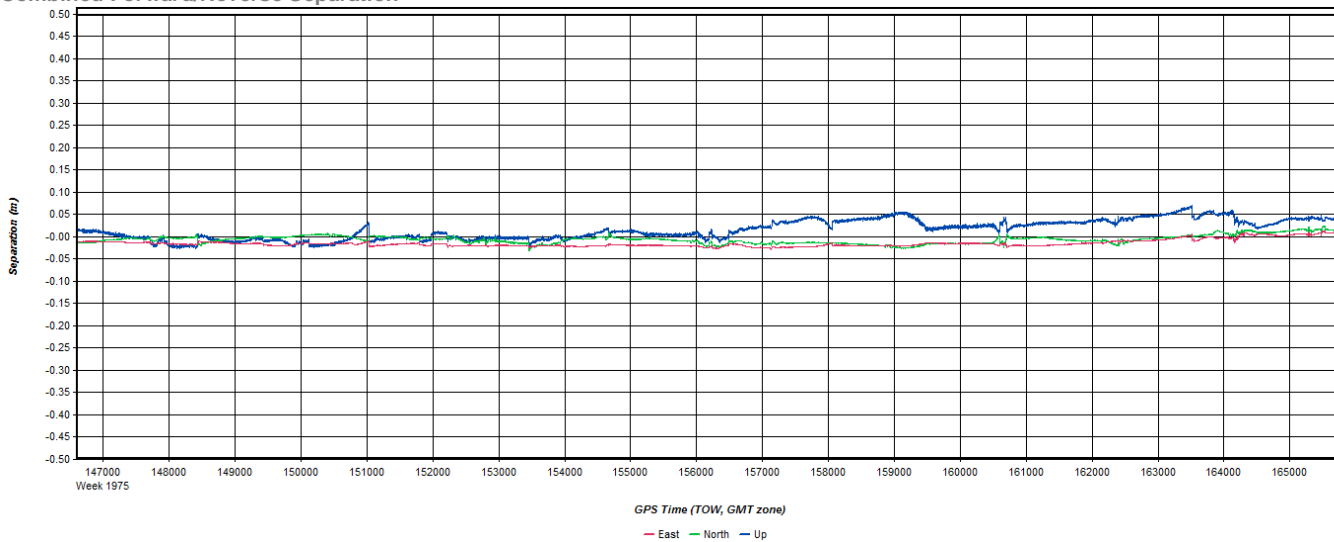
Quality Factor



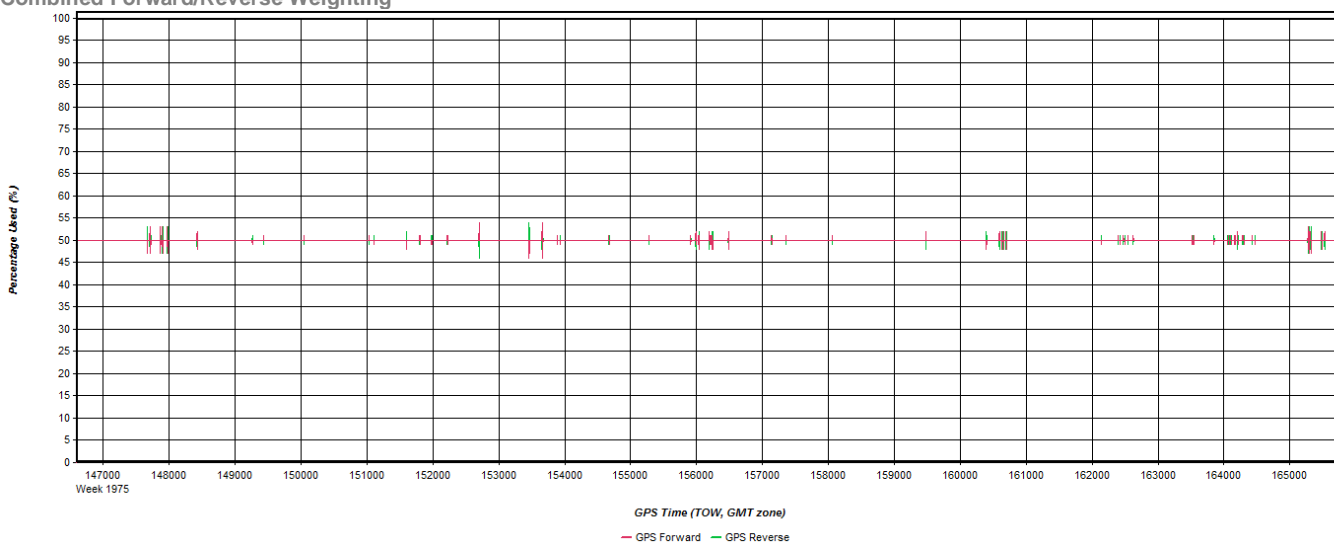
Height



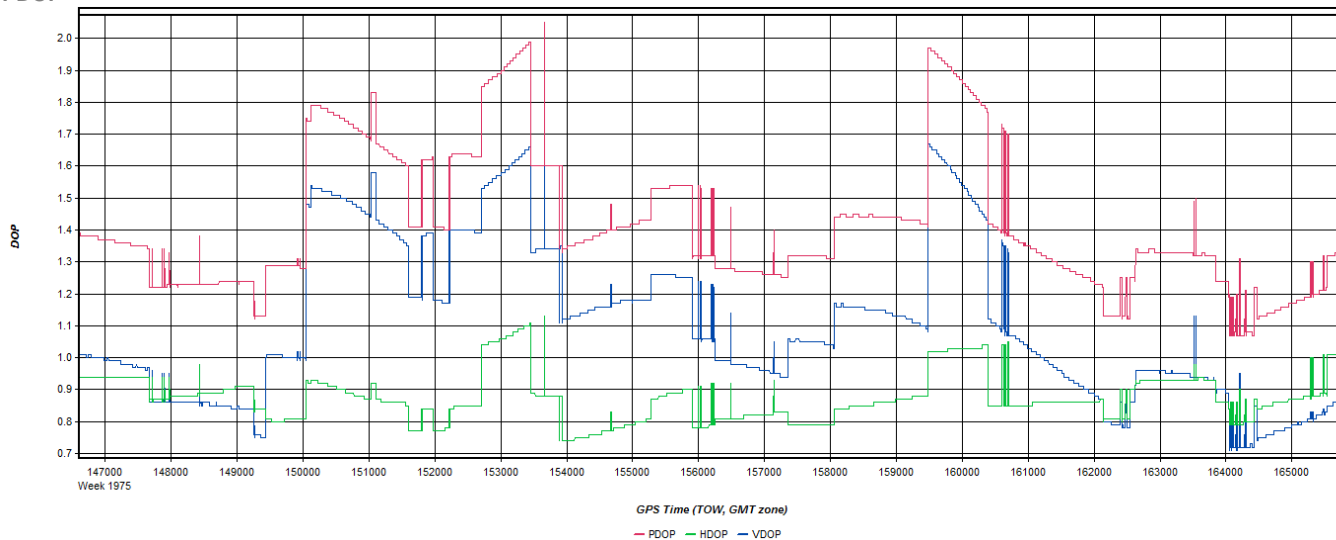
Combined Forward/Reverse Separation



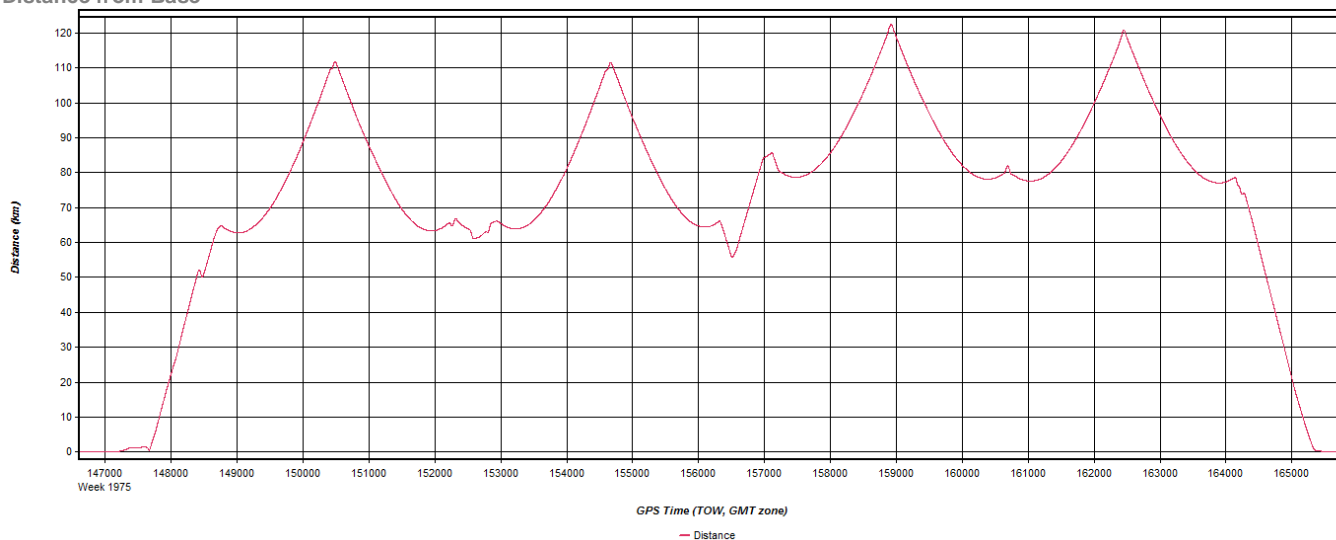
Combined Forward/Reverse Weighting



PDOP

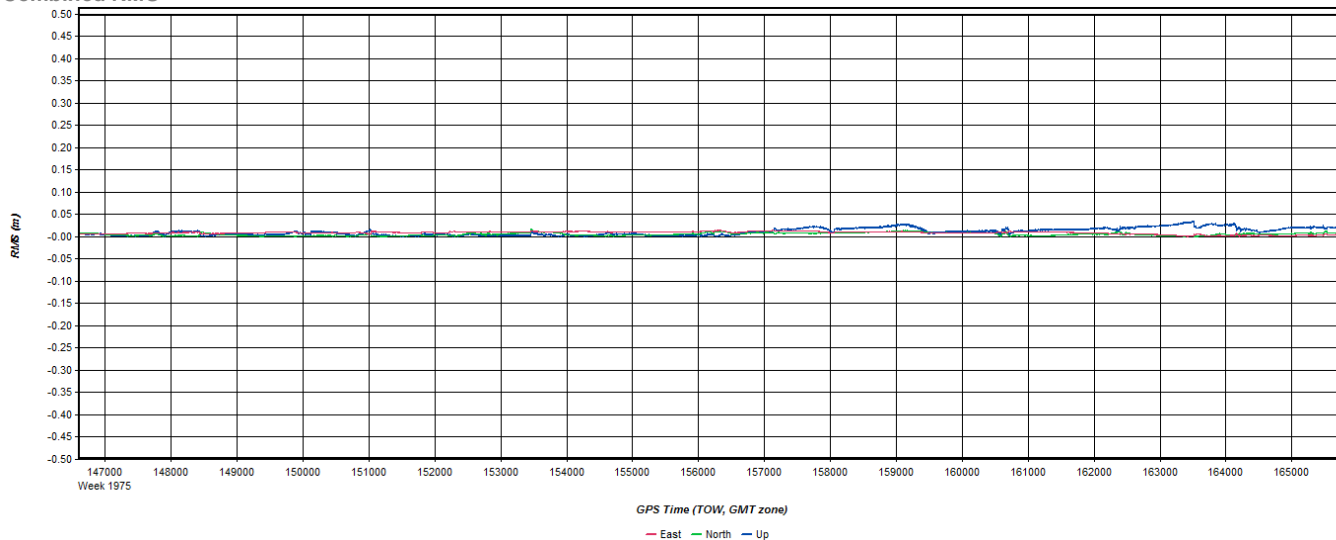


Distance from Base

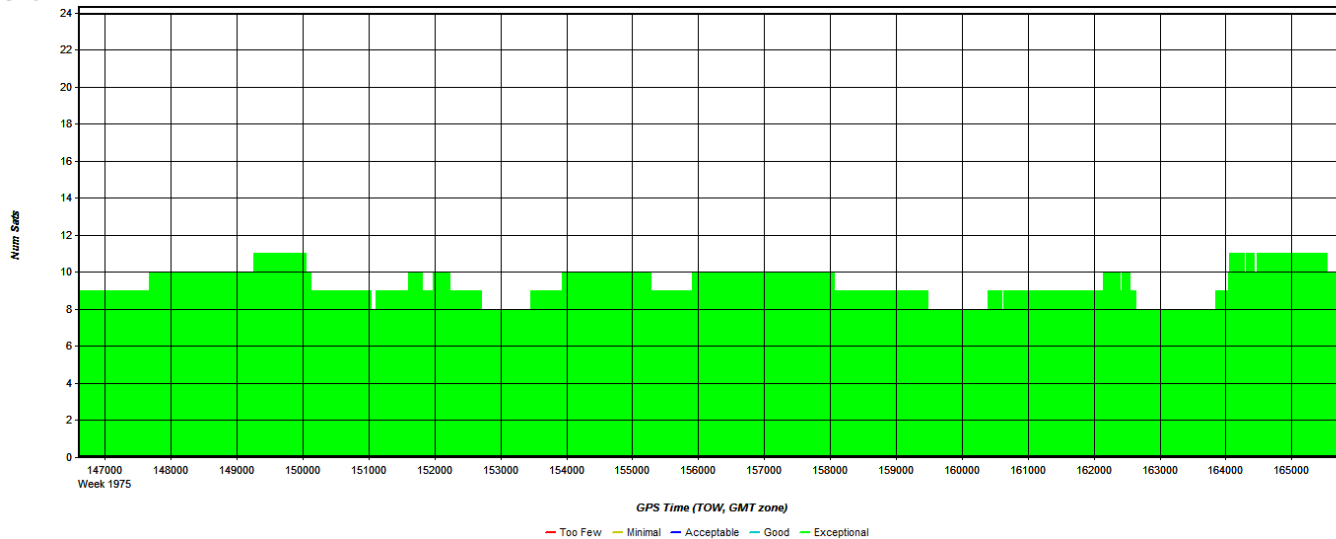




Combined RMS



SVs





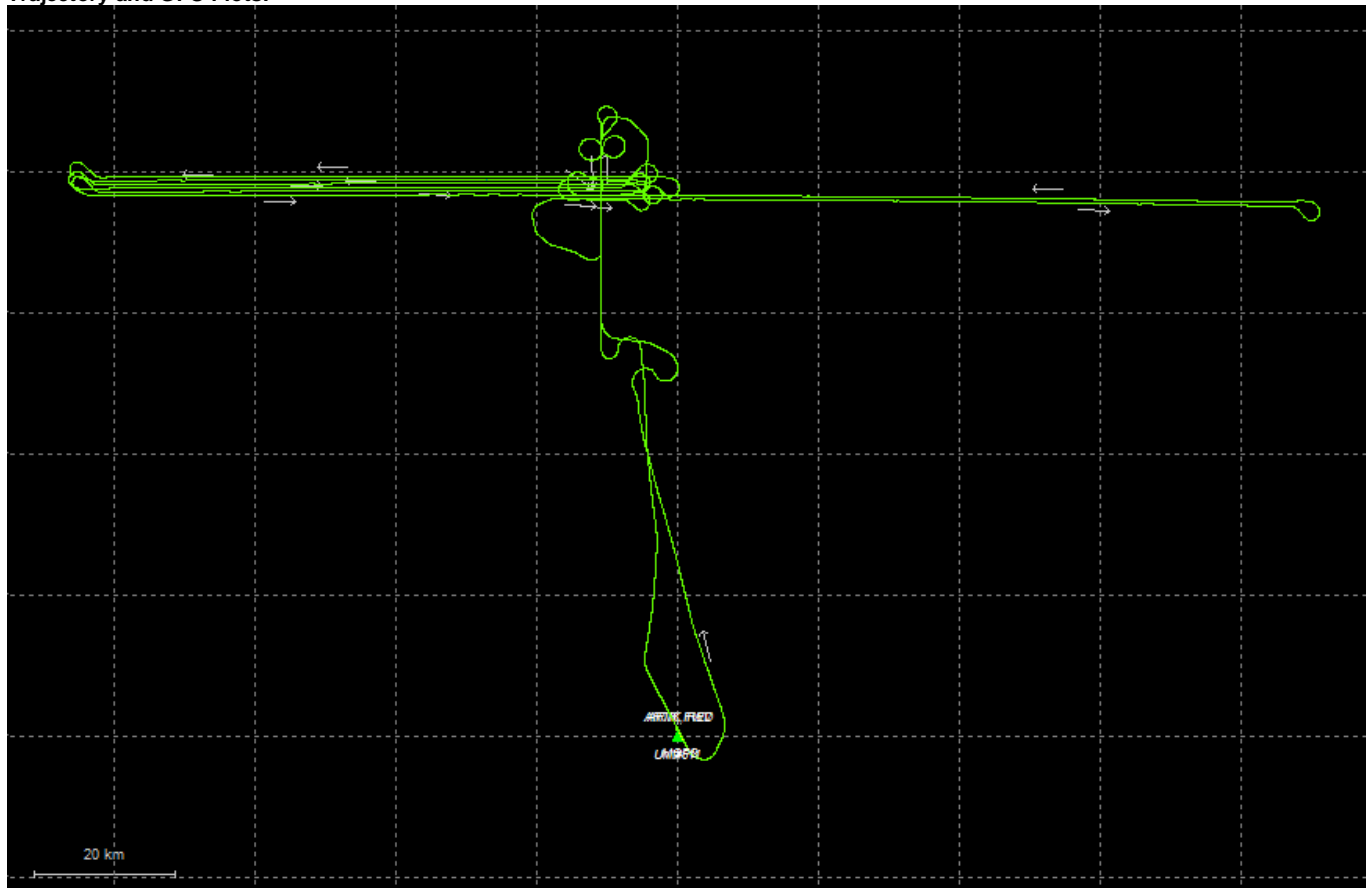
Acquisition and Processing details ----- Collection 18 (November 13, 2017)

Log:

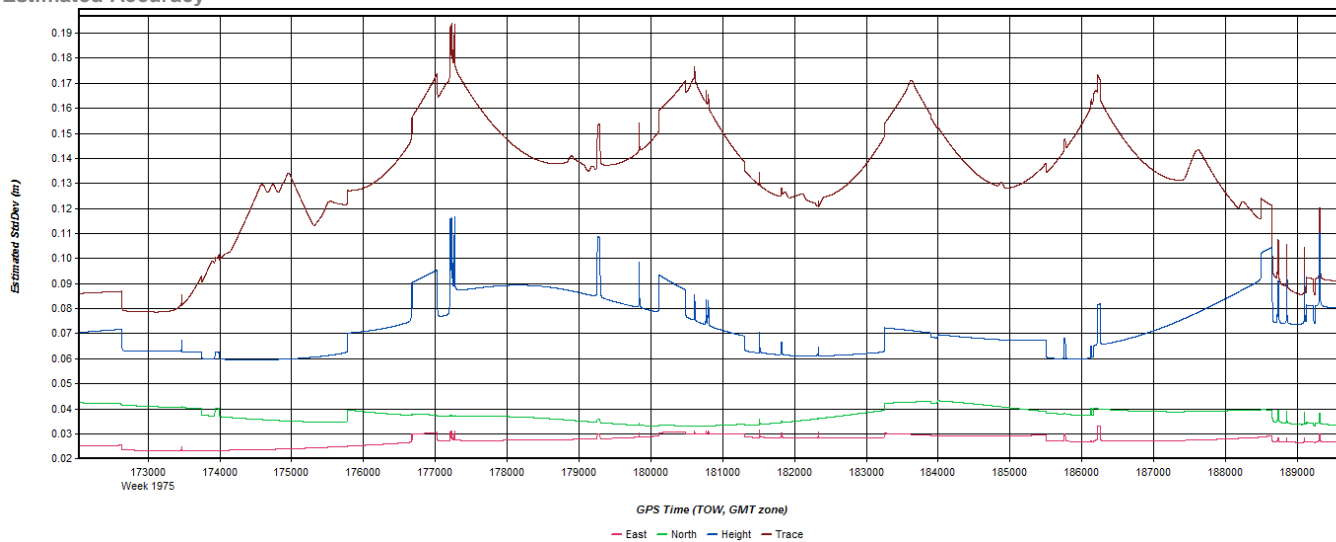
FUGRO		Fugro Geospatial, Inc.										Riegl Flight Log	
17.06		Lift Begin			Lift End			Flt Duration	Flt Hrs	Hobbs Hrs	Activity	AC80-50-00-02	
		Airport	Chocks	Hobbs	Airport	Chocks	Hobbs						
1		KRAP	16:43	7553.7	KRAP	21:43	7558.8	5:00	5:00	5:1	0900-Production		
2													
3													

FGI Job #	Project Name			System	Unit	IMU				Ground Temp °C	Min Range'	Data Logger Drives			
22.17003900	USGS SD Lidar 2017 D17			780	421	AIMU				8.0	1542	03			
Flight Date	GPS Day	Lift		Sun°	Solar Times (UTC)		Pulse Rate			Flying Temp °C	Max Range'	Download Drive			
13-Nov-17	17-317	7		-	-		330/340K			10.0	2933	1TB-42			
Mission ID (yyymmdd_Sen_Job_Lift)	Aircraft	Airport ID	FMS	UTC	AMT (ft)	Speed	FOV	Scan Rate (Hz)	MTA	km/WPT	Altitude Setting	Humidity @ Alt	Shipping Track		
171113_421_17003900_07	N76JN	KRAP	CCNS 4	-7	2400	130	60	130	2	0.440	29.98	60			
Pilot #1		Pilot #2		Operator #1		Operator #2									
Fred Davis				Chris Fought											
Base 1 ID	Location	Rec ID	Ant ID	ARP (m)	Start Time (UTC)		Stop Time (UTC)		GPS Filename	Operator	Data				
FGI 081	KRAP	GR3 U1	Unit 1	1.8	11/13/17 1448		11/14/17 0509		Unit#51113o.tps	Chris Fought	With AB				
Area	Flight #		Wpt		Distance		UTC		Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions	SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End							
							23:50:45	23:55:45					GROUND STATIC	16	1.2
							0:17:00	0:20:00					ALIGNMENT TURNS	17	1.1
EastSD_X	1		135	161	59	70.4	0:24:59	0:28:27	N	5,000	130	120.0	CROSSING LINE	16	1.2
EastSD_X	1		161	140	70.4	61.2	0:37:49	0:40:25	S	5,000	130	120.0	CROSSING LINE	16	1.2
EastSD_B	57		1	222	0	97.2	0:46:26	1:11:51	E	5,000	130	120.0		16	1.2
	58		222	1	97.2	0	1:14:47	1:40:04	W	5,000	130	120.0		15	1.2
													change rpp for 340khz		
West-N	44		158	1	69.1	0	1:49:56	2:08:06	W	5,200	130			15	1.3
	43		1	158	0	69.1	2:11:22	2:29:25	E	5,200	130			15	1.2
	43		158	149	69.1	65.1	2:33:03	2:34:26	W	5,200	130		calibration line	16	1.2
	42		158	1	69.1	0	2:40:26	2:58:31	W	5,200	130			16	1.2
	41		1	158	0	69.1	3:01:55	3:19:56	E	5,200	130			16	1.1
	40		158	1	69.1	0	3:23:02	3:41:20	W	5,200	130			16	1.2
	39		1	158	0	69.1	3:44:28	4:02:29	E	5,200	130			17	1.2
West-NX	2		54	1	23.3	0	4:08:35	4:15:16	S	5,000	130			17	1.2
							4:15:30	4:18:00					ALIGNMENT TURNS	17	1.2
							4:35:15	4:40:15					GROUND STATIC	15	1.3

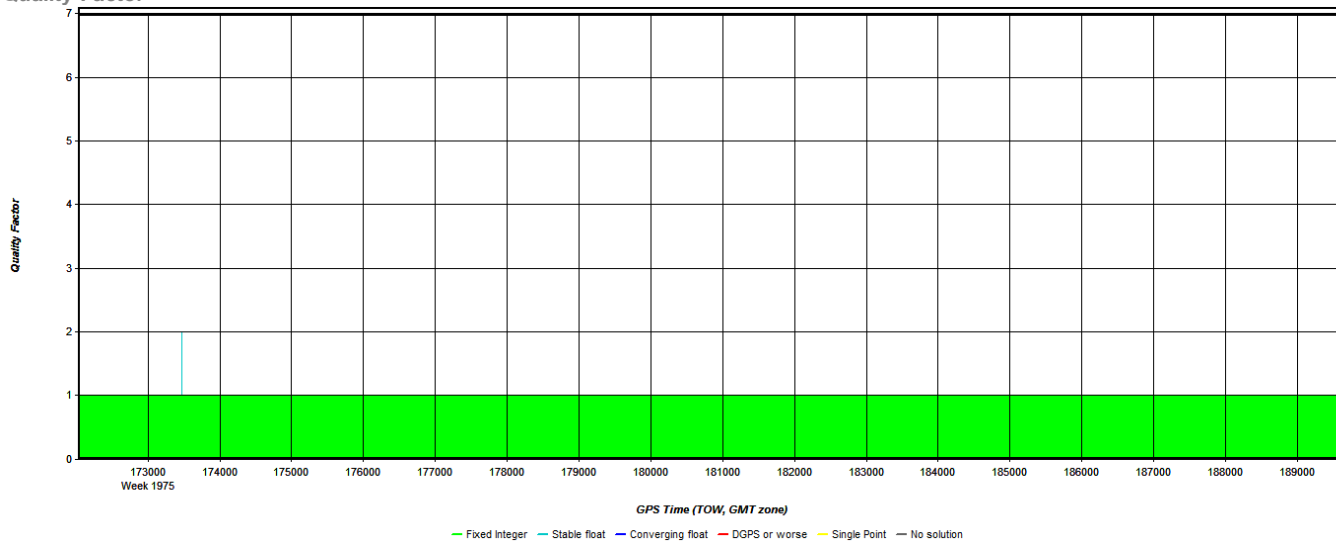
Trajectory and GPS Plots:



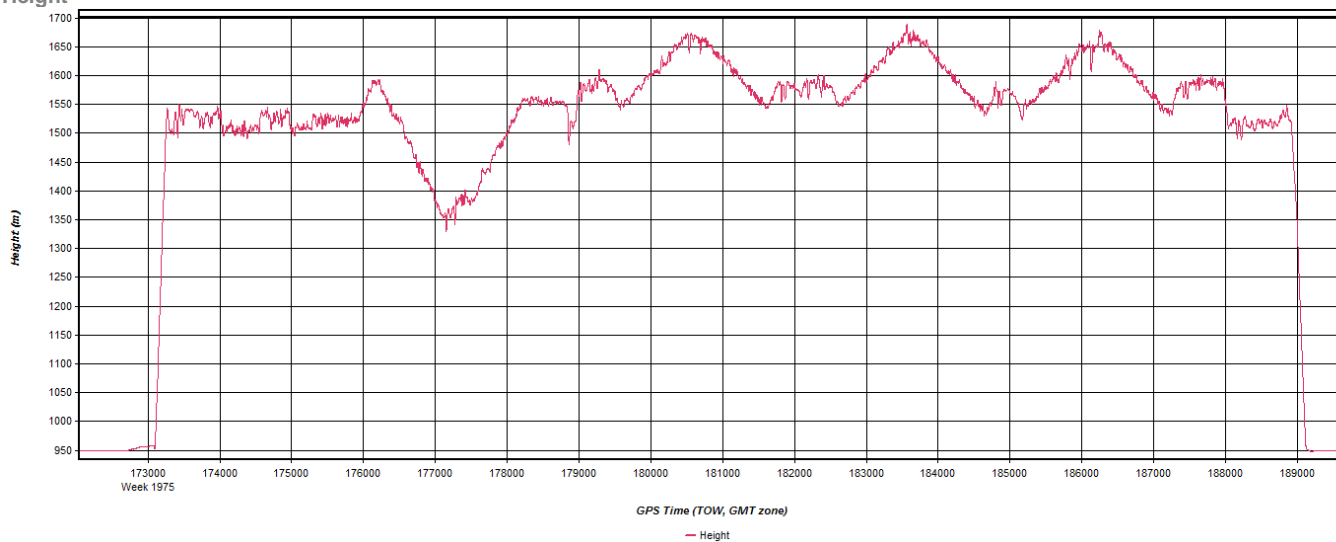
Estimated Accuracy



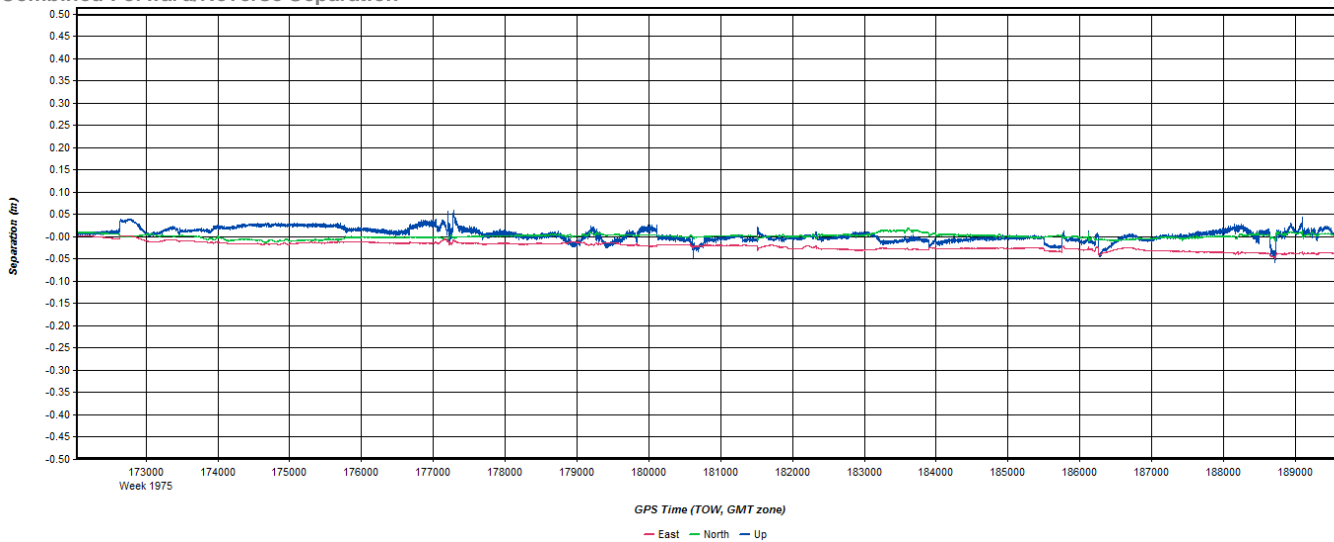
Quality Factor



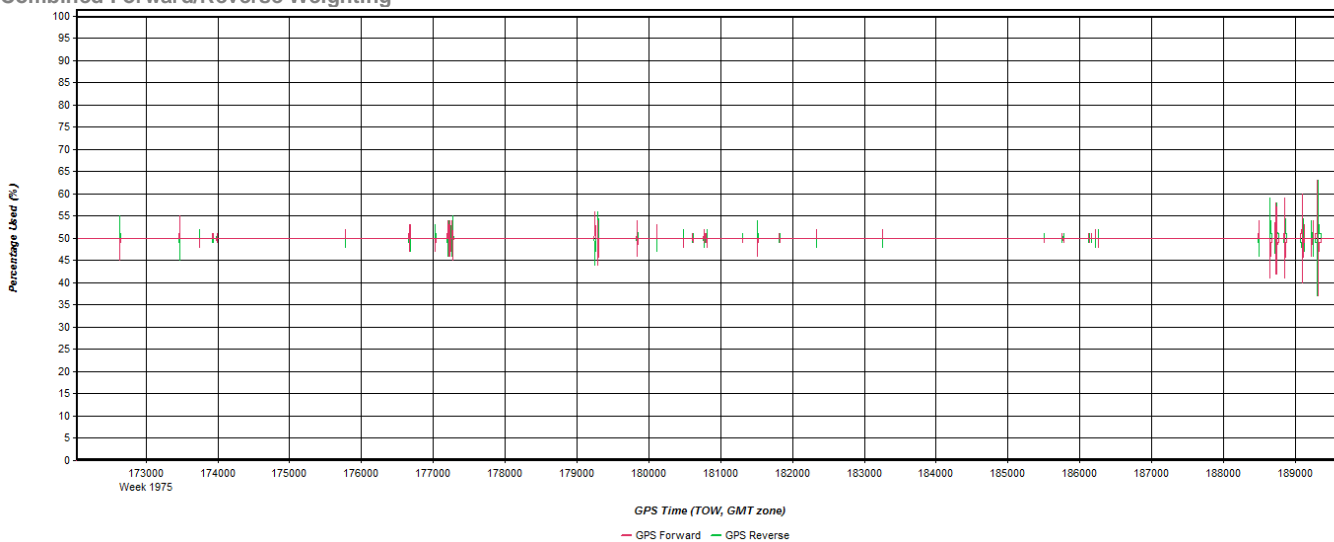
Height



Combined Forward/Reverse Separation

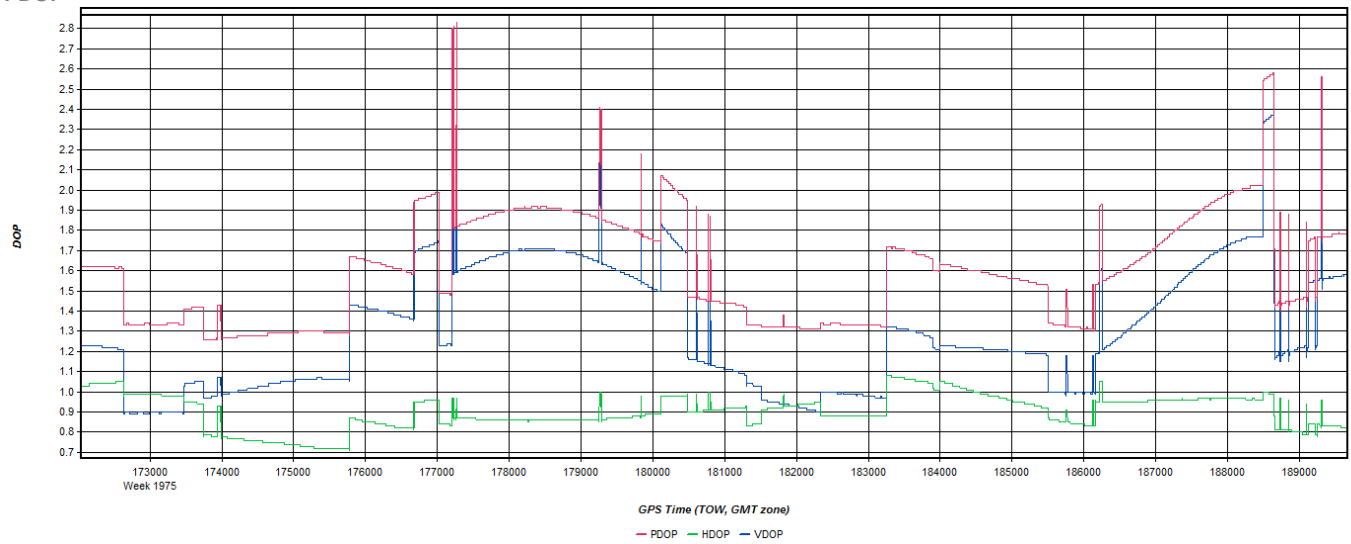


Combined Forward/Reverse Weighting

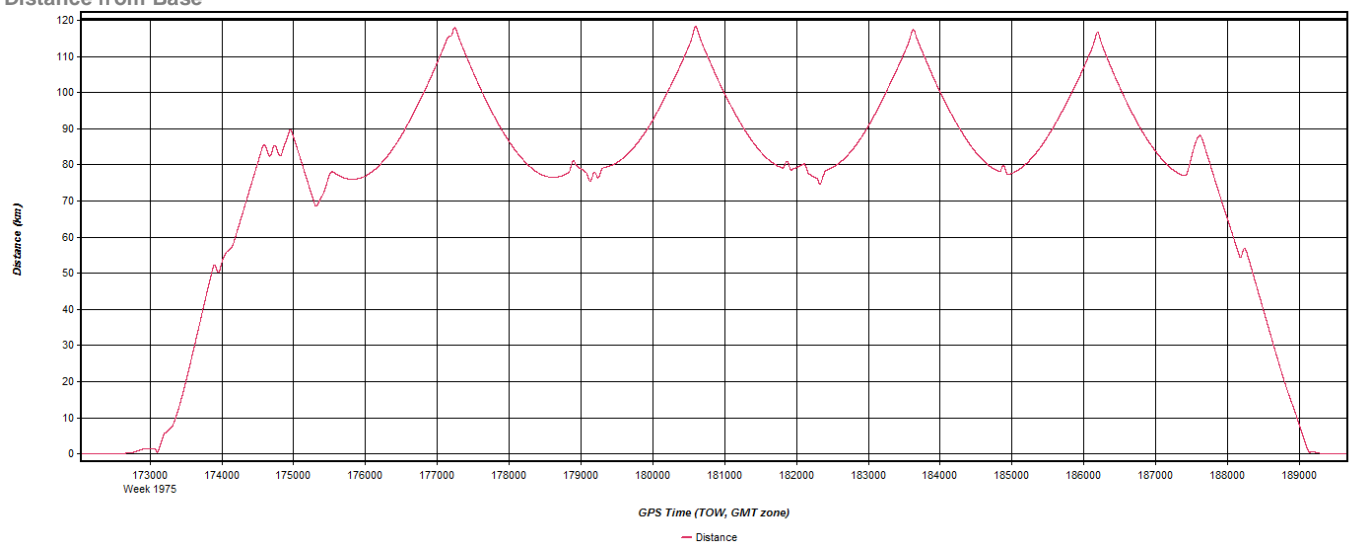


USGS COLLECTION REPORT

PDOP

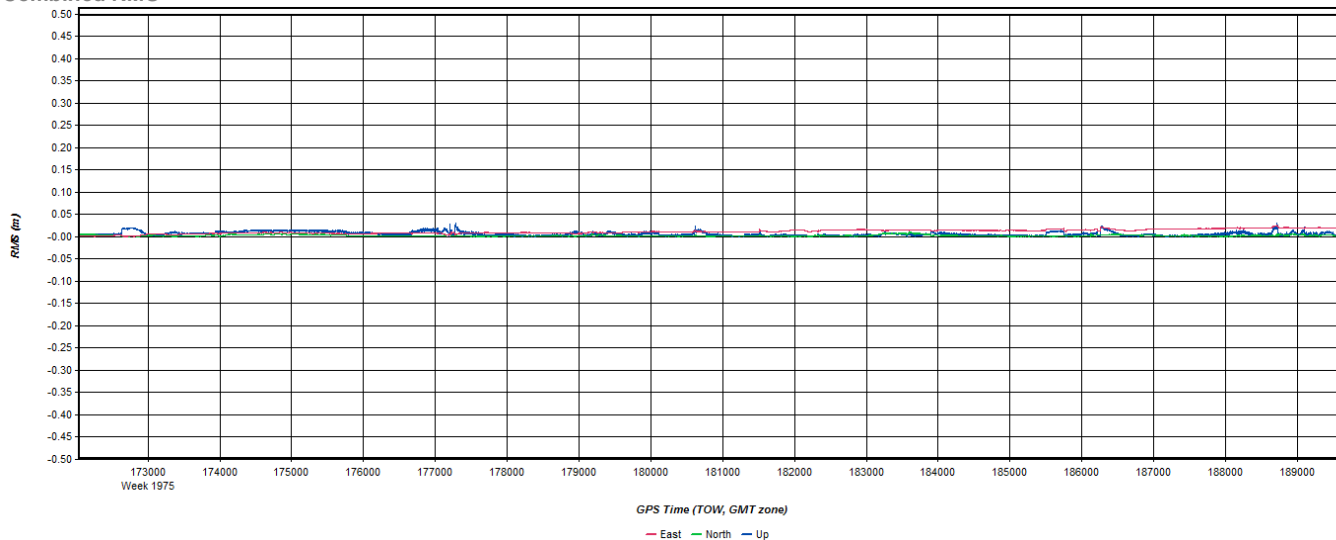


Distance from Base

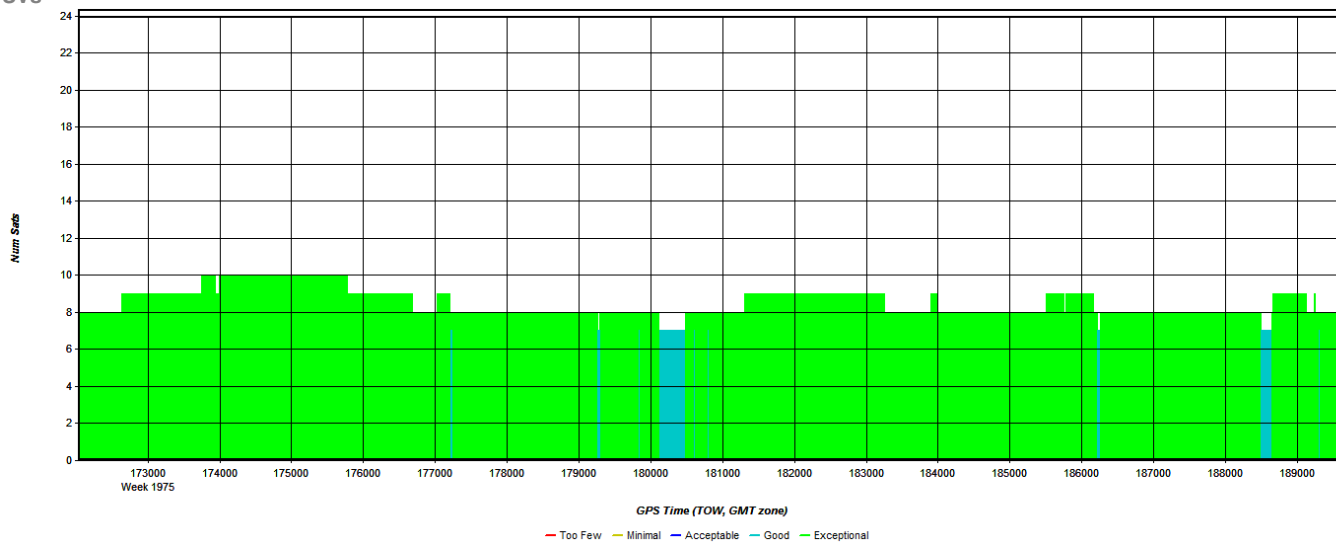




Combined RMS



SVs



**USGS
COLLECTION REPORT**



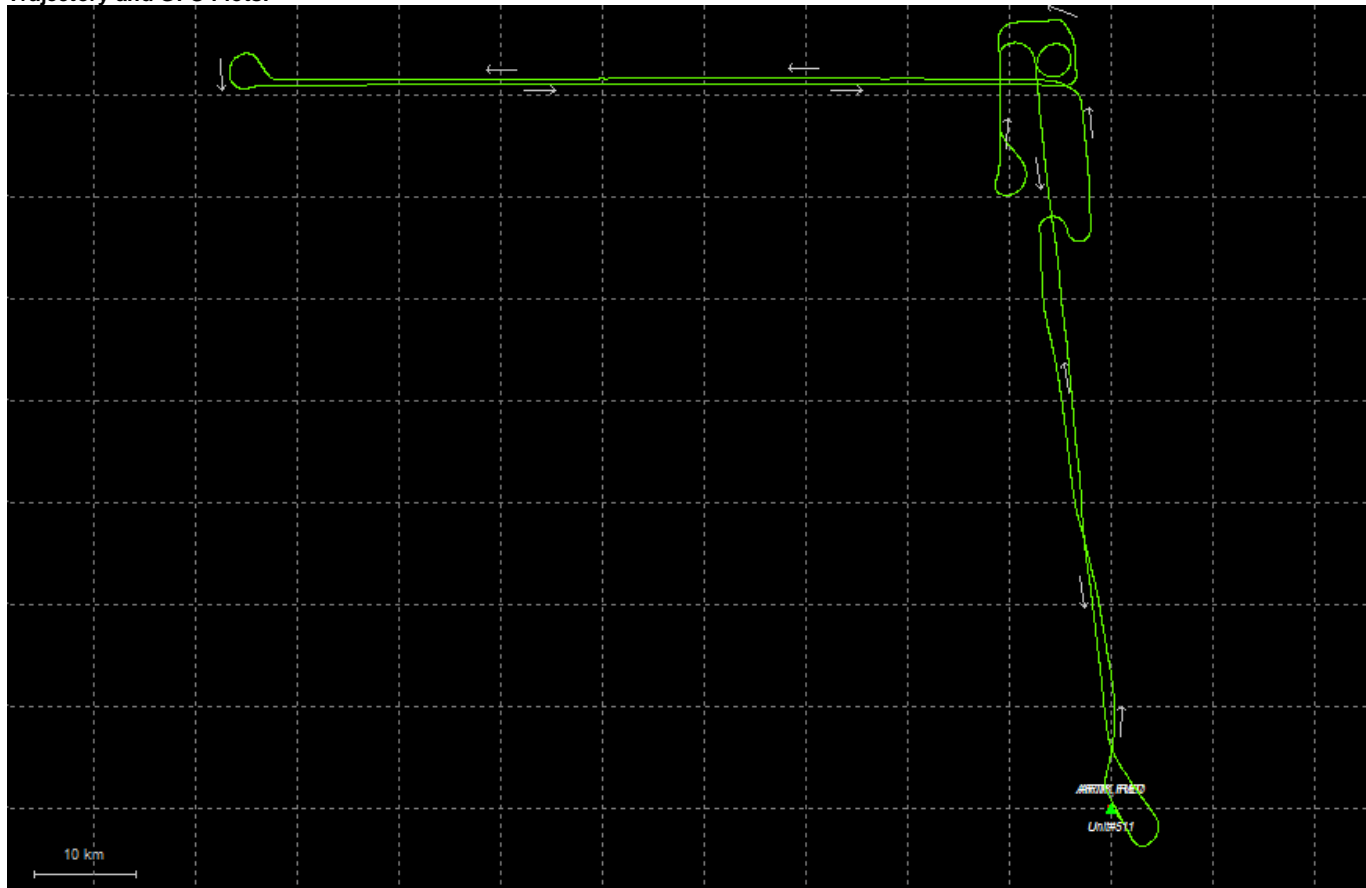
Acquisition and Processing details ----- Collection 19 (November 14, 2017)

Log:

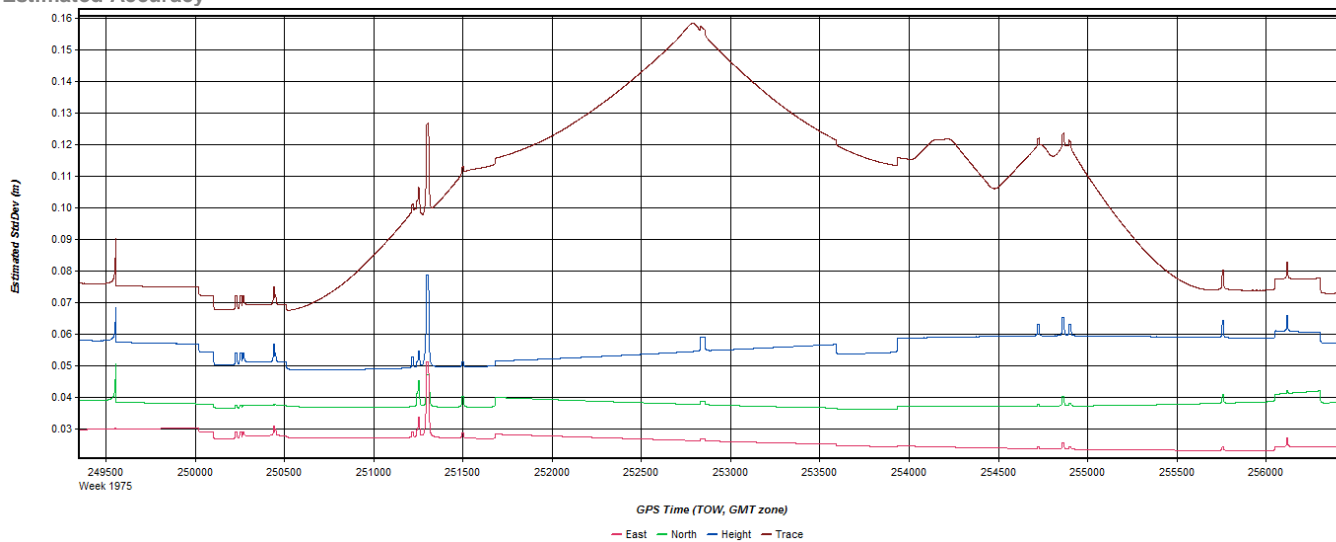
17.06	Lift Begin			Lift End			Fit Duration	Fit Hrs	Hobbs Hrs	Activity
	Airport	Chocks	Hobbs	Airport	Chocks	Hobbs				
1	KRAP	21:06	792.6	KRAP	23:15	794.1	2:09	2:25	1.5	0900-Production
2										
3										

FUGRO		Fugro Geospatial, Inc.		Riegl Flight Log		AC80-50-00-02										
FGI Job # 17003900	Project Name USGS SD Lidar 2017 D17			System 680i	Unit 165	IMU FMU-300	Ground Temp °C 13.0 11.0	Min Range' 1496	Data Logger Drives EU Riegl 03							
Flight Date 14-Nov-17	GPS Day 17-318	Lift 5		Sun° N/A	Solar Times (UTC) N/A	Pulse Rate 340K	Flying Temp °C 2.0 2.0	Max Range' 2844	Download Drive							
Mission ID (yyymmdd_Sen_Job_Lift) 171114_165_17003900_05		Aircraft N97HC	Airport ID KRAP	FMS FCMS	UTC	AMT (ft) 2400	Speed 130	FOV	Scan Rate (Hz) 140	MTA 2	km/WPT 0.441	AltM Setting 29.83 29.89	Humidity @ Alt	Shipping Track		
Pilot #1 Fred Davis		Pilot #2		Operator #1 Lee Scadden		Operator #2 base station on FTP KRAP base 0481										
Base 1 ID FGI 081	Location Rapid City		Rec ID GR3-5	Ant ID GR3-5	ARP (m) 1.8	Start Time (UTC) 171114-15:40		Stop Time (UTC) 171114-23:41		GPS Filename Unit5 1114p		Operator Lee Scadden	Data With AB			
Area	Flight #		Wpt		Distance		UTC		Fit Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions		SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End								
							21:21:45	21:26:47					5-minute ground static		17	1.1
							21:46:31	21:48:14					S-Turn calibration		20	1.0
West-N	29		158	1	69.2	0	21:52:49	22:11:14	272	5,230	125				20	1.0
	28		1	158	0	69.2	22:14:45	22:32:05	089	5,729	132				19	1.1
West-NX	2		100	106	43.7	46.3	22:43:39	22:44:41	001	5,816	130				18	1.2
							22:44:51	22:47:00					S-turns calibration		18	1.2
							23:07:33	23:12:38					5 minute ground static		16	1.1

Trajectory and GPS Plots:

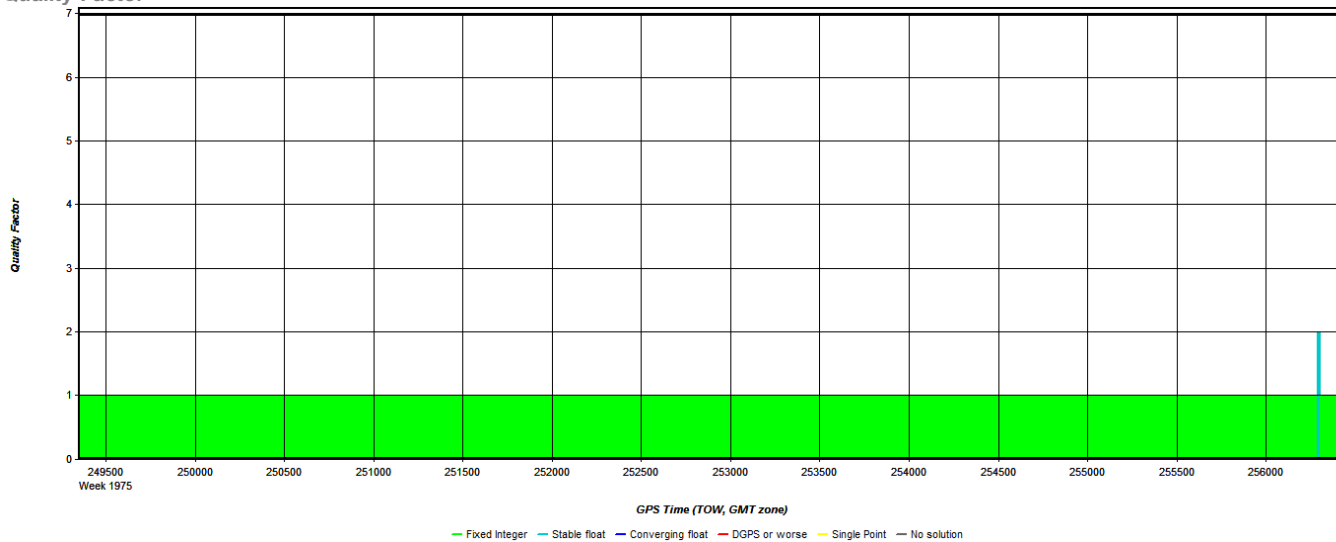


Estimated Accuracy

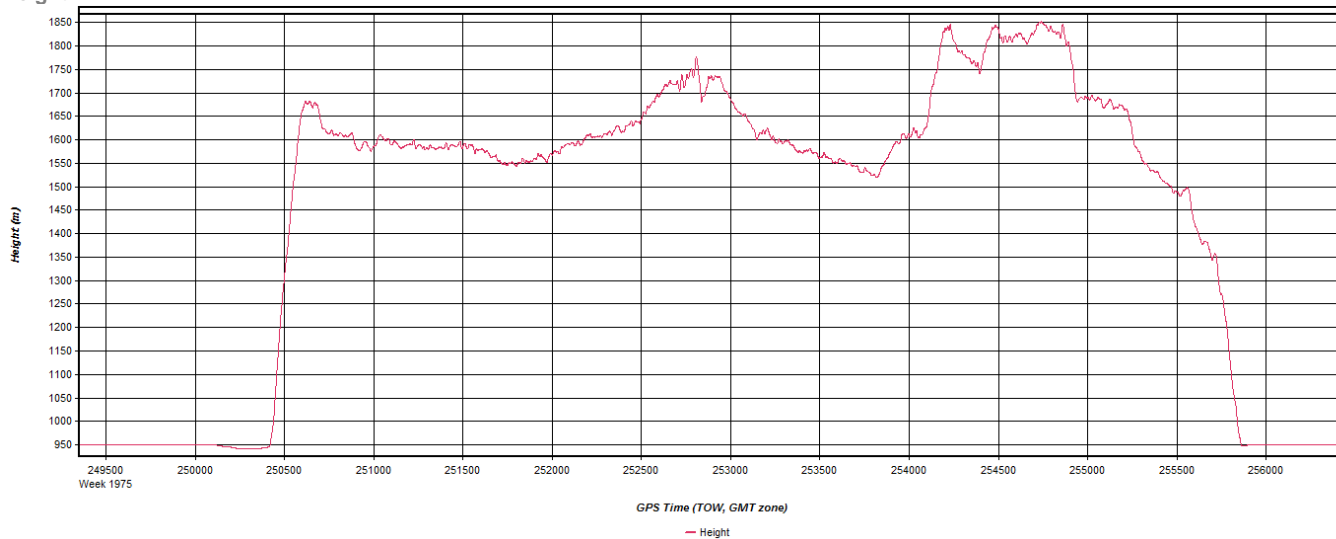




Quality Factor

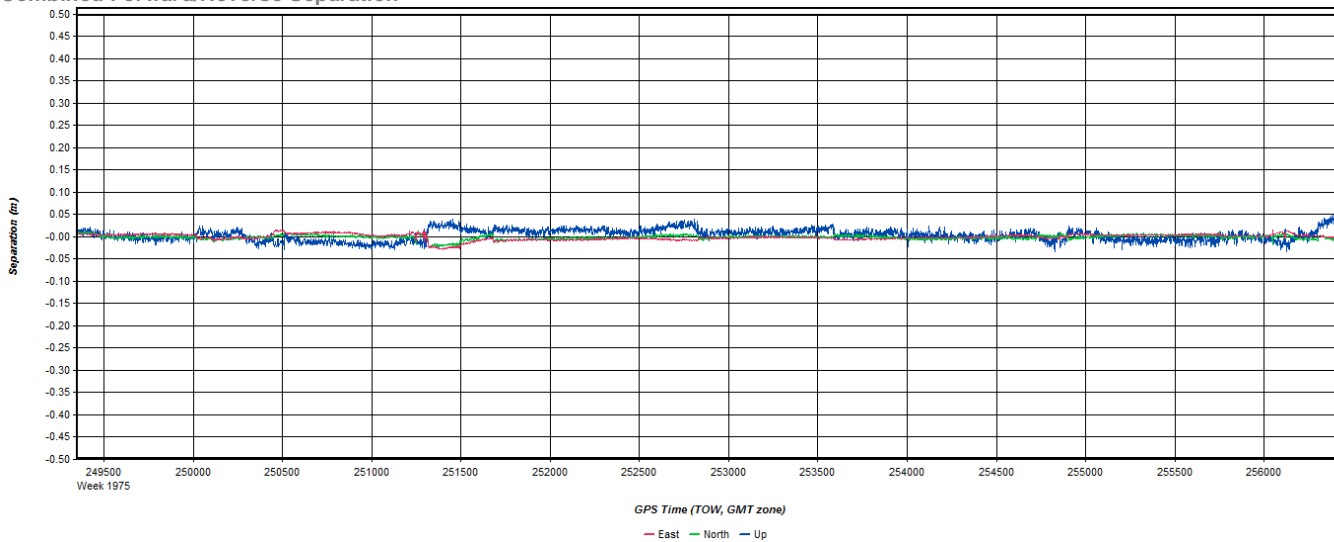


Height

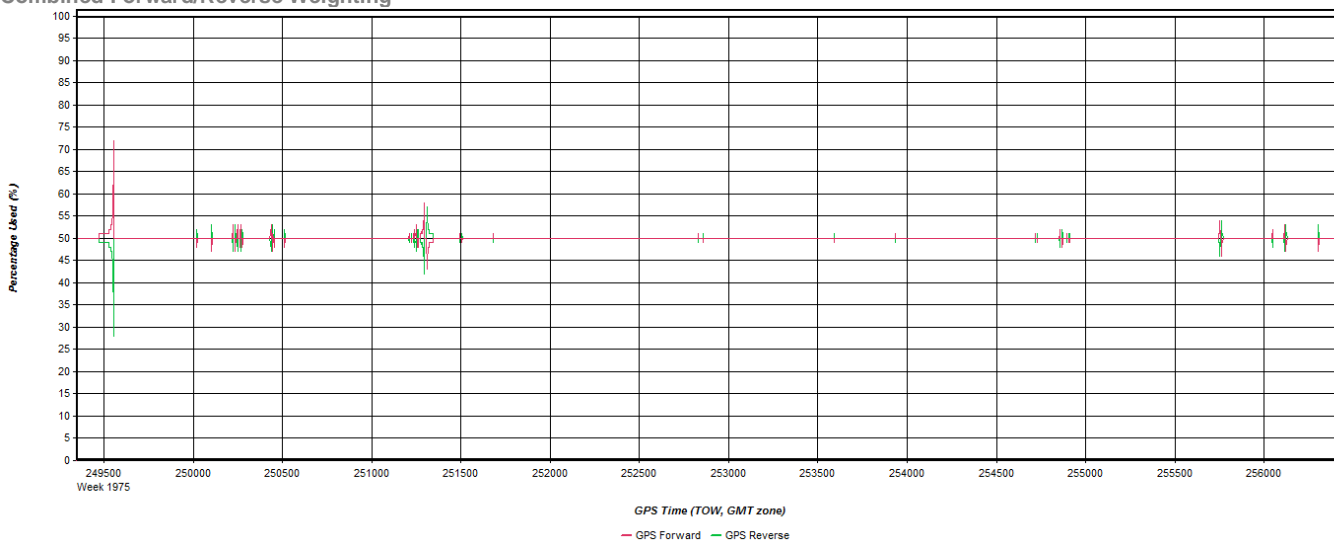




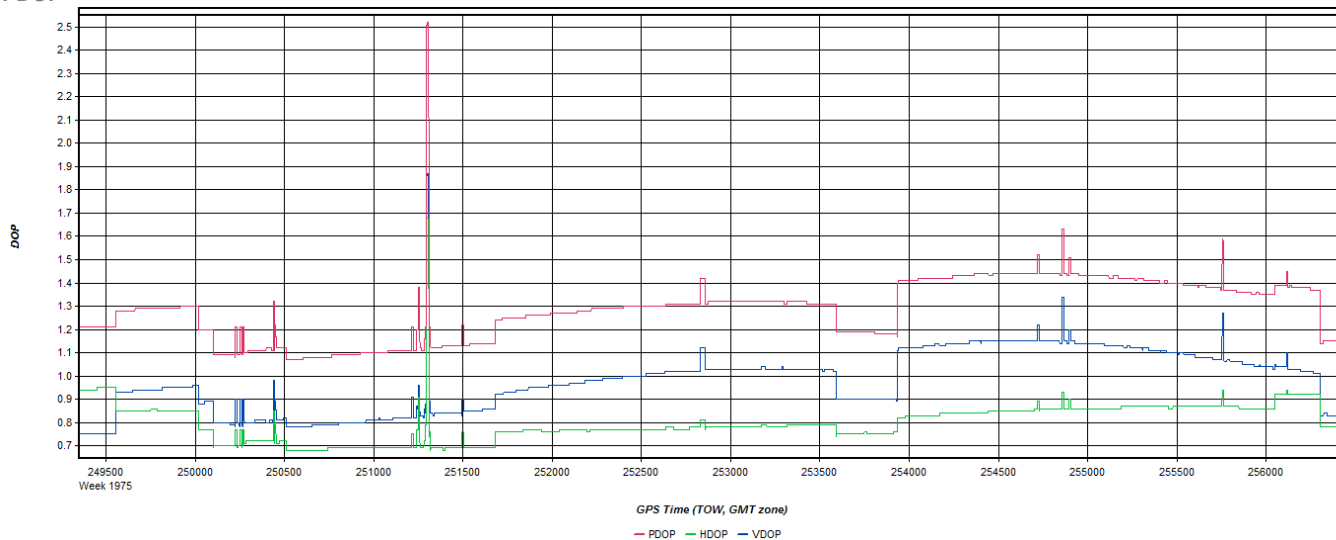
Combined Forward/Reverse Separation



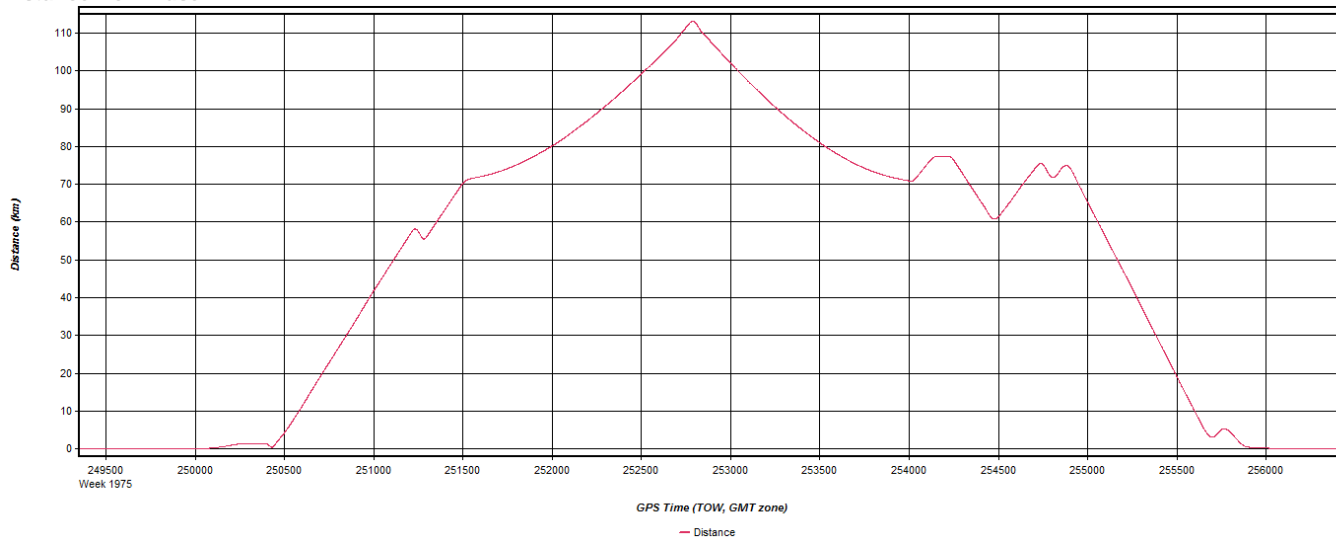
Combined Forward/Reverse Weighting



PDOP

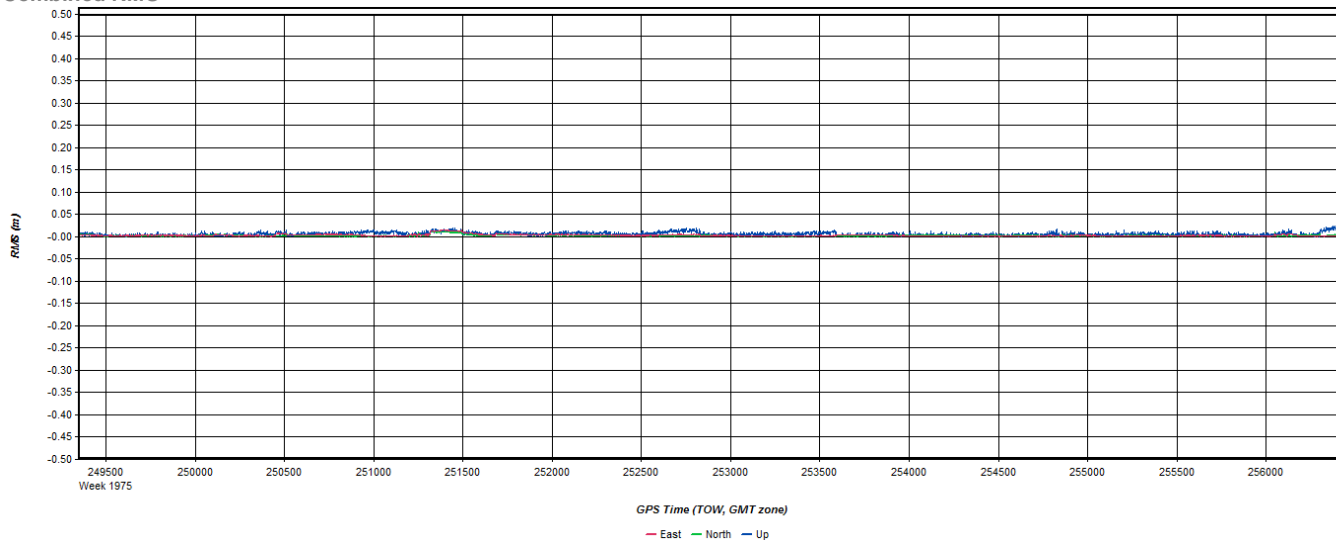


Distance from Base

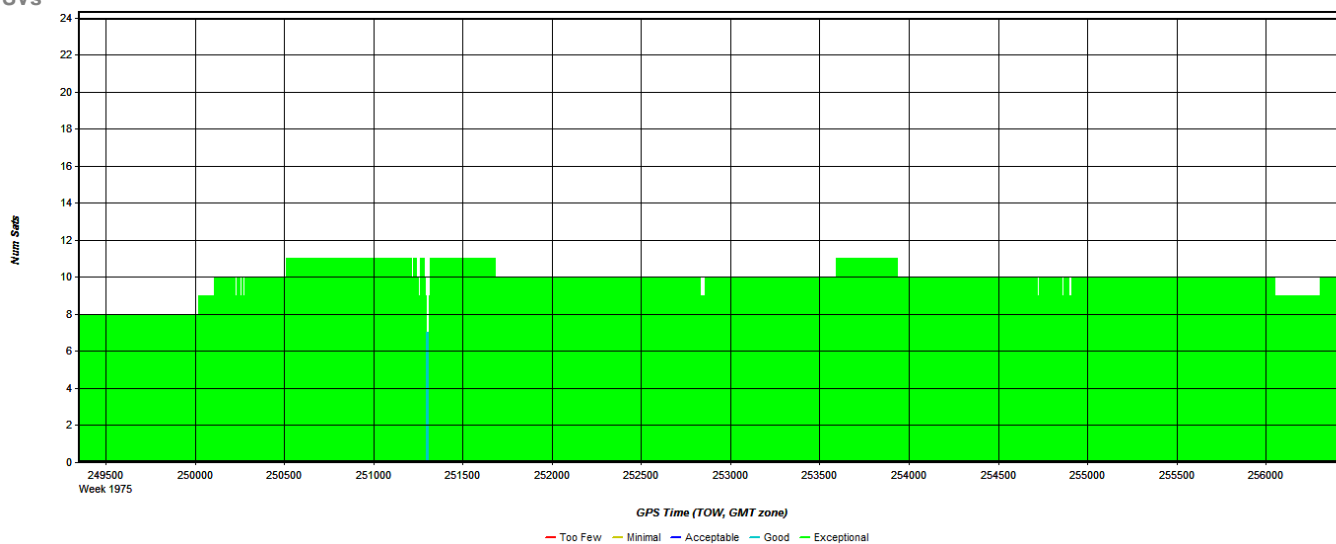




Combined RMS



SVs



**USGS
COLLECTION REPORT**



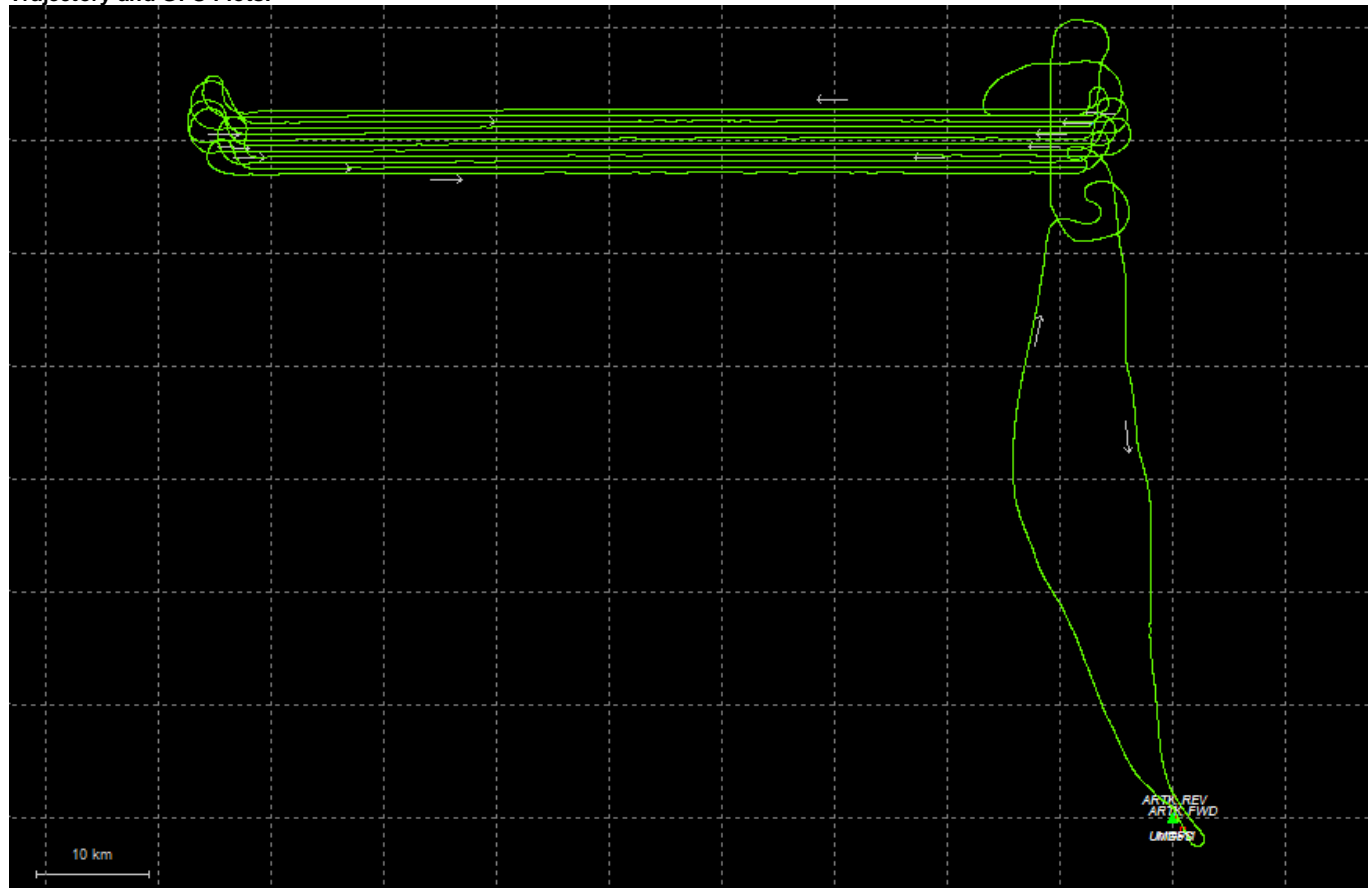
Acquisition and Processing details ----- Collection 20 (November 14, 2017)

Log:

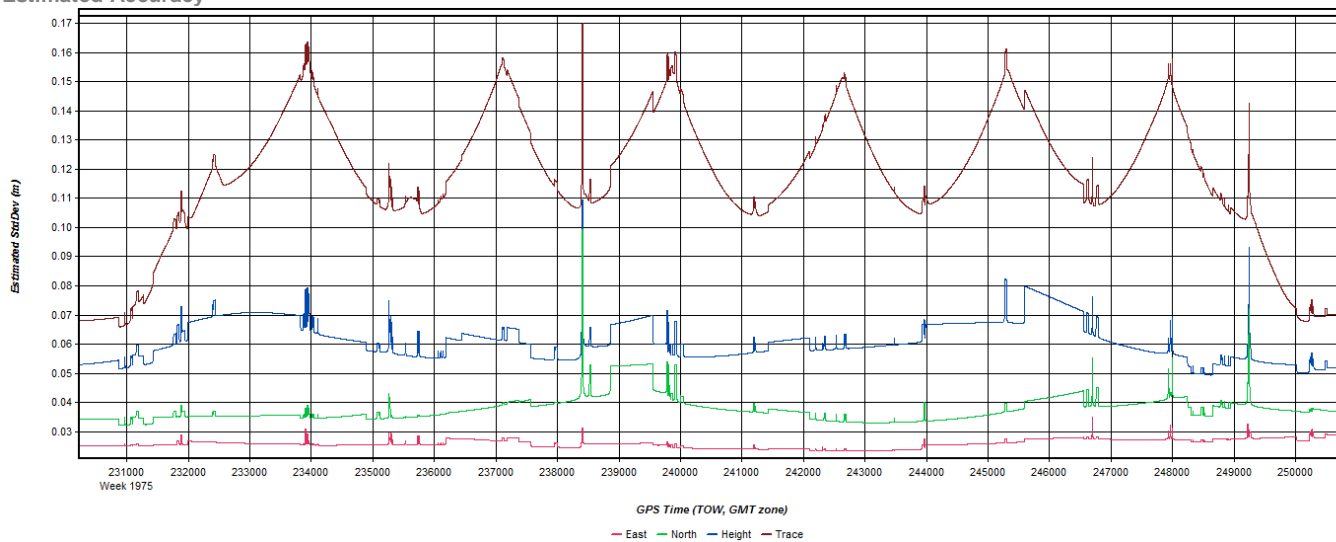
FUGRO		Fugro Geospatial, Inc.										Riegl	
												Flight Log	
17.06		Lift Begin			Lift End			Flt	Flt	Hobbs	Activity		
		Airport	Chocks	Hobbs	Airport	Chocks	Hobbs	Duration	Hrs	Hrs			
1		KRAP	15:30	457.6	KRAP	21:40	463.0	6:09	6:25	5:4	0900-Production		
2													
3													

FGI Job # 22.17003900	Project Name USGS SD Lidar 2017 D17		System 680i	Unit 216	IMU FMU-300					Ground Temp °C 12.0 13.0	Min Range' 1496	Data Logger Drives				
Flight Date 14-Nov-17	GPS Day 17-318	Lift 8			Sun° NA	Solar Times (UTC) NA	Pulse Rate 3400kHz			Flying Temp °C 12.0 11.0	Max Range' 2844	Download Drive				
Mission ID (yyymmdd_Sen_Job_Lift) 171114_216_17003900_08		Aircraft N3832K	Airport ID KRAP	FMS CCNS 6	UTC	AMT (ft) 2400	Speed 130	FOV	Scan Rate (Hz) 110	MTA 2	km/WPT 0.440	Altim Setting 29.88 29.83	Humidity @ Alt	Shipping Track		
Pilot #1 Wayne Manning		Pilot #2		Operator #1 Jonathan Spencer		Operator #2										
Base 1 ID FGI 081	Location KRAP		Rec ID GR3 U5	Ant ID U5	ARP (m) 1.8	Start Time (UTC) 14-Nov-17 15:40		Stop Time (UTC)		GPS Filename		Operator Lee Scadden	Data With AB			
Area	Flight #		Wpt		Distance		UTC		Flt Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions		SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End								
							15:45:00	15:50:00					5 min grd stc			
							16:22:00	16:24:00					S-turn			
West-NX	2		1	19	0	7.9	16:29:00	16:31:00	N	4,998	115	110.0	crossing tie line		16	1.3
West-N	12		158	1	69.1	0	16:36:00	16:56:00	W	5,898	120	110.0			14	1.3
	11		1	158	0	69.1	17:00:00	17:19:00	E	5,848	122	110.0			16	1.2
	11		158	148	69.1	64.7	17:23:00	17:25:00	W	5,848	110	110.0	calibration line		17	1.3
	10		158	1	69.1	0	17:30:00	17:49:00	W	5,798	124	110.0			17	1.2
	9		1	158	0	69.1	17:52:00	18:10:00	E	5,721	126	110.0			15	1.4
	8		158	1	69.1	0	18:16:00	18:35:00	W	5,723	121	110.0			18	1.1
	7		1	158	0	69.1	18:40:00	18:58:00	E	5,698	126	110.0			18	1.1
	6		158	1	69.1	0	19:02:00	19:21:00	W	5,698	127	110.0			19	1.1
	5		1	158	0	69.1	19:25:00	19:44:00	E	5,748	124	110.0			18	1.2
	4		158	1	69.1	0	19:48:00	20:06:00	W	5,748	126	110.0			19	1.2
	3		1	158	0	69.1	20:10:00	20:28:00	E	5,748	127	110.0			17	1.3
	2		158	1	69.1	0	20:31:00	20:50:00	W	5,748	123	110.0			17	1.2
	1		1	158	0	69.1	20:53:00	21:12:00	E	5,748	122	110.0			19	1.0
							21:12:00	21:14:00					S-turn			
							21:34:00	21:39:00					5 min grd stc			

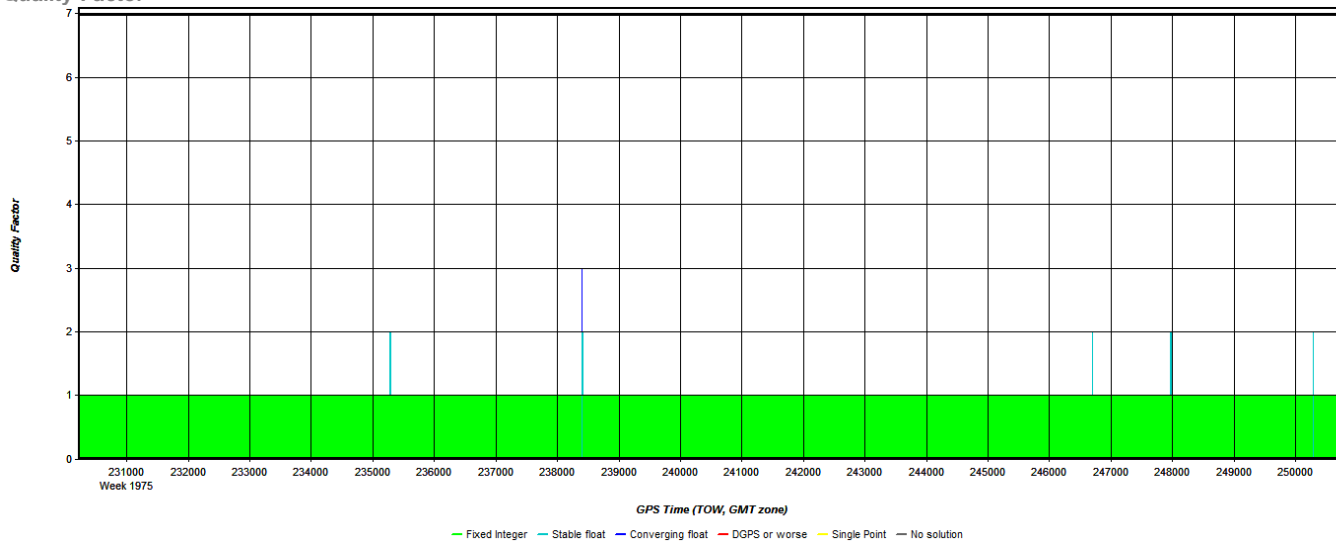
Trajectory and GPS Plots:



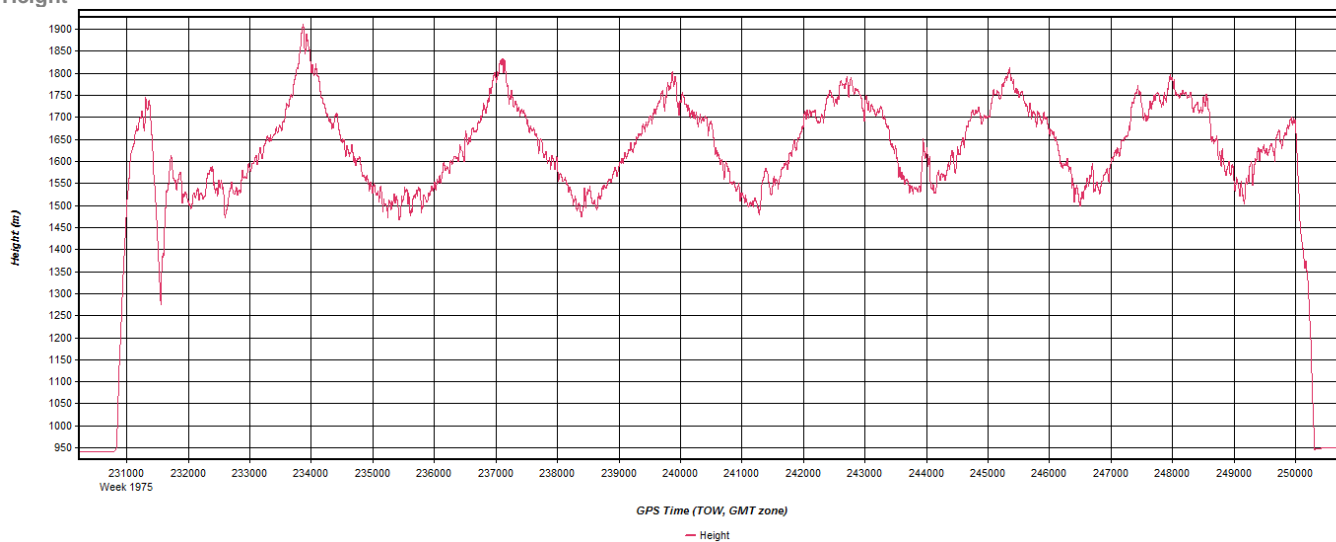
Estimated Accuracy



Quality Factor

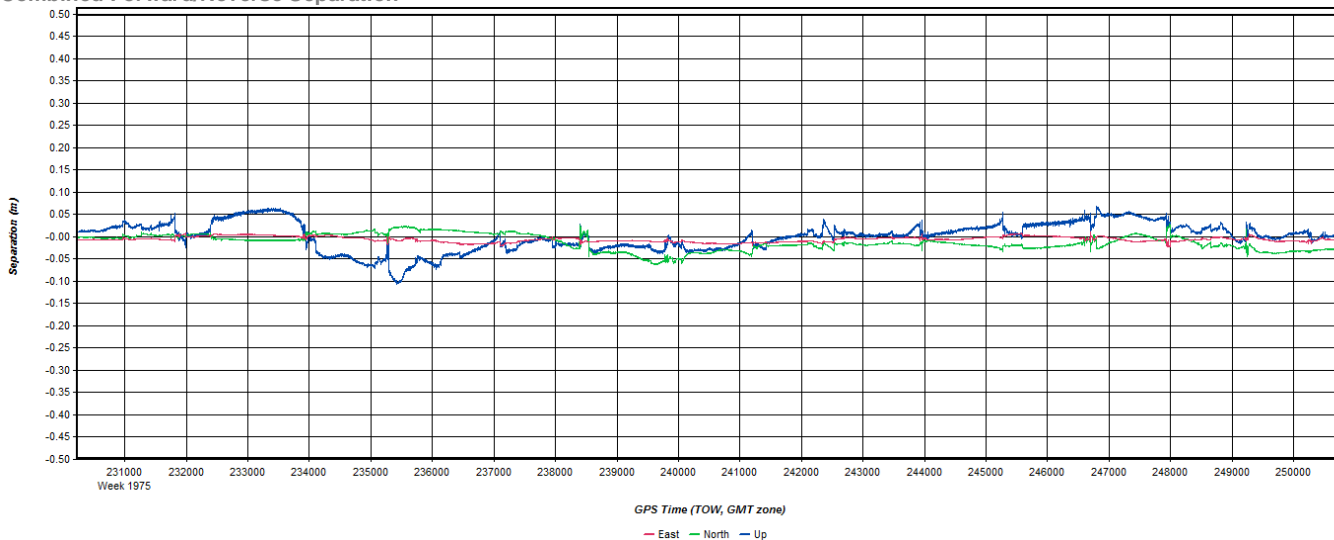


Height

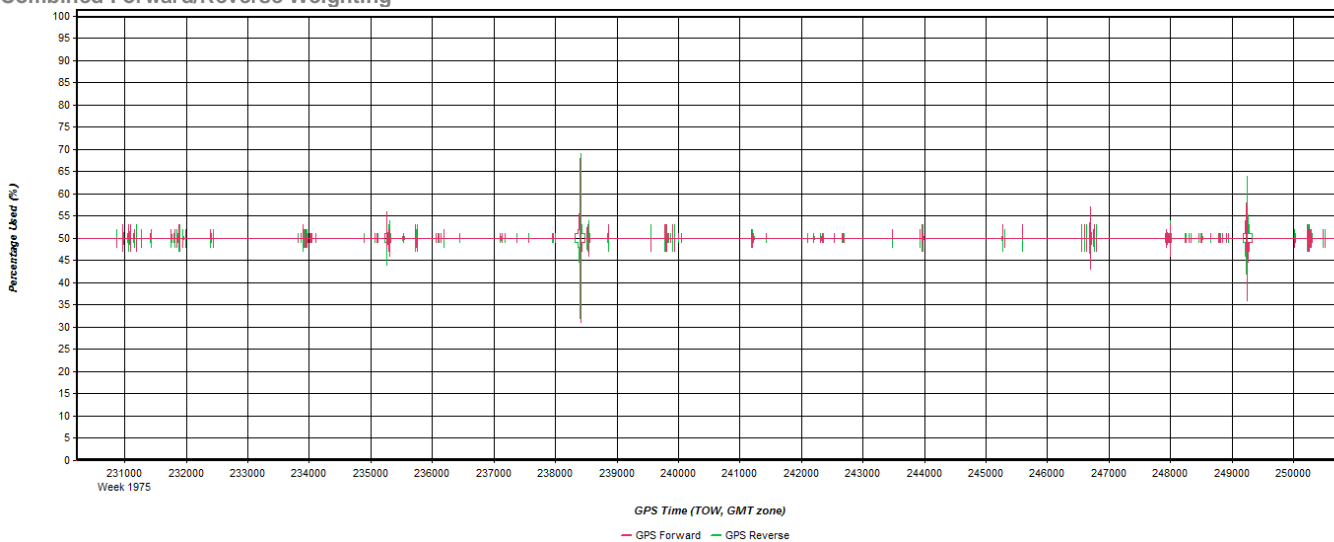




Combined Forward/Reverse Separation

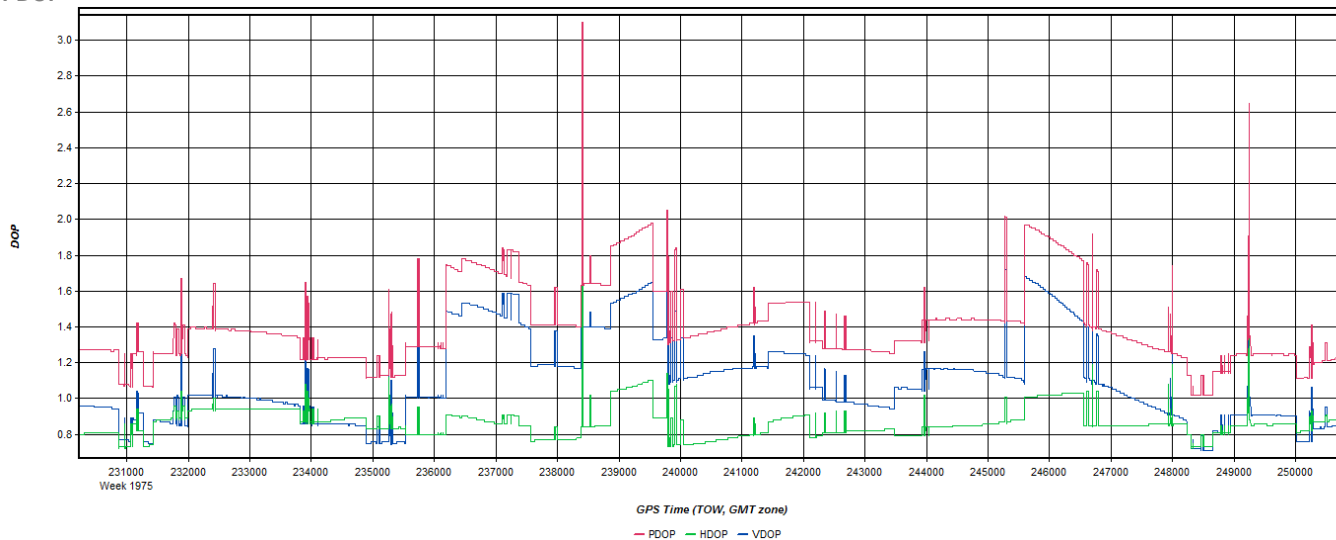


Combined Forward/Reverse Weighting

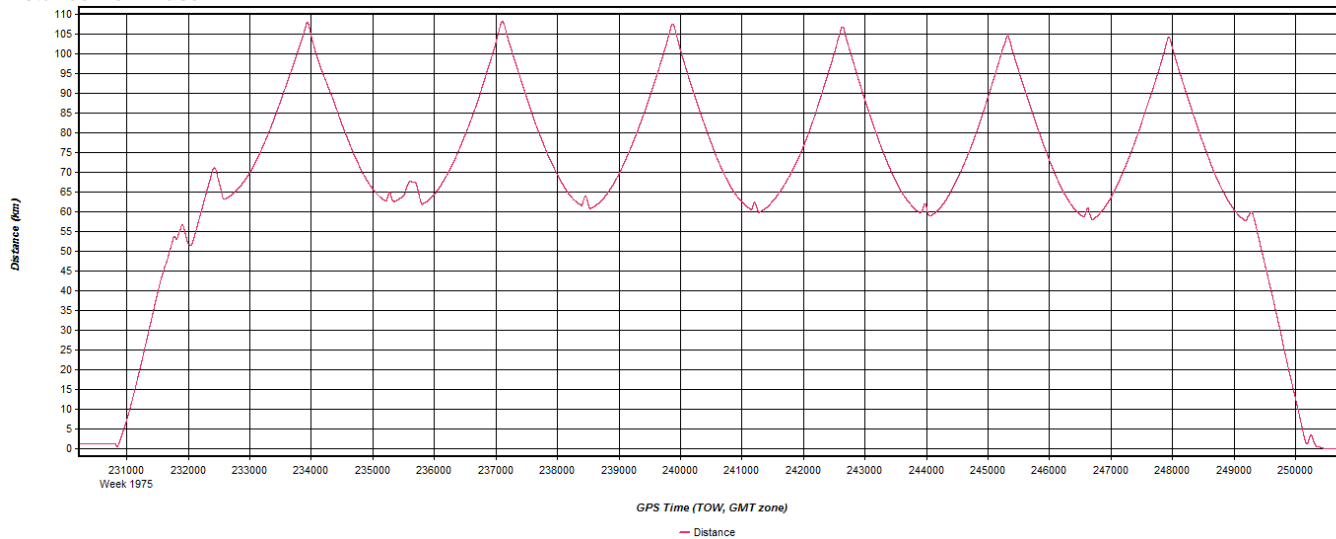




PDOP

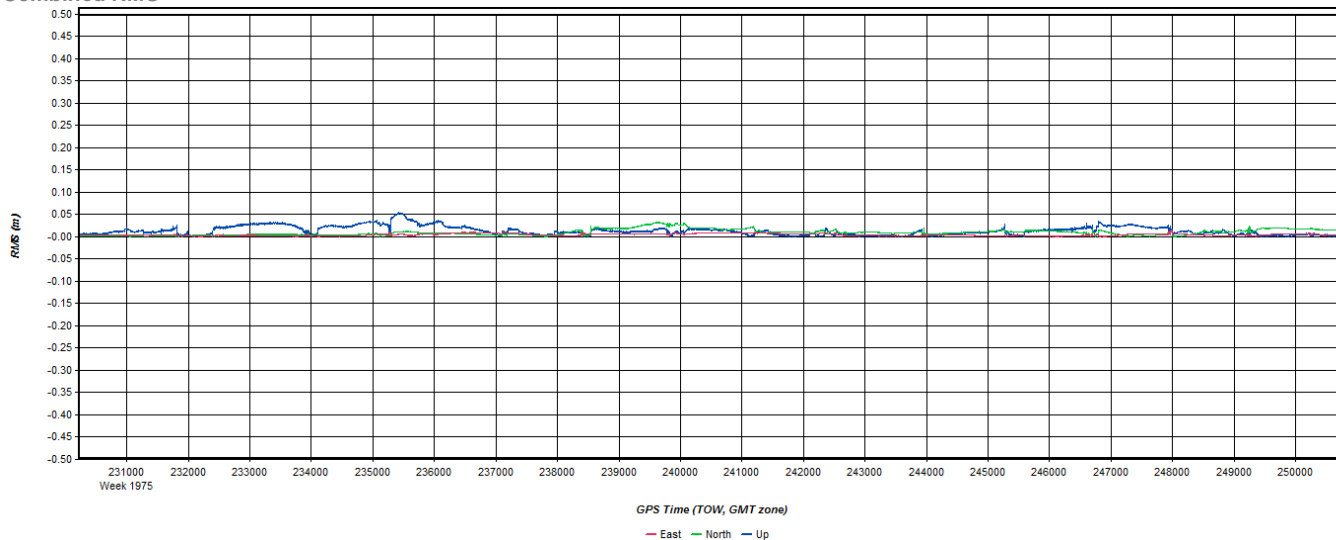


Distance from Base

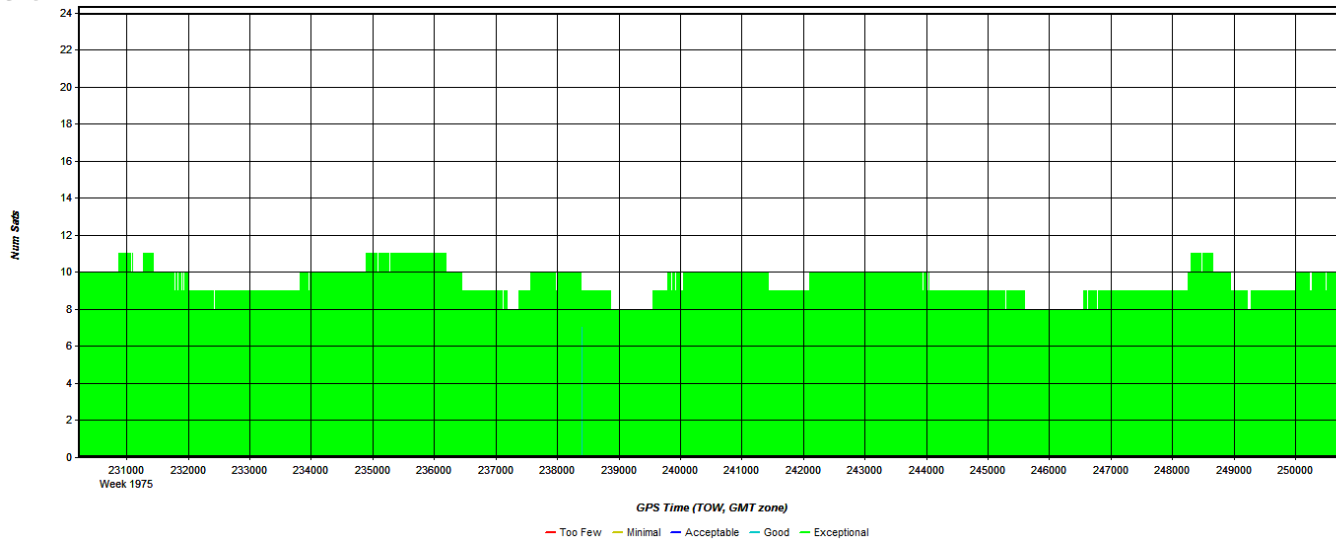




Combined RMS



SVs





Acquisition and Processing details ----- Collection 21 (November 14, 2017)

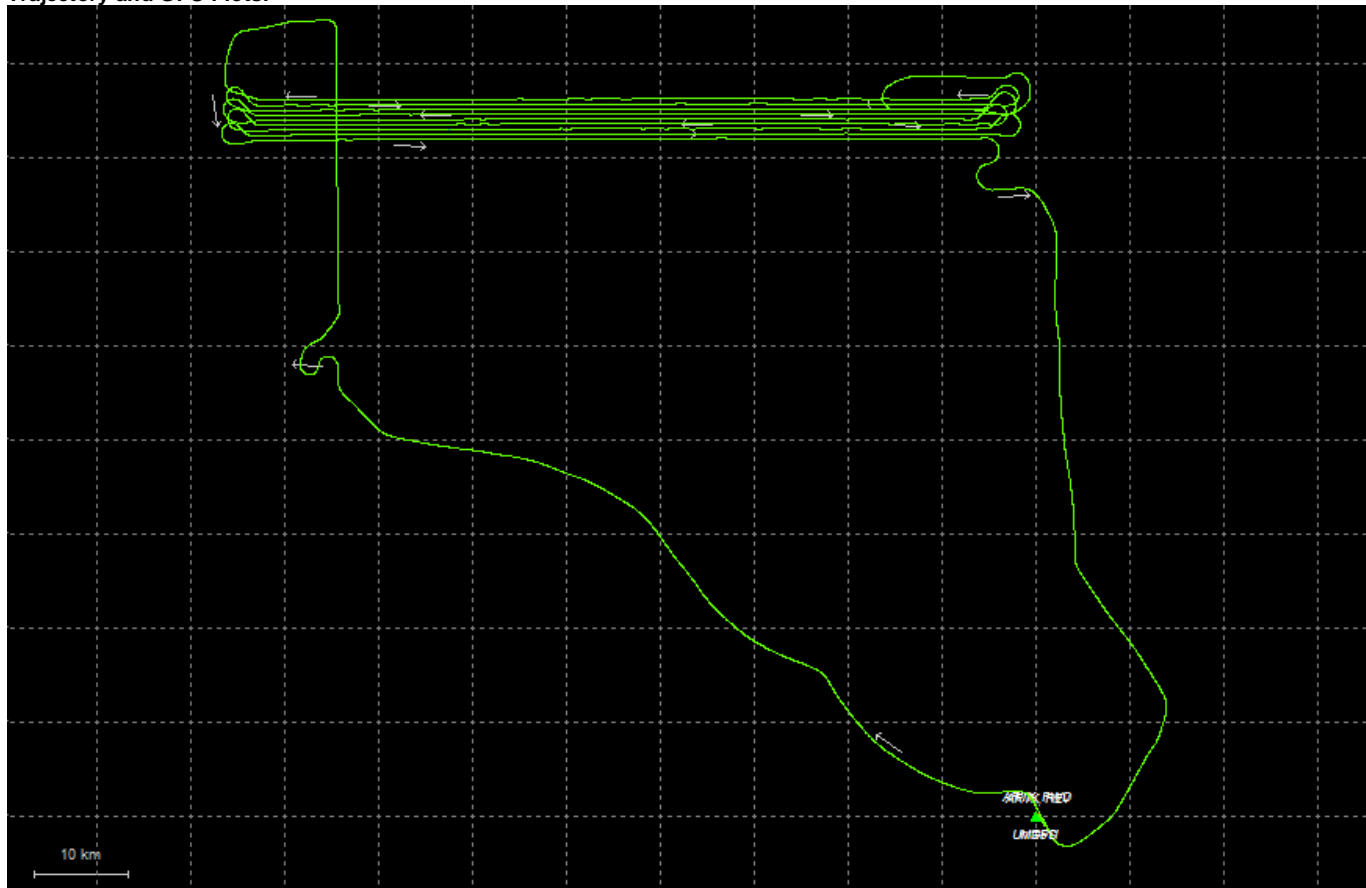
Log:

17.06	Lift Begin			Lift End			Fit Duration	Fit Hrs	Hobbs Hrs	Activity
	Airport	Chocks	Hobbs	Airport	Chocks	Hobbs				
1	KRAP	15:49	7559.1	KRAP	20:48	7564.1	4:59	5.00	5.0	0900-Production
2										
3										

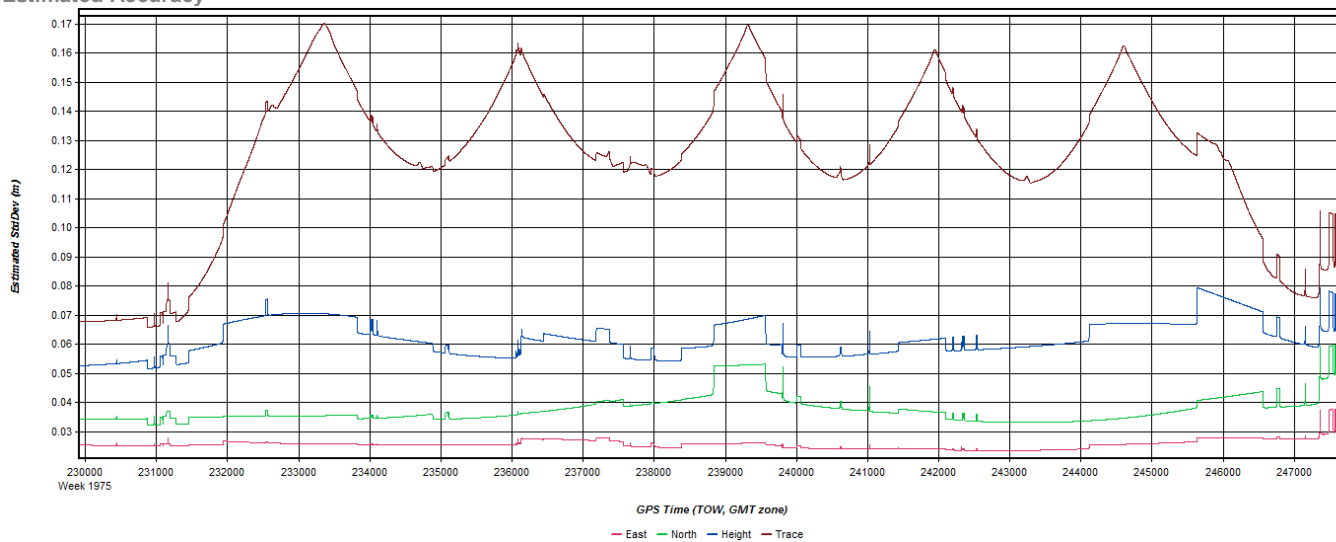
Fugro Geospatial, Inc.		Riegl Flight Log		AC80-50-00-02
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FGI Job # 22.17003900	Project Name USGS SD Lidar 2017 D17		System 780	Unit 421	IMU AIMU			Ground Temp °C 13.0 13.0	Min Range' 1496	Data Logger Drives 01					
Flight Date 14-Nov-17	GPS Day 17-318	Lift 8	Sun° -		Solar Times (UTC) -		Pulse Rate 340k	Flying Temp °C 8.0 6.0	Max Range' 2844	Download Drive NS1TB#10					
Mission ID (yyymmdd_Sen_Job_Lift) 171114_421_17003900_08		Aircraft N76JN	Airport ID KRAP	FMS CCNS 4	UTC -7	AMT (ft) 2400	Speed 130	FOV 60	Scan Rate (Hz) 110	MTA 2	km/WPT 0.440	AltM Setting 29.87 29.75	Humidity @ Alt 46%	Shipping Track	
Pilot #1 George Wilson		Pilot #2		Operator #1 Jacob Amundson		Operator #2 Chris Acuña									
Base 1 ID FGI 081	Location KRAP		Rec ID GR3 U5	Ant ID Unit 5	ARP (m) 1.8	Start Time (UTC) 14-Nov-17 15:40		Stop Time (UTC) -	GPS Filename -	Operator Lee Scadden	Data With AB				
Area	Flight #		Wpt		Distance		UTC		Fit Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions	SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End							
							15:57:19	16:02:19					GROUND STATIC	17	1.2
							16:34:53						ALIGNMENT TURNS	15	1.4
West-NX	1		1	54	0	23.3	16:38:40	16:45:17	N	5,620	128	110.0	CROSSING LINE	15	1.4
West-N	38		1	158	0	69.1	16:51:51	17:09:53	E	5,445	129	110.0		15	1.3
	37		158	1	69.1	0	17:13:56	17:32:49	W	5,250	124	110.0		17	1.3
	36		1	158	0	69.1	17:36:10	17:54:23	E	5,375	130	110.0		17	1.2
	36		158	148	69.1	64.7	17:58:26	17:59:54	W	5,195	129	110.0	CALIBRATION LINE	16	1.1
	35		158	1	69.1	0	18:07:43	18:26:43	W	5,270	121	110.0		16	1.3
	34		1	158	0	69.1	18:30:09	18:48:25	E	5,415	126	110.0		15	1.4
	33		158	1	69.1	0	18:51:59	19:10:40	W	5,175	126	110.0		18	1.1
	32		1	158	0	69.1	19:13:49	19:32:10	E	5,460	129	110.0		18	1.1
	31		158	1	69.1	0	19:36:18	19:54:55	W	5,200	117	110.0		18	1.2
	30		1	158	0	69.1	19:58:18	20:17:21	E	5,600	123	110.0		18	1.2
							20:18:02						ALIGNMENT TURNS	15	1.7
							20:42:34	20:47:34					GROUND STATIC	16	1.3

Trajectory and GPS Plots:

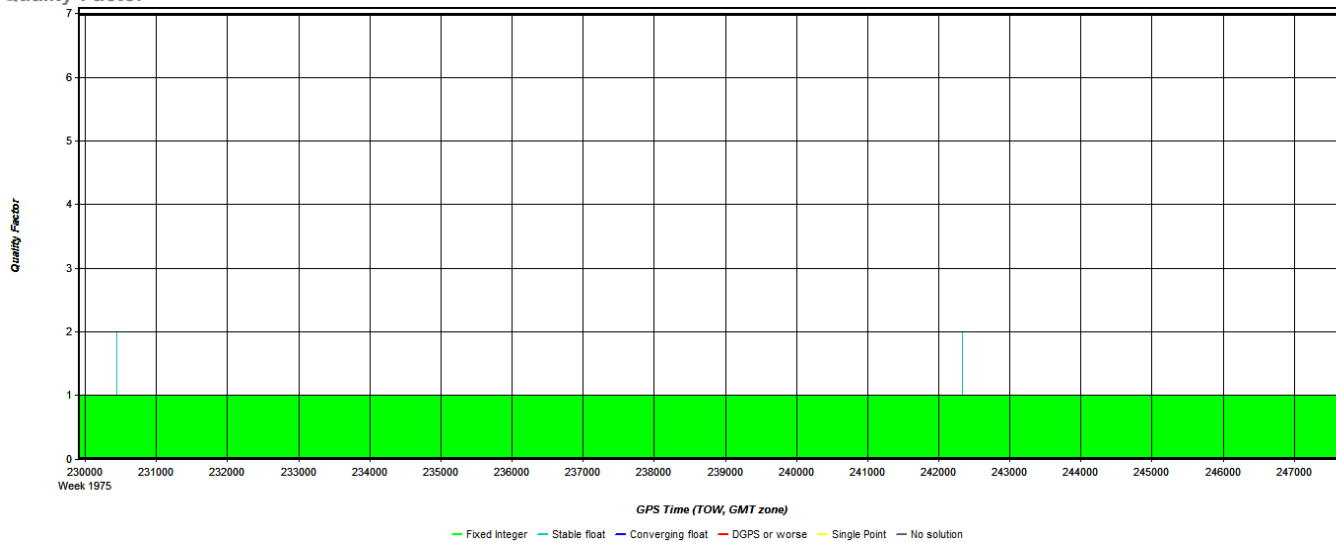


Estimated Accuracy

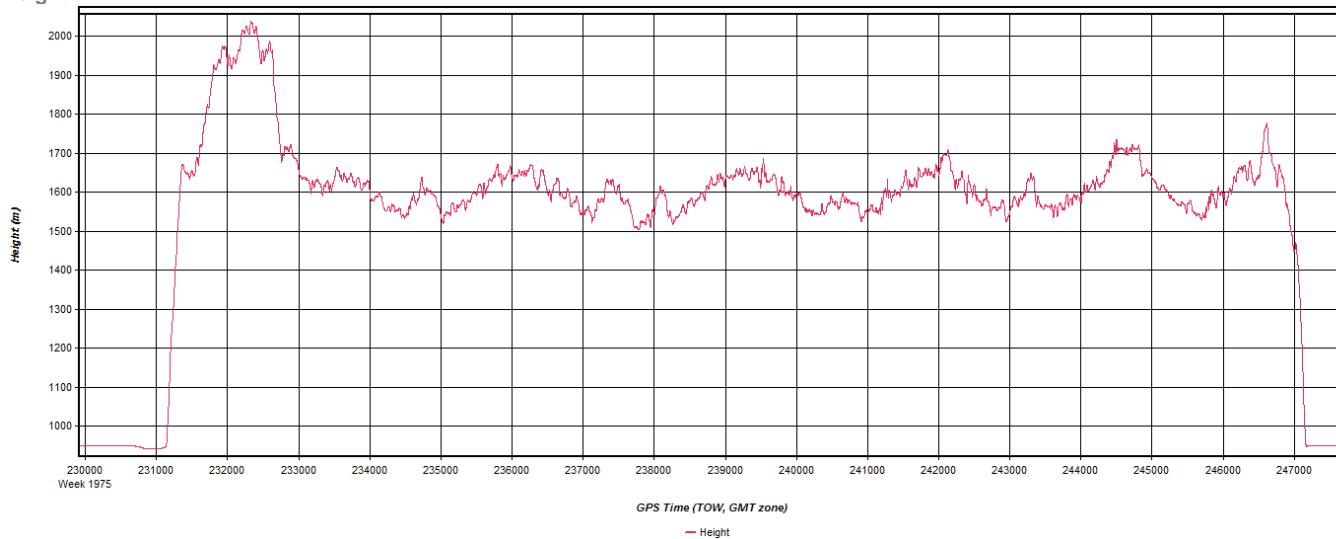




Quality Factor

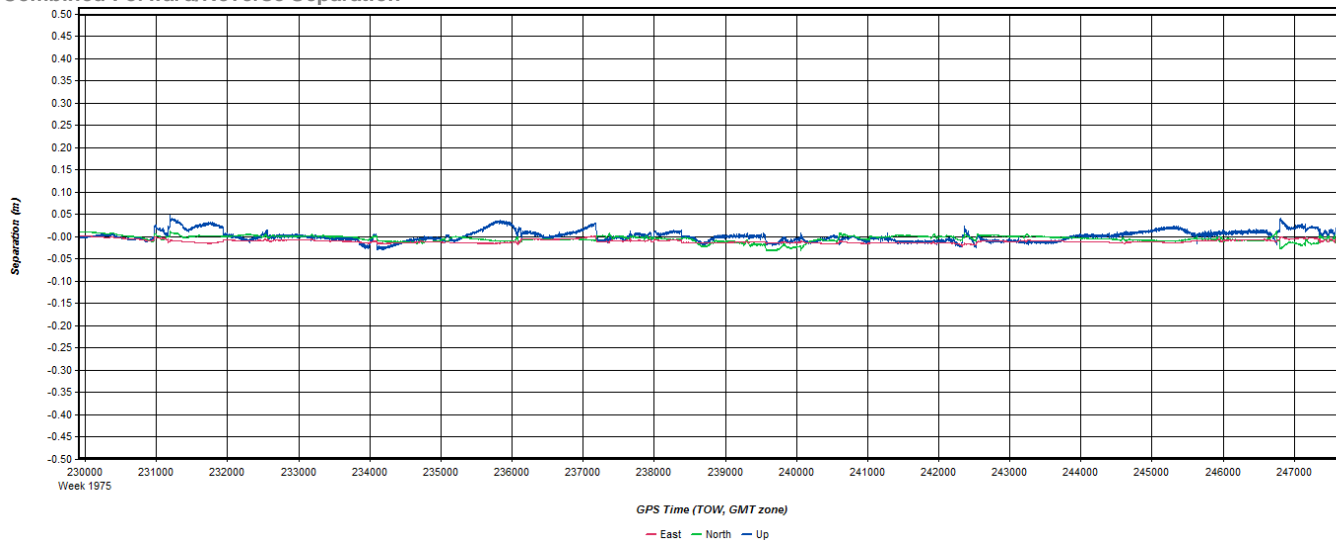


Height

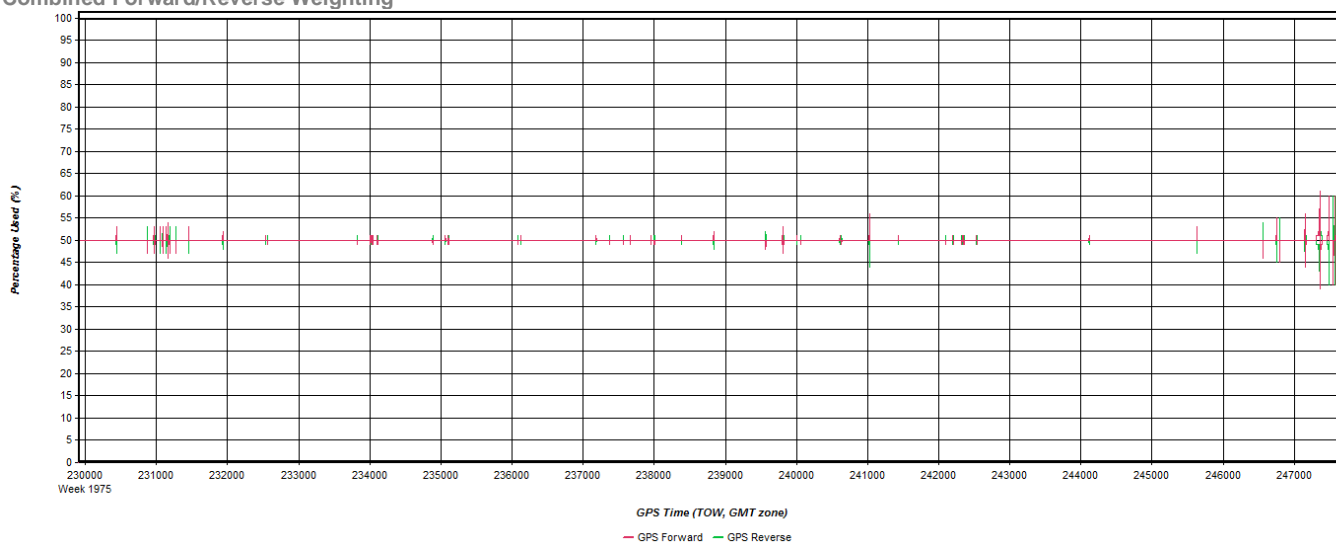




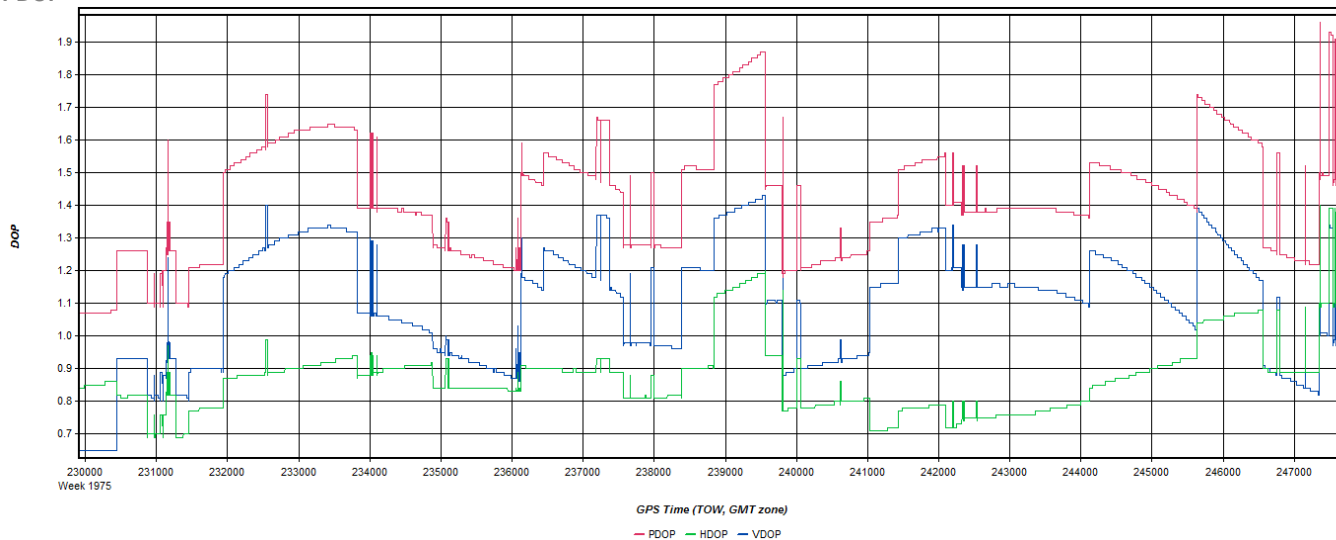
Combined Forward/Reverse Separation



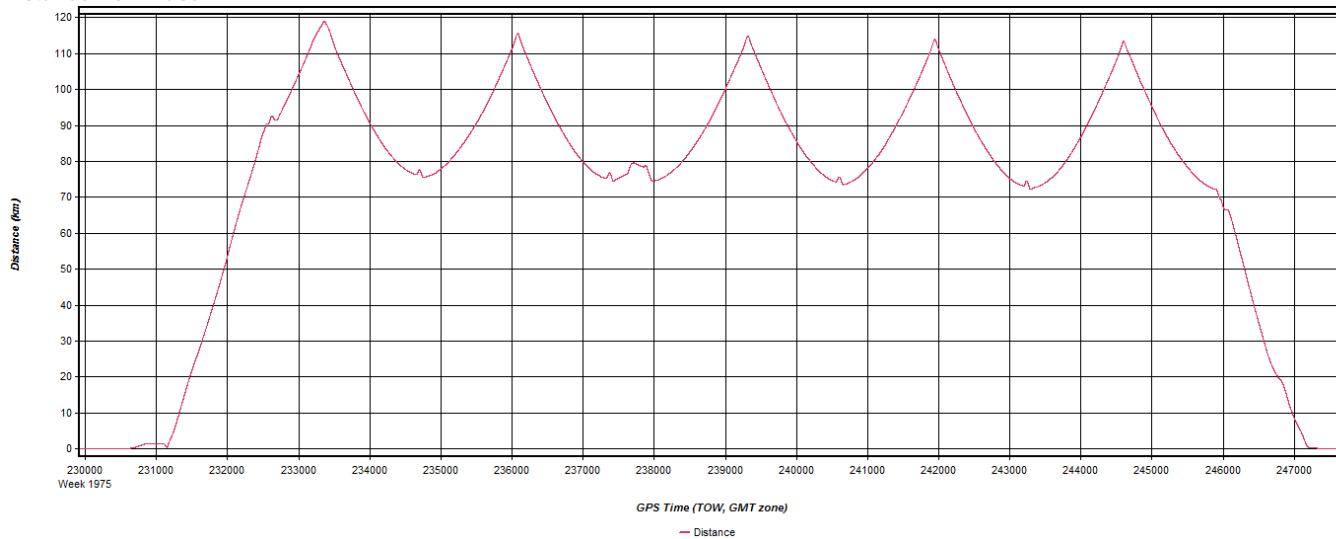
Combined Forward/Reverse Weighting



PDOP

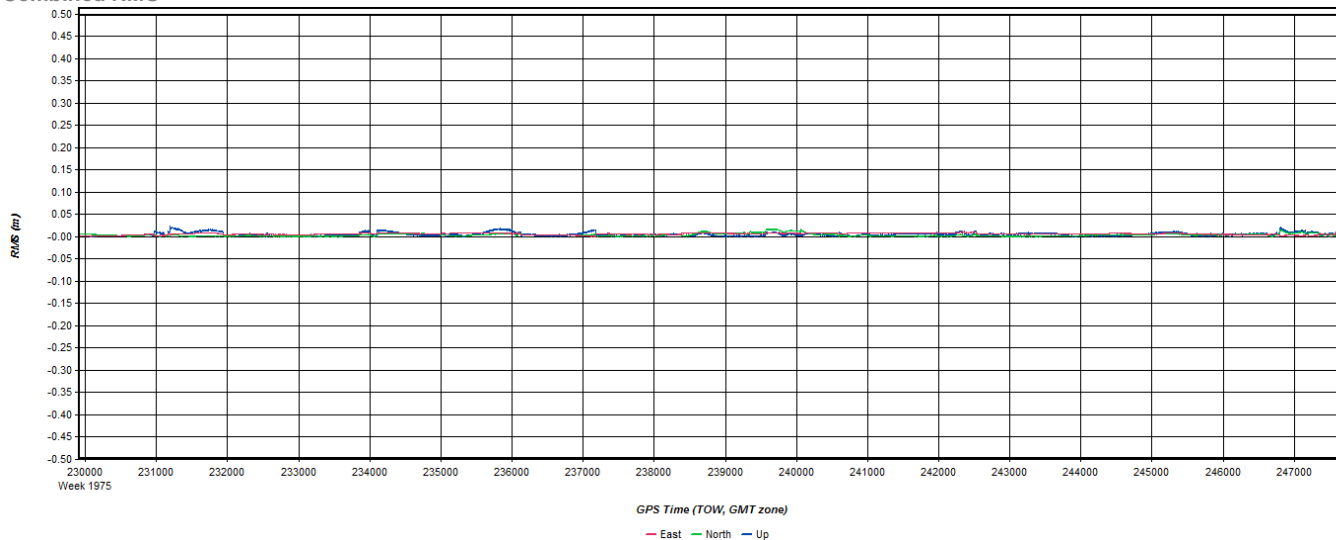


Distance from Base

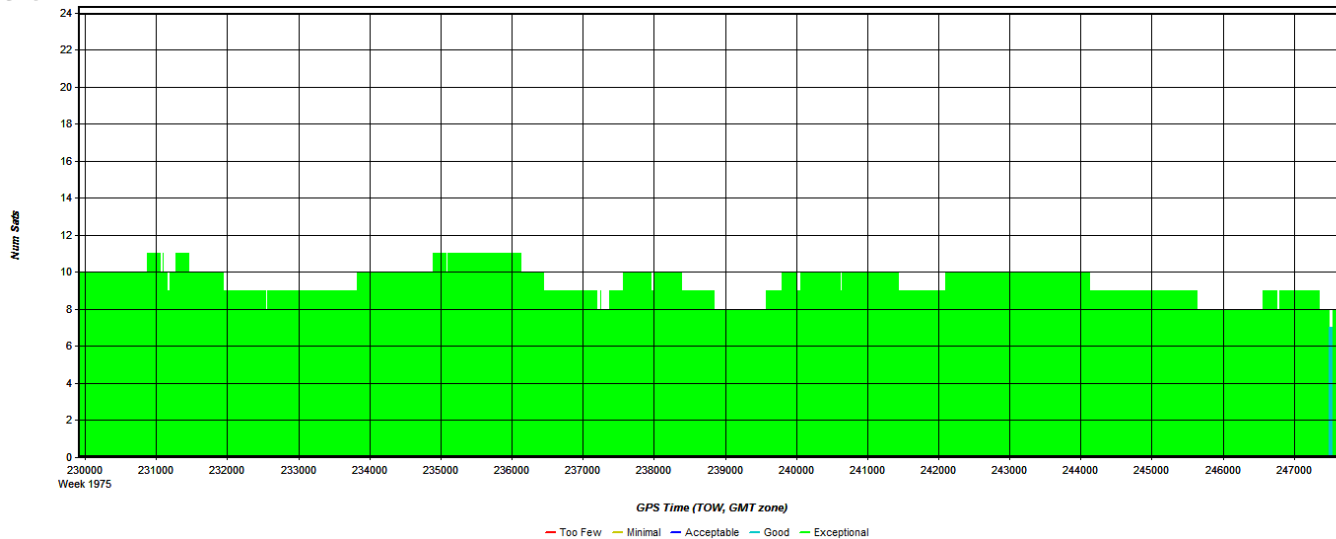




Combined RMS



SVs



**USGS
COLLECTION REPORT**



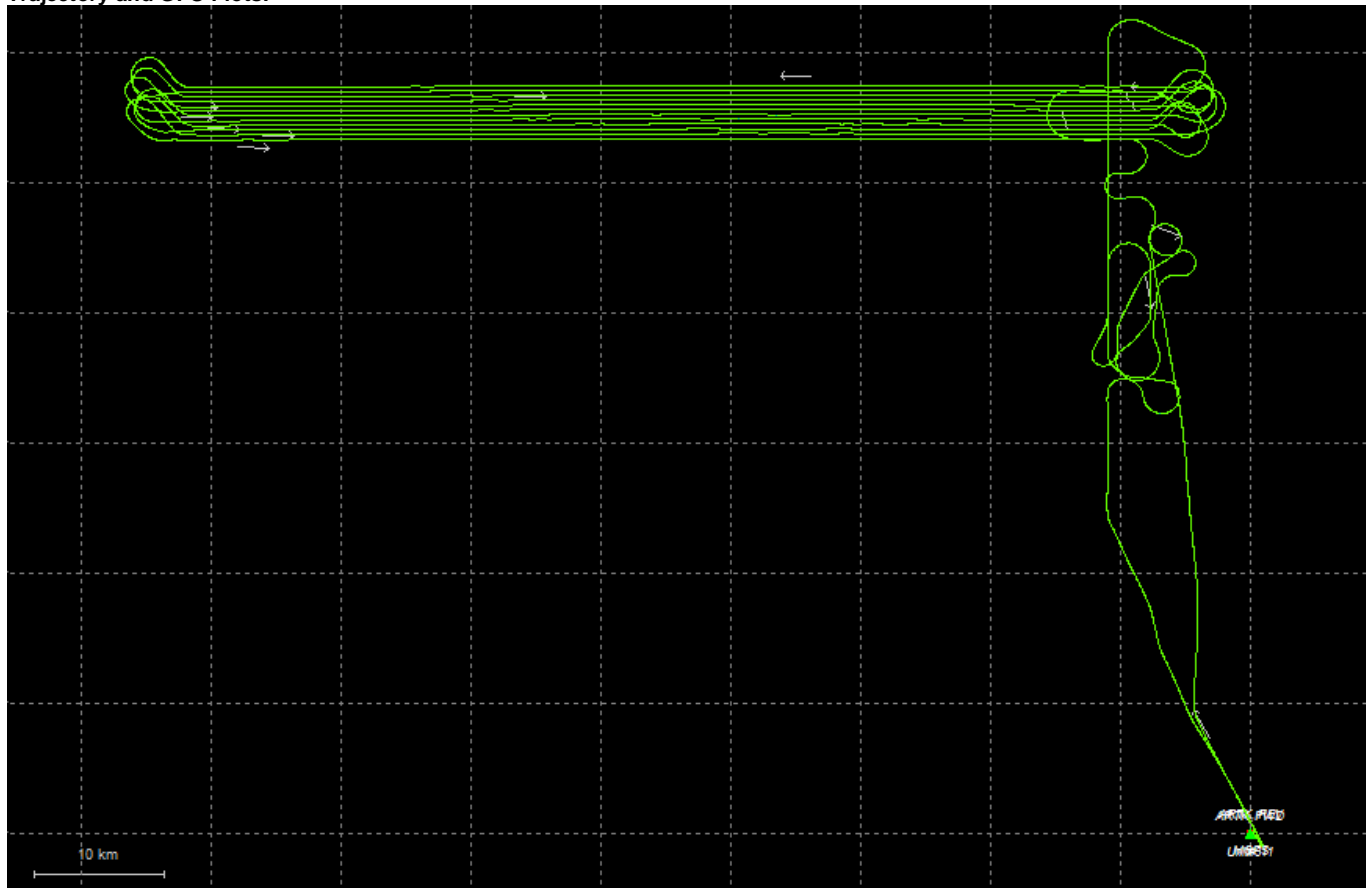
Acquisition and Processing details ----- Collection 22 (November 15, 2017)

Log:

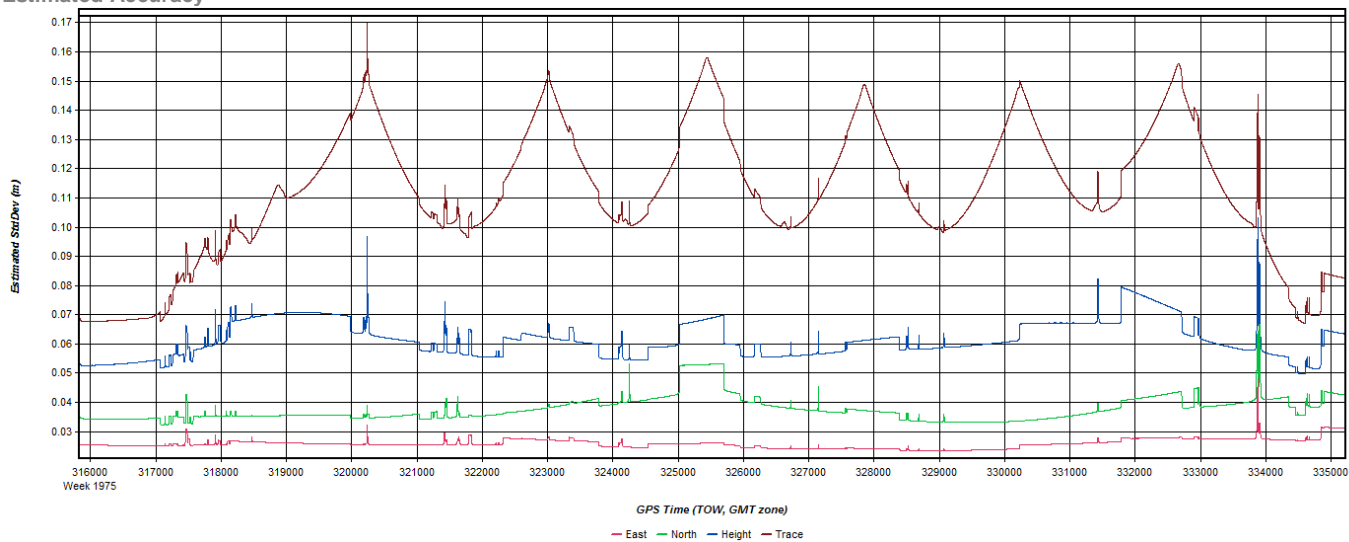
17.06	Lift Begin			Lift End			Fit Duration	Fit Hrs	Hobbs Hrs	Activity
	Airport	Chocks	Hobbs	Airport	Chocks	Hobbs				
	1	KRAP	15:37	794.1	KRAP	21:08	799.0	5:30	5:50	4.9
2										
3										

Fugro Geospatial, Inc.		Riegl Flight Log													
										AC80-50-00-02					
FGI Job # 17003900	Project Name USGS SD Lidar 2017 D17				System 680i	Unit 165	IMU FMU-300				Ground Temp °C 3.0 8.0	Min Range' 2018	Data Logger Drives EU RIEGL 01		
Flight Date 15-Nov-17	GPS Day 17-319	Lift 6			Sun° N/A	Solar Times (UTC) N/A		Pulse Rate 250K			Flying Temp °C -2.0 -1.0	Max Range' 3888	Download Drive NS1TB-106		
Mission ID (yyymmdd_Sen_Job_Lift) 171115_165_17003900_06		Aircraft N97HC	Airport ID KRAP	FMS CCNS 7	UTC	AMT (ft) 3250	Speed 140	FOV	Scan Rate (Hz) 100	MTA 2	km/WPT 0.596	AltM Setting 30.19 30.09	Humidity @ Alt -05	Shipping Track	
Pilot #1 Fred Davis		Pilot #2		Operator #1 Lee Scadden		Operator #2 Ground station in FTP in KRAP Base_0493									
Base 1 ID FGI 081	Location Rapid City		Rec ID GR3-5	Ant ID GR3-5	ARP (m) 1.8	Start Time (UTC) 171115-14:42		Stop Time (UTC) 171115-22:11		GPS Filename Unit#5 1115o		Operator Lee Scadden		Data With AB	
Area	Flight #		Wpt		Distance		UTC		Fit Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions	SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End							
							15:48:48	15:53:47					5-minute ground static	16	1.2
							16:09:42	16:11:38					S-turn	18	1.0
West-X	2		55	83	23.8	36.2	16:28:43	16:33:17	360	5.955	121		Tie line	17	1.1
West-B	38		117	1	51.2	0	16:37:38	16:55:14	270	5.890	129			17	1.2
	37		1	117	0	51.2	16:58:40	17:15:01	090	6.671	139			19	0.9
	37		117	113	51.2	49.4	17:18:40	17:19:45	271	5.813	135		CALIBRATION	17	1.2
	36		117	1	51.2	0	17:24:57	17:41:34	271	5.821	140			17	1.2
	35		1	117	0	69.1	17:45:01	18:01:28	090	6.735	139			17	1.1
	34		117	1	69.1	0	18:05:22	18:21:56	270	5.900	138			17	1.0
	33		1	117	0	69.1	18:25:36	18:42:04	089	6.722	139			18	1.0
	32		117	1	69.1	0	18:45:58	19:02:22	271	5.903	137			20	0.9
	31		1	117	0	69.1	19:05:36	19:22:00	090	6.756	138			19	1.0
	30		117	1	69.1	0	19:25:12	19:41:43	270	5.937	140			18	1.1
	29		1	117	0	69.1	19:45:08	20:01:36	090	6.779	133			19	1.2
	28		117	1	69.1	0	20:05:45	20:22:12	270	5.882	137			17	1.3
	27		1	117	0	69.1	20:26:04	20:42:36	090	6.860	139			17	1.2
							20:42:41	20:44:49					S-Turn	18	1.1
							21:01:19	21:06:27					5-minute ground static	17	1.0

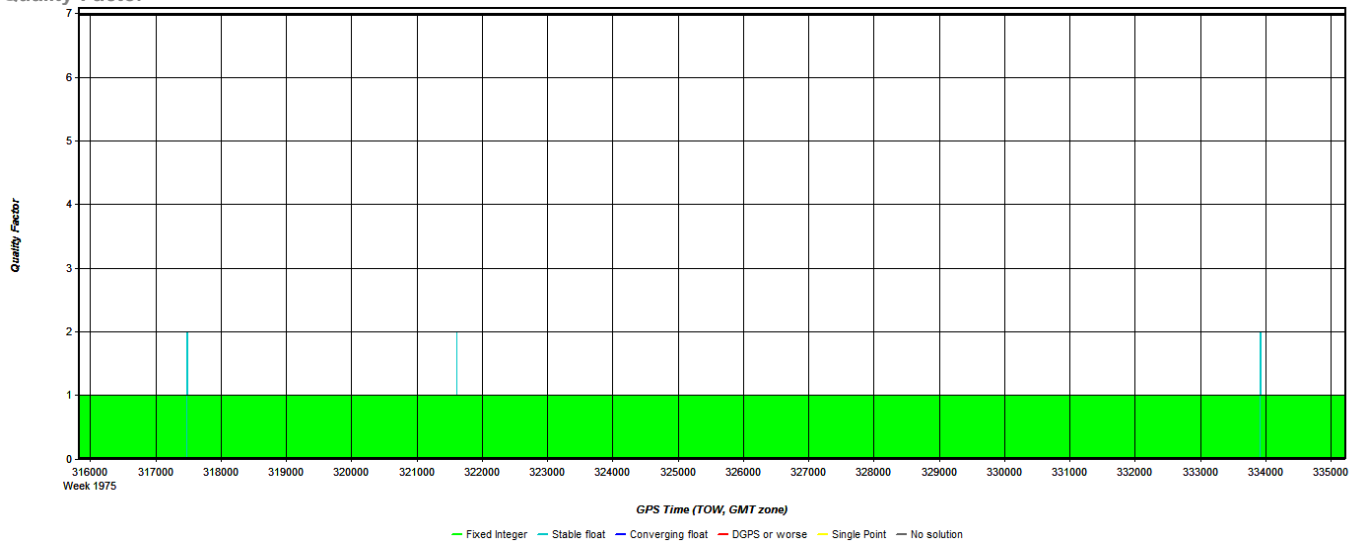
Trajectory and GPS Plots:



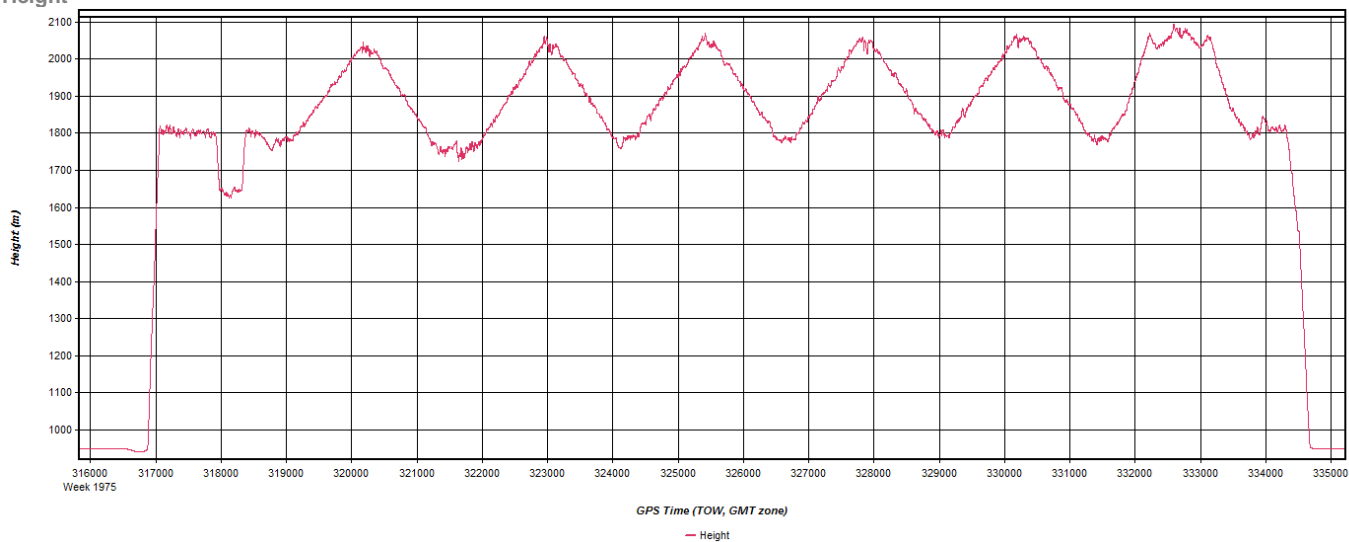
Estimated Accuracy



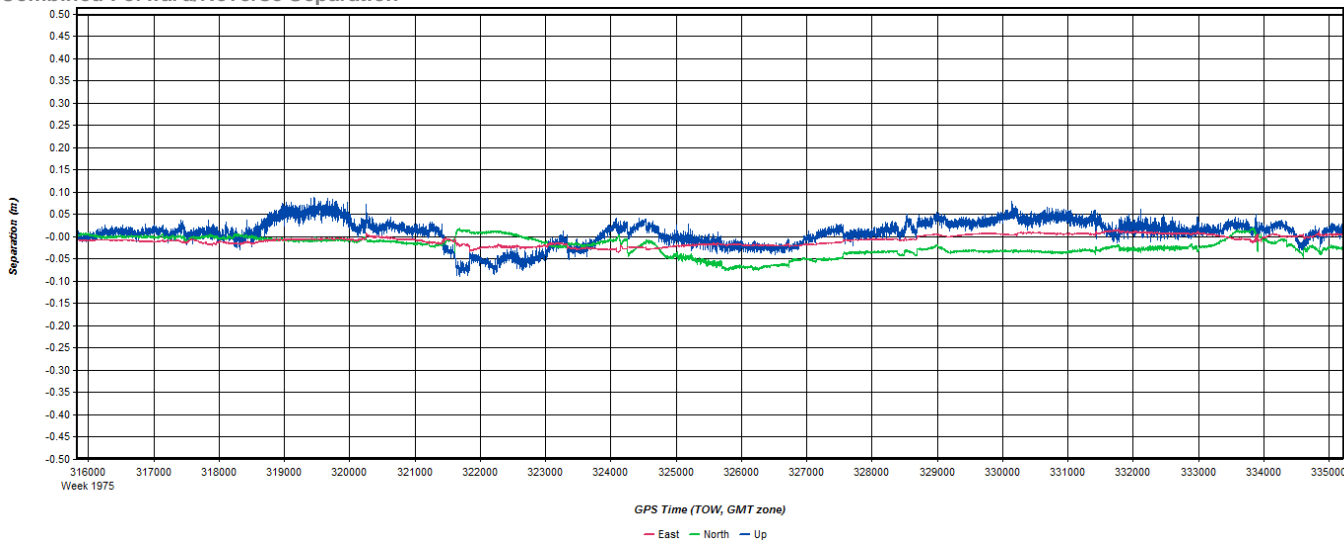
Quality Factor



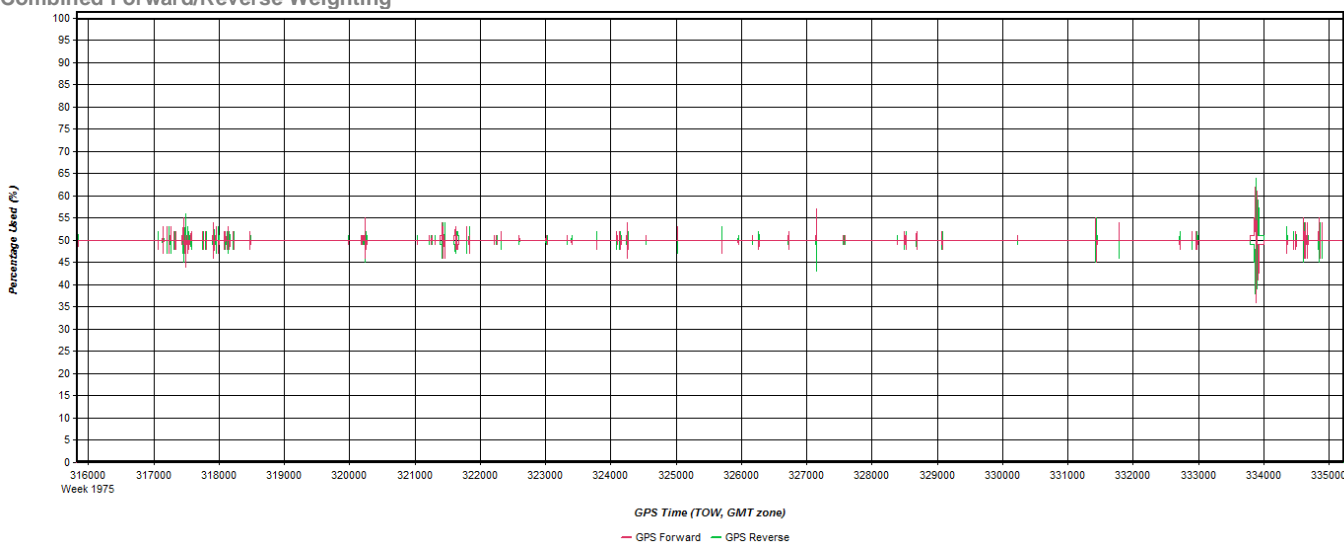
Height



Combined Forward/Reverse Separation

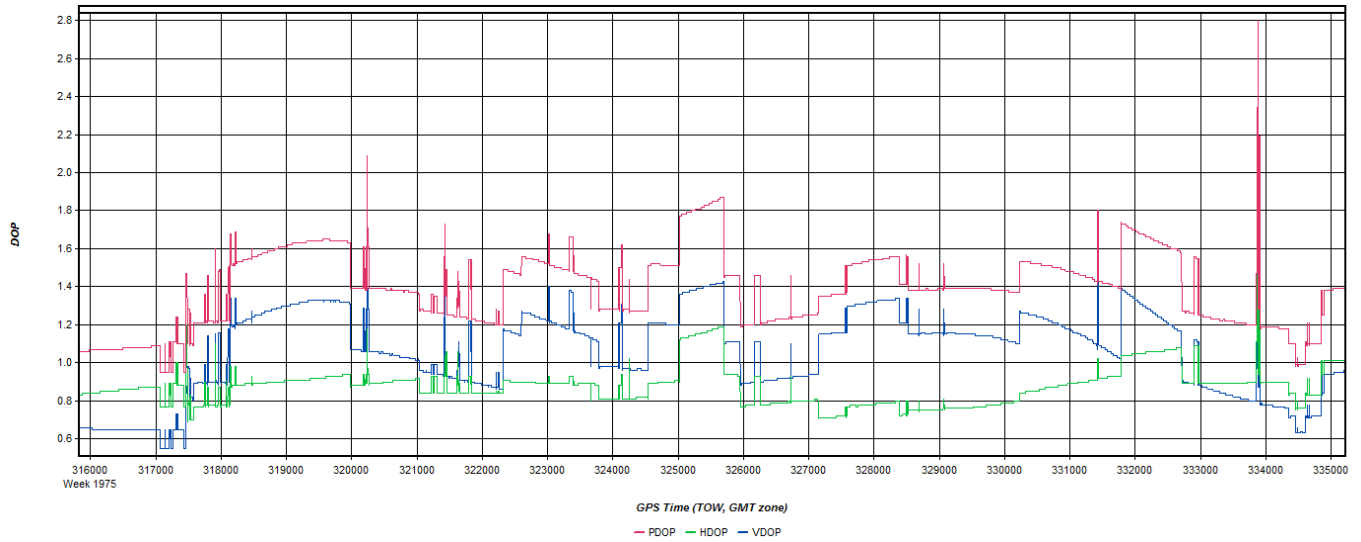


Combined Forward/Reverse Weighting

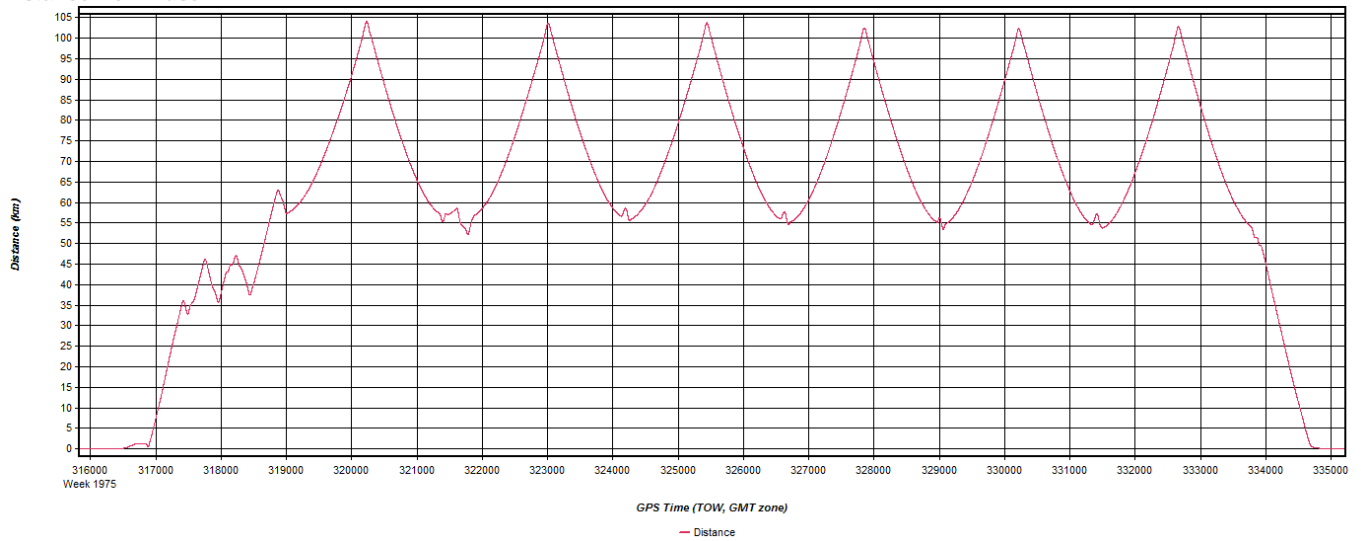


USGS COLLECTION REPORT

PDOP

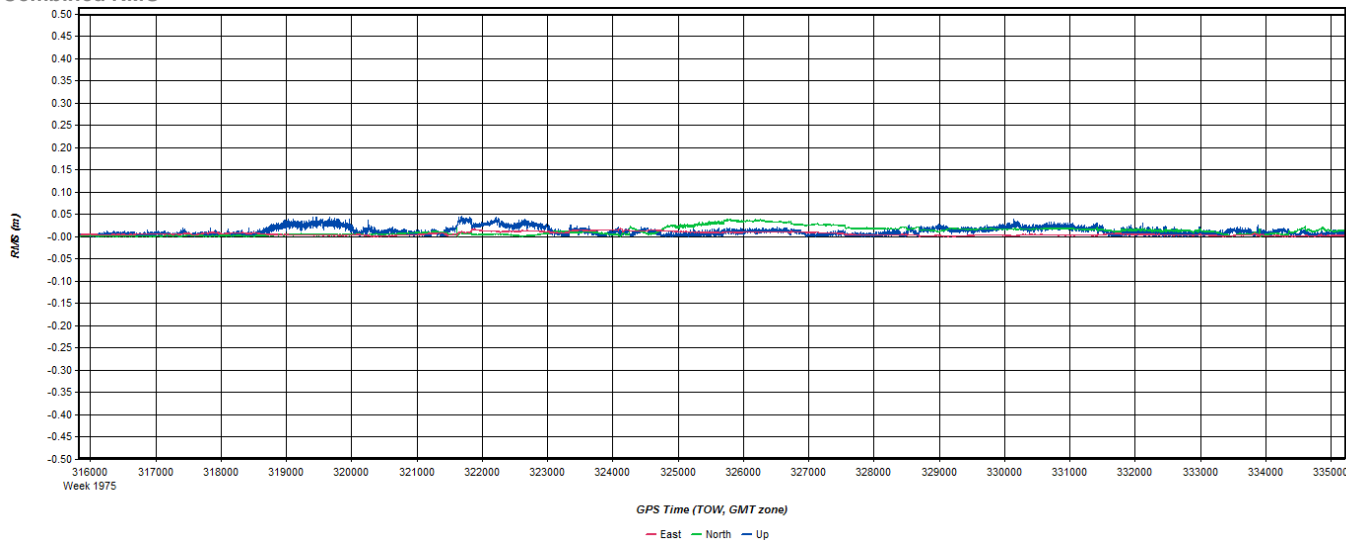


Distance from Base

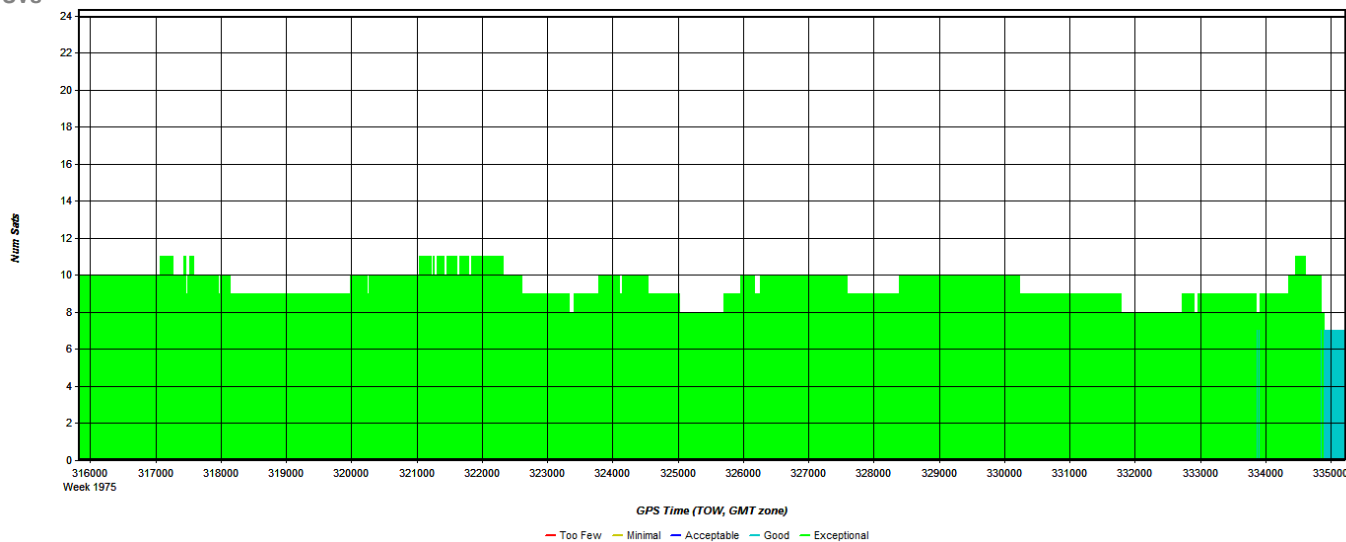




Combined RMS



SVs





Acquisition and Processing details ----- Collection 23 (November 15, 2017)

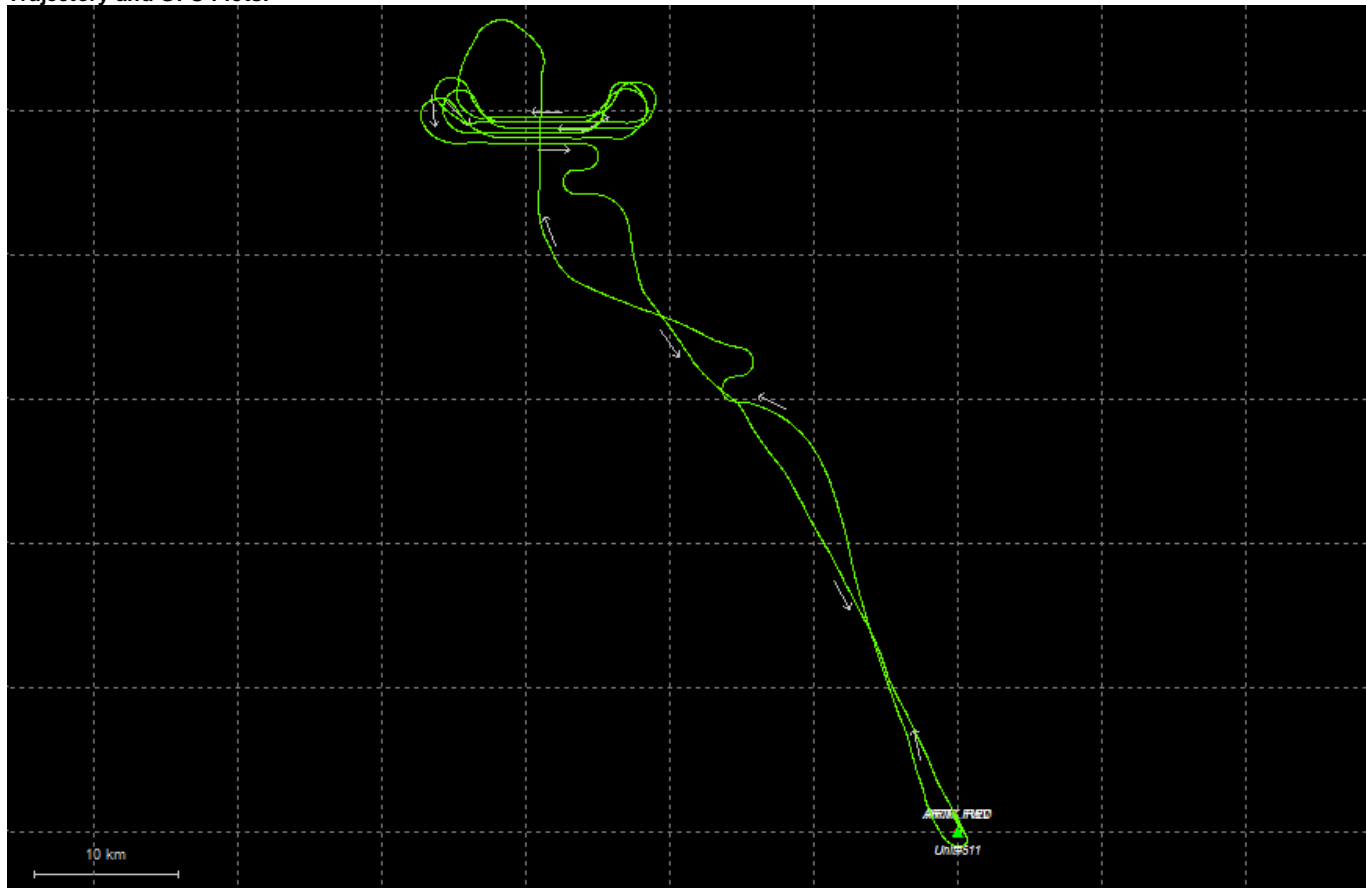
Log:

17.06	Lift Begin			Lift End			Flt Duration	Flt Hrs	Hobbs Hrs	Activity
	Airport	Chocks	Hobbs	Airport	Chocks	Hobbs				
	1	KRAP	18:50	465.2	KRAP	20:24	466.4	1:33	1.50	1.2
2										
3										

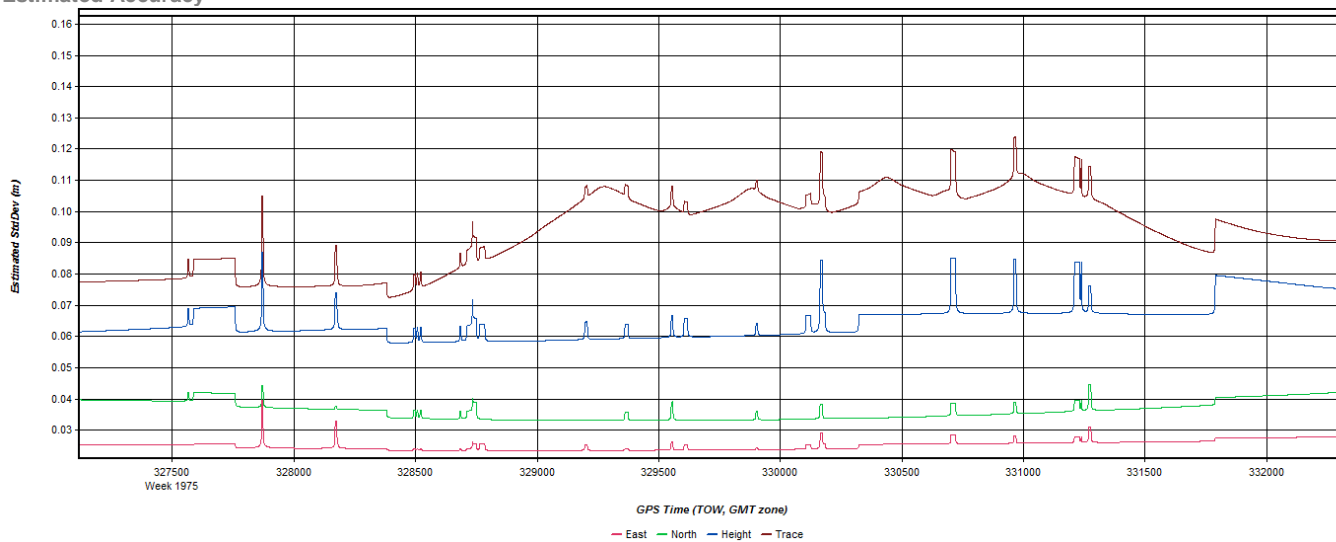
Fugro Geospatial, Inc.		Riegl Flight Log		AC80-50-00-02
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FGI Job # 22.17003900	Project Name USGS SD Lidar 2017 D17		System 680i	Unit 216	IMU FMU-300	Ground Temp °C 8.0 8.0		Min Range' 2018	Data Logger Drives DR680-14						
Flight Date 15-Nov-17	GPS Day 17-319	Lift 9	Sun° -	Solar Times (UTC) -	Pulse Rate 250k	Flying Temp °C 3.0 3.0		Max Range' 3888	Download Drive NS1TB#12						
Mission ID (yyymmdd_Sen_Job_Lift) 171115_216_17003900_09		Aircraft N3832K	Airport ID KRAP	FMS CCNS 6	UTC -7	AMT (ft) 3250	Speed 140	FOV 60	Scan Rate (Hz) 100	MTA 2	km/WPT 0.600	AltM Setting 30.13 30.10	Humidity @ Alt 47%	Shipping Track	
Pilot #1 Wayne Manning		Pilot #2		Operator #1 Jacob Amundson		Operator #2									
Base 1 ID FGI 081	Location KRAP		Rec ID GR3 U5	Ant ID Unit 5	ARP (m) 1.8	Start Time (UTC) 15-Nov-17 14:42		Stop Time (UTC)	GPS Filename	Operator Jonathan Spencer	Data With AB				
Area	Flight #		Wpt		Distance		UTC		Flt Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions	SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End							
							18:55:27	19:00:27					GROUND STATIC	16	1.2
							19:18:07						ALIGNMENT TURNS	18	1.2
West-BB	7		1	6	0	3	19:24:26	19:25:48	N	6,250	136	100.0	CROSSING LINE	18	1.2
	6		1	4	0	1.8	19:29:53	19:31:03	E	6,170	132	100.0		18	1.2
	5		4	1	1.8	0	19:34:36	19:35:55	W	6,200	114	100.0		18	1.2
	5		1	4	0	1.8	19:39:28	19:40:40	E	6,225	126	100.0	CALIBRATION LINE	19	1.2
	4		4	1	1.8	0	19:44:20	19:45:34	W	6,125	125	100.0		19	1.2
	3		1	4	0	1.8	19:48:35	19:49:47	E	6,175	129	100.0		18	1.2
	2		4	1	1.8	0	19:53:15	19:54:29	W	6,220	121	100.0		18	1.2
	1		1	4	0	1.8	19:58:13	19:59:27	E	6,195	126	100.0		17	1.4
							19:59:45						ALIGNMENT TURNS	17	1.4
							20:18:33	20:23:33					GROUND STATIC	15	1.3

Trajectory and GPS Plots:

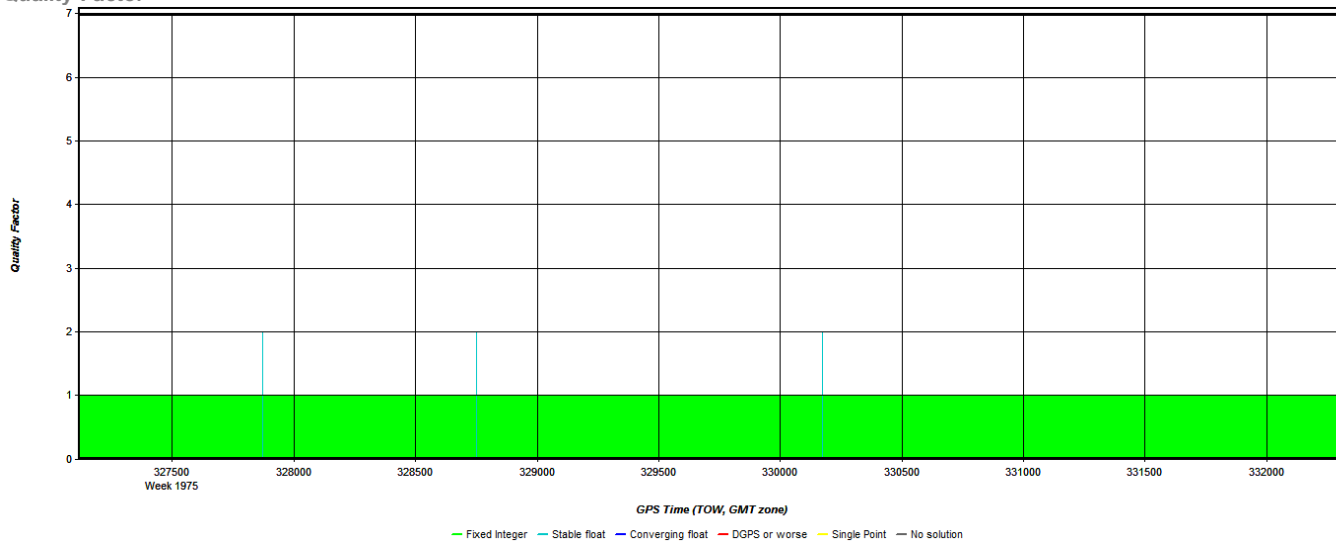


Estimated Accuracy

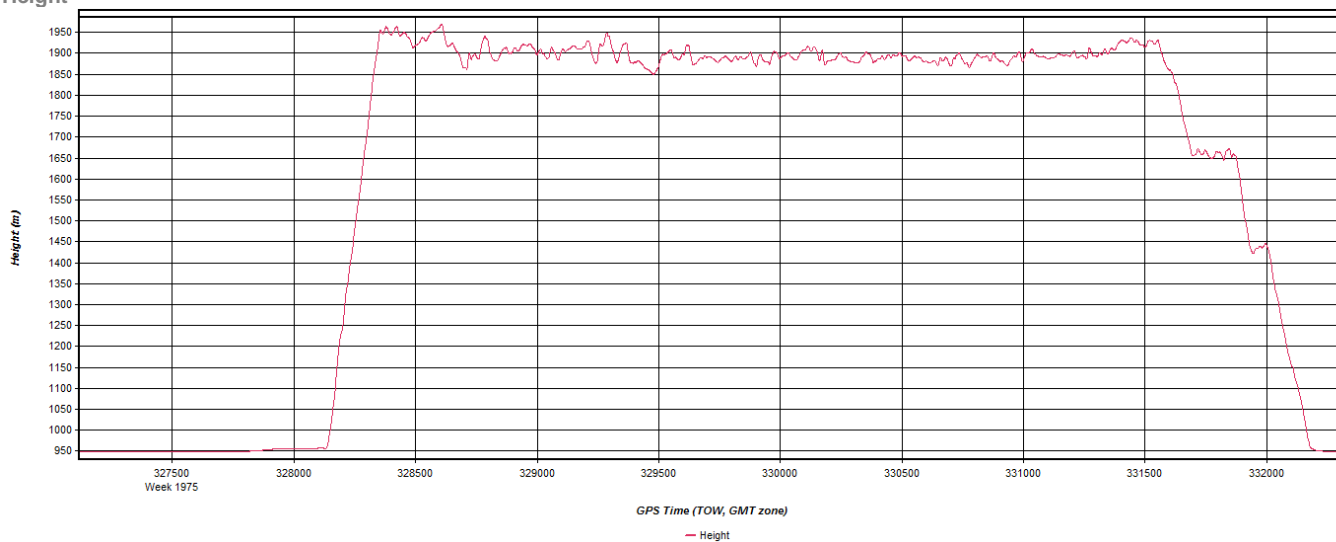




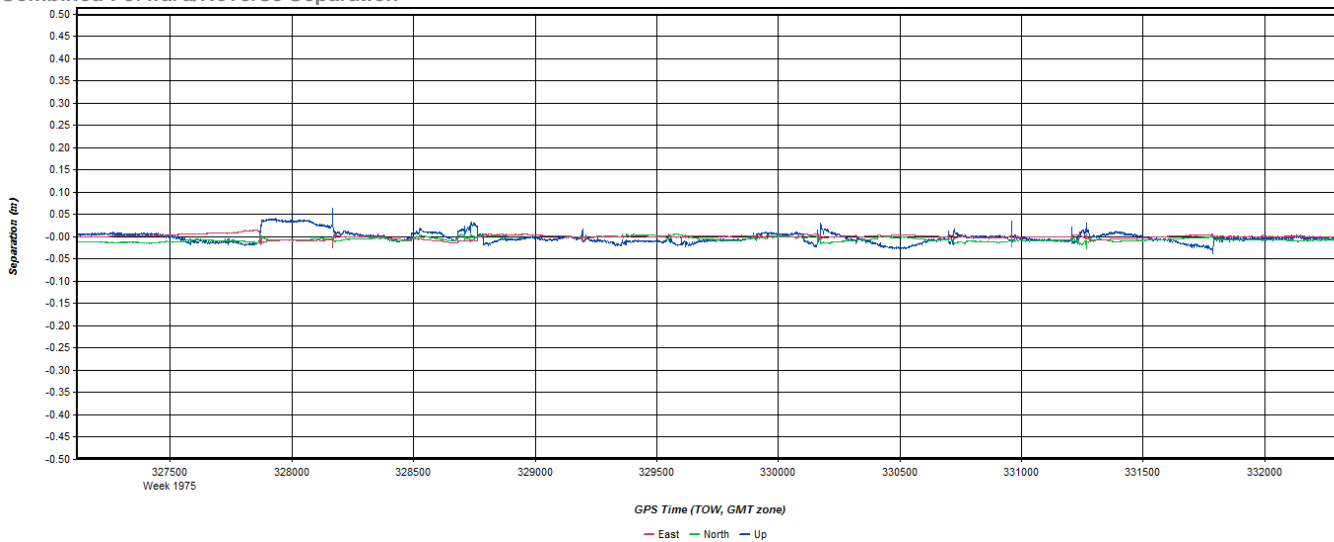
Quality Factor



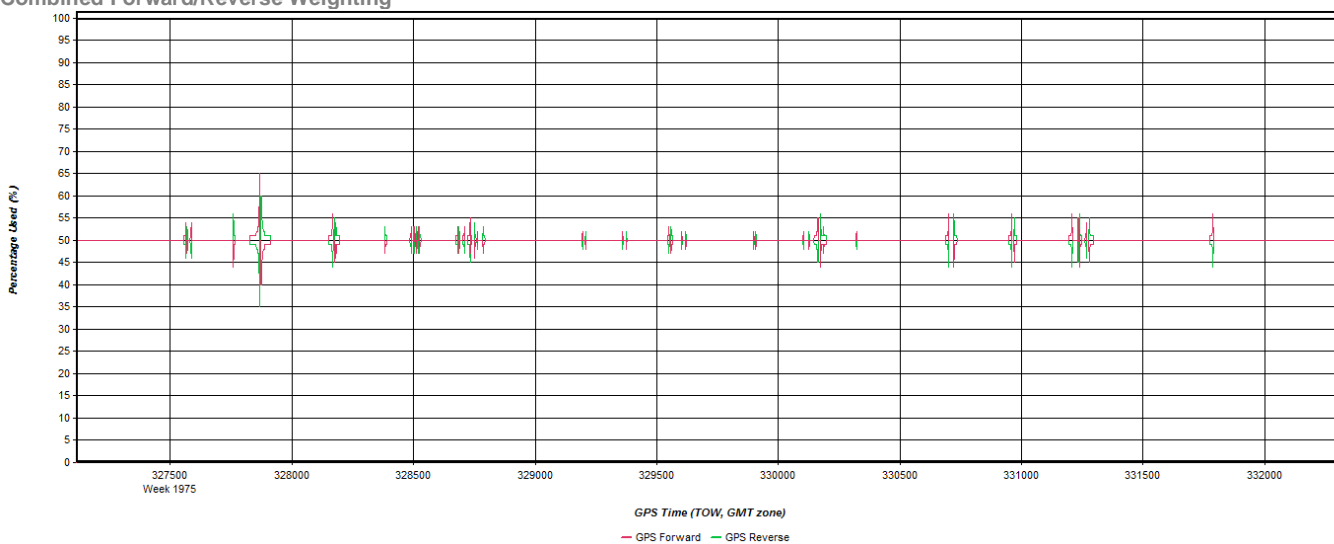
Height



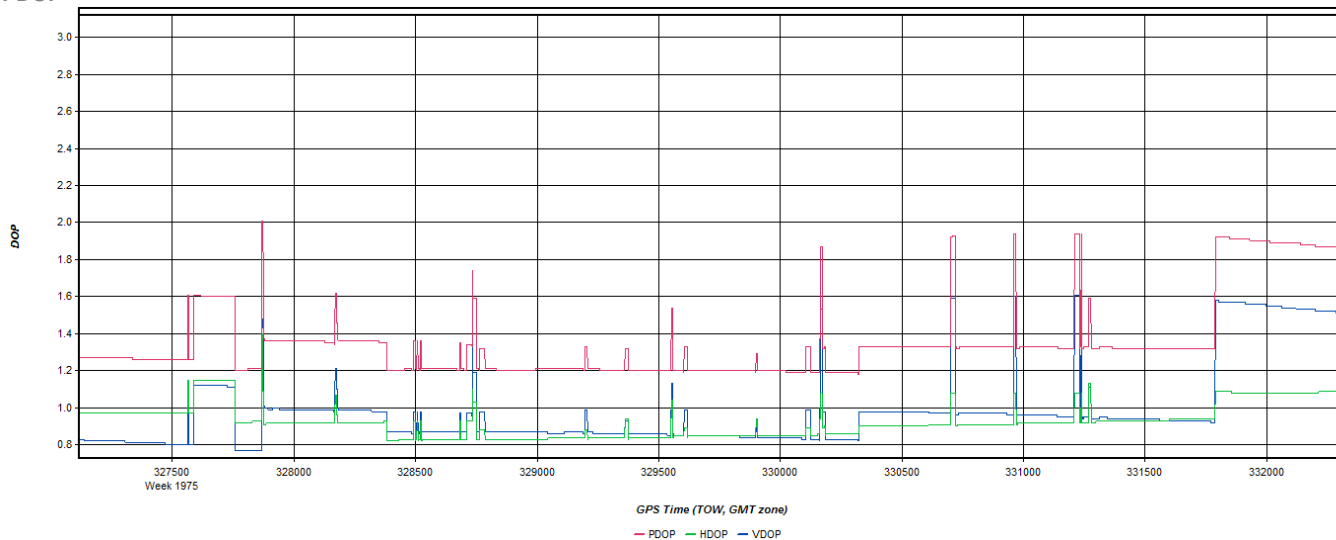
Combined Forward/Reverse Separation



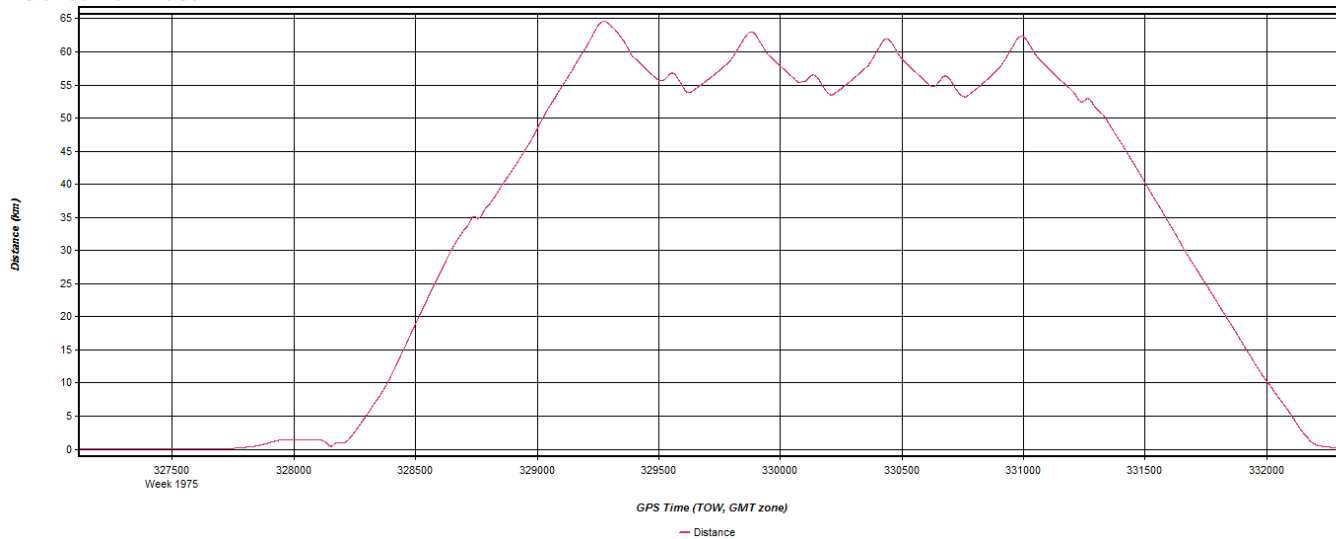
Combined Forward/Reverse Weighting



PDOP

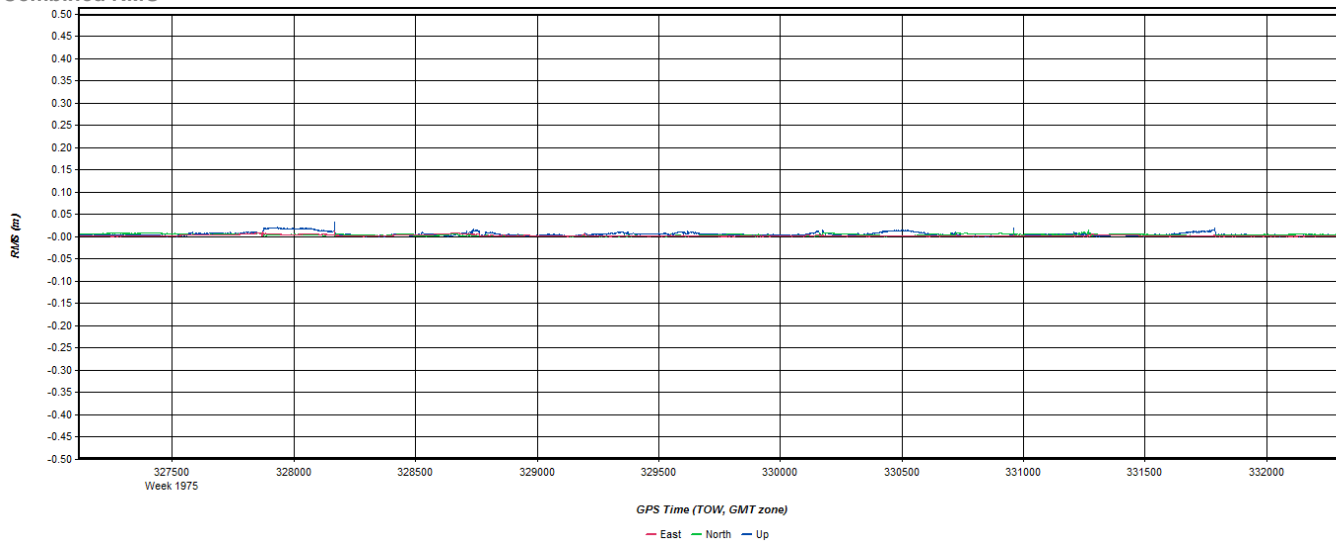


Distance from Base

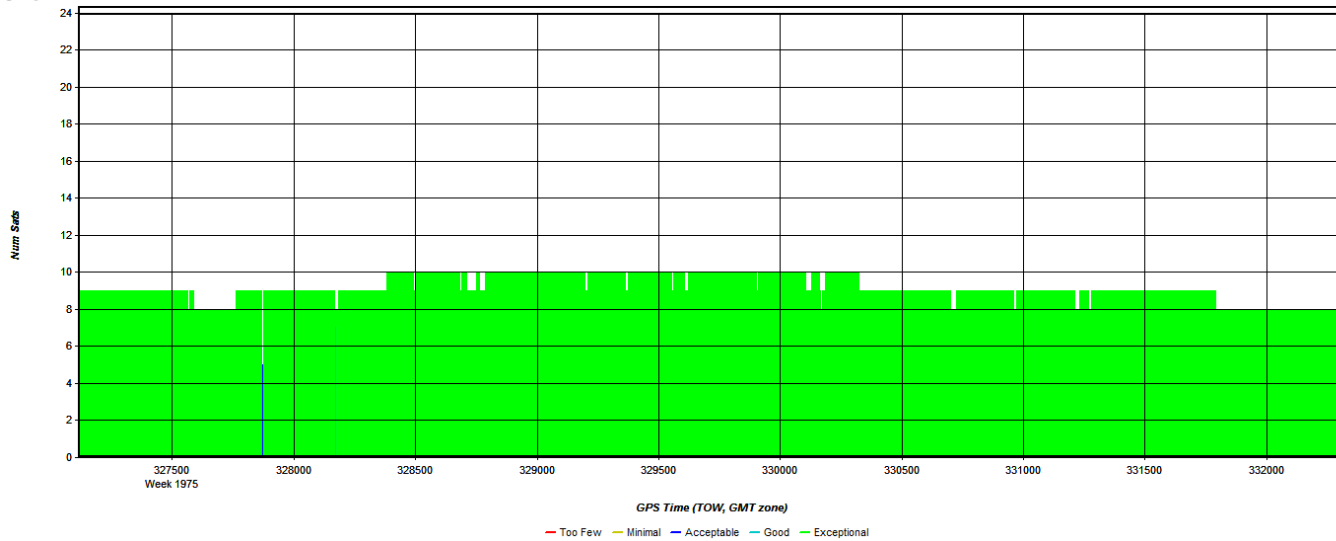




Combined RMS



SVs





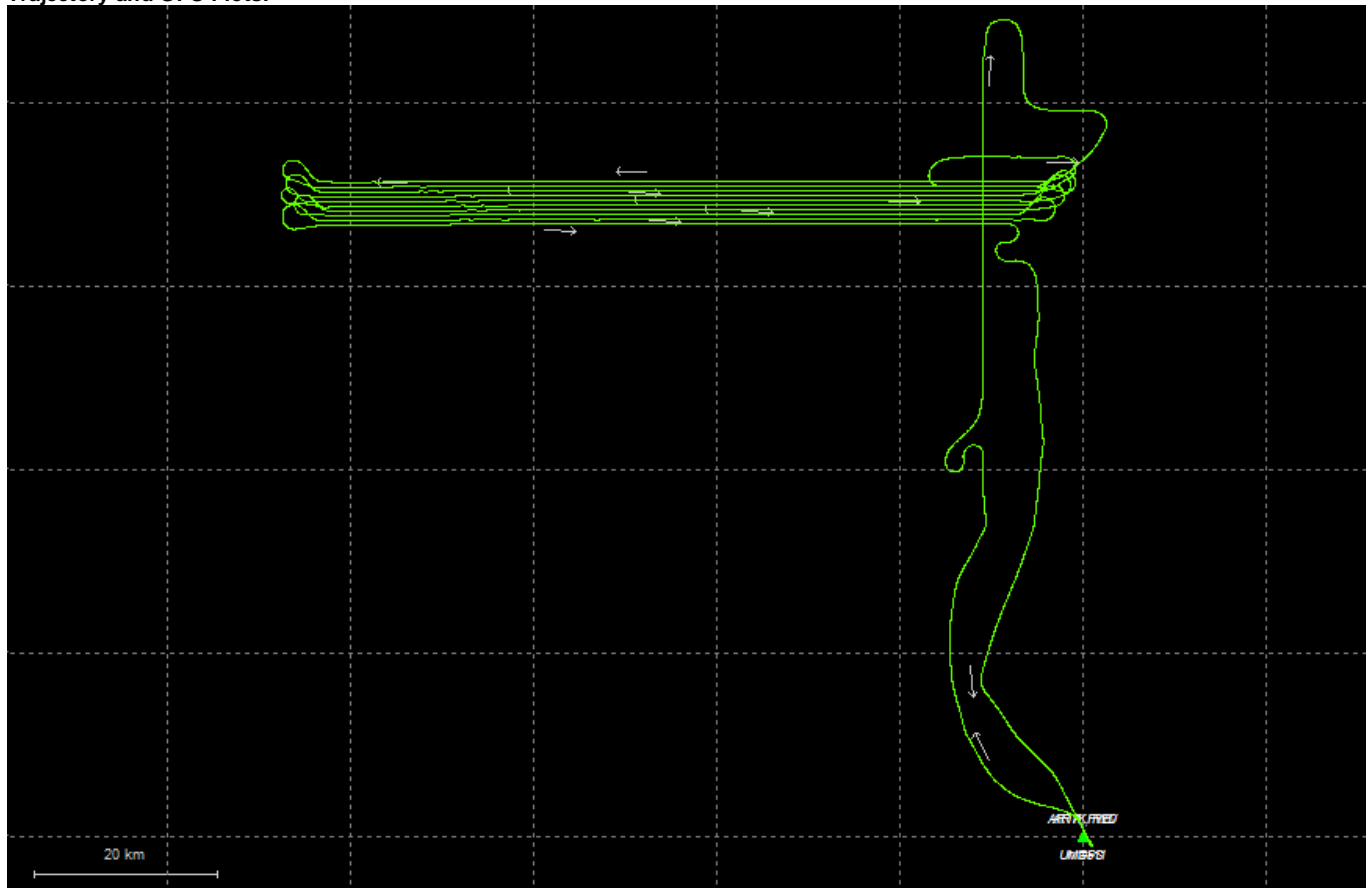
Acquisition and Processing details ----- Collection 24 (November 15, 2017)

Log:

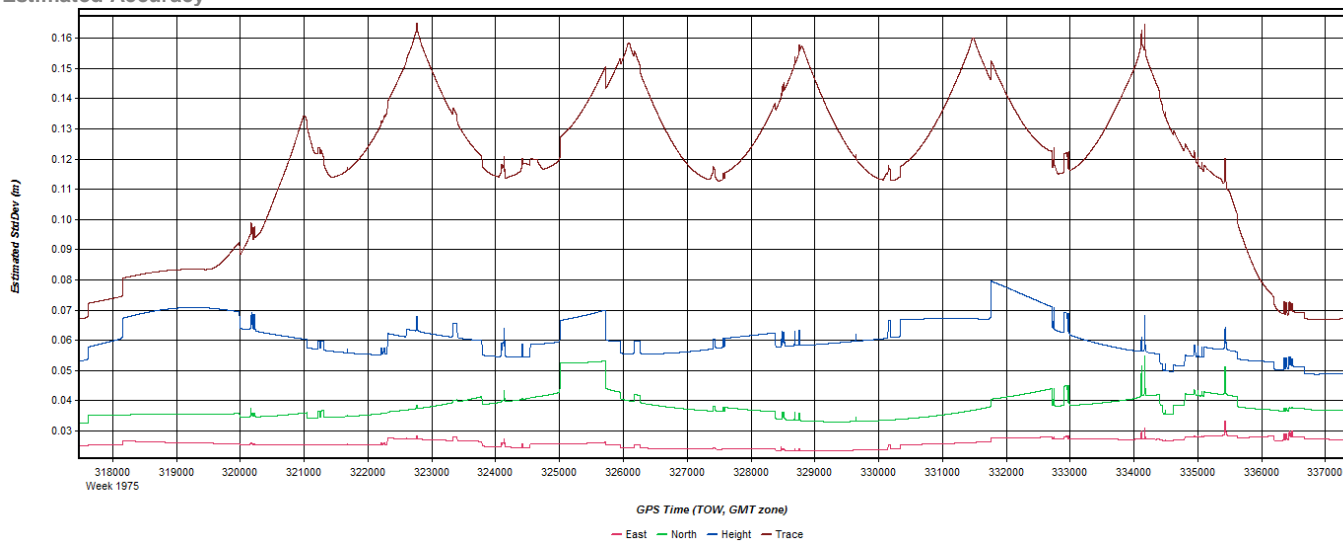
17.06	Lift Begin			Lift End			Fit Duration	Fit Hrs	Hobbs Hrs	Activity
	Airport	Chocks	Hobbs	Airport	Chocks	Hobbs				
	1	KRAP	16:08	7565.6	KRAP	21:42	7571.2	5:34	5:50	5:6
2										
3										

Fugro Geospatial, Inc.		Riegl Flight Log		AC80-50-00-02											
FGI Job # 22.17003900	Project Name USGS SD Lidar 2017 D17		System 780	Unit 421	IMU AIMU	-	-	Ground Temp °C 2.0 8.0	Min Range' 1496	Data Logger Drives 03					
Flight Date 15-Nov-17	GPS Day 17-319	Lift 9	-	Sun° -	Solar Times (UTC) -	Pulse Rate 340k	-	Flying Temp °C 1.0 1.0	Max Range' 2844	Download Drive NS1TB-52					
Mission ID (yyymmdd_Sen_Job_Lift) 171115_421_17003900_09		Aircraft N76JN	Airport ID KRAP	FMS CCNS 4	UTC -7	AMT (ft) 2400	Speed 130	FOV 60	Scan Rate (Hz) 110	MTA 2	km/WPT 0.440	AltM Setting 30.19 30.00	Humidity @ Alt -	Shipping Track NA	
Pilot #1 George Wilson		Pilot #2 -		Operator #1 Chris Acuña		Operator #2 Chris Fought		-							
Base 1 ID FGI 081	Location KRAP		Rec ID GR3 U5	Ant ID Unit 5	ARP (m) 1.8	Start Time (UTC) 15-Nov-17 14:42	Stop Time (UTC) 15-Nov-17 22:11	GPS Filename Unit#51115o	Operator -	Data With AB					
Area	Flight #		Wpt		Distance		UTC		Fit Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions	SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End							
							16:19:34	16:24:34					5 Min GND static alignment at KRAP	17	1.2
							16:55:00	16:57:00					S-Turn in flight alignment	16	1.0
West-N	2		1	45	0	19.4	-	-	-	-	-	110.0	Crossing line	-	-
							17:18:00	17:37:00	E	5,140	117	110.0		17	1.2
							17:41:00	17:59:00	W	5,630	125	110.0		16	1.4
							18:04:00	18:05:00	E	5,165	121	110.0	Calibration Line	17	1.1
							18:13:00	18:32:00	E	5,145	115	110.0		15	1.3
							18:36:00	18:54:00	W	5,670	126	110.0		18	1.0
							18:59:00	19:17:00	E	5,140	129	110.0		18	1.2
							19:21:00	19:40:00	W	5,670	124	110.0		18	1.2
							19:44:00	20:02:00	E	5,130	120	110.0		19	1.2
							20:06:00	20:24:00	W	5,600	125	110.0		17	1.3
							20:27:00	20:46:00	E	5,020	124	110.0		17	1.3
							20:50:00	21:08:00	W	5,645	127	110.0		19	1.0
							21:08:00	21:10:00					S-Turn post in flight alignment	18	1.1
							21:33:34	21:38:34					5 Min post GND static alignment at KRAP	20	1.0

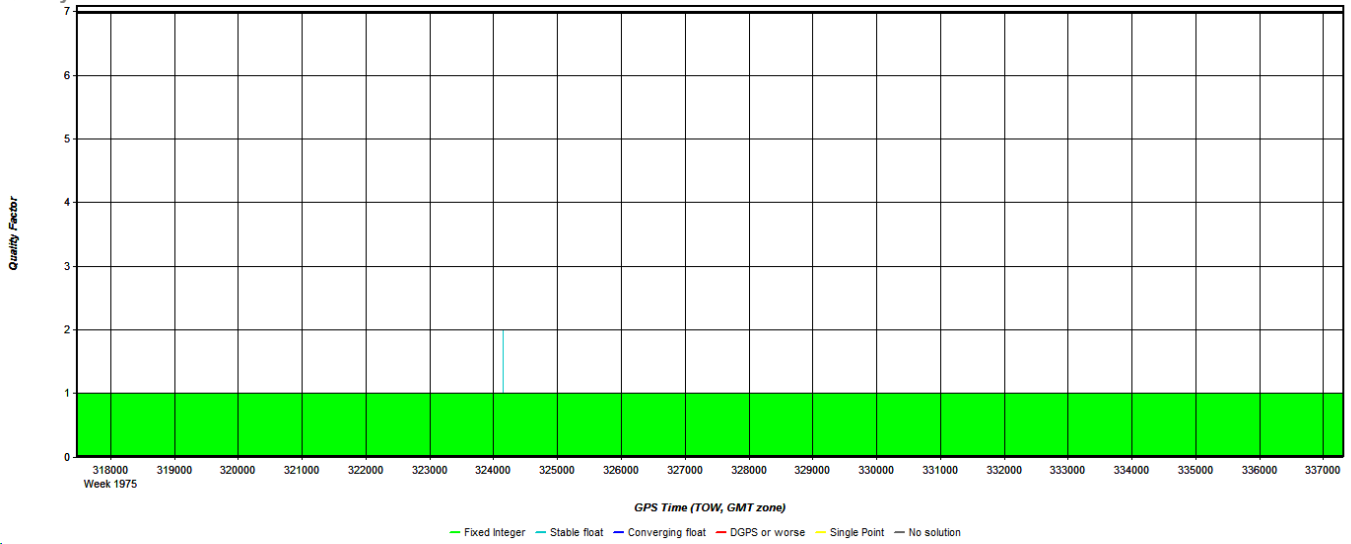
Trajectory and GPS Plots:



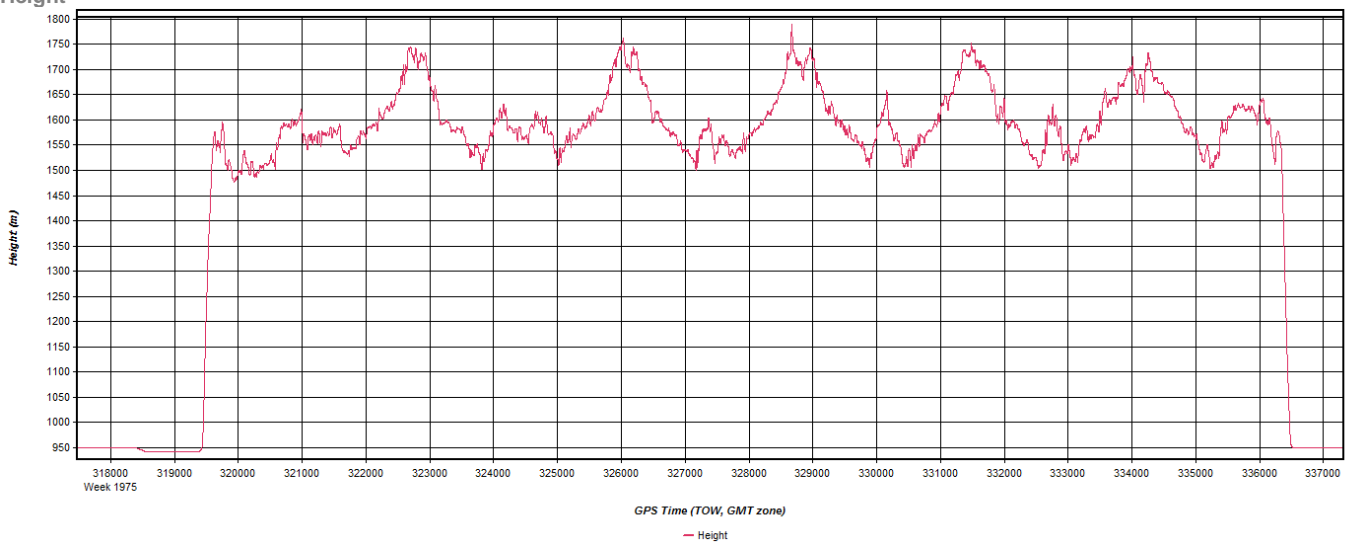
Estimated Accuracy



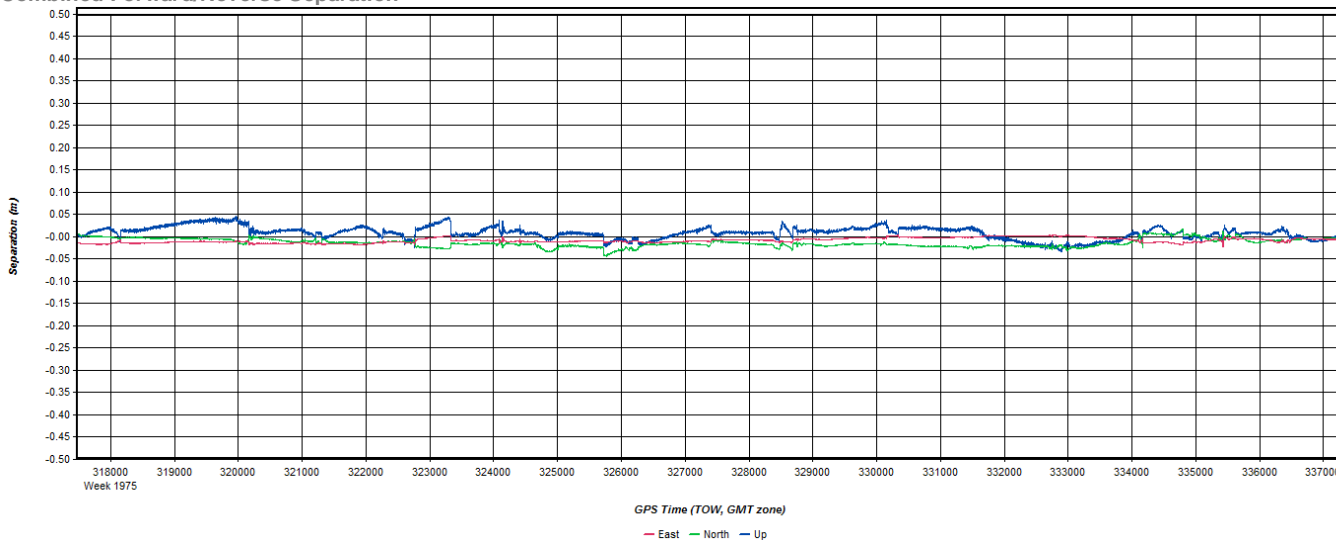
Quality Factor



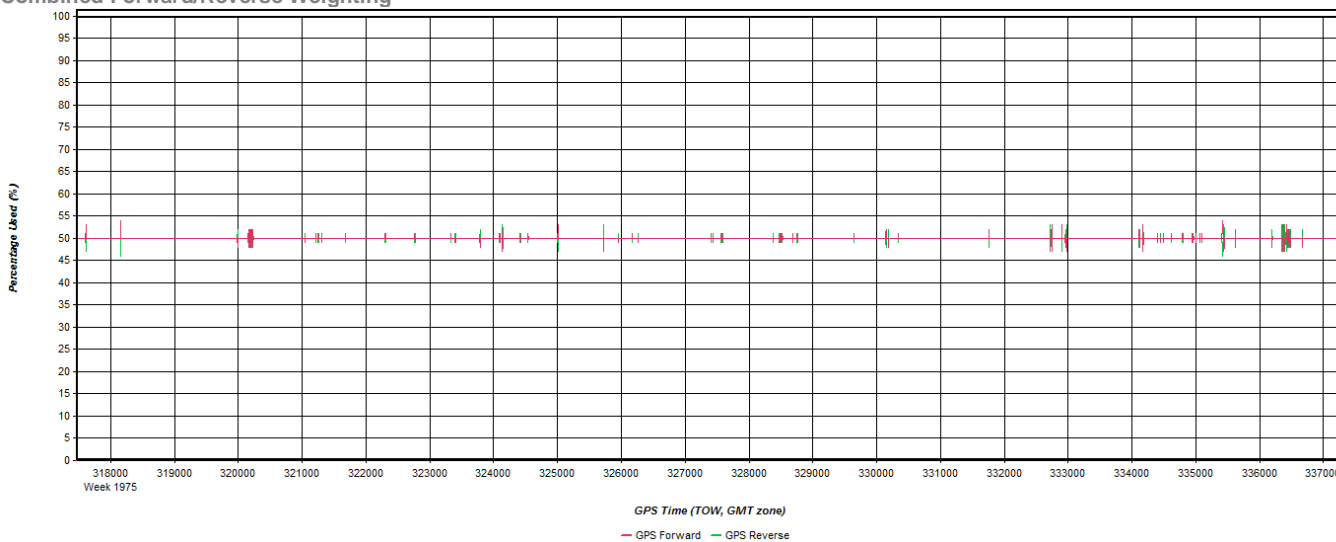
Height



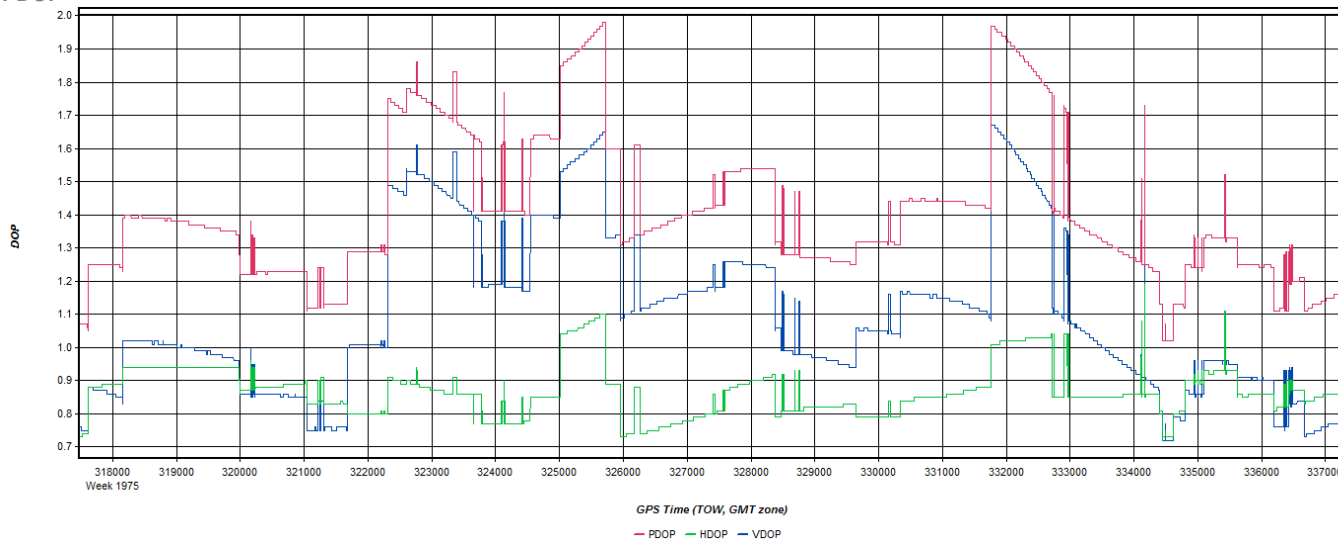
Combined Forward/Reverse Separation



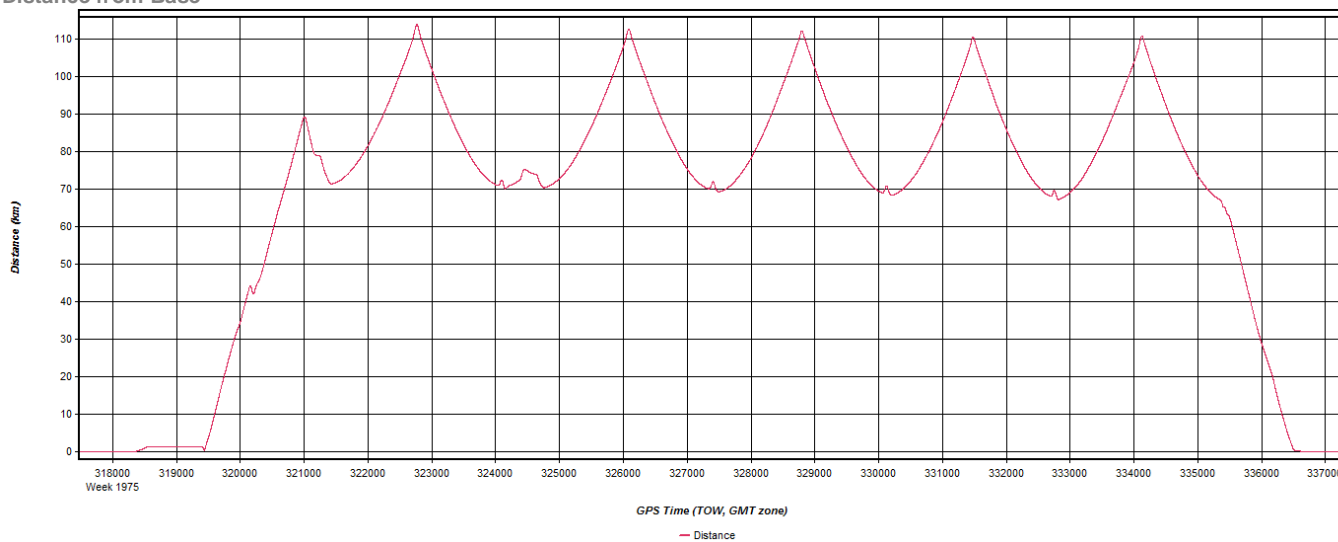
Combined Forward/Reverse Weighting



PDOP

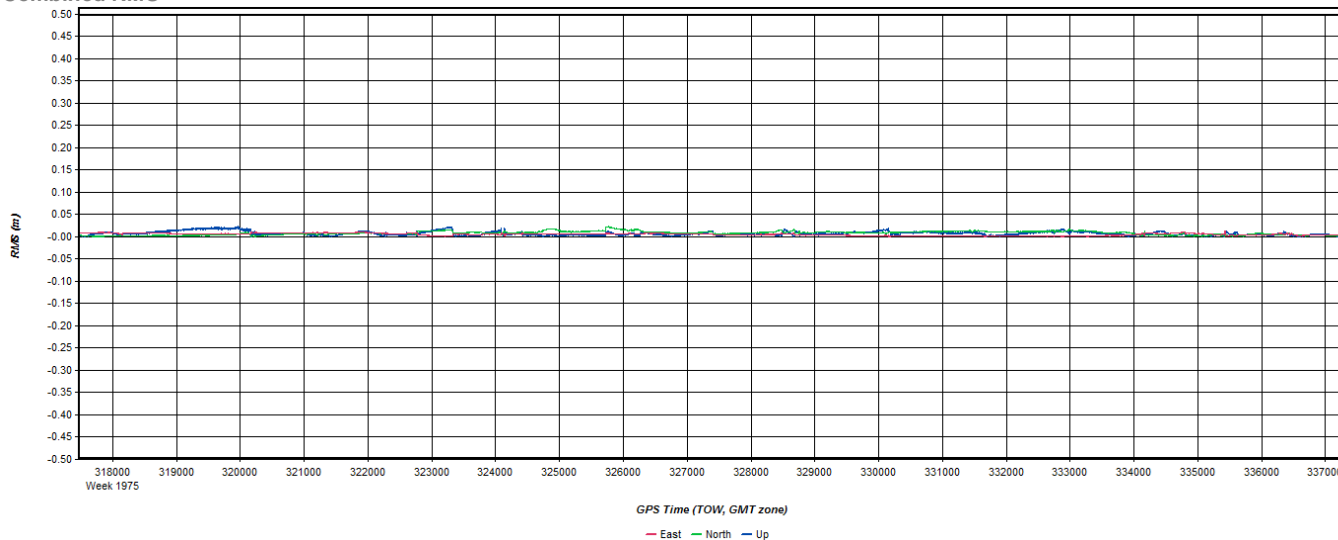


Distance from Base

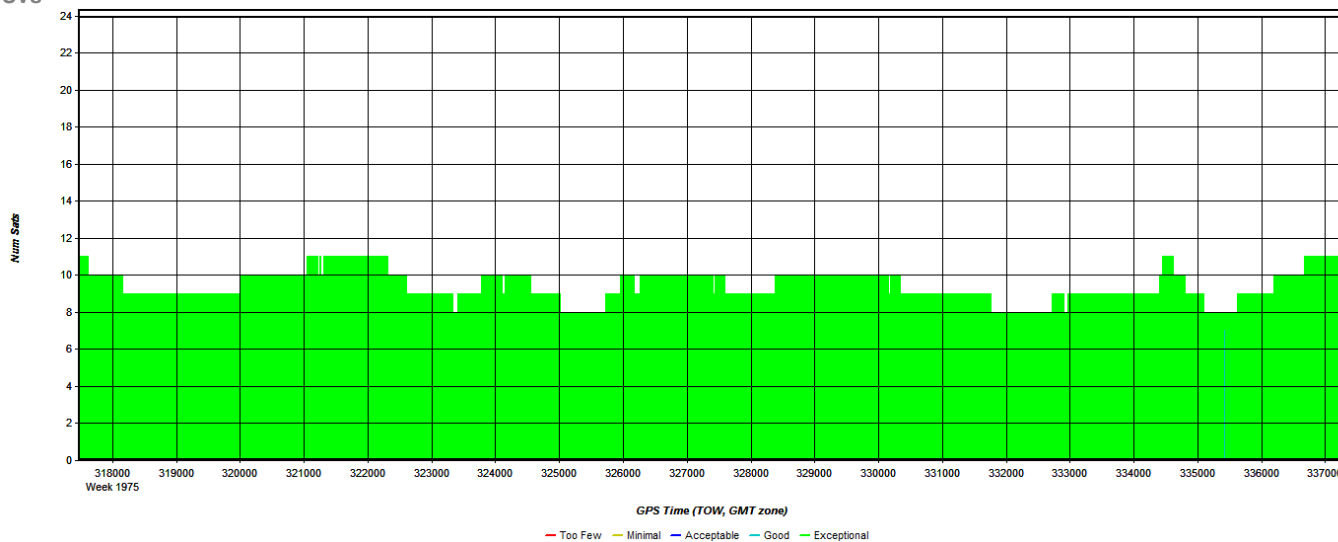




Combined RMS



SVs



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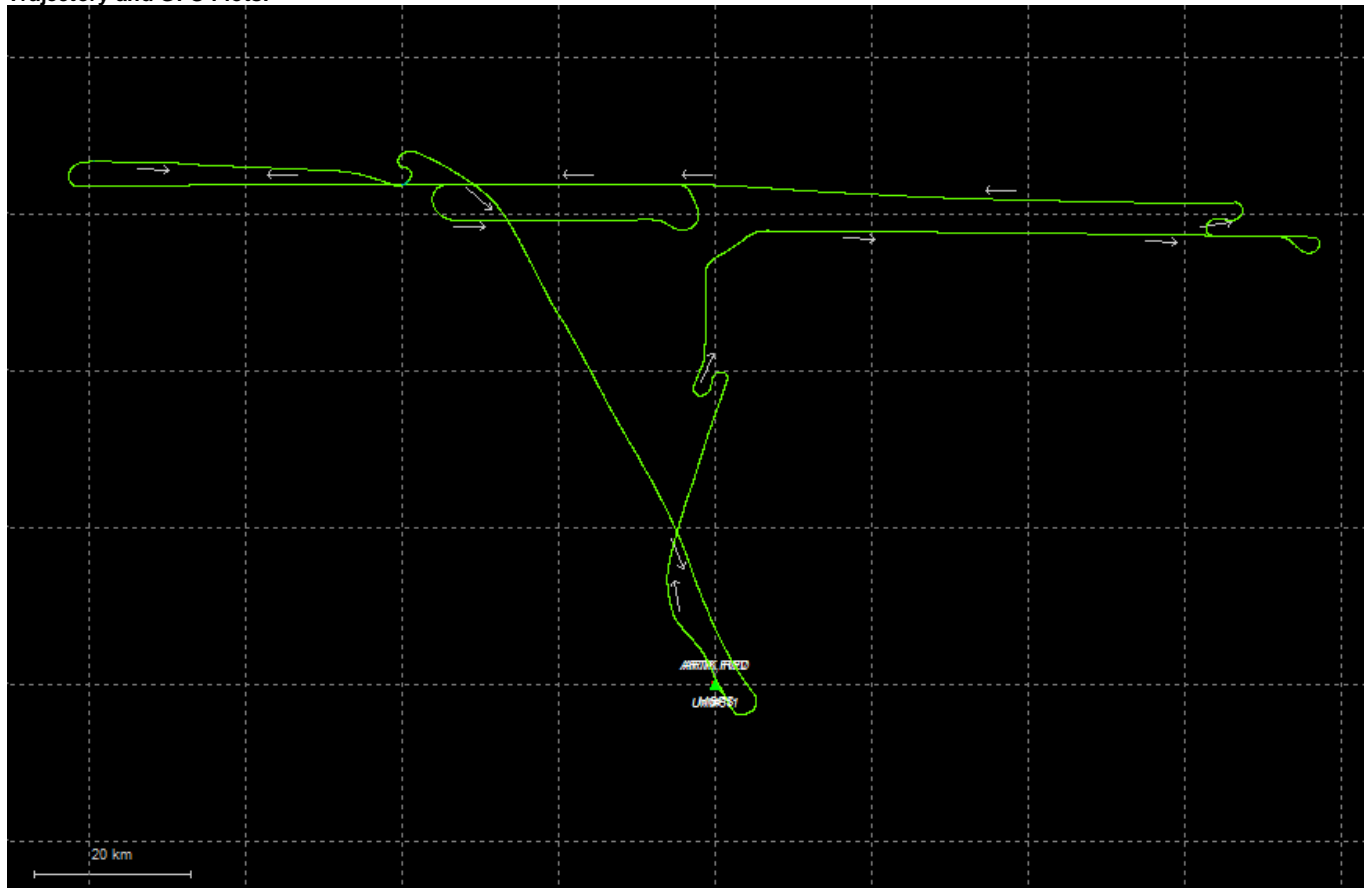
Acquisition and Processing details ----- Collection 25 (November 18, 2017)

Log:

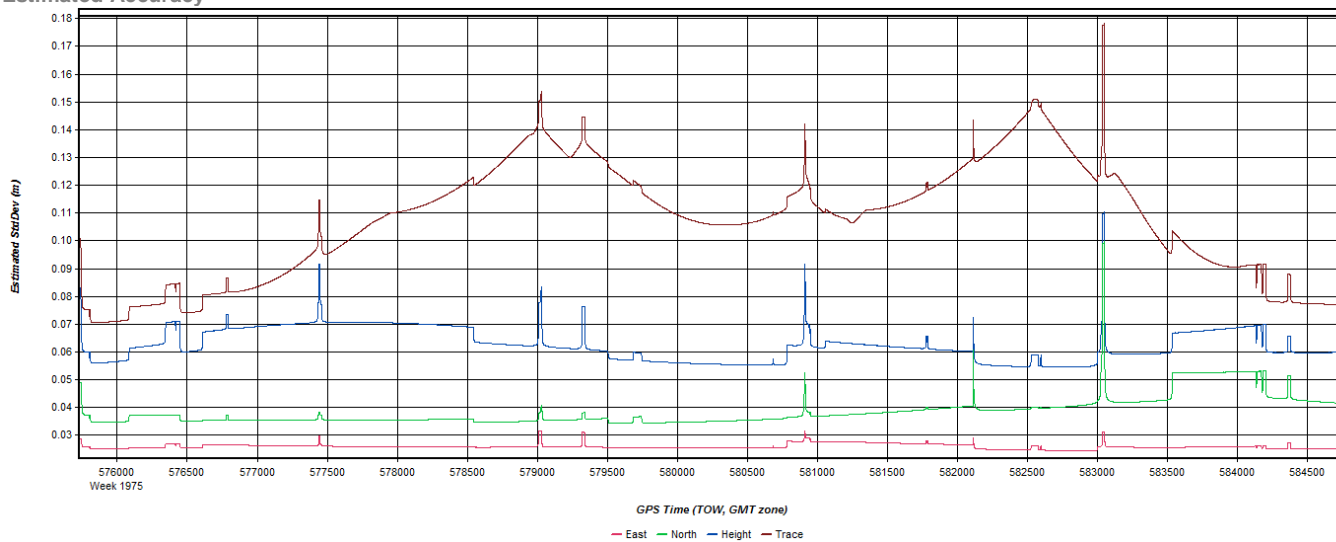
FUGRO		Fugro Geospatial, Inc.										Riegl Flight Log AC80-50-00-02	
17.06		Lift Begin			Lift End			Flt	Flt	Hobbs	Activity		
		Airport	Chocks	Hobbs	Airport	Chocks	Hobbs	Duration	Hrs	Hrs			
1	KRAP	15:52	799.0	KRAP	18:27	801.1	2:35	2.50	2.1	0900-Production			
2													
3													

FGI Job # 22.17003900	Project Name USGS SD Lidar 2017 D17		System 680i	Unit 165	IMU FMU-300					Ground Temp °C 4.0 6.0	Min Range' 1542	Data Logger Drives EU RIEGL 02			
Flight Date 18-Nov-17	GPS Day 17-322	Lift 7	Sun° -		Solar Times (UTC) -		Pulse Rate 330/340k		Flying Temp °C -3.0 -4.0		Max Range' 2933	Download Drive NS1TB#113			
Mission ID (yyymmdd_Sen_Job_Lift) 171118_165_17003900_07		Aircraft N97HC	Airport ID KRAP	FMS CCNS 5	UTC -7	AMT (ft) 2400	Speed 130	FOV 60	Scan Rate (Hz) 130	MTA 2	km/WPT 0.441	Altitude Setting 30.13 30.15	Humidity @ Alt 51%	Shipping Track	
Pilot #1 Fred Davis		Pilot #2		Operator #1 Jacob Amundson		Operator #2									
Base 1 ID FGI 081	Location KRAP		Rec ID GR3 U5	Ant ID Unit 5	ARP (m) 1.8	Start Time (UTC) 18-Nov-17 15:27		Stop Time (UTC) 18-Nov-17 18:47		GPS Filename Unit#51118p.tps		Operator Jacob Amundson	Data With AB		
Area	Flight #		Wpt		Distance		UTC		Flt Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions	SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End							
							15:58:36	16:03:36					GROUND STATIC	16	1.2
							16:23:06						ALIGNMENT TURNS	16	1.2
EastSD_B	23		75	184	32.6	80.7	16:35:34	16:47:49	E	4,890	130	130.0	RE-FLIGHT	17	1.1
	23		184	174	80.7	76.3	16:52:00	16:53:13	W	4,570	127	130.0	CALIBRATION LINE	17	1.1
							16:53:23						ALIGNMENT TURNS	19	1.0
West-N	13		158	1	69.2	0	17:30:16	17:48:06	W	4,965	127	110.0	WIND TOO STRONG, MISSION ABORTED	17	1.1
							17:56:44						ALIGNMENT TURNS	18	1.0
							18:19:18	18:24:18					GROUND STATIC	16	1.3

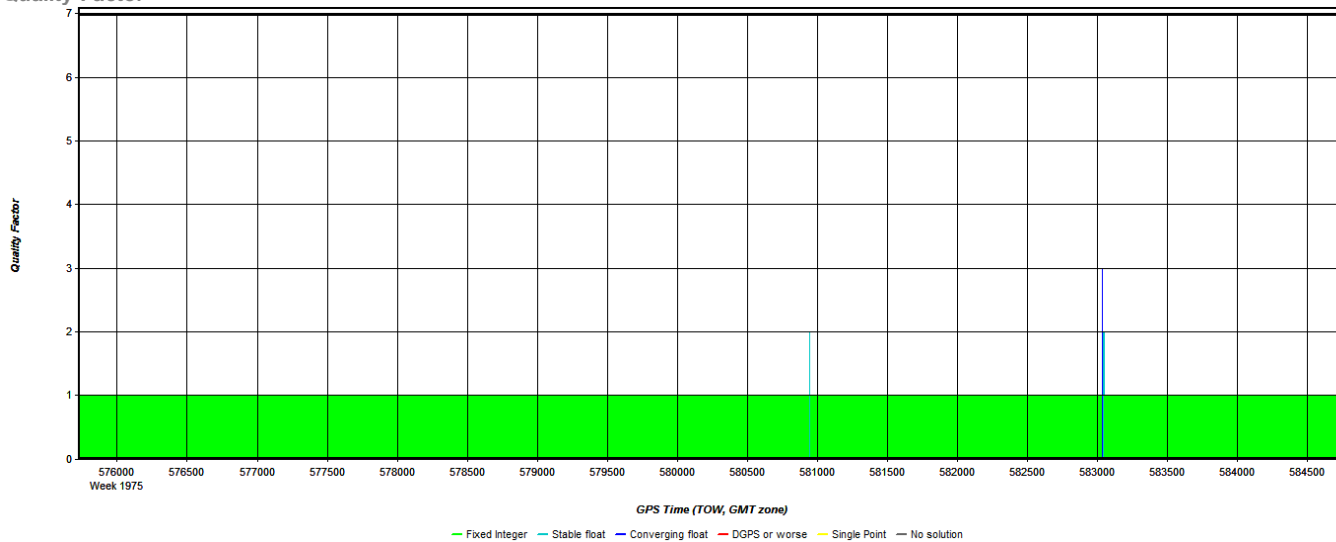
Trajectory and GPS Plots:



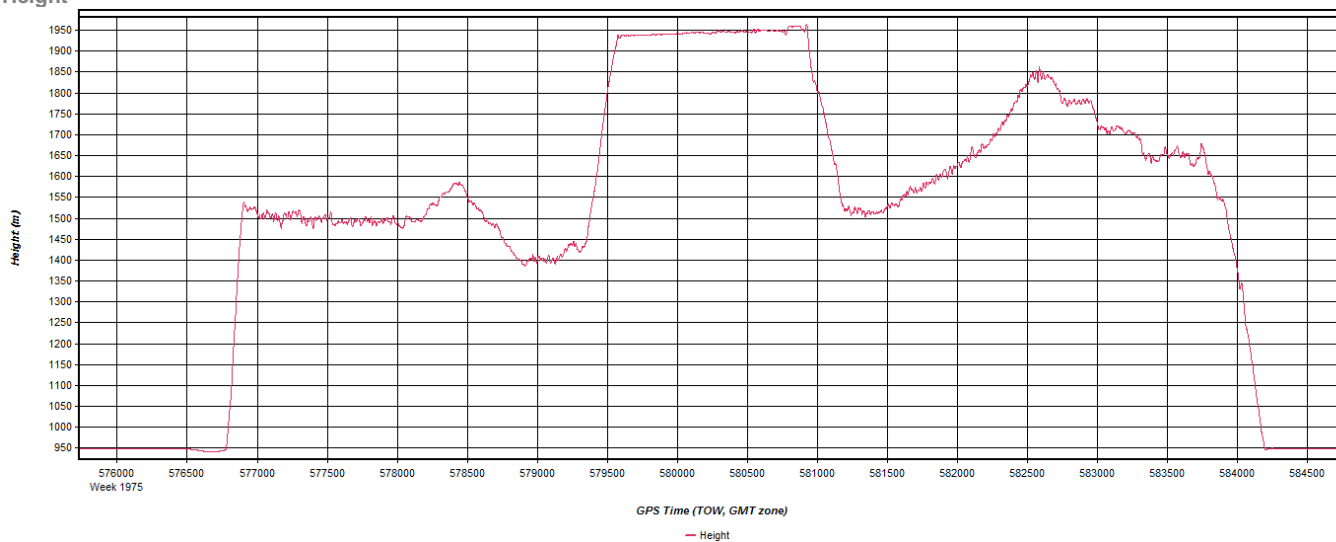
Estimated Accuracy



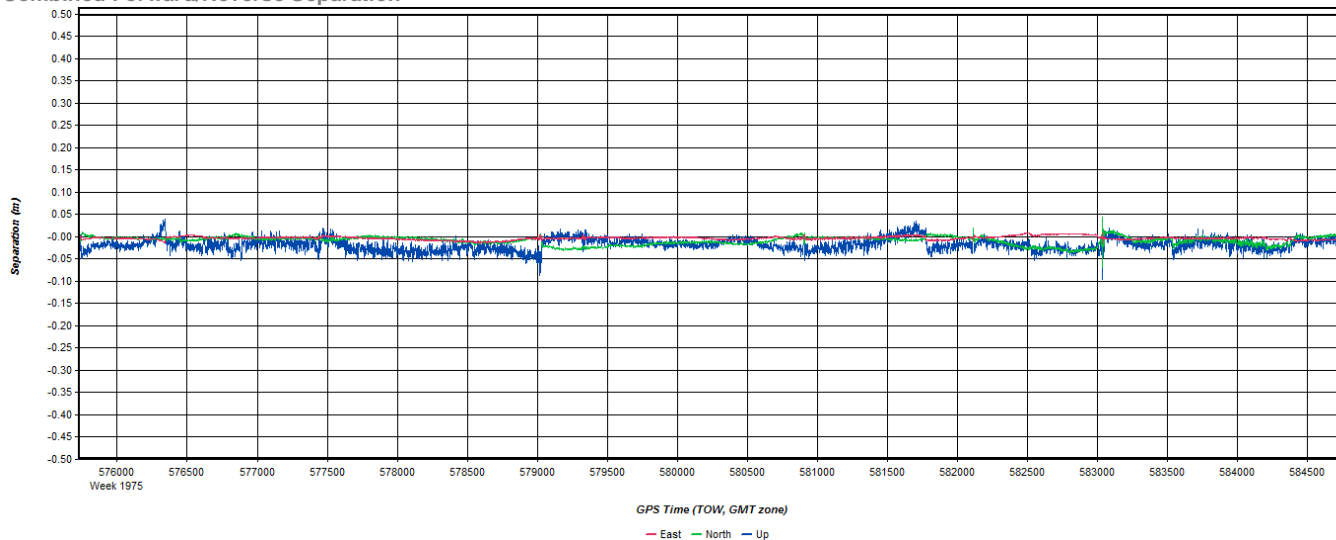
Quality Factor



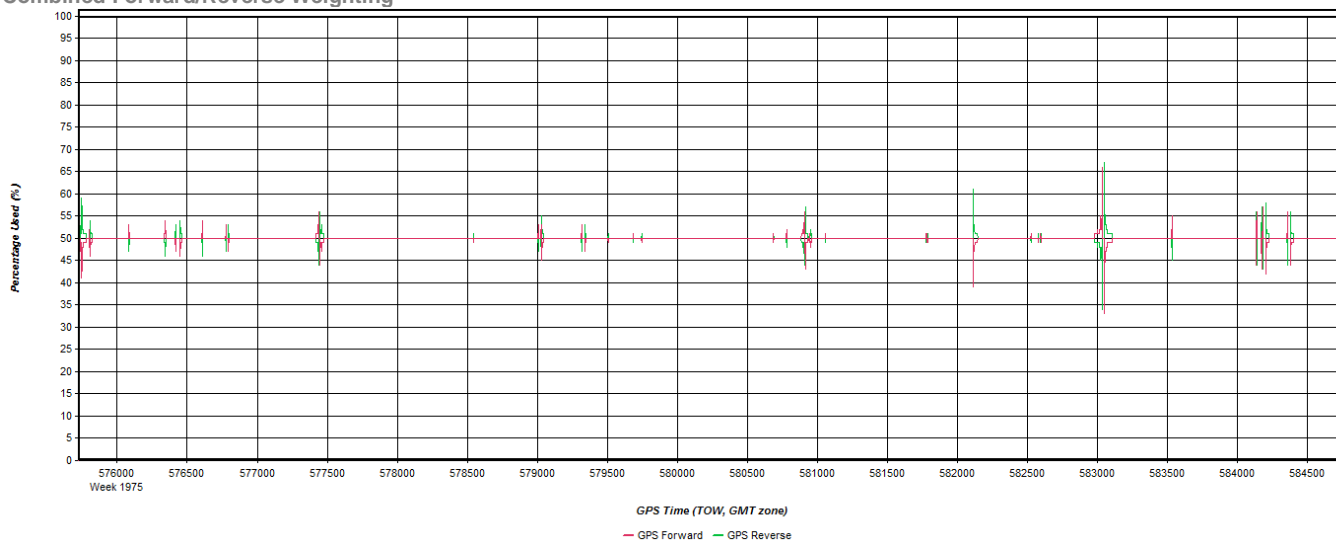
Height



Combined Forward/Reverse Separation

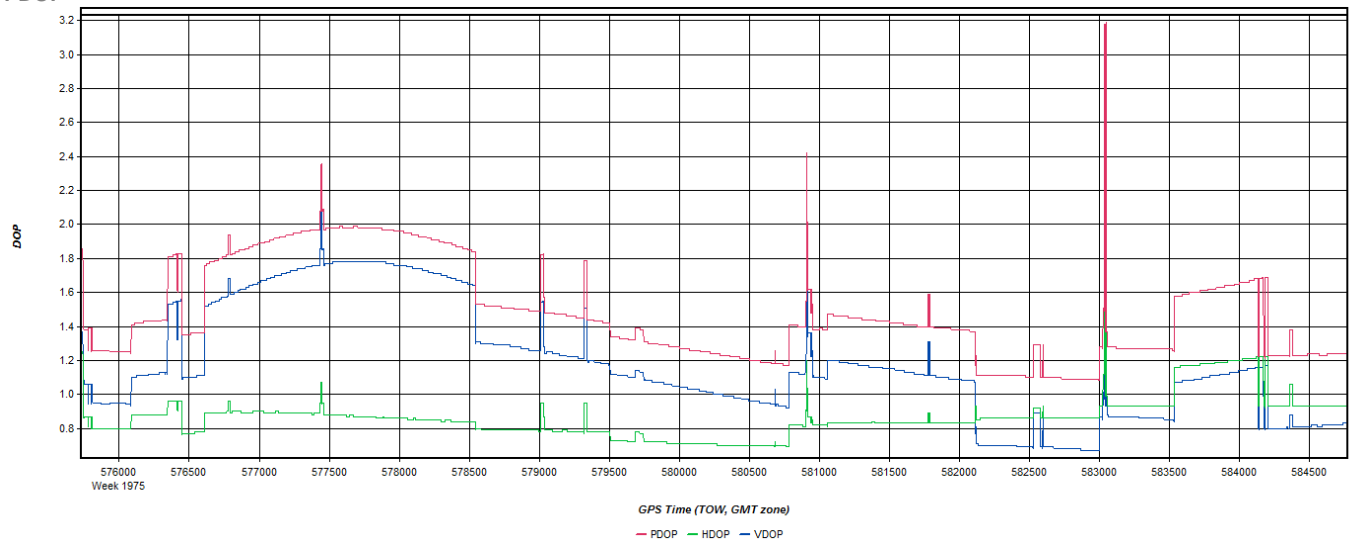


Combined Forward/Reverse Weighting

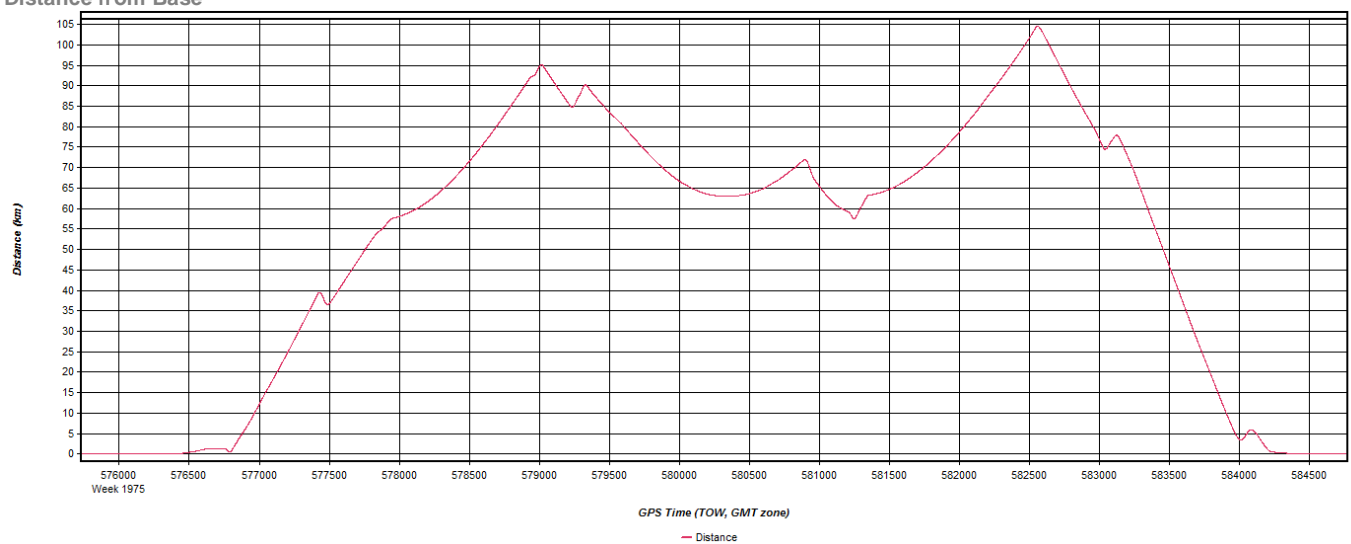


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PDOP

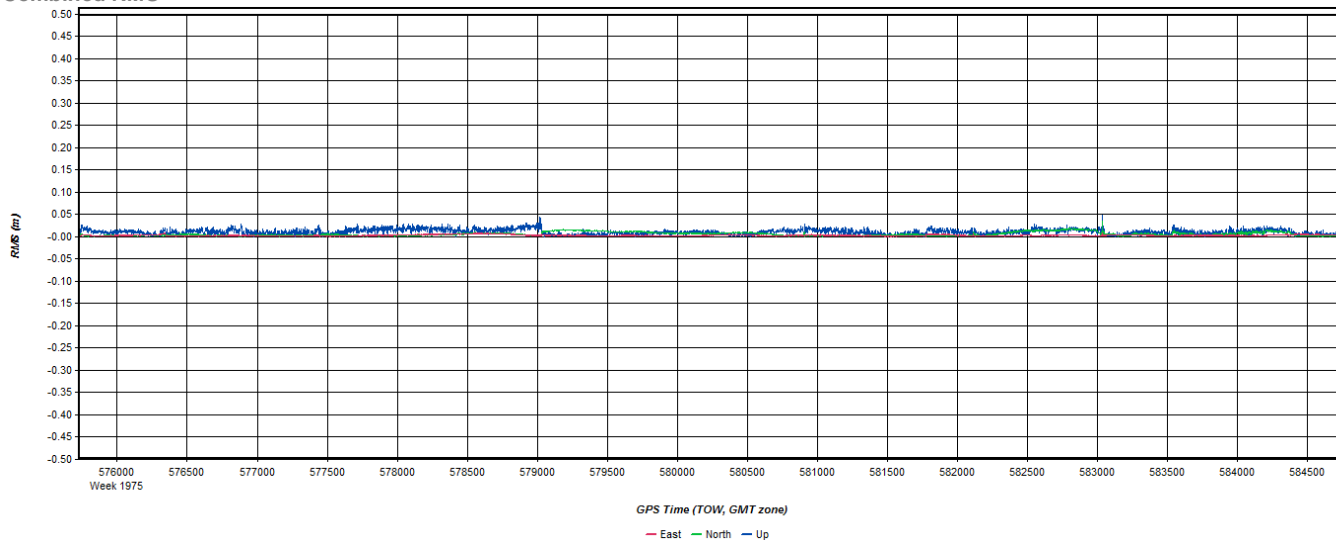


Distance from Base

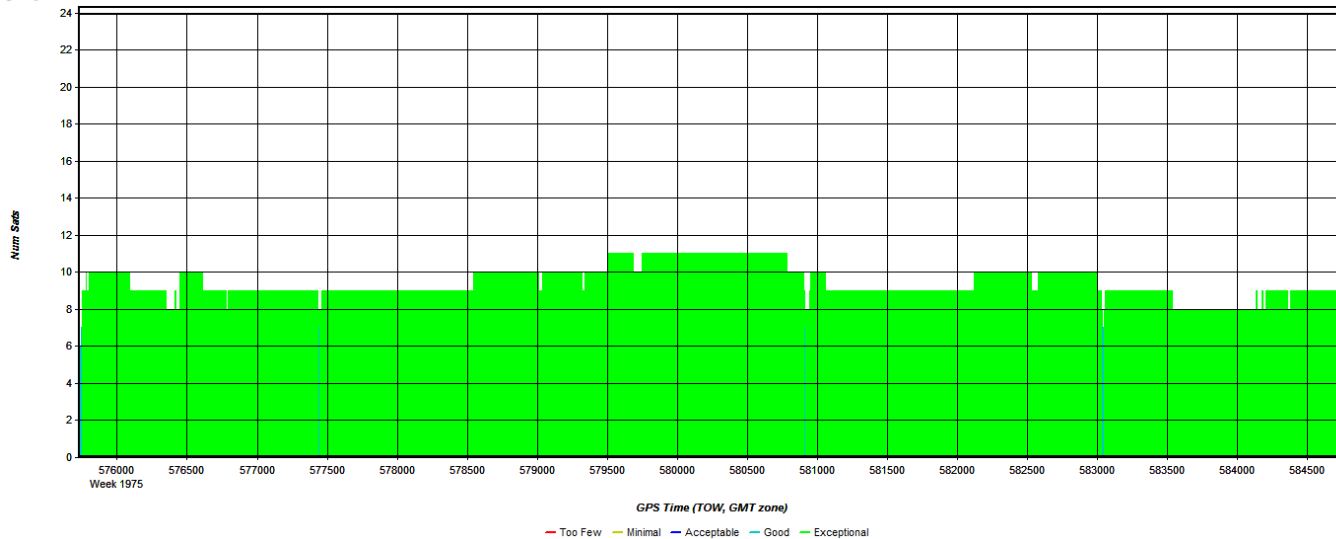




Combined RMS



SVs





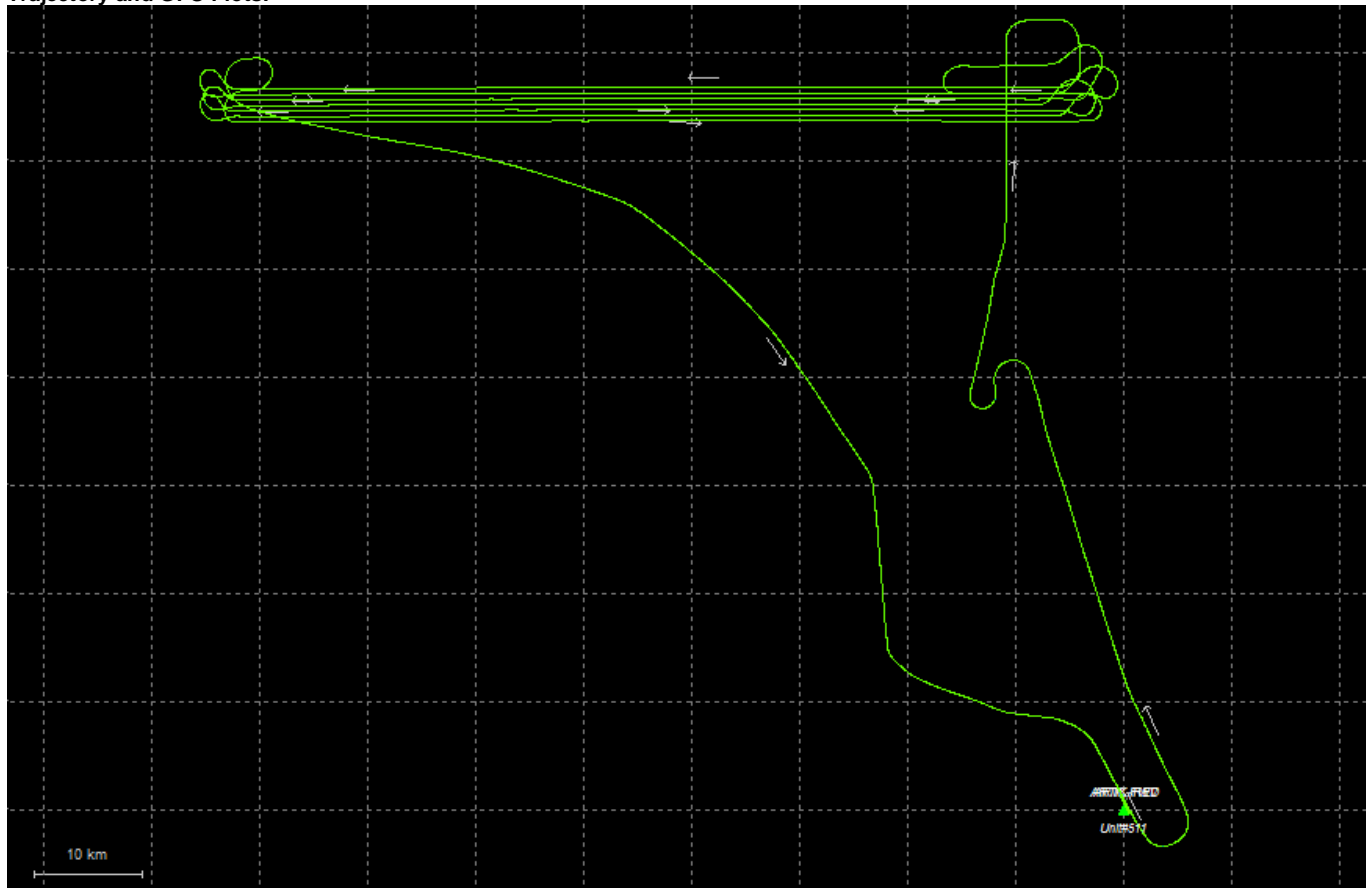
Acquisition and Processing details ----- Collection 26 (November 19, 2017)

Log:

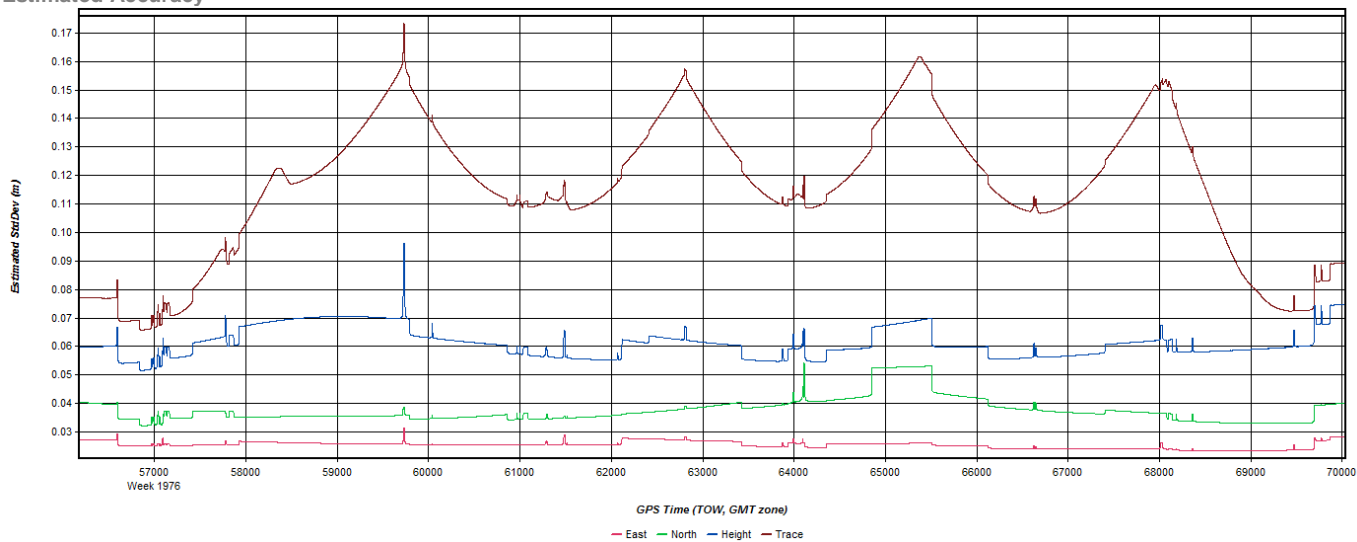
FUGRO		Fugro Geospatial, Inc.										Riegl Flight Log		AC80-50-00-02	
17.06		Lift Begin			Lift End			Flt	Flt	Hobbs	Activity				
		Airport	Chocks	Hobbs	Airport	Chocks	Hobbs	Duration	Hrs	Hrs					
1		KRAP	15:29	801.1	KRAP	19:27	804.6	3:58	4.00	3.5	0900-Production				
2															
3															

FGI Job #	Project Name			System	Unit	IMU				Ground Temp °C	Min Range'	Data Logger Drives				
22.17003900	USGS SD Lidar 2017 D17			680i	165	FMU-300				2.0 11.0	1496	EU RIEGL 04				
Flight Date	GPS Day	Lift				Sun°	Solar Times (UTC)	Pulse Rate	Flying Temp °C		Max Range'	Download Drive				
19-Nov-17	17-323	8				-	-	340k	4.0 6.0		2844	NS1TB-91				
Mission ID (yyymmdd_Sen_Job_Lift)		Aircraft	Airport ID	FMS	UTC	AMT (ft)	Speed	FOV	Scan Rate (Hz)	MTA	km/WPT	Altitude Setting	Humidity @ Alt	Shipping Track		
171119_165_17003900_08		N97HC	KRAP	CCNS 5	-7	2400	130	60	110	2	0.440	29.98 29.89	62%			
Pilot #1		Pilot #2		Operator #1		Operator #2										
Fred Davis				Jacob Amundson												
Base 1 ID	Location		Rec ID	Ant ID	ARP (m)	Start Time (UTC)		Stop Time (UTC)		GPS Filename		Operator	Data			
FGI 081	KRAP		GR3 U5	Unit 5	1.8	19-Nov-17 14:51		19-Nov-17 19:39		Unit#511190.tps		Jacob Amundson	With AB			
Area	Flight #		Wpt		Distance		UTC		Flt	Altitude	Speed	Scan	Comments and Conditions		SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End	Dir	(GPS)	(knots)	Rate				
							15:37:14	15:42:14					GROUND STATIC		16	1.3
							16:01:28						ALIGNMENT TURNS		18	1.0
West-NX	2		13	27	5.3	11.4	16:08:19	16:11:05	N	4,965	128	110.0	CROSSING LINE		17	1.2
West-N	19		158	1	69.1	0	16:15:27	16:33:40	W	5,070	128	110.0			16	1.3
	18		1	158	0	69.1	16:36:12	16:54:24	E	5,710	130	110.0			17	1.0
	18		158	148	69.1	64.7	16:58:49	17:00:19	W	5,055	128	110.0	CALIBRATION LINE		17	1.2
	17		158	1	69.1	0	17:06:47	17:25:10	W	5,055	129	110.0			17	1.2
	16		1	158	0	69.1	17:27:29	17:45:41	E	5,715	129	110.0			17	1.2
	15		158	1	69.1	0	17:49:25	18:07:52	W	4,950	127	110.0			18	1.0
	14		1	158	0	69.1	18:10:36	18:28:42	E	5,790	129	110.0			18	1.0
	13		158	1	69.1	0	18:32:40	18:51:22	W	4,965	120	110.0			18	1.1
							18:51:37						ALIGNMENT TURNS		18	1.1
							19:21:30	19:26:30					GROUND STATIC		17	1.2

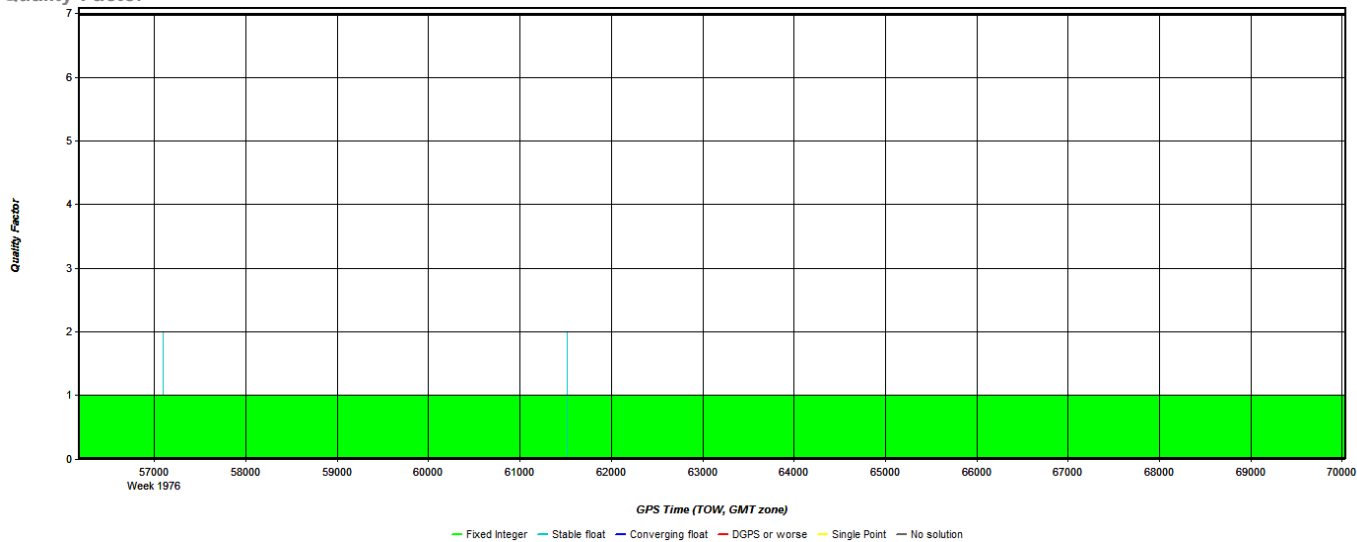
Trajectory and GPS Plots:



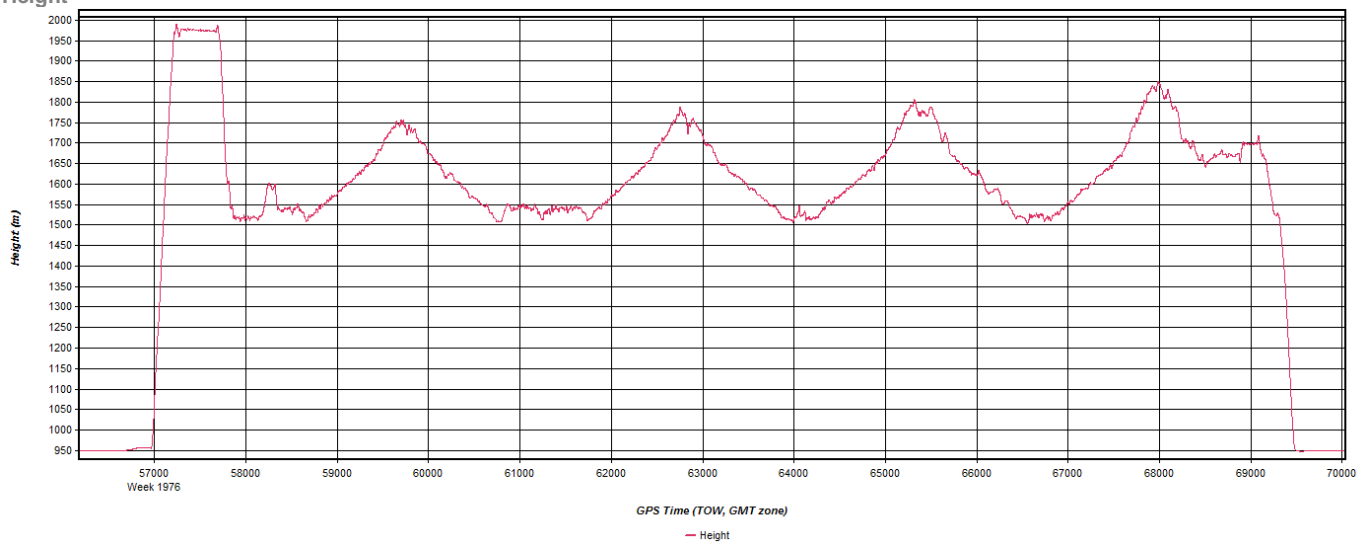
Estimated Accuracy



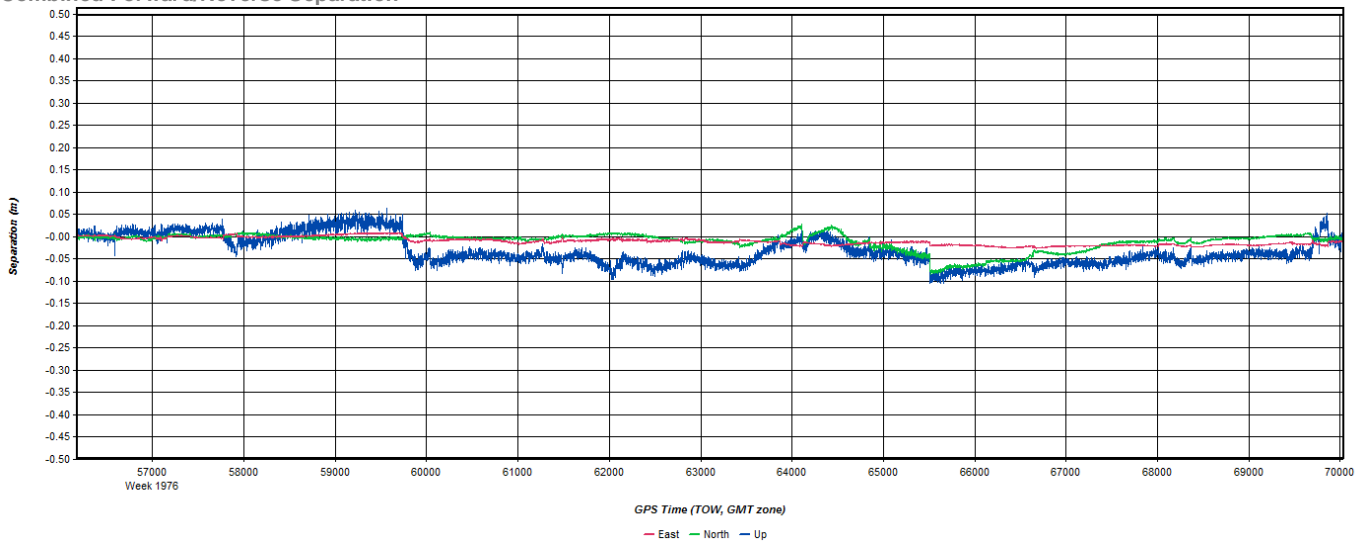
Quality Factor



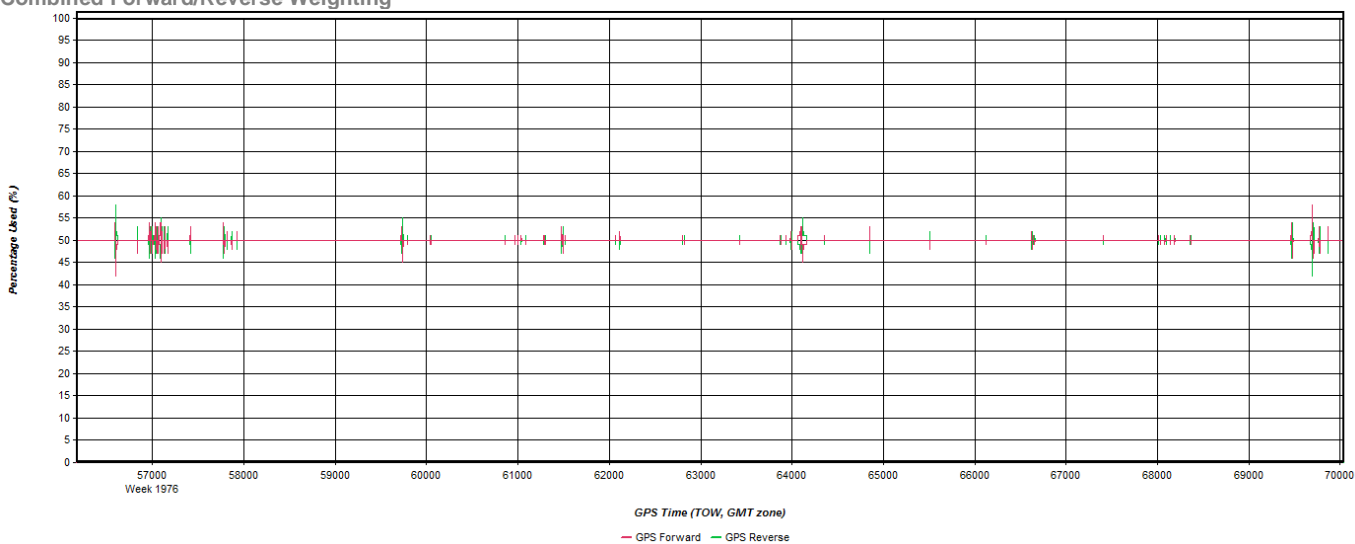
Height



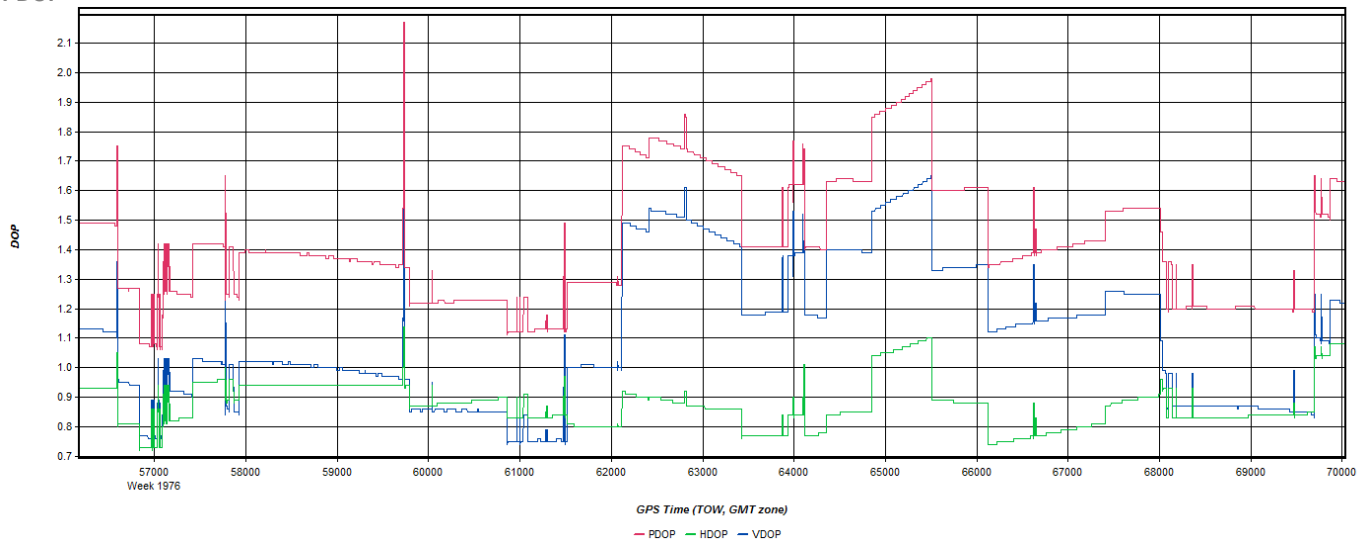
Combined Forward/Reverse Separation



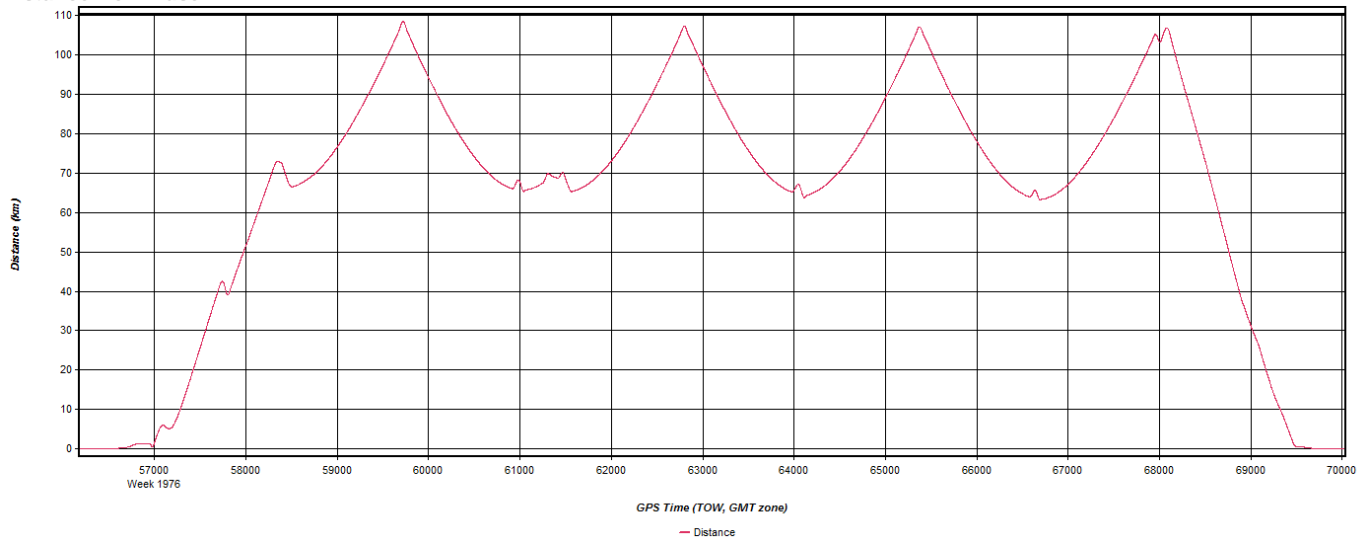
Combined Forward/Reverse Weighting



PDOP

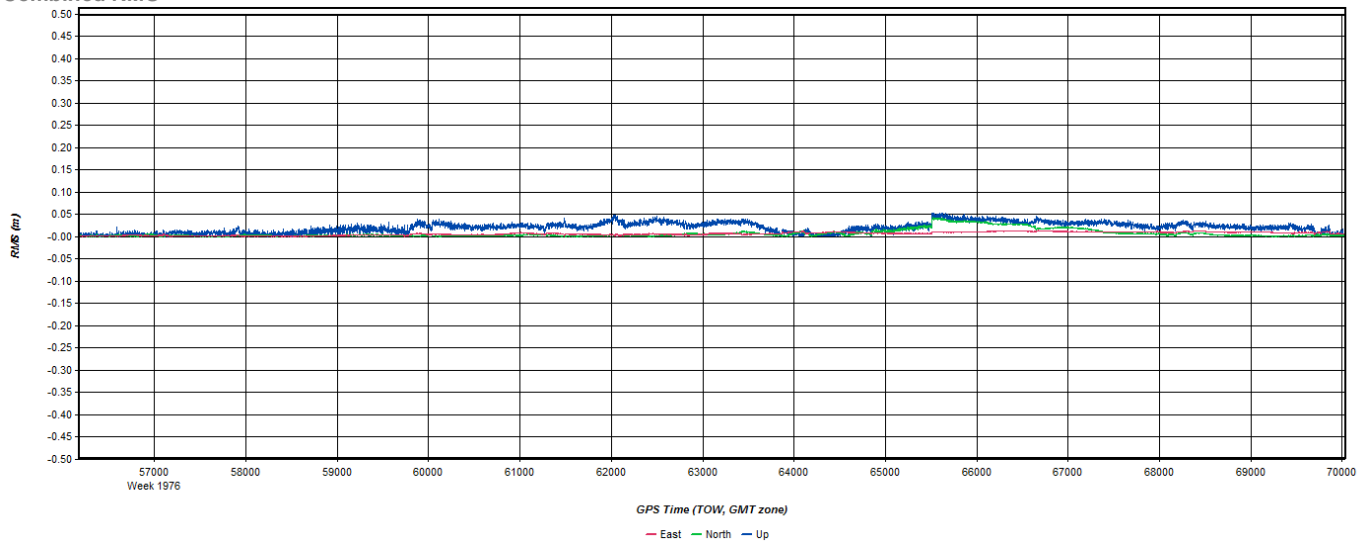


Distance from Base

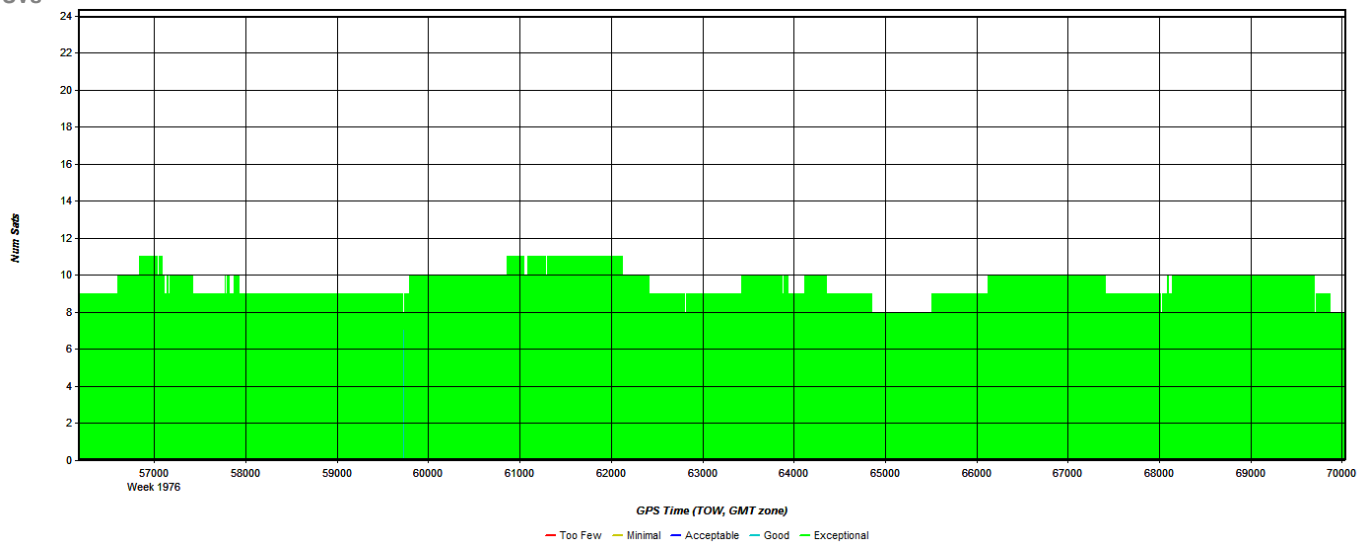




Combined RMS



SVs



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Acquisition and Processing details ----- Collection 27 (November 22, 2017)

Log:

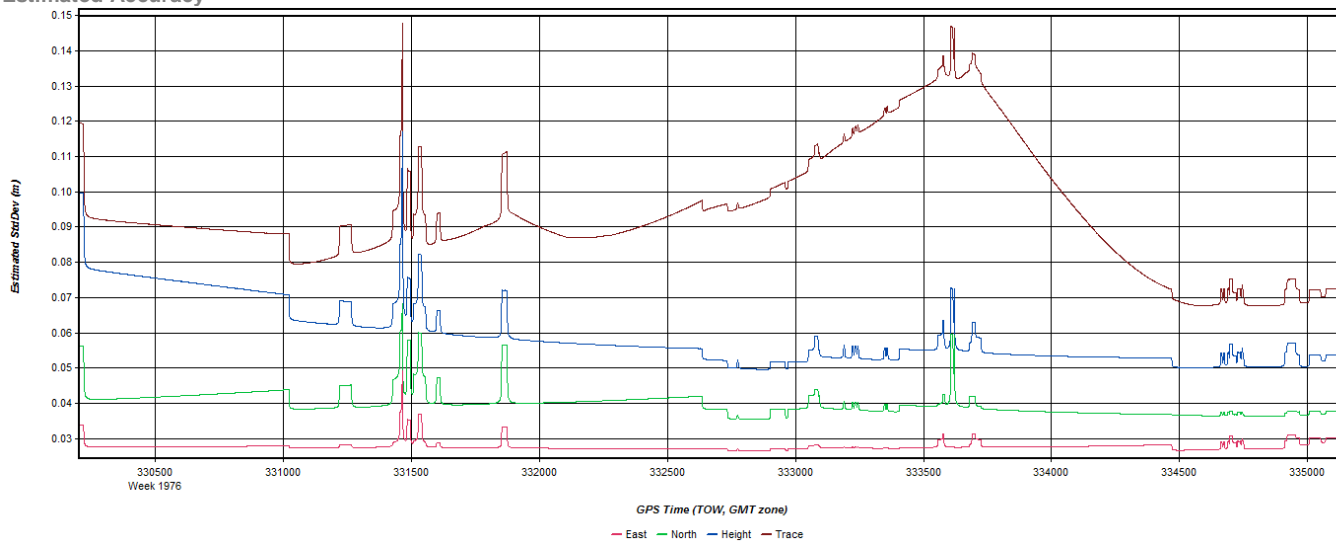
17.06	Lift Begin			Lift End			Fit Duration	Fit Hrs	Hobbs Hrs	Activity
	Airport	Chocks	Hobbs	Airport	Chocks	Hobbs				
1	KRAP	19:30	804.6	KRAP	21:07	805.7	1:37	1.50	1.1	0900-Production
2										
3										

Fugro Geospatial, Inc.		Riegl Flight Log AC80-50-00-02													
FGI Job # 22.17003900	Project Name USGS SD Lidar 2017 D17				System 680i	Unit 165	IMU FMU-300				Ground Temp °C 22.0 21.0	Min Range' 1496	Data Logger Drives EU RIEGL 01		
Flight Date 22-Nov-17	GPS Day 17-326	Lift 9				Sun° -	Solar Times (UTC) -	Pulse Rate 330k			Flying Temp °C 16.0 16.0	Max Range' 2844	Download Drive NS1TB-04		
Mission ID (yyymmdd_Sen_Job_Lift) 171122_165_17003900_09		Aircraft N97HC	Airport ID KRAP	FMS CCNS 5	UTC -7	AMT (ft) 2400	Speed 130	FOV 60	Scan Rate (Hz) 110	MTA 2	km/WPT 0.440	AltM Setting 29.99 29.98	Humidity @ Alt 31	Shipping Track	
Pilot #1 Andy Weathers		Pilot #2		Operator #1 Chris Fought		Operator #2									
Base 1 ID FGI 081	Location KRAP		Rec ID GR3 U5	Ant ID Unit 5	ARP (m) 1.8	Start Time (UTC) 11/22/17 1900	Stop Time (UTC) 11/22/17 2200	GPS Filename Unit#51122s		Operator Chris Fought		Data With AB			
Area	Flight #		Wpt		Distance		UTC		Fit Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions	SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End							
						19:47:30	19:52:30						GROUND STATIC	17	1.2
						20:03:00	20:06:00						ALIGNMENT TURNS	17	1.3
East_A	33		80	85	34.8	37	20:08:28	20:09:08	E	4,900	170	130.0		18	1.2
	33		85	80	37	34.8	20:13:36	20:14:32	W	4,900	120	130.0	reciprocal	18	1.2
													change of laser settings to 340khz		
West-N	21		63	58	27.3	25.1	20:37:40	20:38:32	W	5,200	124	130.0		20	1.0
							20:39:00	20:42:00					ALIGNMENT TURNS	20	1.0
							21:02:00	21:05:00					GROUND STATIC	20	1.0

Trajectory and GPS Plots:

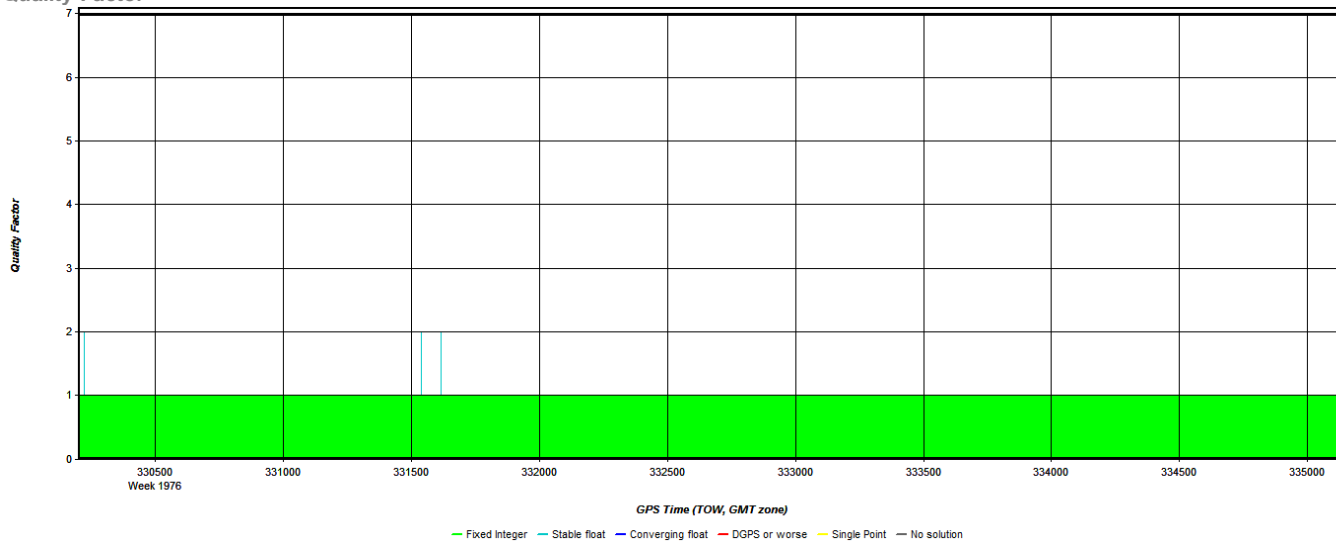


Estimated Accuracy

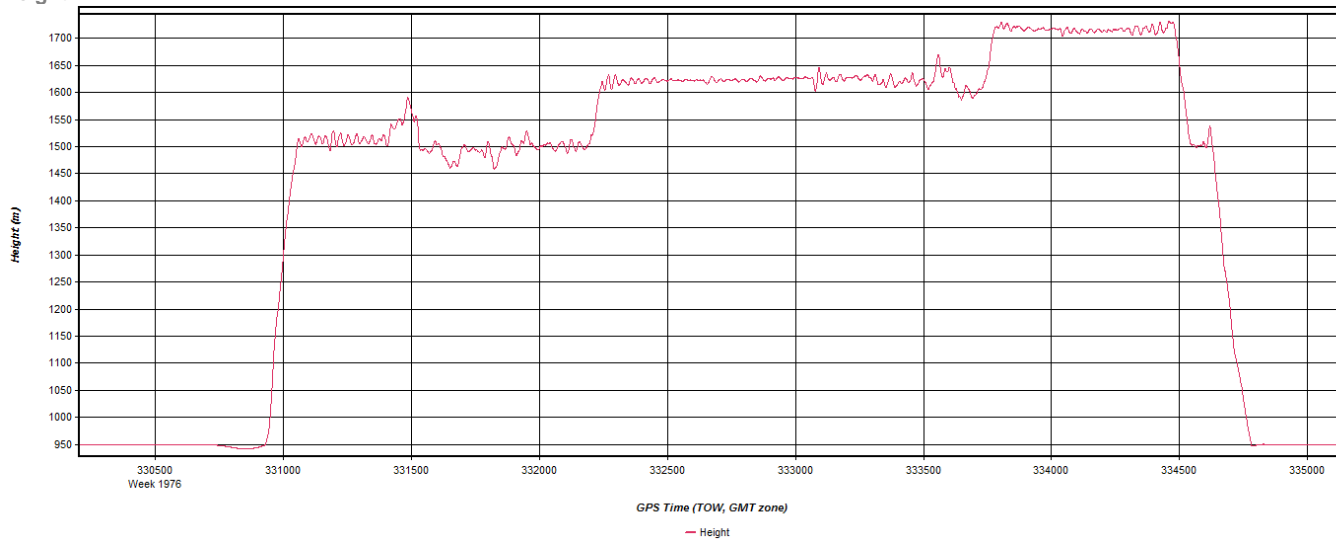




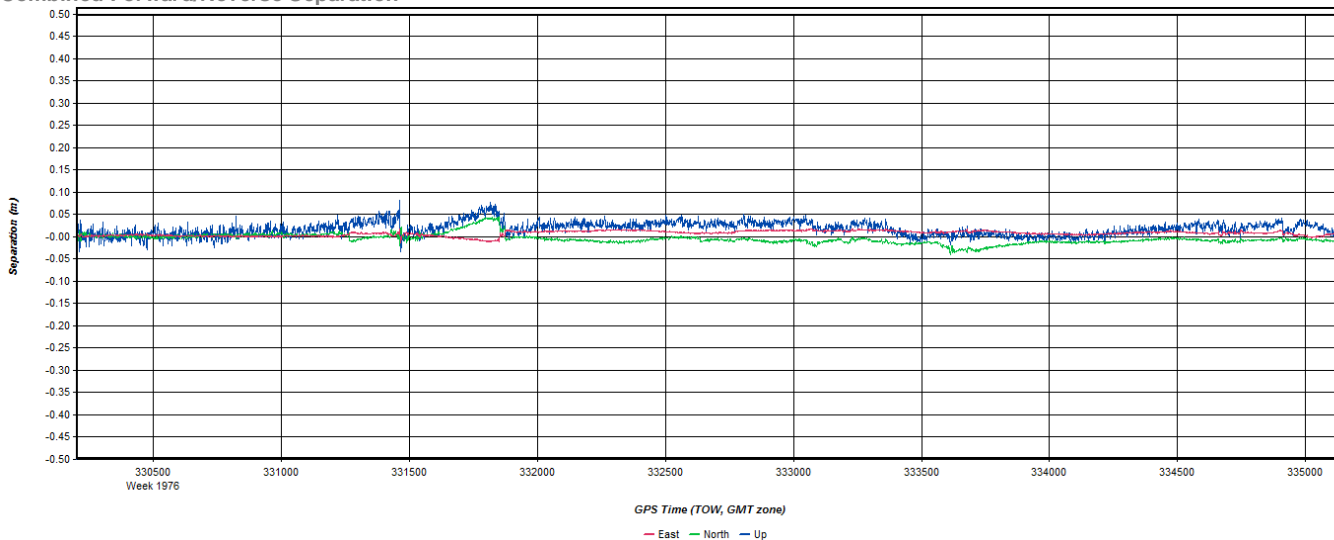
Quality Factor



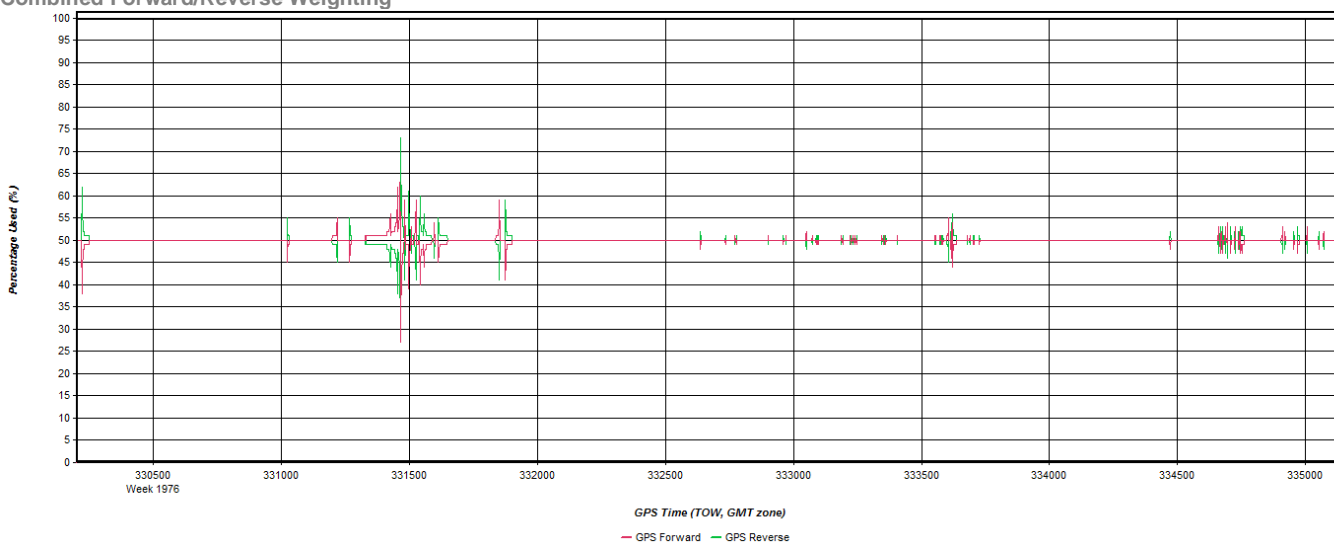
Height



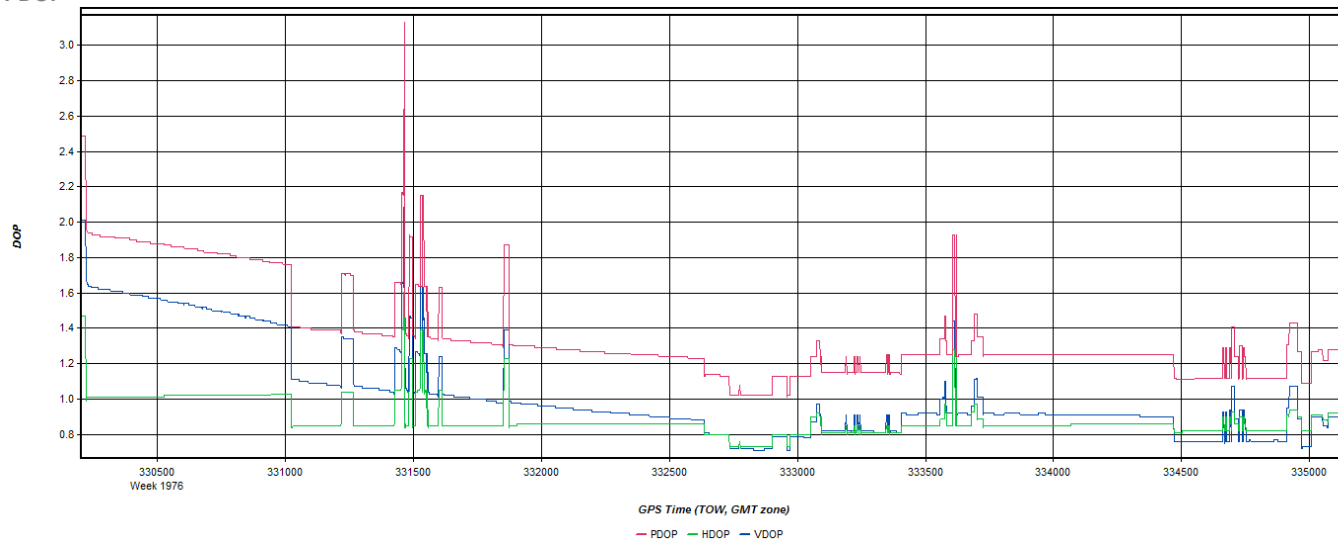
Combined Forward/Reverse Separation



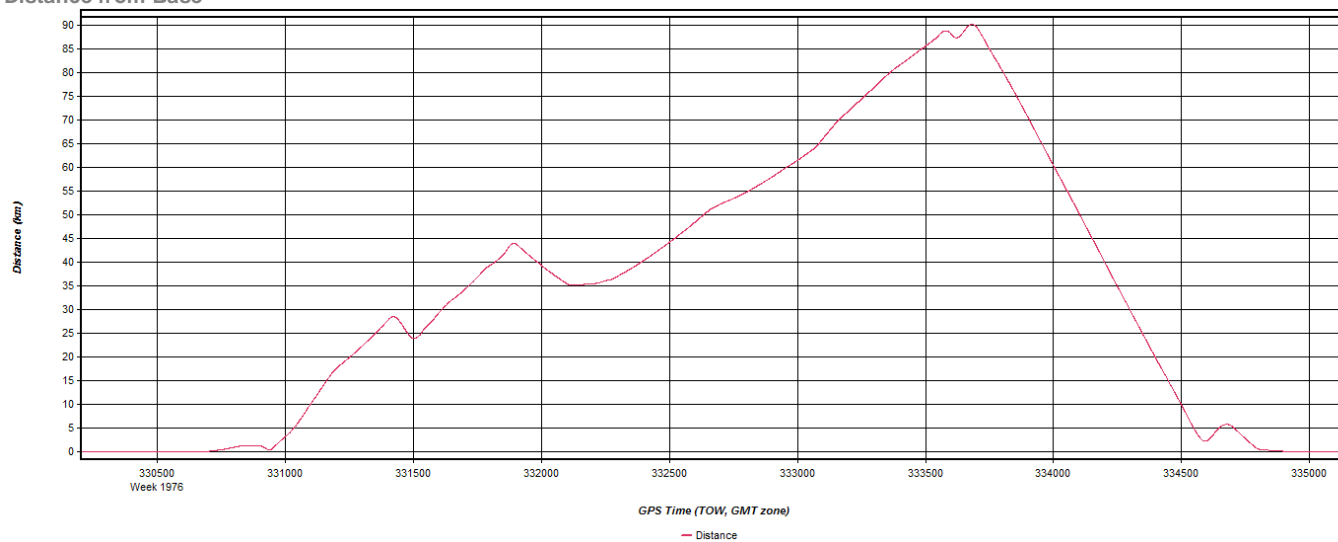
Combined Forward/Reverse Weighting



PDOP

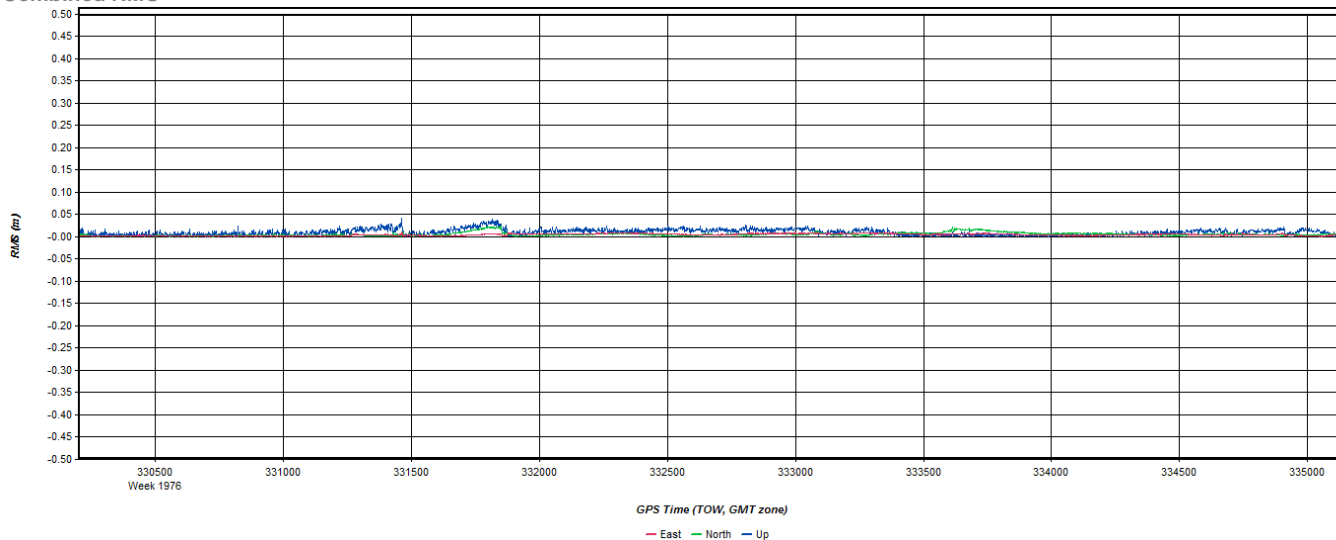


Distance from Base

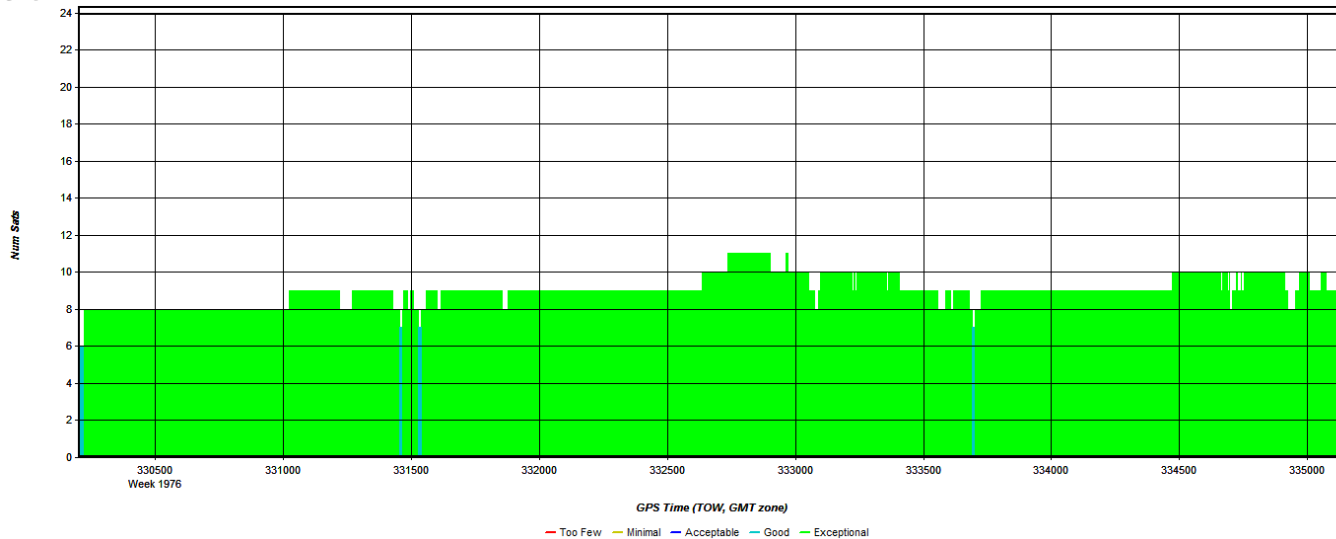




Combined RMS



SVs





Acquisition and Processing details ----- Collection 28 (November 30, 2017)

Log:

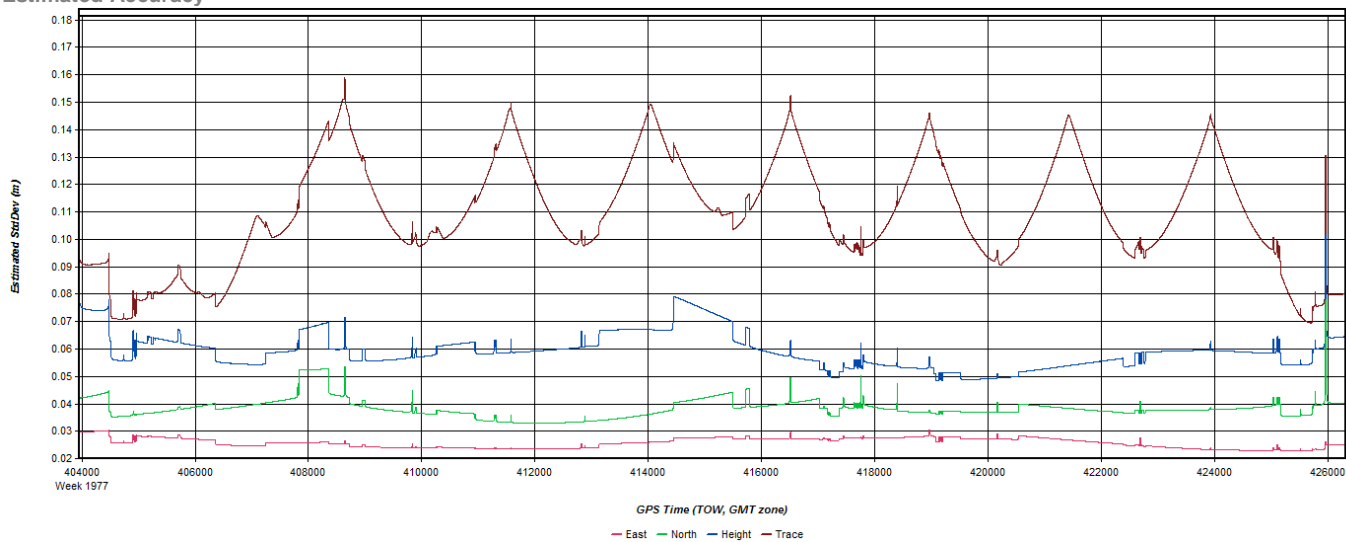
FUGRO		Fugro Geospatial, Inc.										Riegl Flight Log	
17.06		Lift Begin			Lift End			Flt	Flt	Hobbs	Activity		
		Airport	Chocks	Hobbs	Airport	Chocks	Hobbs	Duration	Hrs	Hrs			
1		KRAP	16:04	818.3	KRAP	22:27	824.1	6:22	6:25	5:8	0900-Production		
2													
3													

FGI Job # 17003900	Project Name USGS SD Lidar 2017 D17			System 680i	Unit 165	IMU FMU-300			Ground Temp °C 2.0	Min Range' 2018	Data Logger Drives EU RIEGL 05				
Flight Date 30-Nov-17	GPS Day 17-334	Lift 10			Sun° N/A	Solar Times (UTC) N/A	Pulse Rate 250K	Flying Temp °C -2.0 0.0		Max Range' 3888	Download Drive passport				
Mission ID (yyymmdd_Sen_Job_Lift) 171130_165_17003900_10		Aircraft N97HC	Airport ID KRAP	FMS CCNS 7	UTC	AMT (ft) 3250	Speed 140	FOV	Scan Rate (Hz) 100	MTA 2	km/WPT 0.596	Altitude Setting 30.02	Humidity @ Alt -09 dew pt	Shipping Track	
Pilot #1 Fred Davis		Pilot #2		Operator #1 Lee Scadden		Operator #2									
Base 1 ID FGI 081	Location Rapid City		Rec ID GR3-1	Ant ID GR3-1	ARP (m) 1.8	Start Time (UTC) 171130-15:01		Stop Time (UTC) 171130-22:50		GPS Filename Unit1 1130p	Operator Lee Scadden	Data With AB			
Area	Flight #		Wpt		Distance		UTC		Flt Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions	SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End							
							16:15:09	16:20:14					5-Minute Ground Static	14	1.4
							16:31:58	16:34:33					S-Turn	17	1.1
West-B-X	2		1	85	0	50.1	16:51:19	17:03:17	360	6,388	140			17	1.0
West B	26		117	1	69.1	0	17:10:51	17:27:52	270	5,791	134		wpt 53 ccns moved line 45d. Then came back on line	18	1.0
	25		1	117	0	69.1	17:32:18	17:49:31	090	6,996	134			18	1.0
	25		117	111	69.1	65.6	17:53:27	17:54:21	270	5,859	134		Calibration line	19	1.0
	24		117	1	69.1	0	18:00:03	18:16:57	270	5,832	138			19	1.1
	23		1	117	0	69.1	18:21:25	18:38:13	090	6,990	135			18	1.1
	22		117	1	69.1	0	18:42:01	18:58:50	270	5,819	137			19	1.1
	21		1	117	0	69.1	19:02:14	19:18:47	090	7,056	133			18	1.1
	20		117	1	69.1	0	19:22:46	19:39:49	270	5,908	136			17	1.2
	19		1	117	0	69.1	19:43:30	20:00:09	090	7,124	134			20	0.9
	18		117	1	69.1	0	20:03:38	20:20:36	270	5,889	136			21	0.9
	17		1	117	0	69.1	20:24:14	20:41:13	090	7,244	137			21	0.9
	16		117	1	69.1	0	20:44:39	21:01:29	270	5,883	133			20	1.0
	15		1	117	0	69.1	21:05:44	21:22:34	090	7,343	135		Possible very light snow in spots from wpt 1-26	19	1.1
	14		117	1	69.1	0	21:26:48	21:43:48	270	5,892	136		wpt 45-44, 24-1 possibl w very light snow in spots	20	1.0
	13		1	117	0	69.1	21:46:54	22:03:32	090	7,390	134		wpt 1-24, 46-49 possible very light snow in spots	18	1.2
							22:03:36	22:05:17					S-Turn	20	0.9
							22:19:29	22:24:37					5-Minute Ground Static	18	0.9

Trajectory and GPS Plots:

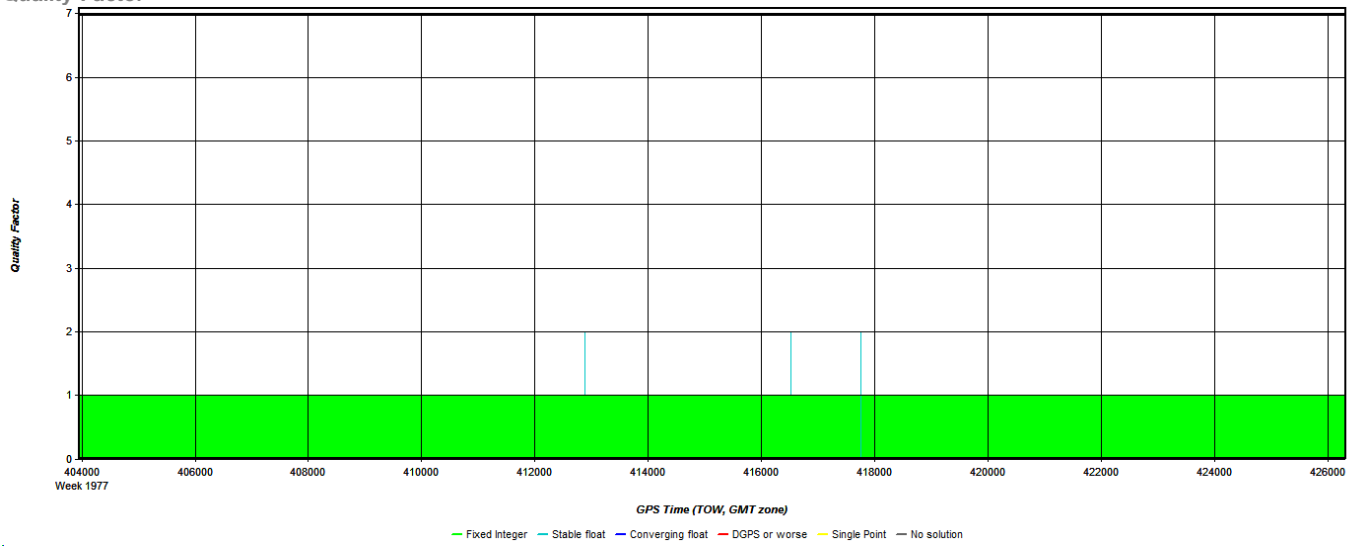


Estimated Accuracy

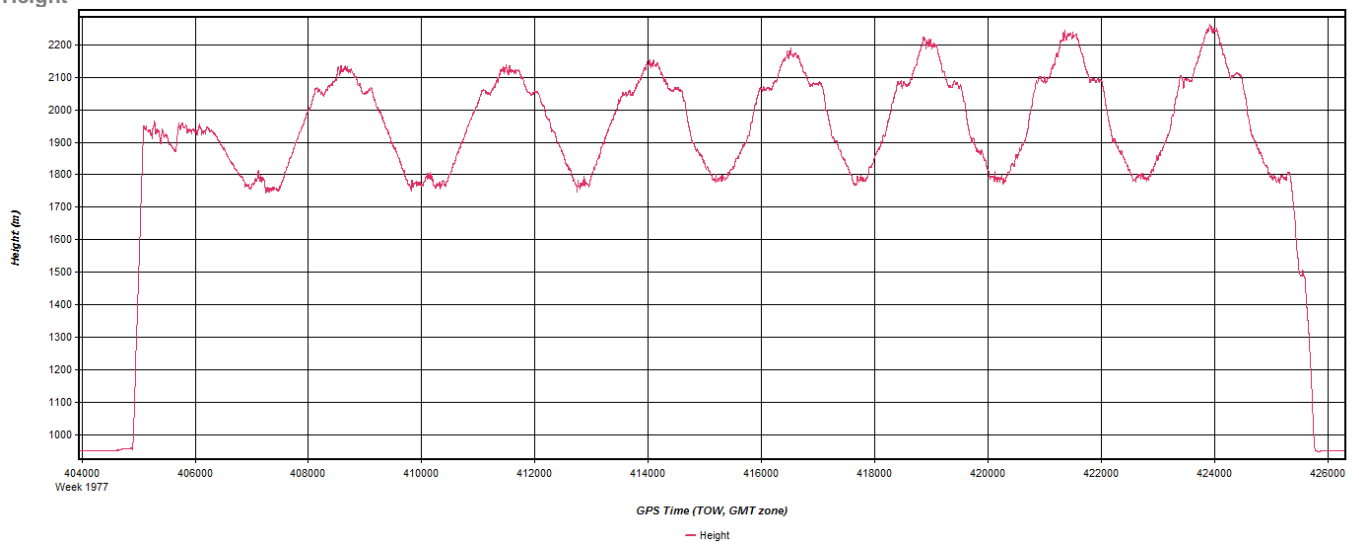


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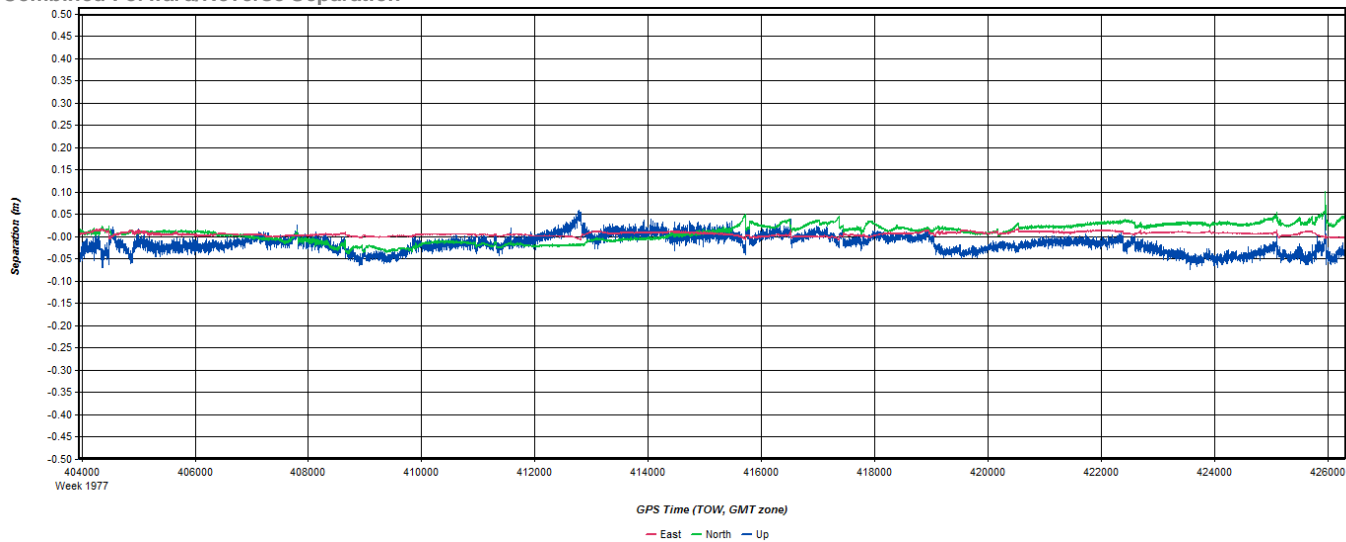
Quality Factor



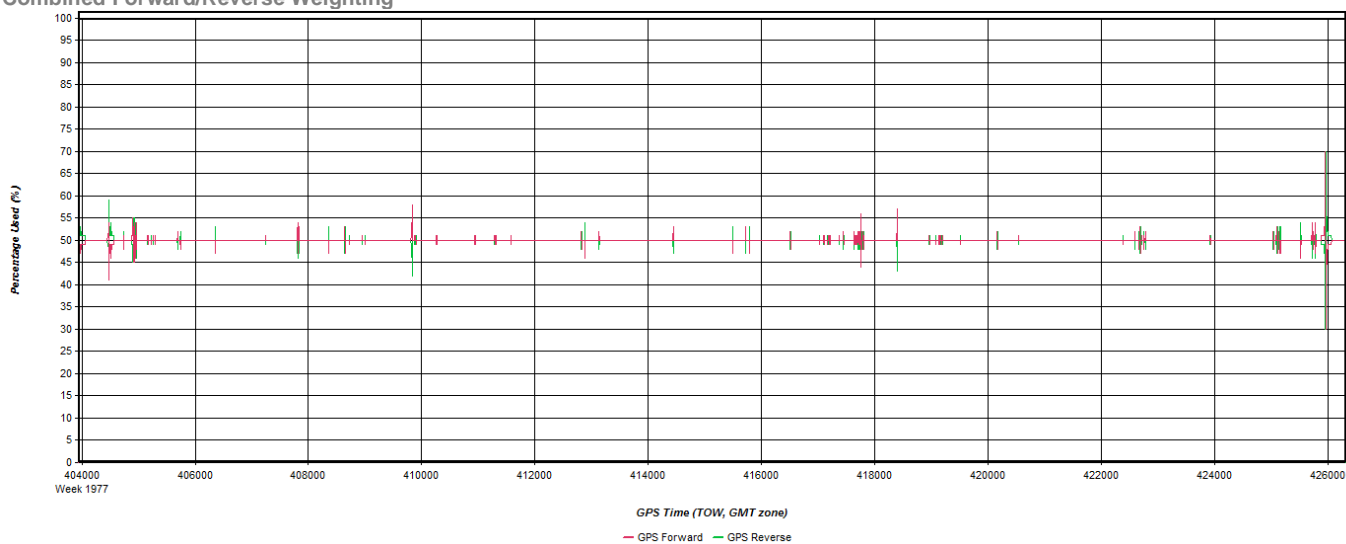
Height



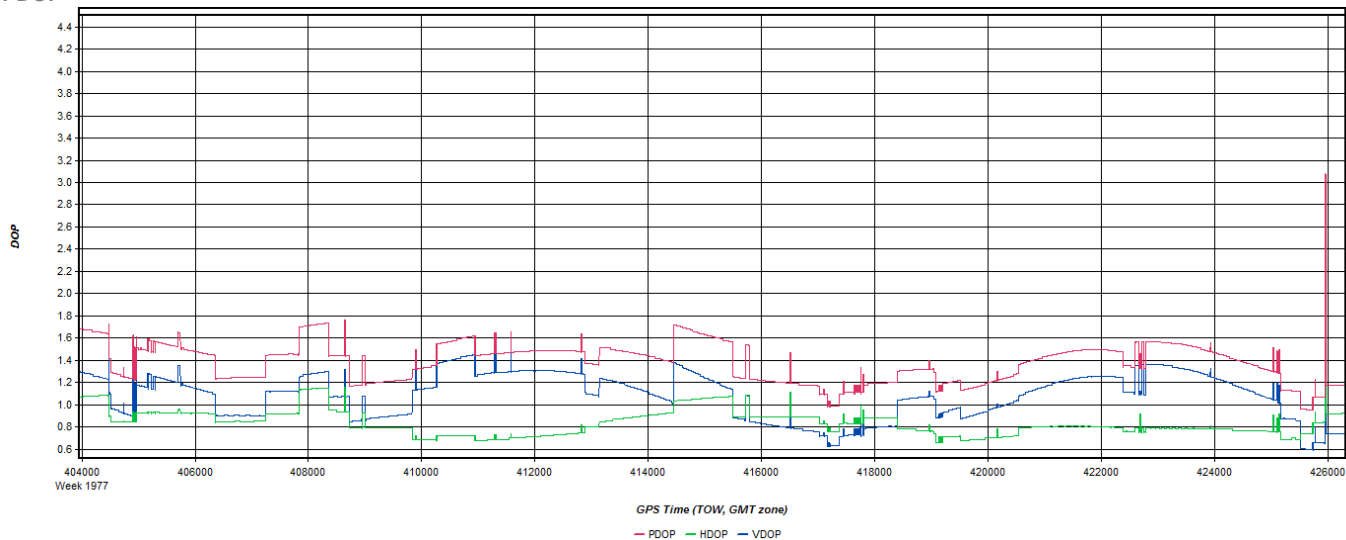
Combined Forward/Reverse Separation



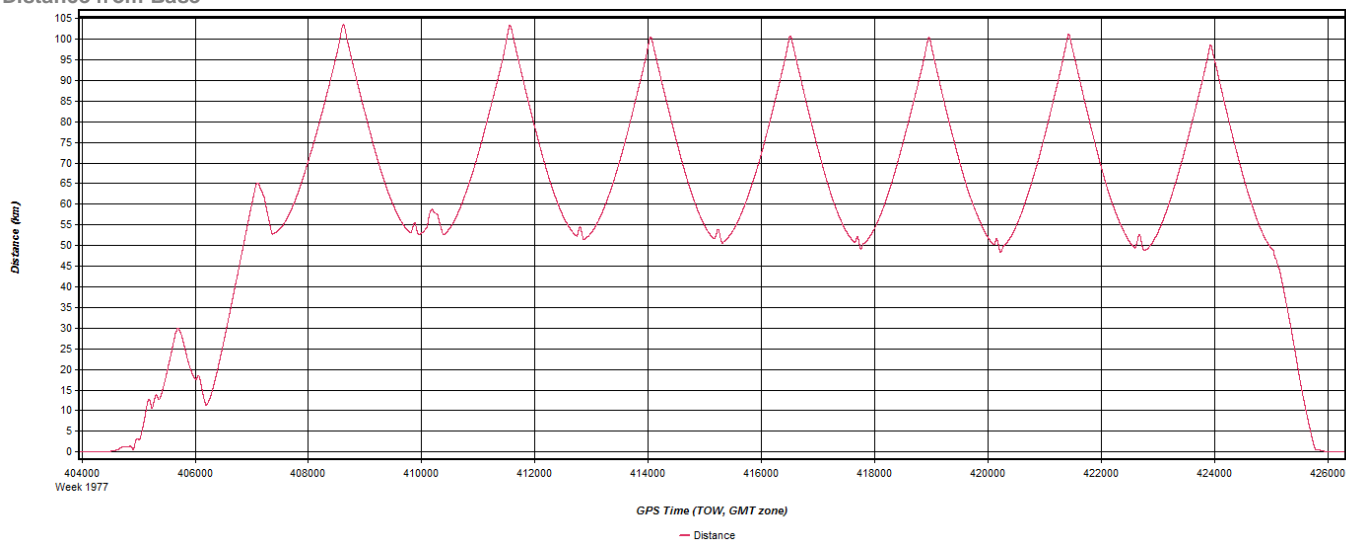
Combined Forward/Reverse Weighting



PDOP

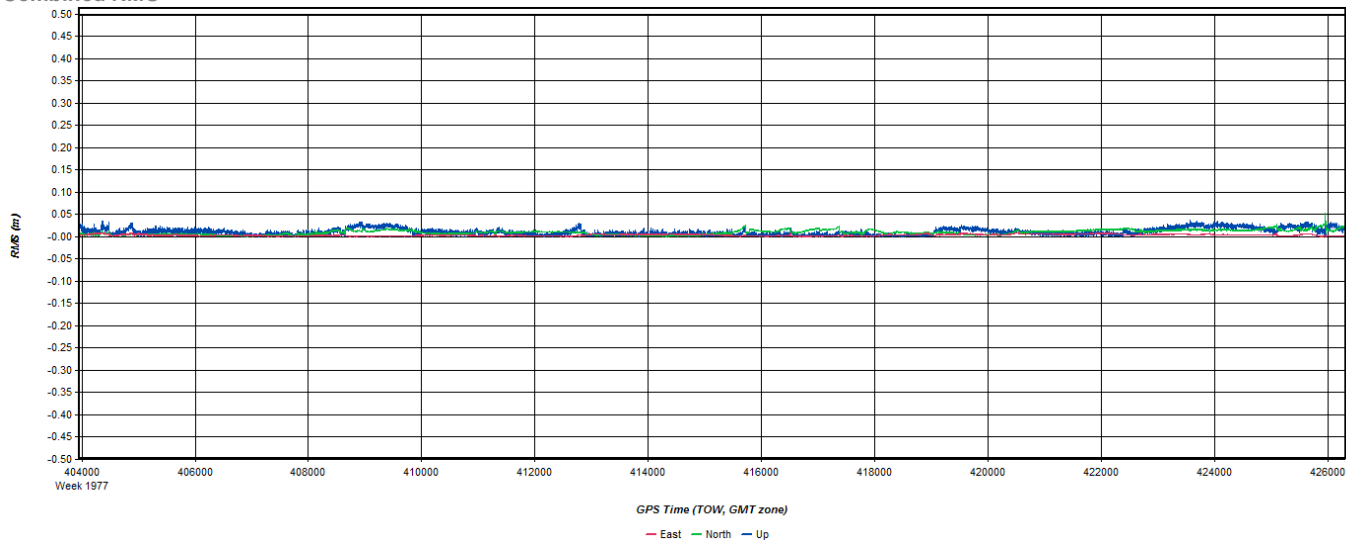


Distance from Base

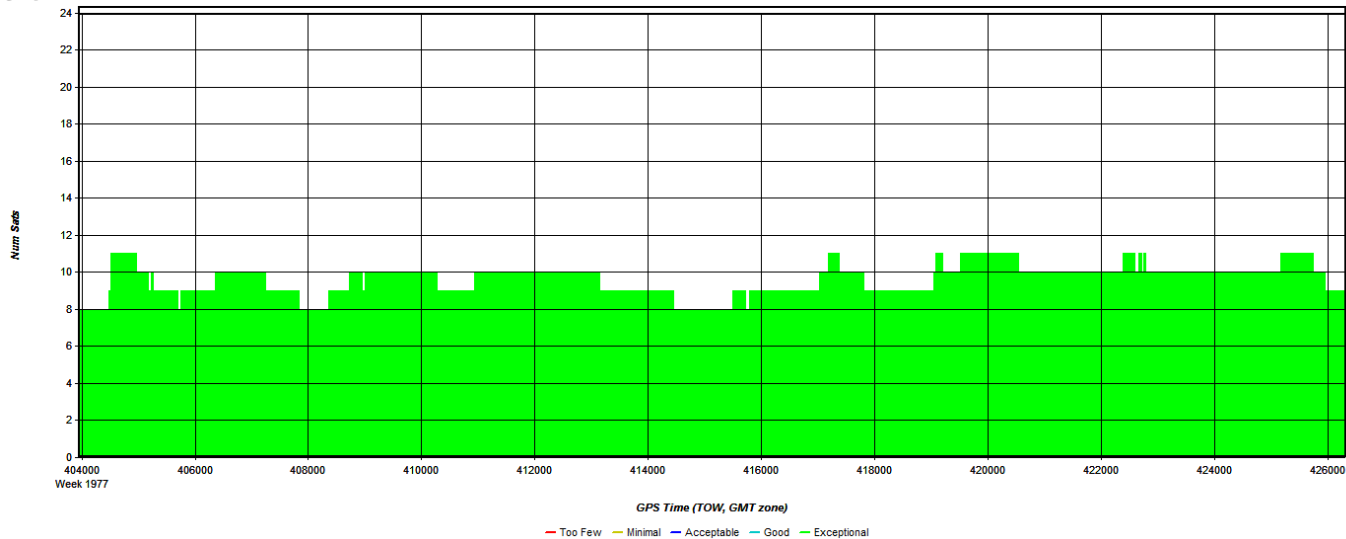




Combined RMS



SVs





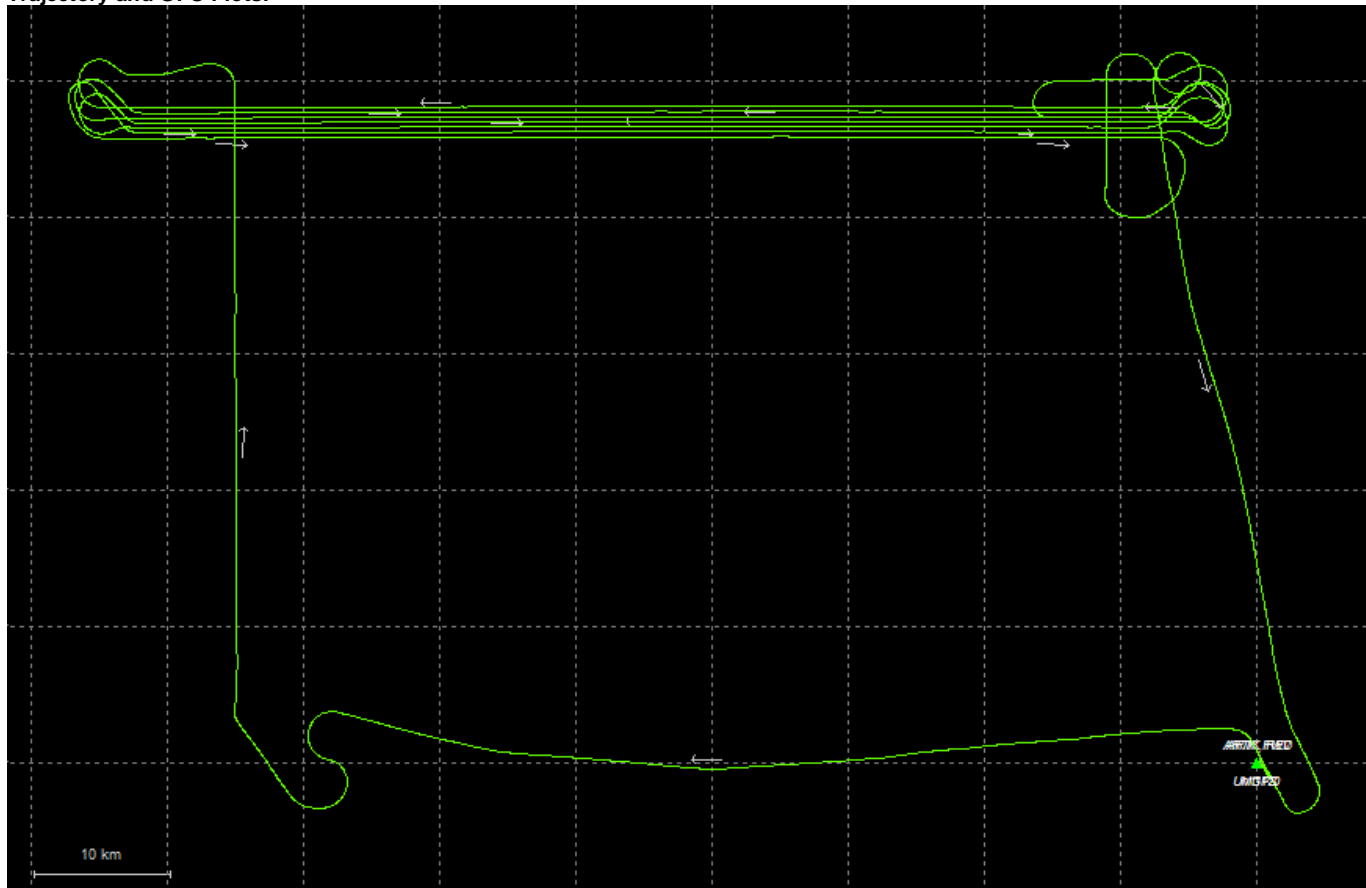
Acquisition and Processing details ----- Collection 29 (December 1, 2017)

Log:

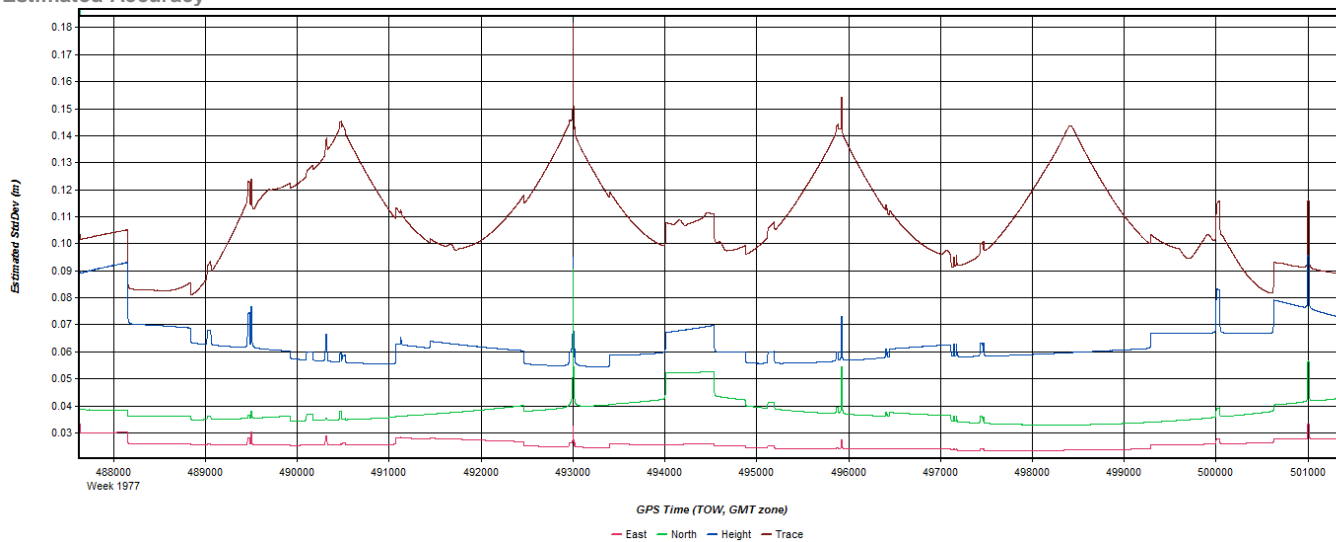
FUGRO Geospatial, Inc.												Riegl Flight Log	
17.06												AC80-50-00-02	
Lift Begin			Lift End			Flt	Flt	Hobbs	Activity				
Airport	Chocks	Hobbs	Airport	Chocks	Hobbs	Duration	Hrs	Hrs					
1	KRAP	15:20	824.1	KRAP	19:18	827.5	3:58	4.00	3.4	0900-Production			
2													
3													

FGI Job # 17003900	Project Name USGS SD Lidar 2017 D17		System 680i	Unit 165	IMU FMU-300			Ground Temp °C 2.0 11.0	Min Range' 2018	Data Logger Drives EU RIEGL 03					
Flight Date 1-Dec-17	GPS Day 17-335	Lift 11	Sun° N/A		Solar Times (UTC) N/A	Pulse Rate 250K	Flying Temp °C 0.0 0.0		Max Range' 3888	Download Drive NS2TB-05					
Mission ID (yyymmdd_Sen_Job_Lift) 171201_165_17003900_11		Aircraft N97HC	Airport ID KRAP	FMS CCNS 7	UTC	AMT (ft) 3250	Speed 140	FOV	Scan Rate (Hz) 100	MTA 2	km/WPT 0.596	AltM Setting 29.99 30.02	Humidity @ Alt	Shipping Track	
Pilot #1 Fred Davis		Pilot #2		Operator #1 Lee Scadden		Operator #2									
Base 1 ID FGI 081	Location Rapid City		Rec ID GR3-1	Ant ID GR3-1	ARP (m) 1.8	Start Time (UTC) 171201-14:43	Stop Time (UTC) 171201-19:35	GPS Filename Unit 1 1201o		Operator Lee Scadden	Data With AB				
Area	Flight #		Wpt		Distance		UTC		Flt Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions	SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End							
							15:28:45	15:33:48					5-Minute Ground Static	13	1.6
							15:56:44	15:59:02					S-Turn		
West-B-X	1		1	85		ND			ND	ND	ND		wpt 25 N. less snow laird peak N. less snow. Wpt 60 N. no snow		
West B	12		1	117	0	69.1	16:16:14	16:32:45	090	7,490	134			17	1.1
	11		117	1	69.1	0	16:36:48	16:53:51	270	5,946	129			17	1.1
	10		1	117	0	69.1	16:57:29	17:14:03	090	7,594	135			17	1.0
	10		117	112	69.1	66.2	17:18:30	17:19:27	270	5,947	131		Calibration line	19	0.9
	9		117	1	69.1	0	17:25:39	17:42:56	270	5,984	129			17	1.0
	8		1	117	0	69.1	17:46:19	18:02:58	090	7,675	140			19	1.0
	7		117	1	69.1	0	18:07:04	18:24:35	270	6,002	132		turbulence from wpt 55-1 wpy 15 big diversion missed young golden e	18	1.1
	6		1	117	0	69.1	18:28:48	18:45:35	090	7,918	140		turbulent wpt 1-58	19	1.1
West-B-X	2		59	67	34.6	39.3	18:49:39	18:50:57	001	5,952	137		cross/tie line	19	1.1
							18:51:04	18:53:15					S-Turn	18	1.2
							19:11:09	19:16:09					5-Minute Ground Static	17	1.1

Trajectory and GPS Plots:

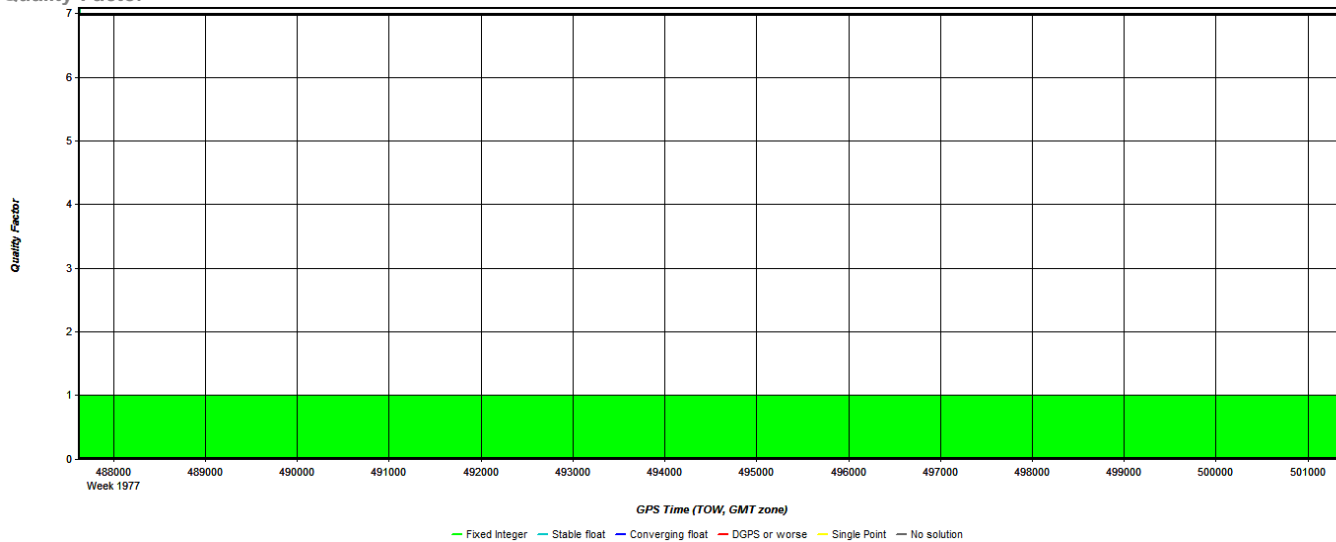


Estimated Accuracy

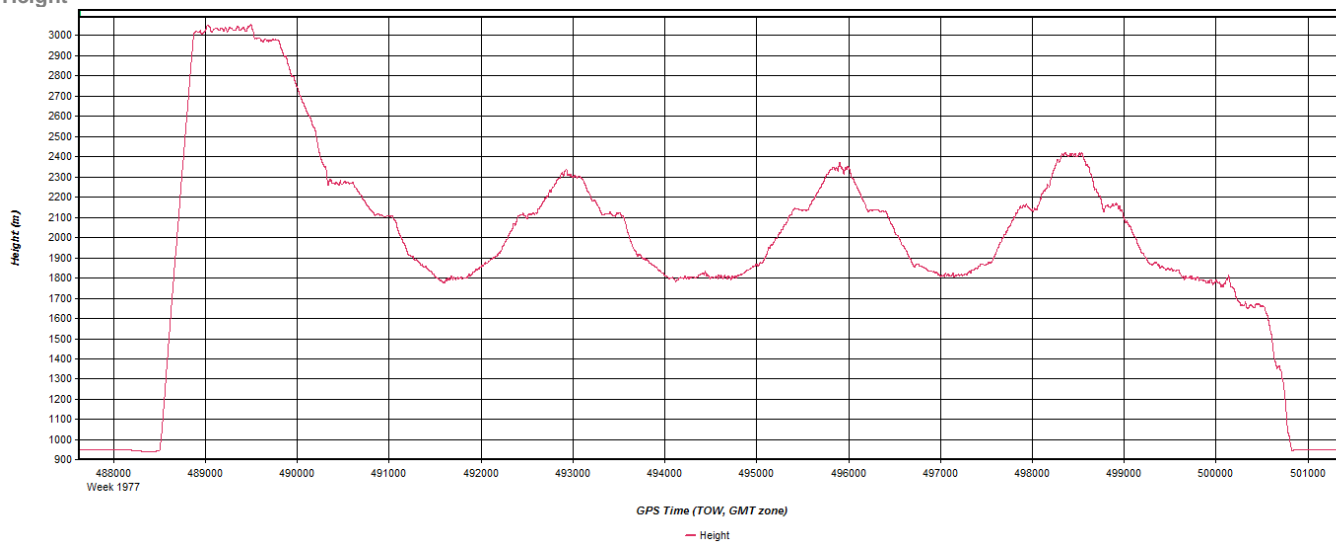




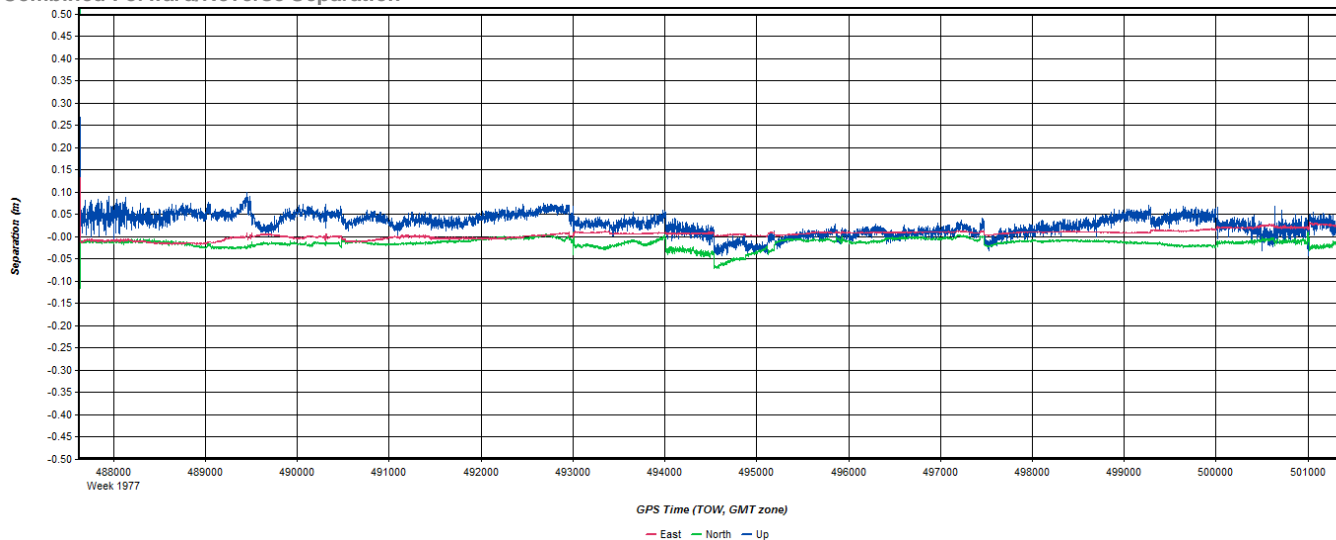
Quality Factor



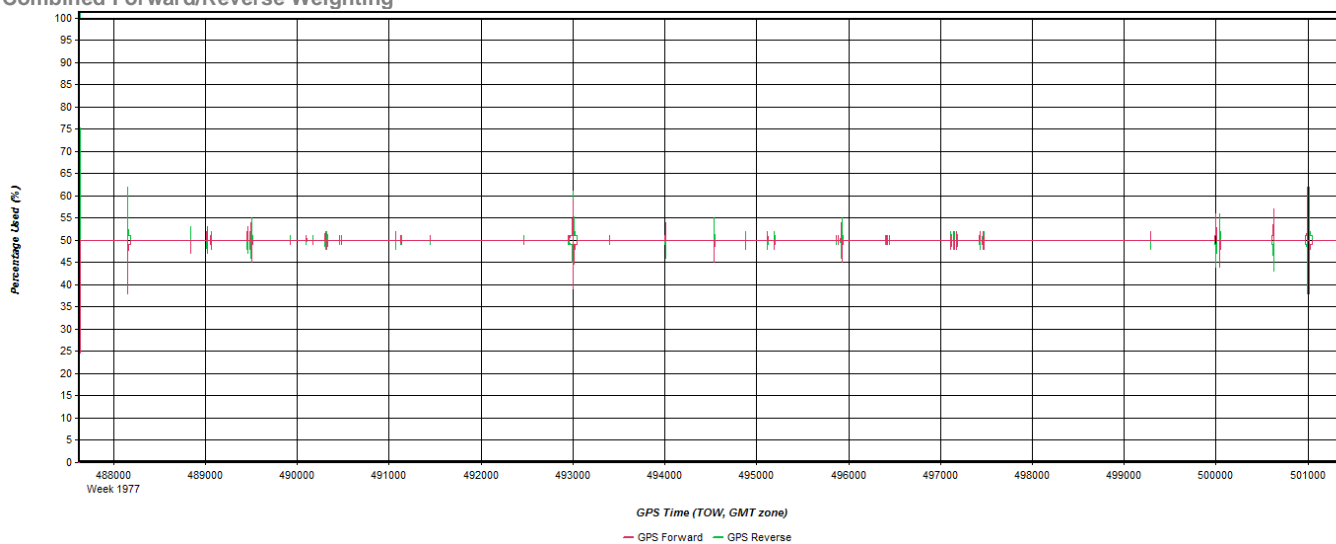
Height



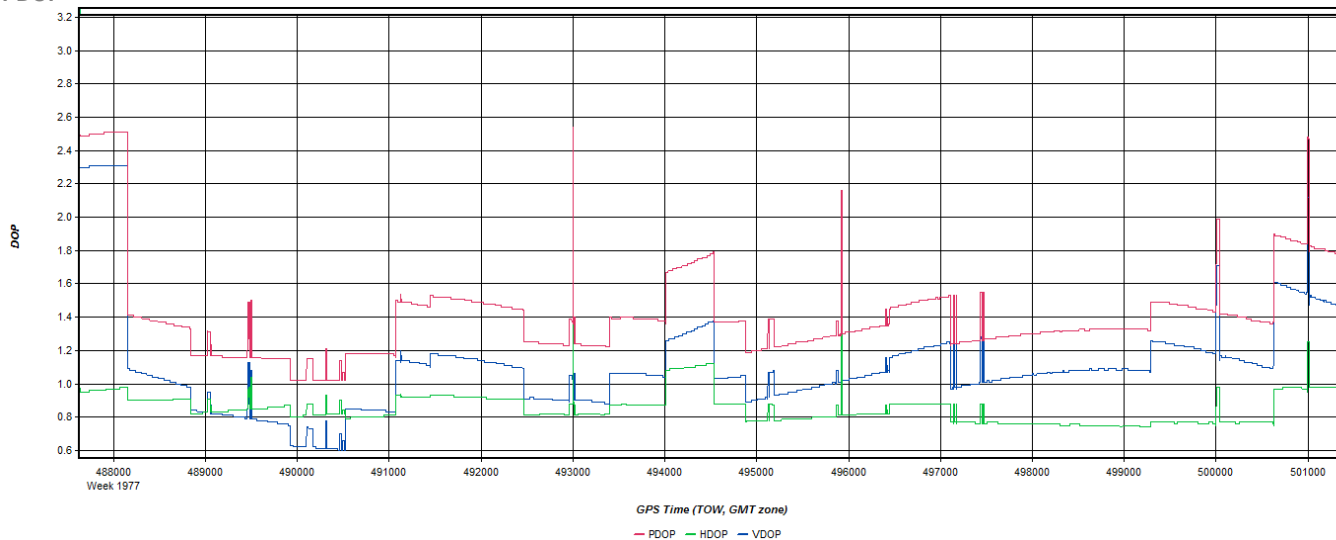
Combined Forward/Reverse Separation



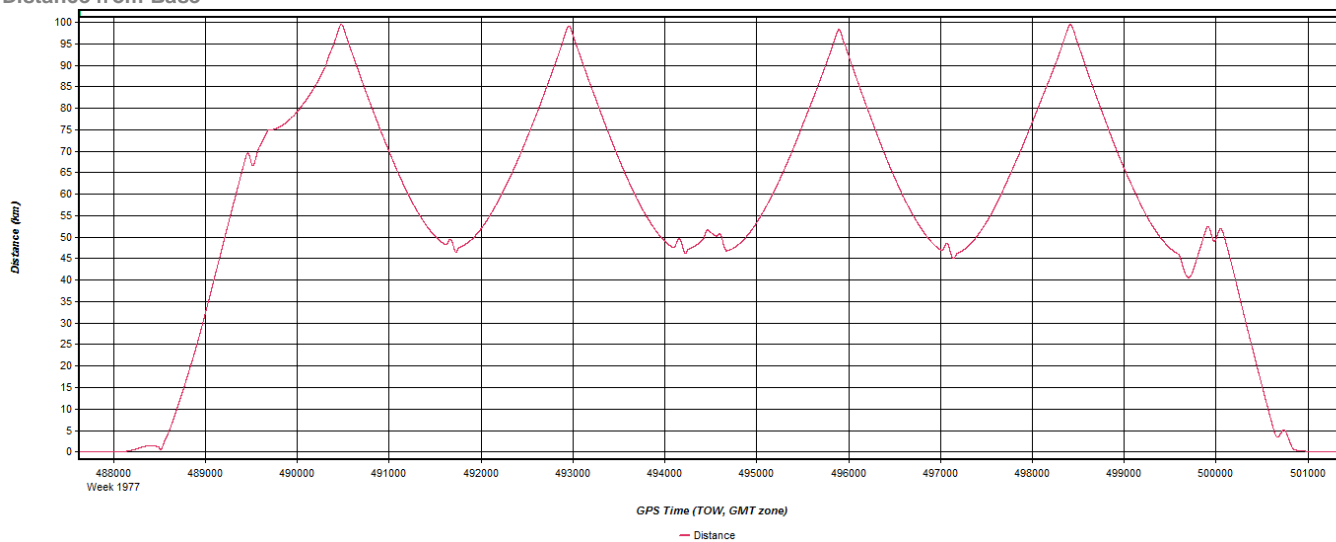
Combined Forward/Reverse Weighting



PDOP

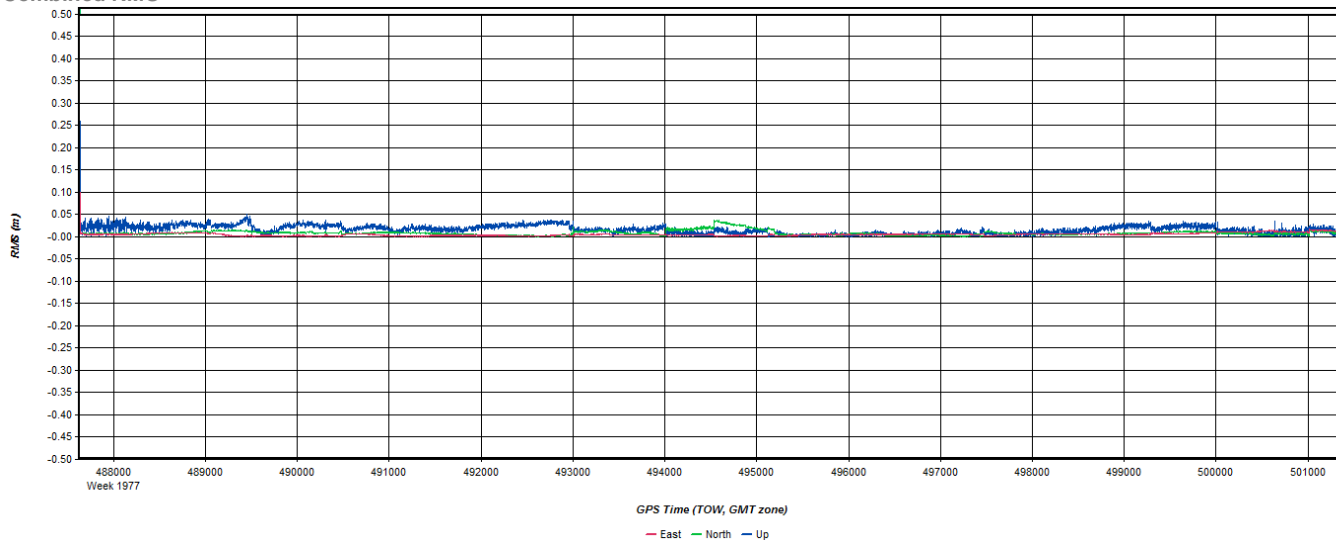


Distance from Base

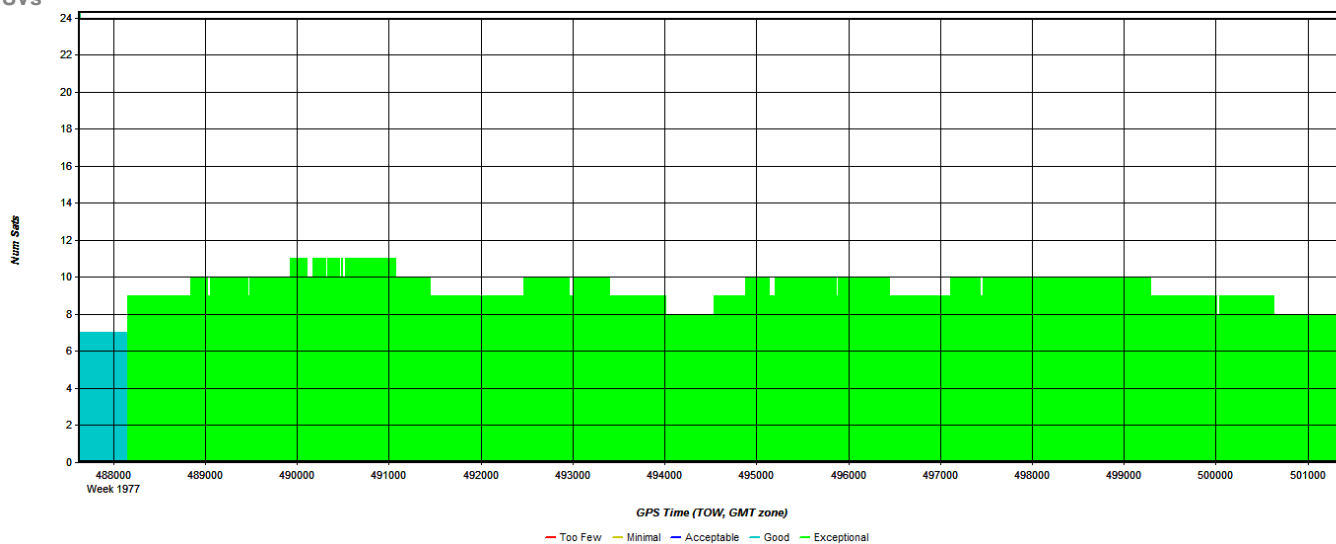




Combined RMS



SVs



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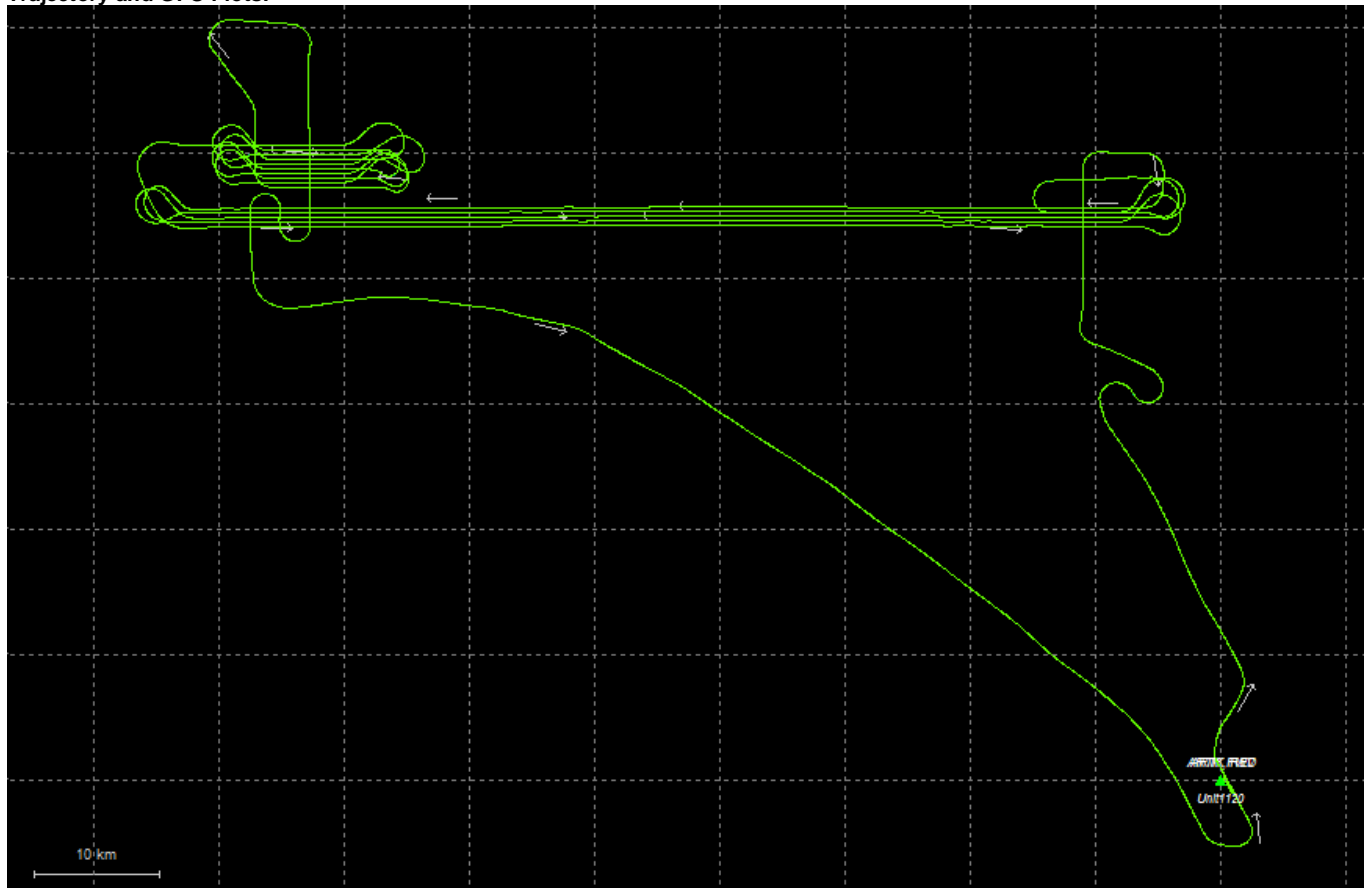
Acquisition and Processing details ----- Collection 30 (December 2, 2017)

Log:

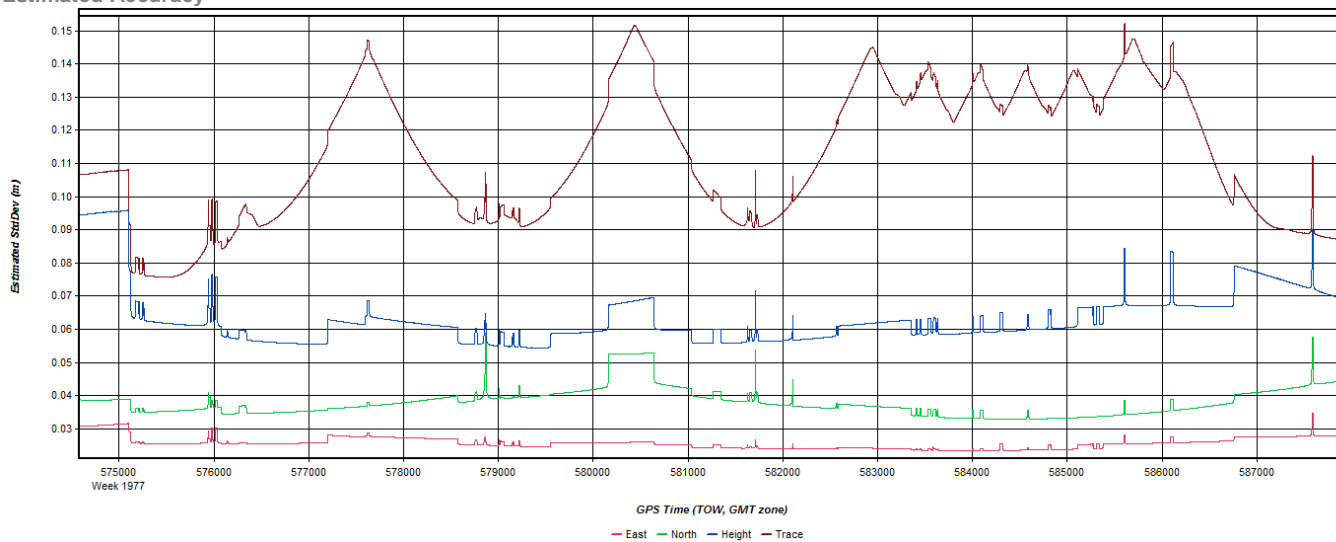
17.06	Lift Begin			Lift End			Flt Duration	Flt Hrs	Hobbs Hrs	Activity
	Airport	Chocks	Hobbs	Airport	Chocks	Hobbs				
1	KRAP	15:27	827.5	KRAP	19:19	830.8	3:52	3.75	3.3	0900-Production
2										
3										

FUGRO		Fugro Geospatial, Inc.		Riegl Flight Log		AC80-50-00-02									
FGI Job # 17003900	Project Name USGS SD Lidar 2017 D17			System 680i	Unit 165	IMU FMU-300	Ground Temp °C 4.0 12.0	Min Range' 2018	Data Logger Drives EU RIEGL 02						
Flight Date 2-Dec-17	GPS Day 17-336	Lift 12		Sun° N/A	Solar Times (UTC) N/A	Pulse Rate 250K	Flying Temp °C 0.0 1.0	Max Range' 3888	Download Drive AP1TB#43						
Mission ID (yyymmdd_Sen_Job_Lift) 171202_165_17003900_12		Aircraft N97HC	Airport ID KRAP	FMS CCNS 7	UTC	AMT (ft) 3250	Speed 140	FOV	Scan Rate (Hz) 100	MTA 2	km/WPT 0.596	AltM Setting 30.00 30.)@	Humidity @ Alt -8c dew	Shipping Track	
Pilot #1 Fred Davis		Pilot #2		Operator #1 Lee Scadden		Operator #2									
Base 1 ID FGI 081	Location Rapid City		Rec ID GR3-1	Ant ID GR3-1	ARP (m) 1.8	Start Time (UTC) 171202-15:02	Stop Time (UTC) 171202-19:35	GPS Filename Unit1 1202p	Operator Lee Scadden	Data With AB					
Area	Flight #		Wpt		Distance		UTC		Flt Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions	SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End							
							15:38:34	15:43:40					5-Minute Ground static	13	1.8
							15:58:32	16:00:17					S-turn	19	0.9
West-B-X	2		56	62	32.8	36.4	16:03:38	16:04:41	360	5,959	137			17	1.2
West-B	5		117	1	69.1	0	16:08:29	16:25:07	270	6,038	139			17	1.2
	4		1	117	0	69.1	16:28:23	16:45:12	090	7,981	137			16	1.3
	4		117	112	69.1	66.2	16:48:46	16:49:39	270	6,102	138		Calibration Line	17	1.0
	3		117	1	69.1	0	16:54:59	17:11:55	270	6,108	140			17	1.0
	2		1	117	0	69.1	17:15:30	17:32:20	090	8,120	132			19	0.9
	1		117	1	69.1	0	17:36:08	17:53:00	270	6,115	134			20	0.9
West-CP	10		1	5	2.4	0	17:58:14	17:59:25	090	7,340	129			18	1.0
	9		5	1	2.4	0	18:02:40	18:03:18	270	7,533	129			18	1.1
	8		1	5	0	2.4	18:06:48	18:07:32	090	7,707	135			18	1.1
	7		7	1	3.6	0	18:11:32	18:12:34	270	7,752	126			18	1.1
	6		1	7	0	3.6	18:15:46	18:16:48	090	8,055	139			18	1.1
	5		6	1	3	0	18:19:45	18:20:36	270	8,051	131			19	1.1
	4		1	6	0	3	18:24:00	18:24:49	090	8,051	139			19	1.1
	3		6	1	3	0	18:28:20	18:29:13	270	8,050	132			19	1.1
	2		1	6	0	3	18:32:27	18:33:16	090	7,957	138			19	1.1
	1		6	1	3	0	18:36:54	18:37:44	270	7,666	133			19	1.1
West-CP-X	11		11	1	6	0	18:44:49	18:46:26	180	7,497	138			19	1.1
							18:46:32	18:48:55					S-Turn	18	1.2
							19:13:04	19:18:12					5-Minute Ground static	16	1.3

Trajectory and GPS Plots:

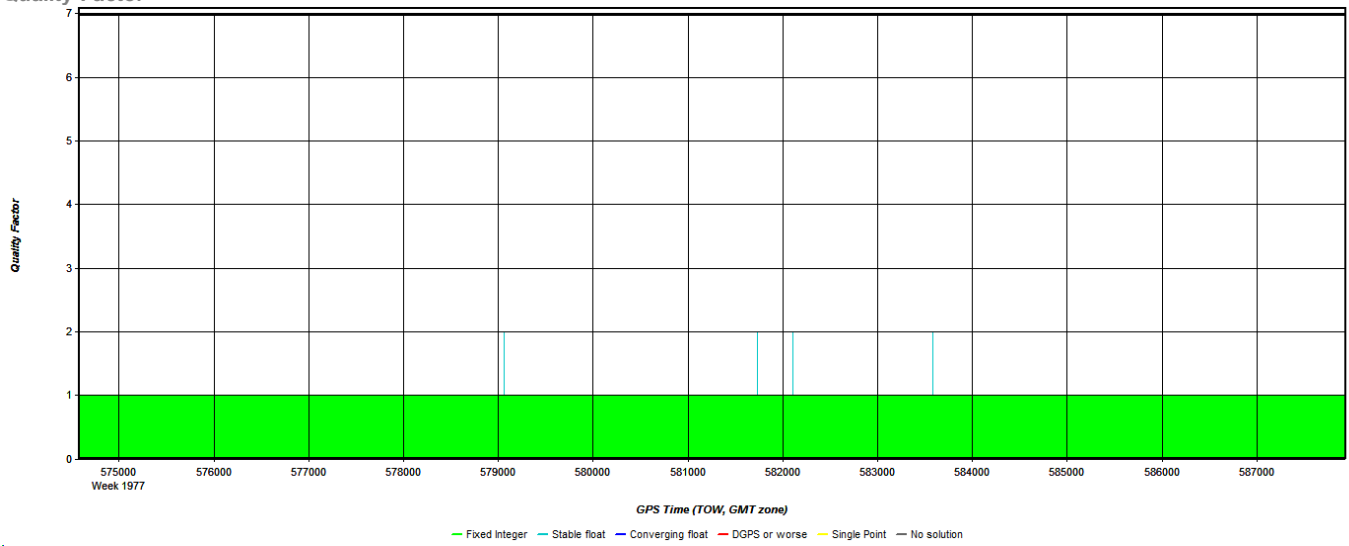


Estimated Accuracy

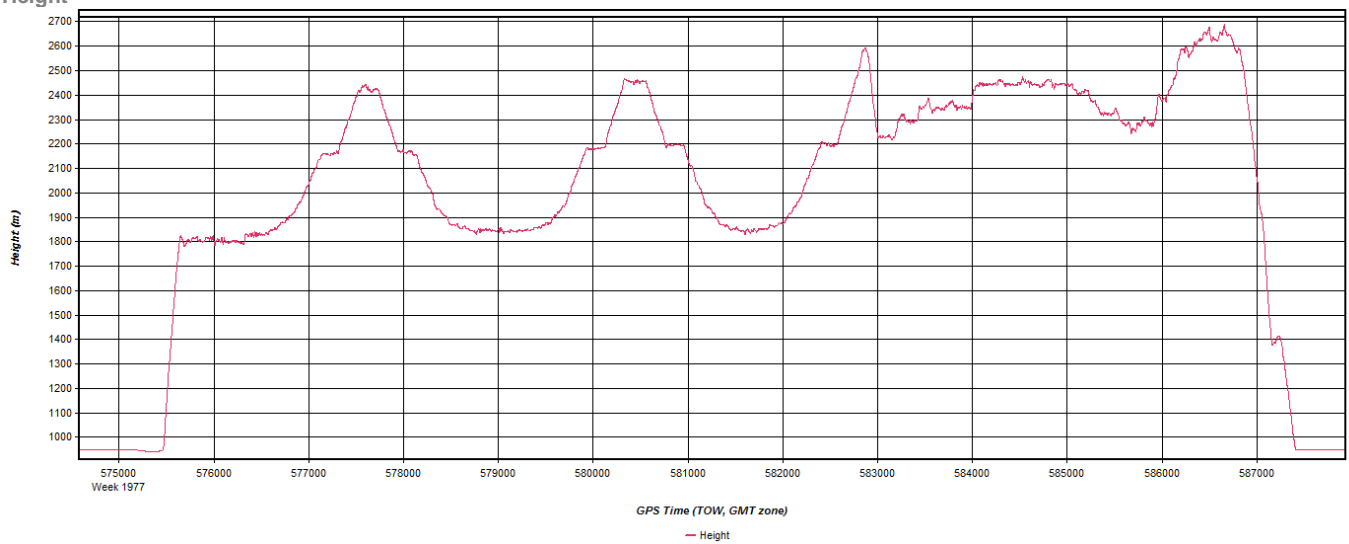


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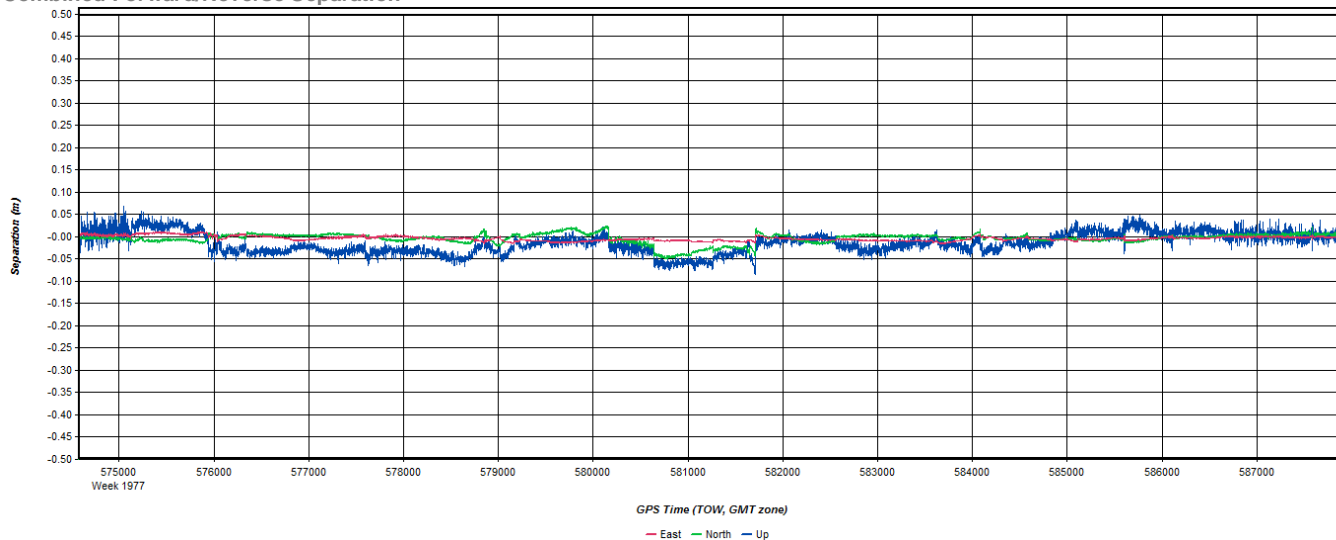
Quality Factor



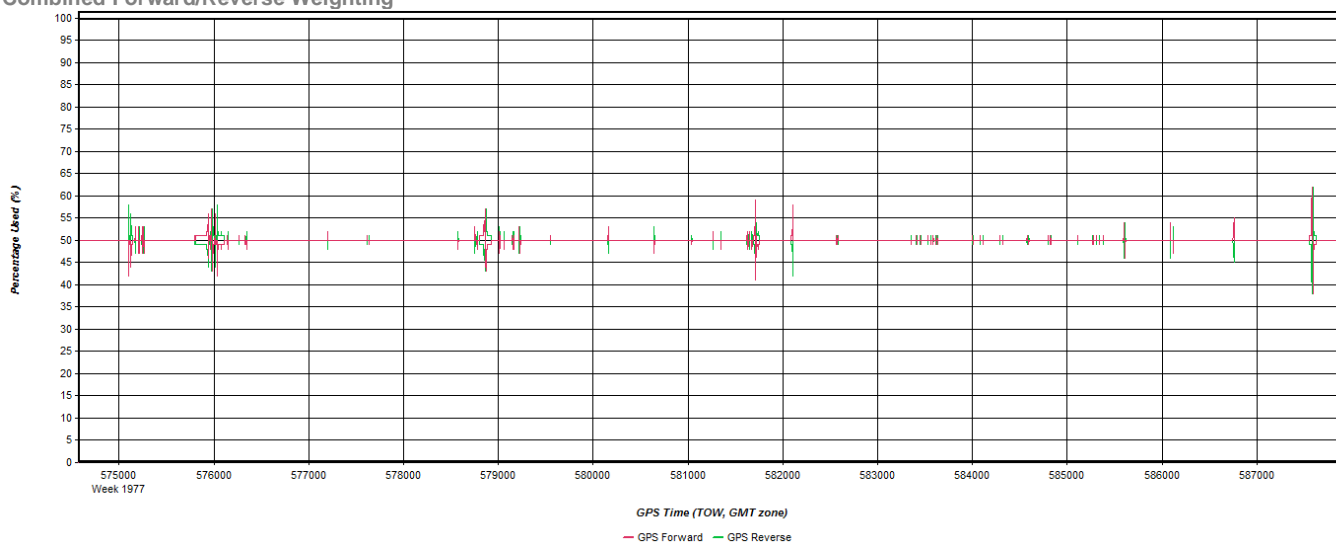
Height



Combined Forward/Reverse Separation

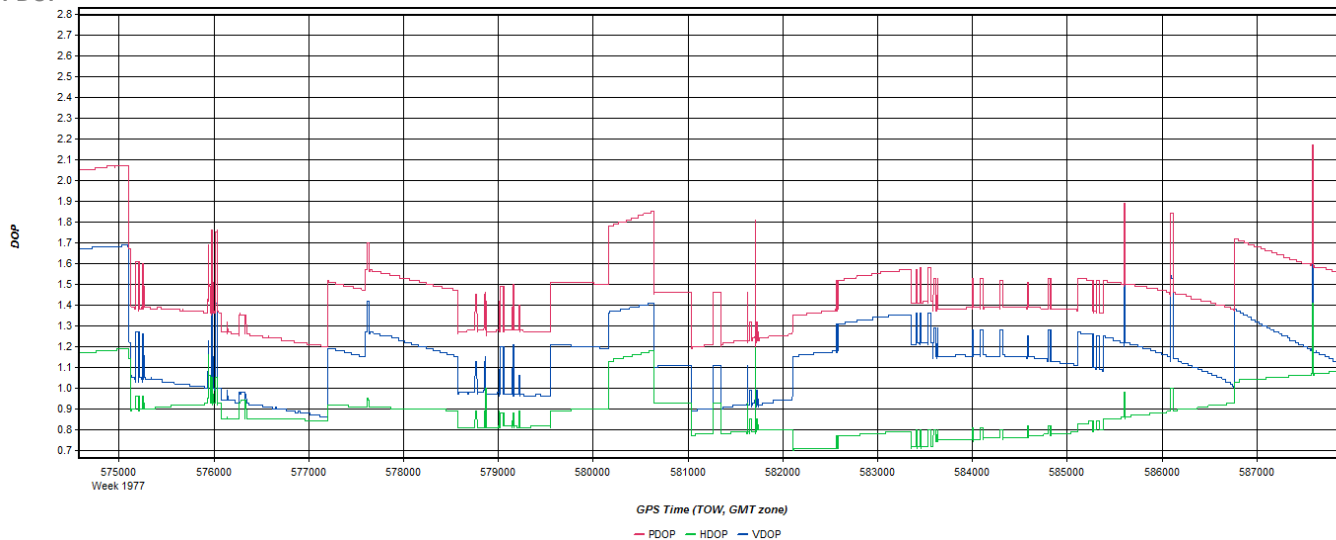


Combined Forward/Reverse Weighting

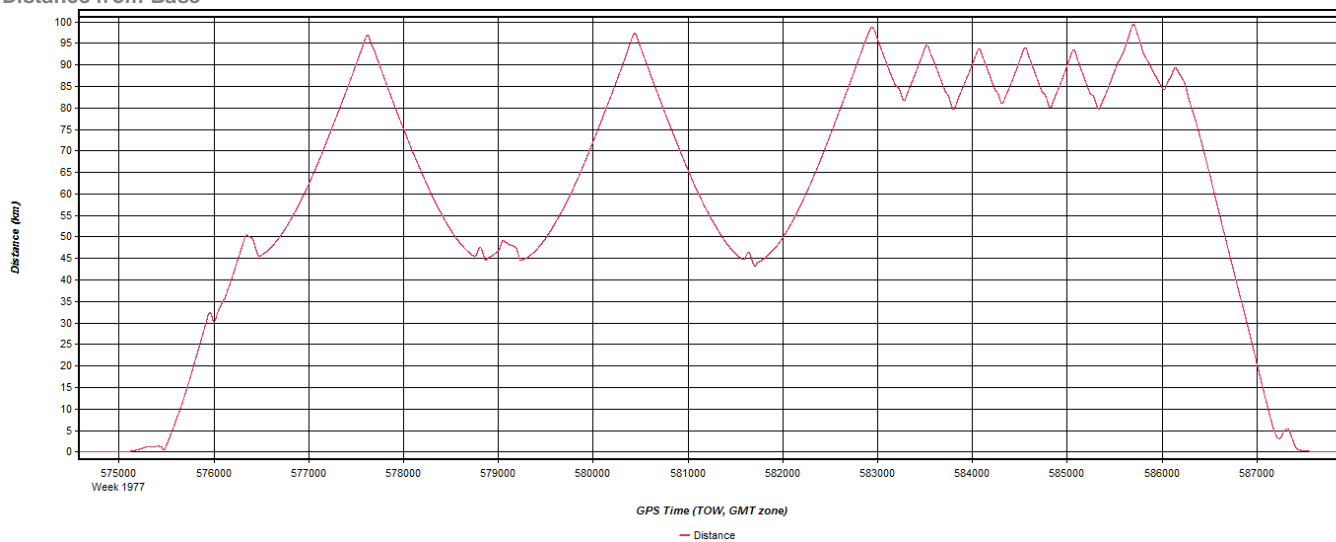




PDOP

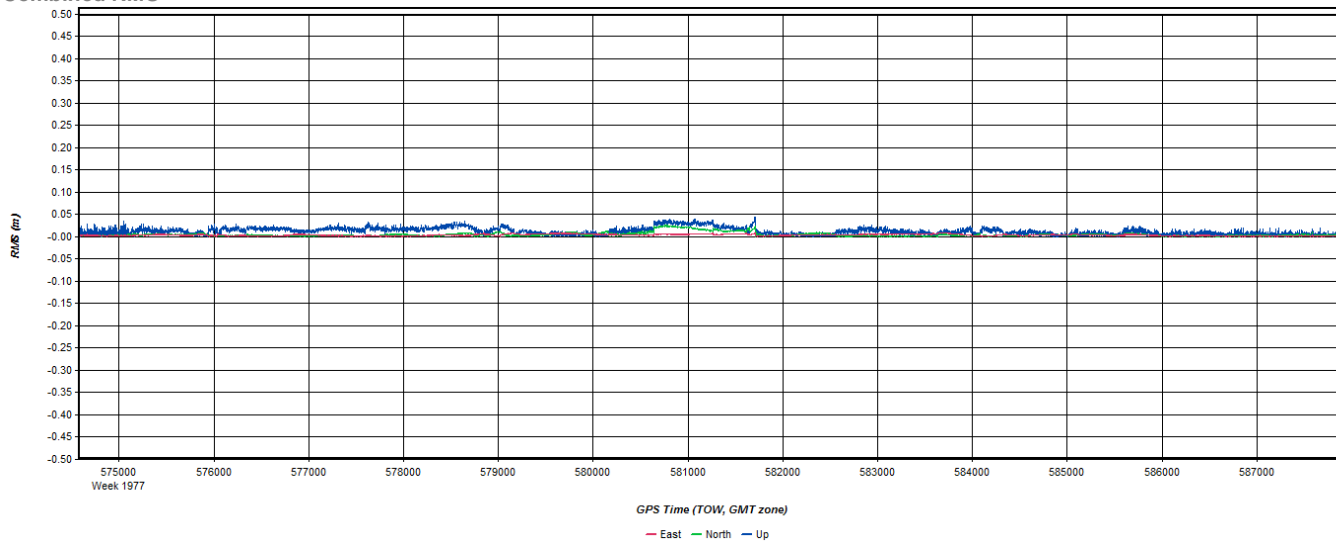


Distance from Base





Combined RMS



SVs

