



FUGRO GEOSPATIAL, INC.

Collection Report – Spring 2018 Collection

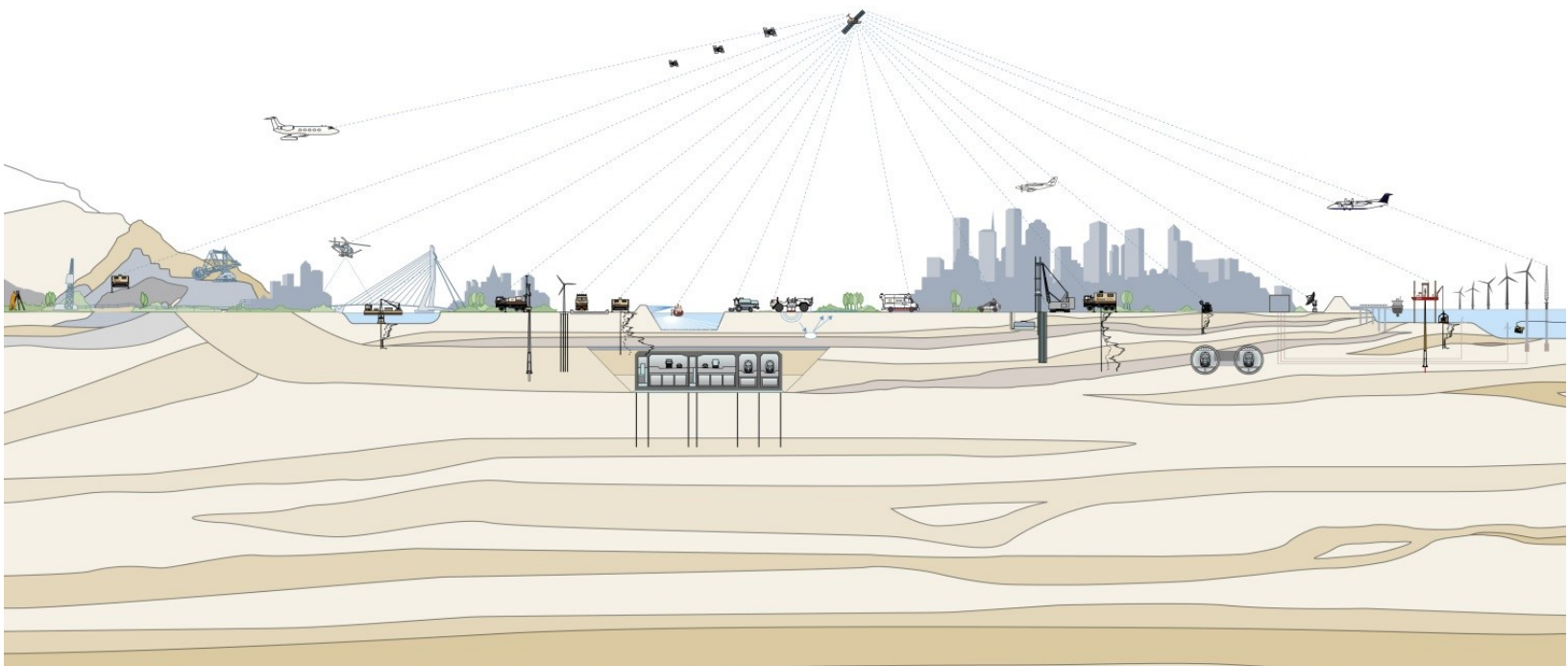
SD_FY17 NRCS Lidar FUGRO_2017_D17

Prepared for:

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

November 30, 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 **spring 2018** acquisition occurred during the acceptable collection windows that existed between May 20 and July 2, 2018.

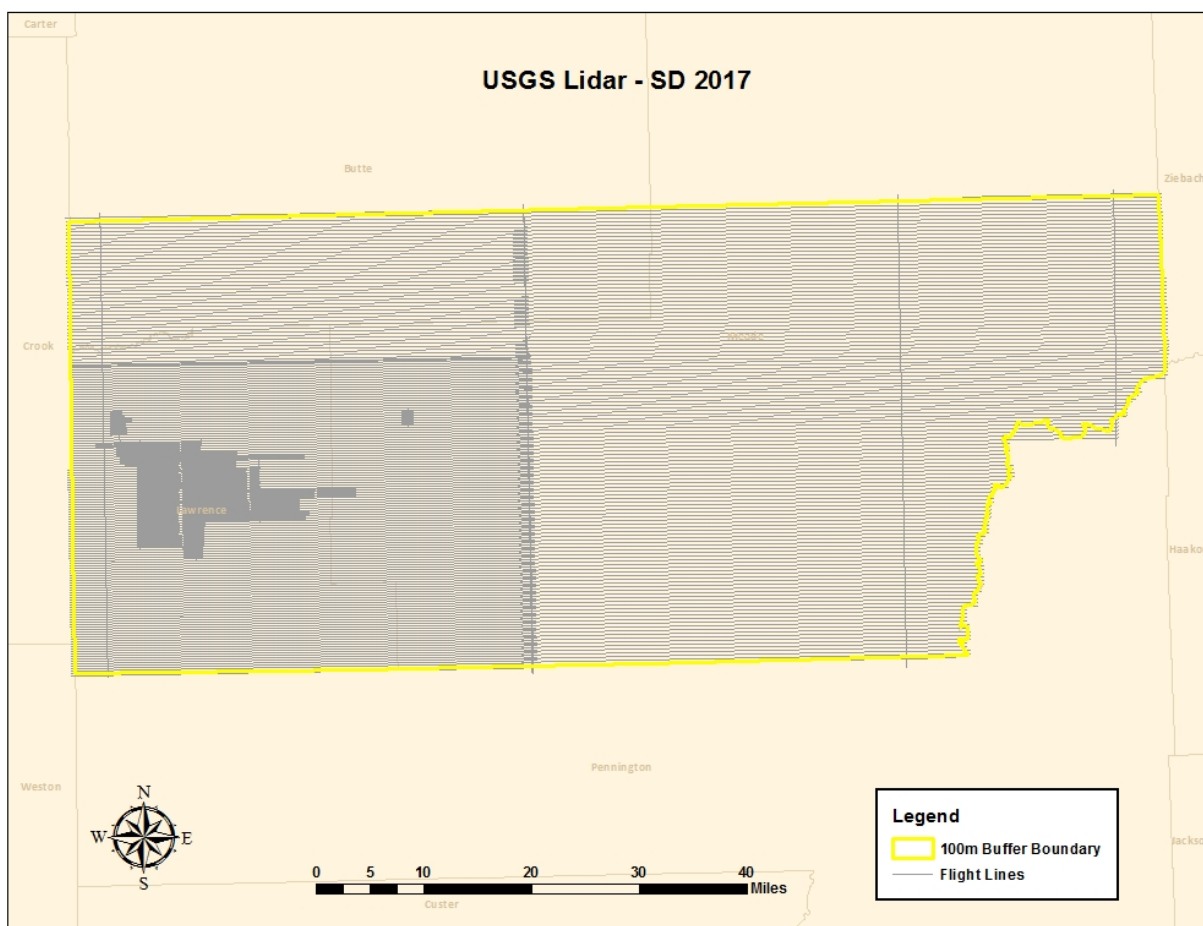


Figure 1: Flight plan

The following is detail on the **spring 2018** lidar acquisition covering the South Dakota FY17 NRCS Lidar buffered boundary.

Collections:	10
Collection Dates:	May 20 th – June 2 nd , 2018
Field of View (FOV):	21, 60 degrees
Average Point Density (planned):	4 ppsm
Flight Level(s) AMT:	7650 ft, 3250 ft, 2400 ft
Sensor Type(s):	Leica ALS80-HP, Riegl LMS-Q680i, Riegl LMS-Q780
Sensor Serial Number(s):	130, 165, 421

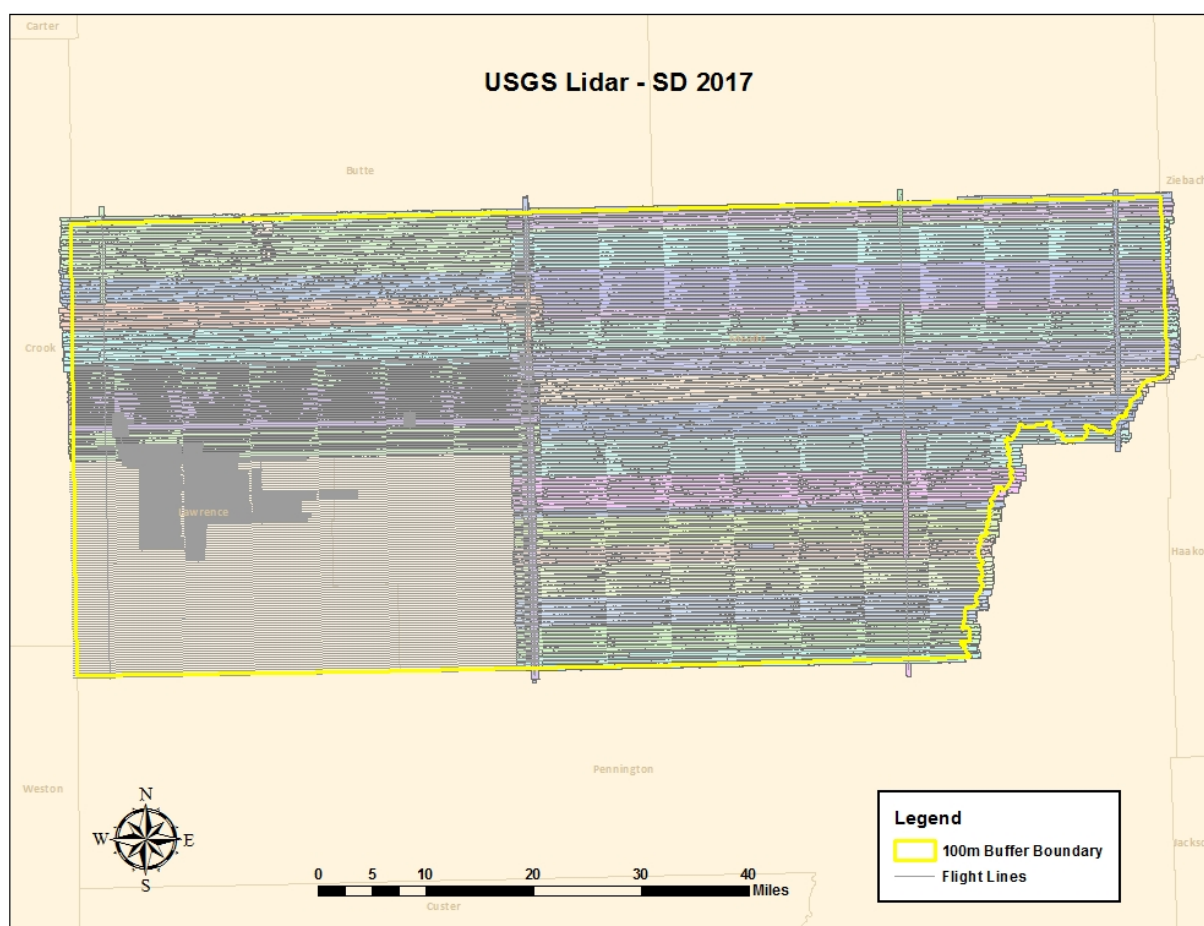


Figure 2: Executed Collection Footprints

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

Below are the acquisition logs and GPS plots from the **spring 2018** collections covering the South Dakota FY17 NRCS Lidar buffered boundary.



Acquisition and Processing details ----- 180520_130_17003900_01 (May 5, 2018)

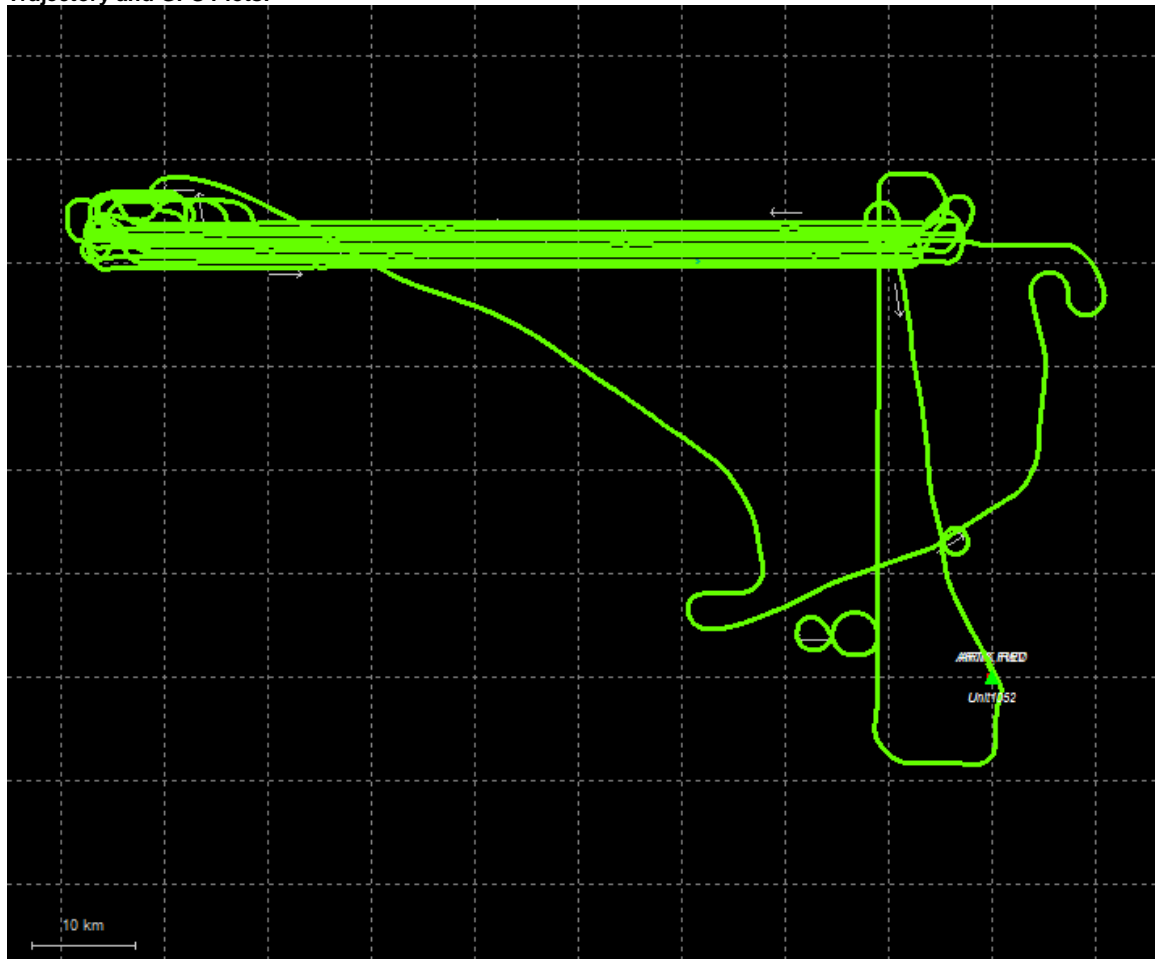
Log:

Menu		18.101			Lift Begin			Lift End			Flt	Flt	Hobbs	Activity
		Airport	Chocks	Hobbs	Airport	Chocks	Hobbs	Duration	Hrs	Hrs				
1	KRAP	15:55	1084.0	KRAP	20:55	1089.0	5:00	5.00	5.0	0900-Production				
2														
3														

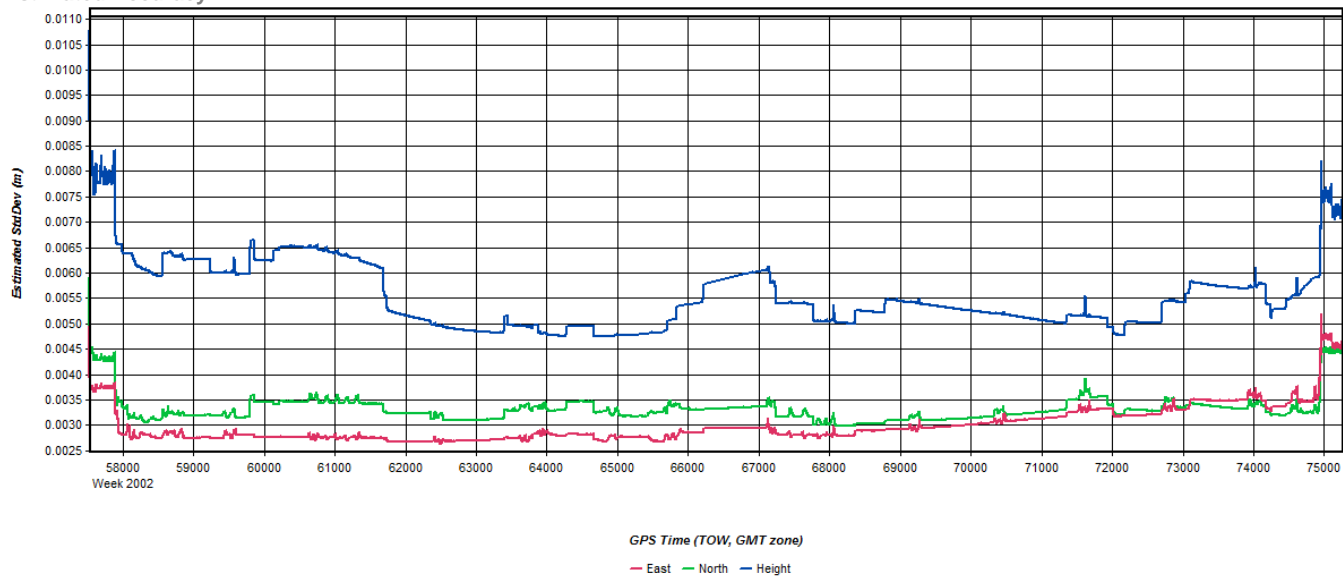
FUGRO USA Land, Inc.		ALS		Flight Log		AC80-44-00-02	
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FGI Job # 17003900	Project Name ALS_West	System ALS80	Unit 130	IMU uRS	PIA 3	SW1	SW2-Gain	Aper	AutoScan Yes	Ground Temp °C 12.0 14.0	Min Range Gate 6013	Data Logger Drive			
Flight Date 20-May-18	GPS Day 18-140	Lift 1	Sun°	Solar Times (UTC)	Laser Power 100%	Pattern Triangle	Flying Temp °C 0.0 0.0	Max Range Gate 7976	Download Drive						
Mission ID (yyymmdd_Sen_Job_Lit) 180520_130_17003900_01	Aircraft N62912	Airport ID KRAP	FMS	UTC	AMT (ft) 7,650	Speed <150	Scan Hz 63.2	Pulse Rate 367k	FOV 21	kmWPT 1.400	Altm Setting	Shipping Track			
Pilot #1 Jeffrey Clarke	Pilot #2	Operator #1 Lee Scadden	Operator #2	Erased this flight log before I saved it. Trying to remember best I c											
Base 1 ID FGI 081	Location KRAP	Rec ID GRD1-	Ant ID GRD1-	ARP (m) 1.8	Start Time (UTC) 180520-12:15	Stop Time (UTC) 180520-02:05	GPS Filename Unit10520m000	Operator Chris Fought	Data FTP						
Area	Flight #		Wpt		Distance		UTC		Flt	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions	SVs	PDOP
	FGI	Client's	From	To	Begin	End	Start	End							
							16:00:00	16:05:00					5-Minute GRD Static	15	1.3
													S-Turn	16	1.2
XLine	2		1	26	0	35			N	145			cross line	18	1.2
ALS West	1		51	1	70	0			W	144				18	1.2
	2		1	51	0	70			E	146			manually started sensor, started at wpt 2, would not auto start	19	1.1
	3		51	1	70	0			W	145			sensor shut off at wpt 4	18	1.3
													S-turn		
	4		51	1	70	0			W	146				18	1.2
	3		1	5	0	5.6			E	142			picked up wpts 1-5 from previous line when sensor shut off early	19	1.1
	5		1	51	0	70			E	144					
	6		51	1	70	0			W	147					
	7		1	51	0	70			E	144			cloud on west end km 1-5		
	8		51	1	70	0			W	145			cloud km 5-1	19	1.3
	9		1	51	0	70			E	143			cloud km 1-5	20	1.1
													S-turn		
													5-Minute GRD Static		

Trajectory and GPS Plots:

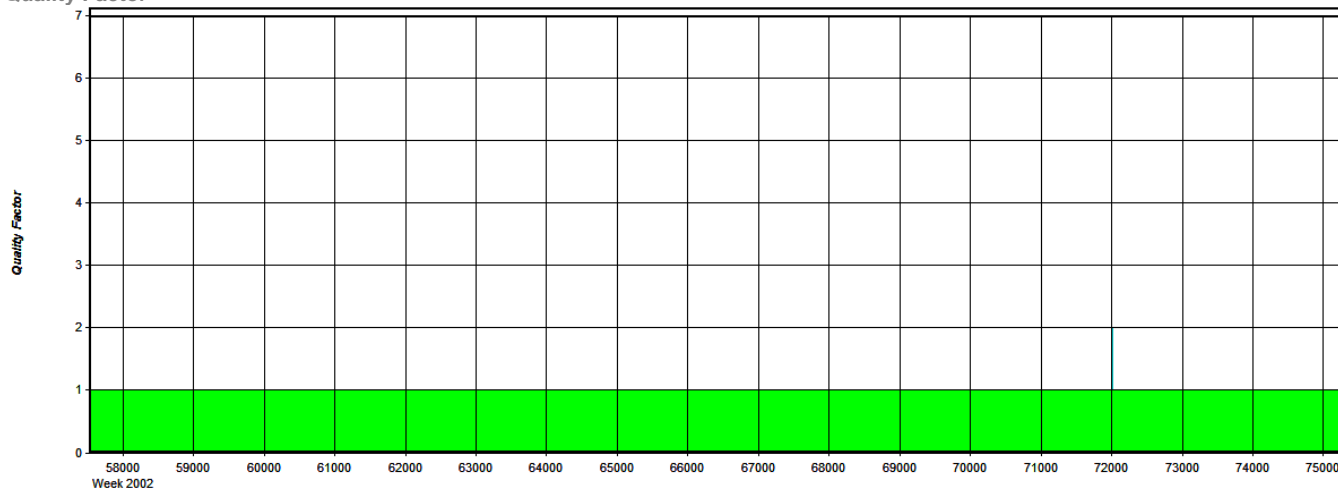


Estimated Accuracy



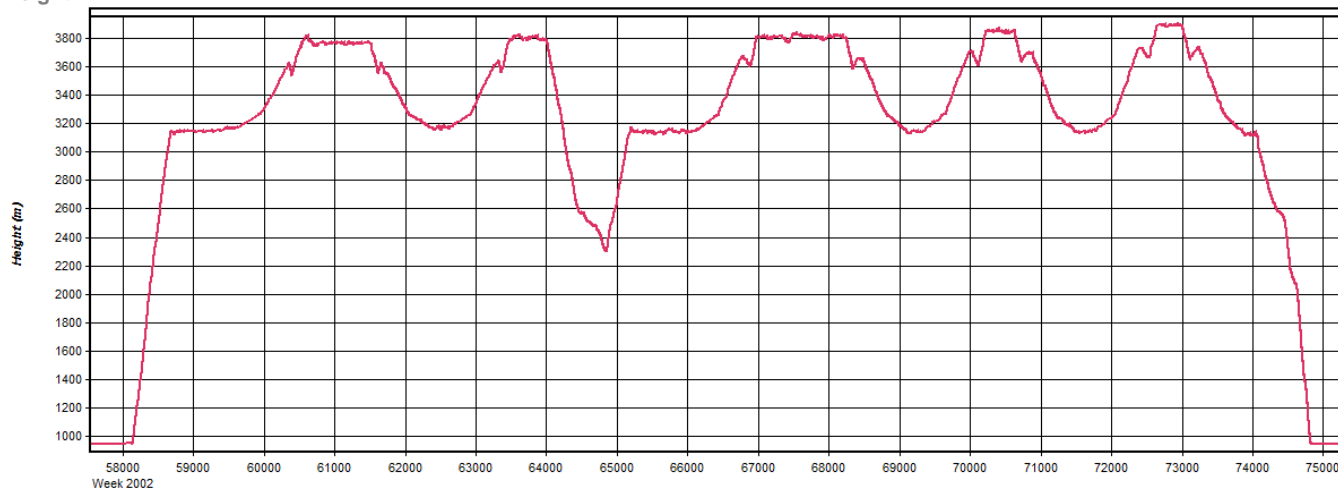


Quality Factor



GPS Time (TOW, GMT zone)
— Fixed Integer — Stable float — Converging float — DGPS or worse — No solution

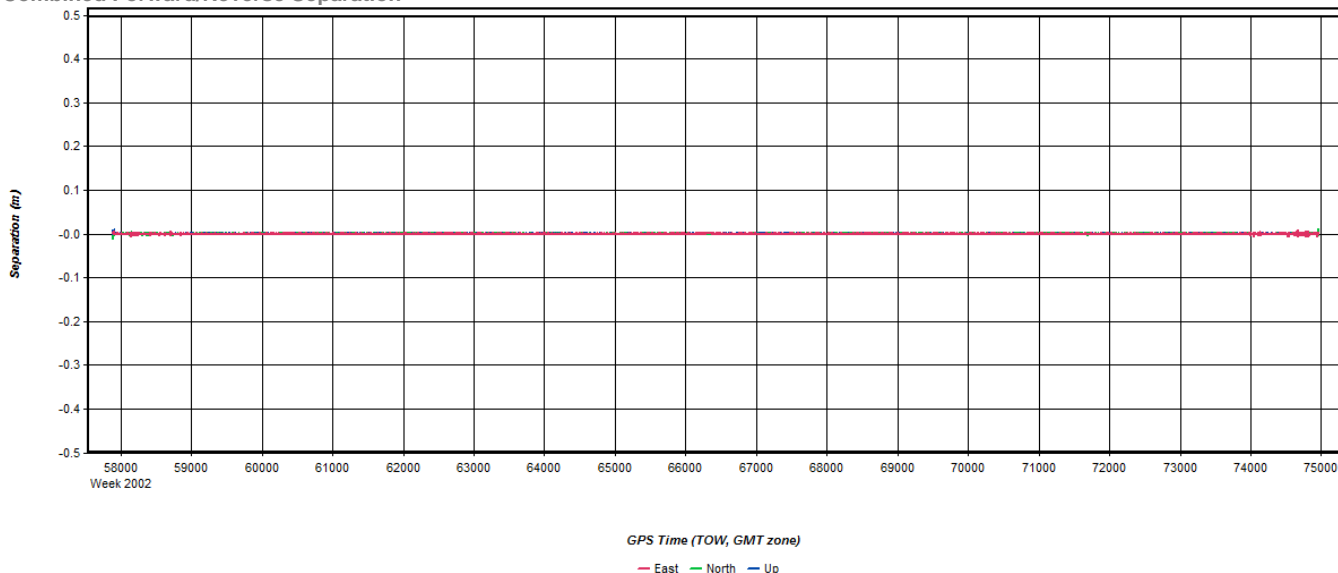
Height



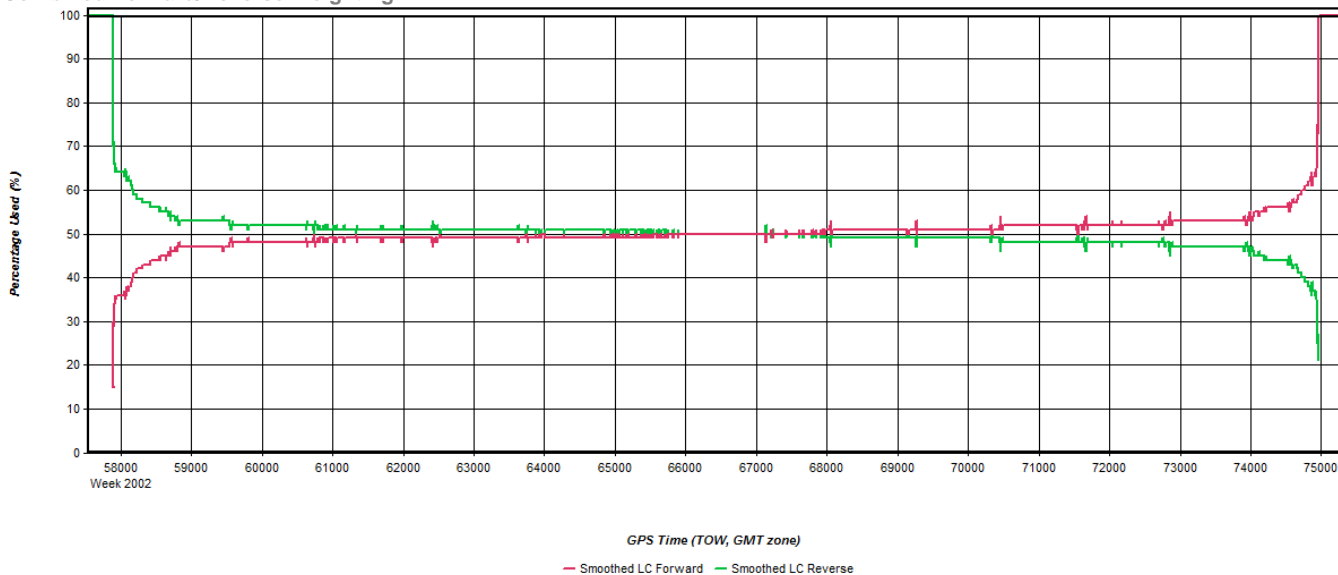
GPS Time (TOW, GMT zone)
— Height



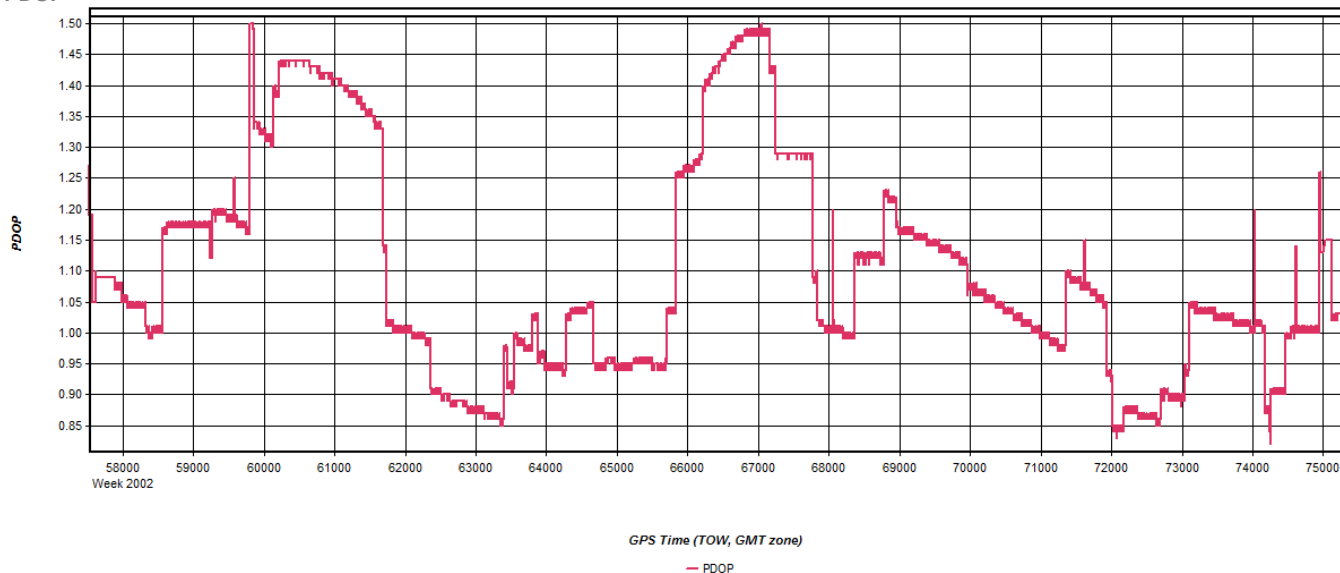
Combined Forward/Reverse Separation



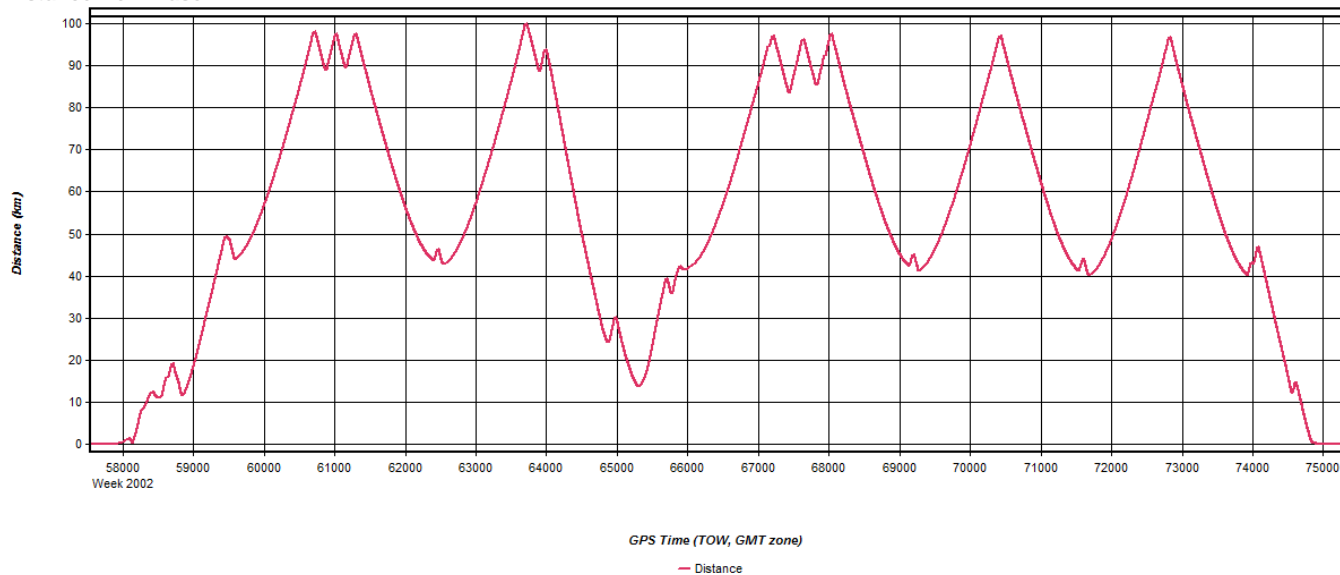
Combined Forward/Reverse Weighting



PDOP

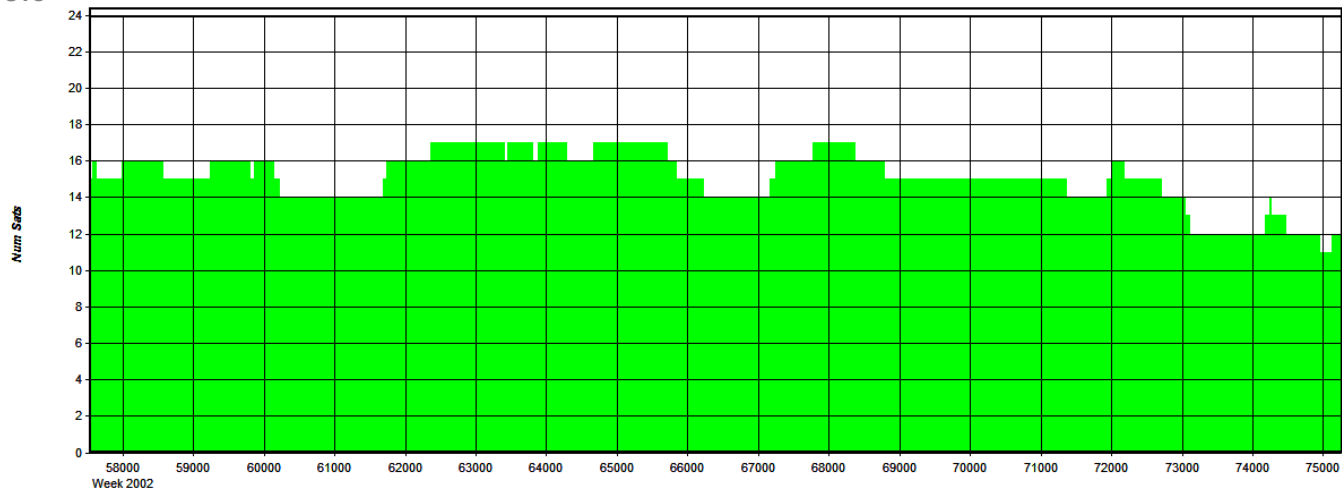


Distance from Base





SVs



GPS Time (TOW, GMT zone)
- Too Few - Minimal - Acceptable - Good - Exceptional

USGS
COLLECTION REPORT



Acquisition and Processing details ----- 180520_130_17003900_02 (May 20, 2018)

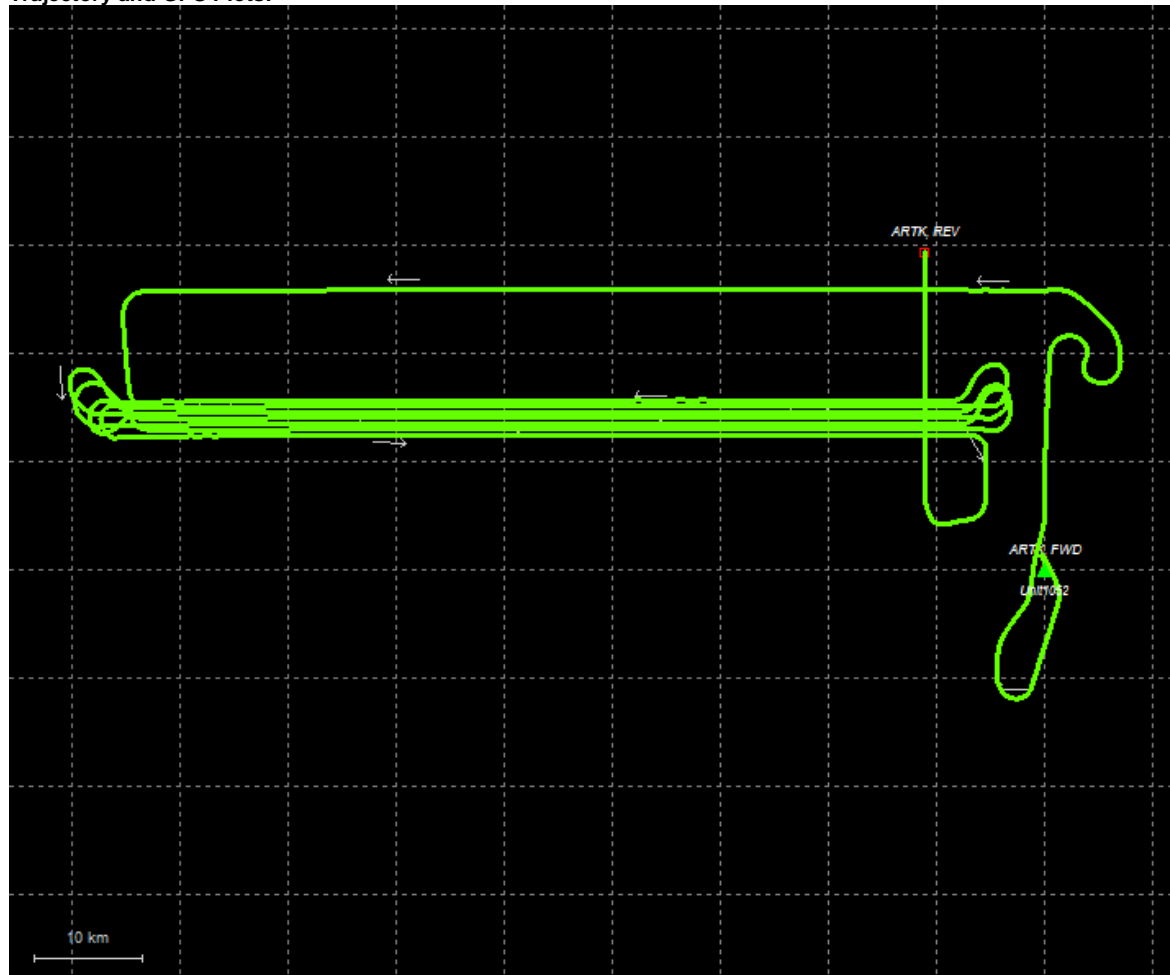
Log:

Menu ▼
18.101

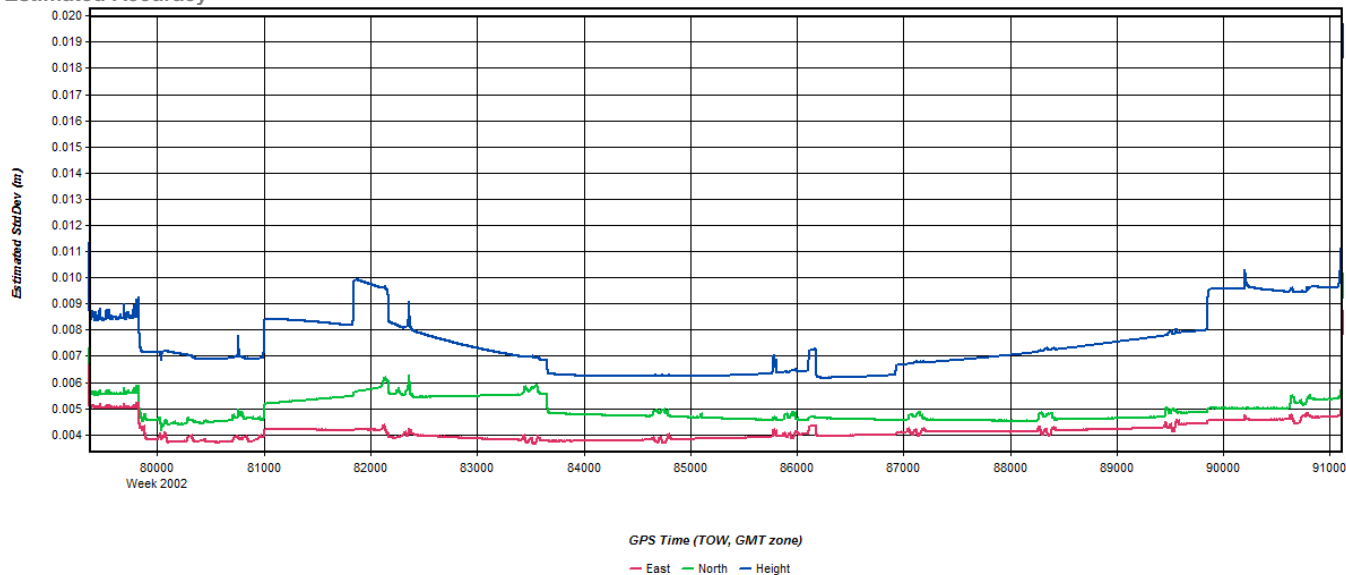
ALS
 Flight Log

FUGRO USA Land, Inc.		AC80-44-00-02													
FGI Job # 17003900	Project Name ALS_West		Data Logger Drive												
Flight Date 20-May-18	GPS Day 18-140	Lift 2	Download Drive												
Mission ID (yymmdd_Sen_Job_Lift) 180520_130_17003900_02	Aircraft N62912	Airport ID KRAP	Shipping Track												
System ALS80		Unit 130	IMU uIRS												
PA 3		SW1	SW2-Gain												
Aper		AutoScan Yes	Ground Temp °C 14.0												
Sun°		Solar Times (UTC)	Min Range Gate 6013												
Laser Power 100%		Pattern Triangle	Flying Temp °C 0.0 0.0												
Pulse Rate 367k		FOV 21	Max Range Gate 7976												
Scan Hz 63.2		km/WPT 1.400	Altitude Setting 30.09												
Operator #1 Jeffrey Clarke		Operator #2 Lee Scadden													
Base 1 ID FGI 081	Location KRAP	Rec ID GRD1-	Ant ID GRD1-												
		ARP (m) 1.8	Start Time (UTC) 180520-12:15												
			Stop Time (UTC) 180520-02:05												
			GPS Filename Unit10520m000												
			Operator Chris Fought												
			Data FTP												
Area	Flight #		Wpt		Distance		UTC		Fit	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions	SVs	PDOP
	FGI	Client's	From	To	Begin	End	Start	End							
							22:02:53	22:08:24					5-Minute GRD Static	15	1.4
							22:24:55	22:27:29					S-Turn	16	1.3
ALS West	34		51	1	70	0	22:31:35	22:47:49	263.1	10550	142		clouds km 11-end	16	1.3
	52		1	51	0	70	22:54:04	23:09:57	82.2	13861	144			17	1.2
	53		51	1	70	0	23:13:40	23:29:45	261.6	10599	142			17	1.4
	54		1	51	0	70	23:34:28	23:50:55	82.3	13824	142			16	1.3
	55		51	1	70	0	23:53:57	0:10:01	263	10584	146			18	1.1
	56		1	51	0	70	0:14:15	0:30:20	81.2	13646	144			19	1.1
	57		51	1	70	0	0:34:16	0:50:21	261.9	10645	144			18	1.1
	58		1	51	0	70	0:53:32	1:09:40	82.7	13663	147			19	1.1
X Tie	2		2	18	1.4	23.8	1:14:24		352.5	10321	146		Cross tie line	19	1.1
X Tie	2		14	1	18.2	0	1:39:34	1:44:06	S				started wpt 14-reflew cross line	18	1.2
							1:44:17	3:53:23					S-Turn	18	1.1
							1:55:20	2:00:48					5 Minute Grd Static	16	1.3

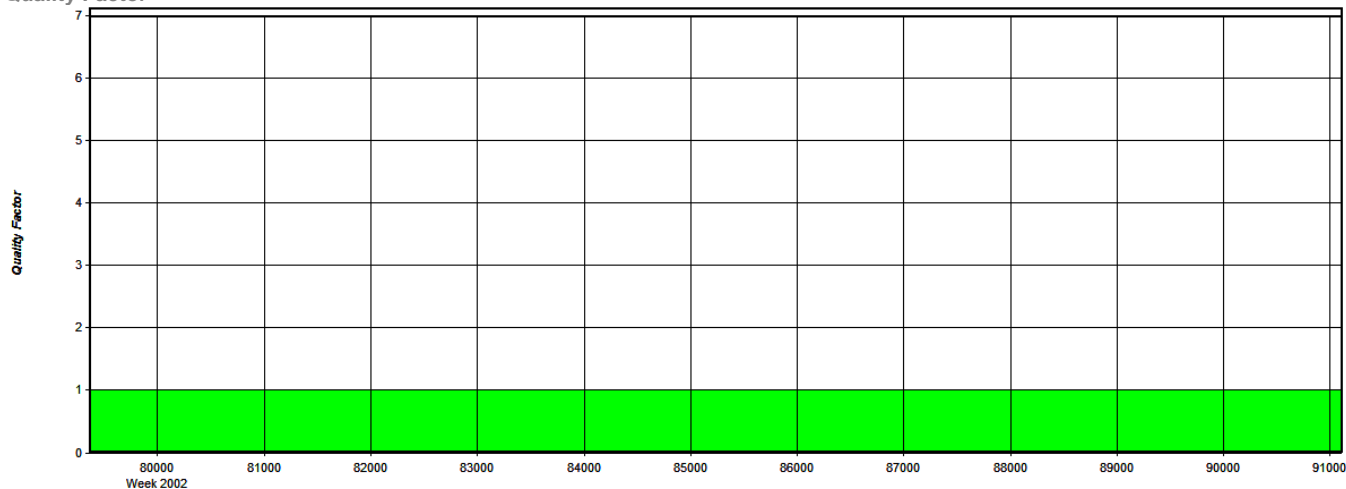
Trajectory and GPS Plots:



Estimated Accuracy

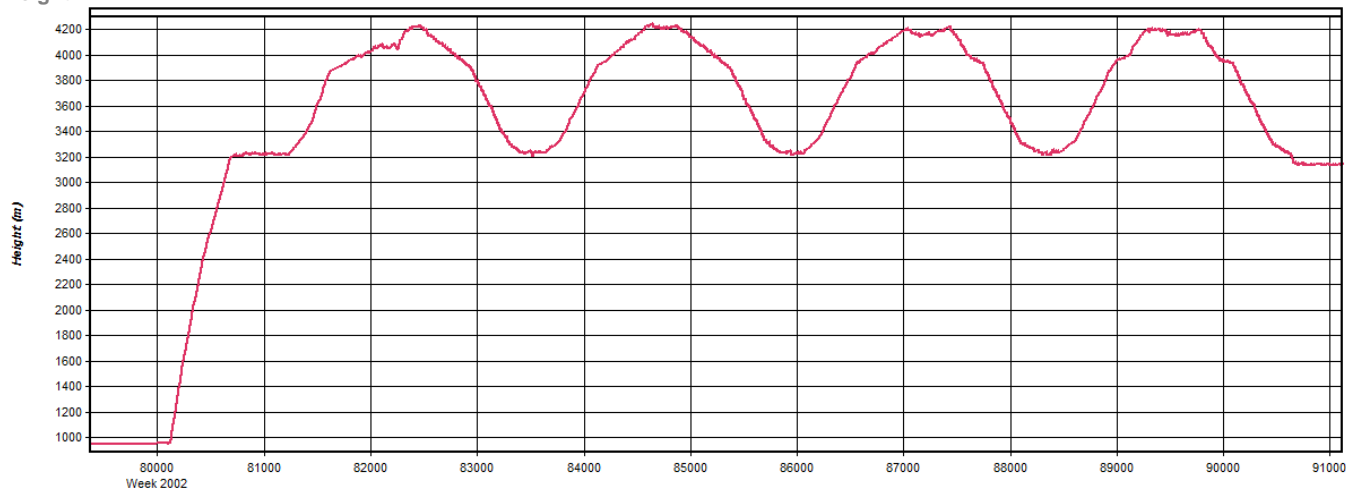


Quality Factor



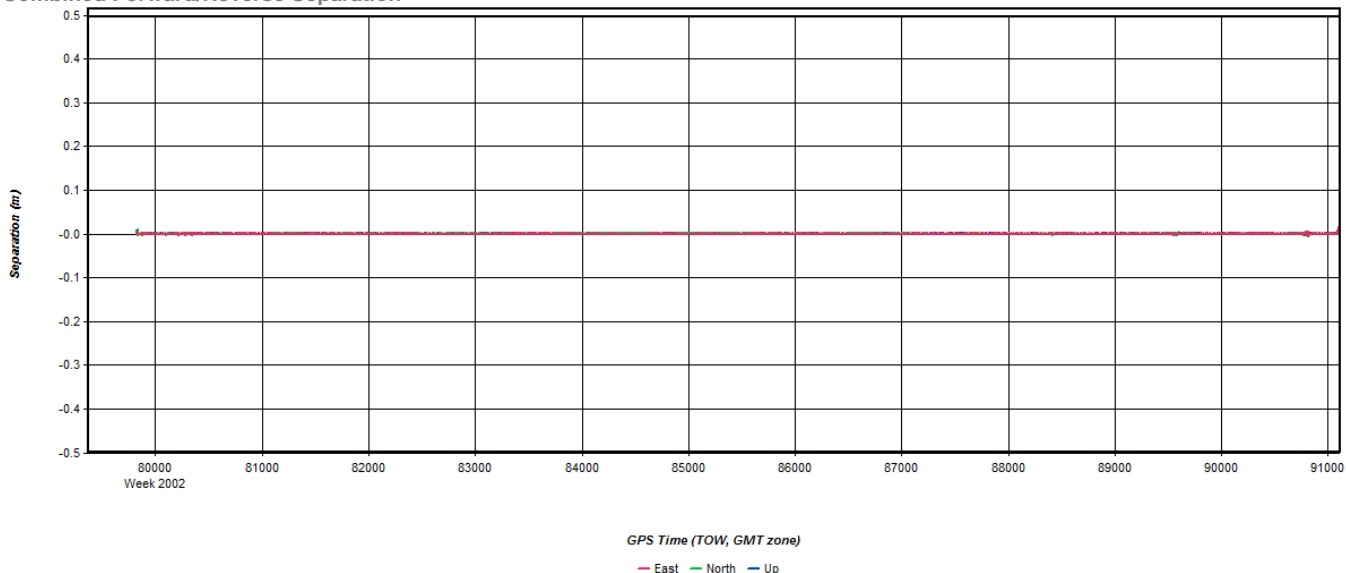
GPS Time (TOW, GMT zone)
— Fixed Integer — Stable float — Converging float — DGPS or worse — No solution

Height

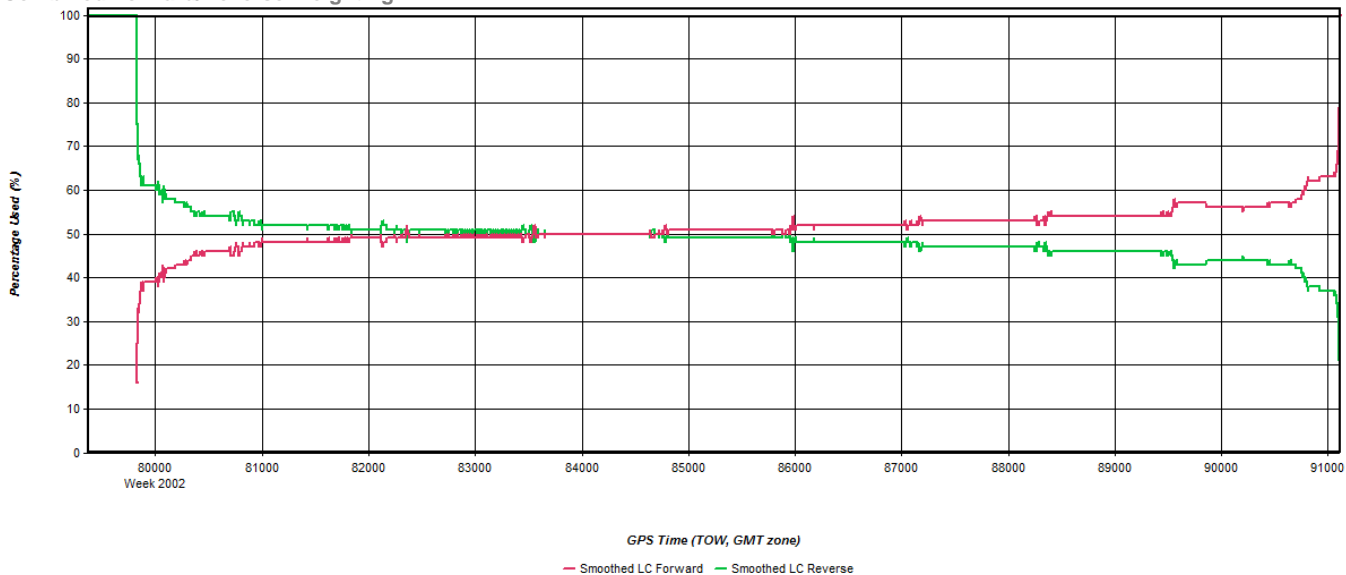


GPS Time (TOW, GMT zone)
— Height

Combined Forward/Reverse Separation



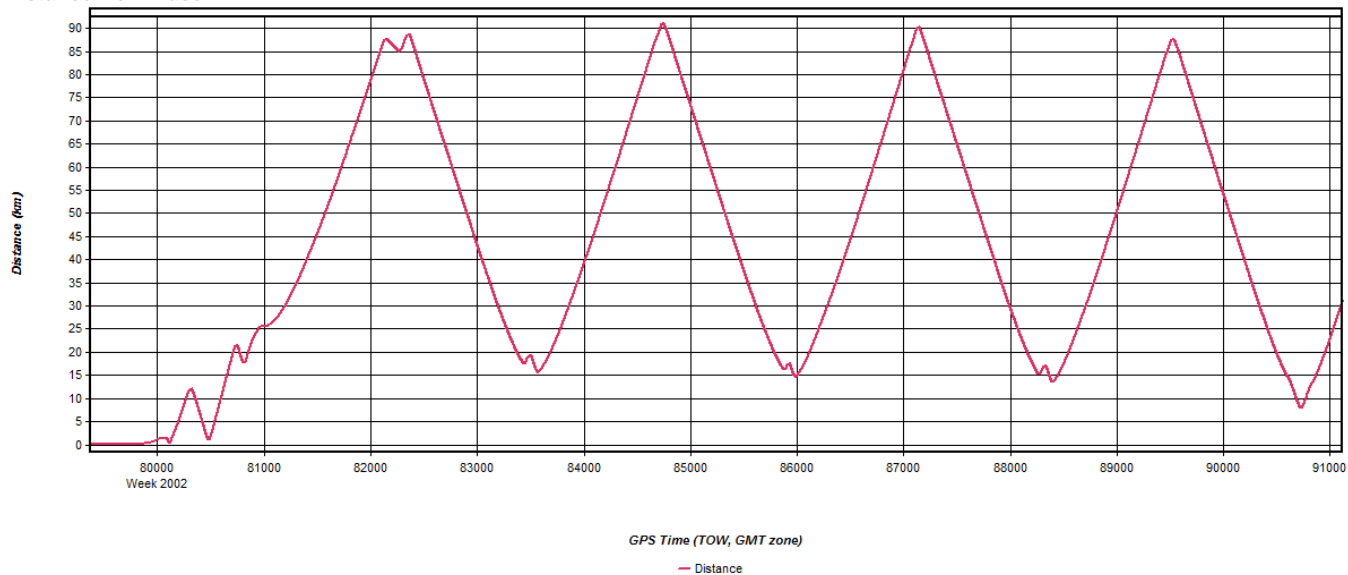
Combined Forward/Reverse Weighting



PDOP

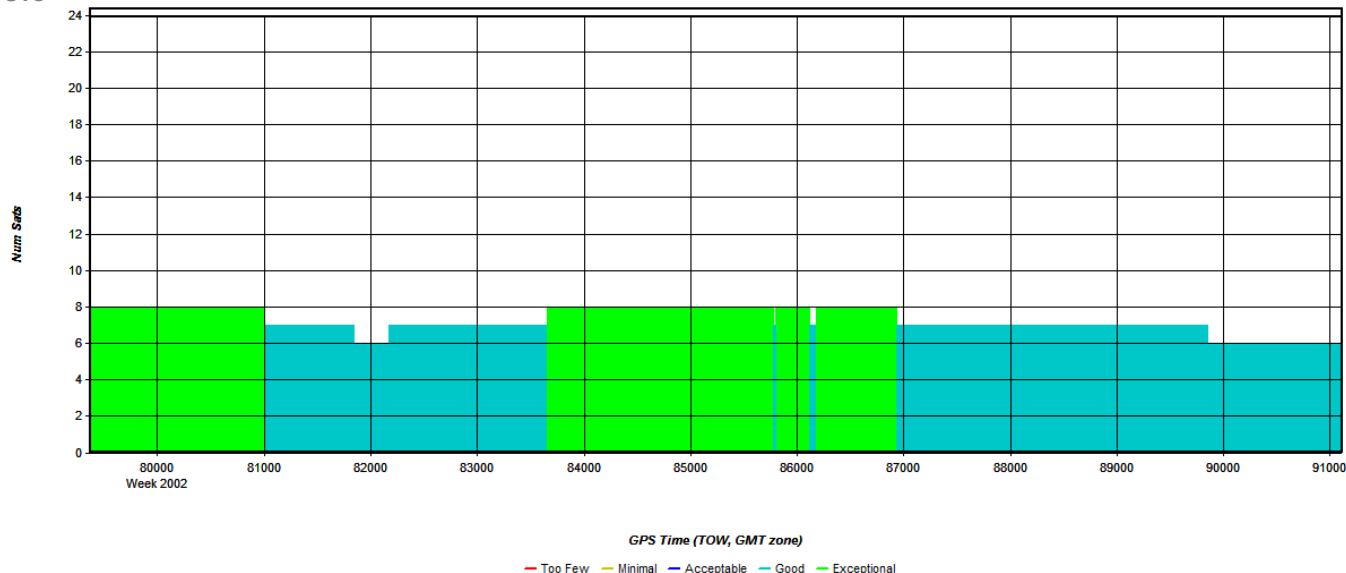


Distance from Base





SVs



USGS
COLLECTION REPORT



Acquisition and Processing details ----- 180521_130_17003900_03 (May 21, 2018)

Log:

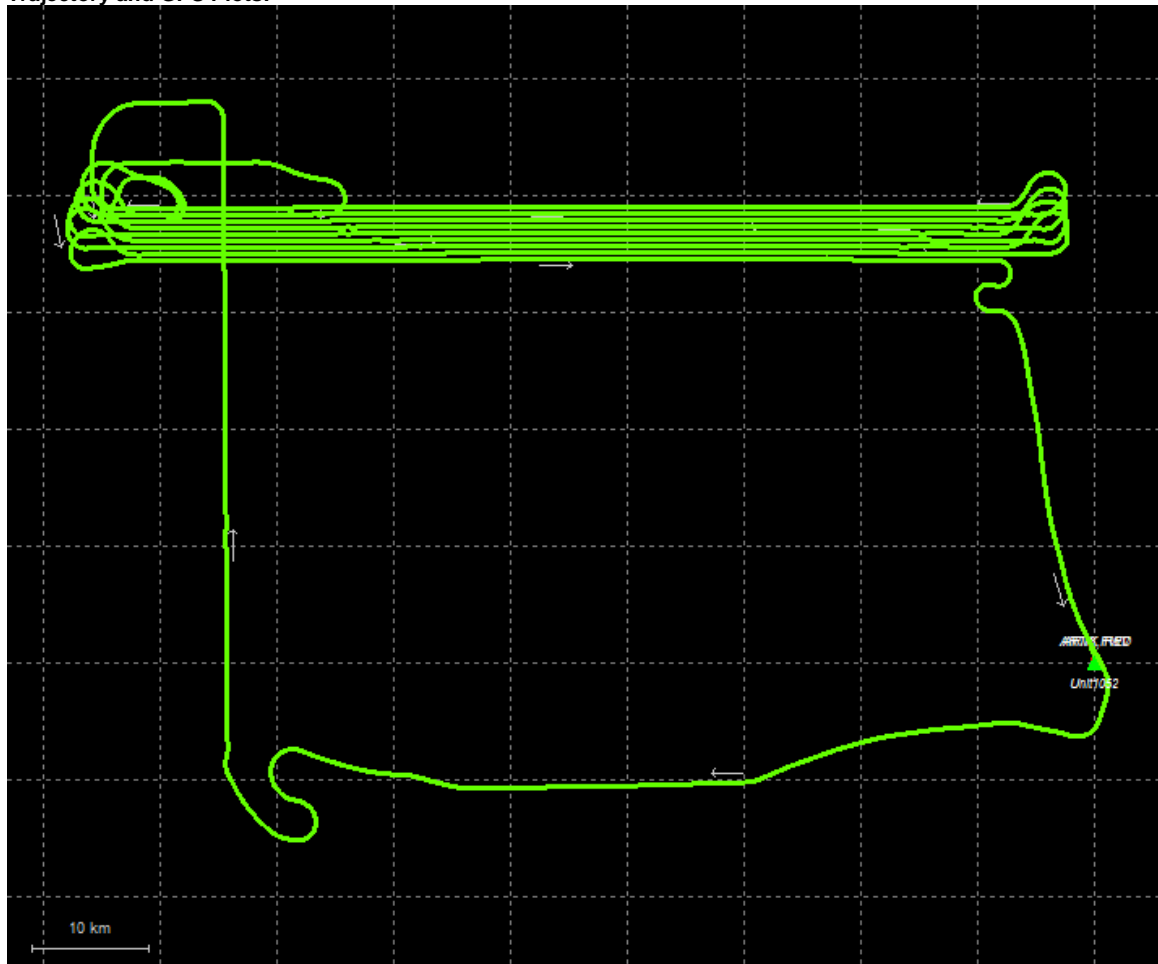
18.101

Lift Begin			Lift End			Fit Duration	Fit Hrs	Hobbs Hrs	Activity	
Airport	Chocks	Hobbs	Airport	Chocks	Hobbs					
1	KRAP	13:21	1093.1	KRAP	17:48	1097.6	4:27	4.50	4.5	0900-Production
2										
3										

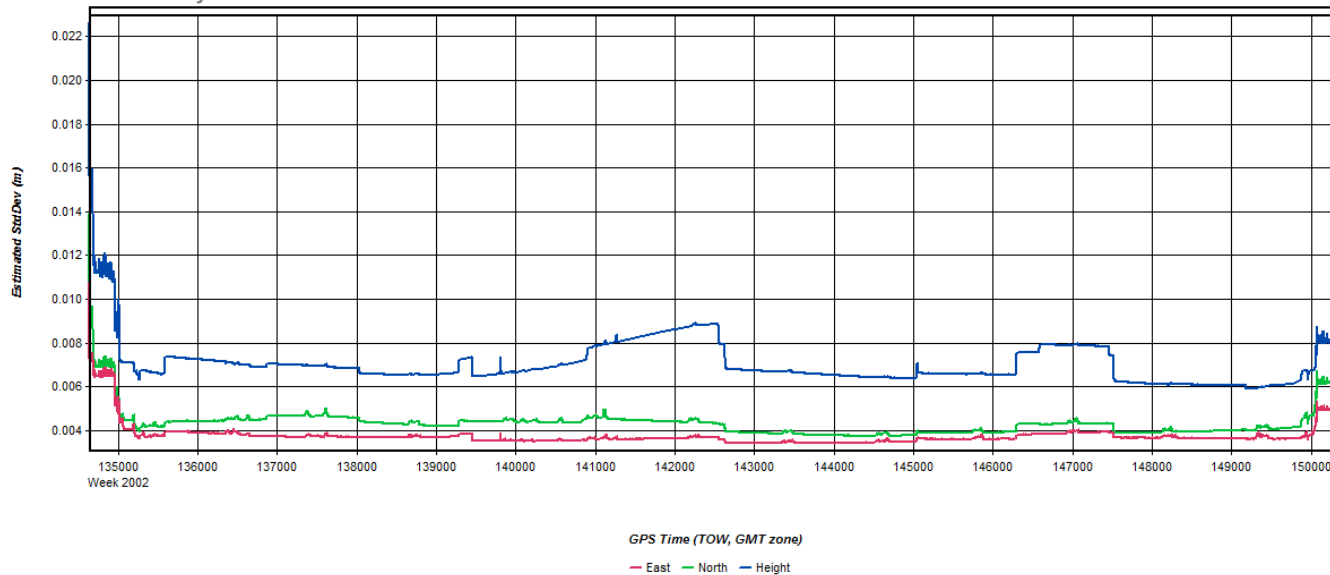
ALS
Flight Log
 AC80-44-00-02

FGI Job # 17003900		Project Name ALS_West				System ALS80	Unit 130	IMU uRS	PA 3	SW1	SW2-Gain	Aper	AutoScan Yes	Ground Temp °C 8.0 19.0	Min Range Gate 6013	Data Logger Drive
Flight Date 21-May-18	GPS Day 18-141	Lift 3			Sun° N/A	Solar Times (UTC) N/A		Laser Power 100%	Pattern Triangle	Flying Temp °C -5.0 0.0	Max Range Gate 7976	Download Drive				
Mission ID (yyymmdd_Sen_Job_Lift) 180521_130_17003900_03		Aircraft N62912	Airport ID KRAP	FMS FCMS	UTC -6	AMT (ft) 7,650	Speed <150	Scan Hz 63.2	Pulse Rate 367k	FOV 21	km/WPT 1.400	AltM Setting 29.99 29.96	Shipping Track			
Pilot #1 Jeffrey Clarke		Pilot #2		Operator #1 Eric Mueller		Operator #2										
Base 1 ID FGI 081	Location KRAP	Rec ID GRD1-	Ant ID GRD1-	ARP (m) 1.8	Start Time (UTC)		Stop Time (UTC)		GPS Filename	Operator Chris Fought	Data FTP					
Area	Flight #		Wpt		Distance		UTC		Fit Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions	SVs	PDOP	
	FGI	Client's	From	To	Begin	End	Start	End								
							13:24:00	13:29:00					GROUND-STATIC @ KRAP	19	1.2	
							13:52:00	13:55:00		14024	153		PRE ACQUISITION CALIBRATION	19	1.1	
ALS_X	1		1	25	0	33.6	14:01:00	14:08:00	351.7	14004	150			19	1.1	
ALS_West	10		1	51	0	70	14:14:00	14:30:00	081.6	12854	143			18	1.1	
	11		51	1	70	0	14:34:00	14:50:00	262.7	12854	145			19	1.1	
	11		1	10	0	12.6	14:58:00	15:01:00	081.5	12854	144		CALIBRATION LINE	19	1.2	
	12		1	51	0	70	15:12:00	15:28:00	081.7	13004	147			20	1.2	
	13		51	1	70	0	15:32:00	15:48:00	262.7	13004	142			19	1.2	
	14		1	51	0	70	15:52:00	16:08:00	081.6	13004	146			20	1.2	
	15		51	1	70	0	16:12:00	16:28:00	262.7	13004	144			23	1.1	
	16		1	51	0	70	16:32:00	16:48:00	081.5	13005	141			21	1.2	
	17		51	1	70	0	16:52:00	17:08:00	262.7	13004	146			21	1.1	
	18		1	51	0	70	17:11:00	17:28:00	081.5	13004	140			22	1.1	
							17:28:15	17:30:00		10176	130		POST ACQUISITION CALIBRATION	24	1.1	
							17:40:50	17:45:50					GROUND-STATIC @ KRAP	25	1.0	

Trajectory and GPS Plots:

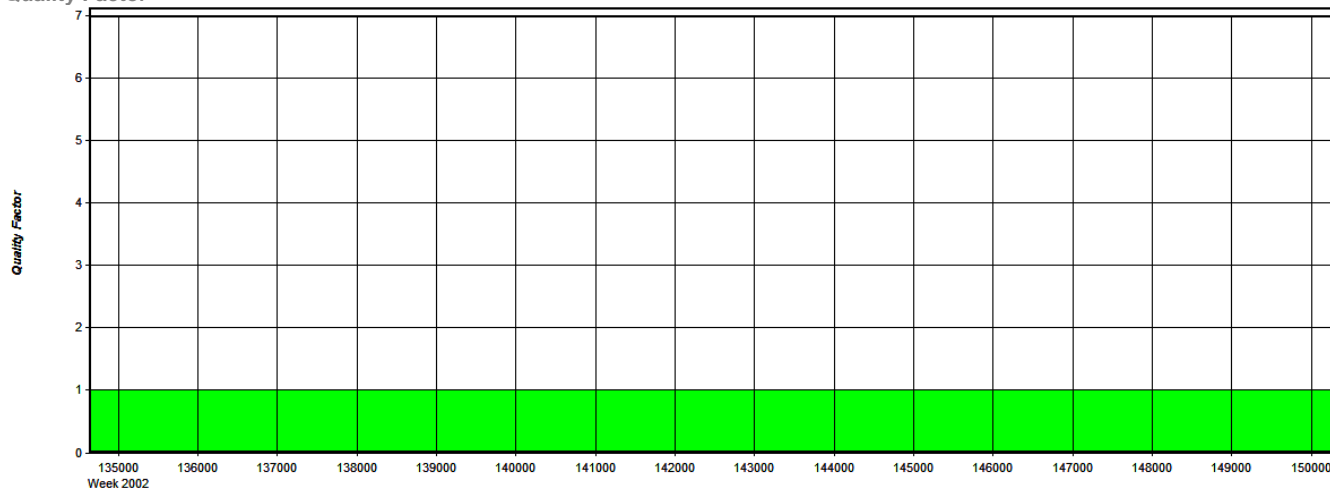


Estimated Accuracy



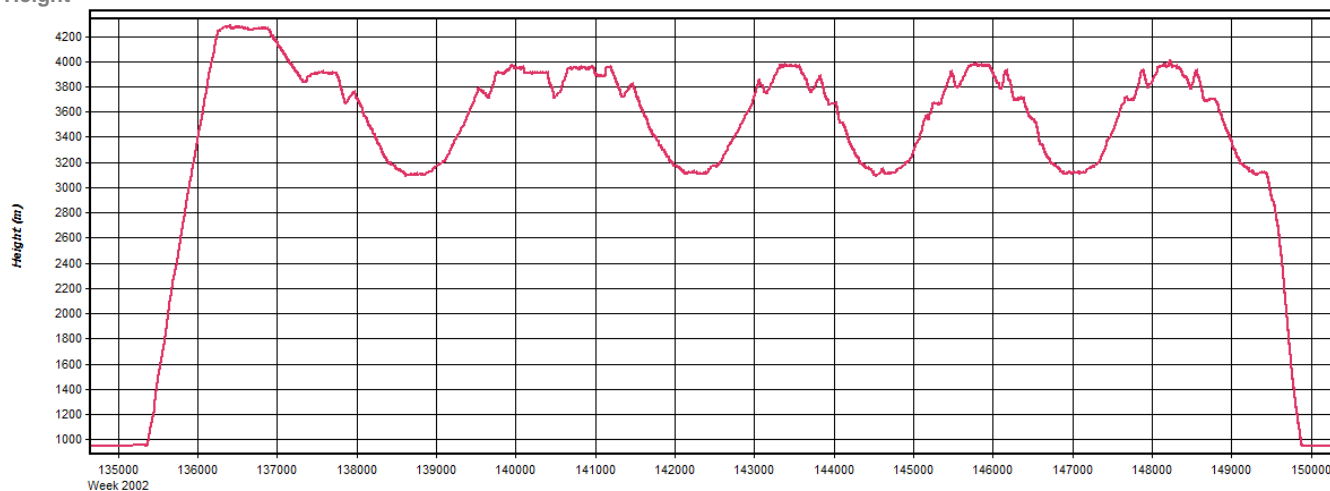


Quality Factor



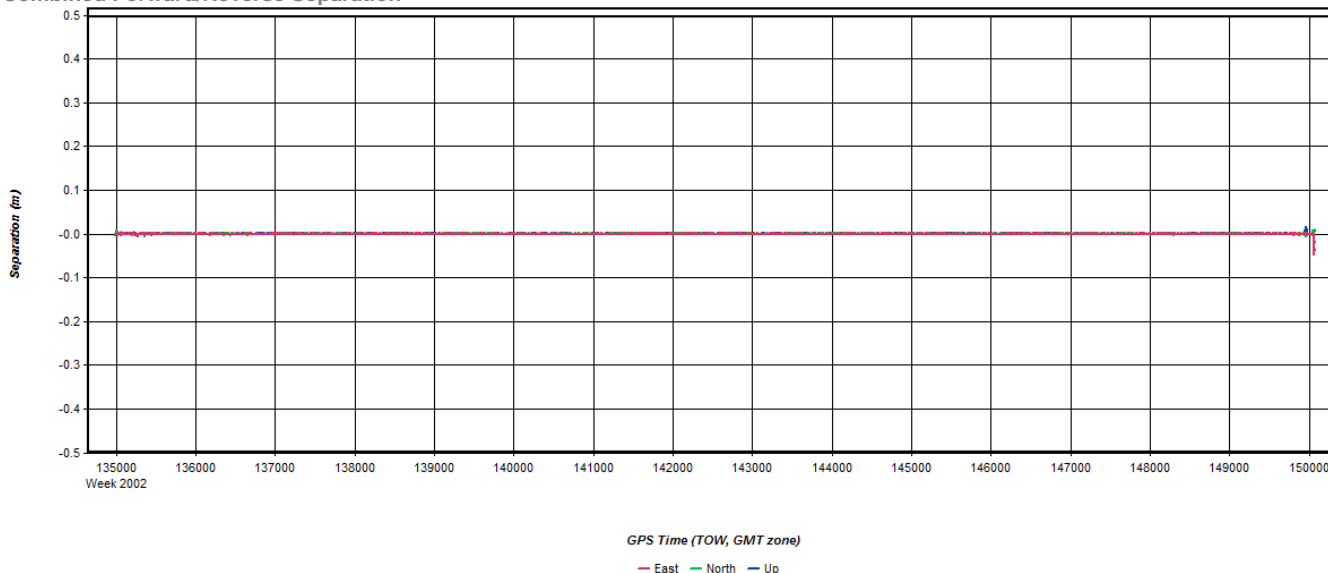
GPS Time (TOW, GMT zone)
— Fixed Integer — Stable float — Converging float — DGPS or worse — No solution

Height

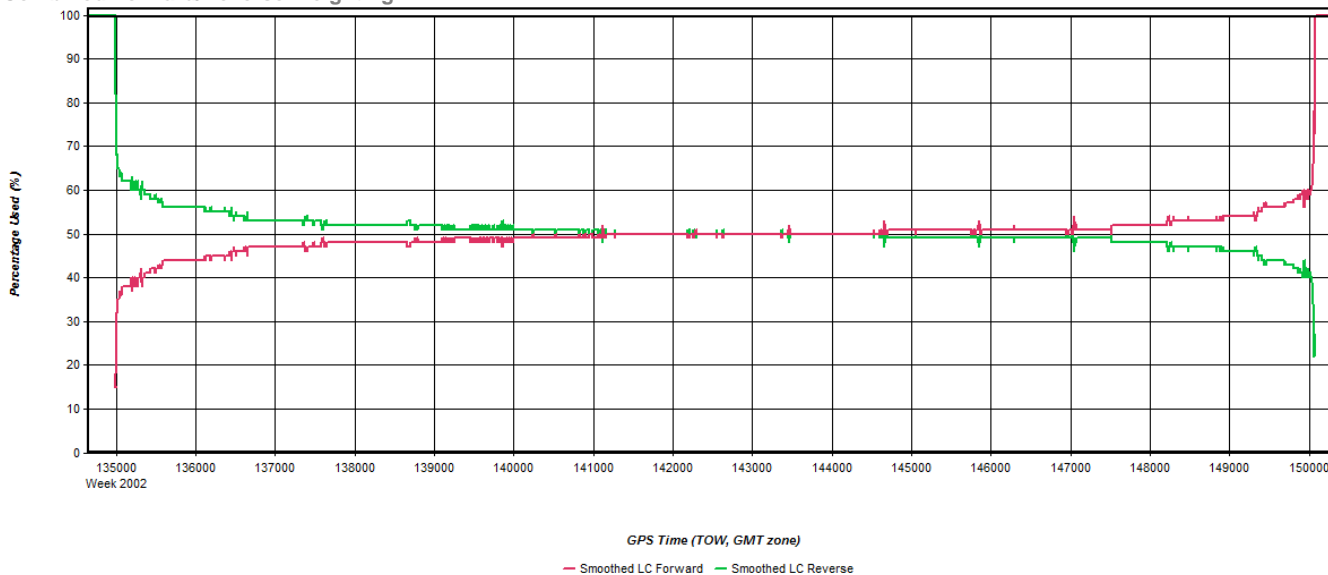


GPS Time (TOW, GMT zone)
— Height

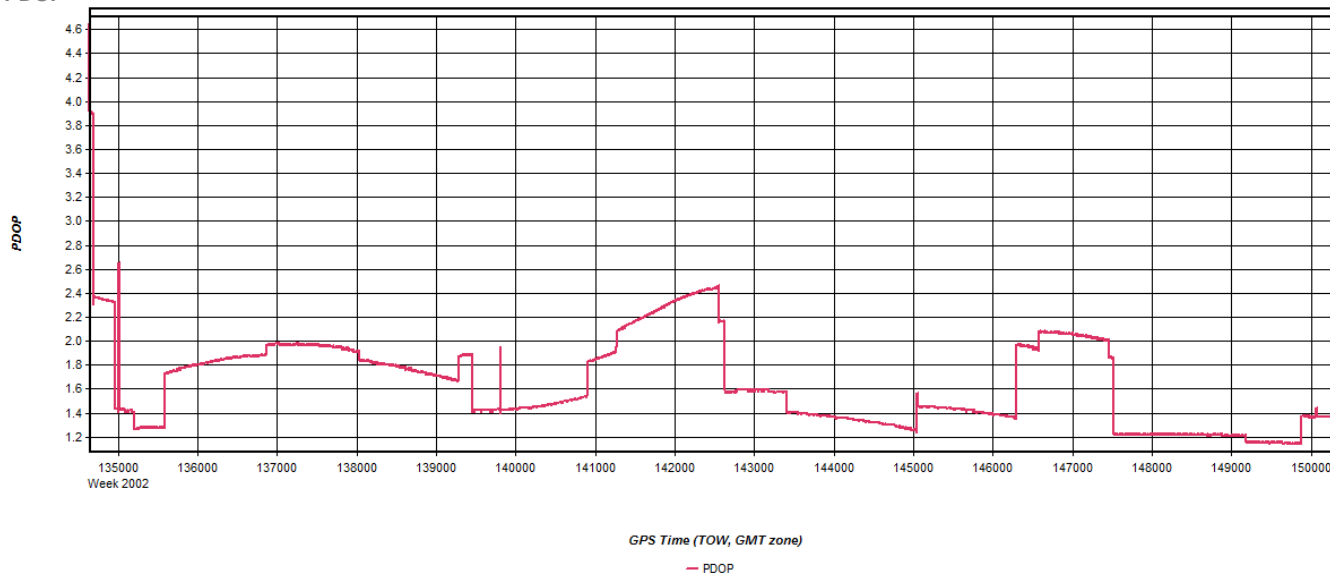
Combined Forward/Reverse Separation



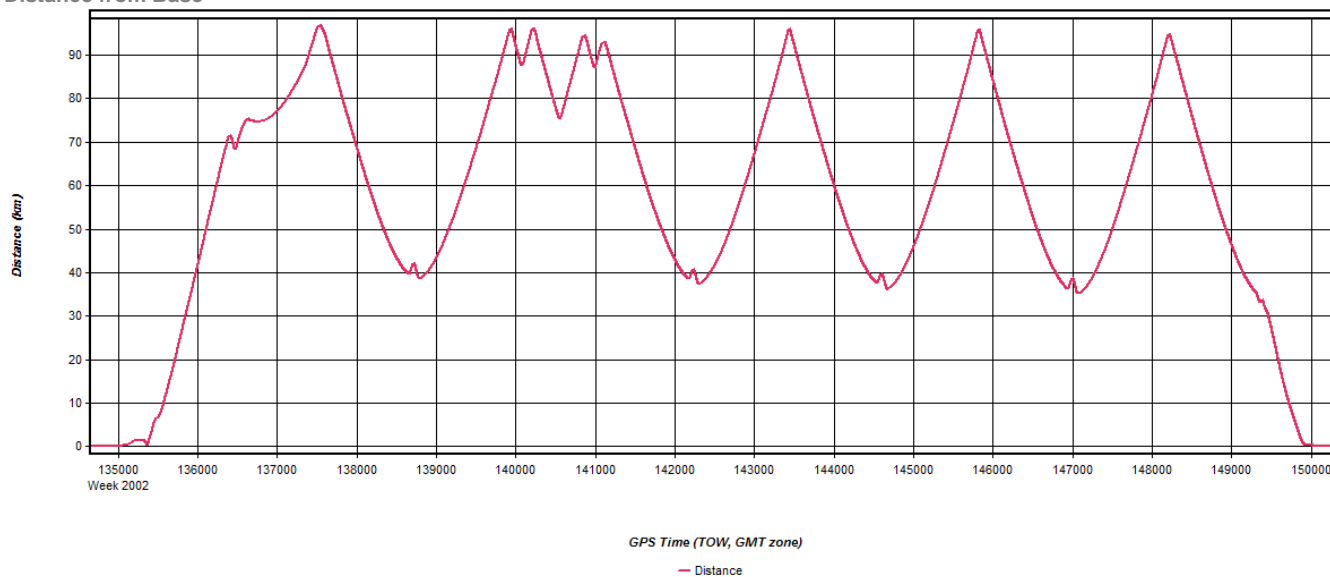
Combined Forward/Reverse Weighting



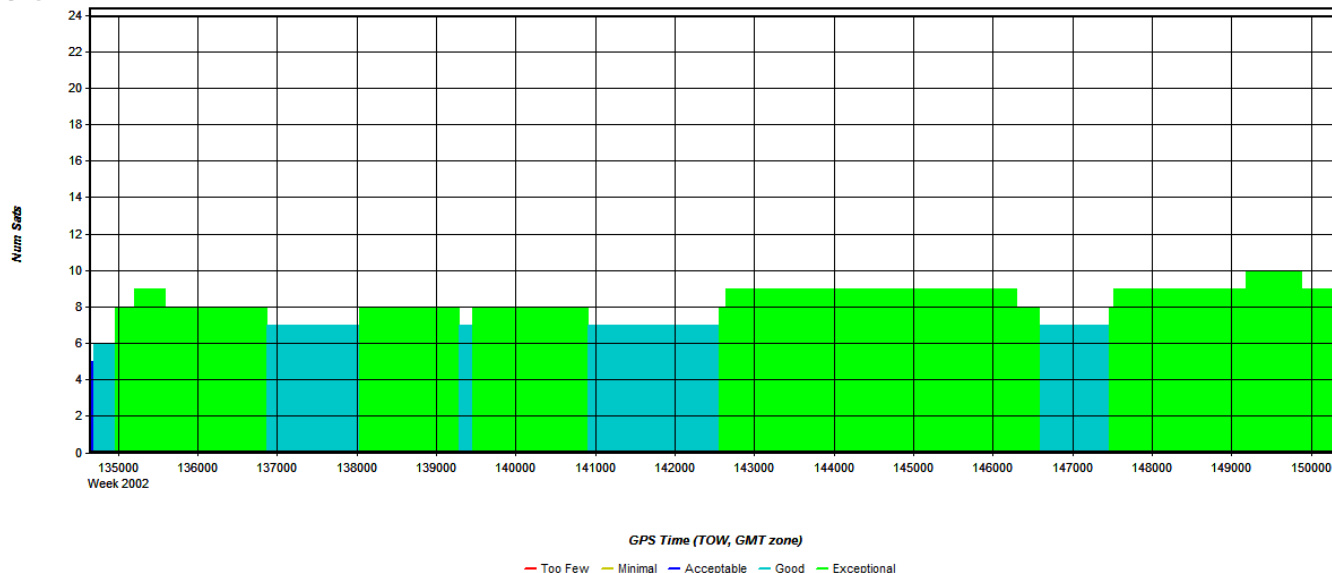
PDOP



Distance from Base



SVs



USGS
COLLECTION REPORT



Acquisition and Processing details ----- 180524_130_17003900_04 (May 24, 2018)

Log:

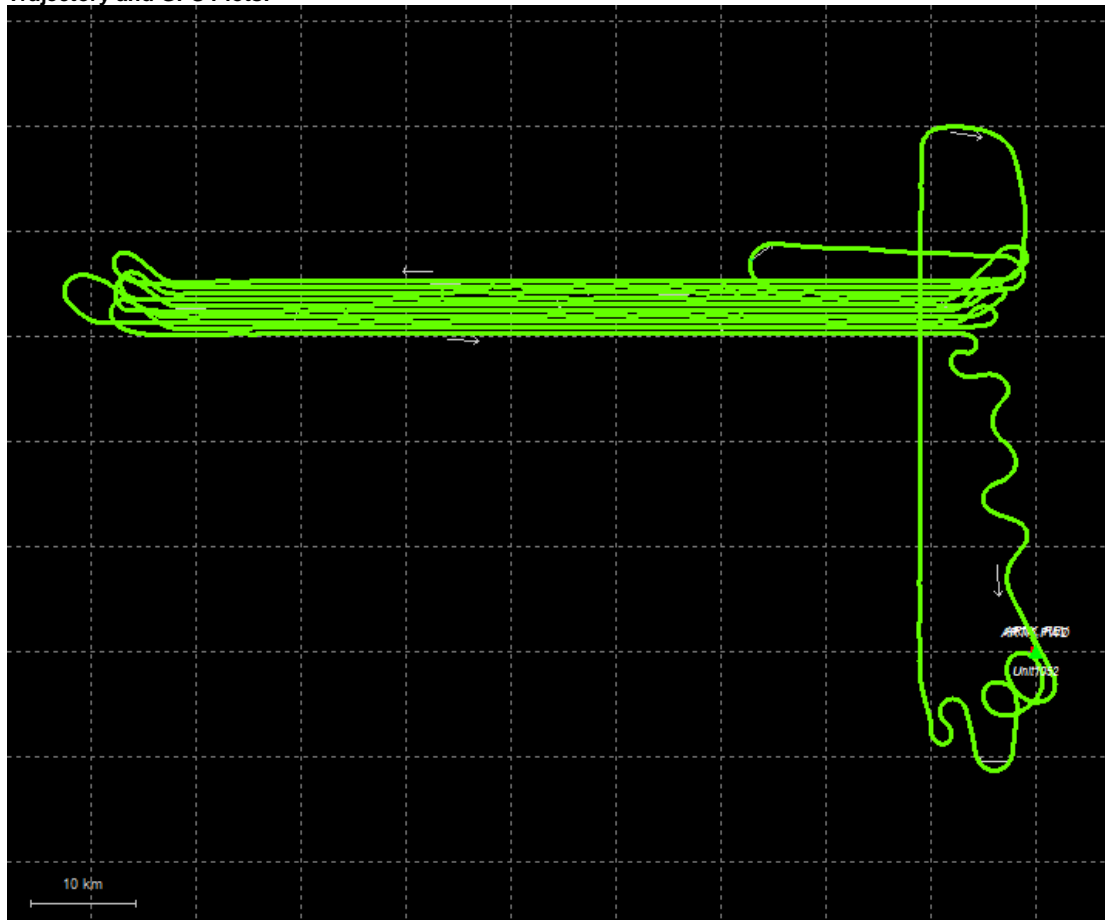
18.101

Lift Begin			Lift End			Fit Duration	Fit Hrs	Hobbs Hrs	Activity	
Airport	Chocks	Hobbs	Airport	Chocks	Hobbs					
1	KRAP	11:30	1105.6	KRAP	16:09	1110.3	4:39	4.75	4.7	0900-Production
2										
3										

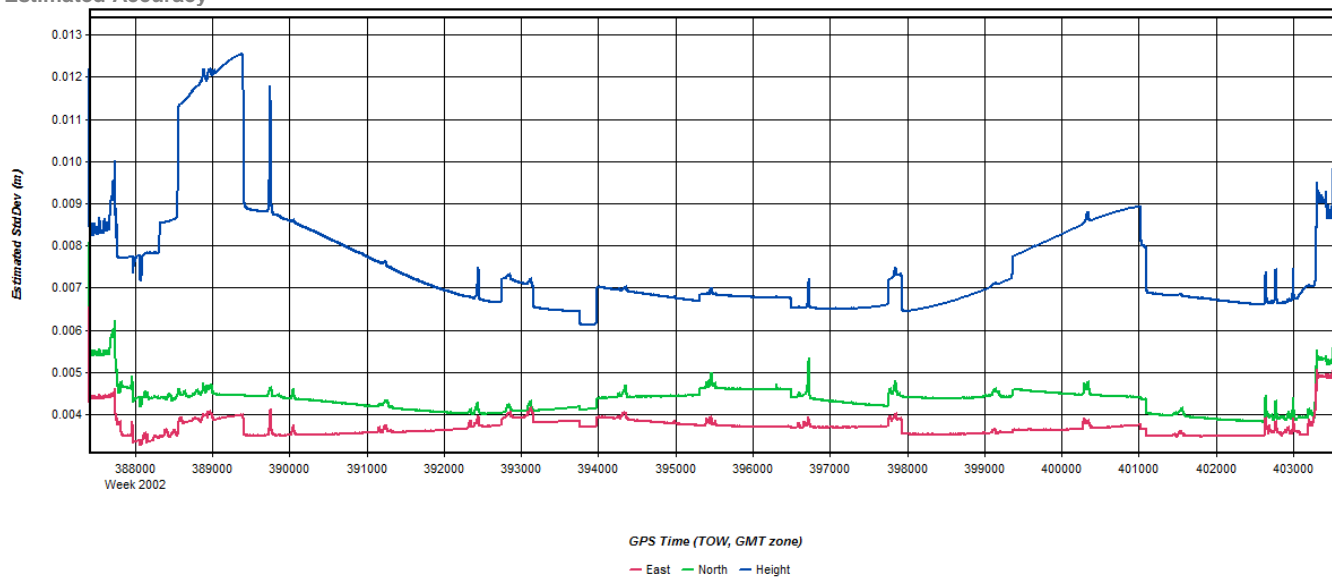
ALS
Flight Log
 AC80-44-00-02

FGI Job # 17003900		Project Name ALS_West				System ALS80	Unit 130	IMU uRS	PA 3	SW1	SW2-Gain	Aper	AutoScan Yes	Ground Temp °C 13.0 23.0		Min Range Gate 6013	Data Logger Drive
Flight Date 24-May-18		GPS Day 18-144	Lift 4	Sun° N/A			Solar Times (UTC) N/A		Laser Power 100%	Pattern Triangle		Flying Temp °C 1.0 3.0		Max Range Gate 7976	Download Drive		
Mission ID (yyymmdd_Sen_Job_Lift) 180524_130_17003900_04		Aircraft N62912	Airport ID KRAP	FMS FCMS	UTC -6	AMT (ft) 7,650	Speed <150	Scan Hz 63.2	Pulse Rate 367k	FOV 21	km/WPT 1.400	Altm Setting 29.91 29.91		Shipping Track			
Pilot #1 George Jordan		Pilot #2		Operator #1 Eric Mueller		Operator #2											
Base 1 ID FGI 081	Location KRAP		Rec ID GRD1-	Ant ID GRD1-	ARP (m) 1.8	Start Time (UTC)		Stop Time (UTC)		GPS Filename		Operator Chris Fought		Data			
Area	Flight #		Wpt		Distance		UTC		Fit Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions			SVs	PDOP
	FGI	Client's	From	To	Begin	End	Start	End									
							11:37:00	11:42:00					GROUND-STATIC @ KRAP			18	1.2
							12:01:50	12:04:01		10240	161		PRE ACQUISITION CALIBRATION			20	1.0
ALS_X	2		1	26	0	35	12:06:34	12:15:43	352.7	10304	147		CROSS LINE			21	1.0
ALS_West	17		51	1	70	0	12:22:21	12:39:36	262.7	13004	149					18	1.2
	18		1	51	0	70	12:42:09	12:59:10	281.6	13004	150					19	1.3
	18		51	42	70	57.4	13:02:49	13:06:59	262.8	13004	138					20	1.1
	19		51	1	70	0	13:13:00	13:31:05	262.6	13204	146					20	1.0
	20		1	51	0	70	13:34:23	13:50:22	281.6	13154	150					18	1.1
	21		51	1	70	0	13:52:00	14:10:07	262.7	13154	150					18	1.1
	22		1	51	0	70	14:13:56	14:29:39	281.6	13154	149					18	1.2
	23		51	1	70	0	14:33:18	14:50:11	262.7	13254	142					19	1.1
	24		1	51	0	70	14:55:55	15:11:33	281.5	13254	149					20	1.1
	25		51	1	70	0	15:14:40	15:31:05	262.7	13254	143					21	1.2
	26		1	51	0	70	15:34:00	15:50:39	281.6	13254	150					21	1.2
							15:51:05	15:53:14		10283	154		POST ACQUISITION CALIBRATION			22	1.2
							16:01:30	16:06:30					GROUND-STATIC @ KRAP			21	1.3

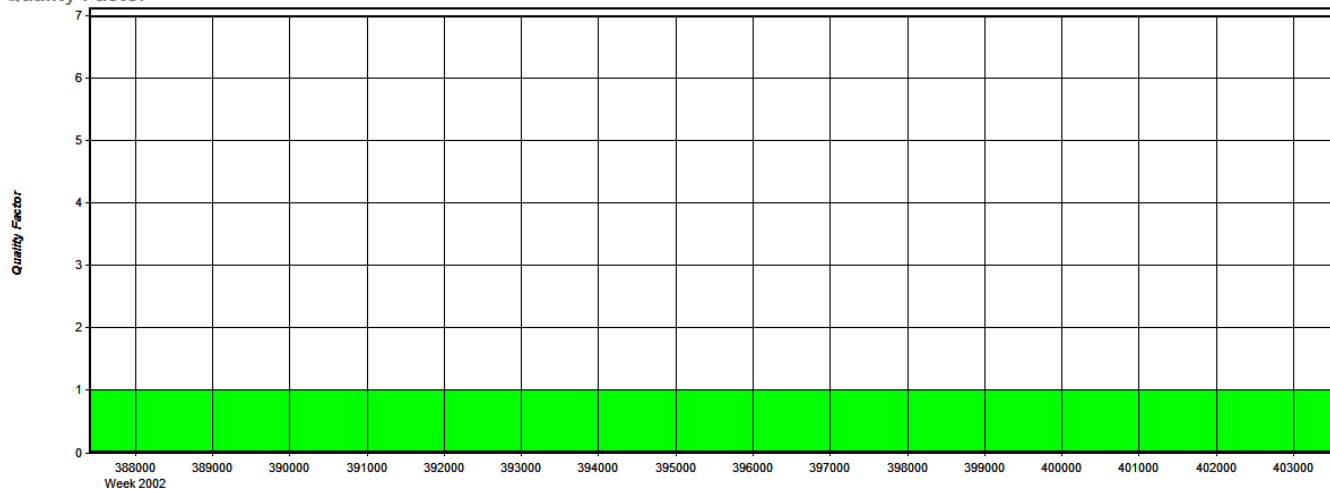
Trajectory and GPS Plots:



Estimated Accuracy

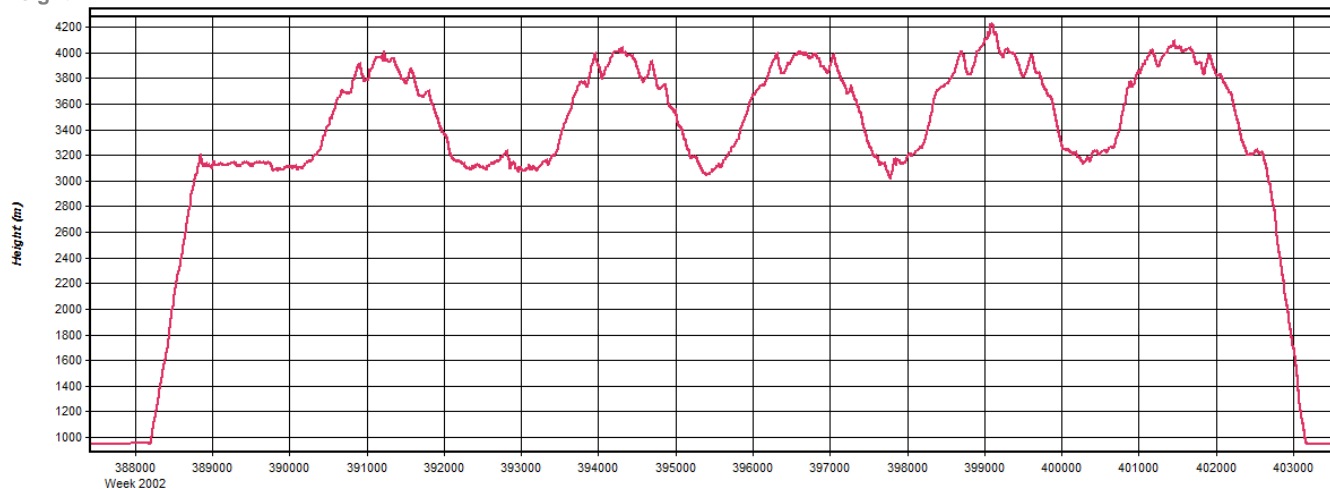


Quality Factor



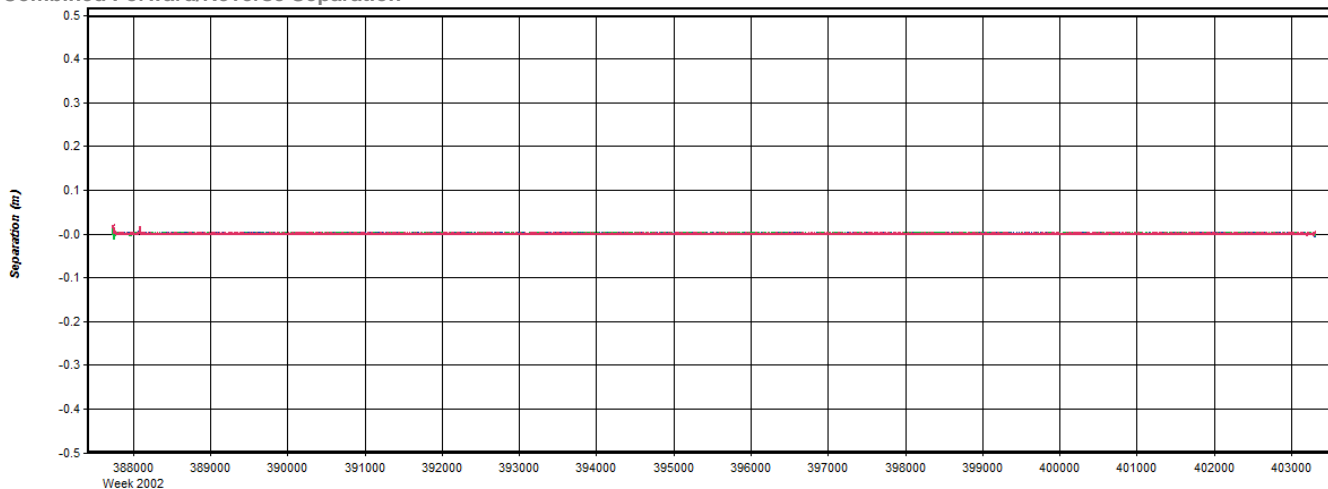
GPS Time (TOW, GMT zone)
— Fixed Integer — Stable float — Converging float — DGPS or worse — No solution

Height



GPS Time (TOW, GMT zone)
— Height

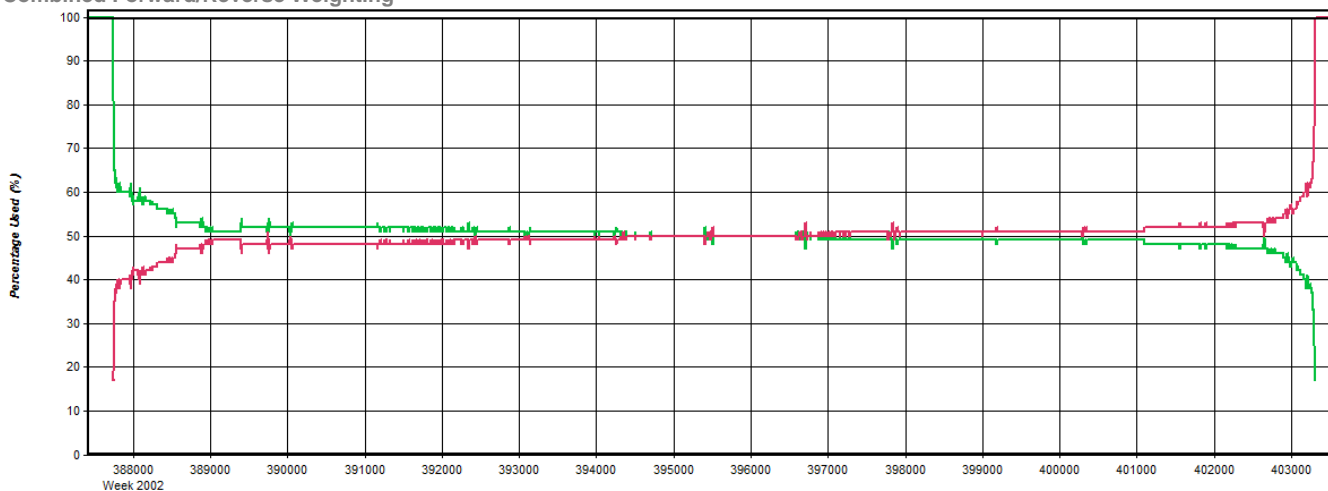
Combined Forward/Reverse Separation



GPS Time (TOW, GMT zone)

— East — North — Up

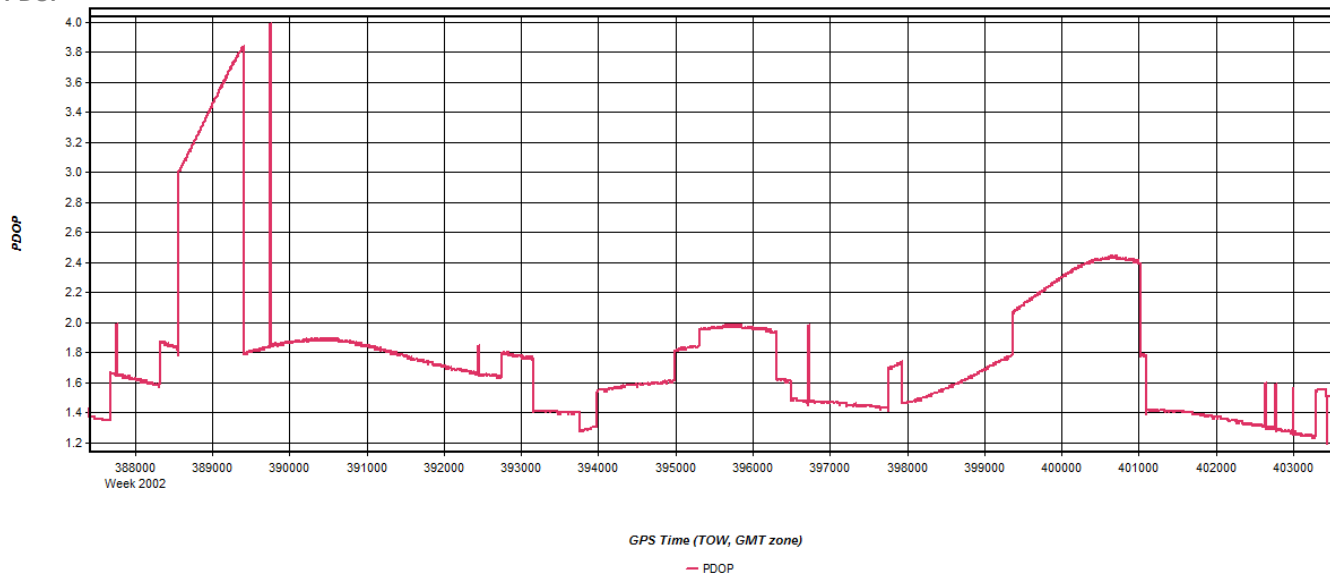
Combined Forward/Reverse Weighting



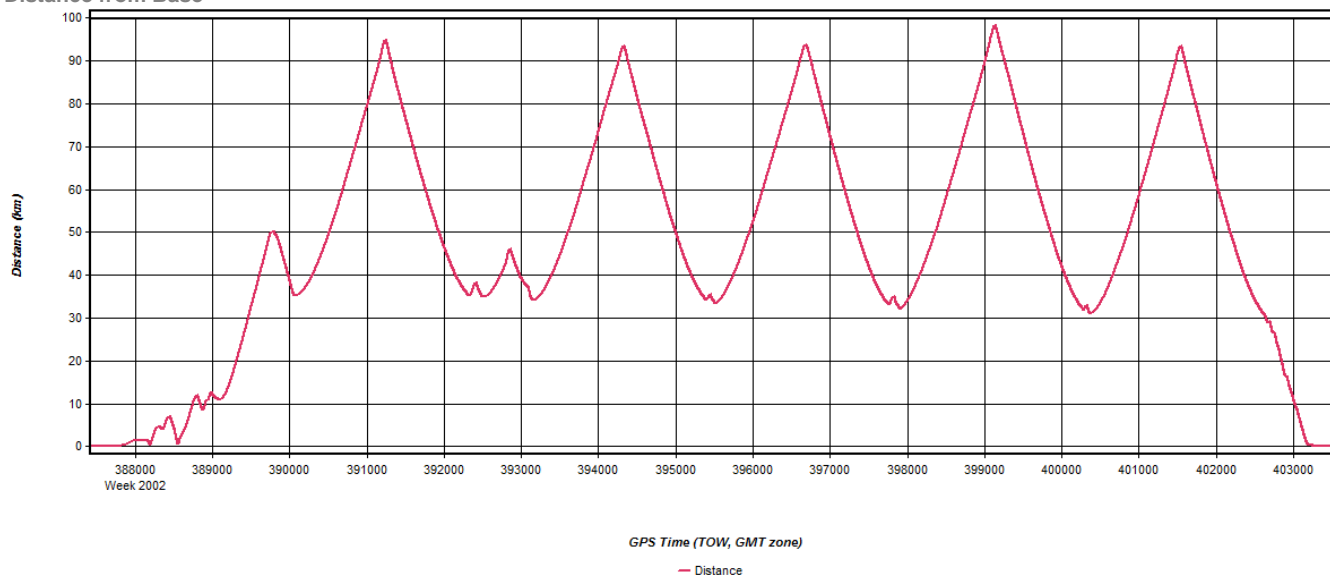
GPS Time (TOW, GMT zone)

— Smoothed LC Forward — Smoothed LC Reverse

PDOP

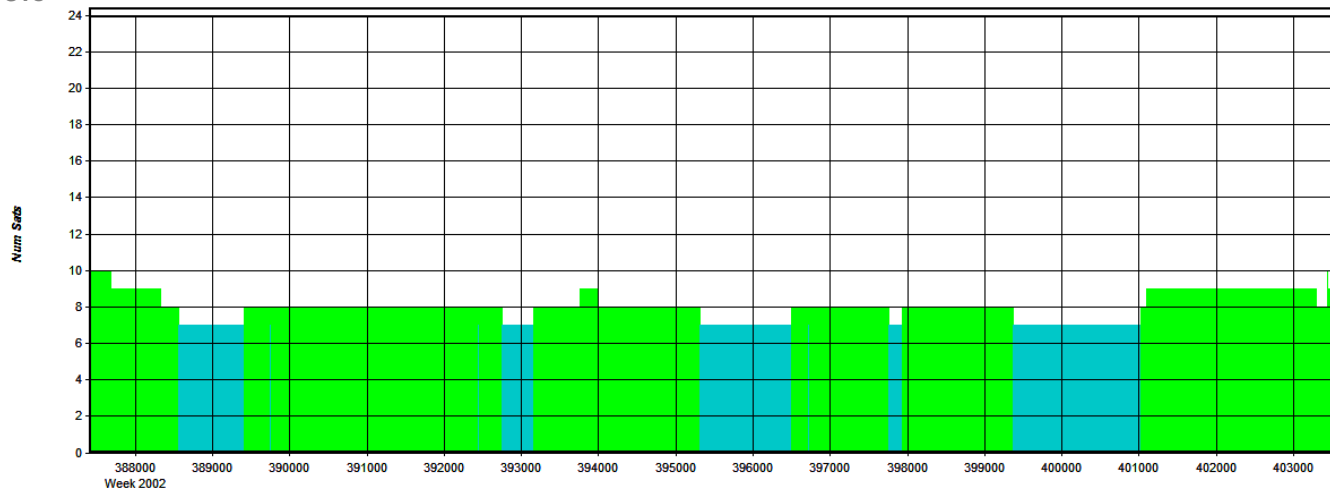


Distance from Base





SVs



GPS Time (TOW, GMT zone)
- Too Few - Minimal - Acceptable - Good - Exceptional

USGS
COLLECTION REPORT



Acquisition and Processing details ----- 180526_130_17003900_05 (May 26, 2018)

Log:

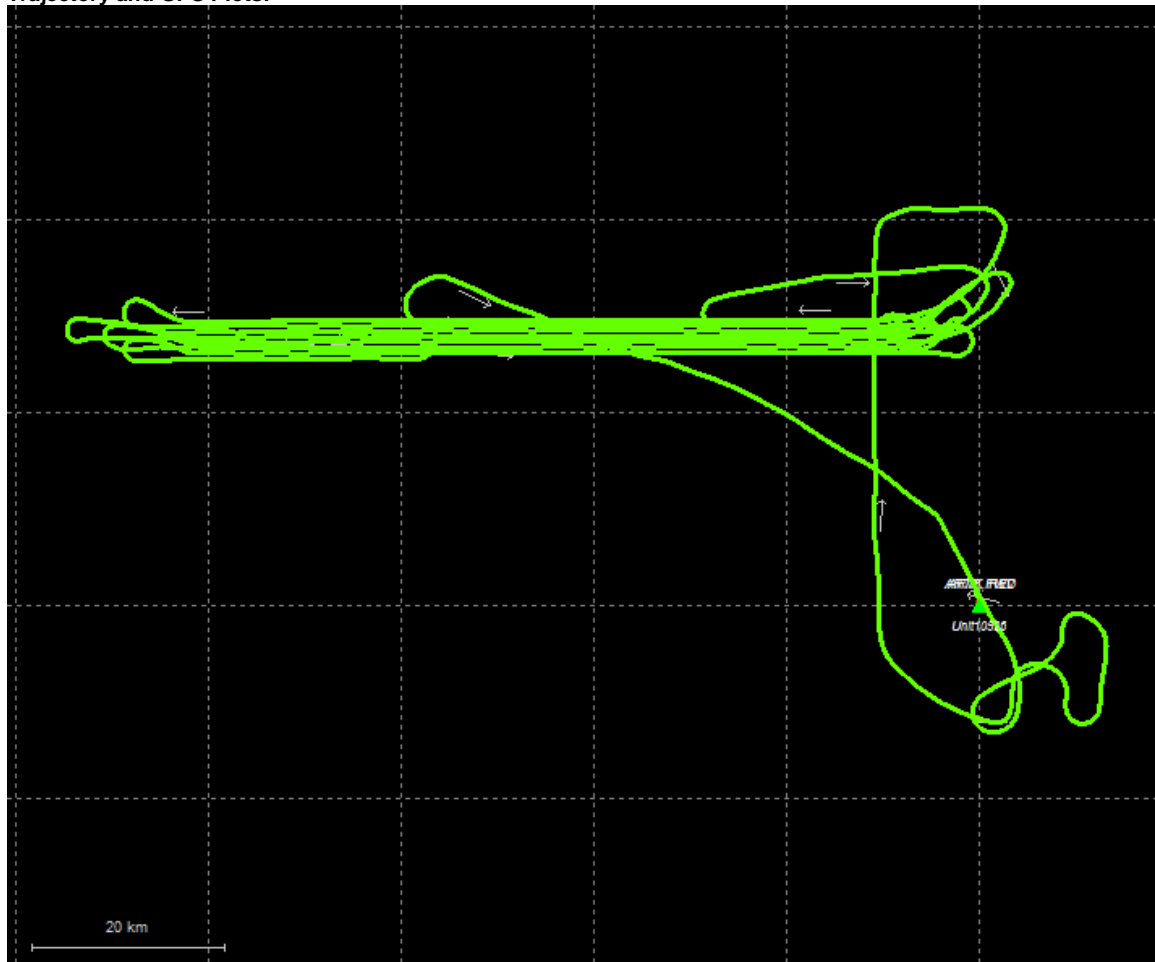
18.101

Lift Begin			Lift End			Flt Duration	Flt Hrs	Hobbs Hrs	Activity	
Airport	Chocks	Hobbs	Airport	Chocks	Hobbs					
1	KRAP	12:02	1121.1	KRAP	16:29	1125.5	4:27	4.50	4.4	0900-Production
2										
3										

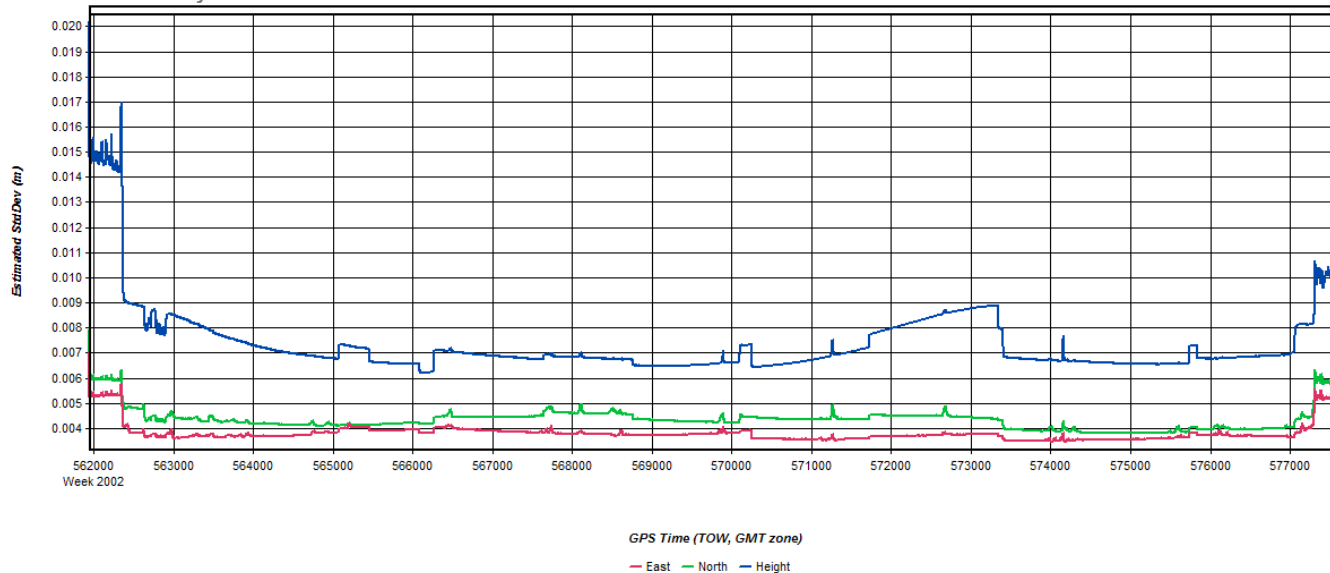
ALS
Flight Log
 AC80-44-00-02

FGI Job # 17003900		Project Name ALS_West				System ALS80	Unit 130	IMU uRS	PA 3	SW1	SW2-Gain	Aper	AutoScan Yes	Ground Temp °C 14.0 24.0	Min Range Gate 6013	Data Logger Drive
Flight Date 26-May-18	GPS Day 18-146	Lift 5			Sun° N/A	Solar Times (UTC) N/A		Laser Power 100%	Pattern Triangle	Flying Temp °C 2.0 4.0	Max Range Gate 7976	Download Drive				
Mission ID (yymmdd_Sen_Job_Lift) 180526_130_17003900_05		Aircraft N62912	Airport ID KRAP	FMS FCMS	UTC -6	AMT (ft) 7,650	Speed <150	Scan Hz 63.2	Pulse Rate 367k	FOV 21	km/WPT 1.400	AltM Setting 29.86 29.83	Shipping Track			
Pilot #1 George Jordan		Pilot #2 Russell Mason		Operator #1 Eric Mueller		Operator #2										
Base 1 ID FGI 081	Location KRAP	Rec ID GR3_Unit1	Ant ID R3_Unit1	ARP (m) 1.8	Start Time (UTC) 180526 1113		Stop Time (UTC)	GPS Filename	Operator Eric Mueller		Data					
Area	Flight #		Wpt		Distance		UTC		Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions	SVs	PDOP	
	FGI	Client's	From	To	Begin	End	Start	End								
							12:06:10	12:11:10					GROUND-STATIC @ KRAP	17	1.1	
							12:35:00	12:38:33			132		PRE ACQUISITION CALIBRATION	18	1.3	
ALS_X	2		1	18	0	23.8	12:45:59	12:51:49	352.8	10304	140	61.0	CROSS LINE	18	1.2	
ALS_West	27		51	1	70	0	13:00:07	13:19:20	262.8	13254	128	61.0		20	1.0	
	28		1	51	0	70	13:22:50	13:40:10	081.6	13354	142	61.0		18	1.1	
	28		51	42	70	57.4	13:43:33	13:48:02	262.8	13354	132	61.0	CALIBRATION LINE	19	1.1	
	29		51	1	70	0	13:58:45	14:15:11	262.6	13354	141	61.0		18	1.2	
	30		1	51	0	70	14:22:02	14:38:33	081.6	13354	137	61.0		19	1.2	
	31		51	1	70	0	14:45:37	15:02:38	262.7	13354	146	61.0		18	1.3	
	32		1	51	0	70	15:07:57	15:25:12	081.6	13354	131	61.0		18	1.1	
	33		51	1	70	0	15:32:58	15:51:28	262.7	13454	124	61.0		18	1.2	
	34		1	51	0	70	15:56:03		081.6	13354	135	61.0		21	1.1	
							16:01:25	16:05:11			142		POST ACQUISITION CALIBRATION	20	1.1	
							16:21:40	16:26:40					GROUND-STATIC @ KRAP	20	1.1	

Trajectory and GPS Plots:

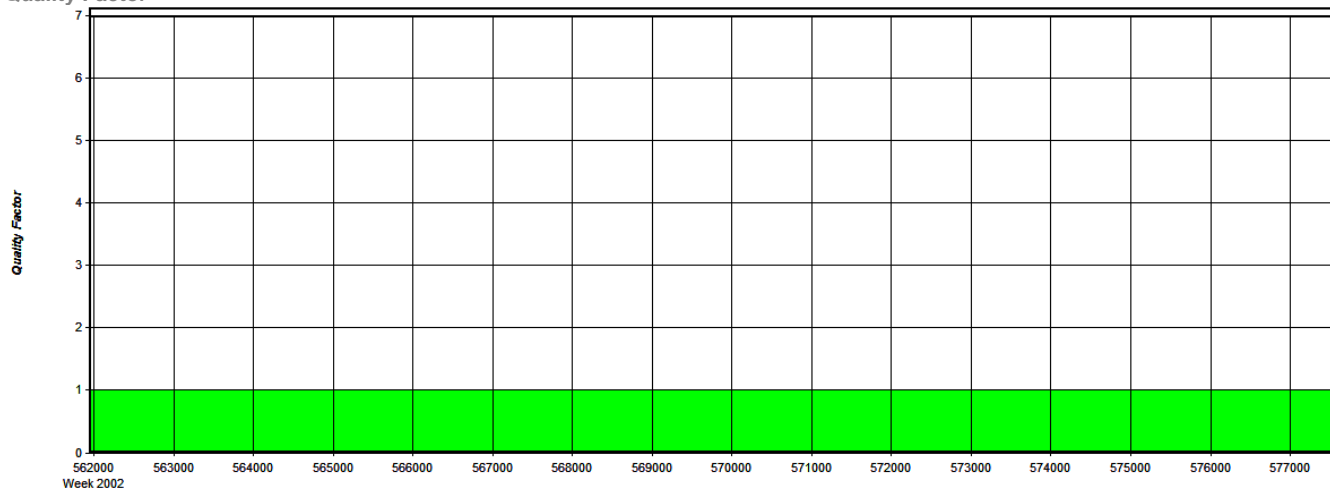


Estimated Accuracy





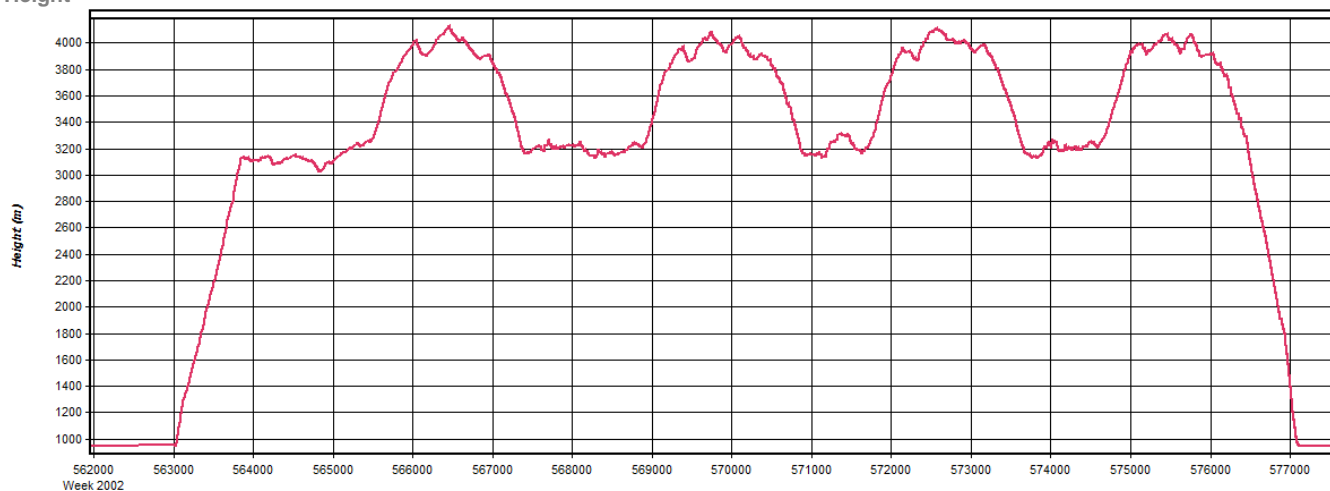
Quality Factor



GPS Time (TOW, GMT zone)

Fixed Integer Stable float Converging float DGPS or worse No solution

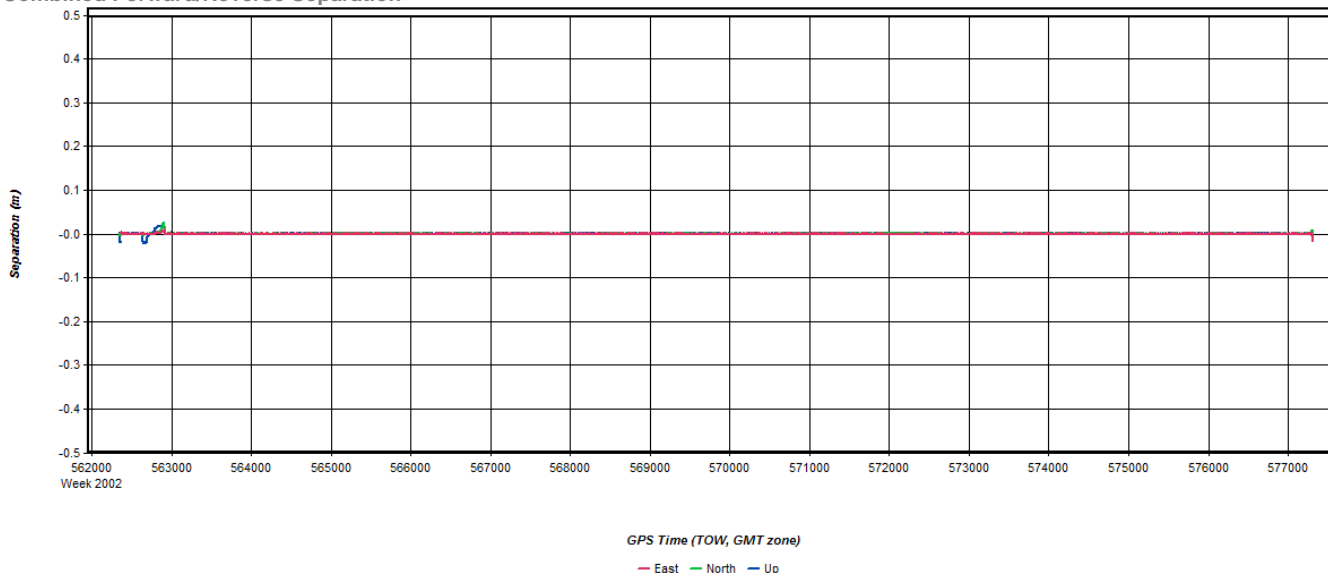
Height



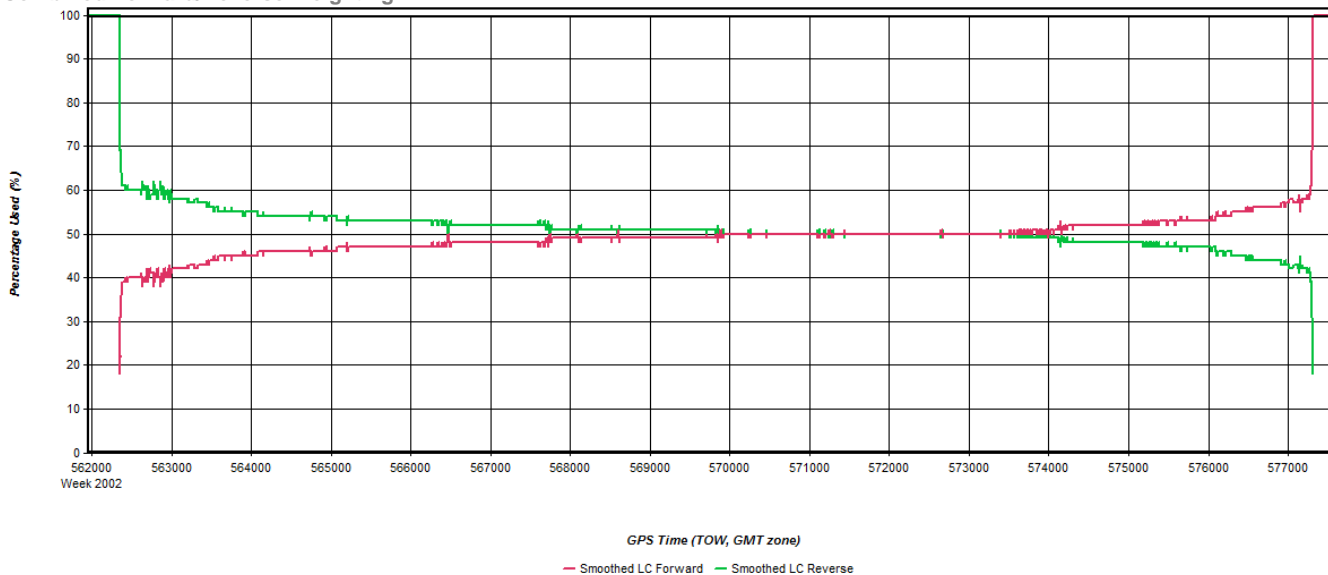
GPS Time (TOW, GMT zone)

Height

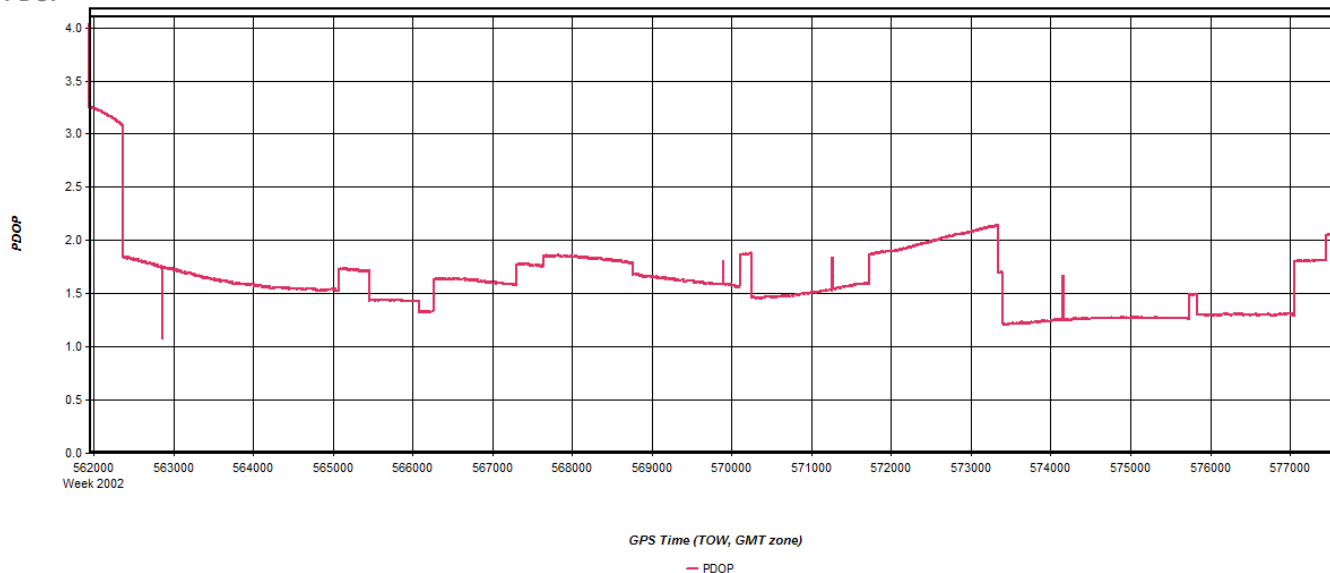
Combined Forward/Reverse Separation



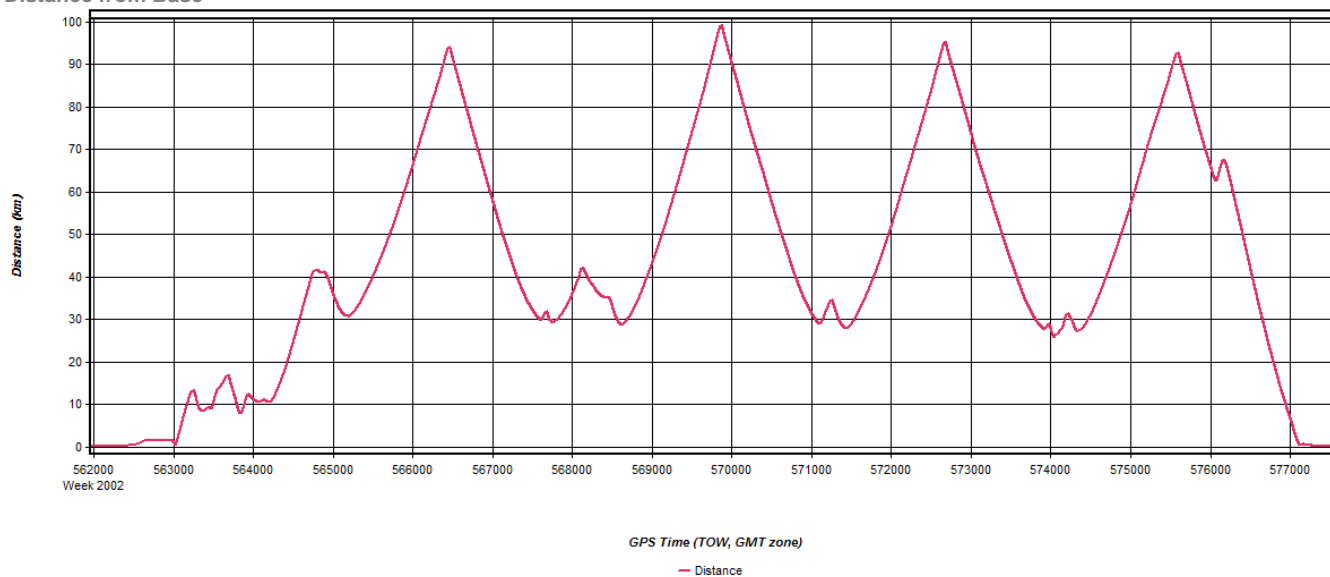
Combined Forward/Reverse Weighting



PDOP

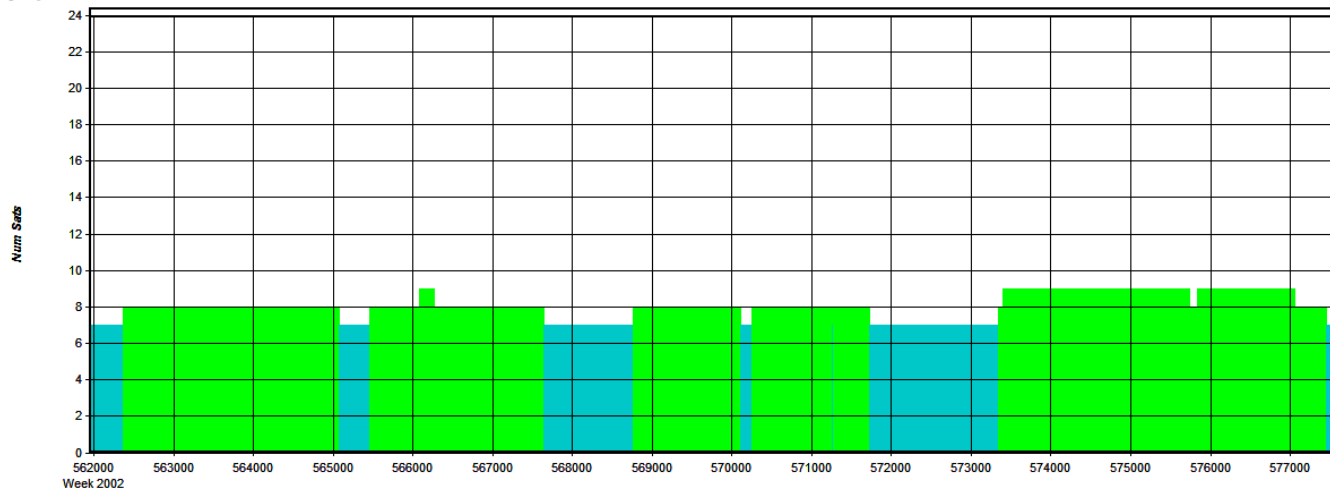


Distance from Base





SVs



GPS Time (TOW, GMT zone)


Too Few Minimal Acceptable Good Exceptional

USGS
COLLECTION REPORT




Acquisition and Processing details ----- 180526_130_17003900_06 (May 26, 2018)

Log:


Menu
18.101

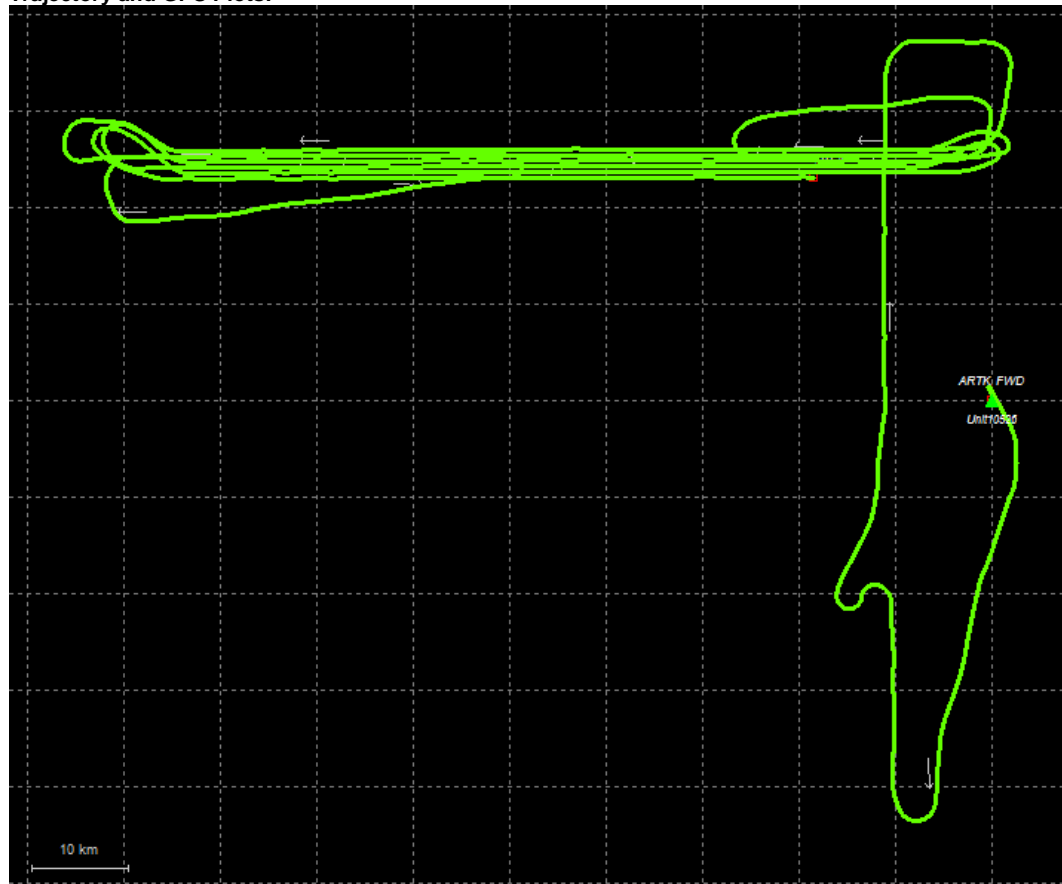
Lift Begin			Lift End			Flt	Flt	Hobbs	Activity	
Airport	Chocks	Hobbs	Airport	Chocks	Hobbs	Duration	Hrs	Hrs		
1	KRAP	17:20	1125.5	KRAP	21:25	1129.6	4:05	4:00	4.1	0900-Production
2										
3										



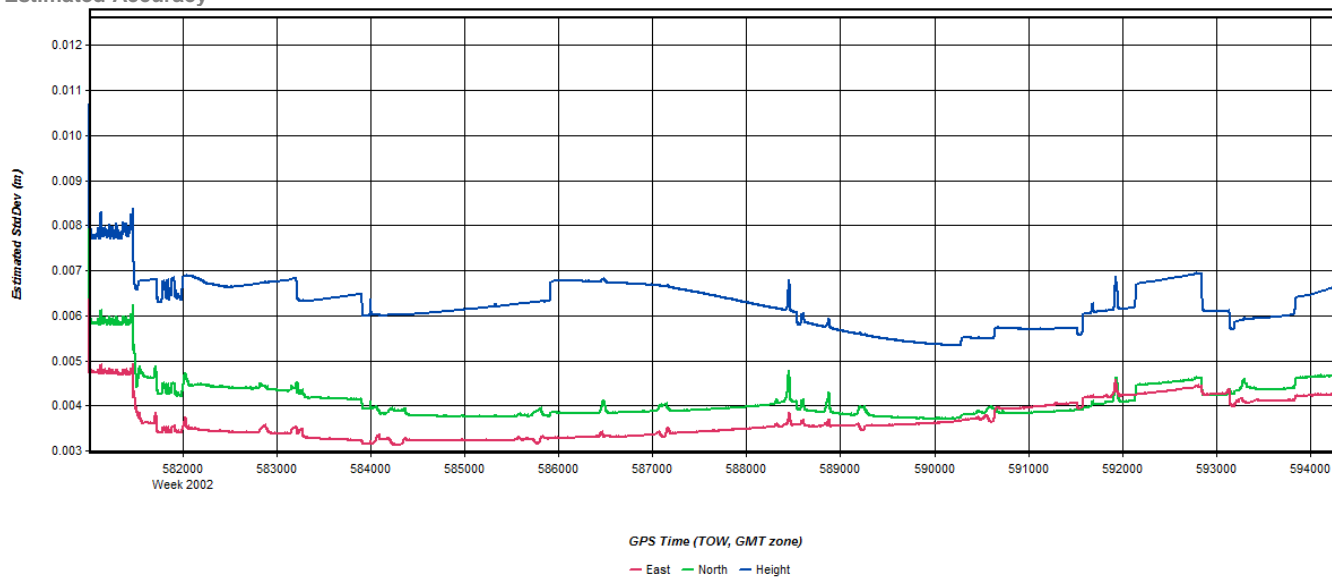
ALS
 Flight Log
 AC80-44-00-02

FGI Job #	Project Name			System	Unit	IMU	PIA	SW1	SW2-Gain	Aper	AutoScan	Ground Temp °C	Min Range Gate	Data Logger Drive		
17003900	ALS_West			ALS80	130	uRS	3				Yes	27.0 31.0	6013			
Flight Date	GPS Day	Lift				Sun°	Solar Times (UTC)	Laser Power	Pattern	Flying Temp °C	Max Range Gate	Download Drive				
26-May-18	18-146	6				N/A	N/A	100%	Triangle	3.0 10.0	7976					
Mission ID (yyymmdd_Sen_Job_Lift)	Aircraft	Airport ID	FMS	UTC	AMT (ft)	Speed	Scan Hz	Pulse Rate	FOV	kmWPT	Altm Setting	Shipping Track				
180526_130_17003900_06	N62912	KRAP	FCMS	-6	7,650	<150	63.2	367k	21	1.400	29.80 29.74					
Pilot #1		Pilot #2		Operator #1		Operator #2										
George Jordan		Russell Mason		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		GR3_Unit1	R3_Unit1	1.8	180526 1113				Eric Mueller	FTP					
Area	Flight #		Wpt		Distance		UTC		Flt	Altitude	Speed	Scan	Comments and Conditions		SVs	PDOF
	FGI	Client's	From	To	Begin	End	Start	End	Dir	(GPS)	(knots)	Rate				
							17:24:00	17:29:00					GROUND-STATIC @ KRAP		23	1.0
							17:59:52	18:02:07			146		PRE ACQUISITION CALIBRATION		22	1.1
ALS_X	2		1	15	0	19.6	18:08:48	18:13:40	352.7	10304	136	61.0	CROSS LINE		22	1.0
ALS_West	34		51	1	70	0	18:21:13	18:39:37	262.8	13354	143	61.0			22	1.1
	35		1	51	0	70	18:46:33		081.6	13504	144	61.0	ABORTED DUE TO LATERAL DEVIATION		20	1.2
	35		1	51	0	70	19:08:38	19:25:26	081.6	13504	141	61.0			18	1.3
	35		51	42	70	57.4	19:30:58	19:34:22	262.7	13504	143	61.0	CALIBRATION LINE		20	1.1
	36		51	1	70	0	19:43:52	20:00:56	262.6	13504	134	61.0			21	1.0
	37		1	51	0	70	20:06:52	20:23:33	081.6	13604	137	61.0			21	1.0
	38		51	1	70	0	20:27:00	20:45:44	262.7	13504	144	61.0			19	1.1
	39		1	51	0	70	20:51:53		081.6	13604	139	61.0			20	1.1
							21:10:49	21:12:27			144		POST ACQUISITION CALIBRATION		21	1.1
							21:12:42						SHUTDOWN		19	1.2

Trajectory and GPS Plots:

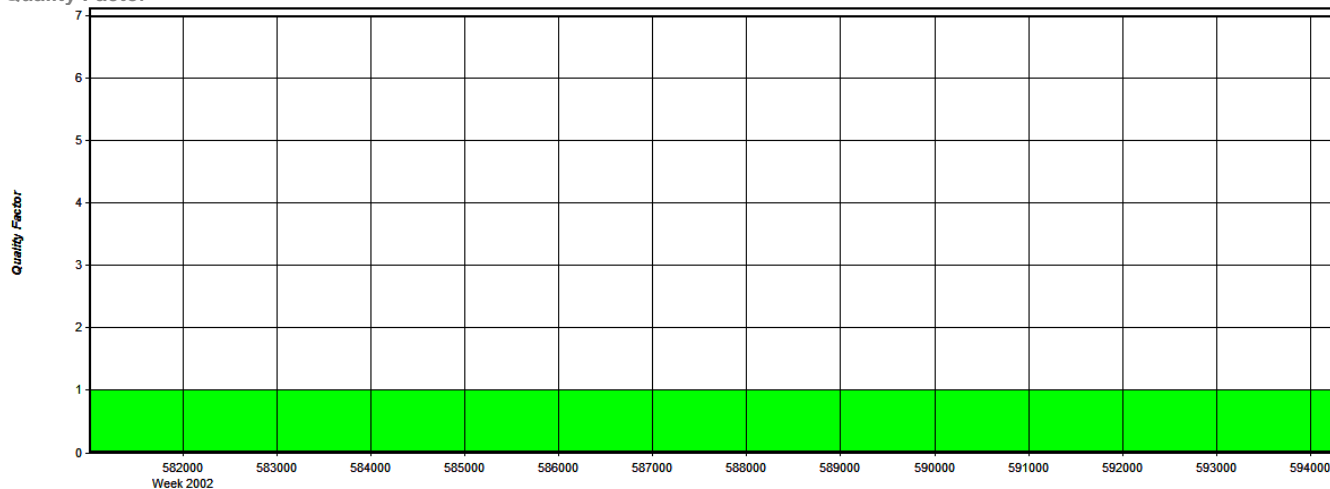


Estimated Accuracy





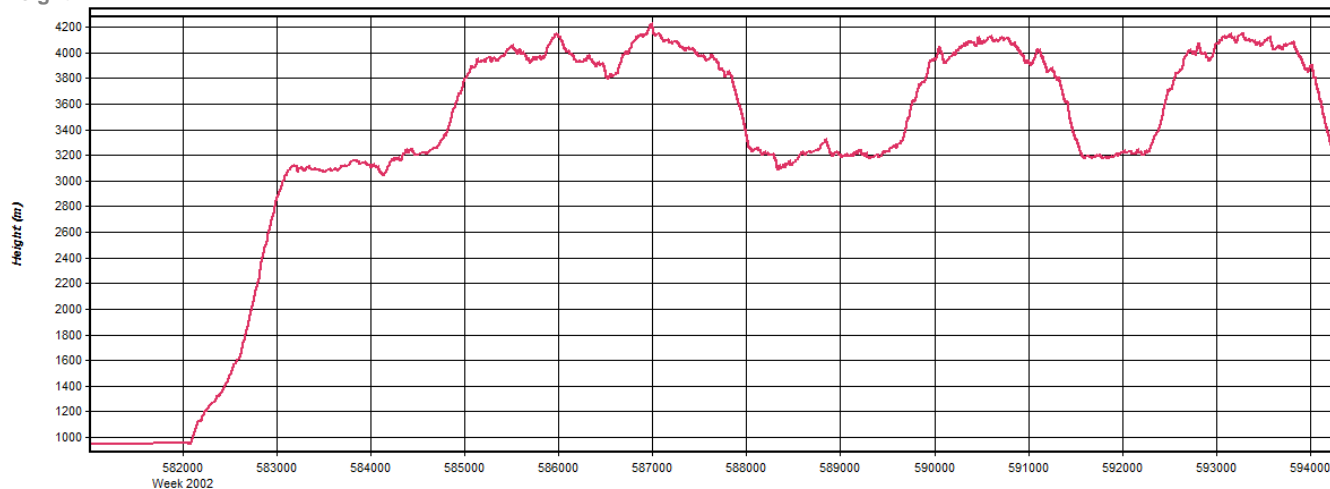
Quality Factor



GPS Time (TOW, GMT zone)

— Fixed Integer — Stable float — Converging float — DGPS or worse — No solution

Height

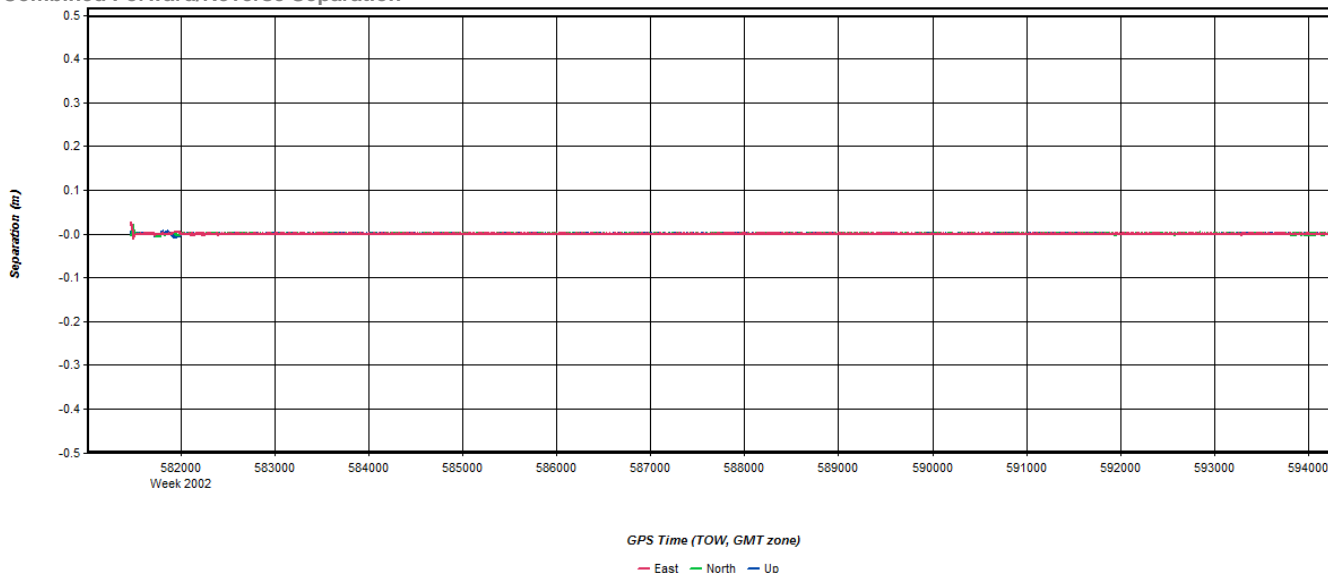


GPS Time (TOW, GMT zone)

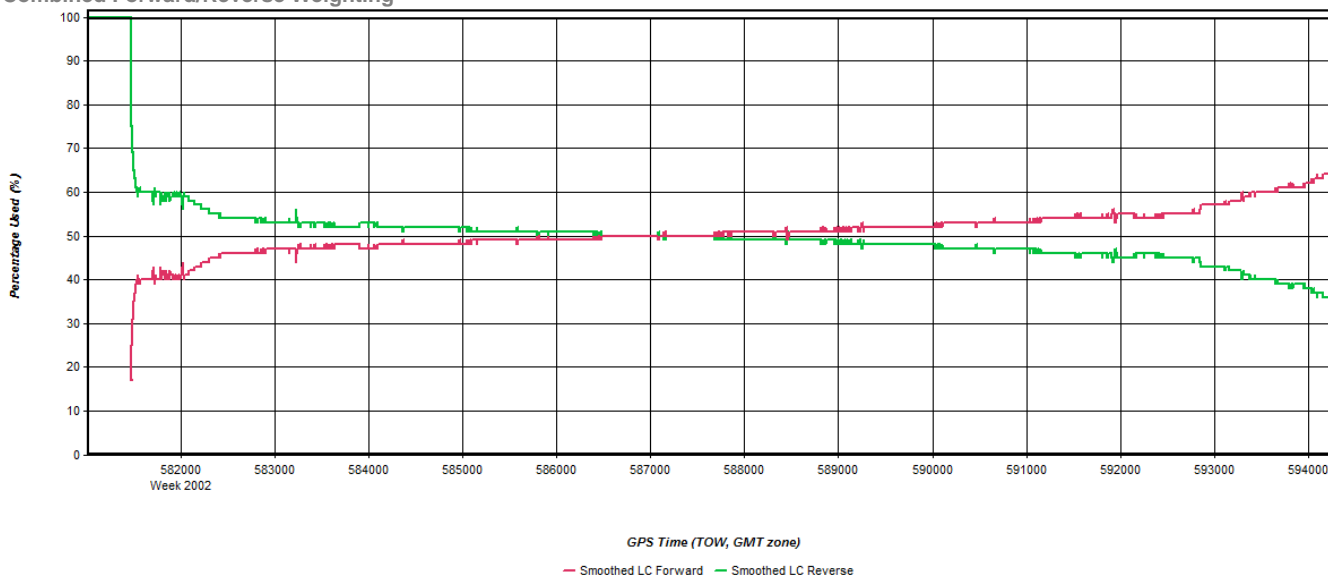
— Height



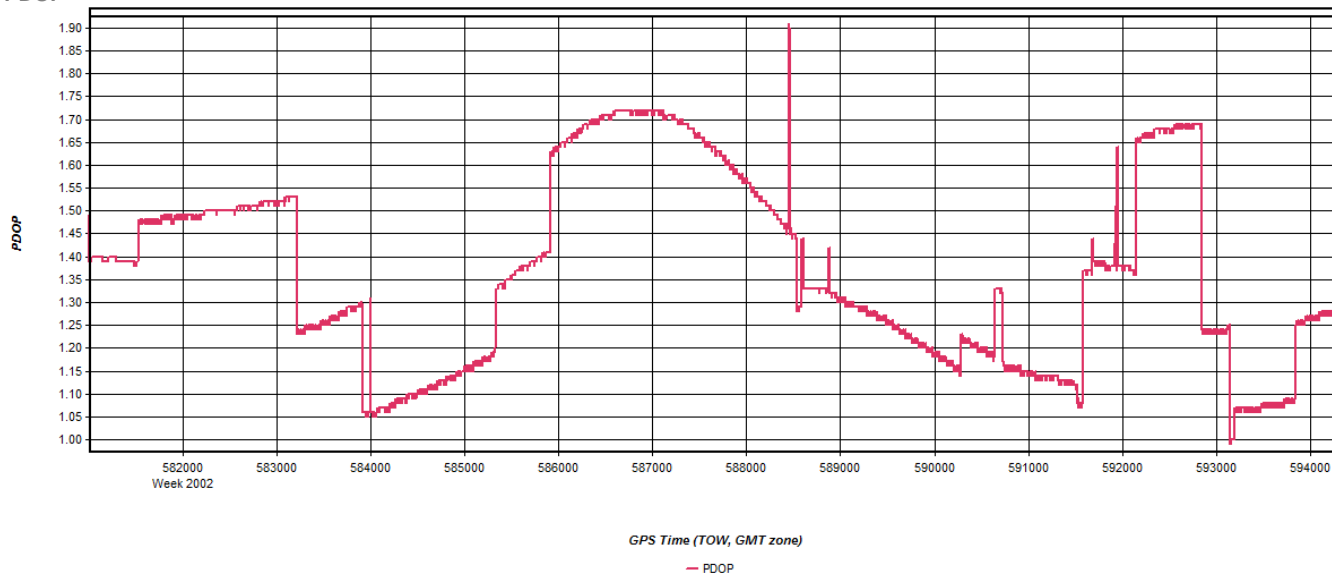
Combined Forward/Reverse Separation



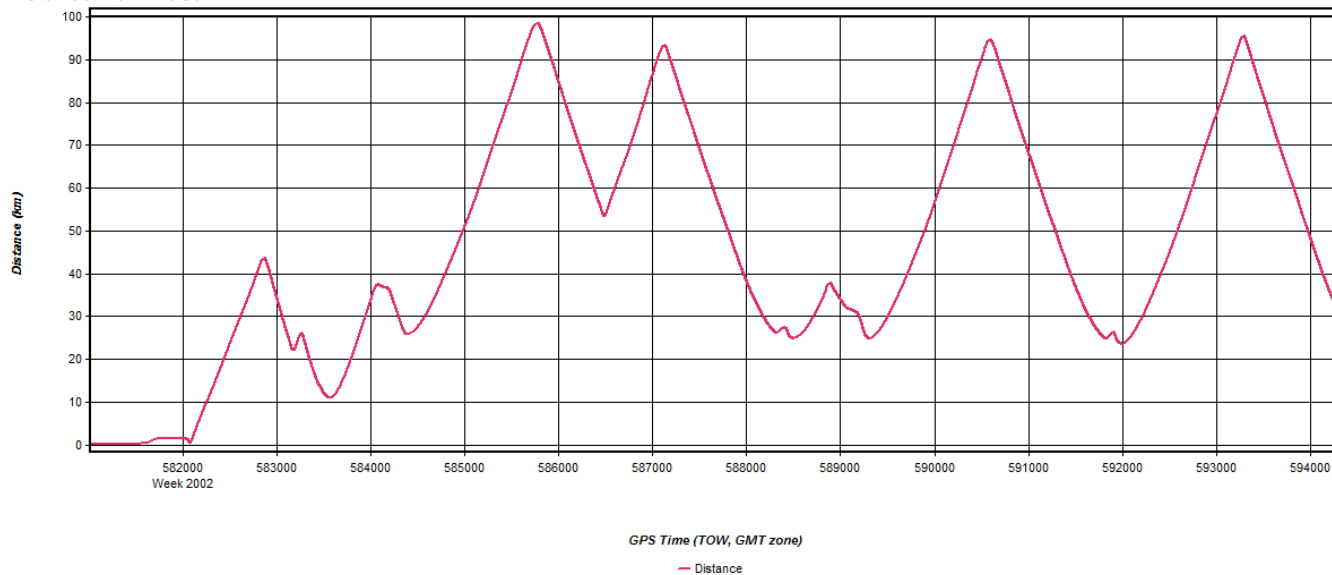
Combined Forward/Reverse Weighting



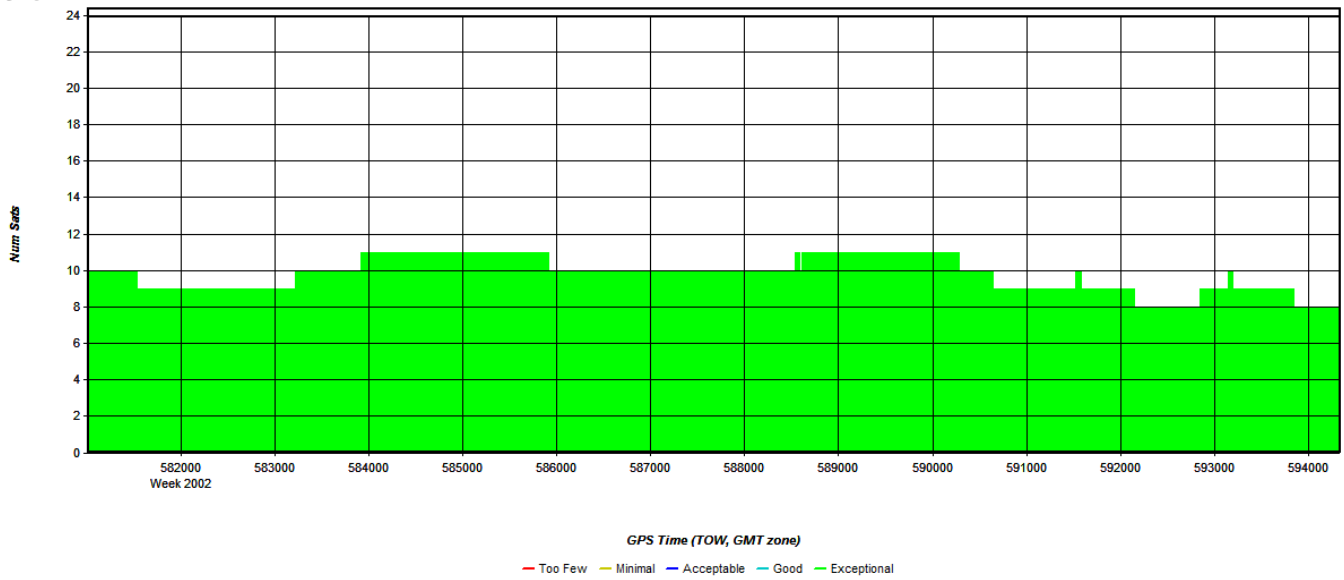
PDOP



Distance from Base



SVs



USGS
COLLECTION REPORT



Acquisition and Processing details ----- 180601_165_17003900_13 (June 1, 2018)

Log:



Fugro USA Land, Inc.

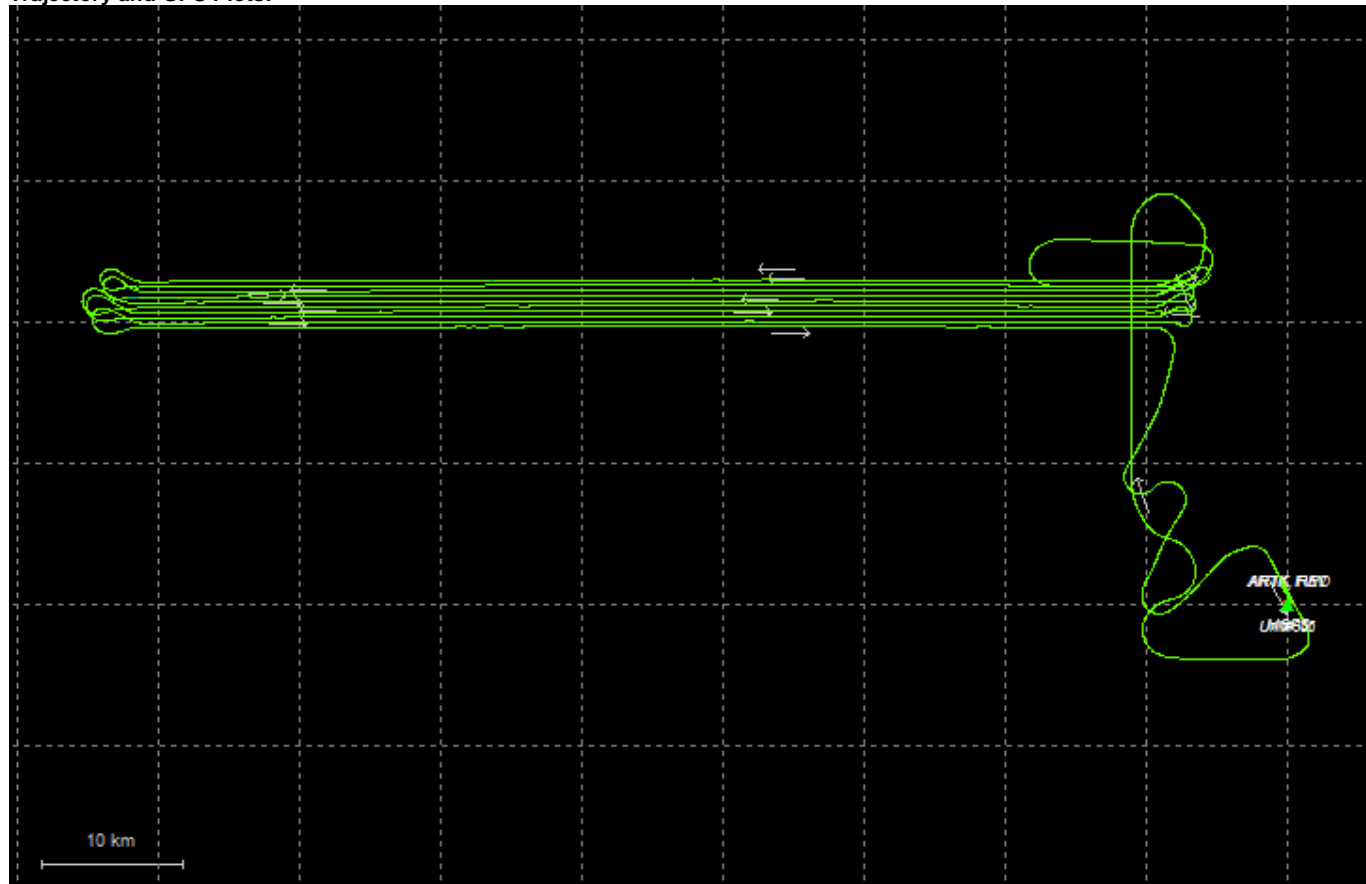
18.01	Lift Begin			Lift End			Fit Duration	Fit Hrs	Hobbs Hrs	Activity
	Airport	Chocks	Hobbs	Airport	Chocks	Hobbs				
1	KRAP	12:19	1195.5	KRAP	16:29	1199.2	4:10	4.25	3.7	0900-Production
2										
3										



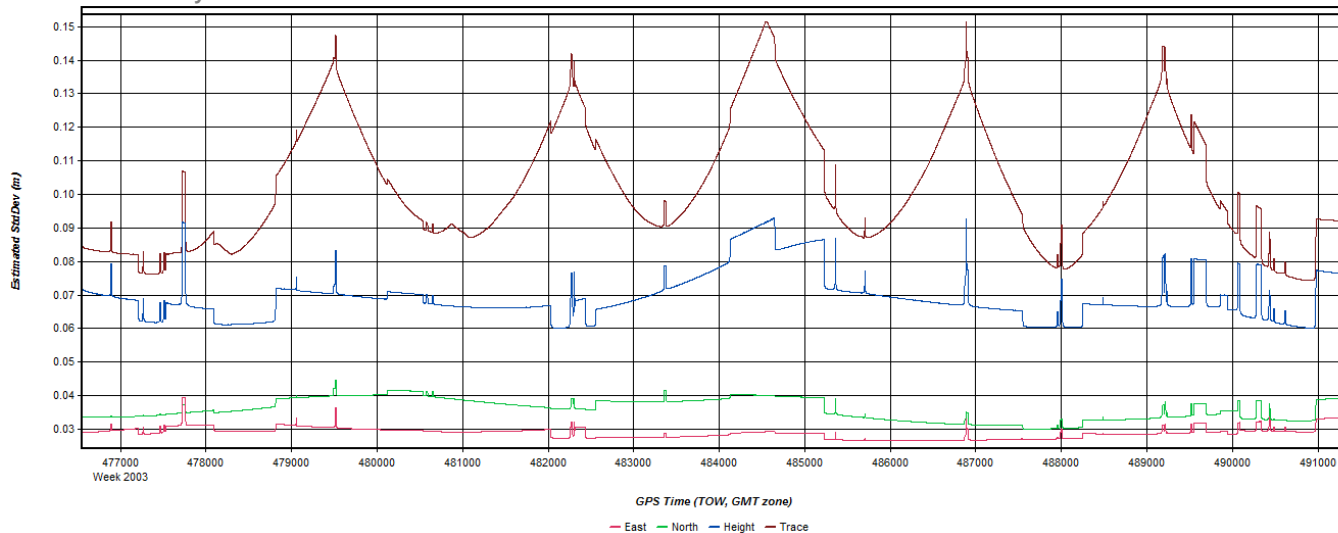
AC80-50-00-02

FGI Job #	Project Name				System	Unit	IMU			Ground Temp °C		Min Range'	Data Logger Drives			
04.17003900	USGS SD FY2017 Lidar West				680I	165				19.0	23.0	2018				
Flight Date	GPS Day	Lift				Sun°	Solar Times (UTC)		Pulse Rate	Flying Temp °C		Max Range'	Download Drive			
1-Jun-18	18-152	13				NA	NA		250	16.0 14.0		3888				
Mission ID (yymmdd_Sen_Job_Lift)		Aircraft	Airport ID	FMS	UTC	AMT (ft)	Speed	FOV	Scan Rate (Hz)	MTA	km/WPT	Altitude Setting	Humidity @ Alt	Shipping Track		
180601_165_17003900_13		N97HC	KRAP	CCNS 5		3250	140		100	2	0.596	29.68 29.66				
Pilot #1		Pilot #2		Operator #1			Operator #2									
Grant Cassell				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	01-Jun-18 11:55		01-Jun-18 17:01		Unit#50601I		Jonathan Spencer		FTP		
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								
													5 min grd stc		15	1.3
													S-turn		19	1.0
West-X	2		10	25	5.4	14.3	12:44:02	12:47:14	N	6,357	140	100.0	crossing line		17	1.0
West-A	34		118	1	69.7	0	12:52:07	13:10:13	W	9,554	127	100.0			17	1.1
	33		1	118	0	69.7	13:12:07	13:29:05	E	9,554	136	100.0			14	1.3
	33		118	108	69.7	63.8	13:31:33	13:33:16	W	9,554	133	100.0	calibration line		17	1.1
	32		118	1	69.7	0	13:38:33	13:56:31	W	9,554	132	100.0			16	1.1
	31		1	118	0	69.7	13:58:14	14:15:07	E	9,554	138	100.0			17	1.1
	30		118	1	69.7	0	14:16:55	14:34:16	W	9,554	134	100.0			17	1.2
	29		1	118	0	69.7	14:36:45	14:53:23	E	9,554	140	100.0			17	1.2
	28		118	1	69.7	0	14:55:23	15:13:16	W	9,554	130	100.0			17	1.2
	27		1	118	0	69.7	15:15:33	15:32:06	E	9,554	141	100.0			19	1.1
	26		118	1	69.7	0	15:34:04	15:51:46	W	9,554	127	100.0			19	1.1
	25		1	118	0	69.7	15:53:50	16:10:10	E	9,554	143	100.0			18	1.2
							16:12:53	16:14:41					S-turn		18	1.2
							16:23:13	16:28:13					5 min grd stc		16	1.3

Trajectory and GPS Plots:

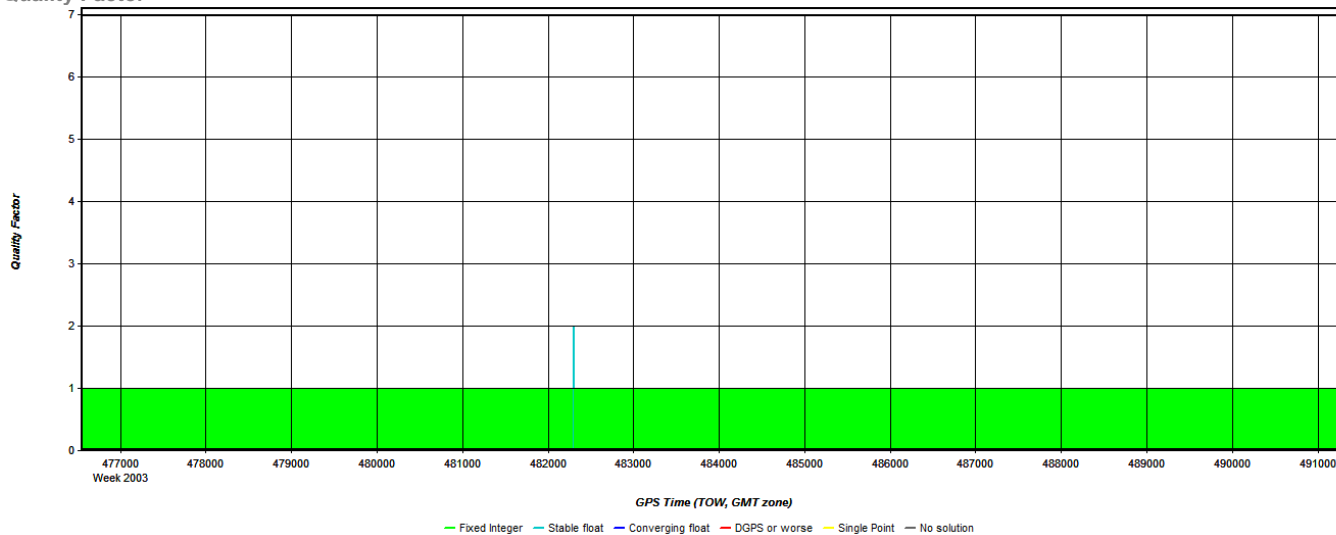


Estimated Accuracy

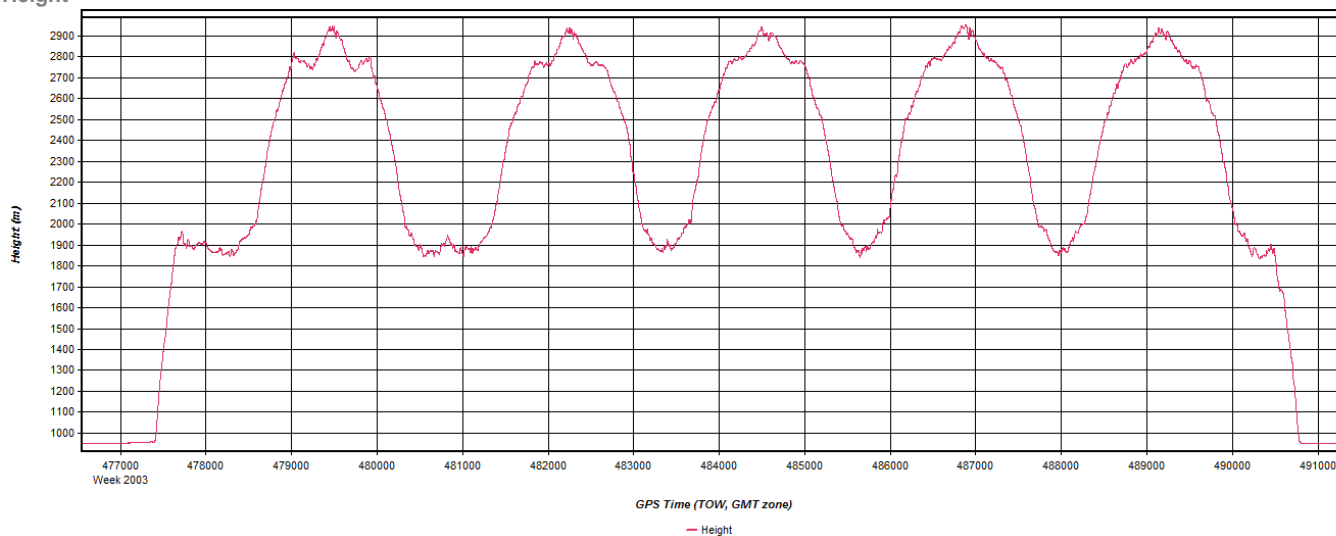




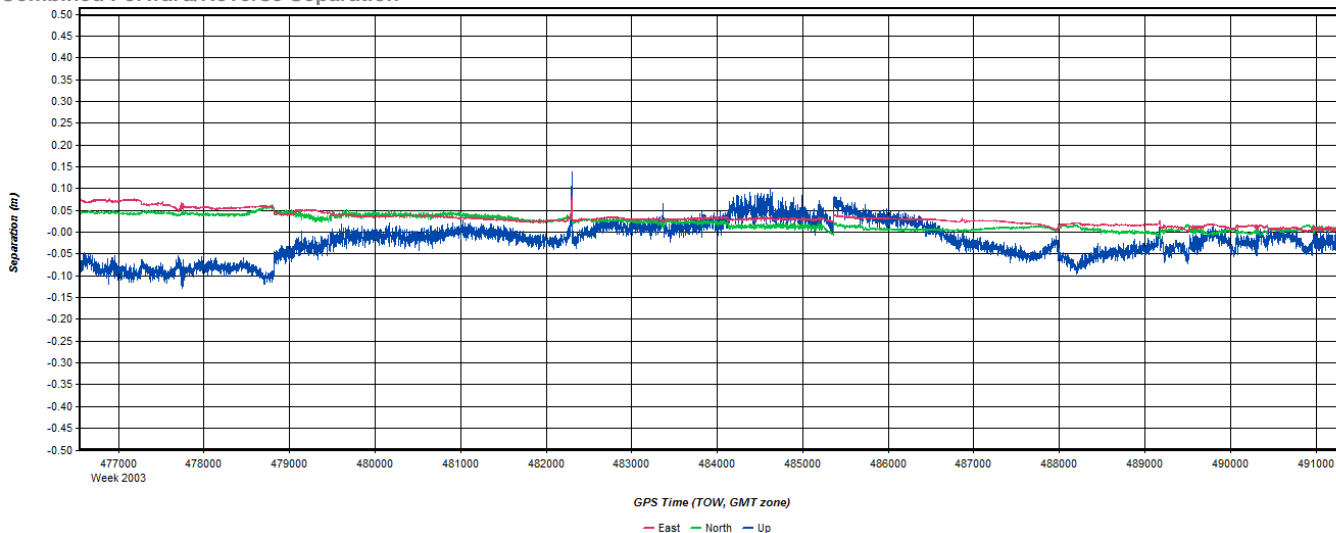
Quality Factor



Height



Combined Forward/Reverse Separation

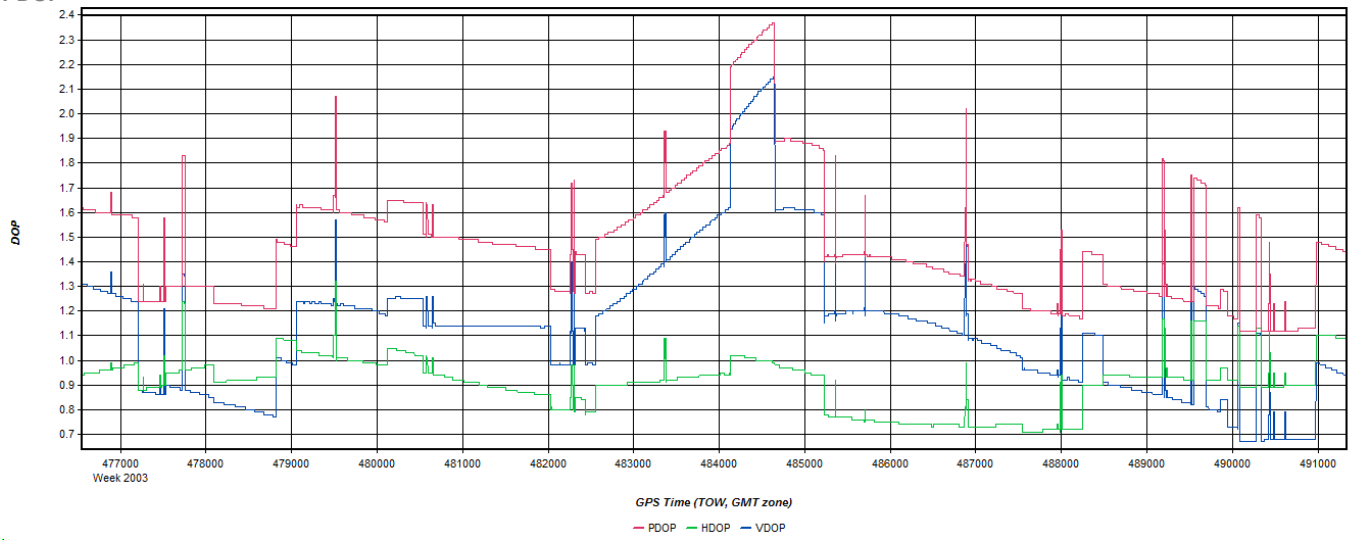


Combined Forward/Reverse Weighting

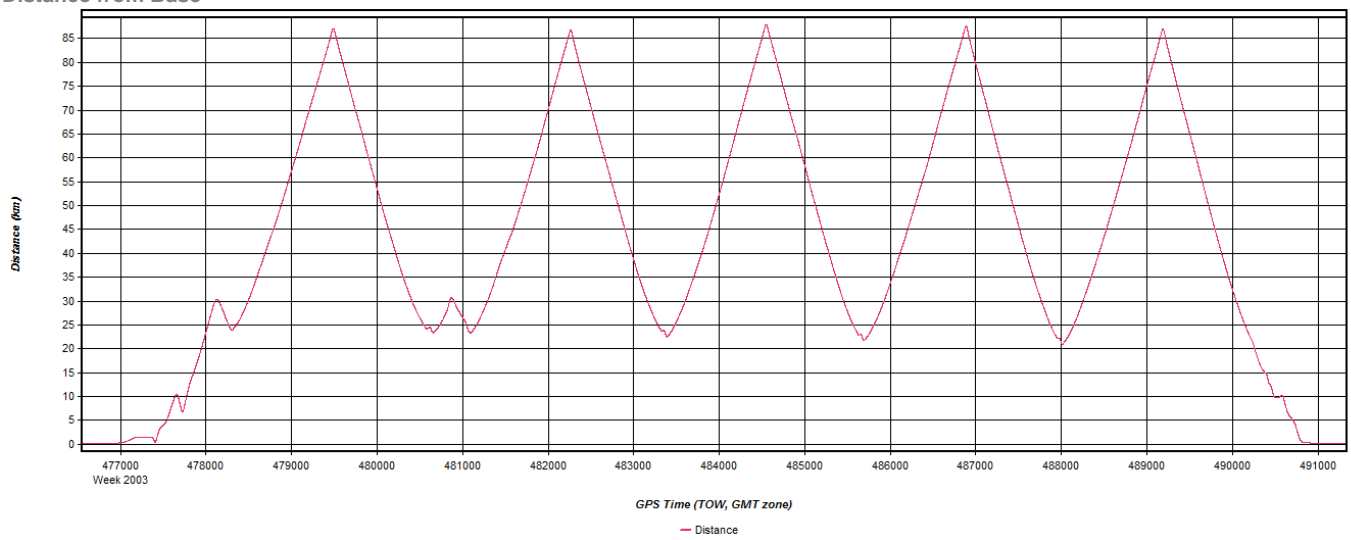


USGS COLLECTION REPORT

PDOP

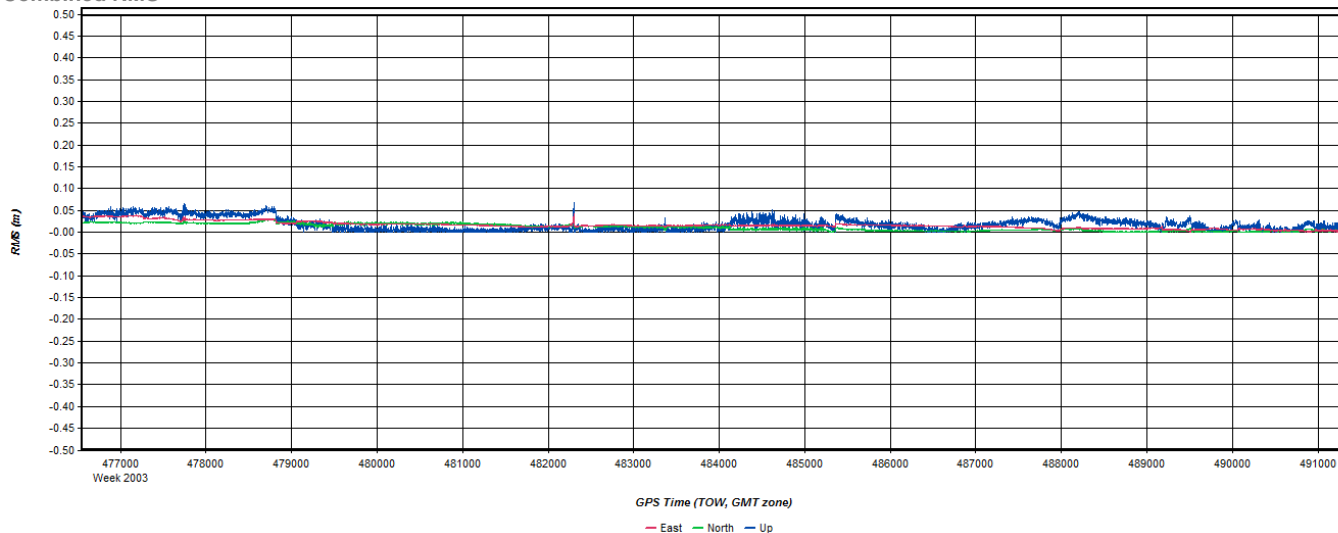


Distance from Base

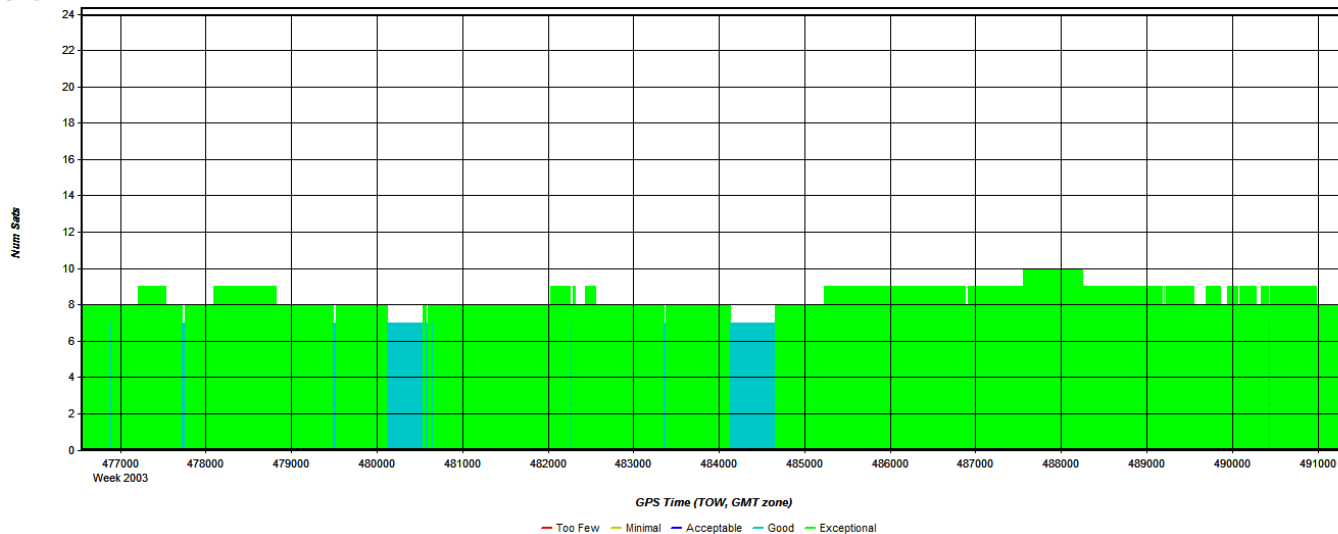




Combined RMS



SVs



**USGS
COLLECTION REPORT**



Acquisition and Processing details ----- 180601_421_17003900_10 (June 1, 2018)

Log:



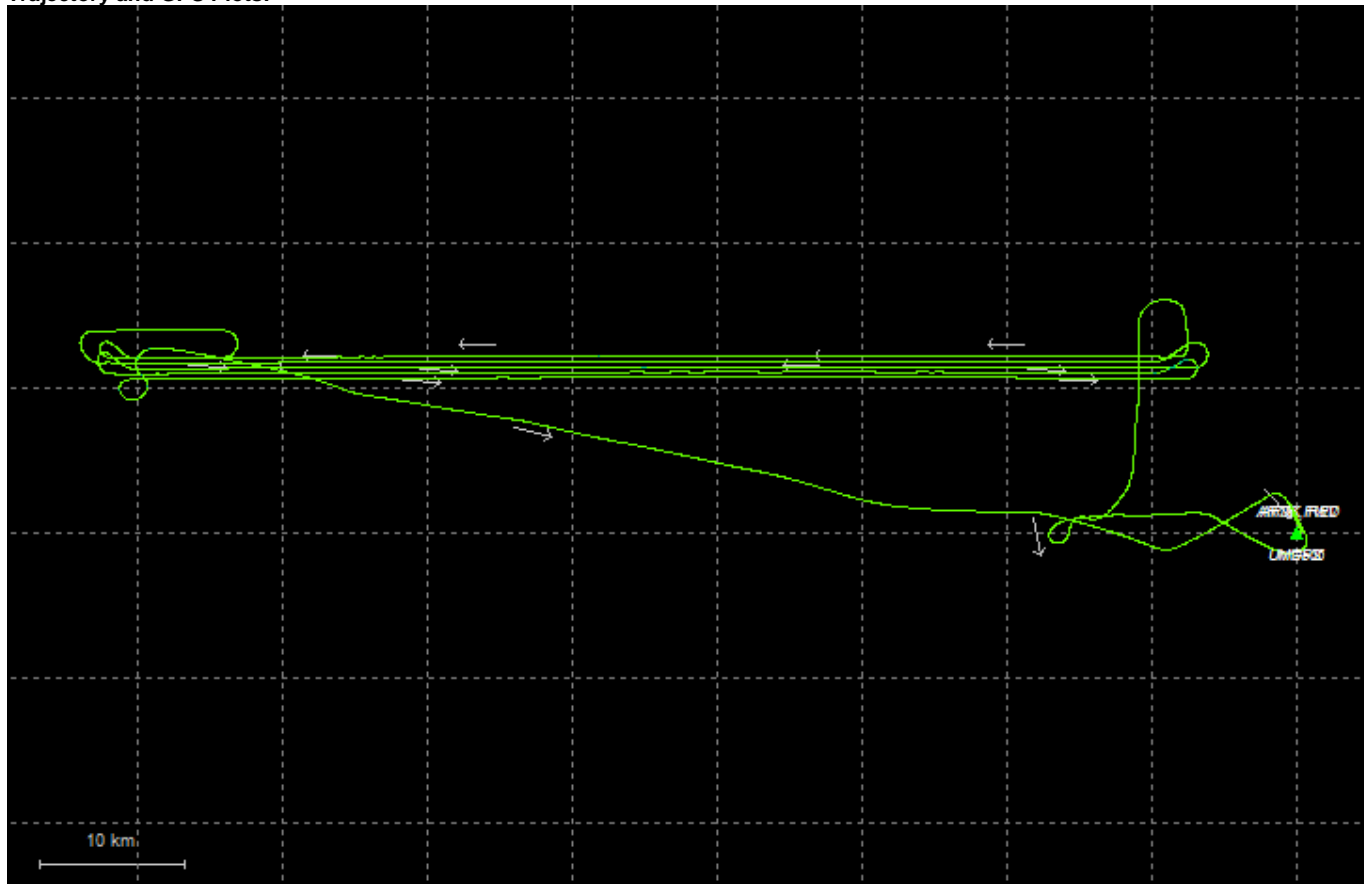
Fugro USA Land, Inc.

18.01	Lift Begin			Lift End			Fit Duration	Fit Hrs	Hobbs Hrs	Activity
	Airport	Chocks	Hobbs	Airport	Chocks	Hobbs				
1	KRAP	12:23	2275.8	KRAP	15:22	2278.3	2:59	3.00	2.5	0900-Production
2										
3										

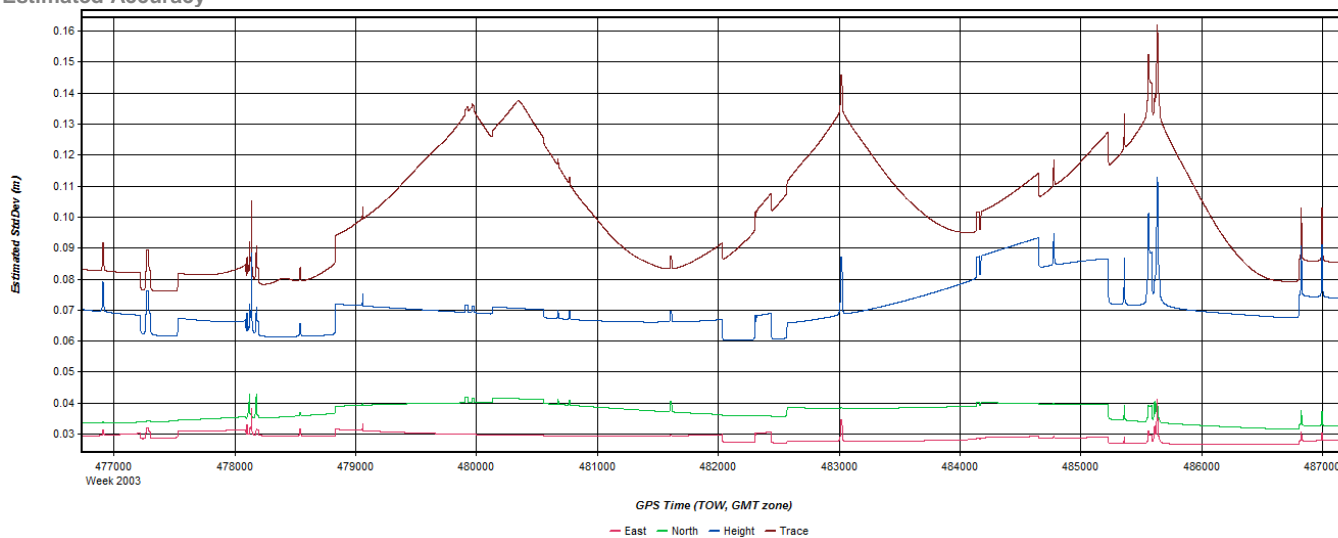
**Riegl
Flight Log**
AC80-50-00-02

FGI Job #	Project Name		System	Unit	IMU				Ground Temp °C	Min Range'	Data Logger Drives				
17003900	SD USGS FY17		780	421	AIMU				18.0 21.0	2018	23				
Flight Date	GPS Day	Lift	Sun°		Solar Times (UTC)		Pulse Rate		Flying Temp °C		Max Range'	Download Drive			
1-Jun-18	18-152	10					250		19.0 19.0		3888				
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		
180601_421_17003900_10	N88N	KRAP	CCNS 6	-6	3250	140		130	2	0.370	29.68 29.65	77			
Pilot #1		Pilot #2		Operator #1		Operator #2									
Rachel Hedman				Riley Forsyth											
Base 1 ID	Location		Rec ID	Ant ID	ARP (m)	Start Time (UTC)		Stop Time (UTC)		GPS Filename	Operator	Data			
FGI 081	Rapid City, SD		GR3-5	GR3-5	1.8					unit506011	Riley Forsyth				
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							
							12:29:00	12:34:00					ground static at KRAP	14	1.3
							12:48:10						s turn	16	1.0
West-X	2		1	7	0	8.9	12:51:36	12:52:32	N	6,460	138		cross tie line	16	1.0
West-A	5		118	1	43.3	0	12:55:52	13:18:00	W	6,380	96			16	1.0
	5		1	10	0	3.3	13:19:33	13:21:19	E	9,460	117		calibration line	16	0.9
	4		1	118	0	43.3	13:26:33	13:44:57	E	9,579	132			15	1.0
	3		118	1	43.3	0	13:47:10	14:08:59	W	6,523	124			16	1.0
	2		1	118	0	43.3	14:10:40	14:27:56	E	9,511	134			16	1.1
	1		118	1	43.3	0	14:29:56	14:52:19	W	6,485	111			17	1.1
							14:52:26						s turn	15	1.2
							15:13:00	15:18:00					ground static at KRAP	16	1.2

Trajectory and GPS Plots:

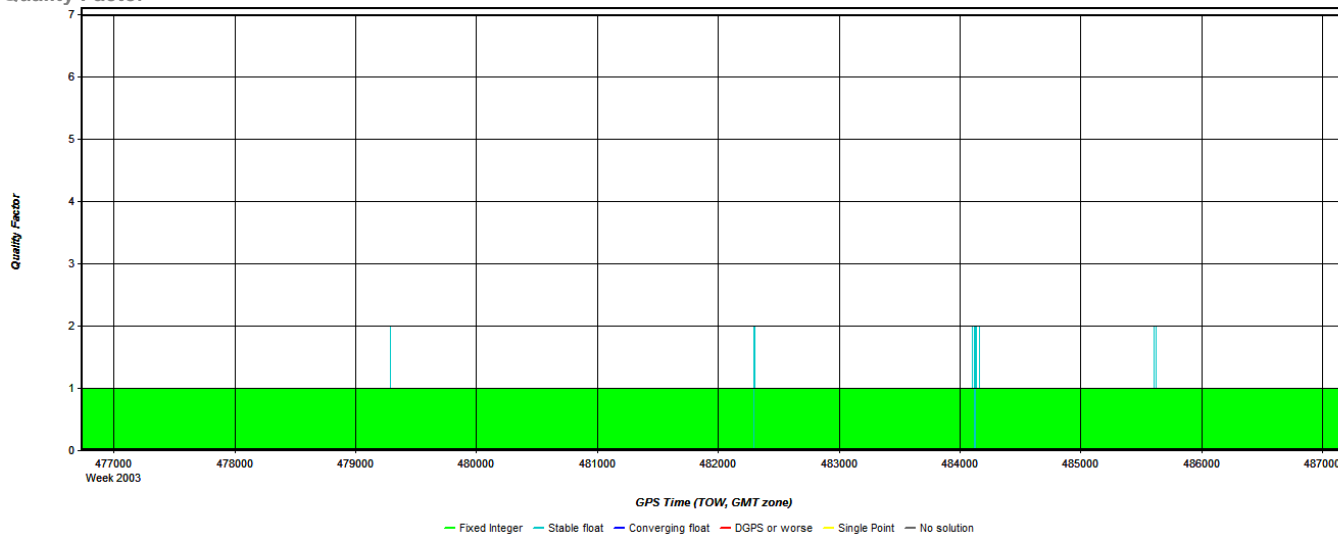


Estimated Accuracy

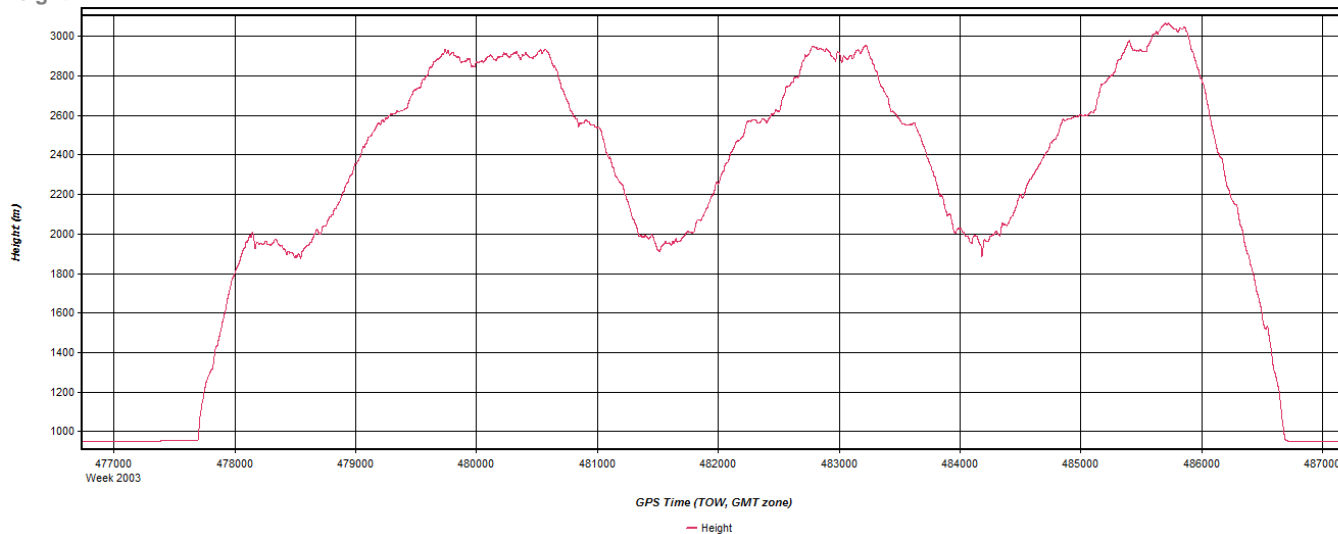




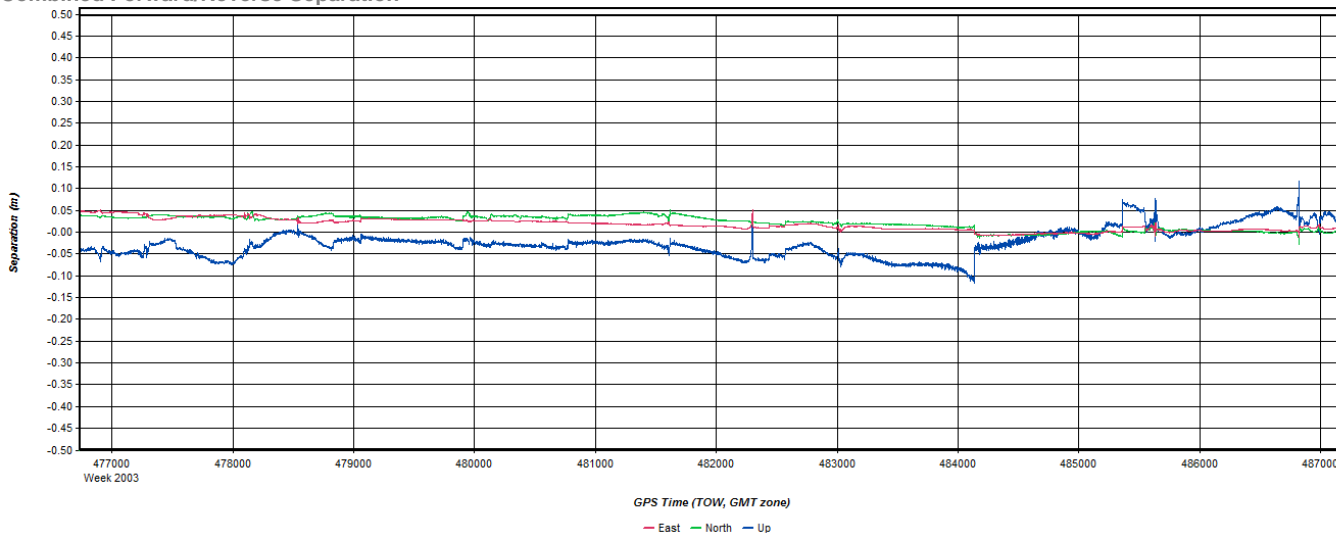
Quality Factor



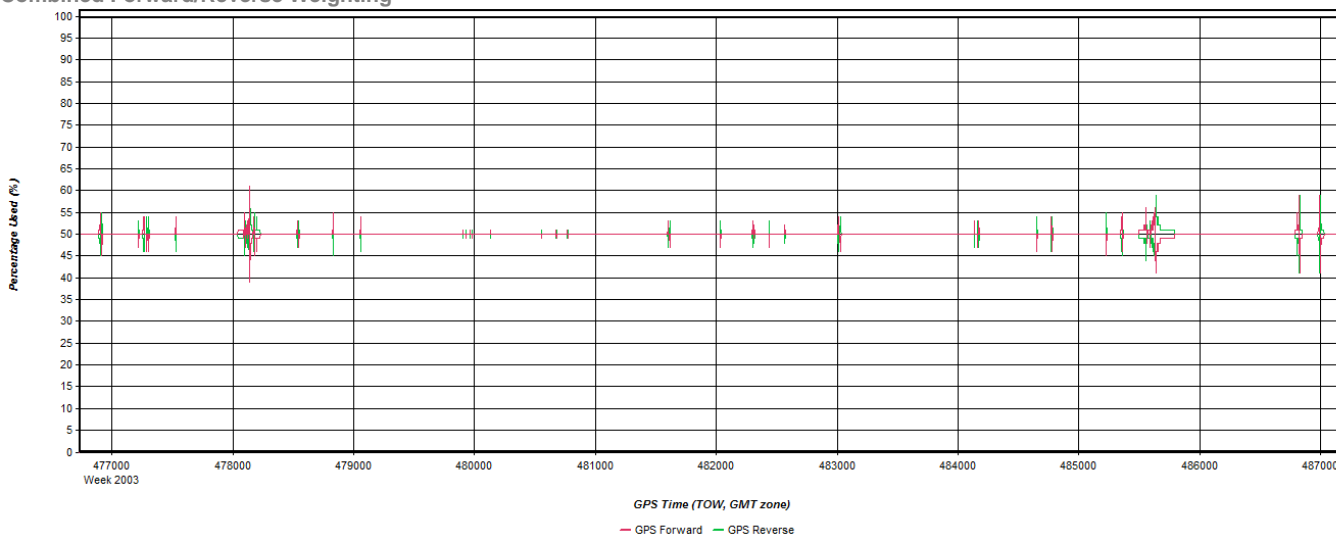
Height



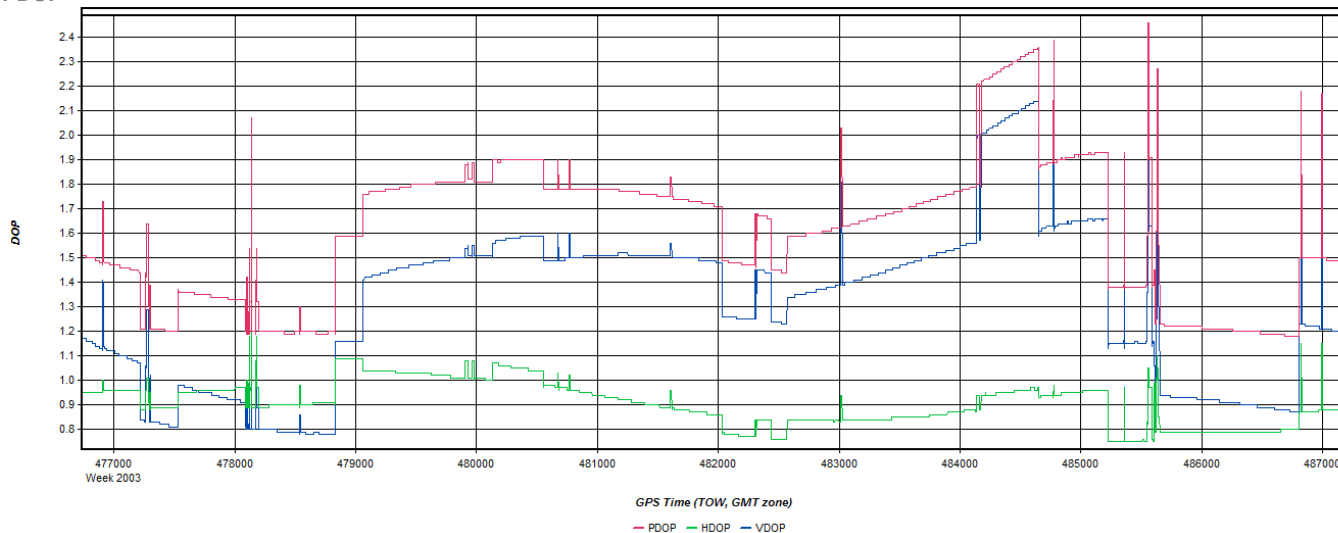
Combined Forward/Reverse Separation



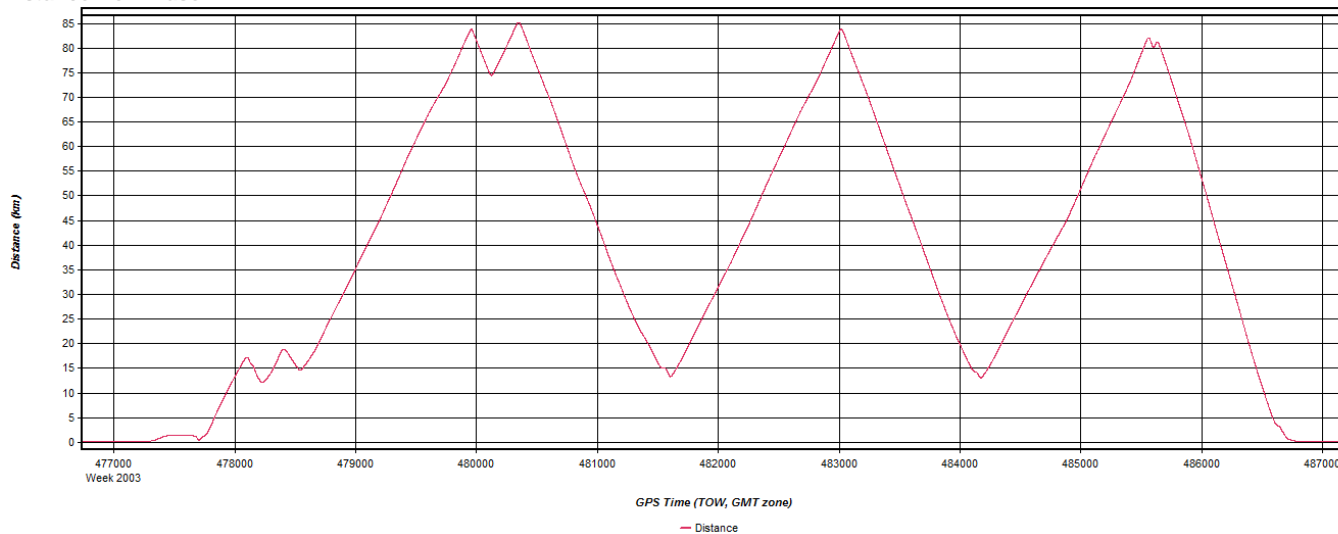
Combined Forward/Reverse Weighting



PDOP

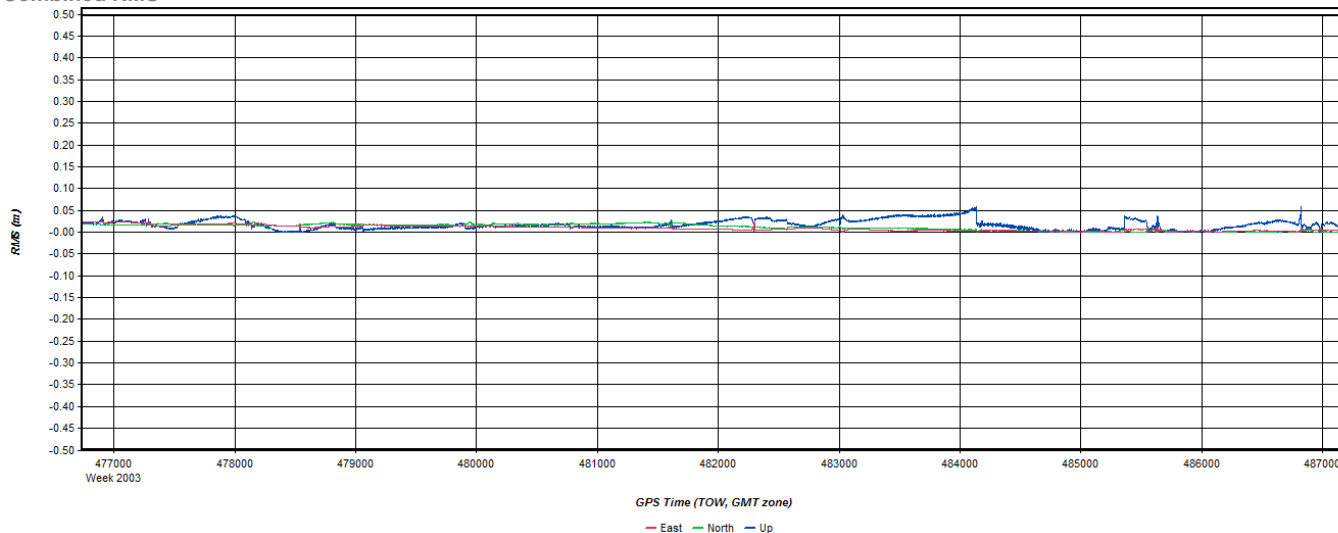


Distance from Base

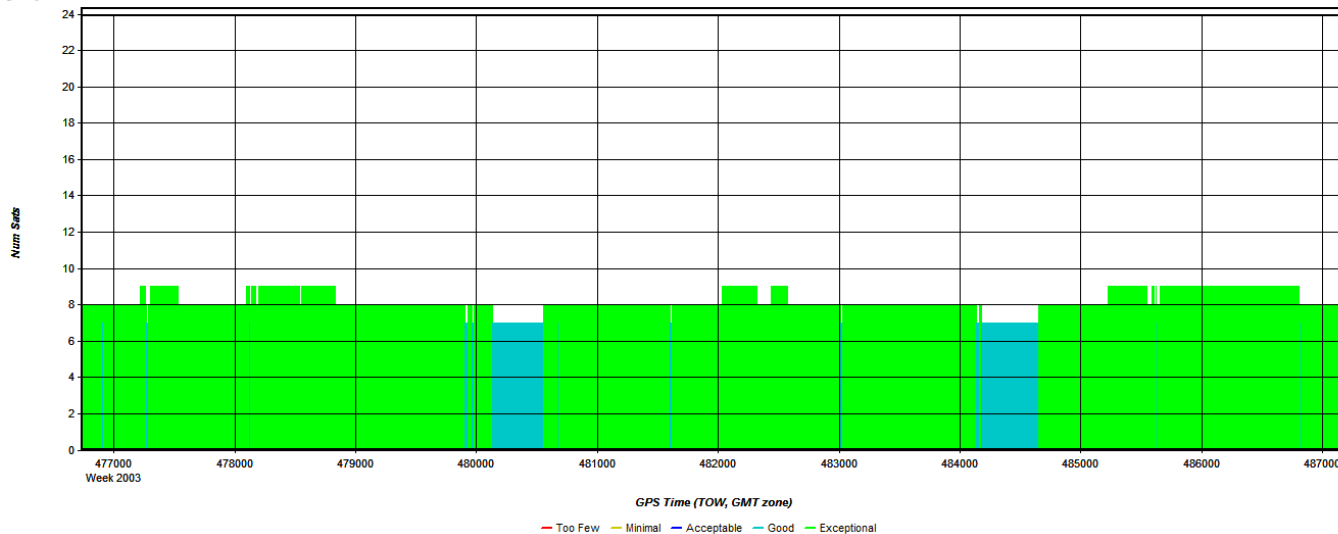




Combined RMS



SVs



USGS
COLLECTION REPORT



Acquisition and Processing details ----- 180602_165_17003900_14 (June 2, 2018)

Log:



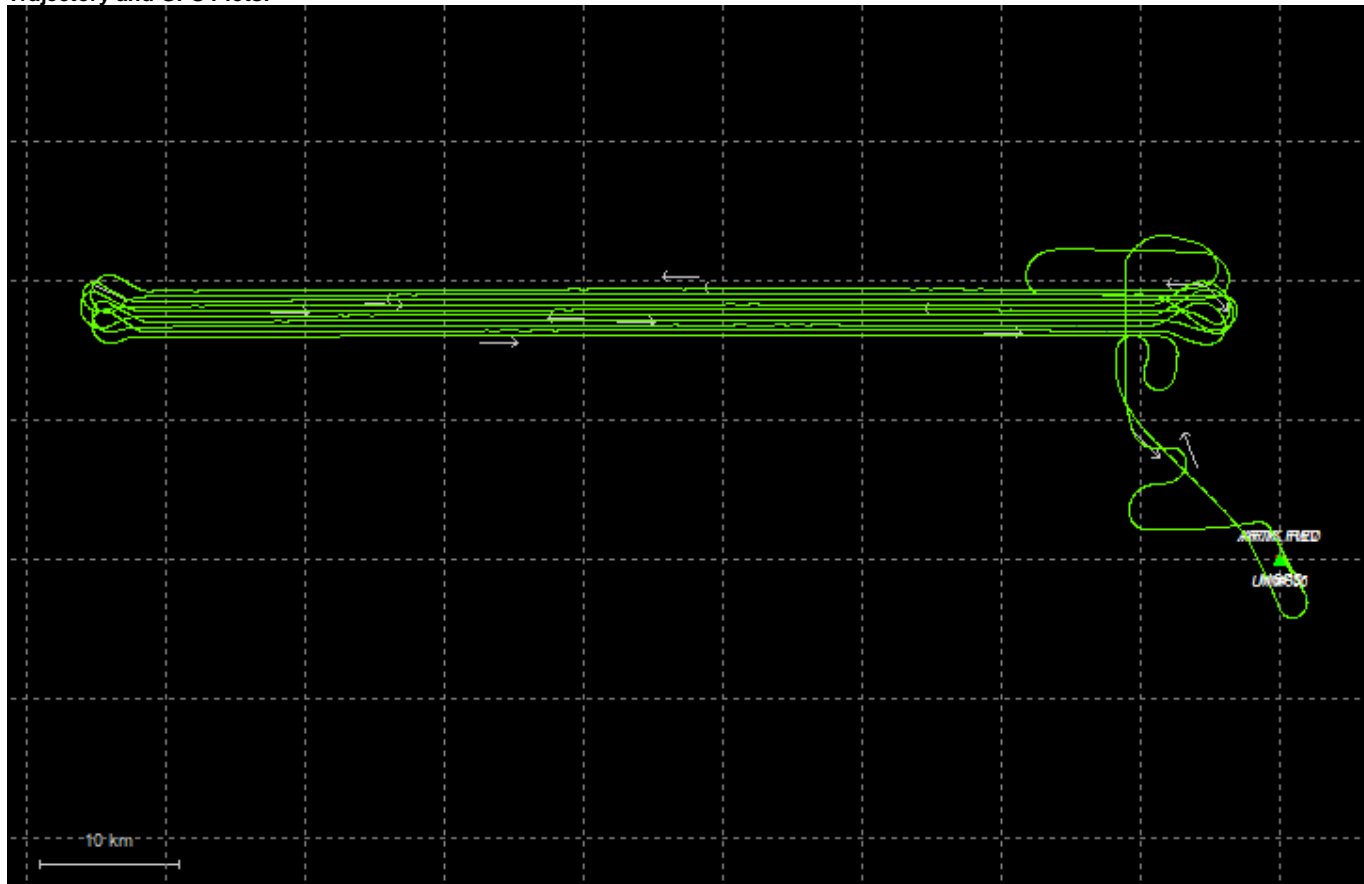
Fugro USA Land, Inc.

18.01	Lift Begin			Lift End			Fit Duration	Fit Hrs	Hobbs Hrs	Activity
	Airport	Chocks	Hobbs	Airport	Chocks	Hobbs				
1	KRAP	15:27	1199.9	KRAP	19:42	1203.7	4:15	4.25	3.8	0900-Production
2										
3										

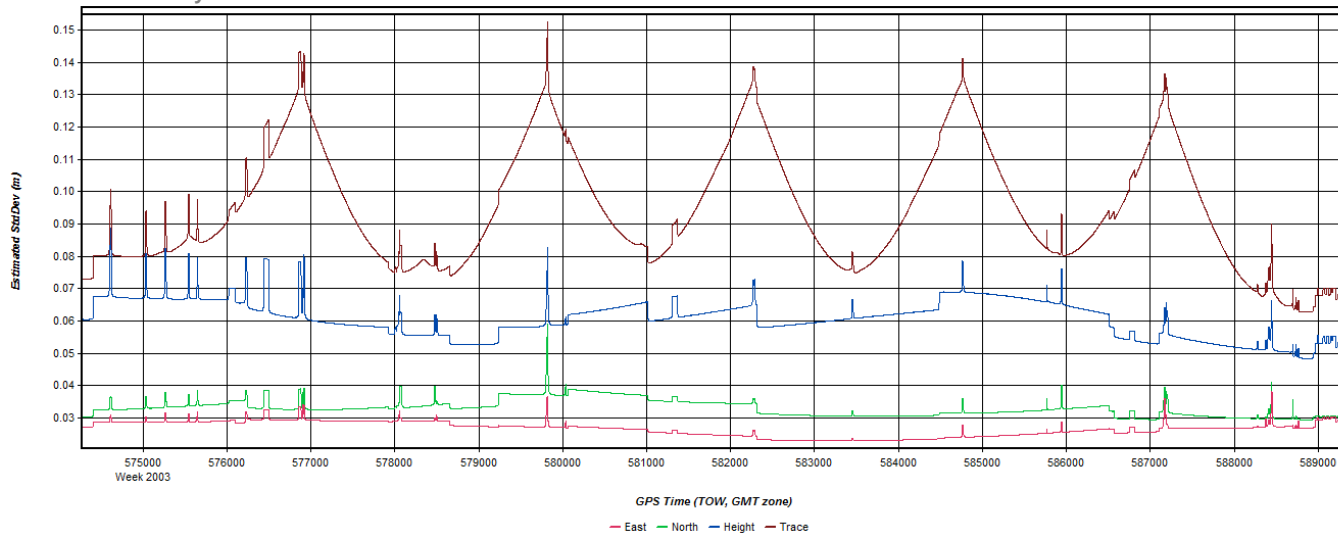


FGI Job #	Project Name				System	Unit	IMU					Ground Temp °C		Min Range'	Data Logger Drives	
04.17003900	USGS SD FY2017 Lidar West				680I	165						17.0	21.0	2018		
Flight Date	GPS Day	Lift				Sun°	Solar Times (UTC)		Pulse Rate			Flying Temp °C		Max Range'	Download Drive	
2-Jun-18	18-153	14				NA	NA		250			6.0	4.0	3888		
Mission ID (yymmdd_Sen_Job_Lift)		Aircraft	Airport ID	FMS	UTC	AMT (ft)	Speed	FOV	Scan Rate (Hz)	MTA	km/WPT	Altm Setting		Humidity @ Alt	Shipping Track	
180602_165_17003900_14		N97HC	KRAP	CCNS 5		3250	140		100	2	0.596	30.17	30.15			
Pilot #1		Pilot #2		Operator #1			Operator #2									
Grant Cassell				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		GR3U5	GR3U5	1.8	02-Jun-18 12:00		02-Jun-18 19:55		Unit#50602m		Jonathan Spencer		FTP		
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								
							15:30:59	15:35:59					5 min grd stc		19	1.1
							15:46:00	15:48:21					S-turn		18	1.2
West-X	2		9	18	4.8	10.1	15:50:08	15:51:44	N	6,357	126	100.0	crossing line		18	1.2
West-A	24		118	1	69.7	0	15:55:12	16:13:02	W	9,454	126	100.0			19	1.1
	23		1	118	0	69.7	16:15:29	16:32:10	E	9,454	139	100.0			19	1.1
	23		118	108	69.7	63.8	16:35:53	16:37:41	W	9,454	123	100.0	calibration line		19	1.1
	22		118	1	69.7	0	16:43:00	17:01:26	W	9,454	120	100.0			20	1.1
	21		1	118	0	69.7	17:04:12	17:20:52	E	9,454	137	100.0			19	1.1
	20		118	1	69.7	0	17:24:25	17:42:43	W	9,454	125	100.0			18	1.2
	19		1	118	0	69.7	17:45:37	18:02:23	E	9,454	136	100.0			20	1.1
	18		118	1	69.7	0	18:06:01	18:24:23	W	9,454	124	100.0			19	1.2
	17		1	118	0	69.7	18:26:57	18:43:29	E	9,454	140	100.0			19	1.1
	16		118	1	69.7	0	18:46:43	19:04:27	W	9,454	127	100.0			17	1.2
	15		1	118	0	69.7	19:06:58	19:23:46	E	9,454	136	100.0			18	1.0
							19:25:00	19:27:07					S-turn		19	1.0
							19:36:32	19:41:32					5 min grd stc		18	1.0

Trajectory and GPS Plots:

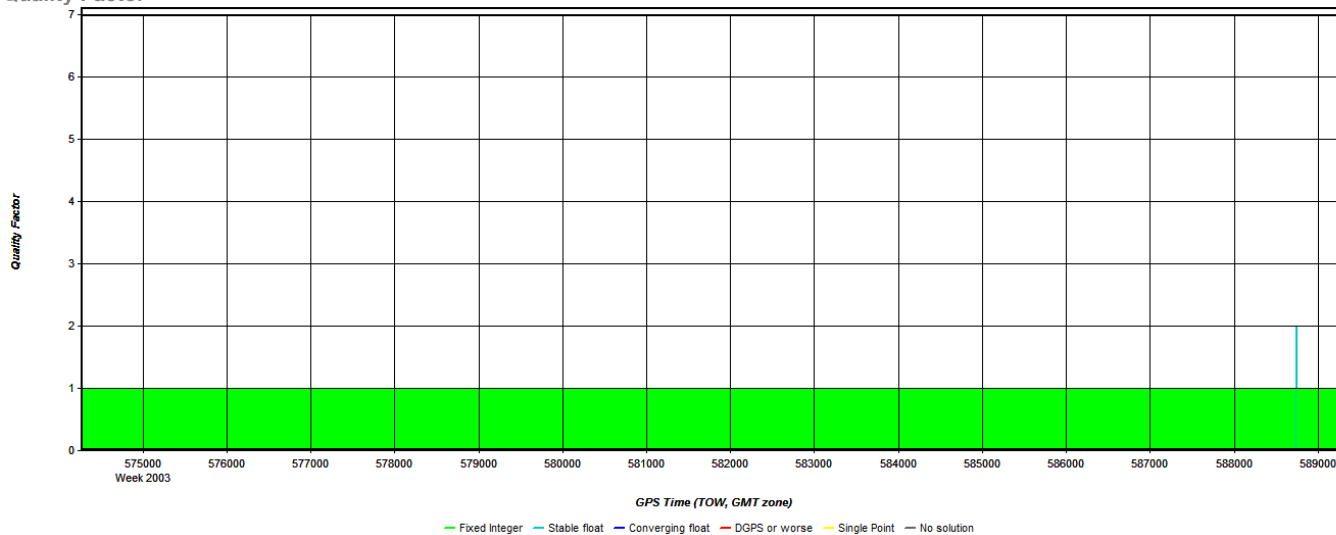


Estimated Accuracy

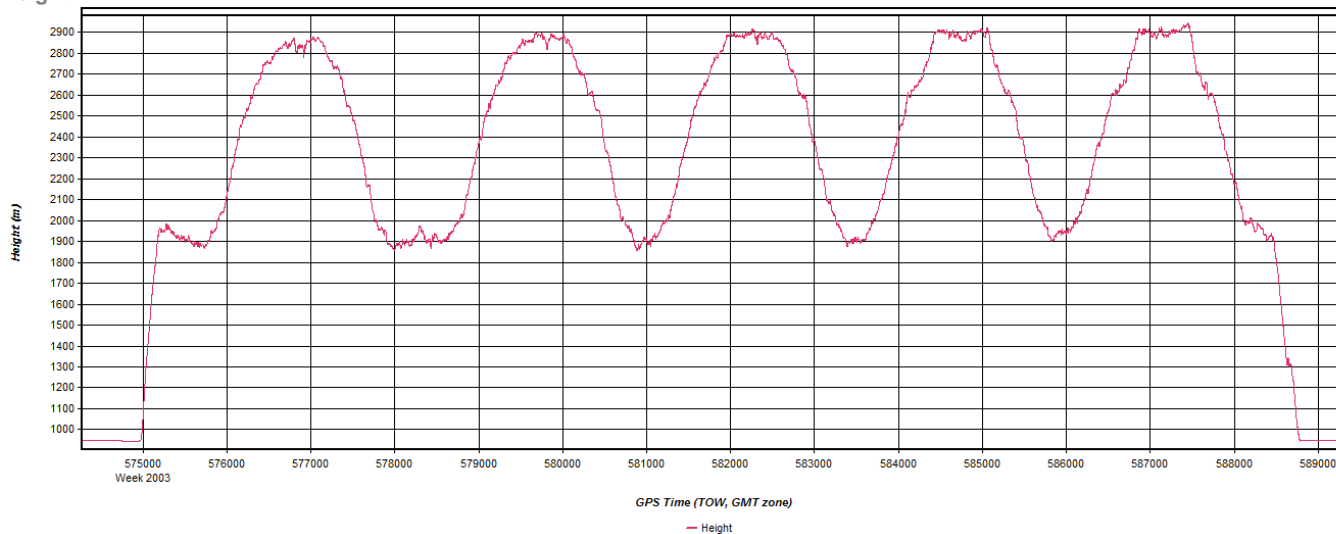




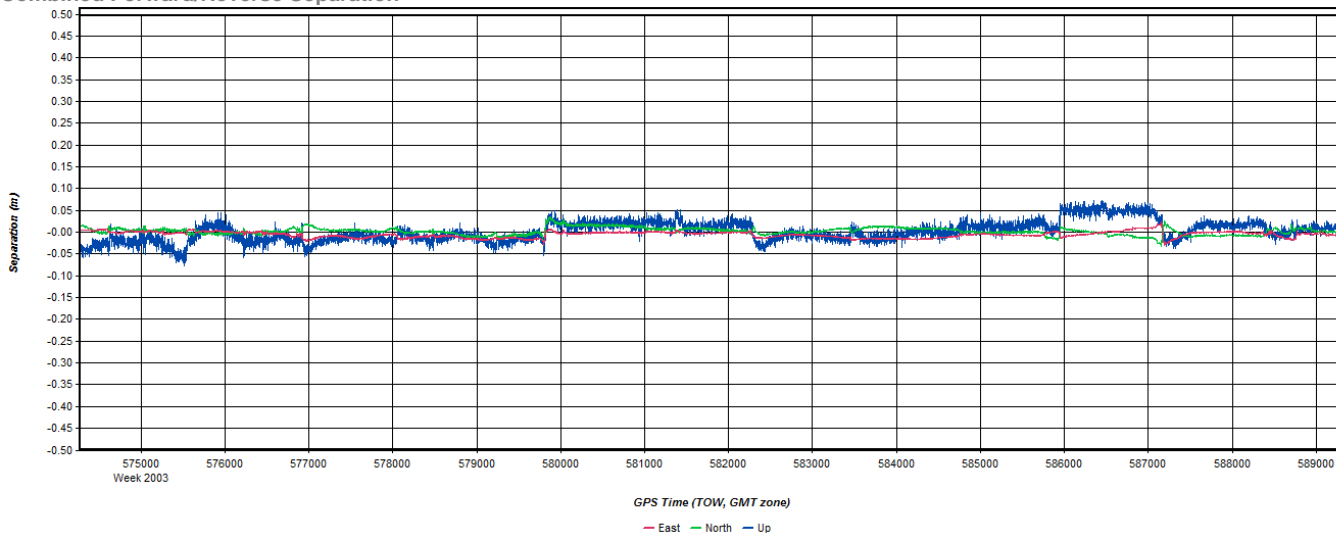
Quality Factor



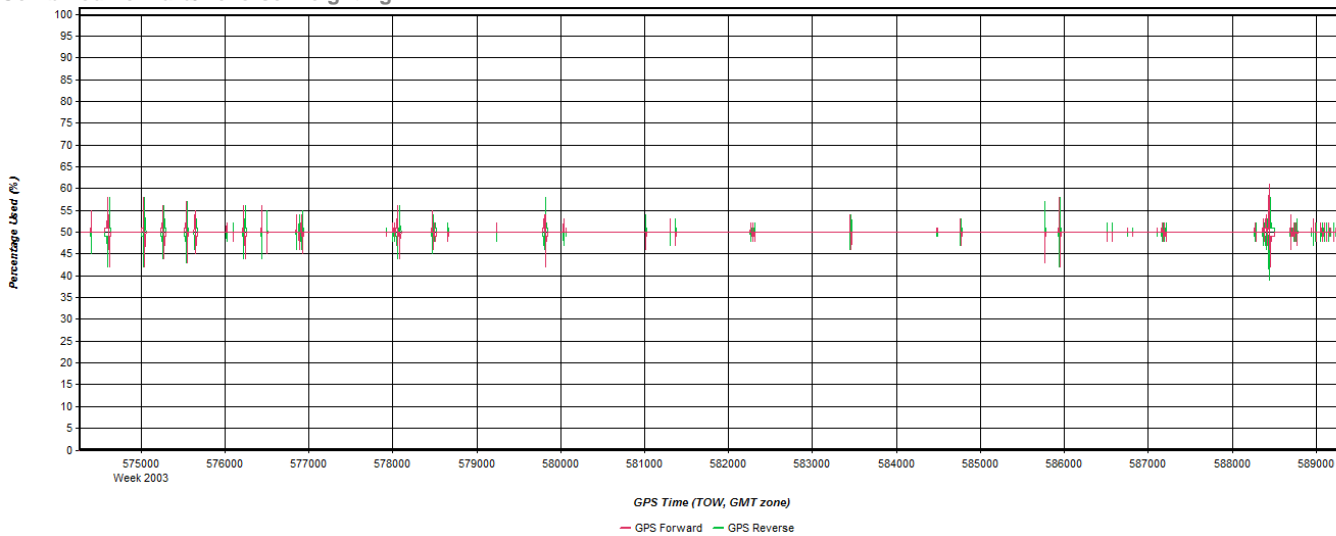
Height



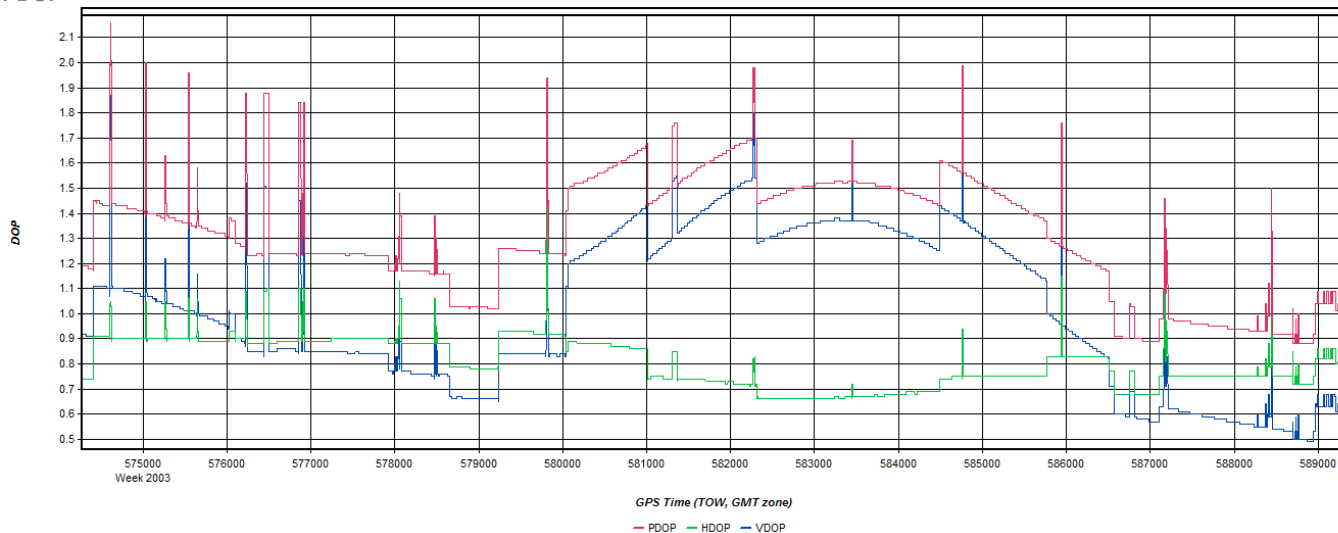
Combined Forward/Reverse Separation



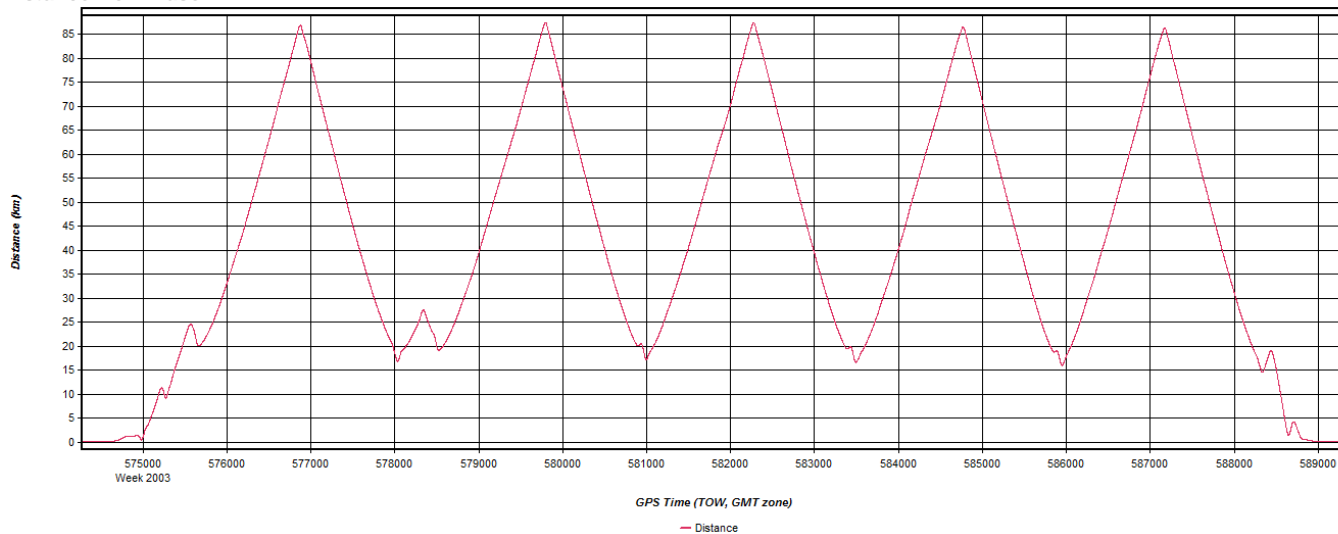
Combined Forward/Reverse Weighting



PDOP

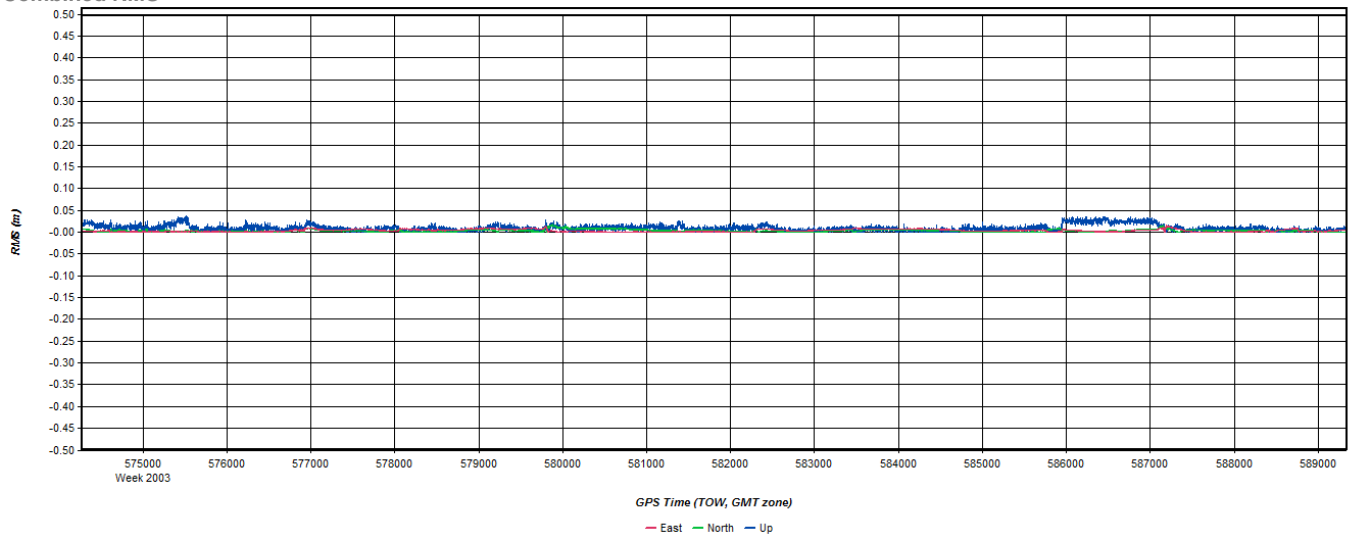


Distance from Base

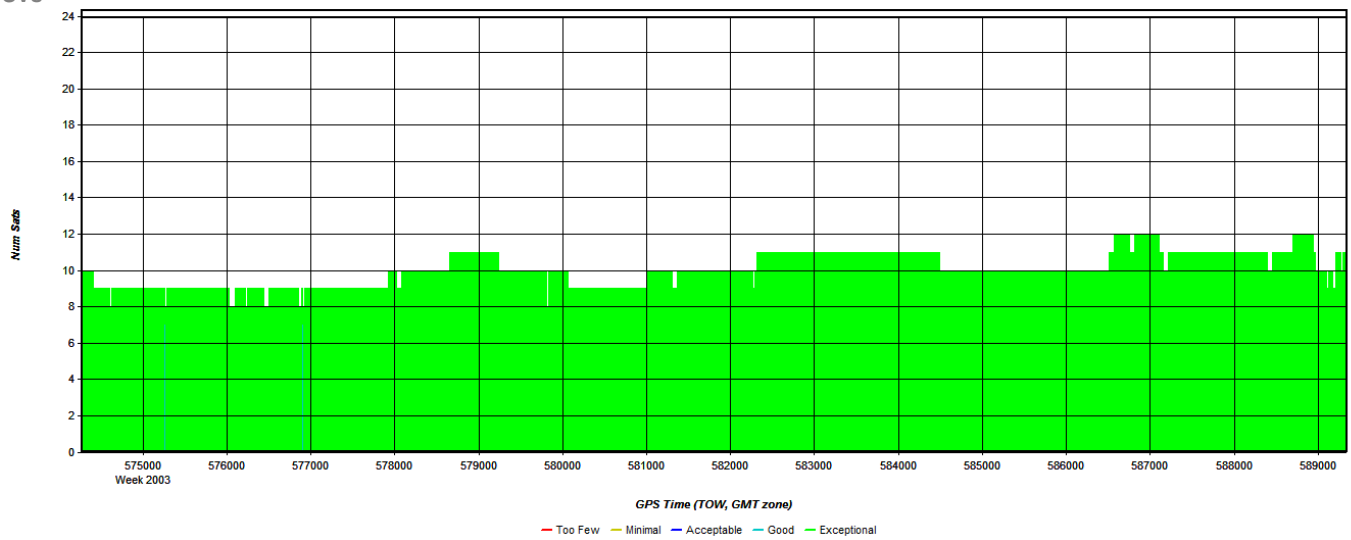


USGS COLLECTION REPORT

Combined RMS



SVs



USGS
COLLECTION REPORT



Acquisition and Processing details ----- 180702_165_17003900_15 (July 2, 2018)

Log:

Menu



Fugro USA Land, Inc.

Lift	Lift Begin			Lift End			Fit Duration	Fit Hrs	Hobbs Hrs	Activity
	Airport	Chocks	Hobbs	Airport	Chocks	Hobbs				
1	KRAP	14:40	1221.9	KRAP	16:55	1223.6	2:15	2.25	1.7	
2										
3										



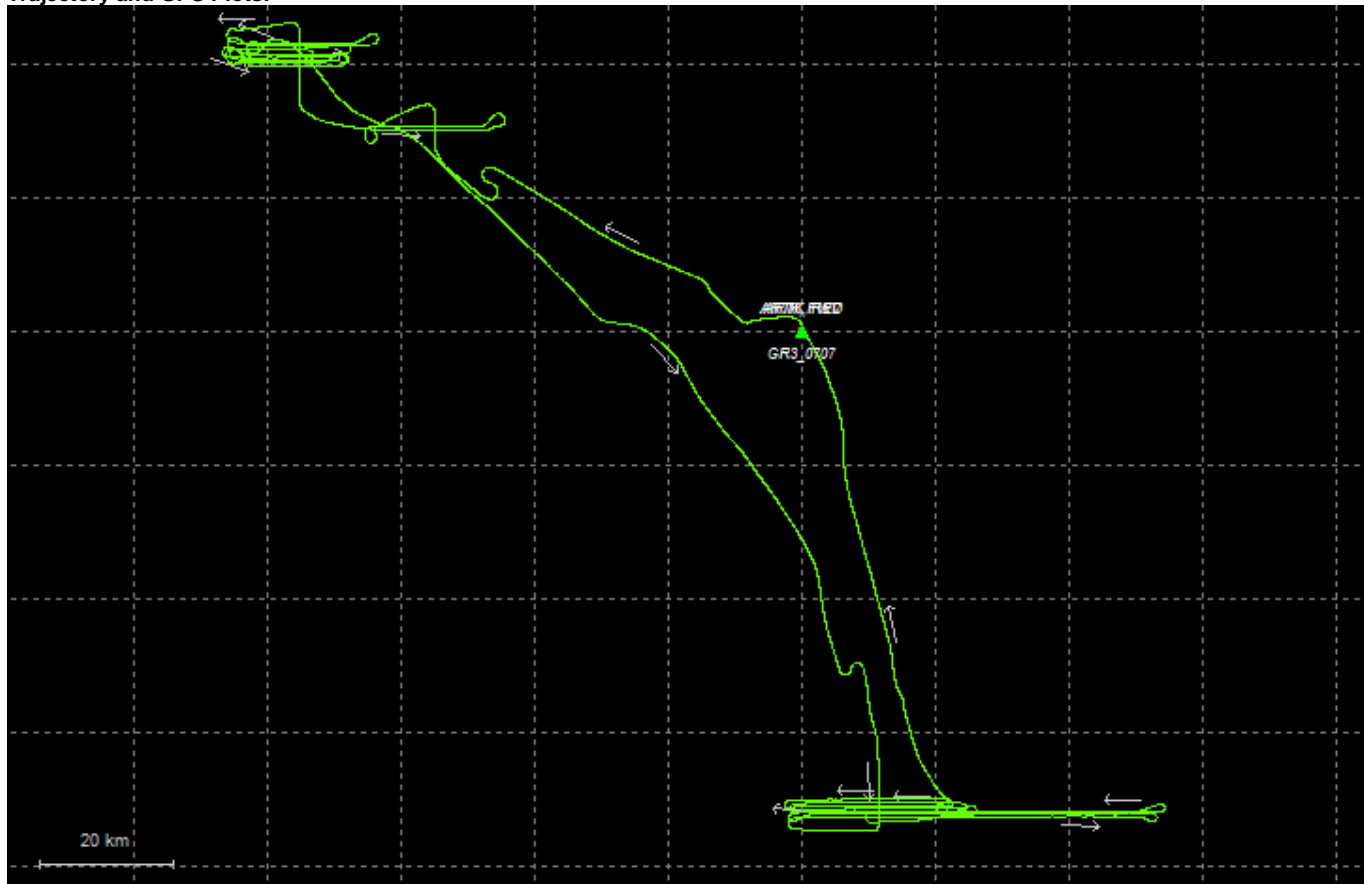
AC80-50-00-02

FGI Job # 17003900	Project Name SD USGS		System 680i	Unit 165	IMU	Ground Temp °C 20.0 27.0		Min Range' 456	Data Logger Drives 15					
Flight Date 2-Jul-18	GPS Day 18-183	Lift 15	Sun*		Solar Times (UTC)	Pulse Rate 340	Flying Temp °C 18.0 22.0	Max Range' 867	Download Drive					
Mission ID (yyymmdd_Sen_Job_Lift) 180702_165_17003900_15		Aircraft N97HC	Airport ID KRAP	FMS CCNS 5	UTC -6	AMT (ft) 2400	Speed 130	FOV	Scan Rate (Hz) 110	MTA 2	km/WPT 0.440	AltM Setting 29.87 29.86	Humidity @ Alt 64	Shipping Track
Pilot #1 Stuart Mills		Pilot #2		Operator #1 Riley Forsyth		Operator #2								

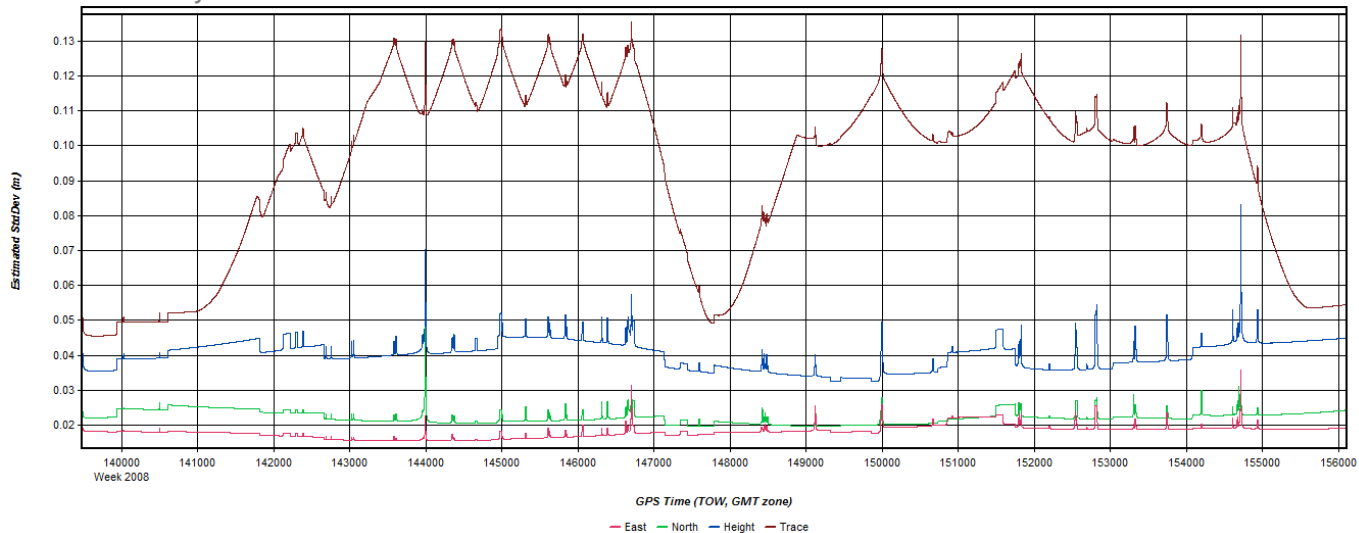
Base 1 ID FGI 081	Location KRAP	Rec ID GR3-01	Ant ID GR3-01	ARP (m) 1.8	Start Time (UTC)	Stop Time (UTC)	GPS Filename GR3_070702n	Operator Jonathan Spencer	Data
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Area	Flight #		Wpt		Distance		UTC		Fit Dir	Altitude (GPS)	Speed (knots)	Scan Rate	Comments and Conditions	SVs	PDOP
	FGI	Client	From	To	Begin	End	Start	End							
							14:48:00	14:53:00					Ground static at KRAP	20	1.0
							15:22:19						s turn	19	1.1
reflights	12		1	4	0	1.3	15:27:53	15:28:19	N	7881	128			18	1.3
	10		1	24	0	10.1	15:34:00	15:36:59	E	7838	118			20	1.0
	11		24	1	10.1	0	15:39:56	15:42:45	W	7756	119			20	1.1
	9		1	15	0	6.2	15:47:33	15:49:28	N	7474	123			20	1.1
	1		1	31	0	13.2	15:54:08	15:57:51	E	7312	121			19	1.2
	2		31	1	13.2	0	16:00:31	16:04:26	W	7279	105			18	1.3
	3		1	16	0	6.6	16:06:54	16:08:56	E	7435	119			19	1.1
	4		21	1	8.8	0	16:12:19	16:14:51	W	7569	121			19	1.1
	5		1	21	0	8.8	16:17:34	16:20:15	E	7585	128			19	1.1
	6		21	1	8.8	0	16:22:39	16:25:24	W	7669	110			19	1.1
	6		1	17	0	7	16:27:55	16:29:58	E	7648	120		calibration line	18	1.2
	7		1	18	0	7.5	16:35:32	16:37:55	E	7618	115			17	1.3
	8		21	1	8.8	0	16:40:35	16:43:06	W	7766	122			17	1.2
							16:43:13						s turn	18	1.1

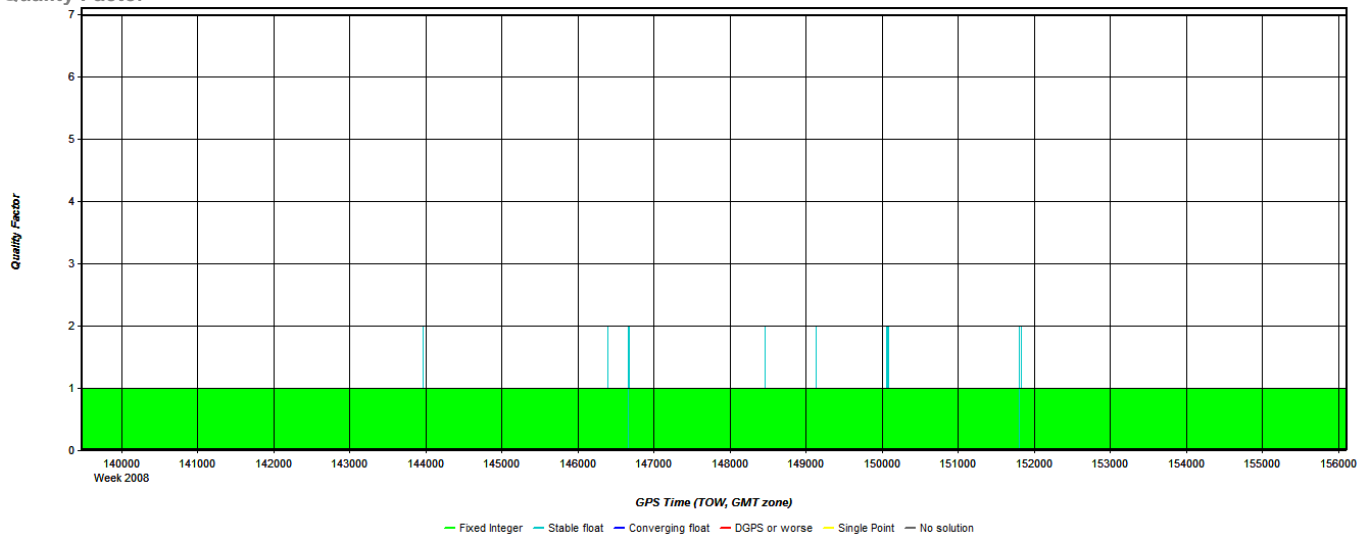
Trajectory and GPS Plots:



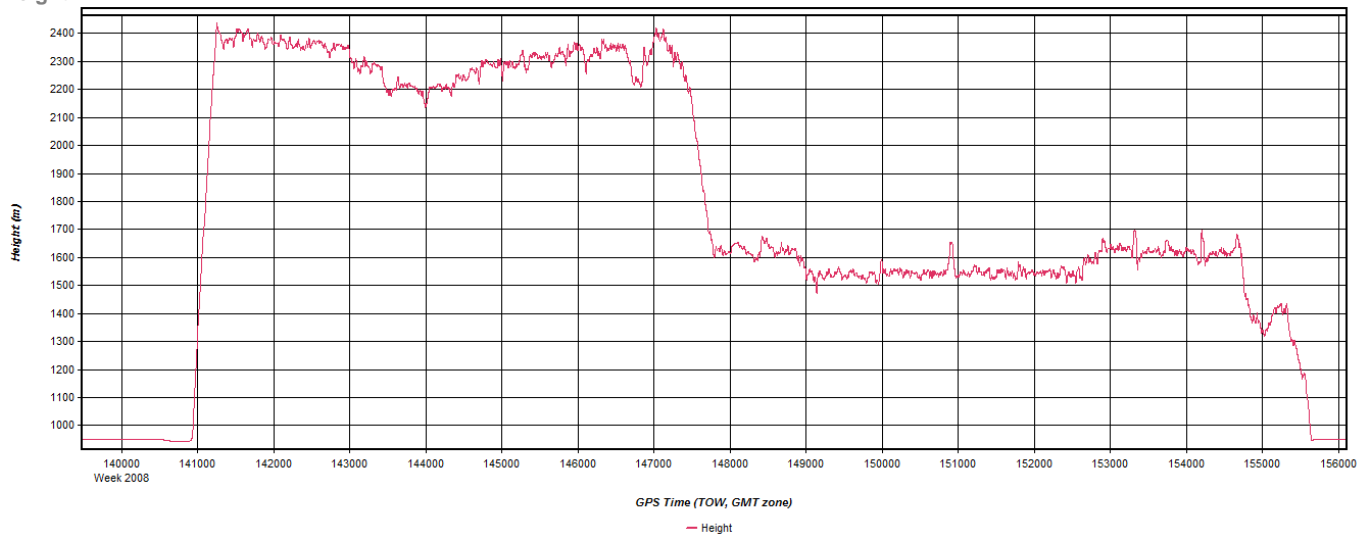
Estimated Accuracy



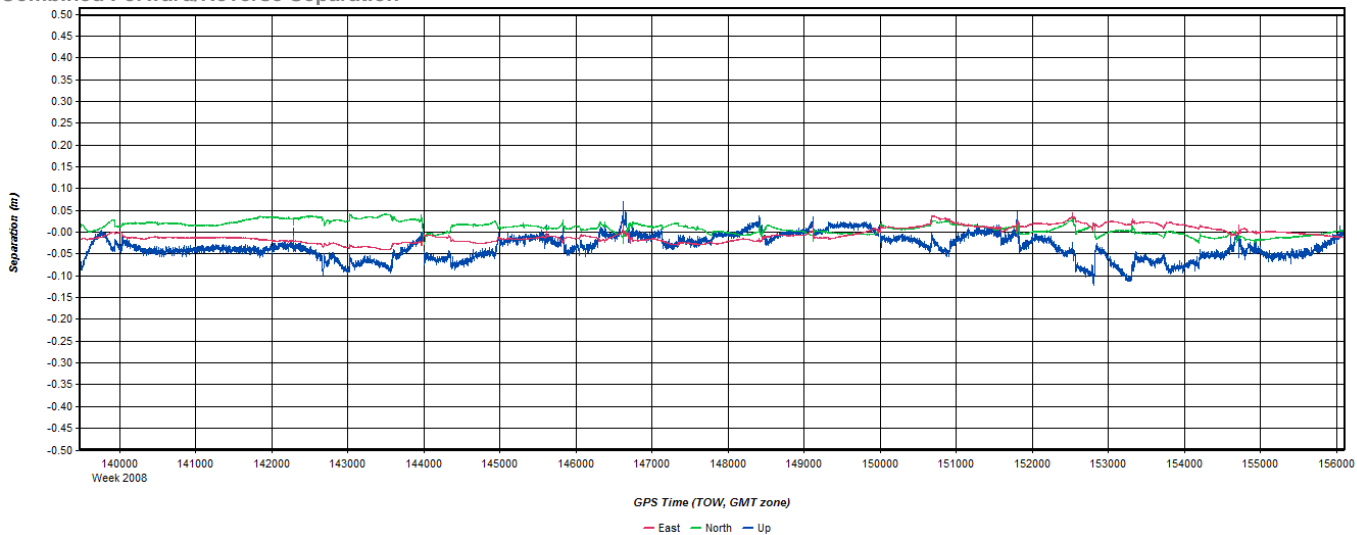
Quality Factor



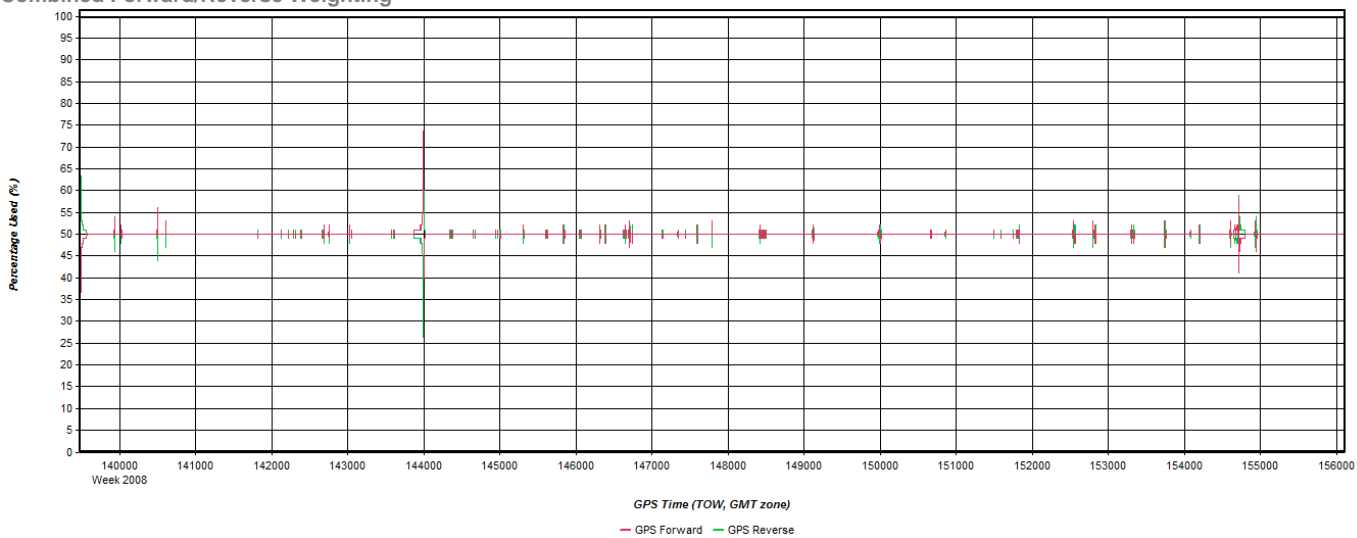
Height



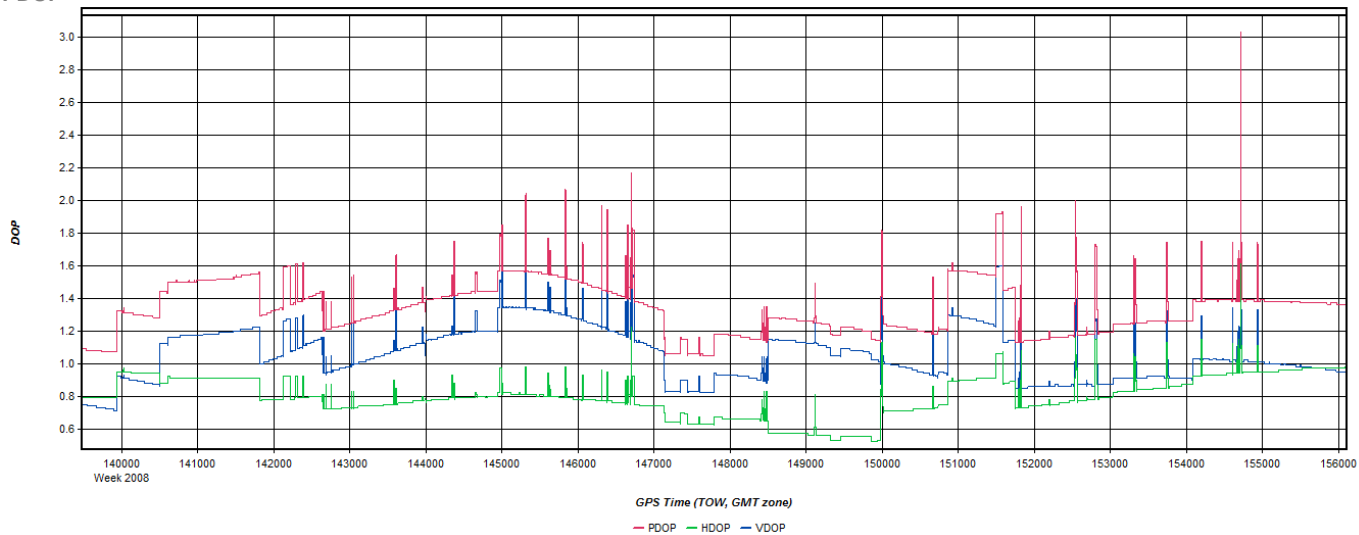
Combined Forward/Reverse Separation



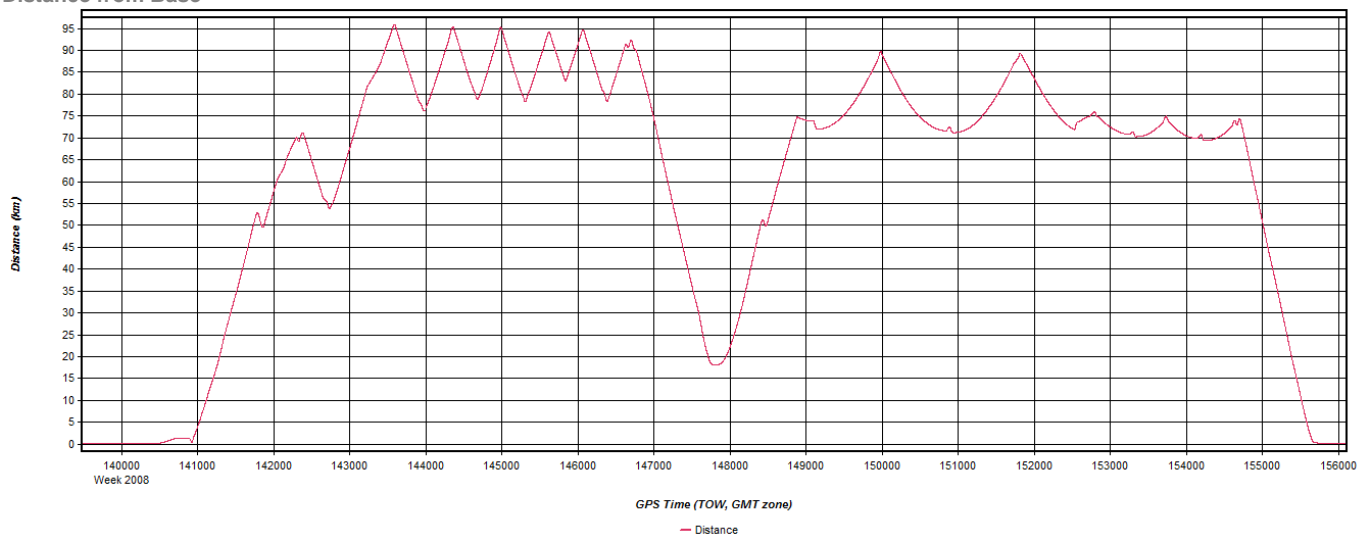
Combined Forward/Reverse Weighting



PDOP

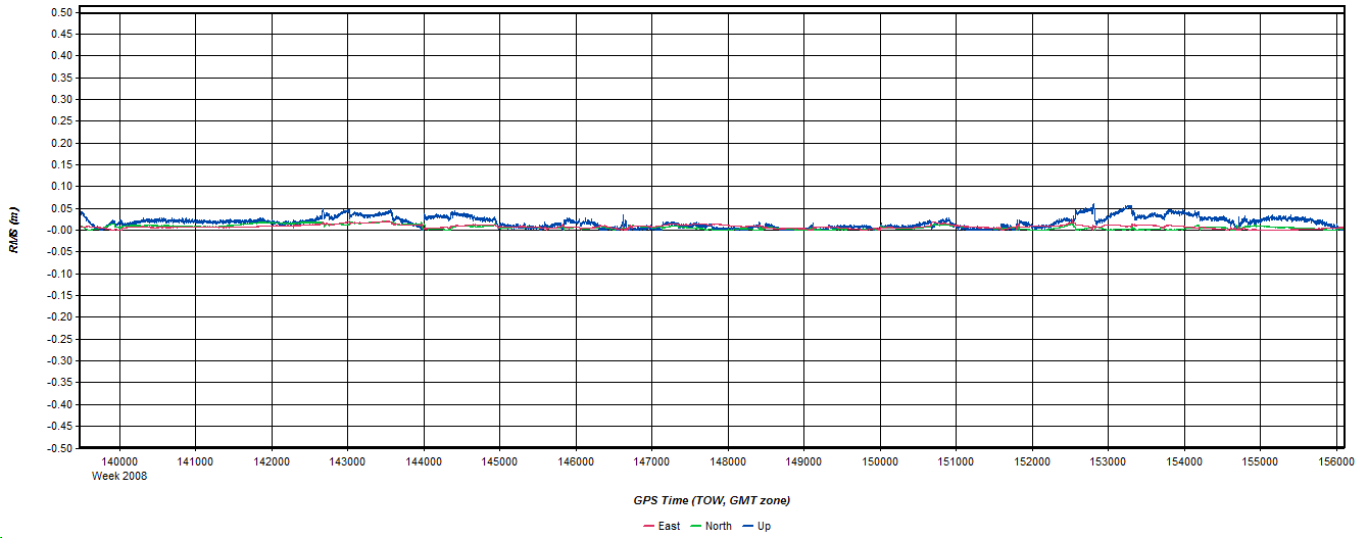


Distance from Base



USGS COLLECTION REPORT

Combined RMS



SVs

