

Utah 2016 - Washington County AOI QL2 LiDAR Project Report

Contract # AV2408

Submitted: September 22, 2017

Prepared by:



Quantum Spatial, Inc
523 Wellington Way, Suite 375
Lexington, KY 40503
859-277-8700



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1. Summary / Scope

1.1. Summary

This report contains a summary of the Utah 2016 - Washington County LiDAR acquisition task order, issued by State of Utah, Department of Technology Services, Division of Integrated Technology, Automated Geographic Reference Center (AGRC) under their contract signed on August 12, 2016. The task order yielded a project area covering 7,536 square miles over western Utah and southern Idaho. The intent of this document is only to provide specific validation information for the data acquisition/collection work completed as specified in the task order.

1.2. Scope

Aerial topographic LiDAR was acquired using state of the art technology along with the necessary surveyed ground control points (GCPs) and airborne GPS and inertial navigation systems. The aerial data collection was designed with the following specifications listed in Table 1 below.

Table 1. Originally Planned LiDAR Specifications

Average Point Density	Flight Altitude (AGL)	Field of View	Minimum Side Overlap	RMSEz
2 pts / m ²	2,100 m	40°	30%	≤ 10 cm

1.3. Coverage

The total LiDAR project boundary covers approximately 7,536 square kilometers. This report focuses on the QL2 Washington County area of interest, which covers approximately 1,337.5 square kilometers. This AOI includes partial coverage of Washington County in southern Utah.

A buffer of 100 meters was created to meet task order specifications. LiDAR extents are shown in Figure 1.

1.4. Duration

LiDAR data was acquired from January 8, 2017 to July 14, 2017 in fourteen total lifts. See “Section: 2.5. Time Period” for more details.

1.5. Issues

There were no issues to report with this project.

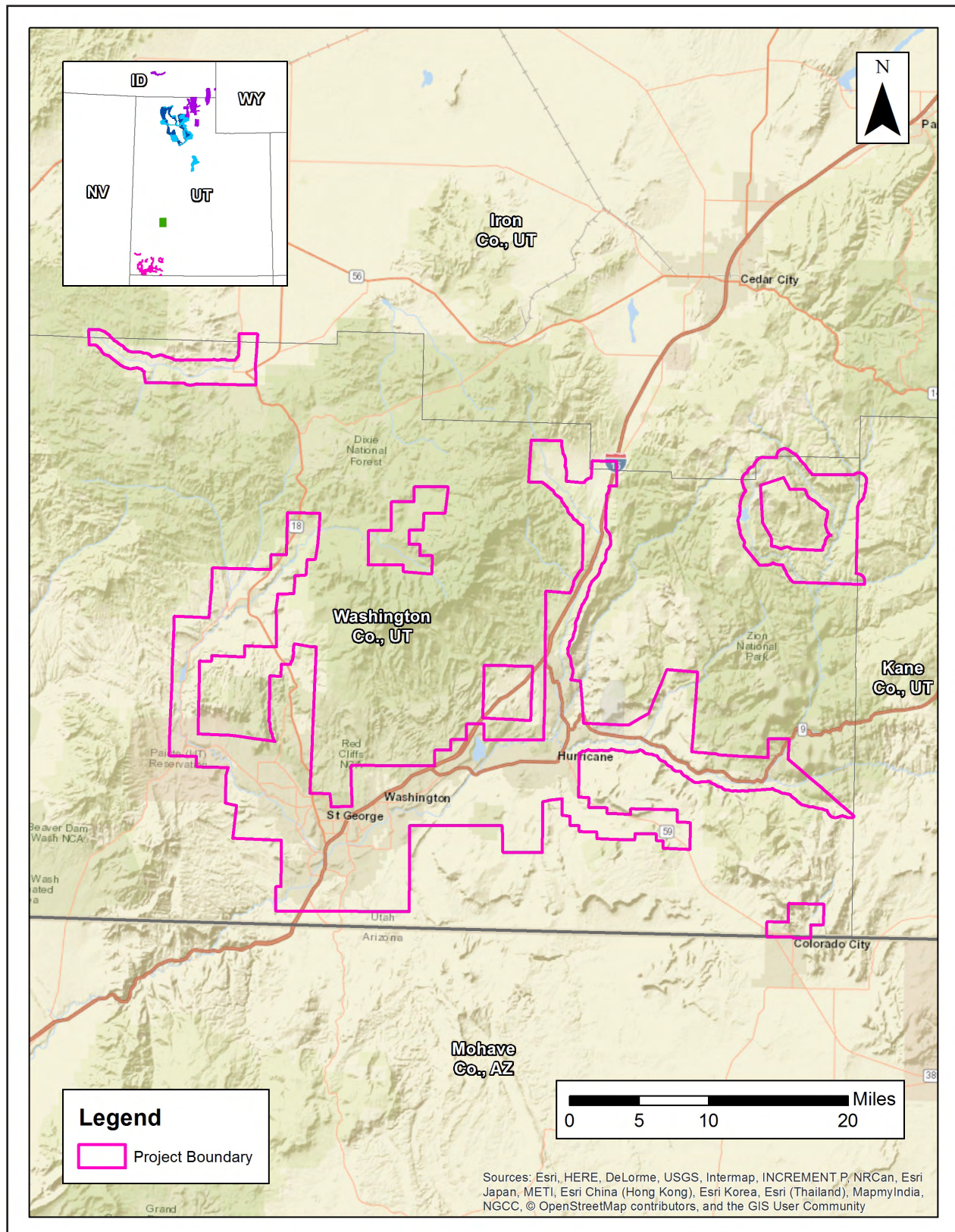
1.6. Deliverables

The following products were produced and delivered:

- Raw LiDAR point cloud data swaths in LAS 1.4 format
- Classified LiDAR point cloud data, tiled, in LAS 1.4 format
- Hydro-flattened breaklines in Esri shapefile format
- 0.5-meter hydro-flattened bare-earth raster DEM, tiled, in ERDAS .IMG format
- 0.5-meter first return raster DSM, tiled, in ERDAS .IMG format
- 0.5-meter intensity images, tiled, in GeoTIFF format
- Processing boundary in Esri shapefile format
- Tile index in Esri shapefile format
- Calibration and QC checkpoints in Esri shapefile format
- Accuracy assessment in .XLSX format
- Project-, deliverable-, and lift-level metadata in .XML format

All geospatial deliverables were produced in NAD83 (2011) UTM Zone 12, meters; NAVD88 (GEOID12B), meters. All .LAS tiled deliverables have a tile size of 1,000 meters x 1,000 meters. All other tiled deliverables have a tile size of 2,000 meters x 2,000 meters. All tile names follow US National Grid naming conventions. Tile names are based on the southwest corner of the tile.

Figure 1. Project Boundary



2. Planning / Equipment

2.1. Flight Planning

Flight planning was based on the unique project requirements and characteristics of the project site. The basis of planning included: required accuracies, type of development, amount / type of vegetation within project area, required data posting, and potential altitude restrictions for flights in project vicinity.

Detailed project flight planning calculations were performed for the project using Leica MissionPro planning software. The entire target area was comprised of 200 planned flight lines measuring approximately 1,751 total flight line miles (Figure 2).

2.2. LiDAR Sensor

Quantum Spatial utilized a Leica ALS 70 serial number 7161, and two Leica ALS 80 LiDAR sensors, serial numbers 8239 and 8121, during the project (Figure 3).

The Leica ALS 70 system is capable of collecting data at a maximum frequency of 500 kHz, which affords elevation data collection of up to 500,000 points per second. The system utilizes a Multi-Pulse in the Air option (MPIA). The sensor is also equipped with the ability to measure up to 4 returns per outgoing pulse from the laser and these come in the form of 1st, 2nd, 3rd and last returns. The intensity of the returns is also captured during aerial acquisition.

The Leica ALS 80 system is capable of collecting data at a maximum frequency of 1,000 kHz. The system utilizes a Multi-Pulse in the Air option (MPIA). The sensor is also equipped with the ability to measure up to 6 returns per outgoing pulse from the laser. The intensity of the returns is also captured during aerial acquisition.

A brief summary of the aerial acquisition parameters for the project are shown in the LiDAR System Specifications in Table 2.

Figure 2. Planned Flight Lines

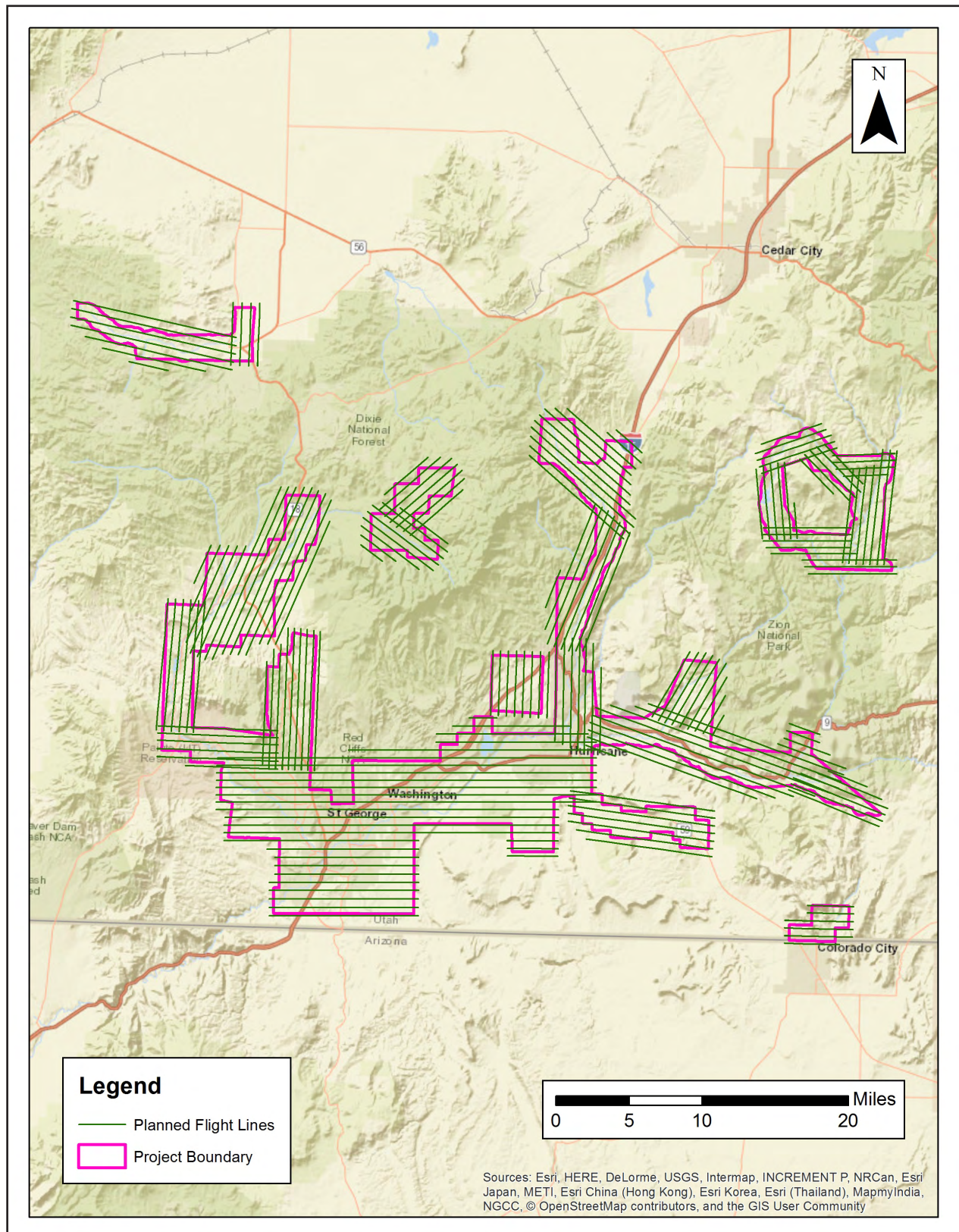
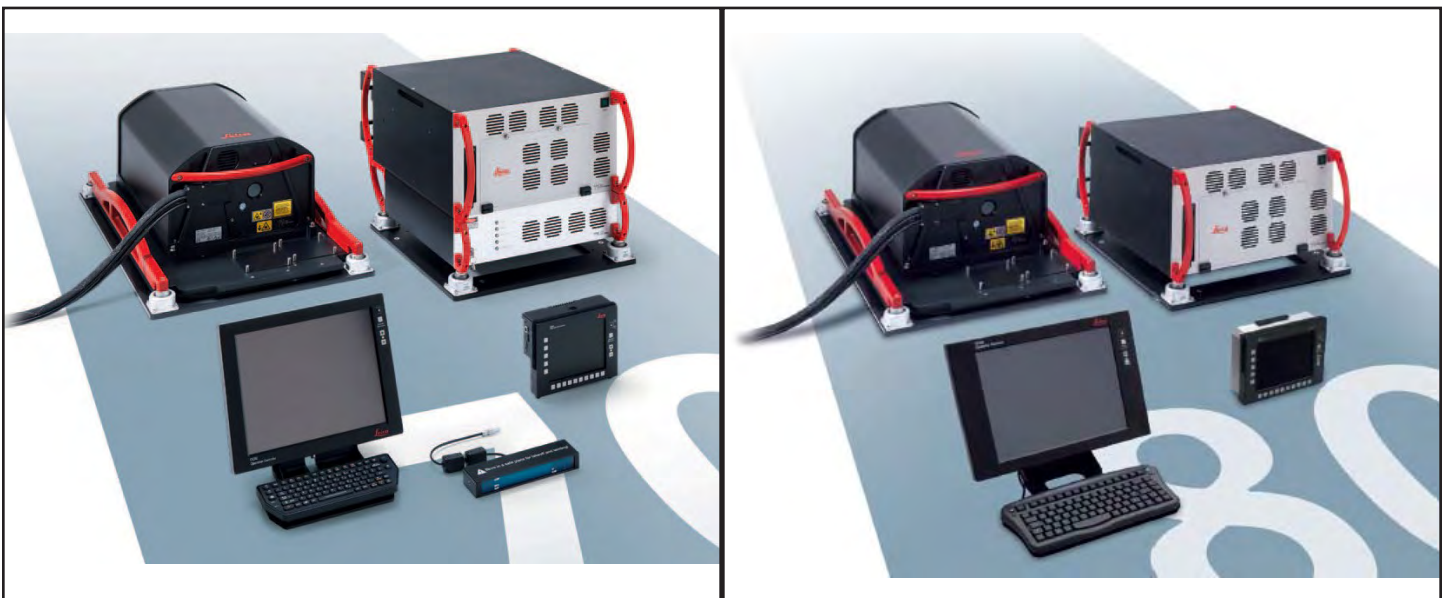


Table 2. Lidar System Specifications

		7161	8121	8239
Terrain and Aircraft Scanner	Flying Height	1,750 m	2,100 m	2,100 m
	Recommended Ground Speed	105 kts	110 kts	110 kts
Scanner	Field of View	30°	38°	38°
	Scan Rate Setting Used	45.7 Hz	48.5 Hz	48.1 Hz
Laser	Laser Pulse Rate Used	160.4 kHz	263 kHz	253 kHz
	Multi Pulse in Air Mode	Disabled	Enabled	Enabled
Coverage	Full Swath Width	938 m	1,446 m	1,446 m
Point Spacing and Density	Average Point Spacing	0.7 m	0.7 m	0.7 m
	Average Point Density	2 pts / m ²	2 pts / m ²	2 pts / m ²

Figure 3. Leica ALS 70 80 LiDAR Sensors



2.3. Aircraft

All flights for the project were accomplished through the use of customized planes, three Cessna Caravan (single-turboprop) aircraft, Tail Numbers: N208NR, N604MD and N704MD. These aircraft provided an ideal, stable aerial base for LiDAR acquisition. These aerial platforms has relatively fast cruise speeds which are beneficial for project mobilization / demobilization while maintaining relatively slow stall speeds which proved ideal for collection of high-density, consistent data posting using a state-of-the-art Leica LiDAR systems. Some of Quantum Spatial's operating aircraft can be seen in Figure 4 below.

Figure 4. Some of Quantum Spatial's Planes



2.4. Base Station Information

GPS base stations were utilized during all phases of flight. The base station locations were verified using NGS OPUS service and subsequent surveys. Base station locations, data sheets, graphical depiction of base station locations or log sheets used during station occupation are available in Appendix A.

2.5. Time Period

Project specific flights were conducted over several months. Fourteen sorties, or aircraft lifts were completed. Accomplished sorties are listed below.

- Jan 8, 2017-A (N604MD, SN8239)
- Jan 10, 2017-A (N604MD, SN8239)
- Jan 10, 2017-B (N604MD, SN8239)
- Jan 13, 2017-A (N604MD, SN8239)
- Jan 16, 2017-A (N208NR, SN8239)
- Jan 17, 2017-A (N208NR, SN8239)
- Mar 9, 2017-A (N704MD, SN8121)
- Mar 9, 2017-B (N704MD, SN8121)
- Mar 10, 2017-A (N704MD, SN8121)
- Jun 11, 2017-A (N704MD, SN7161)
- Jun 13, 2017-A (N704MD, SN7161)
- Jun 13, 2017-B (N704MD, SN7161)
- Jun 14 2017-A (N704MD, SN7161)
- Jul 14, 2017-A (N704MD, SN8239)

3. Processing Summary

3.1. Flight Logs

Flight logs were completed by LIDAR sensor technicians for each mission during acquisition. These logs depict a variety of information, including:

- Job / Project #
- Flight Date / Lift Number
- FOV (Field of View)
- Scan Rate (HZ)
- Pulse Rate Frequency (Hz)
- Ground Speed
- Altitude
- Base Station
- PDOP avoidance times
- Flight Line #
- Flight Line Start and Stop Times
- Flight Line Altitude (AMSL)
- Heading
- Speed
- Returns
- Crab

Notes: (Visibility, winds, ride, weather, temperature, dew point, pressure, etc). Project specific flight logs for each sortie are available in Appendix A.

3.2. LiDAR Processing

Inertial Explorer software was used for post-processing of airborne GPS and inertial data (IMU), which is critical to the positioning and orientation of the LiDAR sensor during all flights. Inertial Explorer combines aircraft raw trajectory data with stationary GPS base station data yielding a “Smoothed Best Estimate Trajectory (SBET)” necessary for additional post processing software to develop the resulting geo-referenced point cloud from the LiDAR missions.

During the sensor trajectory processing (combining GPS & IMU datasets) certain statistical graphs and tables are generated within the Inertial Explorer processing environment which are commonly used as indicators of processing stability and accuracy. This data for analysis include: Max horizontal / vertical GPS variance, separation plot, altitude plot, PDOP plot, base station baseline length, processing mode, number of satellite vehicles, and mission trajectory. All relevant graphs produced in the Inertial Explorer processing environment for each sortie during the project mobilization will be available in the full report.

The generated point cloud is the mathematical three dimensional composite of all returns from all laser pulses as determined from the aerial mission. Laser point data are imported into TerraScan and a manual calibration is performed to assess the system offsets for pitch, roll, heading and scale. At this point this data is ready for analysis, classification, and filtering to generate a bare earth surface model in which the above-ground features are removed from the data set. Point clouds were created using the Leica CloudPro software. GeoCue distributive processing software was used in the creation of some files needed in downstream processing, as well as in the tiling of the dataset into more manageable file sizes. TerraScan and TerraModeler software packages were then used for the automated data classification, manual cleanup, and bare earth generation. Project specific macros were developed to classify the ground and remove side overlap between parallel flight lines.

All data was manually reviewed and any remaining artifacts removed using functionality provided by TerraScan and TerraModeler. Global Mapper was used as a final check of the bare earth dataset. GeoCue was used to create the deliverable industry-standard LAS files for both the All Point Cloud Data and the Bare Earth. In-house software was then used to perform final statistical analysis of the classes in the LAS files.

3.3. LAS Classification Scheme

The classification classes are determined by the USGS Version 1.2 specifications and are an industry standard for the classification of LIDAR point clouds. All data starts the process as Class 1 (Unclassified), and then through automated classification routines, the classifications are determined using TerraScan macro processing.

The classes used in the dataset are as follows and have the following descriptions:

- Class 1 – Processed, but Unclassified – These points would be the catch all for points that do not fit any of the other deliverable classes. This would cover features such as vegetation, cars, etc.
- Class 2 – Bare-Earth Ground – This is the bare earth surface
- Class 7 – Low Noise – Low points, manually identified below the surface that could be noise points in point cloud.
- Class 9 – In-land Water – Points found inside of inland lake/ponds
- Class 10 – Ignored Ground – Points found to be close to breakline features. Points are moved to this class from the Class 2 dataset. This class is ignored during the DEM creation process in order to provide smooth transition between the ground surface and hydro flattened surface.
- Class 17 – Bridge Decks – Points falling on bridge decks.
- Class 18 – High Noise – High points, manually identified above the surface that could be noise points in point cloud.

3.4. Classified LAS Processing

The point classification is performed as described below. The bare earth surface is then manually reviewed to ensure correct classification on the Class 2 (Ground) points. After the bare-earth surface is finalized, it is then used to generate all hydro-breaklines through heads-up digitization.

All ground (ASPRS Class 2) lidar data inside of the Lake Pond and Double Line Drain hydroflattened breaklines were then classified to Water (ASPRS Class 9) using TerraScan macro functionality. A buffer of 1 meter was also used around each hydro-flattened feature to classify these ground (ASPRS Class 2) points to Ignored ground (ASPRS Class 10). All Lake Pond Island and Double Line Drain Island features were checked to ensure that the ground (ASPRS Class 2) points were reclassified to the correct classification after the automated classification was completed. All bridge decks were classified to Class 17.

All overlap data was processed through automated functionality provided by TerraScan to classify the overlapping flight line data to approved classes by USGS. The overlap data was classified using standard LAS overlap bit. These classes were created through automated processes only and were not verified for classification accuracy. Due to software limitations within TerraScan, these classes were used to trip the withheld bit within various software packages. These processes were reviewed and accepted by USGS through numerous conference calls and pilot study areas.

All data was manually reviewed and any remaining artifacts removed using functionality

provided by TerraScan and TerraModeler. Global Mapper was used as a final check of the bare earth dataset. GeoCue was then used to create the deliverable industry-standard LAS files for both the All Point Cloud Data and the Bare Earth. Quantum Spatial, Inc. proprietary software was used to perform final statistical analysis of the classes in the LAS files, on a per tile level to verify final classification metrics and full LAS header information.

3.5. Hydro-Flattened Breakline Processing

Class 2 (ground) lidar points were used to create a bare earth surface model. The surface model was then used to heads-up digitize 2D breaklines of inland streams and rivers with a 100-foot nominal width and inland ponds and lakes of 2 acres or greater surface area.

Elevation values were assigned to all Inland Ponds and Lakes, Inland Pond and Lake Islands, Inland Stream and River Islands, using TerraModeler functionality. Elevation values were assigned to all inland streams and rivers using Quantum Spatial, Inc. proprietary software. All Ground (ASPRS Class 2) lidar data inside of the collected inland breaklines were then classified to Water (ASPRS Class 9) using TerraScan macro functionality. A buffer of 1 meter was also used around each hydro-flattened feature. These points were moved from ground (ASPRS Class 2) to Ignored Ground (ASPRS Class 10).

The breakline files were then translated to Esri file geodatabase format using Esri conversion tools.

Breaklines are reviewed against lidar intensity imagery to verify completeness of capture. All breaklines are then compared to TINs (triangular irregular networks) created from ground only points prior to water classification. The horizontal placement of breaklines is compared to terrain features and the breakline elevations are compared to lidar elevations to ensure all breaklines match the lidar within acceptable tolerances. Some deviation is expected between breakline and lidar elevations due to monotonicity, connectivity, and flattening rules that are enforced on the breaklines. Once completeness, horizontal placement, and vertical variance is reviewed, all breaklines are reviewed for topological consistency and data integrity using a combination of Esri Data Reviewer tools and proprietary tools.

3.6. Hydro-Flattened Raster DEM Processing

Class 2 LiDAR in conjunction with the hydro breaklines were used to create a 0.5-meter hydro-flattened raster DEM. Using automated scripting routines within ArcMap, an ERDAS Imagine .IMG file was created for each tile. Each surface is reviewed using Global Mapper to check for any surface anomalies or incorrect elevations found within the surface.

3.7. First Return Raster DSM Processing

First return lidar points were used to create a 0.5 meter first-return raster DSM. Using automated scripting routines within ArcMap, an ERDAS Imagine .IMG file was created for each tile. Each surface is reviewed using Global Mapper to check for any surface anomalies or incorrect elevations found within the surface.

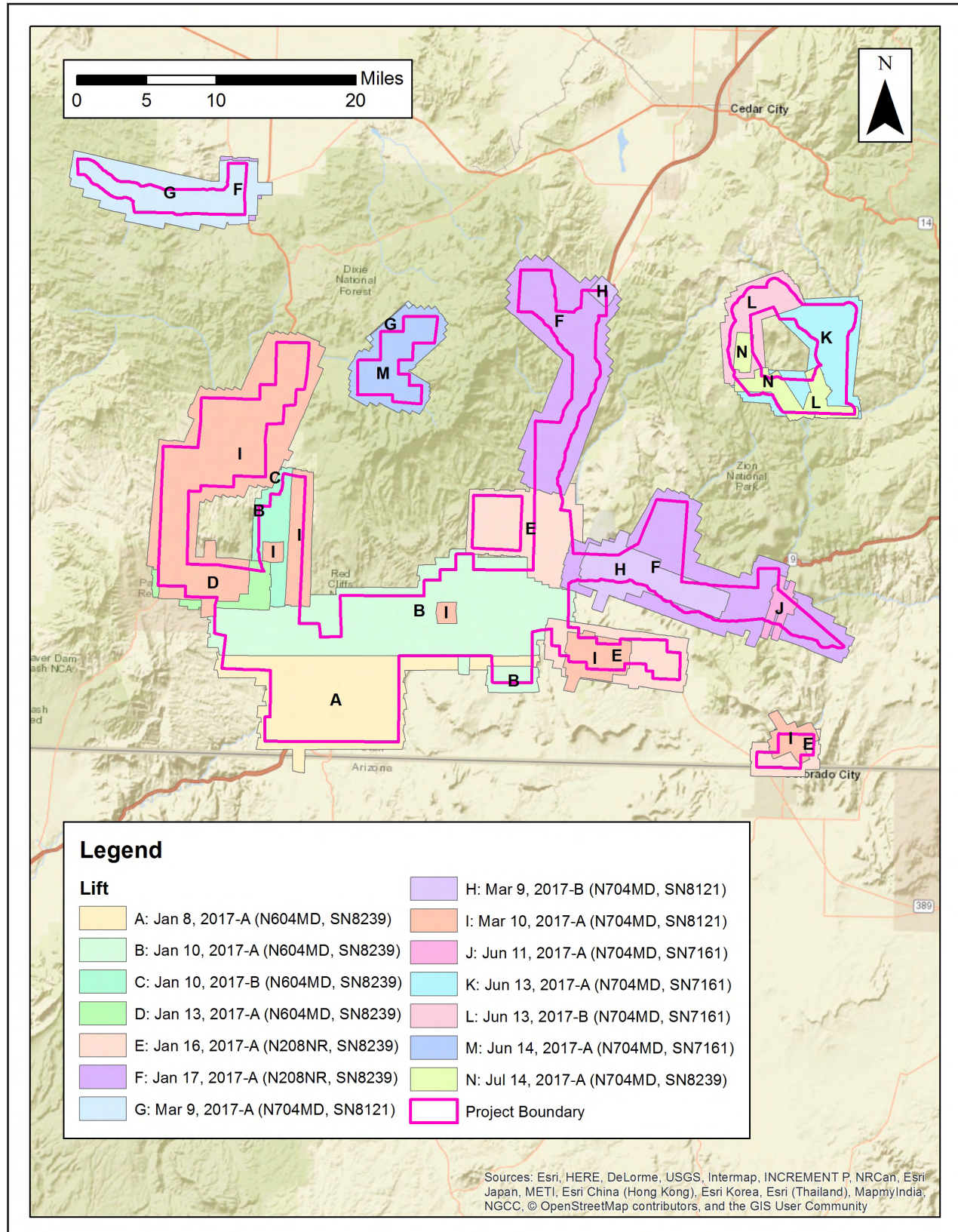
3.8. Intensity Image Processing

GeoCue software was used to create the deliverable Intensity Images. All overlap classes were ignored during this process. This helps to ensure a more aesthetically pleasing image. The GeoCue software was then used to verify full project coverage as well. TIF/TWF files were then provided as the deliverable for this dataset requirement.

4. Project Coverage Verification

Coverage verification was performed by comparing coverage of processed .LAS files captured during project collection to generate project shape files depicting boundaries of specified project areas. Please refer to Figure 5.

Figure 5. Flightline Swath LAS File Coverage



5. Ground Control and Check Point Collection

Quantum Spatial completed a field survey of 144 ground control (calibration) points along with 59 blind QA points in Vegetated and Non-Vegetated land cover classifications (total of 203 points) as an independent test of the accuracy of this project.

A combination of precise GPS surveying methods, including static and RTK observations were used to establish the 3D position of ground calibration points and QA points for the point classes above. GPS was not an appropriate methodology for surveying in the forested areas during the leaf-on conditions for the actual field survey (which was accomplished after the LiDAR acquisition). Therefore the 3D positions for the forested points were acquired using a GPS-derived offset point located out in the open near the forested area, and using precise offset surveying techniques to derive the 3D position of the forested point from the open control point. The explicit goal for these surveys was to develop 3D positions that were three times greater than the accuracy requirement for the elevation surface. In this case of the blind QA points the goal was a positional accuracy of 5 cm in terms of the RMSE.

The required accuracy testing was performed on the LiDAR dataset (both the LiDAR point cloud and derived DEM's) according to the USGS LiDAR Base Specification Version 1.2 (2014). In this document, horizontal coordinates for ground control and QA points for all LiDAR classes are reported in NAD83 (2011) UTM Zone 12, meters; NAVD88 (GEOID12B), meters.

5.1. Calibration Control Point Testing

Figure 6 shows the location of each bare earth calibration point for the project area. Note that these results of the surface calibration are not an independent assessment of the accuracy of these project deliverables, but the statistical results do provide additional feedback as to the overall quality of the elevation surface.

5.2. Point Cloud Testing

The project specifications require that only Non-Vegetated Vertical Accuracy (NVA) be computed for raw lidar point cloud swath files. The required accuracy (ACCz) is: 19.6 cm at a 95% confidence level, derived according to NSSDA, i.e., based on RMSE of 10 cm in the "bare earth" and "urban" land cover classes. The NVA was tested with 34 of 36 checkpoints located in bare earth and urban (non-vegetated) areas points BE103 and UA09 were removed as they were obstructed. These check points were not used in the calibration or post processing of the lidar point cloud data. The checkpoints were distributed throughout the project area and were surveyed using GPS techniques.

Elevations from the unclassified lidar surface were measured for the x,y location of each check point. Elevations interpolated from the lidar surface were then compared to the elevation values of the surveyed control points. AccuracyZ has been tested to meet 19.6 cm or better Non-Vegetated Vertical Accuracy at 95% confidence level using $RMSE(z) \times 1.9600$ as defined by the

National Standards for Spatial Data Accuracy (NSSDA); assessed and reported using National Digital Elevation Program (NDEP)/ASRPS Guidelines. See Figure 7.

5.3. Digital Elevation Model (DEM) Testing

The project specifications require the accuracy (ACCz) of the derived DEM be calculated and reported in two ways:

1. The required NVA is: 19.6 cm at a 95% confidence level, derived according to NSSDA, i.e., based on RMSE of 10 cm in the “bare earth” and “urban” land cover classes. This is a required accuracy. The NVA was tested with 34 of 36 checkpoints located in bare earth and urban (non-vegetated) areas points; BE103 and UA09 were removed as they were obstructed. See Figure 7.
2. Vegetated Vertical Accuracy (VVA): VVA shall be reported for “forested”, “brushlands/low trees” and “tall weeds/crops” land cover classes. The target VVA is: 29.4 cm at the 95th percentile, derived according to ASPRS Guidelines, Vertical Accuracy Reporting for Lidar Data, i.e., based on the 95th percentile error in all vegetated land cover classes combined. This is a target accuracy. The VVA was tested with 25 checkpoints located in forested, tall weeds/crops and brushlands/low trees (vegetated) areas. The checkpoints were distributed throughout the project area and were surveyed using GPS techniques. See Figure 8.

AccuracyZ has been tested to meet 19.6 cm or better Non-Vegetated Vertical Accuracy at 95% confidence level using $RMSE(z) \times 1.9600$ as defined by the National Standards for Spatial Data Accuracy (NSSDA); assessed and reported using National Digital Elevation Program (NDEP)/ASRPS Guidelines.

For more information, see the FOCUS on Accuracy report.

Accuracy Test	Target	Measured	Points Used
Raw NVA	0.196 m	0.0911 m	34
NVA	0.196 m	0.0896 m	34
VVA	0.294m	0.1389 m	25

Figure 6. Calibration Control Point Locations

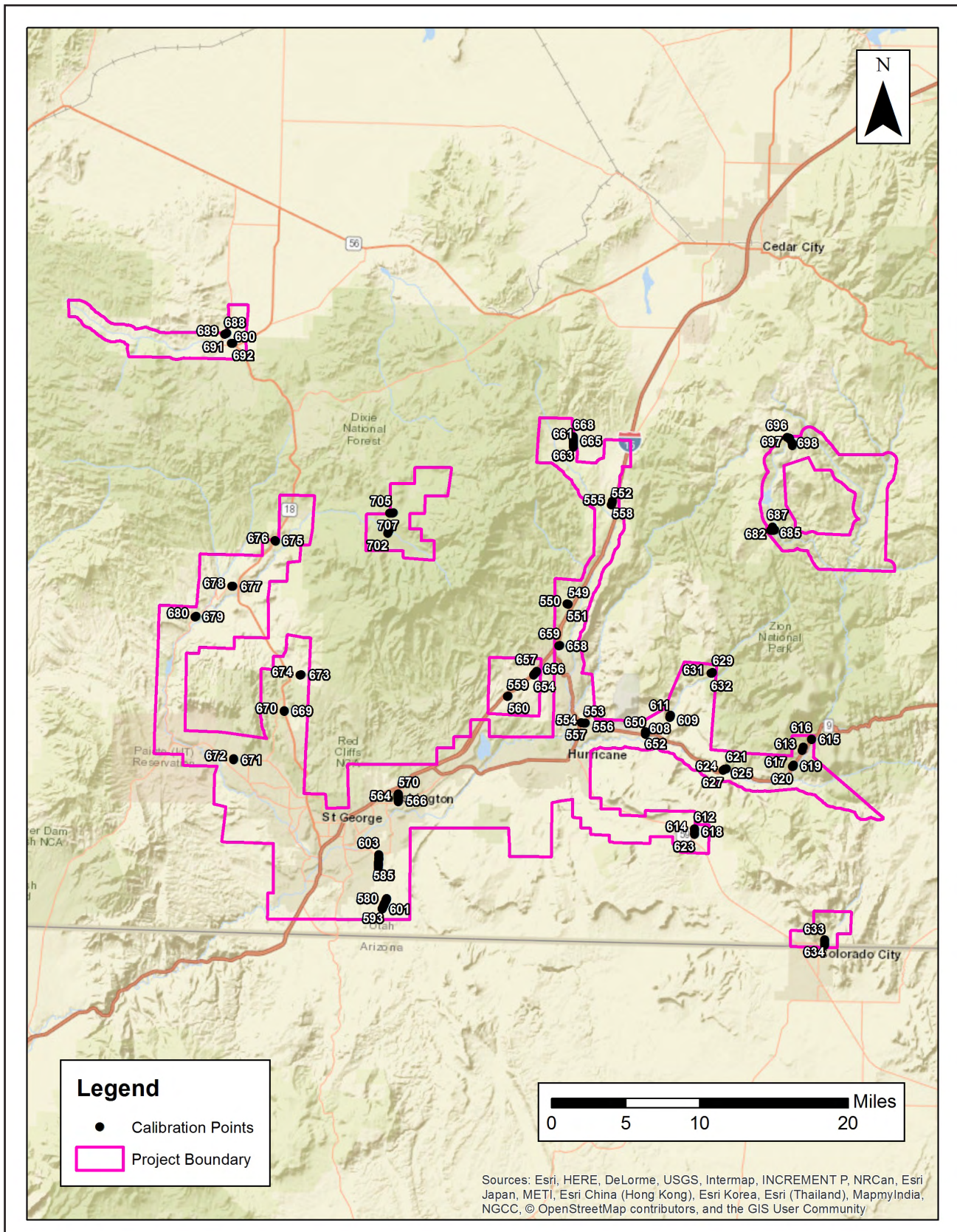


Figure 7. QC Checkpoint Locations - NVA

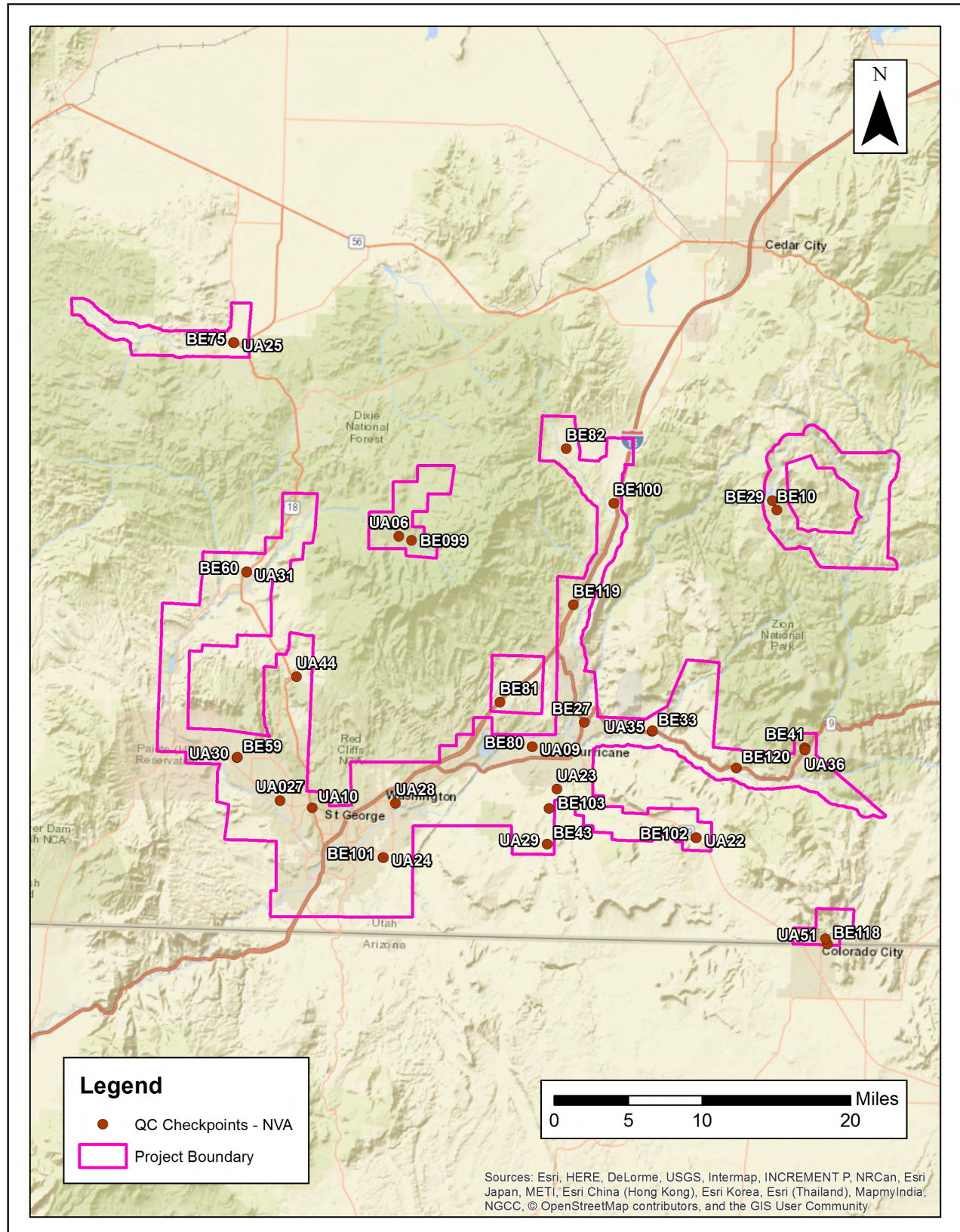
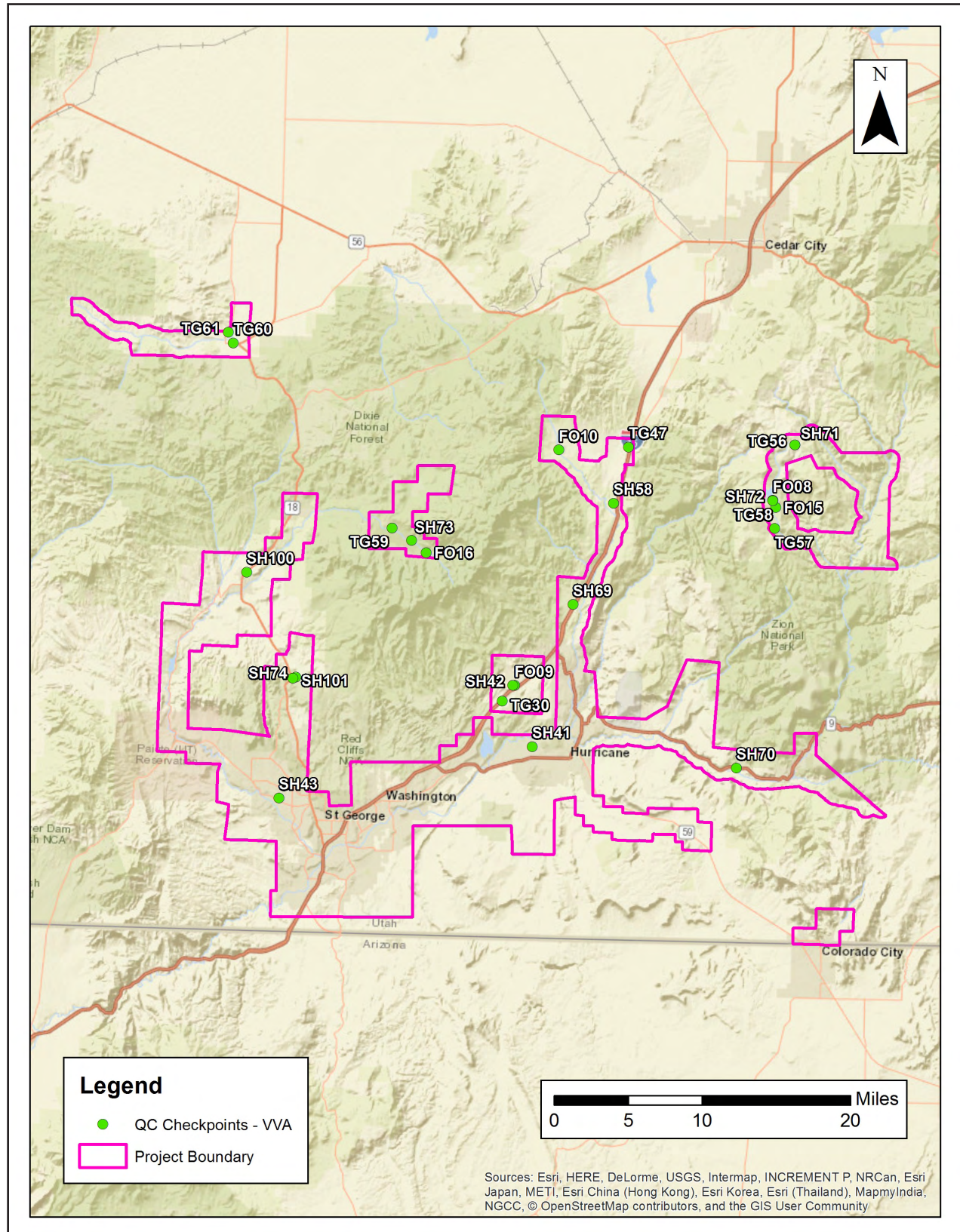


Figure 8. QC Checkpoint Locations - VVA



Project Report Appendices

The following section contains the appendices as listed in the Utah 2016 - Washington County AOI Project Report.

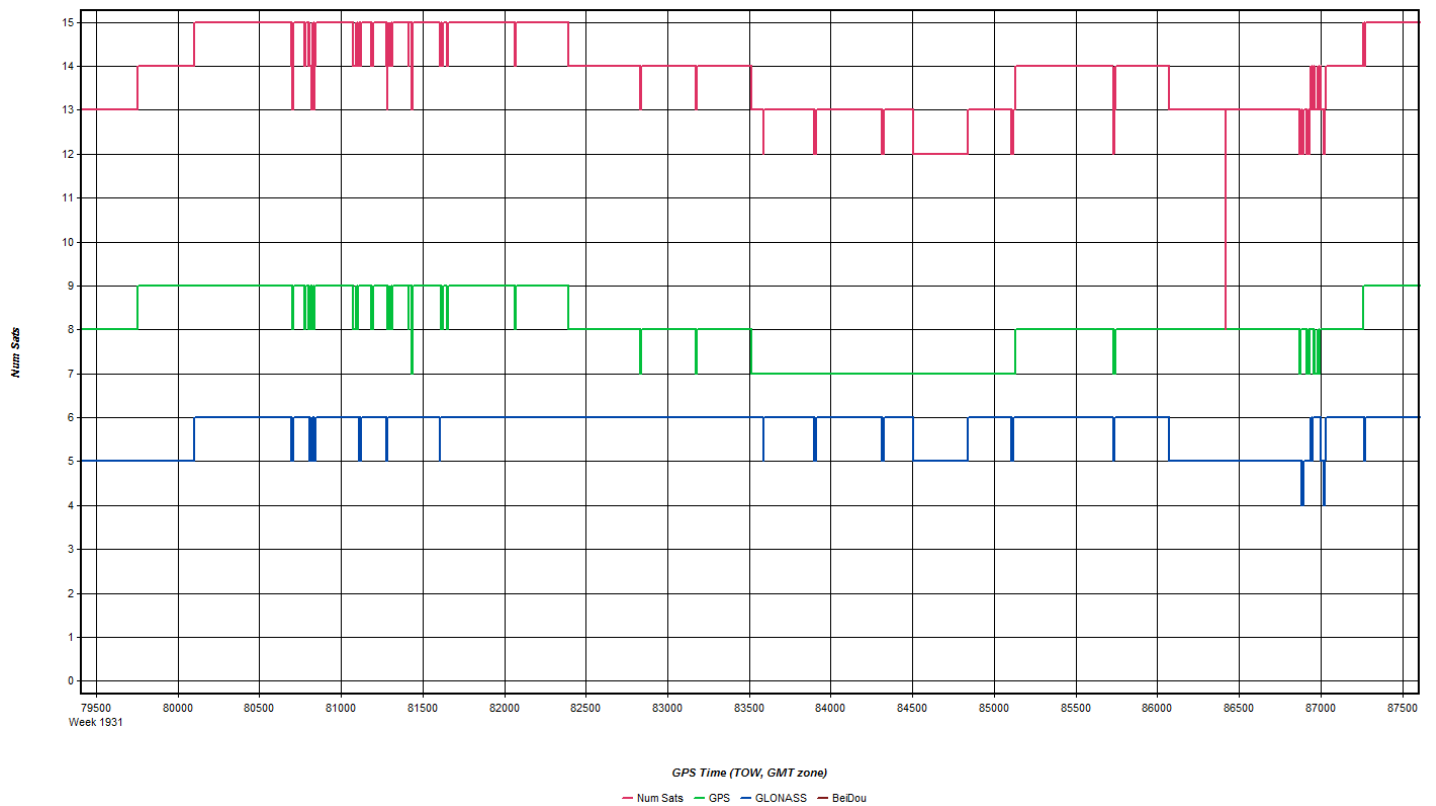
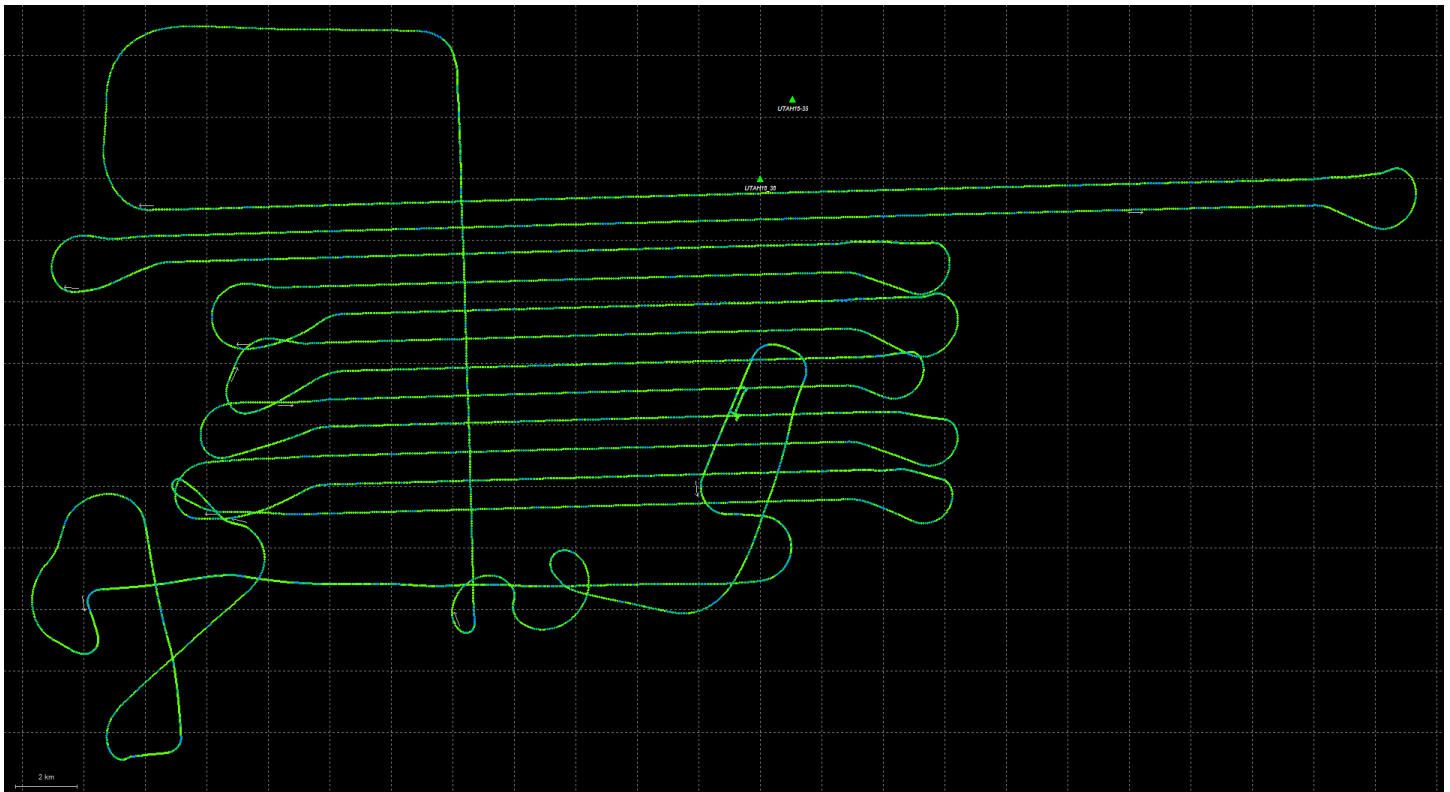
Appendix A

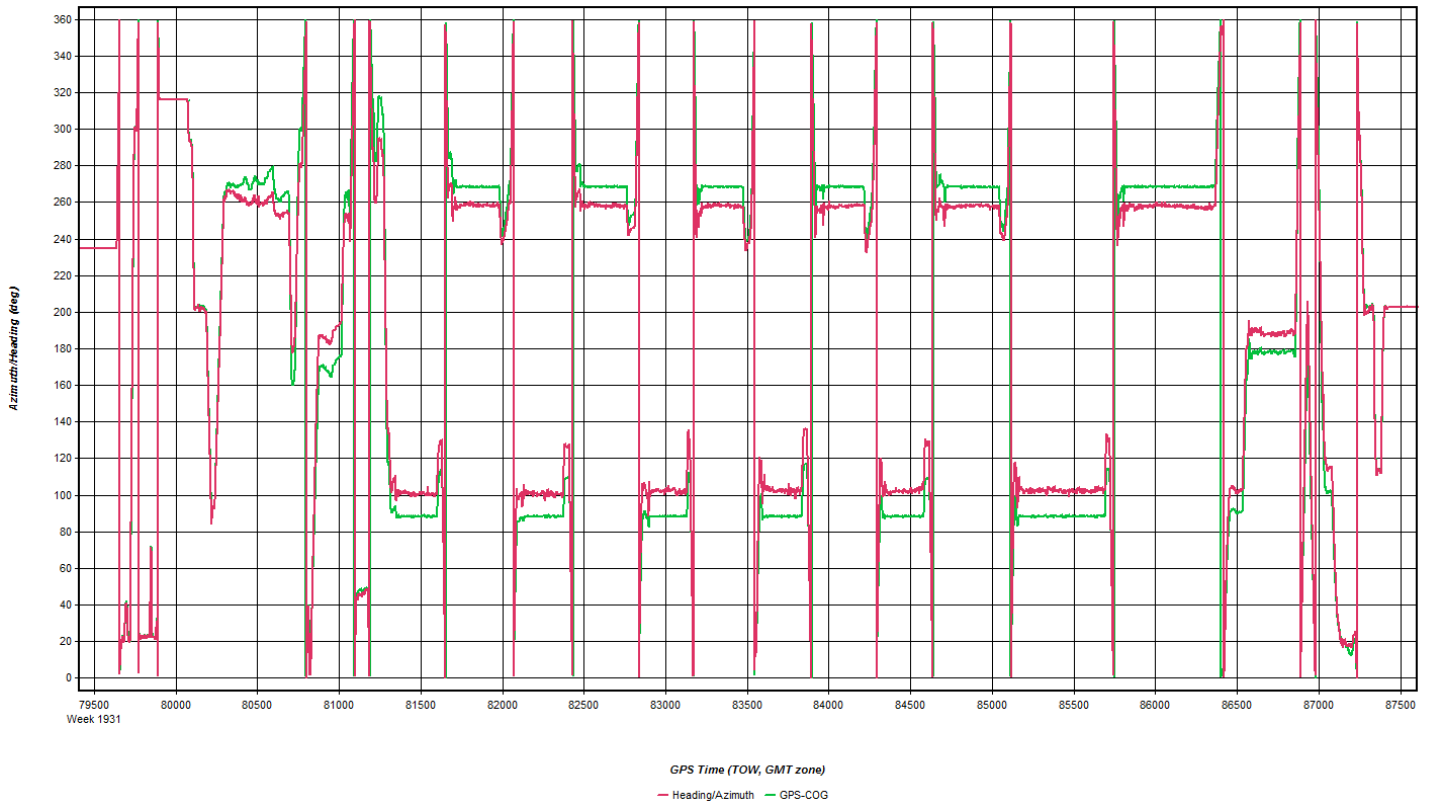
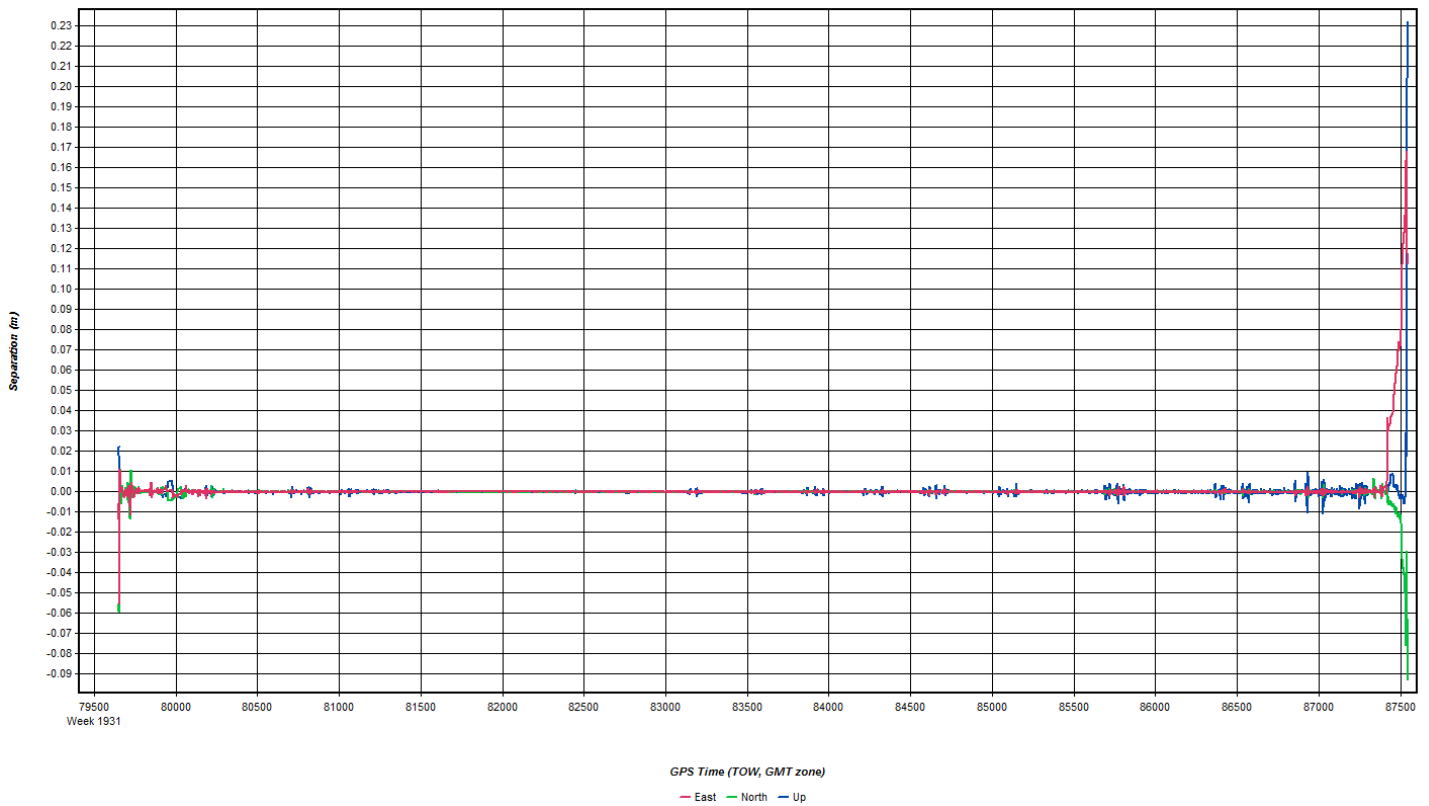
GPS/IMU Statistics Flight Logs

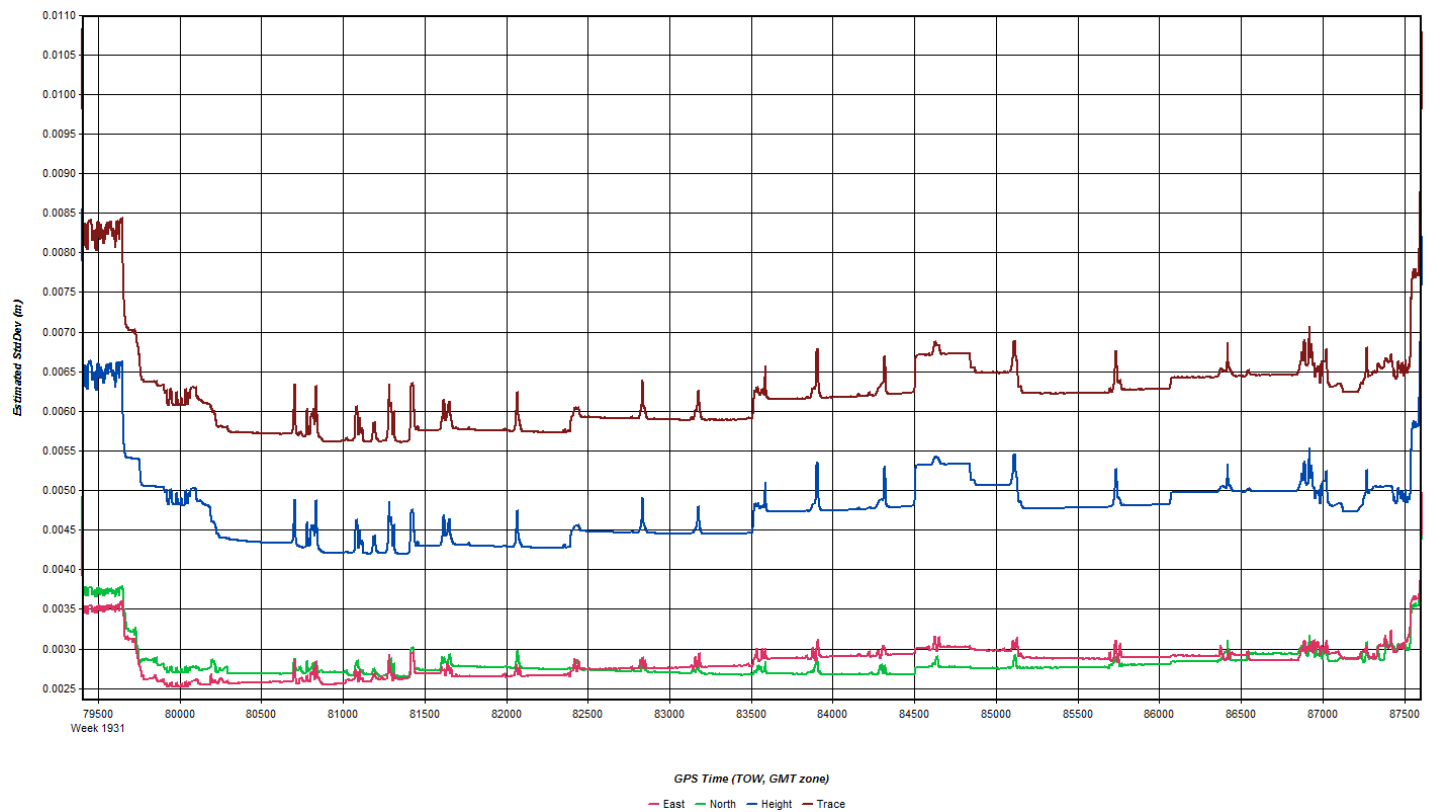
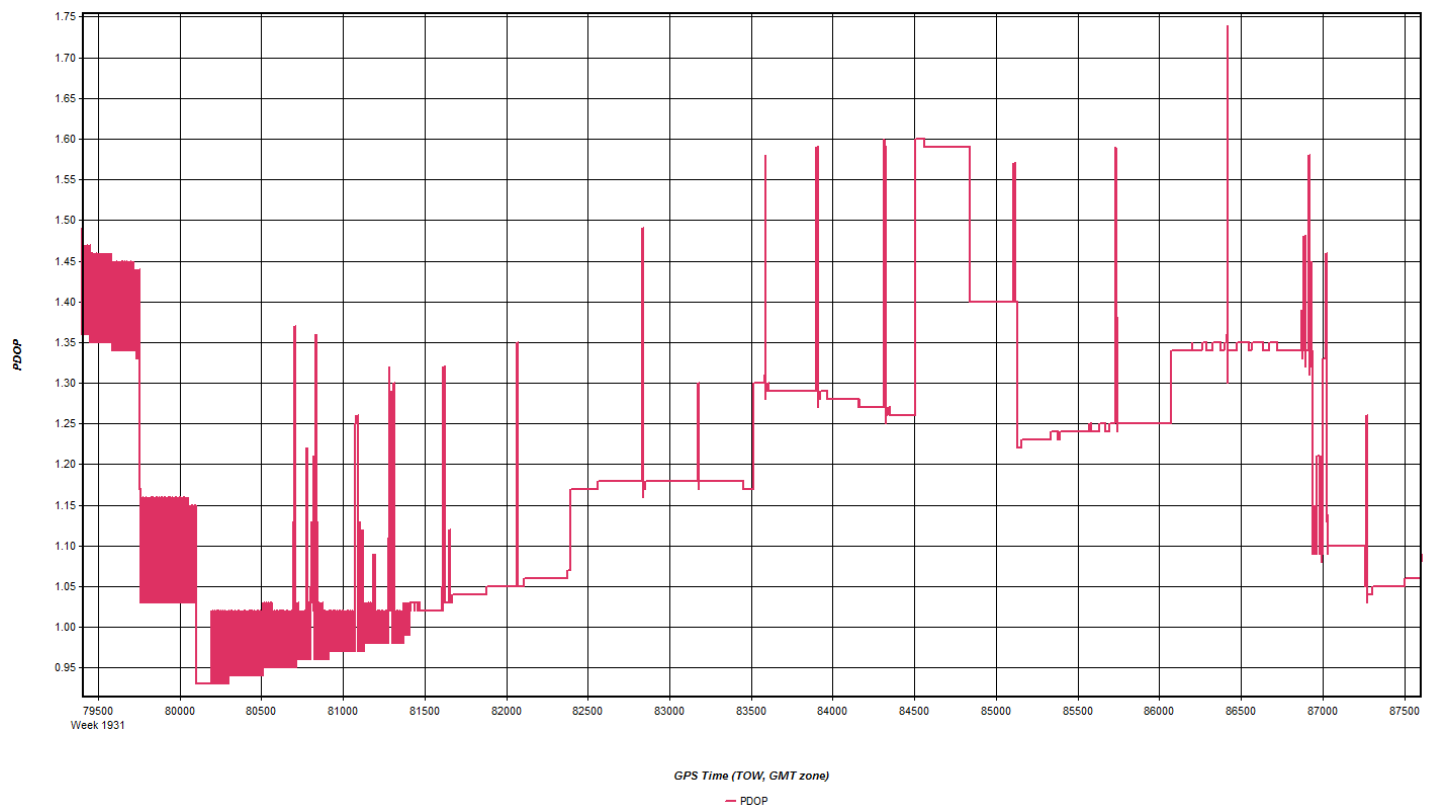
There were 14 total lifts. Graph reports generated from processing software and flight logs are found on the following pages.

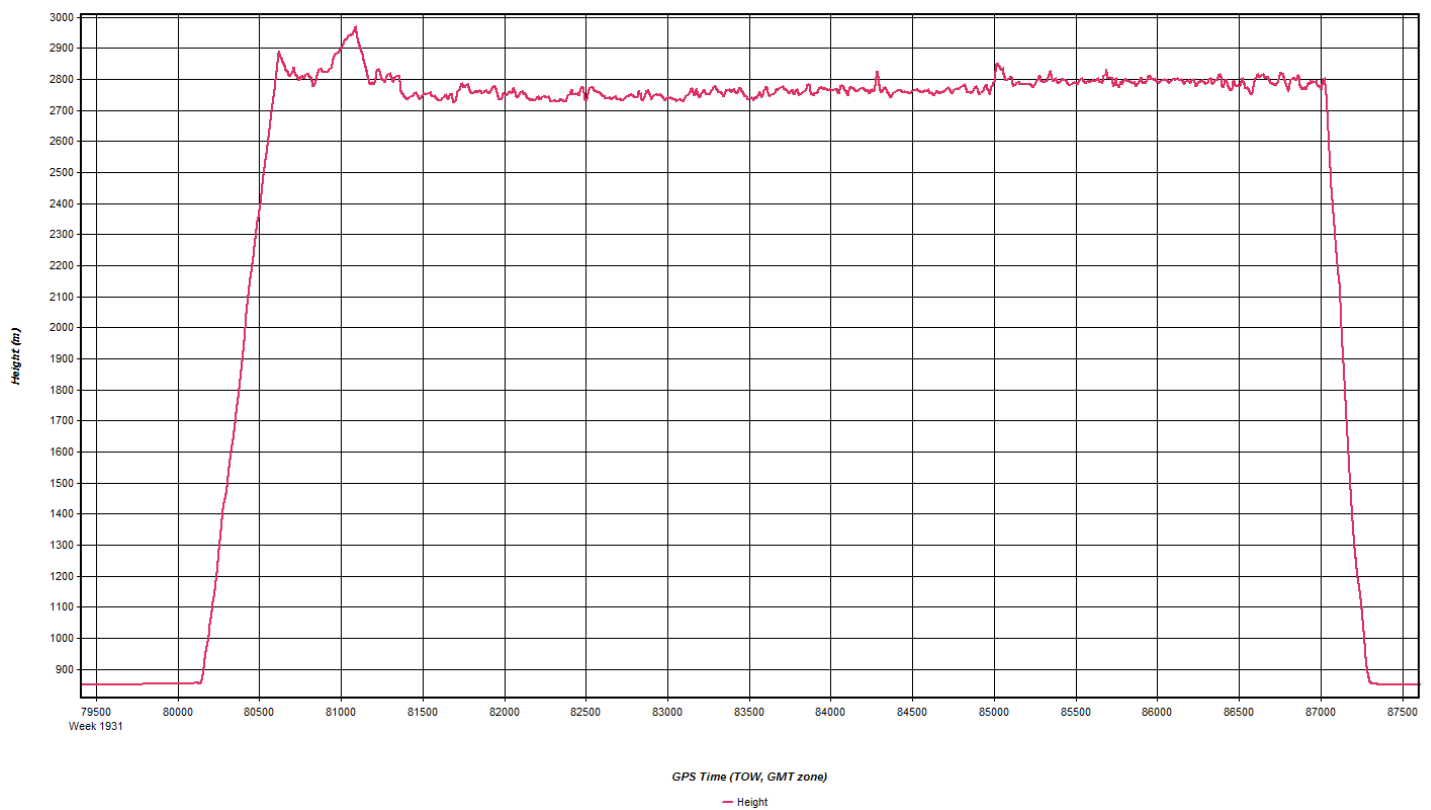
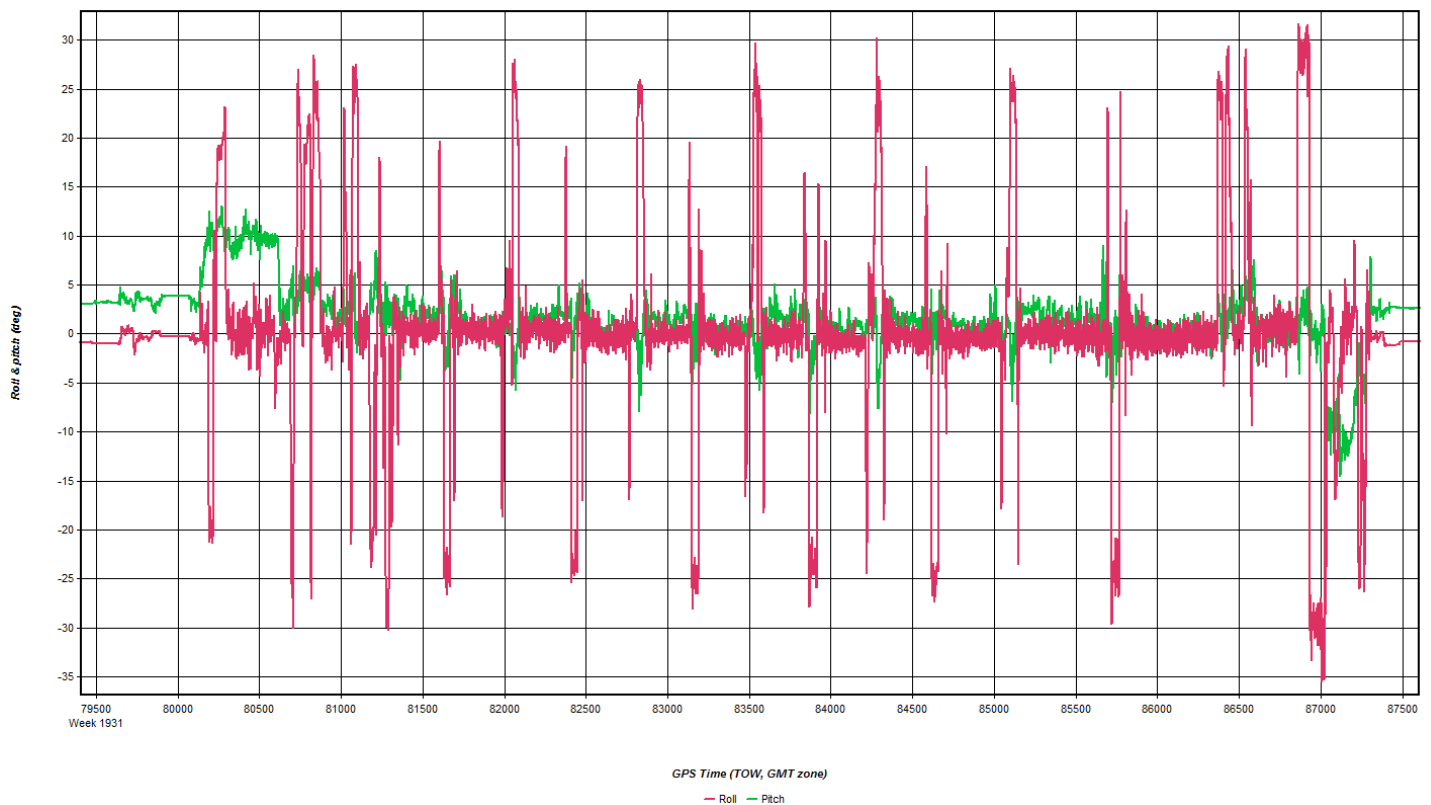
Jan 8, 2017-A (N604MD, SN8239)	2
Flight Log.....	10
Jan 10, 2017-A (N604MD, SN8239).....	12
Flight Log.....	20
Jan 10, 2017-B (N604MD, SN8239).....	22
Flight Log.....	30
Jan 13, 2017-A (N604MD, SN8239)	32
Flight Log.....	39
Jan 16, 2017-A (N208NR, SN8239).....	41
Flight Log.....	49
Jan 17, 2017-A (N208NR, SN8239).....	51
Flight Log.....	59
Mar 9, 2017-A (N704MD, SN8121).....	62
Flight Log.....	70
Mar 9, 2017-B (N704MD, SN8121)	72
Flight Log.....	79
Mar 10, 2017-A (N704MD, SN8121)	81
Flight Log.....	89
Jun 11, 2017-A (N704MD, SN7161)	91
Flight Log.....	99
Jun 13, 2017-A (N704MD, SN7161).....	100
Flight Log.....	108
Jun 13, 2017-B (N704MD, SN7161).....	109
Flight Log.....	117
Jun 14, 2017-A (N704MD, SN7161)	118
Flight Log.....	126
Jul 14, 2017-A (N704MD, SN8239)	127
Flight Log.....	134

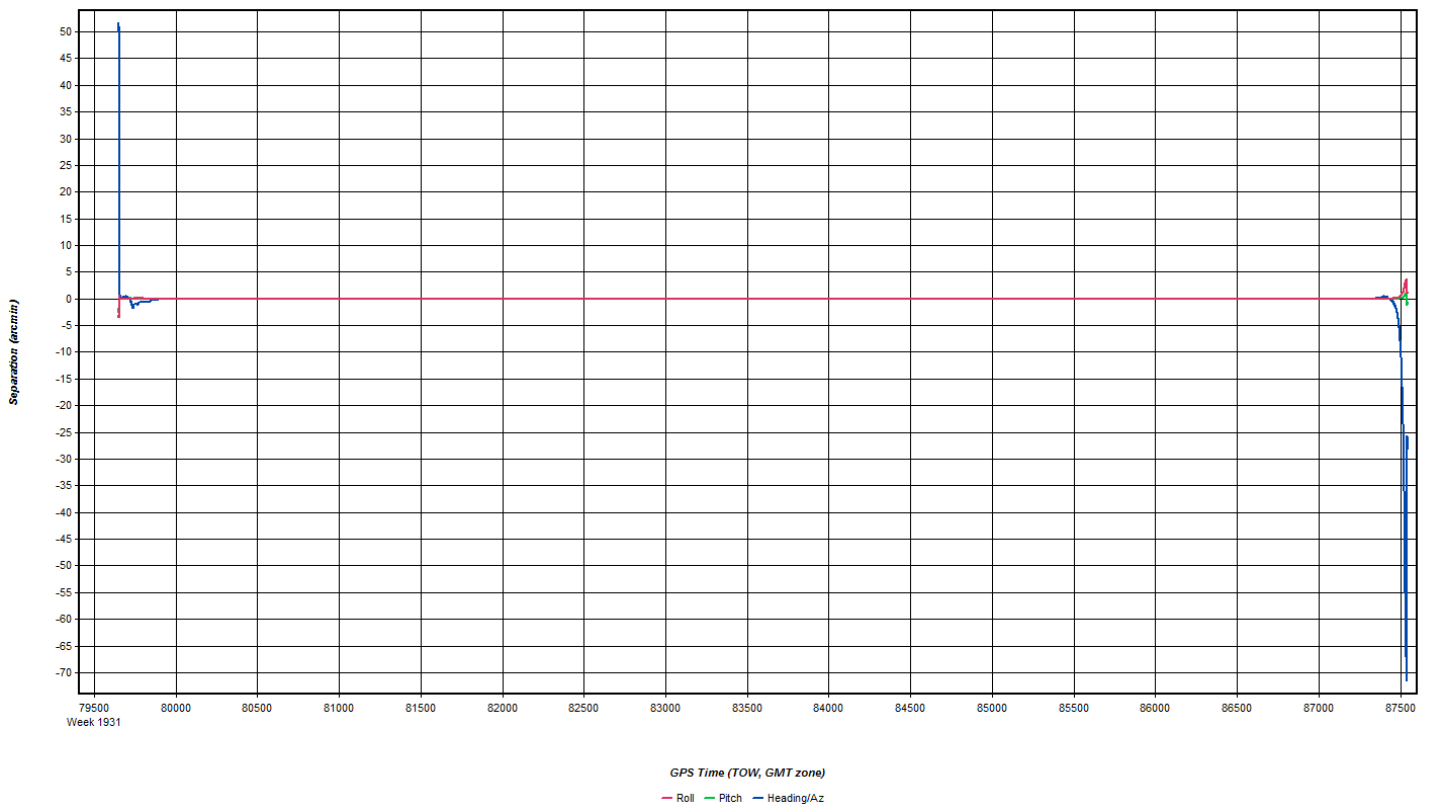
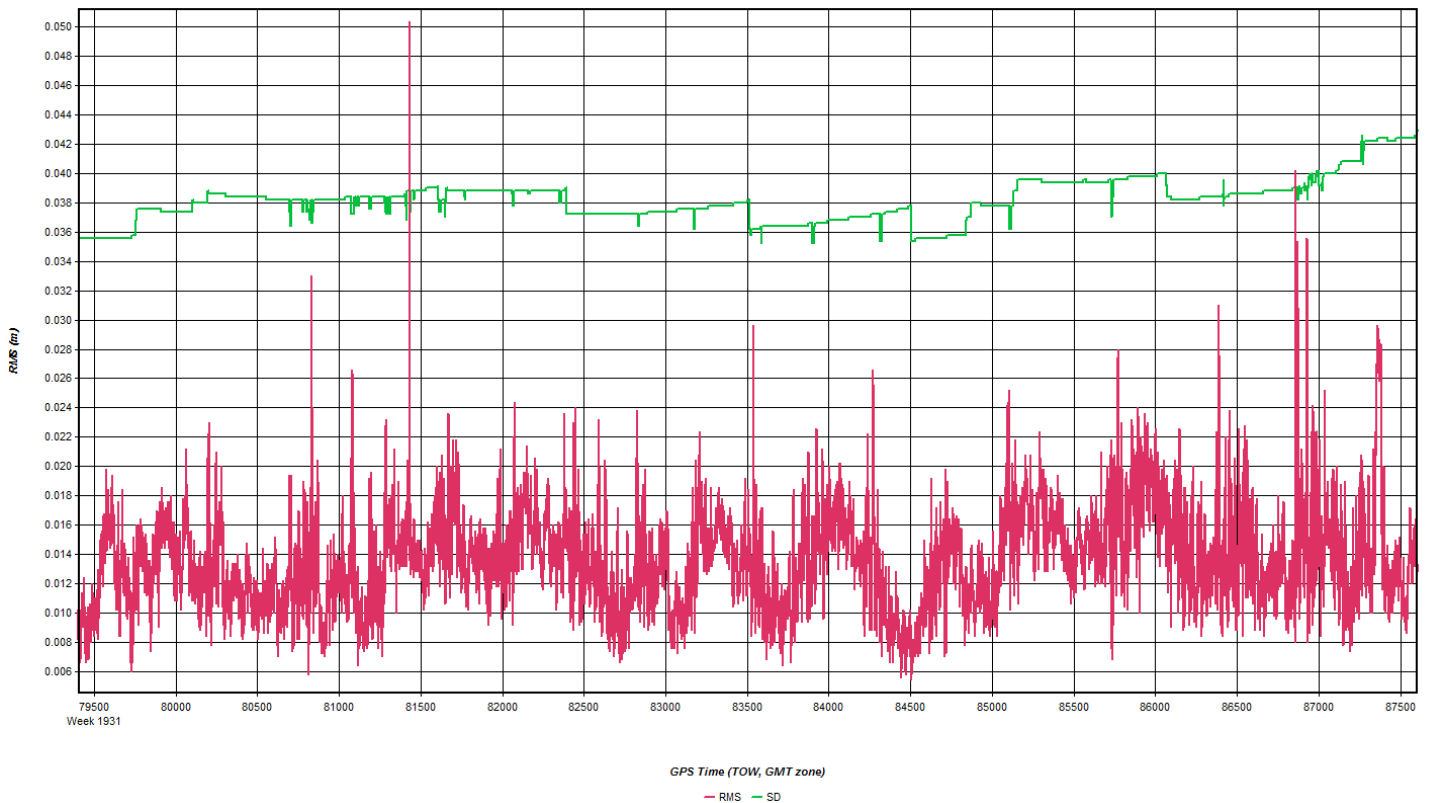
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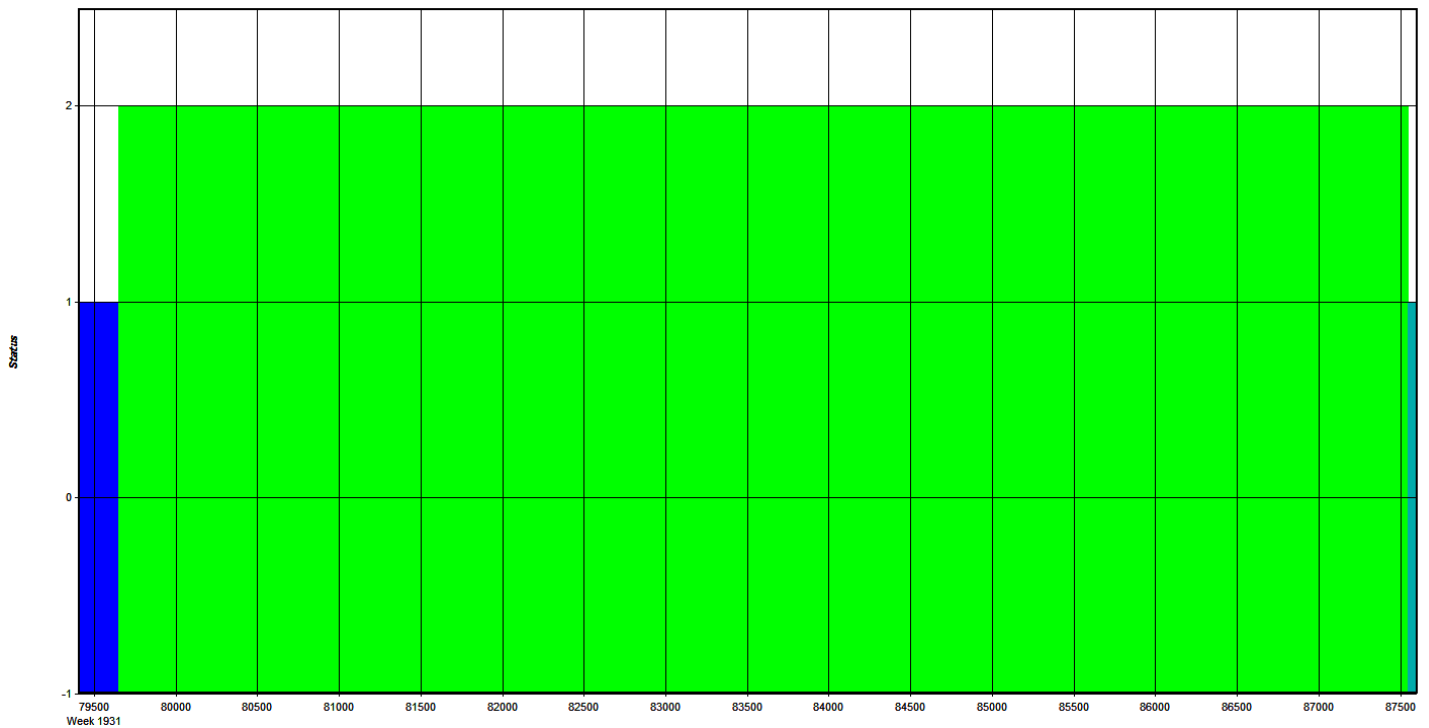












GPS Time (TOW, GMT zone)

— Float — Forward Fixed — Reverse Fixed — Fixed (2 or more)

Master Remote

Base Station

2: UTAH16-35
Name: UTAH16-35
☐ Disabled

File: E:\Proc\29083_UTAH\From_Lara_Heitmeyer_1-26-17\Survey_Da

Coordinates

Latitude: North 37 07 53.89287 Compute from PPP
Longitude: West 113 29 06.63661 Enter Grid Values
Ellipsoidal height: 838.881 m Enter MSL Height
Datum: WGS84 Datum Options
Select From Favorites Add To Favorites Use Average Position

Antenna Height

From station file: TRM55971.00 View STA File
Antenna profile: TRM57971.00 Info
Measured height: 1.800 m
ARP to L1 offset: 0.067 m
Applied height: 1.867 m
Measured to:
☒ ARP
☐ L1 Phase Centre
Compute From Slant

OK Cancel

Coordinate/Antenna Settings ? X

Master Remote

Base Station
 1: UTAH16_36 Name: UTAH16_36 ☐ Disabled
 File: E:\Proc\29083_UTAH\From_Lara_Heitmeyer_1-26-17\Survey_Da

Coordinates
 Latitude: North 37 06 30.25986 Compute from PPP
 Longitude: West 113 29 48.66465 Enter Grid Values
 Ellipsoidal height: 783.396 m Enter MSL Height
 Datum: WGS84 Datum Options
 Select From Favorites Add To Favorites Use Average Position

Antenna Height
 From station file: TRM55971.00 View STA File
 Antenna profile: TRM57971.00 Info
 Measured height: 1.800 m
 ARP to L1 offset: 0.067 m
 Applied height: 1.867 m

Measured to
☒ ARP
☐ L1 Phase Centre
 Compute From Slant

OK Cancel

Flight Log

Date: 11/20/2016	Aircraft:	Sensor:
Project: Utah 2016 LiDAR		Project #: R029083
Flight Mgmt File: FMSL_Utah_WACounty_SN8239		
Pilot: Bob Cale		Sensor Operator: Charlie Oncea

	Flight 1	Flight 2	Flight 3	Flight 4
Wheels Up	3:14:00 PM			
Wheels Down	5:19:00 PM			
Begin Hobbs	11972.8			
End Hobbs	11974.8			
On-line Hobbs: 1.8		Mob Hobbs: 0.2		

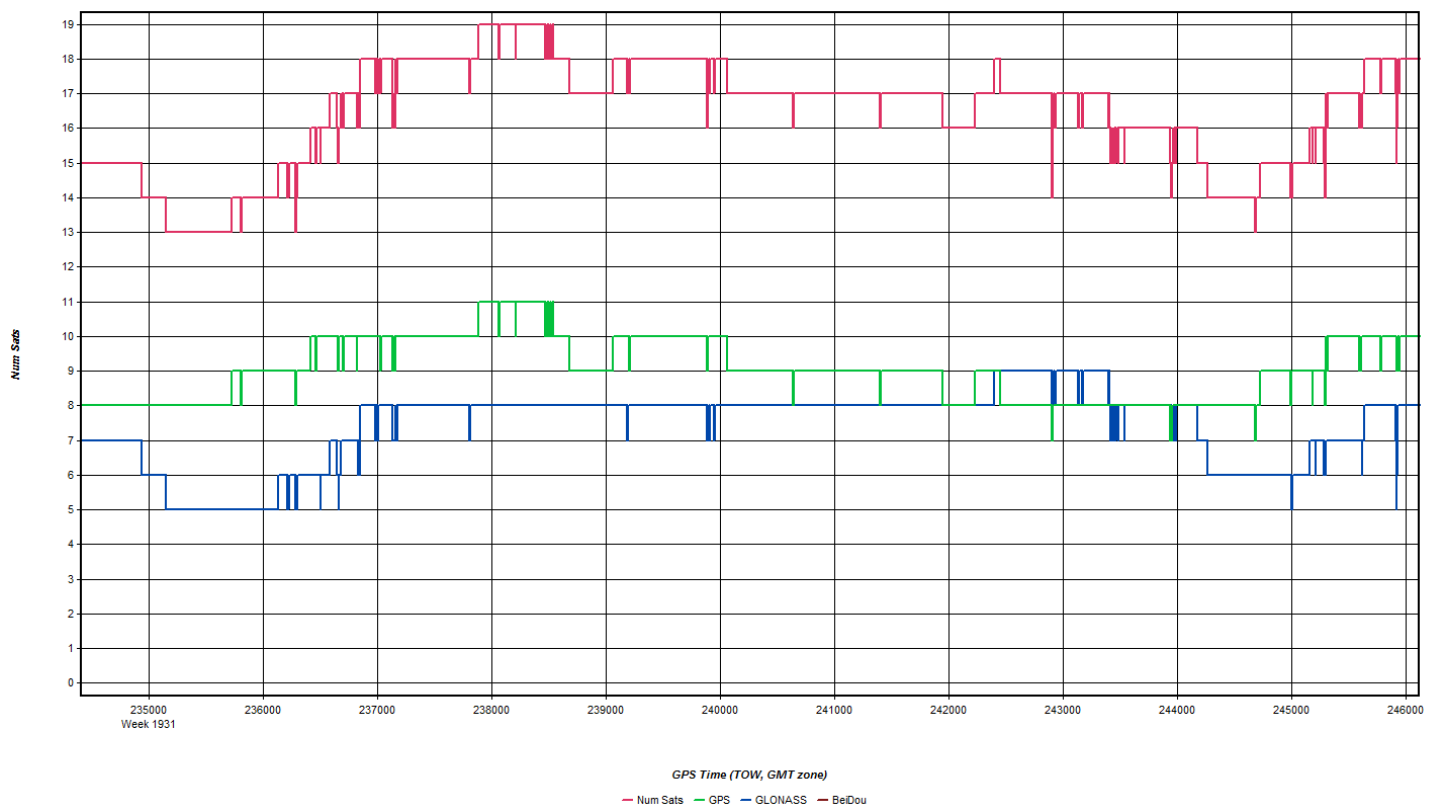
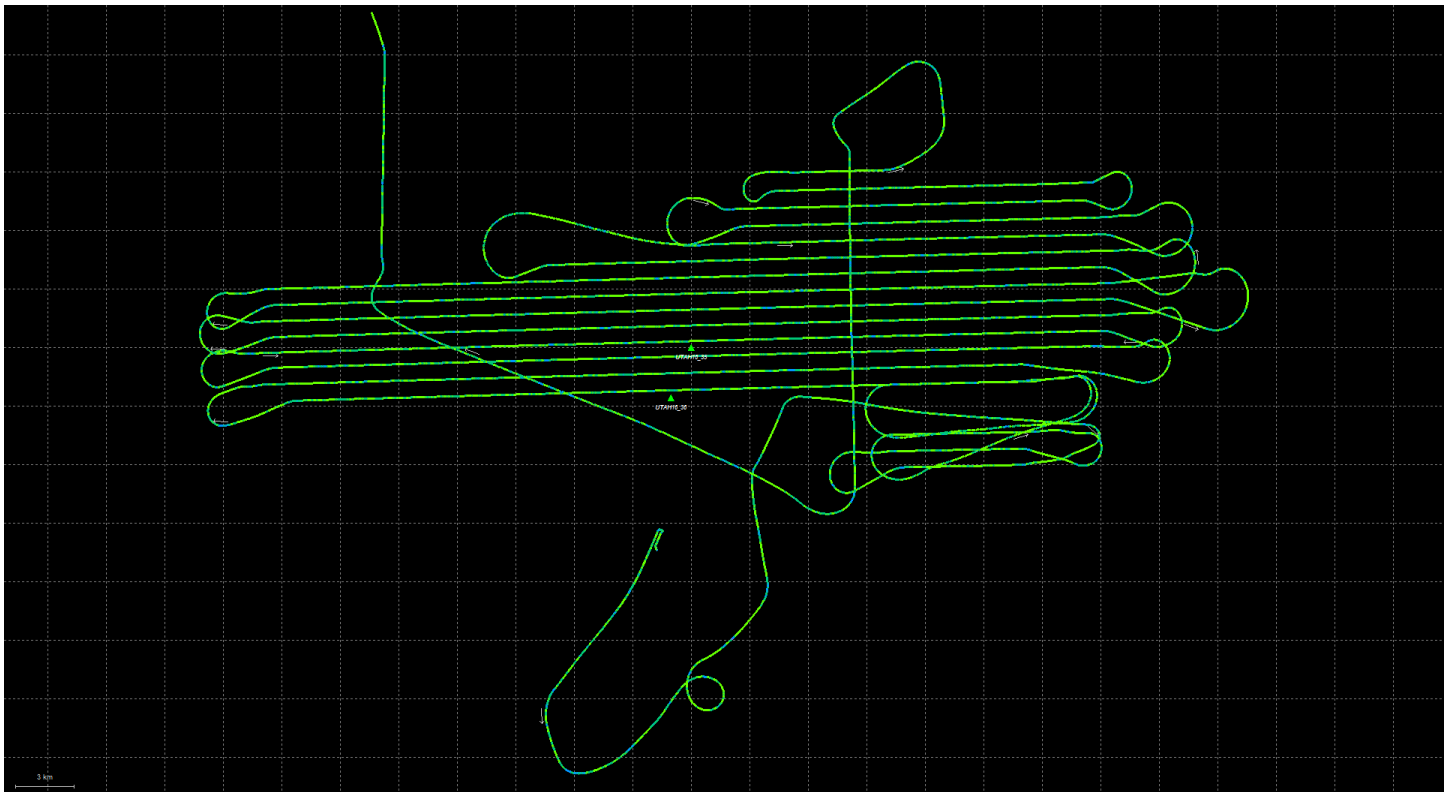
Notes

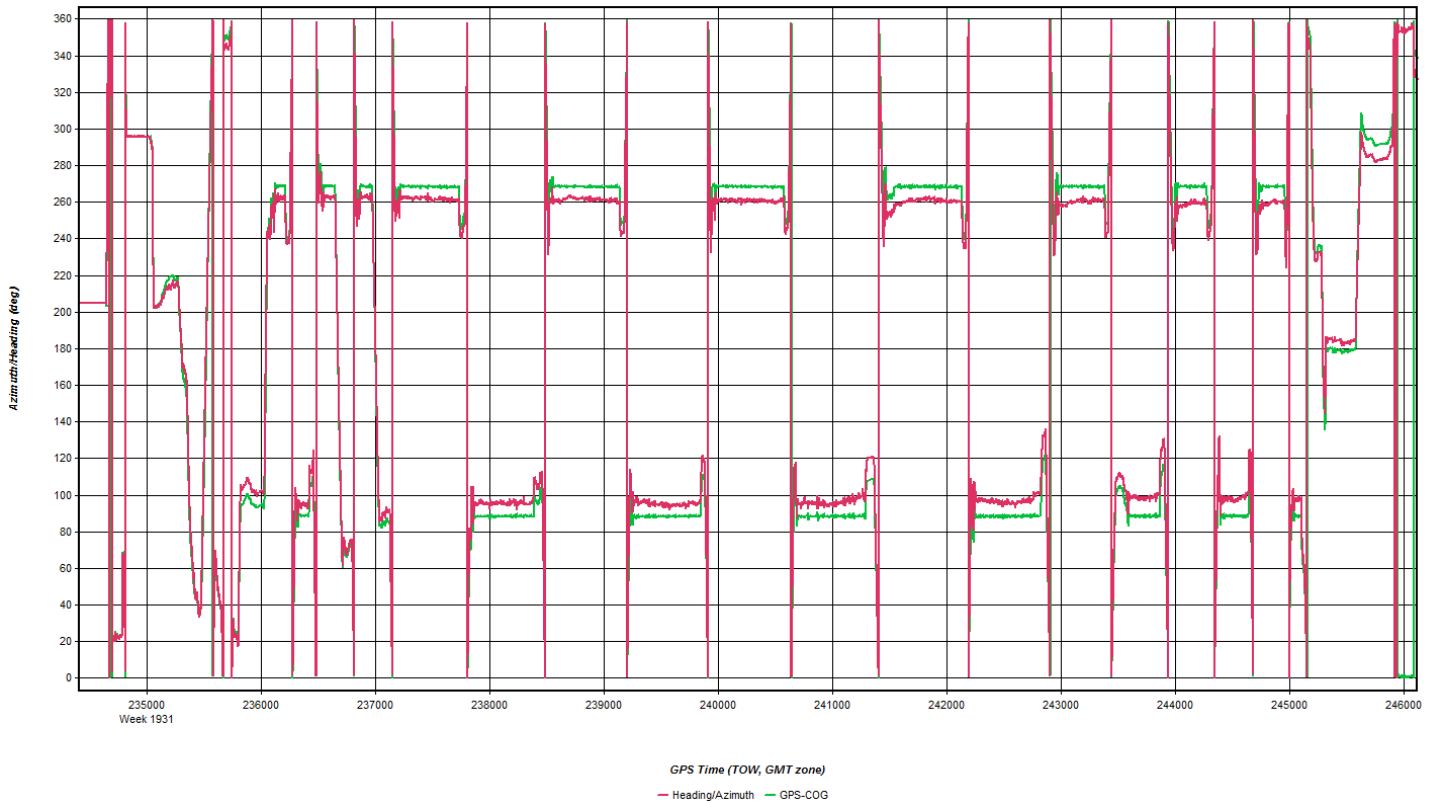
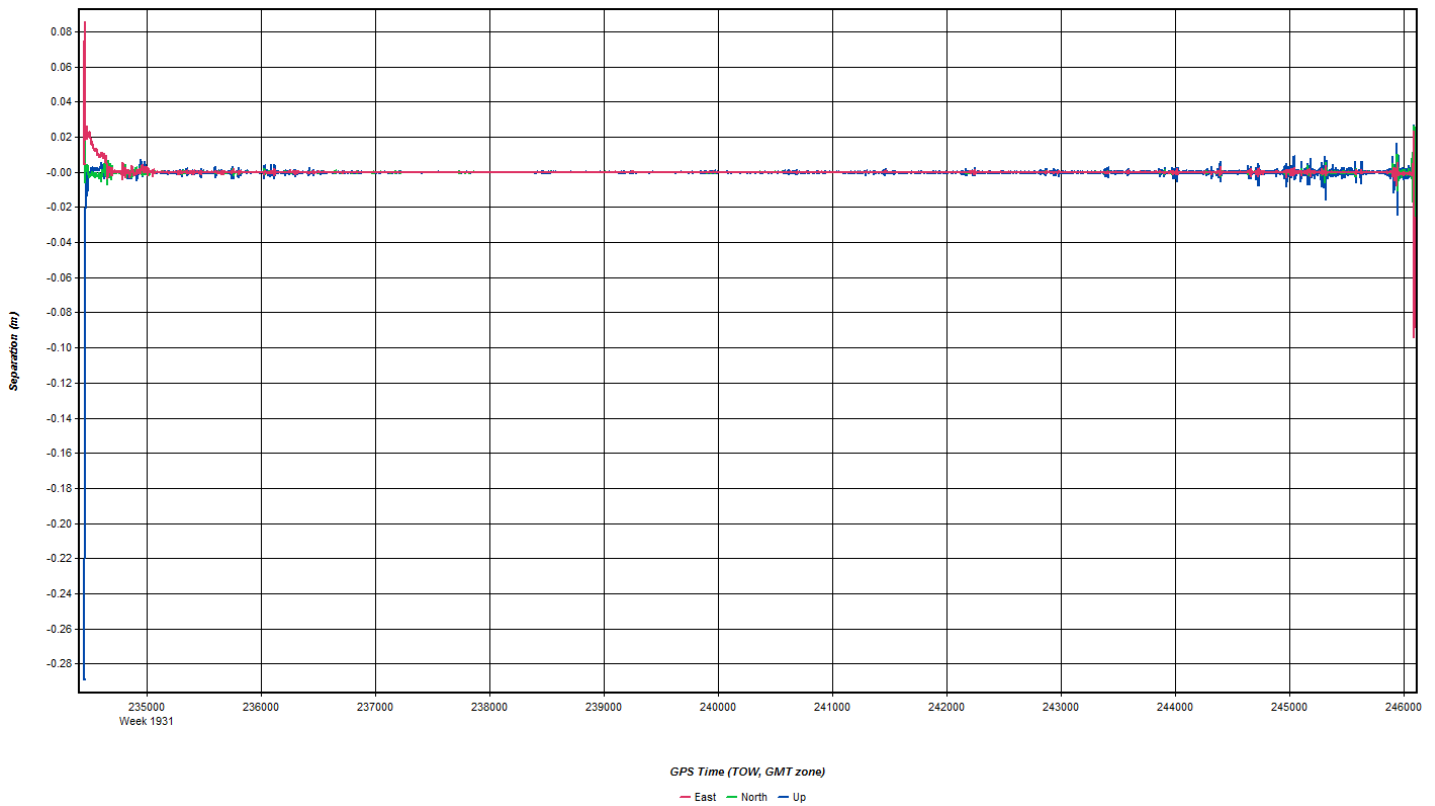
Went to the airport early and waited all day for the clouds to lift. they stayed just below the project height until late in the day, and we got a chance for a short evening flight.

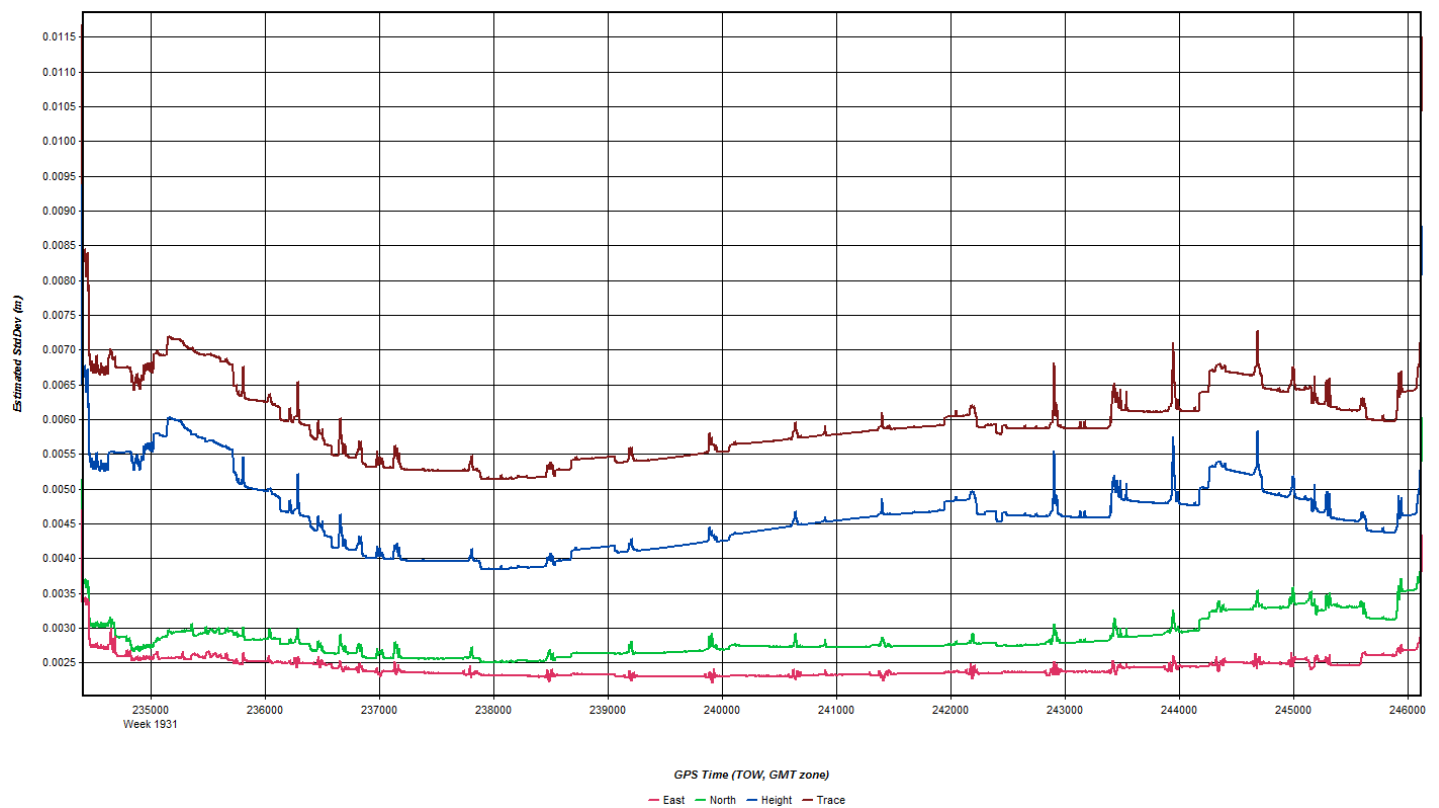
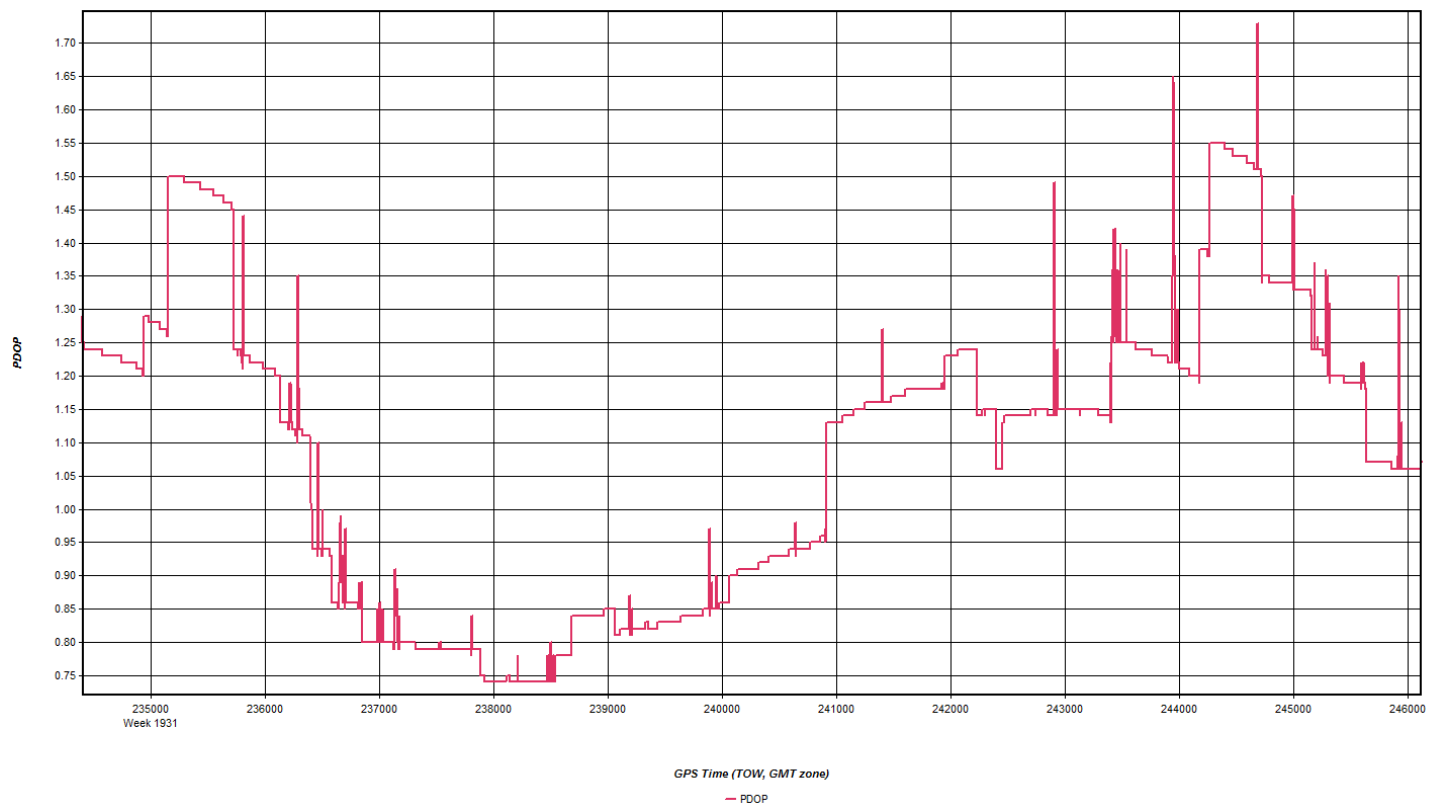
Flt Mgmt File: FMSL_Utah_WACounty_SN8239

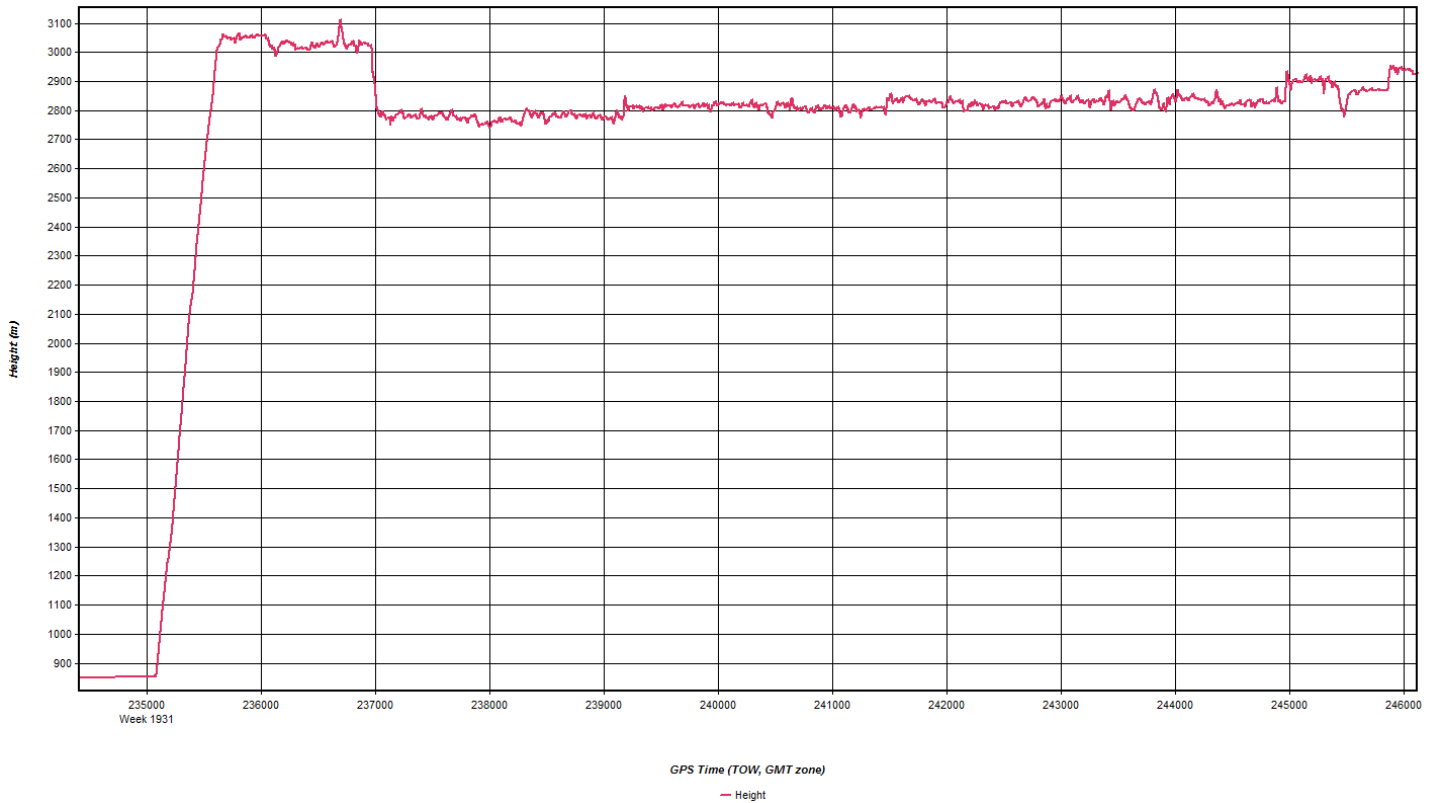
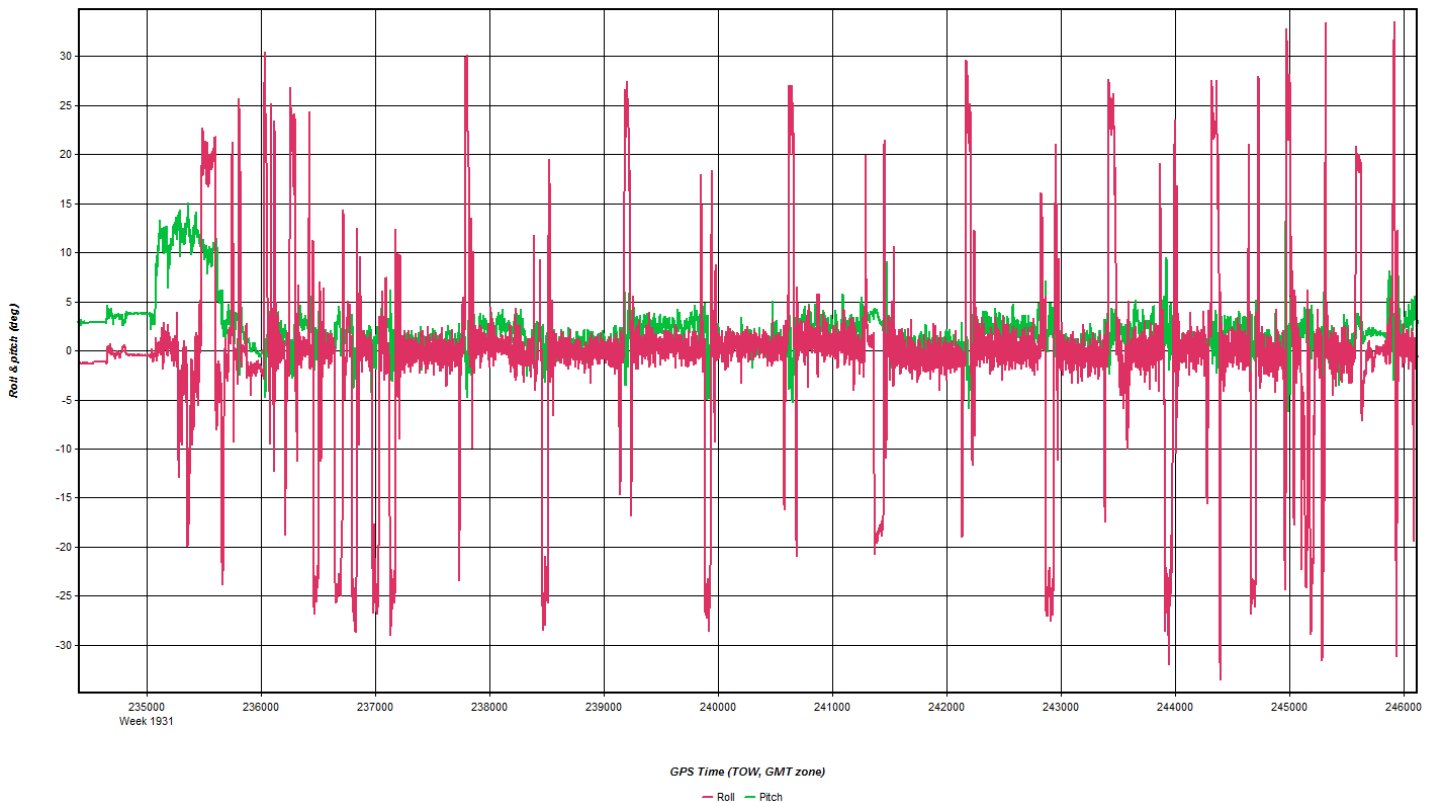
26	10:35:00 PM	2053.2178	10:39:00 PM
25	10:41:00 PM	1896.709	10:46:00 PM
24	10:48:00 PM	2024.0305	10:52:00 PM
23	10:54:00 PM	1826.4469	10:59:00 PM
22	11:01:00 PM	1978.5013	11:05:00 PM
21	11:06:00 PM	1892.3292	11:10:00 PM
20	11:13:00 PM	1965.6786	11:16:00 PM
19	11:19:00 PM	1904.408	11:23:00 PM
18	11:25:00 PM	1894.822	11:29:00 PM
17	11:31:00 PM	1843.6351	11:37:00 PM
16	11:39:00 PM	1825.5376	11:47:00 PM
15	11:49:00 PM	1471.9822	11:59:00 PM
UL001	12:02:00 AM	1935.3015	12:07:00 AM

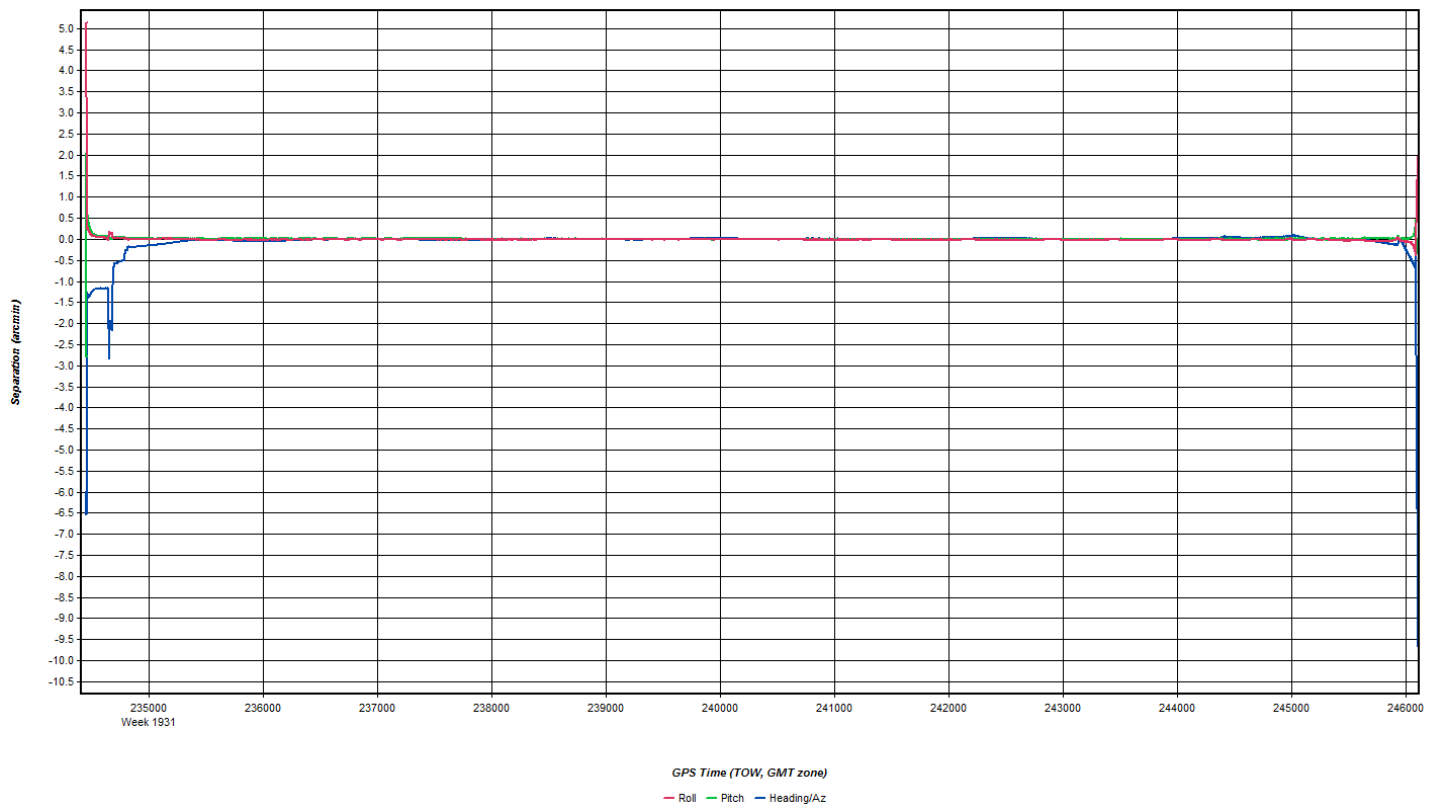
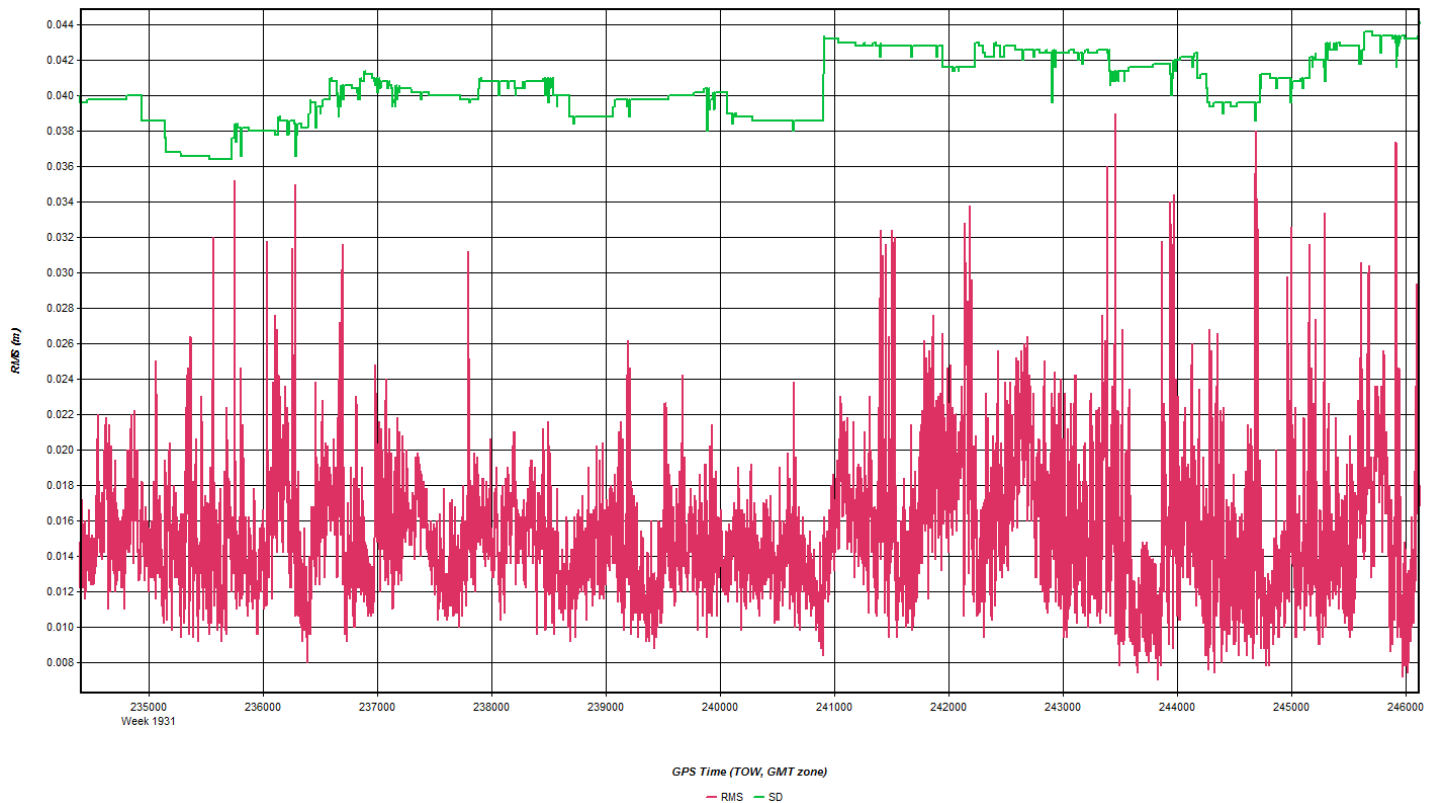
Jan 10, 2017-A (N604MD, SN8239)

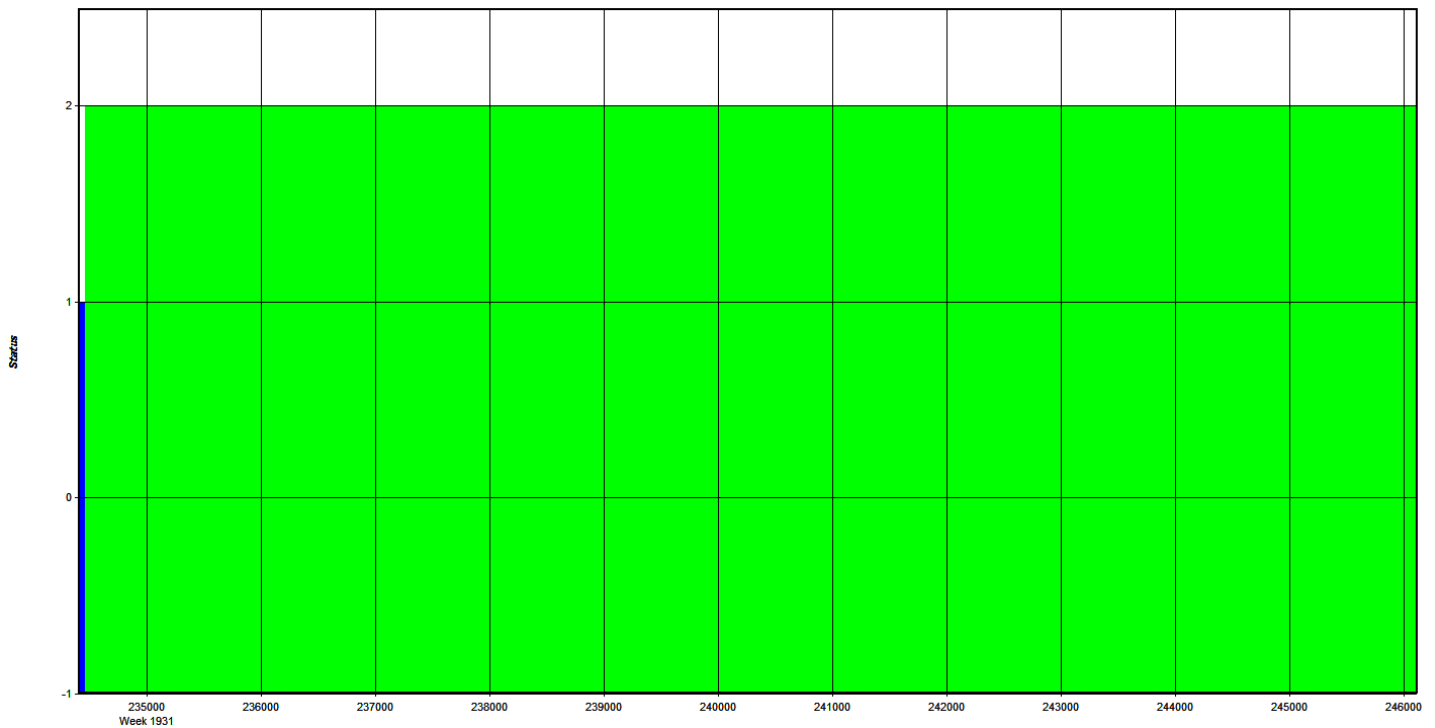












Coordinate/Antenna Settings

Master Remote

Base Station

1: UTAH16_35 Name: UTAH16_35 ☐ Disabled

File: E:\Proc\29083_UTAH\From_Lara_Heitmeyer_1-26-17\Survey_Da

Coordinates

Latitude: North 37 07 53.89287 Compute from PPP

Longitude: West 113 29 06.63661 Enter Grid Values

Ellipsoidal height: 838.881 m Enter MSL Height

Datum: WGS84 Datum Options

Select From Favorites Add To Favorites Use Average Position

Antenna Height

From station file: TRM55971.00 View STA File

Antenna profile: TRM57971.00 Info

Measured height: 1.800 m

ARP to L1 offset: 0.067 m

Applied height: 1.867 m

Measured to

☒ ARP

☐ L1 Phase Centre

Compute From Slant

OK Cancel

Coordinate/Antenna Settings ? X

Master Remote

Base Station
 2: UTAH16_36 Name: UTAH16_36 ☐ Disabled
 File: E:\Proc\29083_UTAH\From_Lara_Heitmeyer_1-26-17\Survey_Da

Coordinates
 Latitude: North 37 06 30.25986 Compute from PPP
 Longitude: West 113 29 48.66465 Enter Grid Values
 Ellipsoidal height: 783.396 m Enter MSL Height
 Datum: WGS84 Datum Options
 Select From Favorites Add To Favorites Use Average Position

Antenna Height
 From station file: TRM55971.00 View STA File
 Antenna profile: TRM57971.00 Info
 Measured height: 1.800 m
 ARP to L1 offset: 0.067 m
 Applied height: 1.867 m

Measured to
☒ ARP
☐ L1 Phase Centre
 Compute From Slant

OK Cancel

Flight Log

Date: 1/10/2017	Aircraft: N604MD	Sensor: 8239
Project: Utah 2016 LiDAR		Project #: R029083
Flight Mgmt File: FMSL_Utah_WACounty_SN8239		
Pilot: Bob Cale		Sensor Operator: Charlie Oncea

	Flight 1	Flight 2	Flight 3	Flight 4
Wheels Up	9:17:00 AM			
Wheels Down	2:18:00 AM			
Begin Hobbs	11975.2			
End Hobbs	11980.1			
On-line Hobbs: 4.1		Mob Hobbs: 0.8		

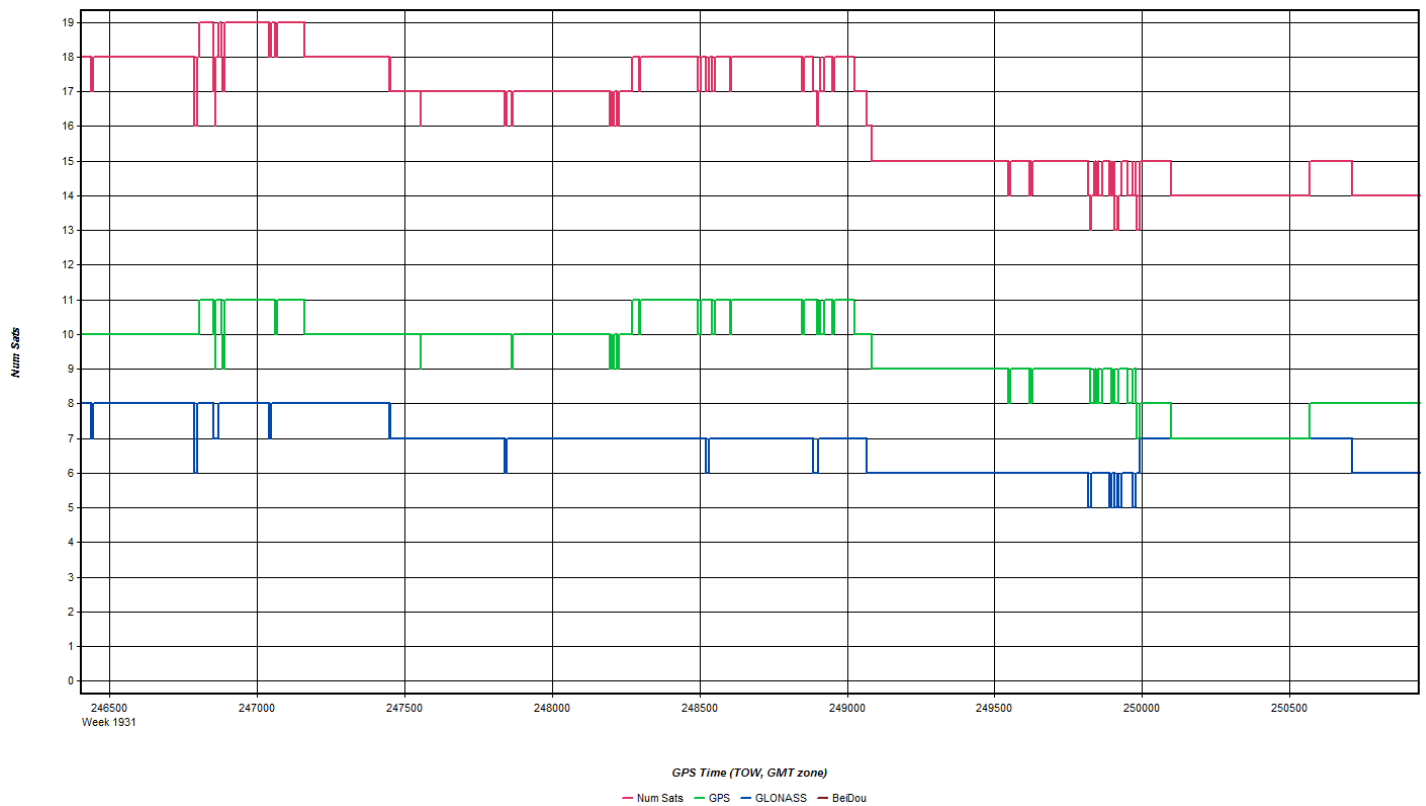
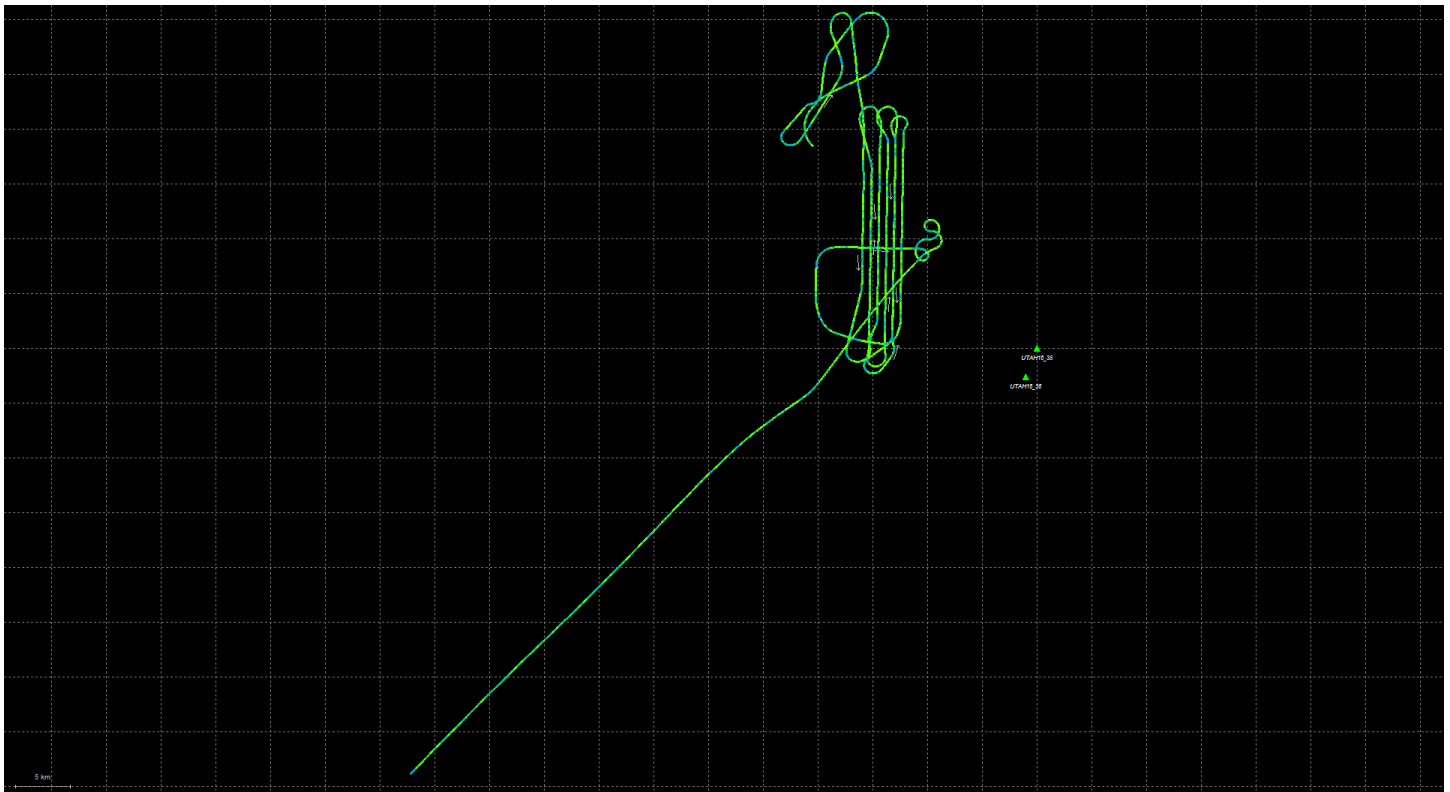
Notes

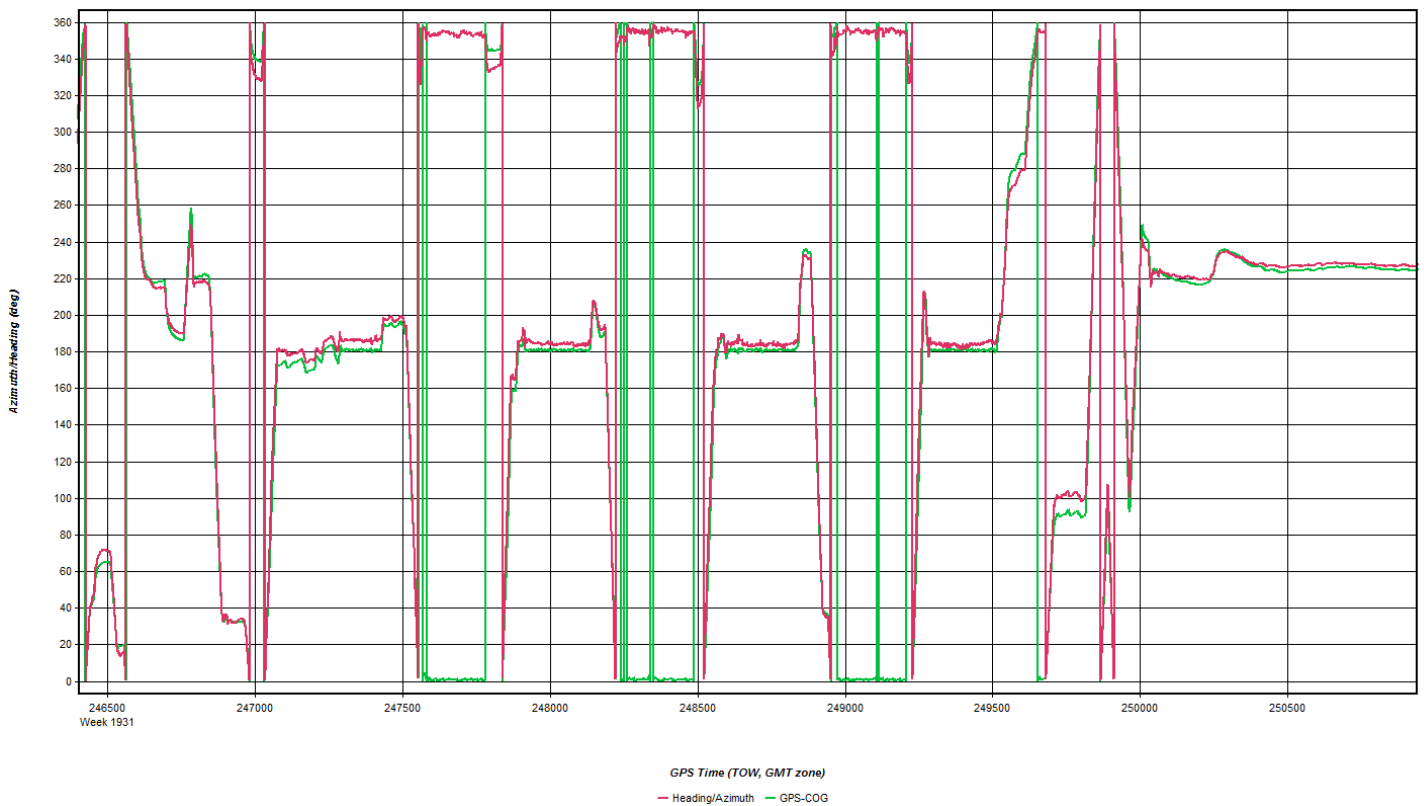
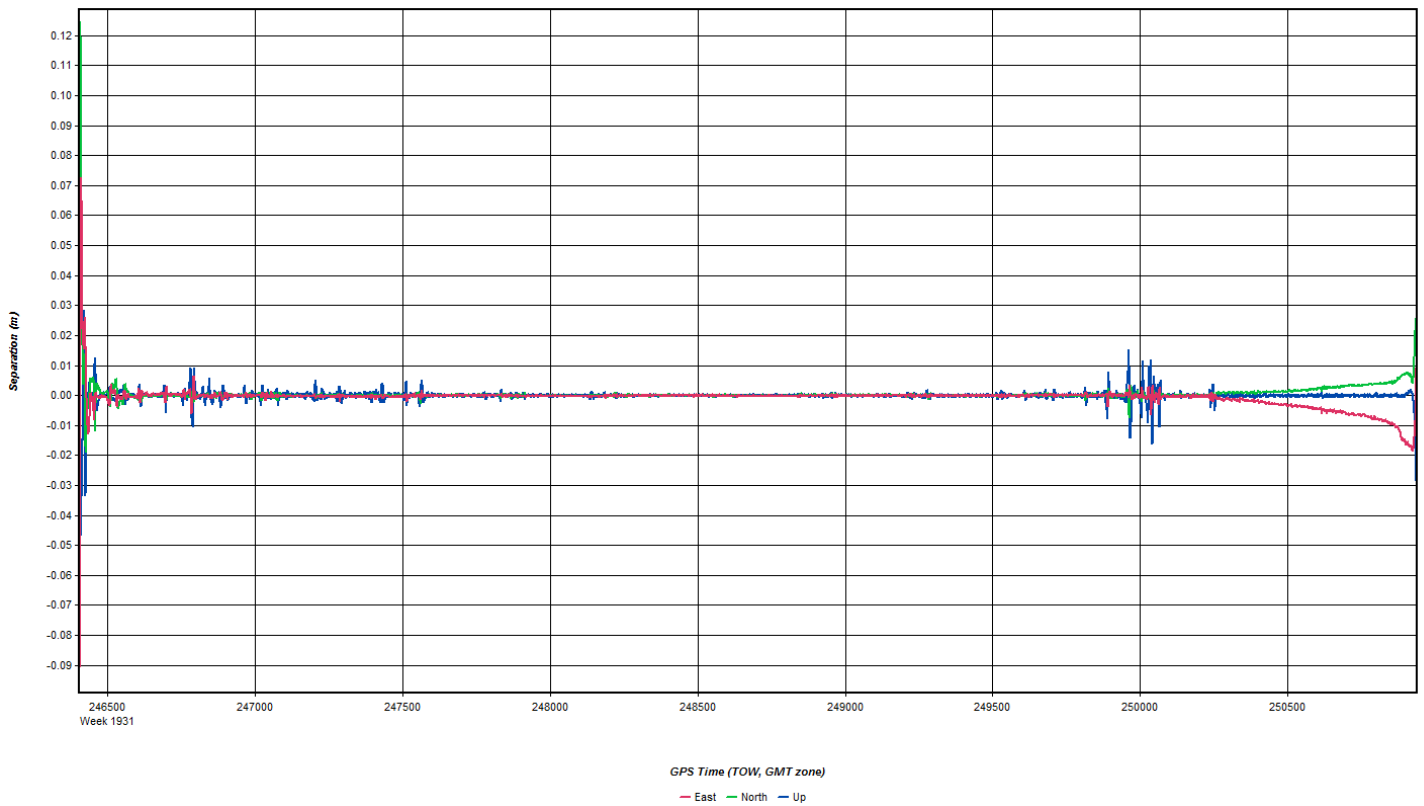
Finally got a chance at a good flight, cut it a bit short due to turbulence. Some snow scouting, a few areas still have snow but melting fast. No WA county DEM available, still waiting on it for INS2KML processing

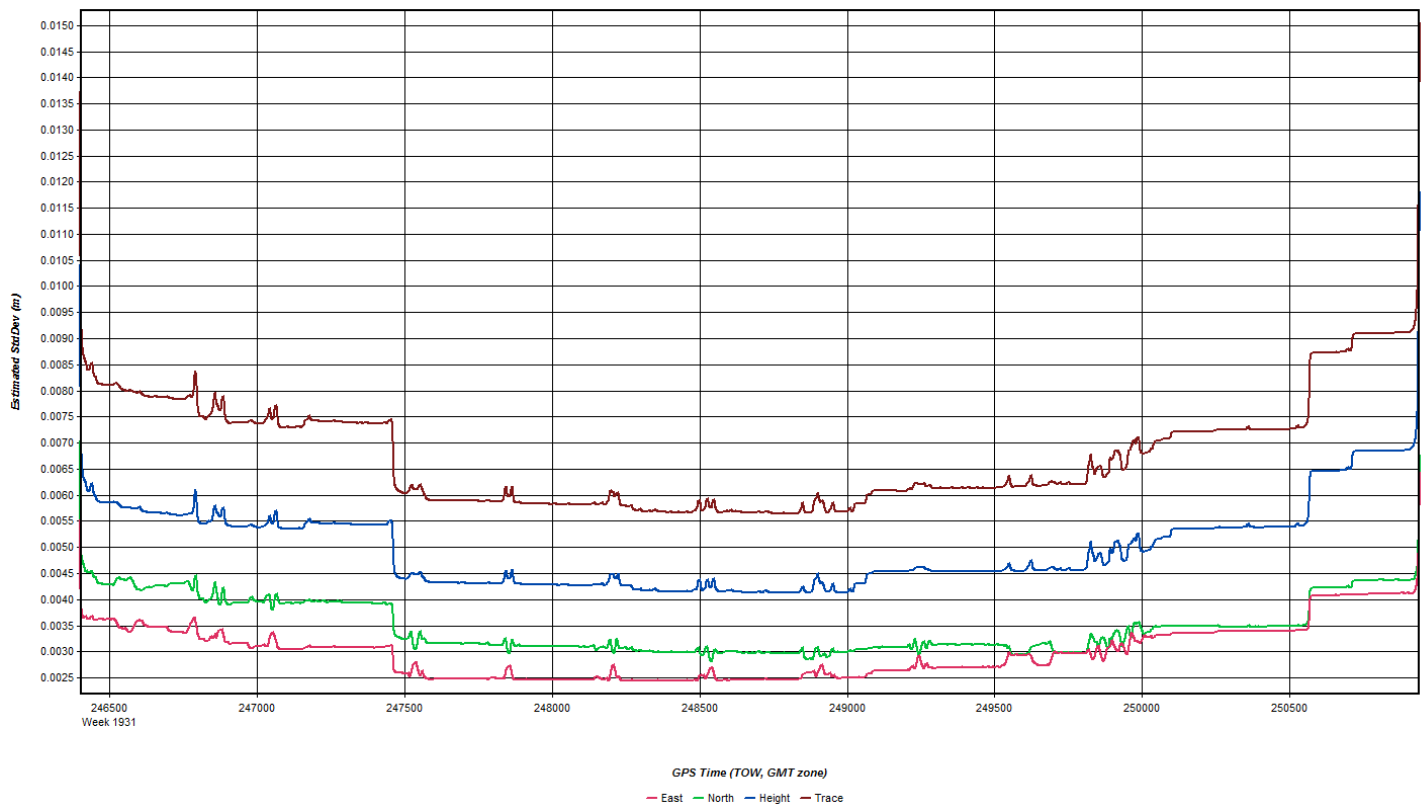
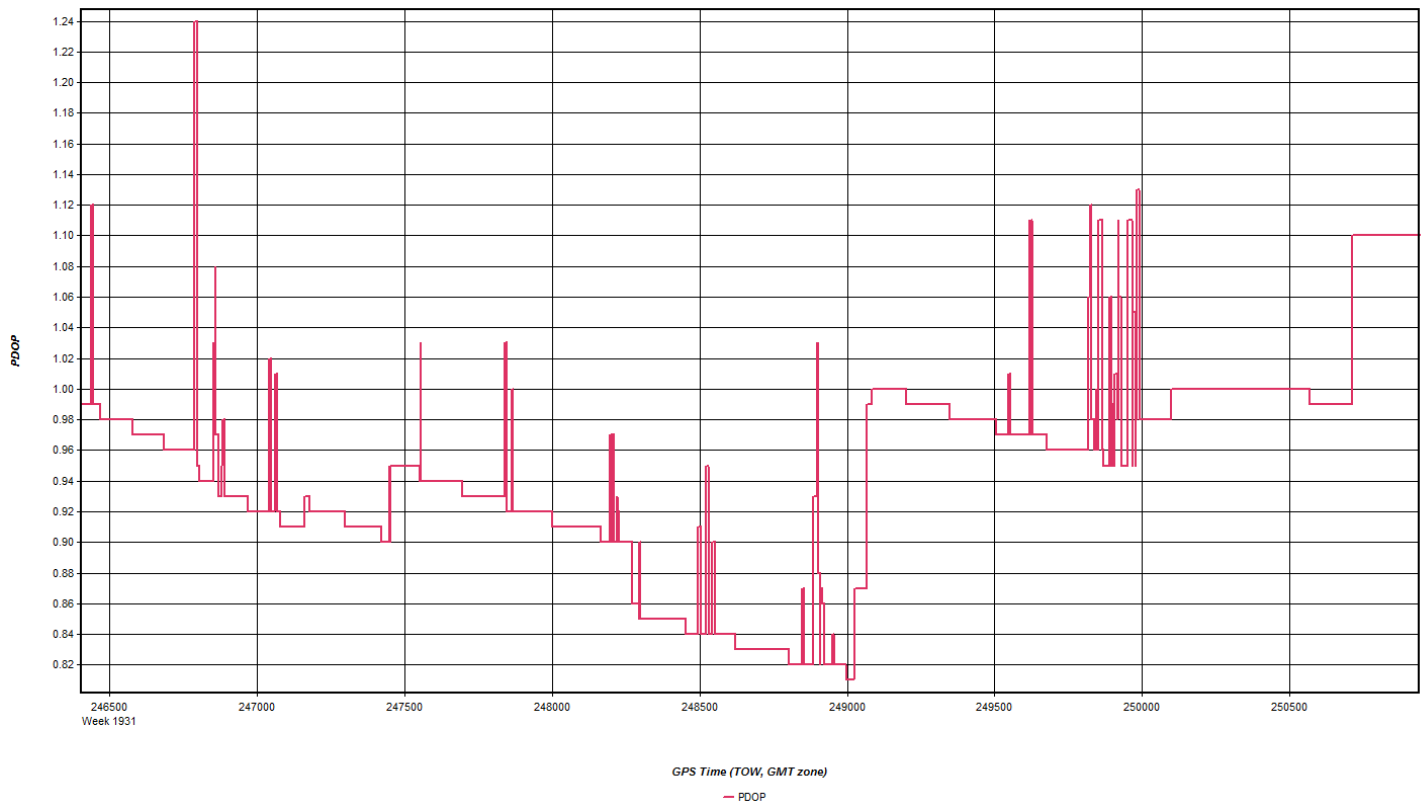
Flt Mgmt File: FMSL_Utah_WACounty_SN8239

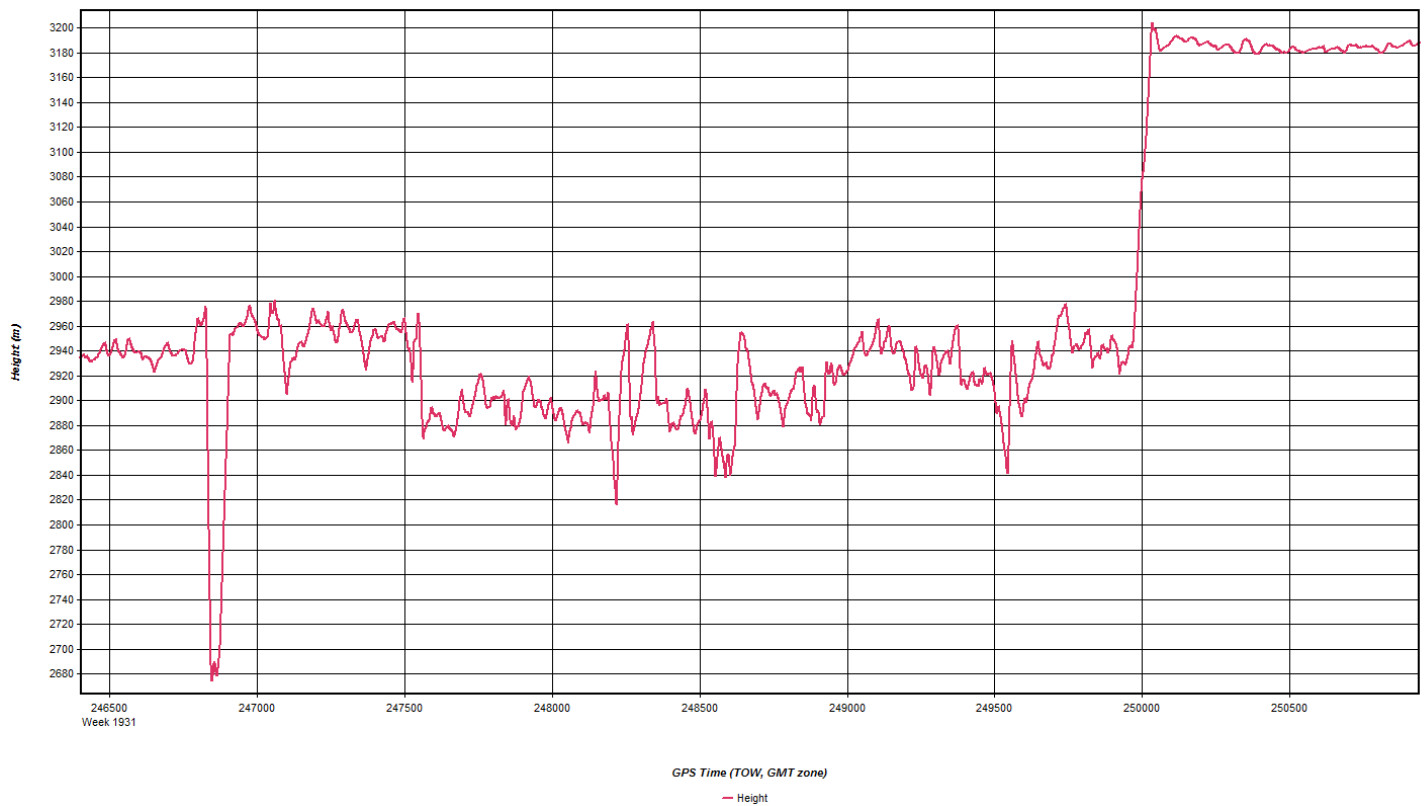
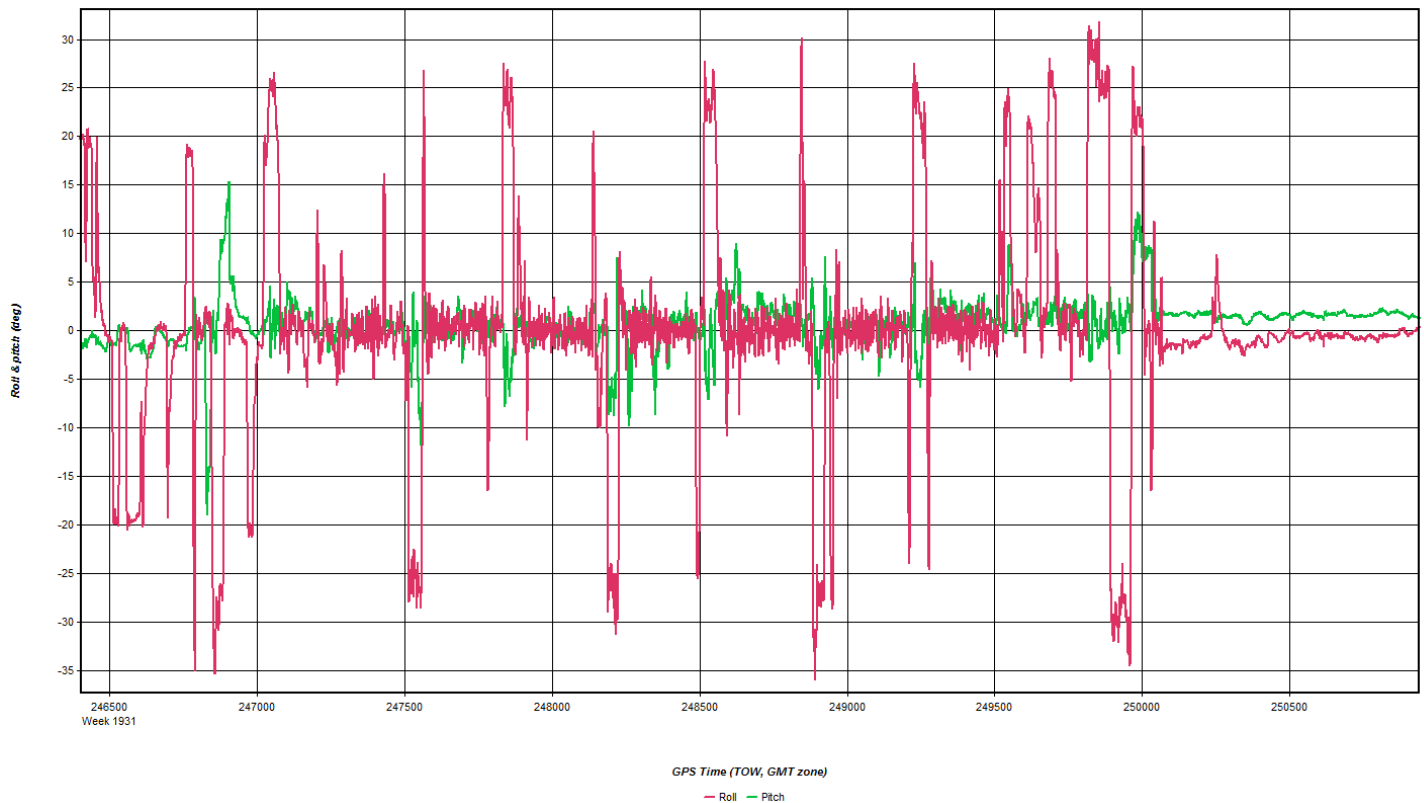
129	5:35:01 PM	1657.807007	5:36:33 PM
128	5:38:37 PM	2053.199463	5:40:03 PM
127	5:42:16 PM	1663.133789	5:43:44 PM
14	5:47:39 PM	1725.480713	5:49:24 PM
14	5:53:17 PM	1504.791748	6:01:57 PM
13	6:04:08 PM	1693.159424	6:12:50 PM
12	6:15:34 PM	1519.195557	6:25:21 PM
11	6:27:28 PM	1823.555664	6:37:13 PM
10	6:39:29 PM	1577.410767	6:49:23 PM
9	6:51:25 PM	1870.961914	7:01:08 PM
8	7:05:29 PM	1678.911255	7:15:18 PM
7	7:17:10 PM	1805.286377	7:26:49 PM
6	7:29:36 PM	1709.731079	7:36:05 PM
5	7:39:58 PM	1831.113159	7:44:10 PM
4	7:46:49 PM	1781.921143	7:51:03 PM
3	7:53:11 PM	1737.742798	7:57:08 PM
2	7:59:10 PM	1894.985107	8:02:23 PM
1	8:03:58 PM	1814.487915	8:04:49 PM
130	8:19:03 PM	2015.191162	8:21:11 PM
UL002	8:08:37 PM	2005.675415	8:12:11 PM

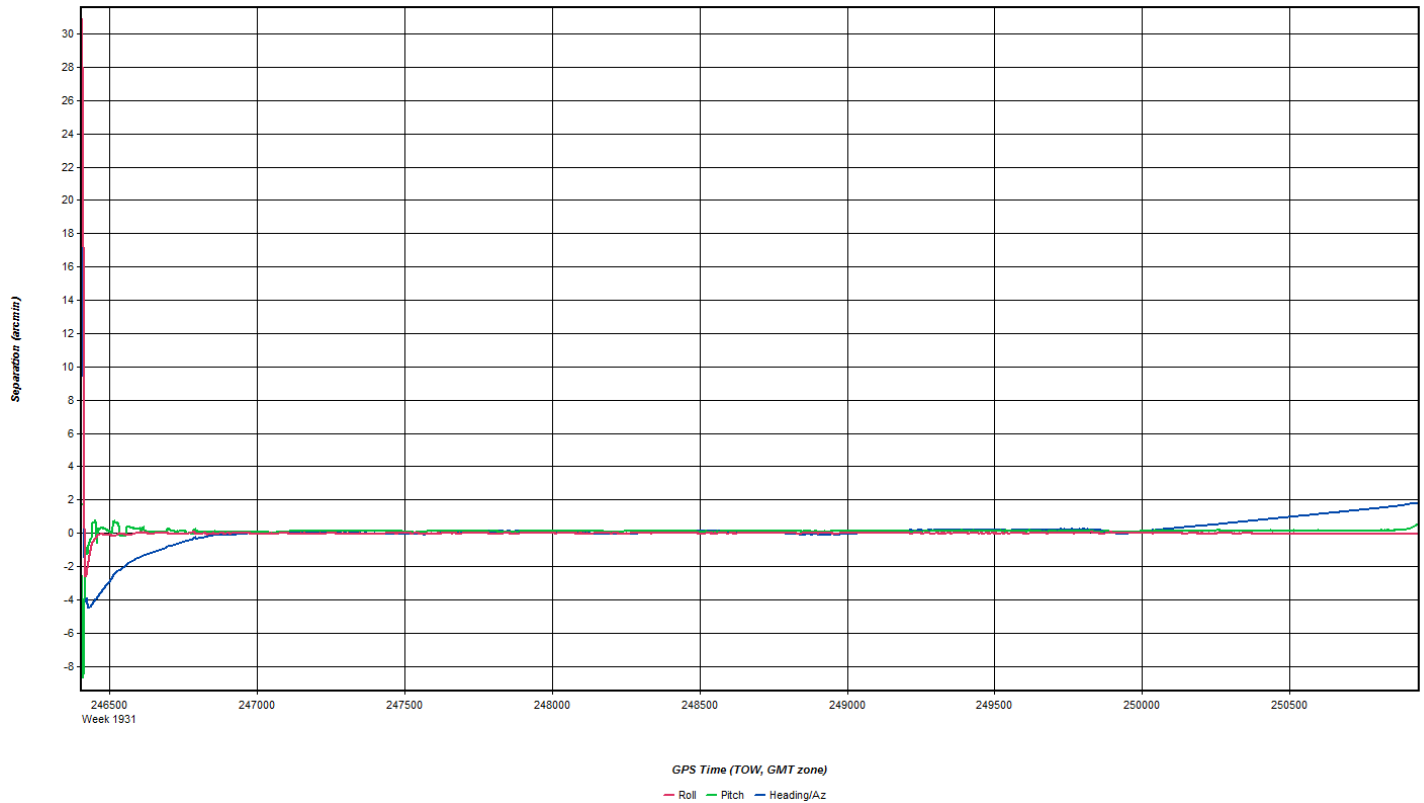
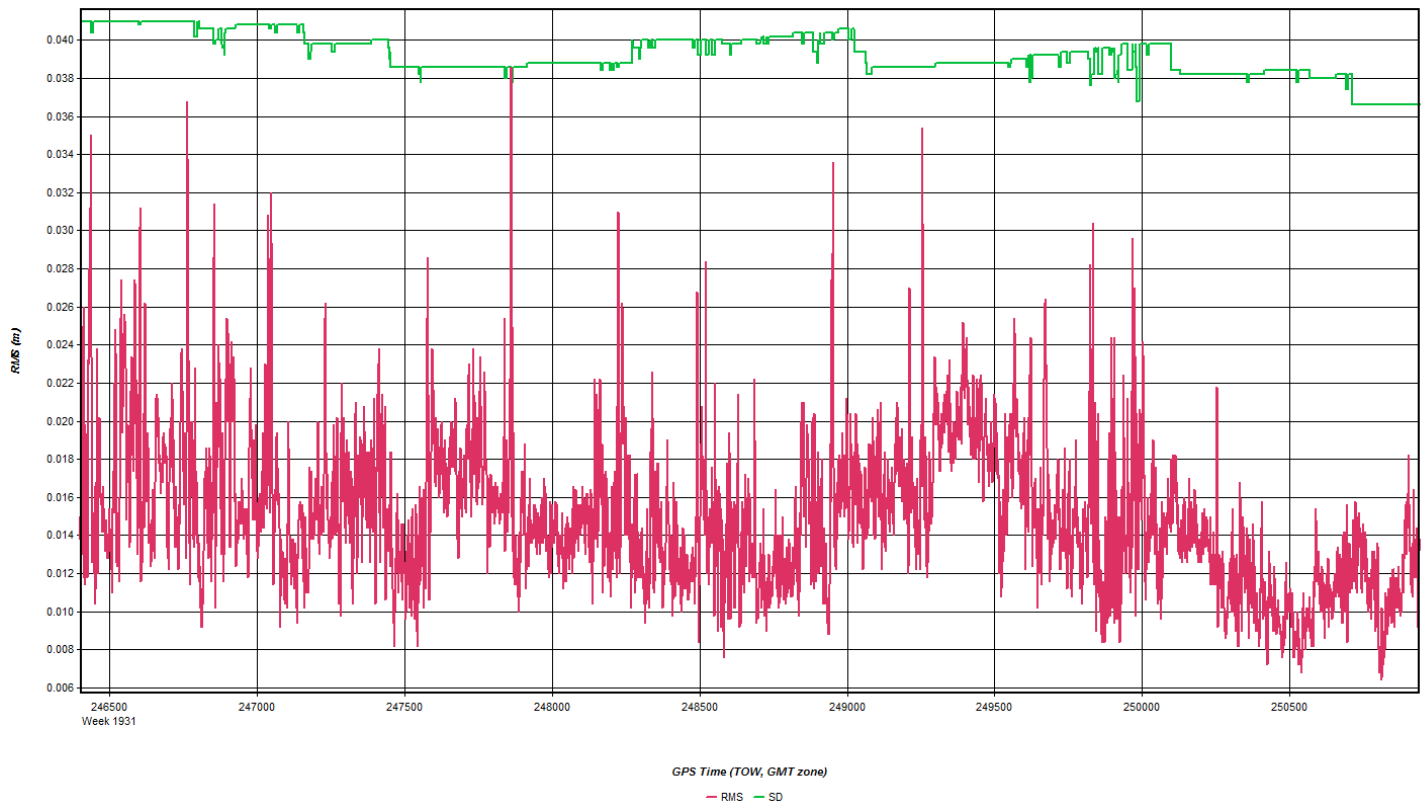
Jan 10, 2017-B (N604MD, SN8239)

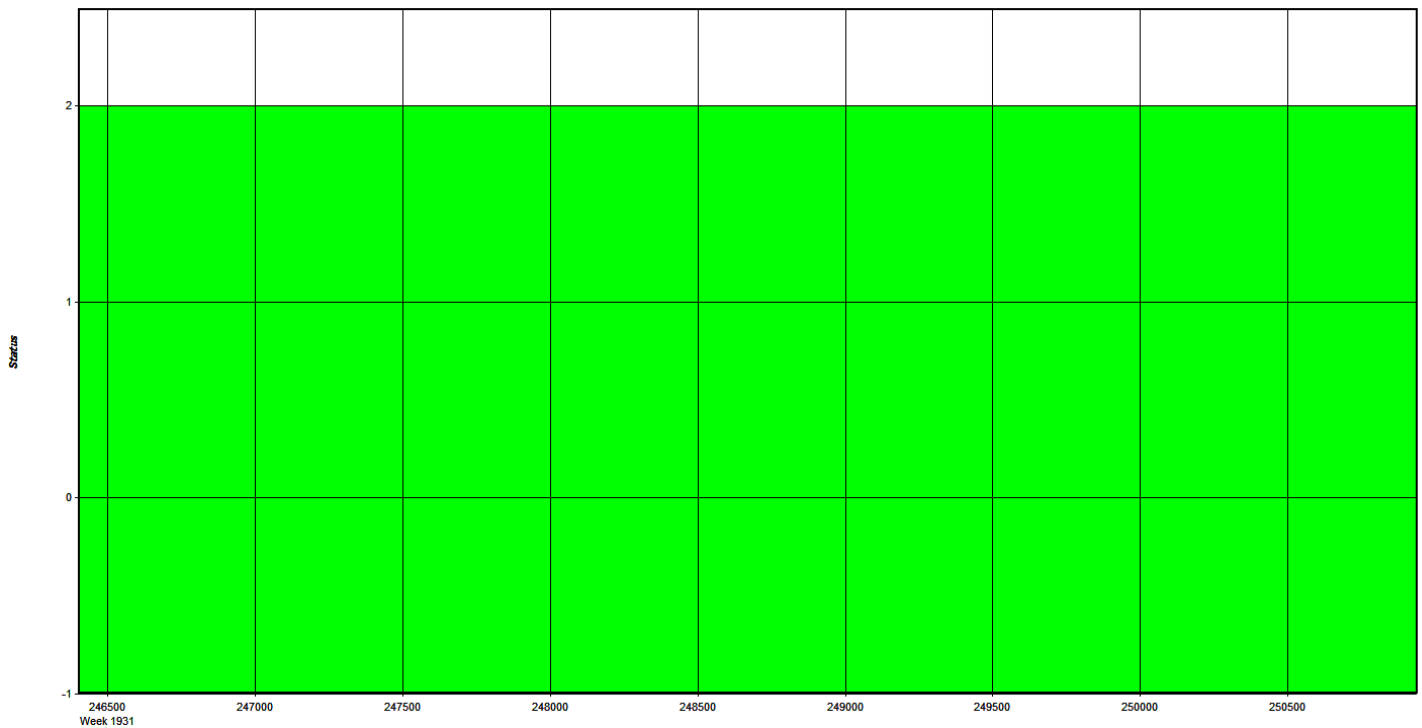












GPS Time (TOW, GMT zone)

— Float — Forward Fixed — Reverse Fixed — Fixed (2 or more)

Coordinate/Antenna Settings

?

×

Master

Remote

Base Station

1: UTAH16_35

Name: UTAH16_35

☐ Disabled

File: E:\Proc\29083_UTAH\From_Lara_Heitmeyer_1-26-17\Survey_Da

Coordinates

Latitude: North 37 07 53.89287

Longitude: West 113 29 06.63661

Ellipsoidal height: 838.881 m

Datum: WGS84

Compute from PPP

Enter Grid Values

Enter MSL Height

Datum Options

Select From Favorites

Add To Favorites

Use Average Position

Antenna Height

From station file: TRM55971.00

Antenna profile: TRM57971.00

Measured height: 1.800 m

ARP to L1 offset: 0.067 m

Applied height: 1.867 m

View STA File

Info

Measured to

☒ ARP

☐ L1 Phase Centre

Compute From Slant

OK

Cancel

Coordinate/Antenna Settings ? X

Master Remote

Base Station
 2: UTAH16_36 Name: UTAH16_36 ☐ Disabled
 File: E:\Proc\29083_UTAH\From_Lara_Heitmeyer_1-26-17\Survey_Da

Coordinates
 Latitude: North 37 06 30.25986 Compute from PPP
 Longitude: West 113 29 48.66465 Enter Grid Values
 Ellipsoidal height: 783.396 m Enter MSL Height
 Datum: WGS84 Datum Options
 Select From Favorites Add To Favorites Use Average Position

Antenna Height
 From station file: TRM55971.00 View STA File
 Antenna profile: TRM55971.00 Info
 Measured height: 1.800 m
 ARP to L1 offset: 0.067 m
 Applied height: 1.867 m

Measured to
☒ ARP
☐ L1 Phase Centre
 Compute From Slant

OK Cancel

Flight Log

Date: 1/10/2017	Aircraft: N604MD	Sensor: 8239
Project: Utah 2016 LiDAR		Project #: R029083
Flight Mgmt File: FMSL_Utah_WACounty_SN8239		
Pilot: Bob Cale		Sensor Operator: Charlie Oncea

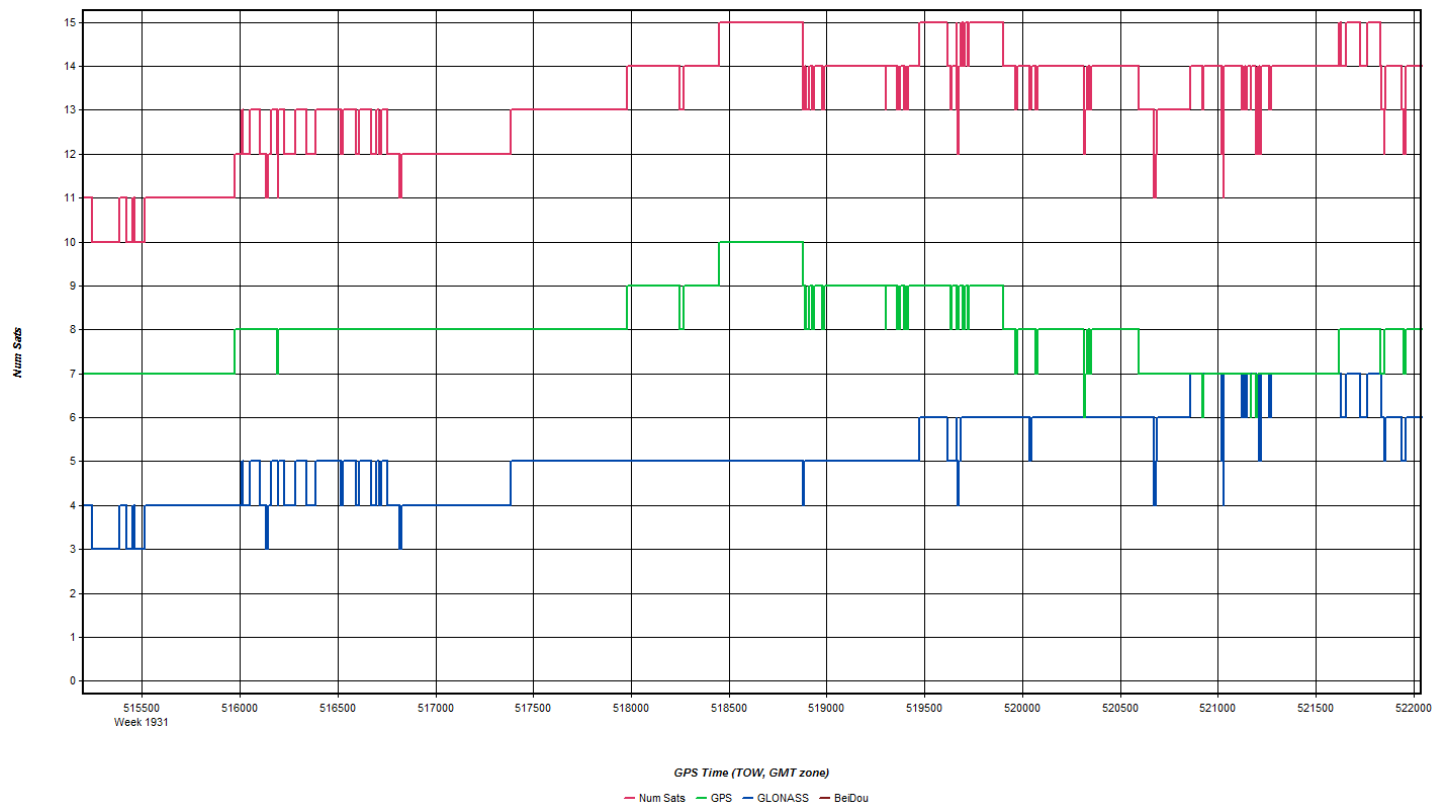
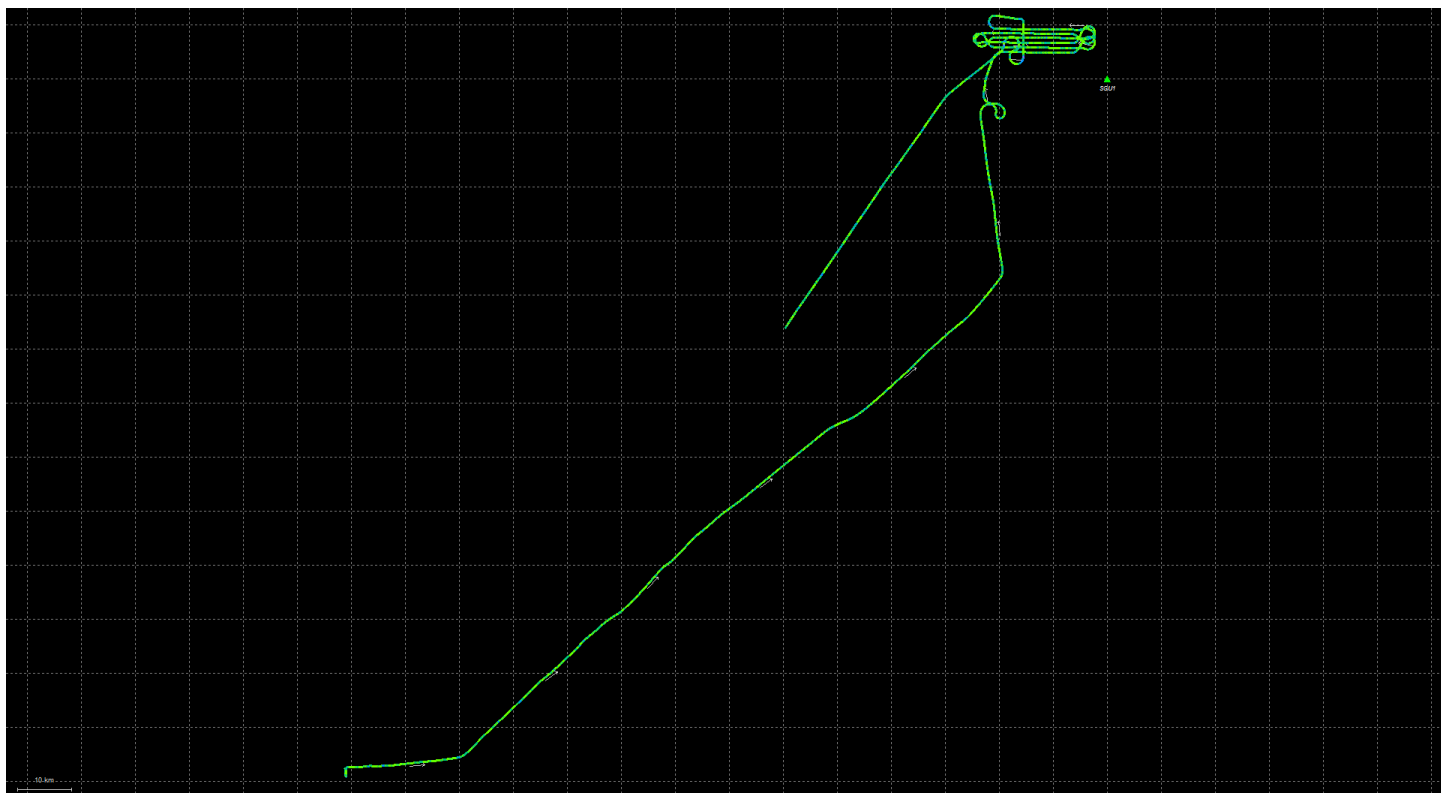
	Flight 1	Flight 2	Flight 3	Flight 4
Wheels Up				
Wheels Down				
Begin Hobbs				
End Hobbs				
On-line Hobbs:		Mob Hobbs:		

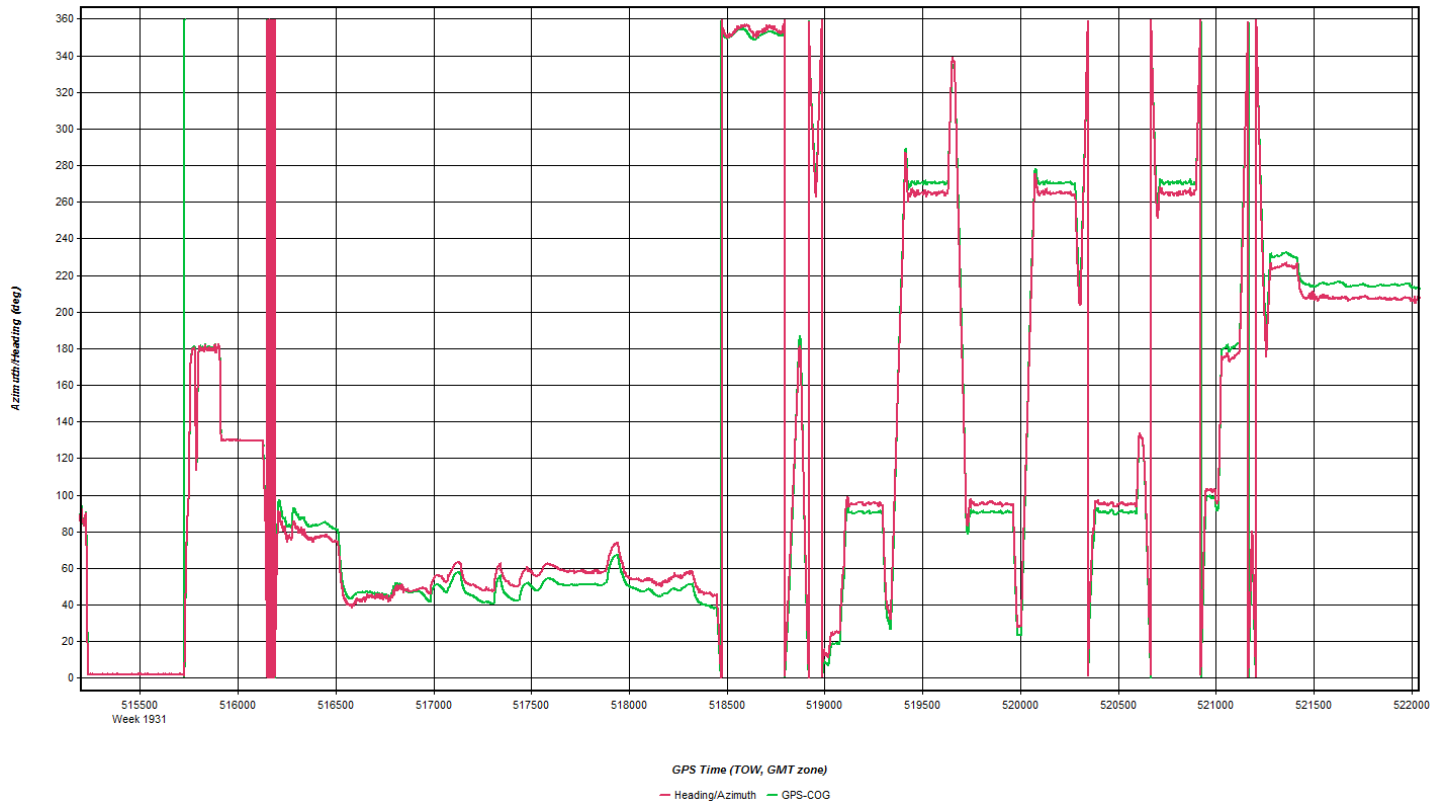
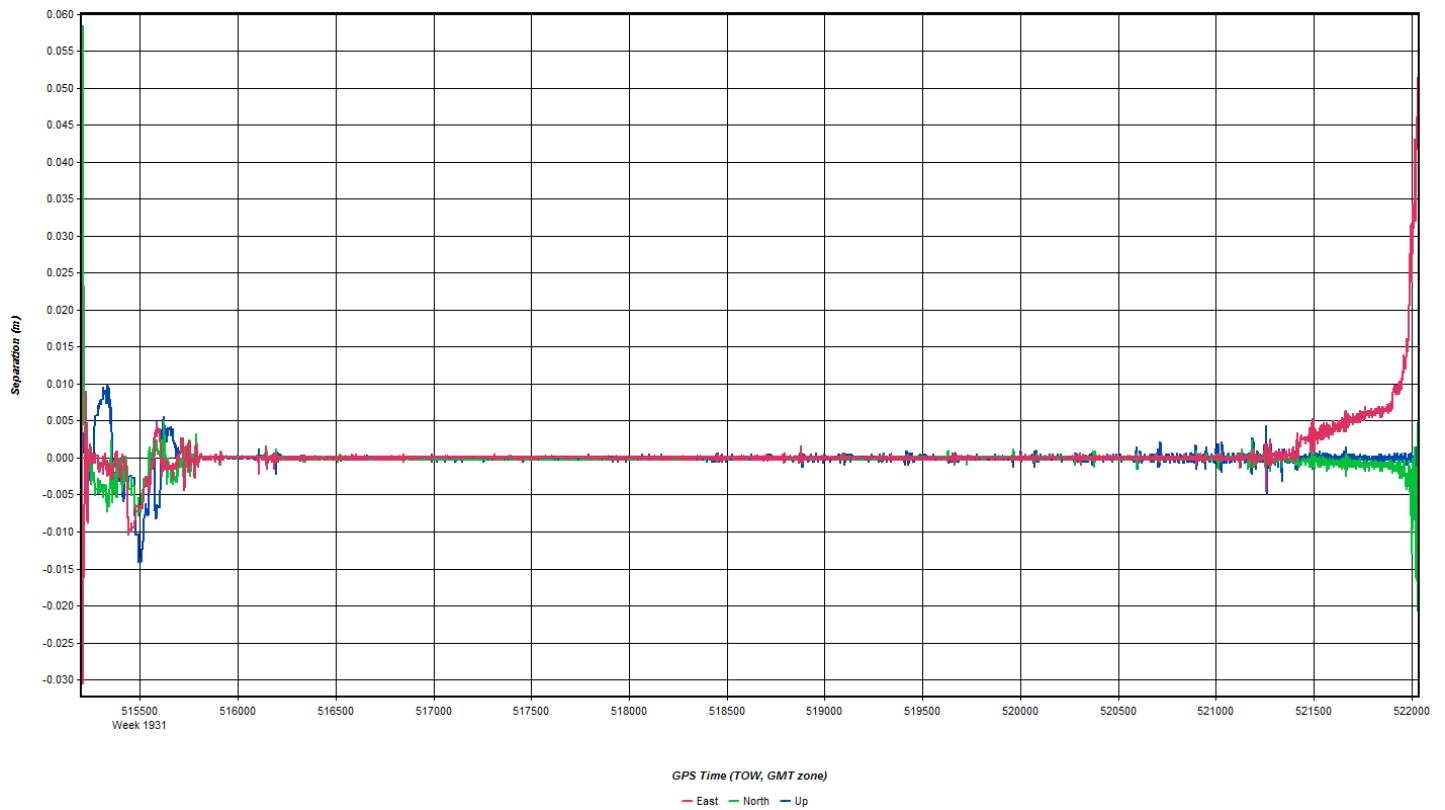
Notes

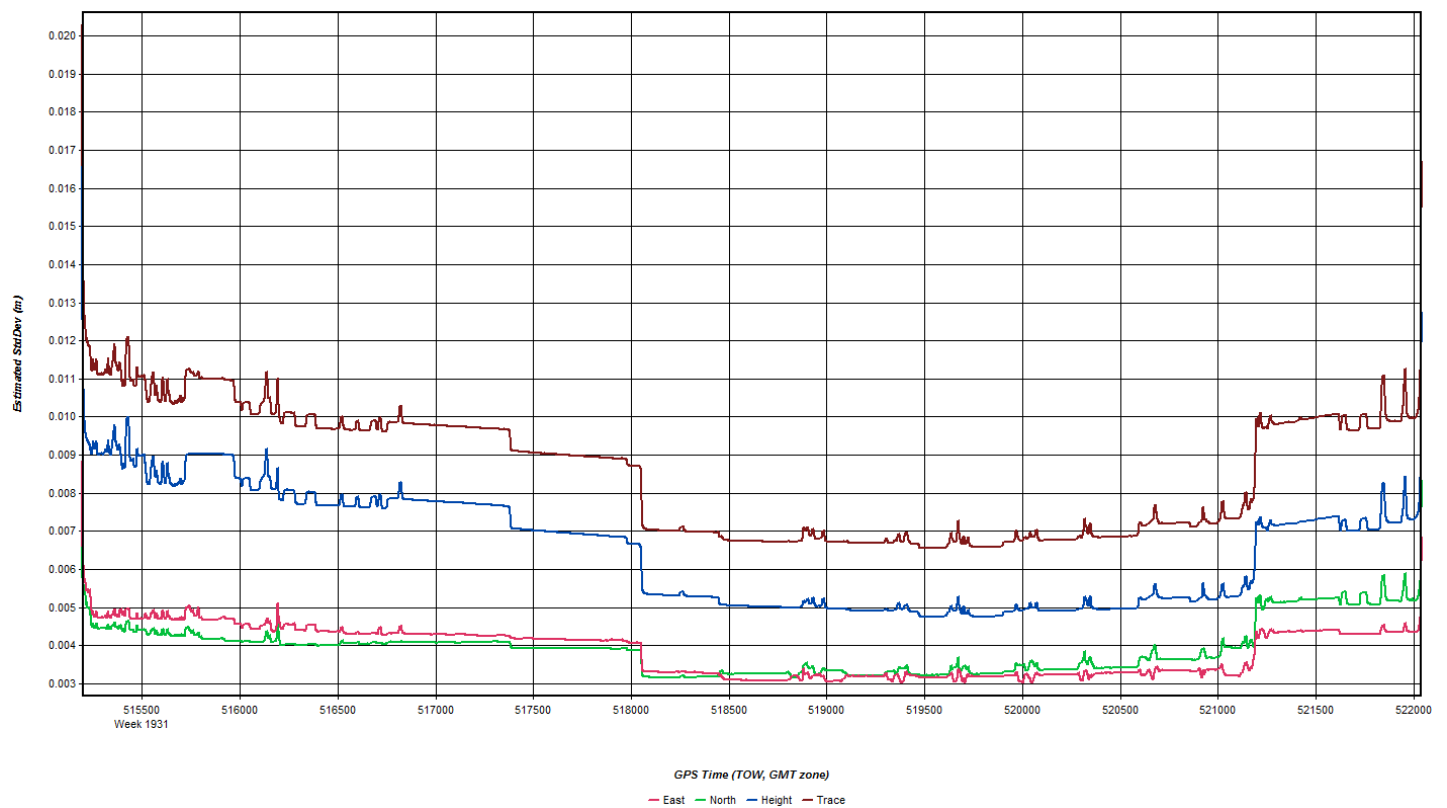
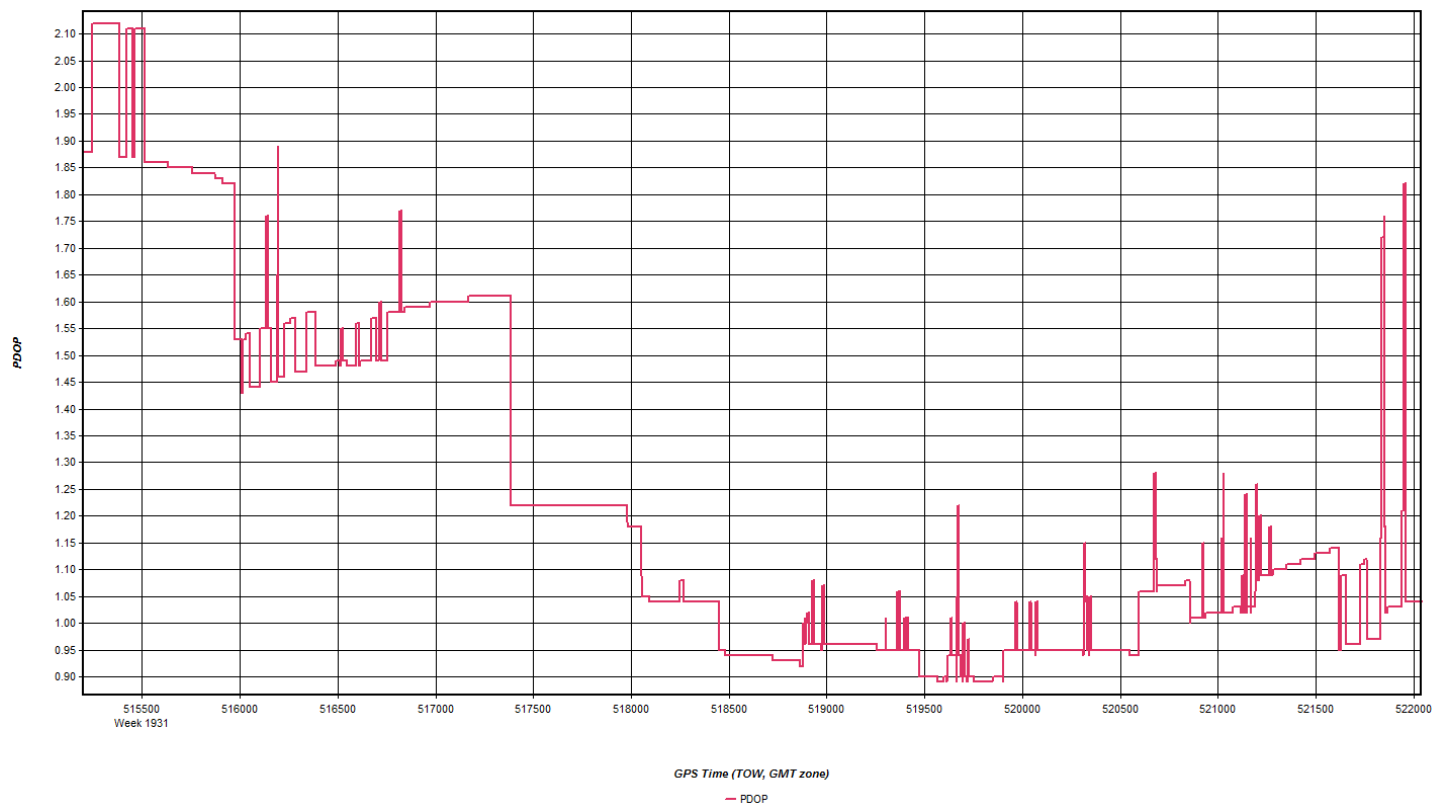
Flt Mgmt File: FMSL_Utah_WACounty_SN8239

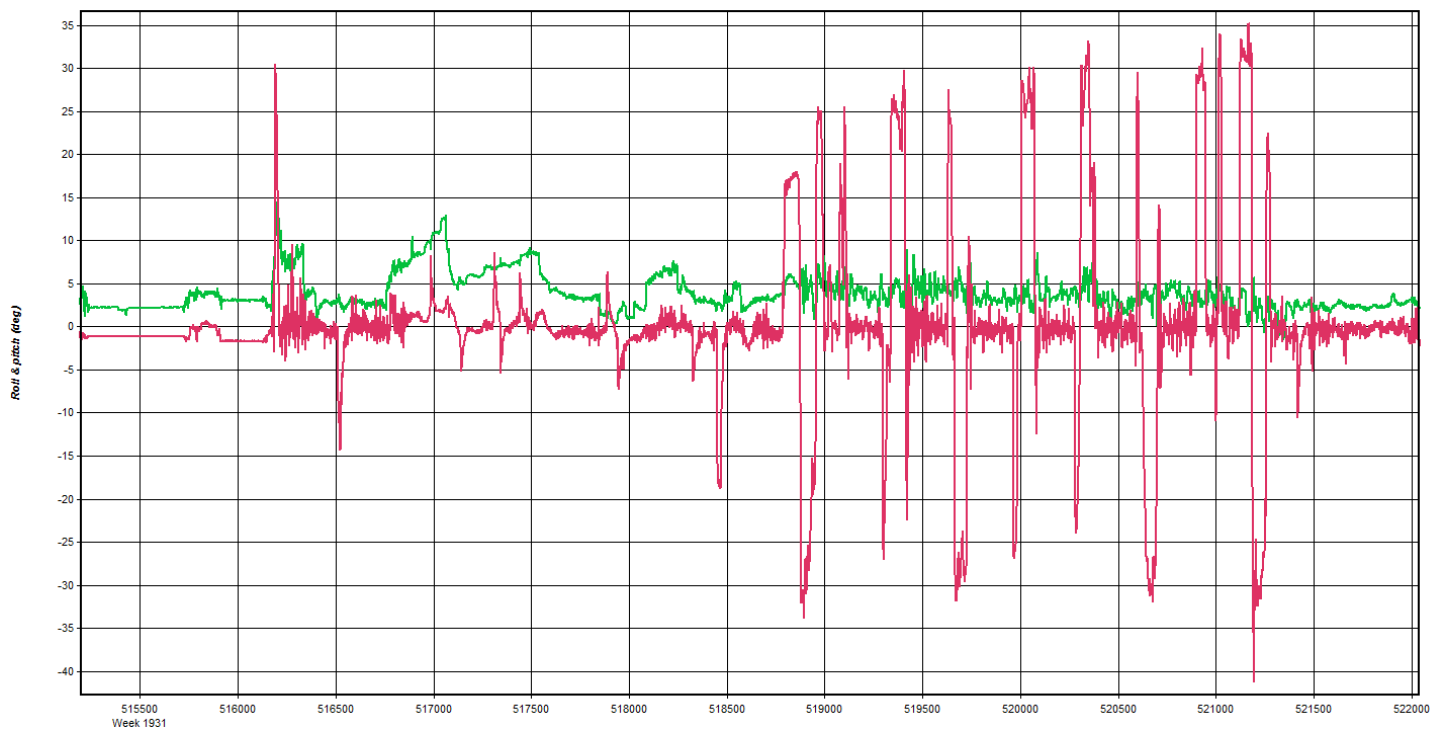
130	8:43:33 PM	1496.664673	8:41:18 PM
131	8:49:23 PM	2047.178955	8:46:14 PM
132	8:55:22 PM	1456.033813	8:51:45 PM
133	9:01:13 PM	2085.202637	8:57:29 PM
134	9:06:47 PM	1395.109375	9:03:00 PM
134	9:13:10 PM	2079.142334	9:09:29 PM
135	9:18:18 PM	1395.893311	9:14:34 PM
UL003	9:23:16 PM	1937.08374	9:22:14 PM

Jan 13, 2017-A (N604MD, SN8239)



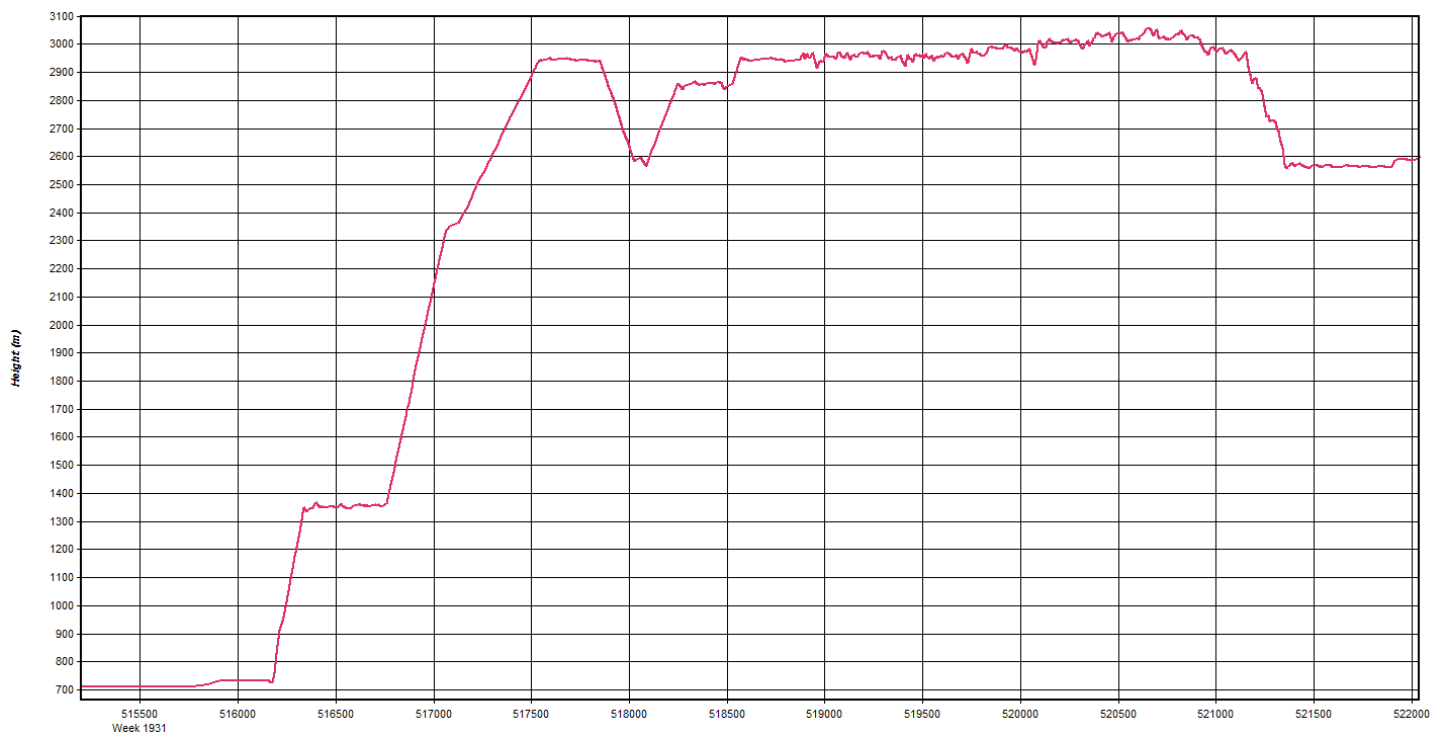






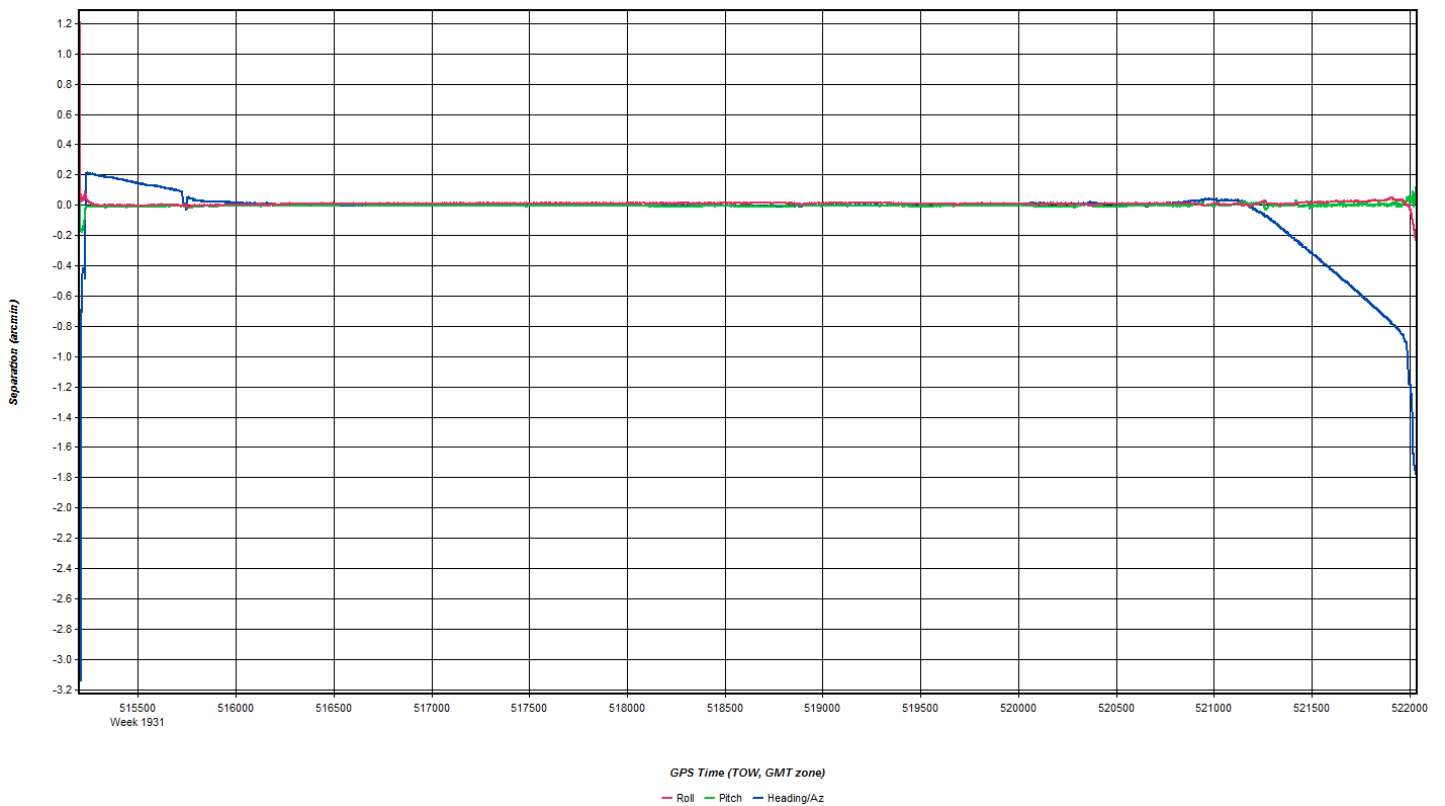
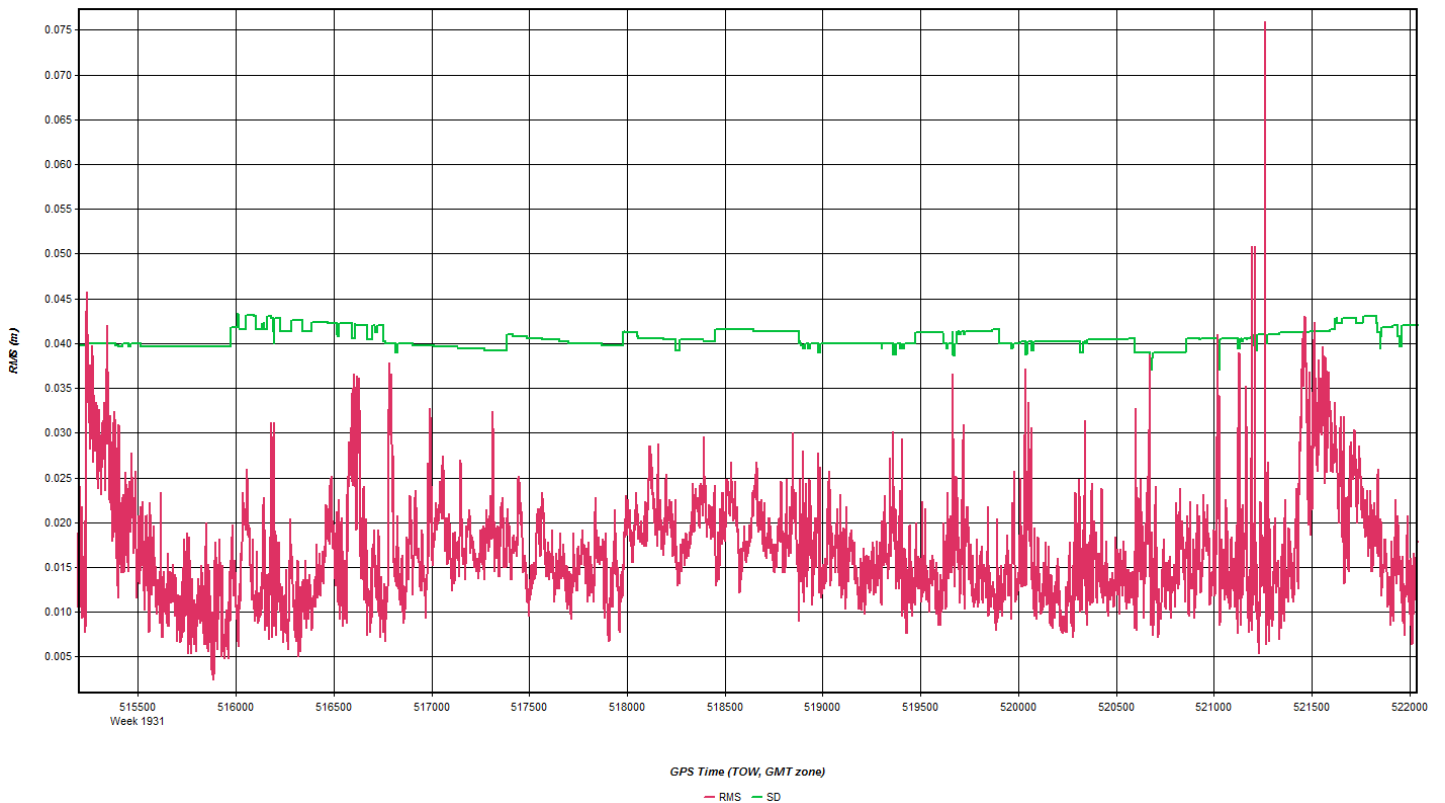
GPS Time (TOW, GMT zone)

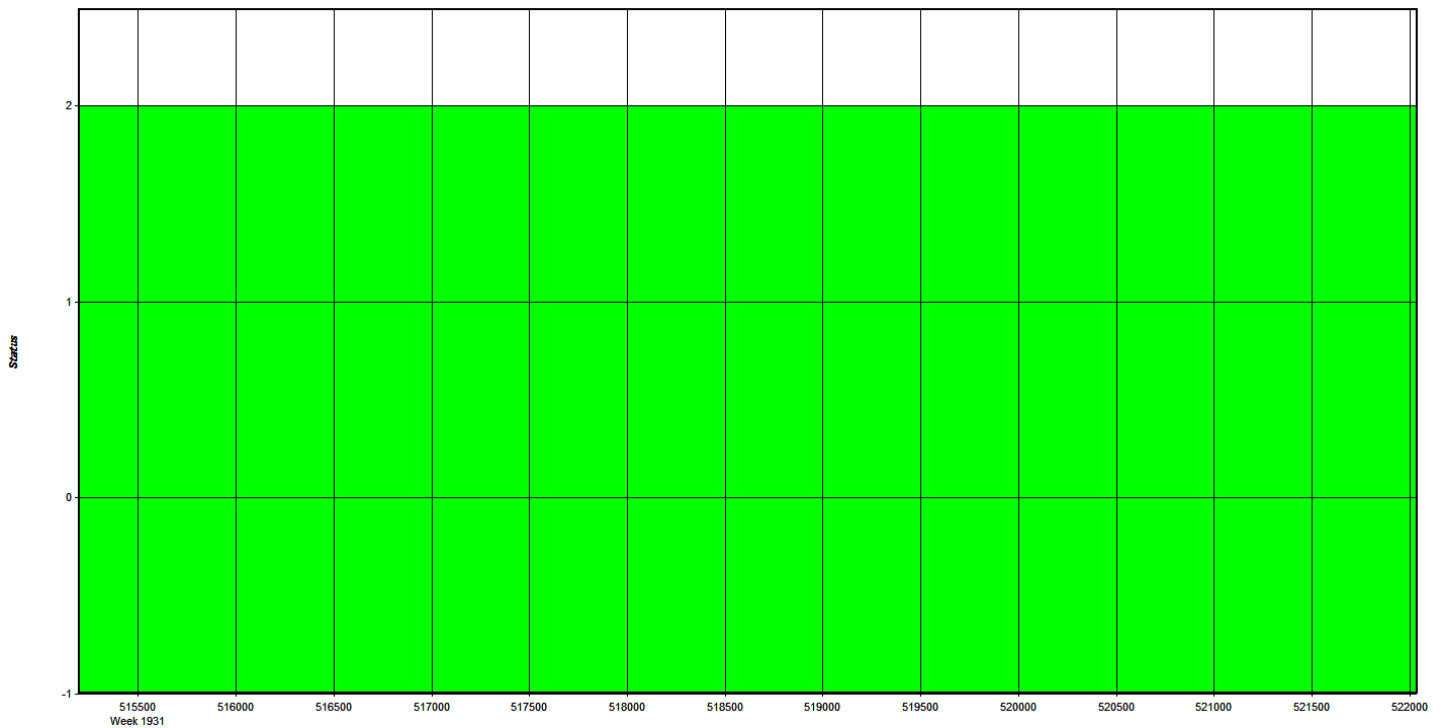
Roll Pitch



GPS Time (TOW, GMT zone)

Height





Coordinate/Antenna Settings

Master Remote

Base Station

1: SGU1 Name: SGU1 ☐ Disabled

File: E:\Proc\29083_UTAH\From_Lara_Heitmeyer_1-26-17\Survey_Da

Coordinates

Latitude: North 37 06 47.48170 Compute from PPP

Longitude: West 113 34 13.02341 Enter Grid Values

Ellipsoidal height: 895.579 m Enter MSL Height

Datum: WGS84 Datum Options

Select From Favorites Add To Favorites Use Average Position

Antenna Height

From station file: ASH701945E_M, SNOW View STA File

Antenna profile: ASH701945E_M, SNOW Info

Measured height: 0.000 m

ARP to L1 offset: 0.090 m

Applied height: 0.090 m

Measured to

☒ ARP

☐ L1 Phase Centre

Compute From Slant

OK Cancel

Flight Log

Date: 1/13/2017	Aircraft: N604MD	Sensor: 8239
Project: Utah 2016 LiDAR		Project #: R029083
Flight Mgmt File: FMSL_Utah_WACounty_SN8239		
Pilot: Eric Petersen		Sensor Operator: Scott White

	Flight 1	Flight 2	Flight 3	Flight 4
Wheels Up	3:21:00 PM			
Wheels Down	5:30:00 PM			
Begin Hobbs	11980.1			
End Hobbs	11982.2			
On-line Hobbs: 0.9		Mob Hobbs: 1.2		

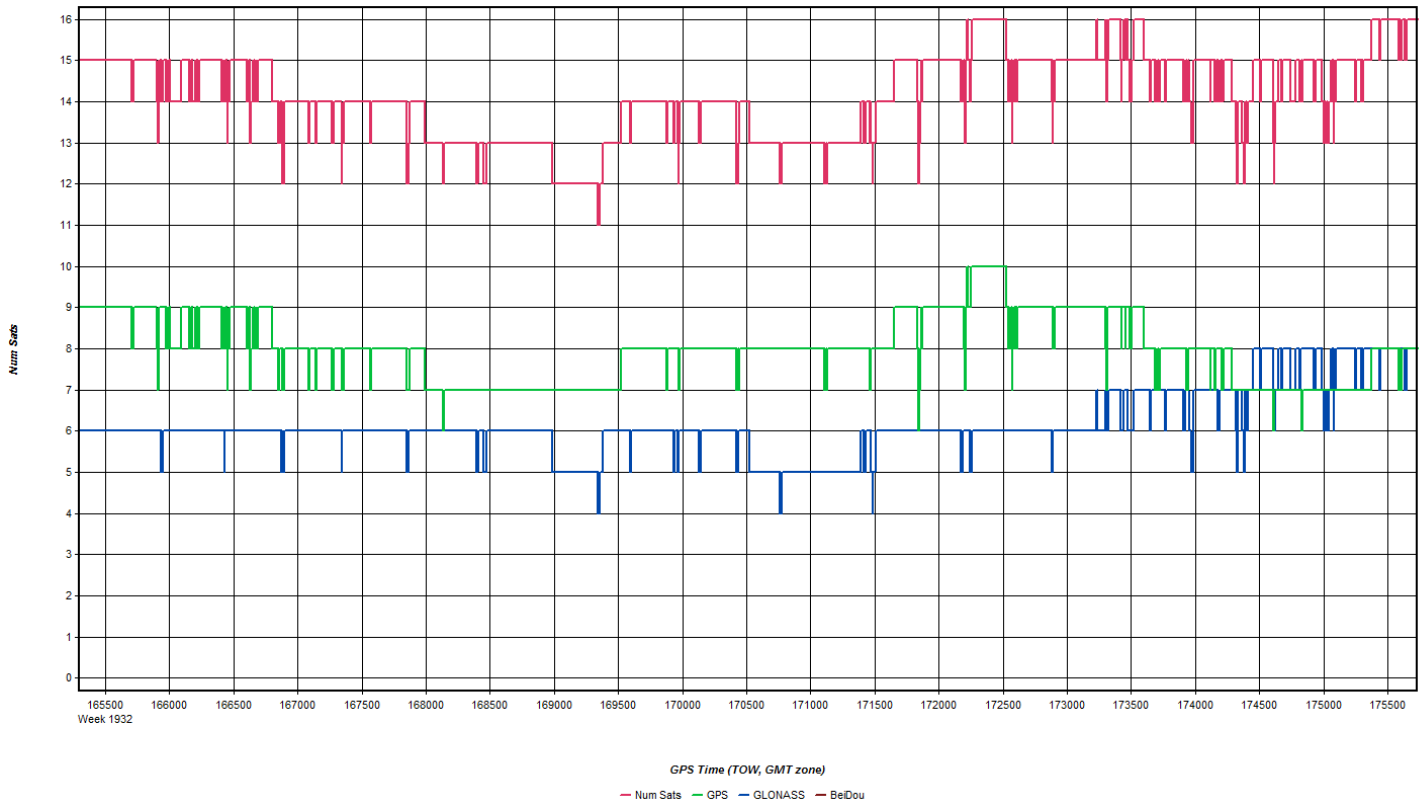
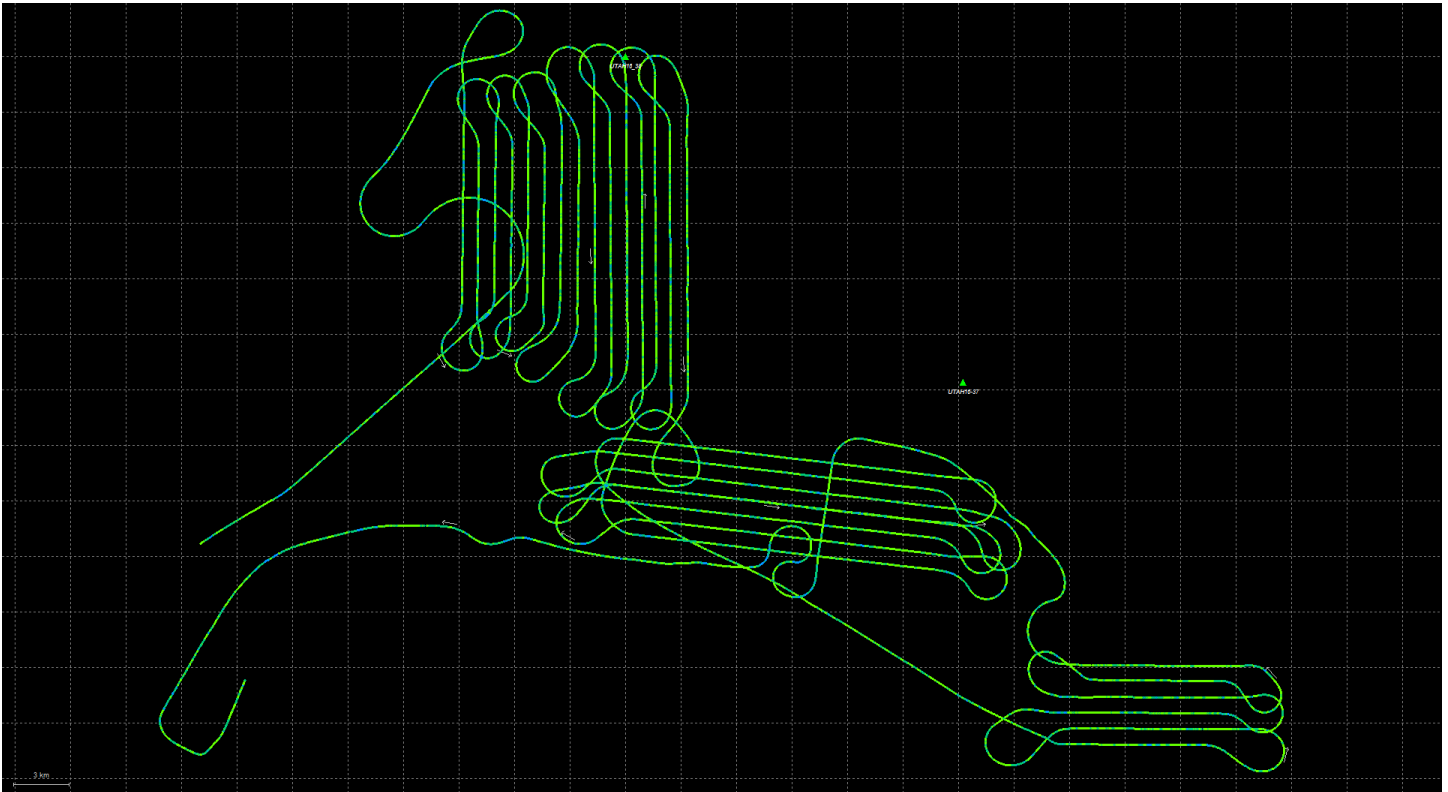
Notes

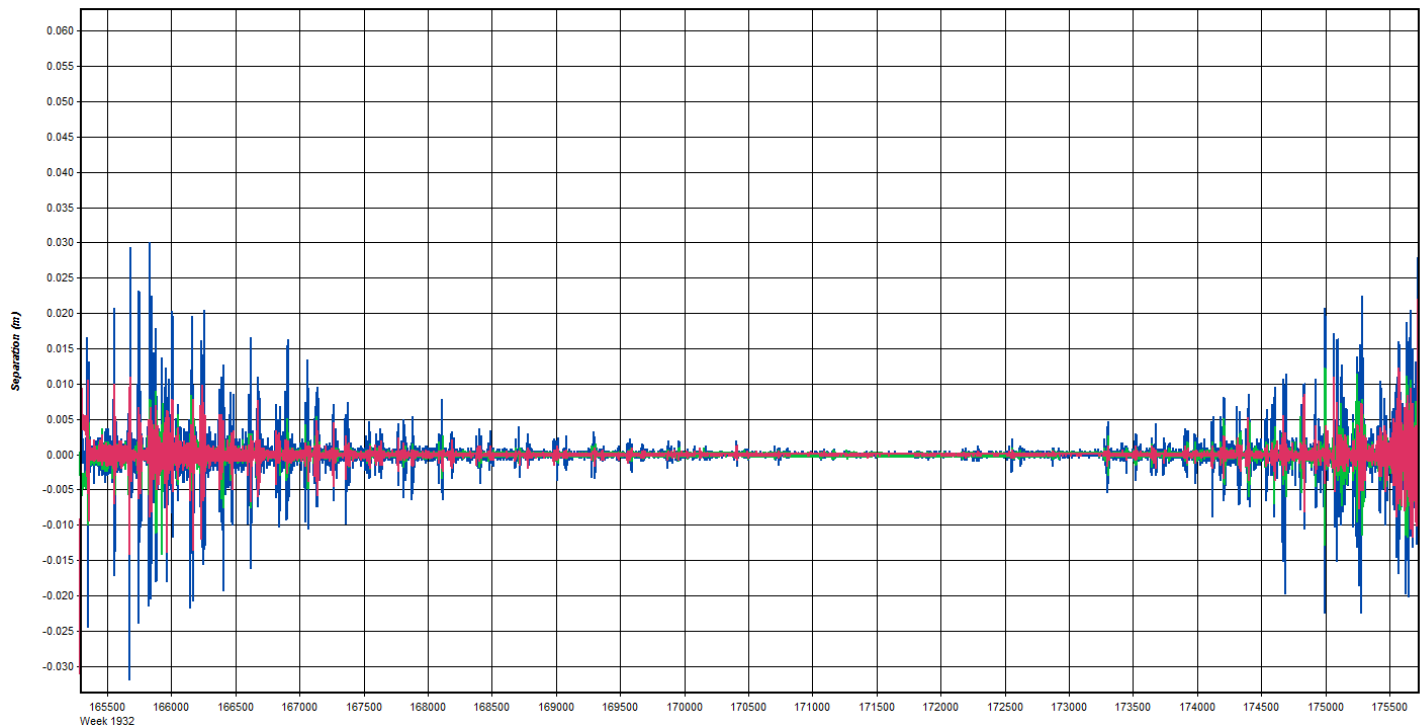
Monitored weather and waited for our opportunity to come in the afternoon. Saw some clouds clearing so we took a chance and was able to get a small block in. We wanted to get some lines in EG's base range but they were clouded out. Fortunately there were some COR's type stations that we could fly off of according to SV and was able to get a small block in thus avoiding the clouds. Heading back to KHSH in order to be in an area where LR can swap out sensors from 604MD to 208NR. After backing up the data, CloudPro wouldn't work properly, it was clipping the edges off. Will have to try to troubleshoot more tomorrow.

Flt Mgmt File: FM SL_Utah_WACounty_SN8239

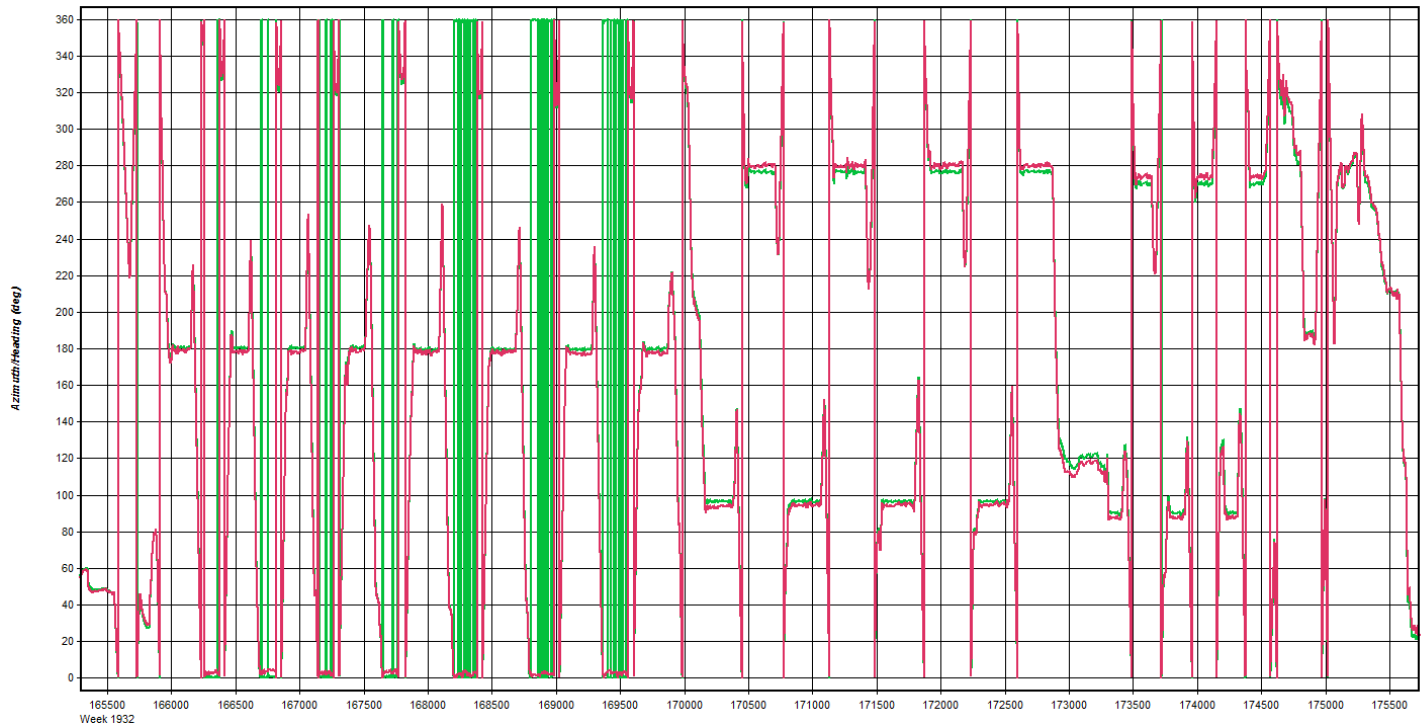
144	12:12:05 AM	1893.503906	12:14:40 AM
143	12:17:06 AM	2090.370605	12:20:11 AM
142	12:22:35 AM	1893.415161	12:25:47 AM
141	12:28:06 AM	2095.03125	12:31:03 AM
140	12:33:14 AM	1996.337769	12:36:18 AM
139	12:38:26 AM	1947.512695	12:41:22 AM
UL002	12:43:48 AM	1991.856812	12:45:06 AM

Jan 16, 2017-A (N208NR, SN8239)

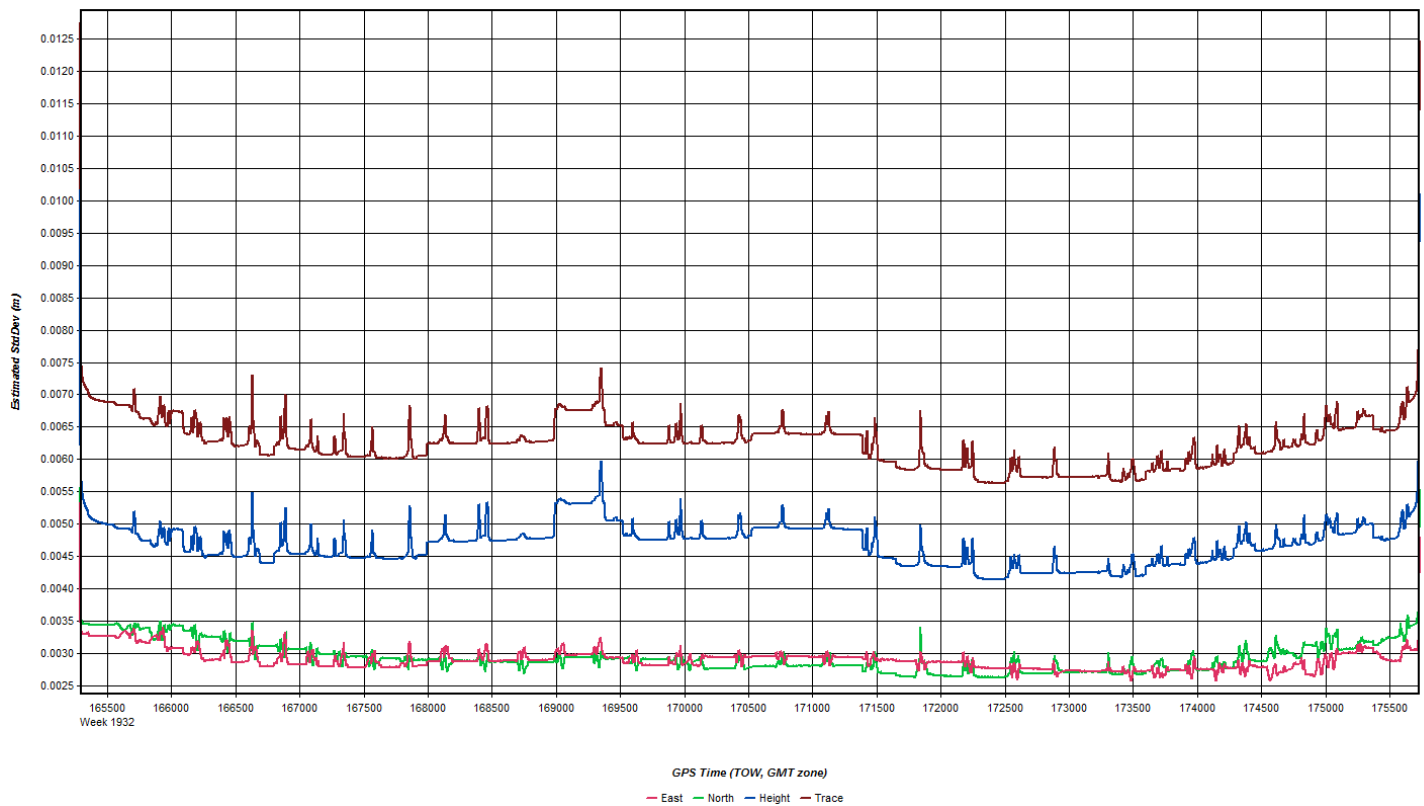
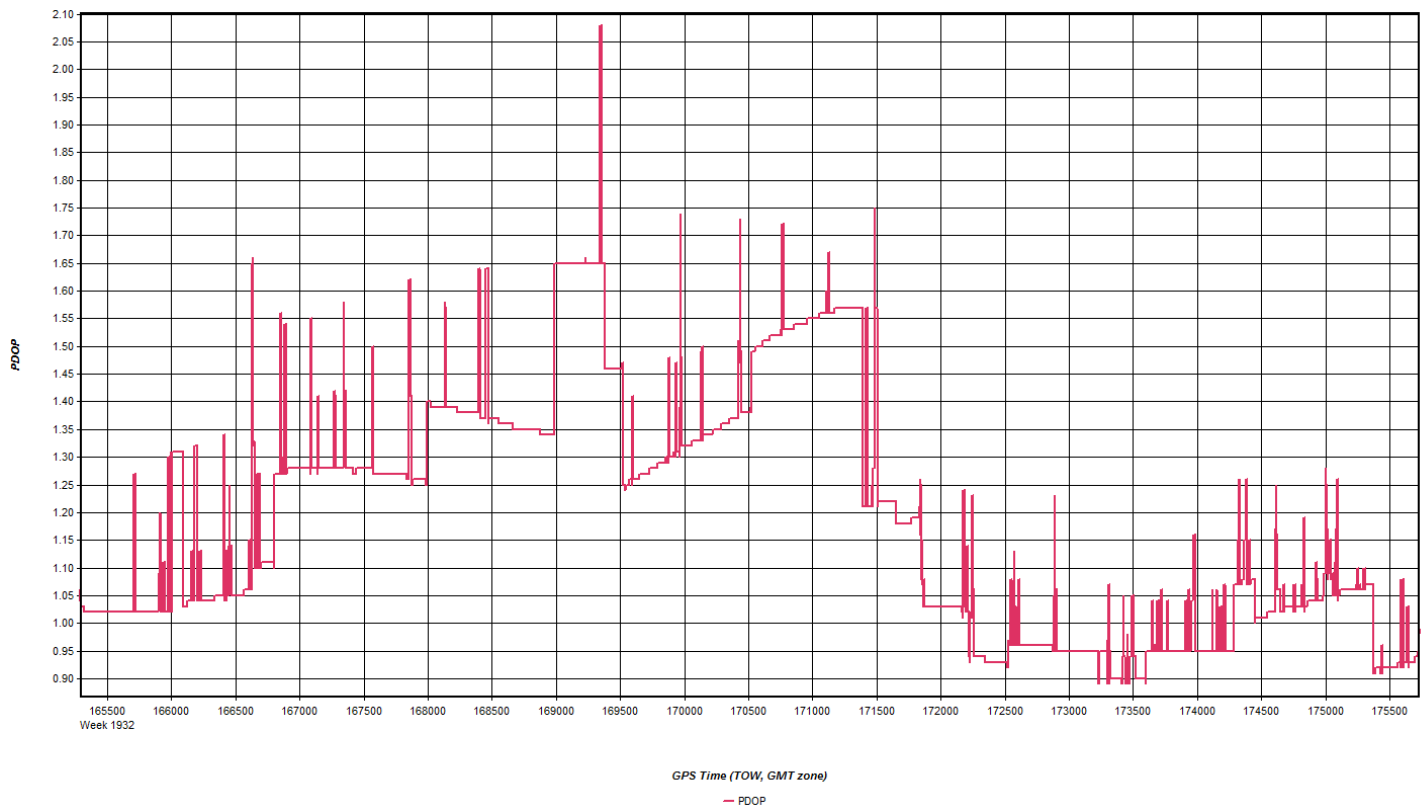


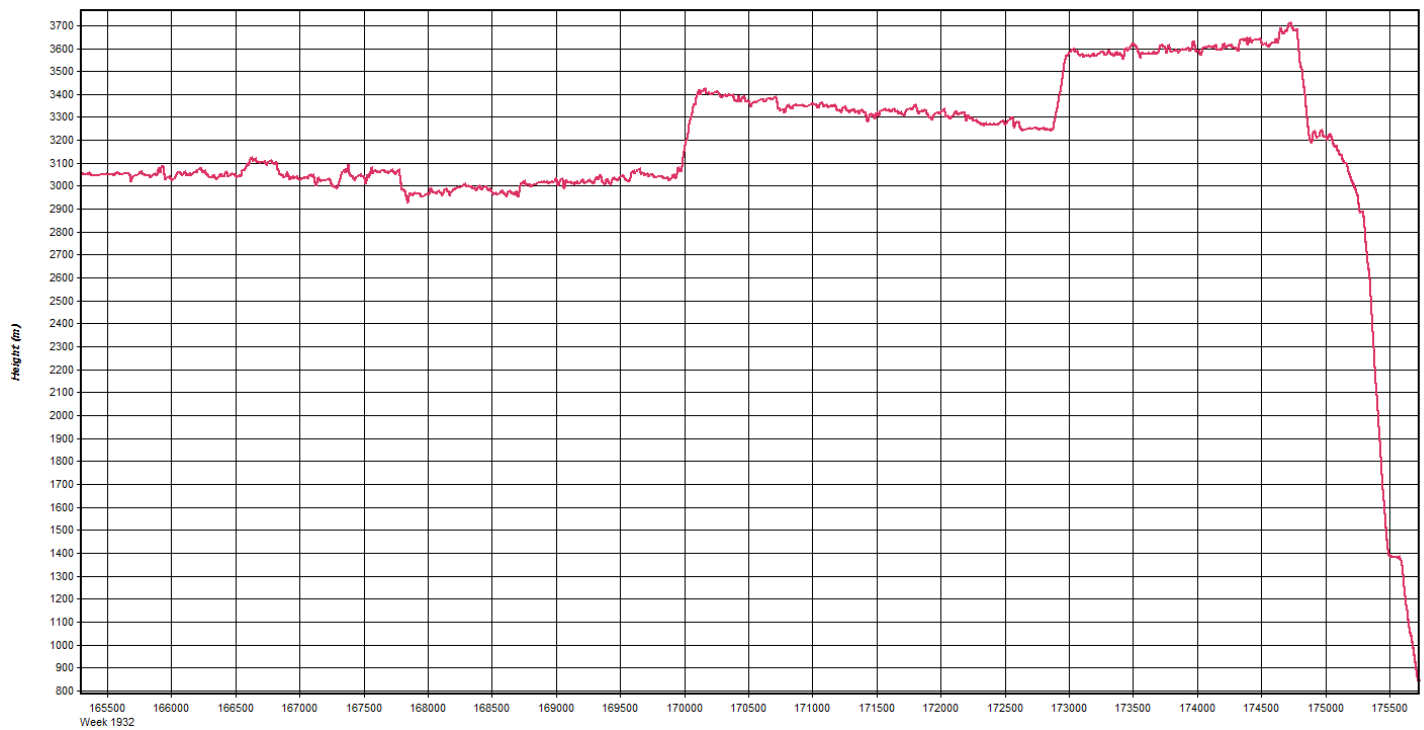
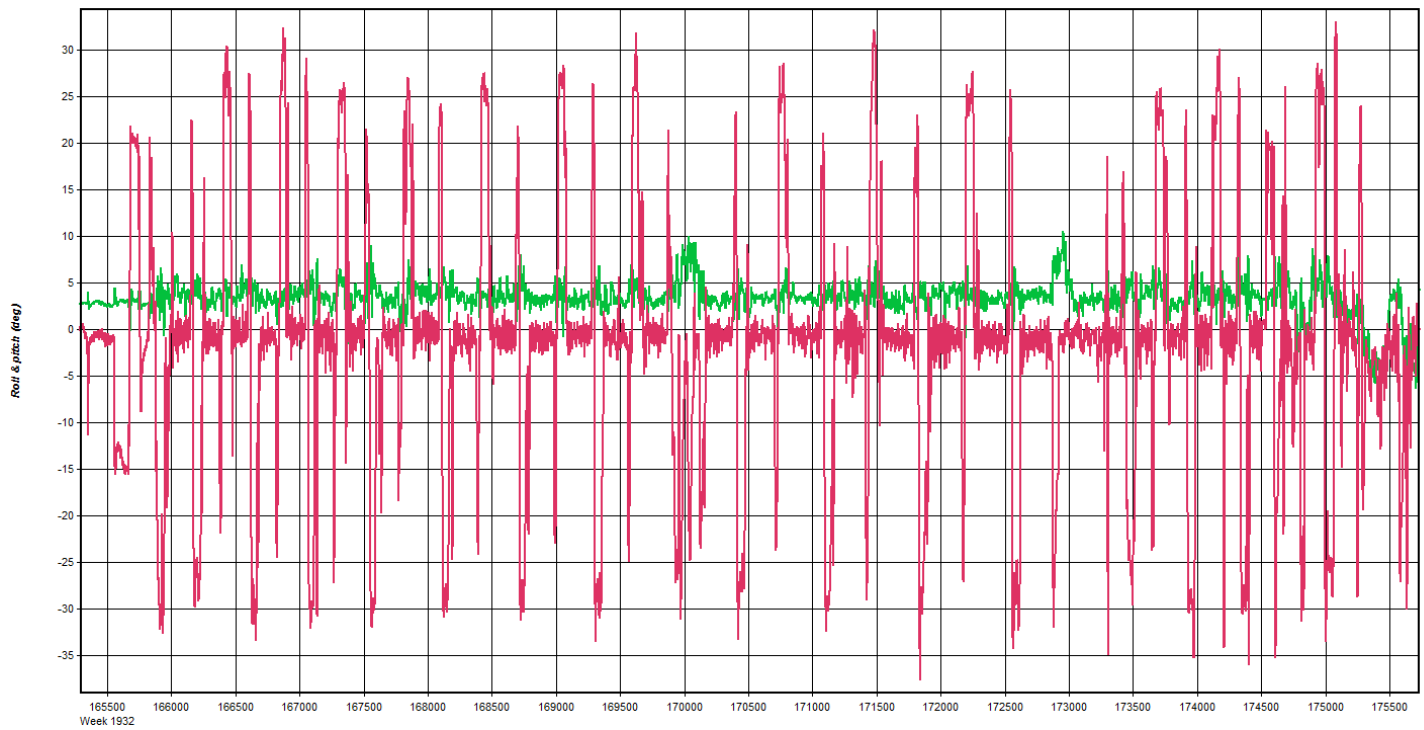


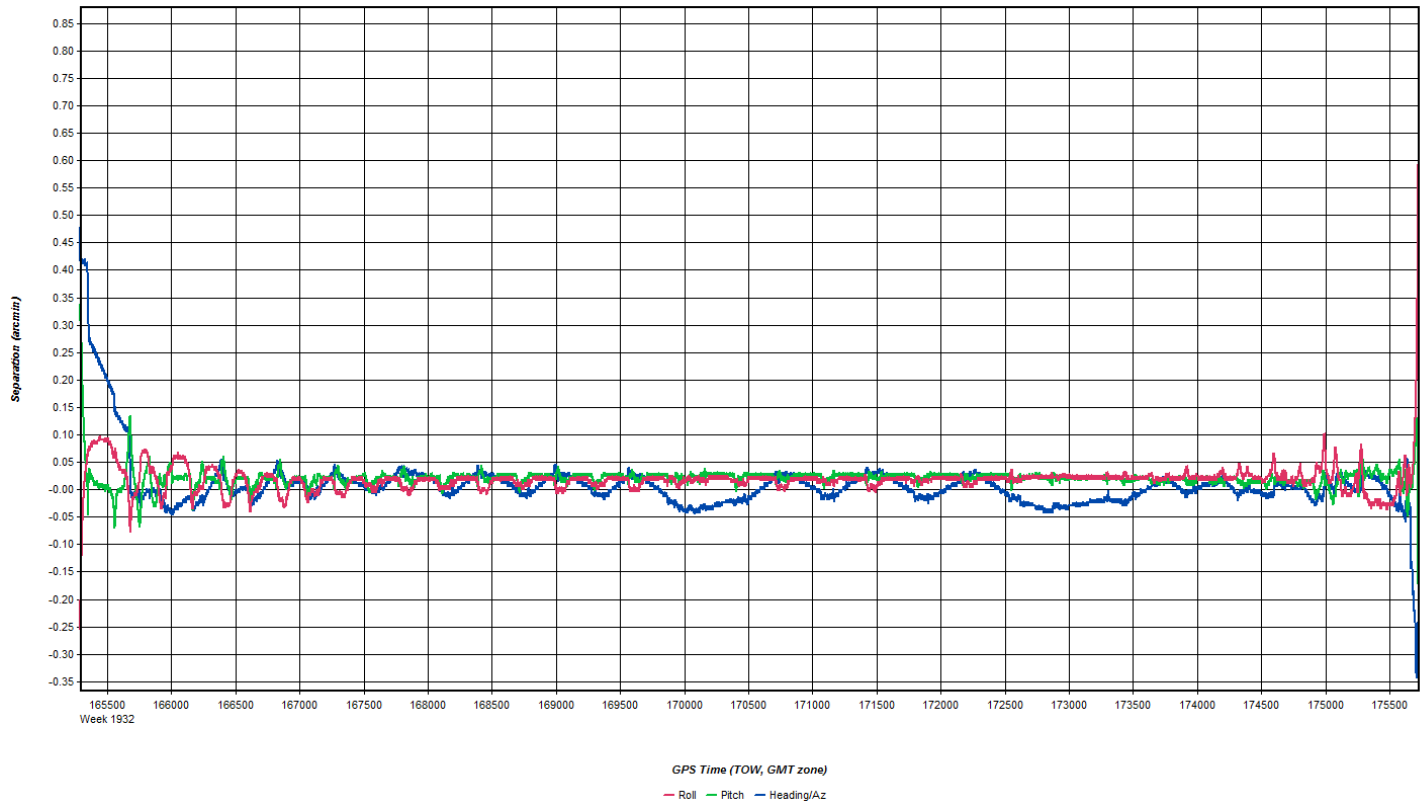
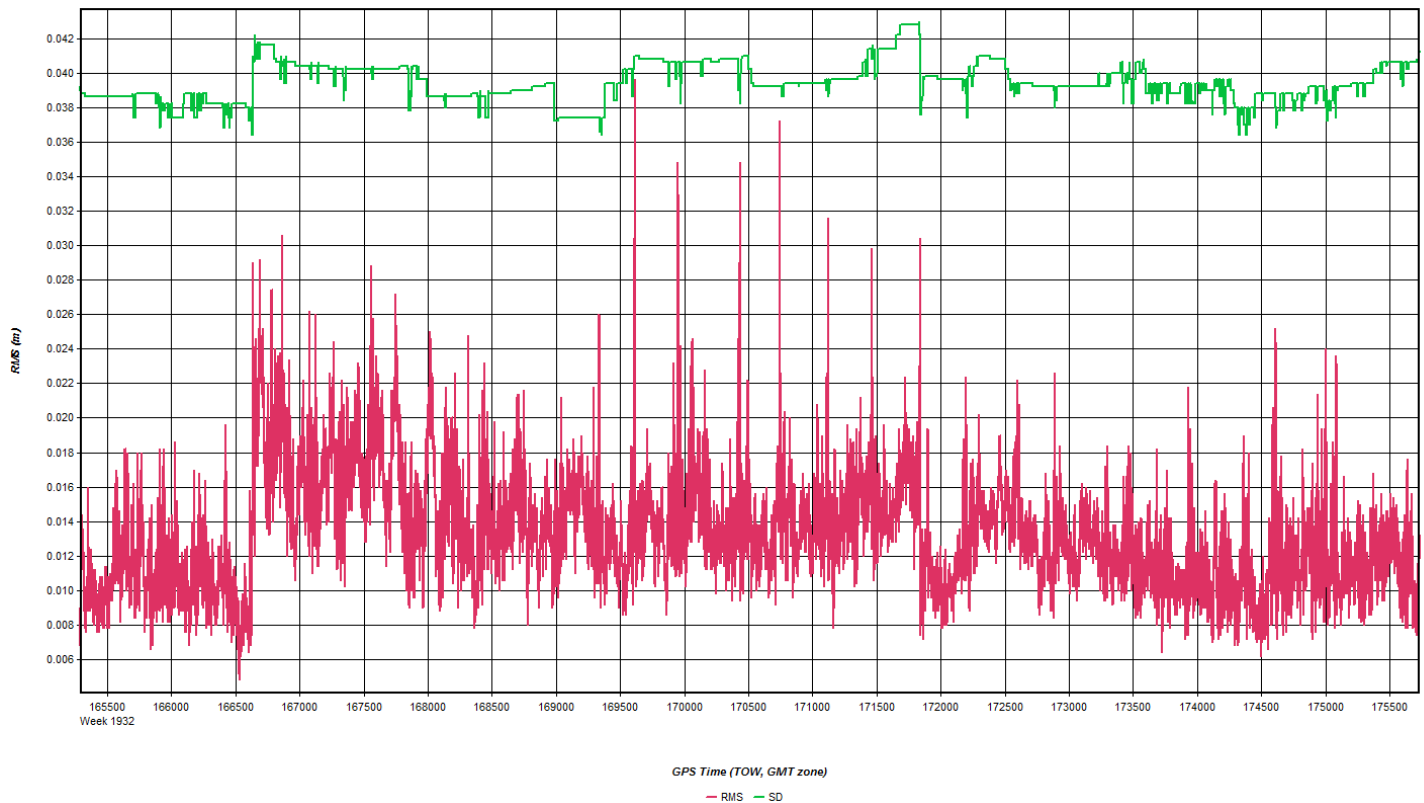
GPS Time (TOW, GMT zone)
— East — North — Up

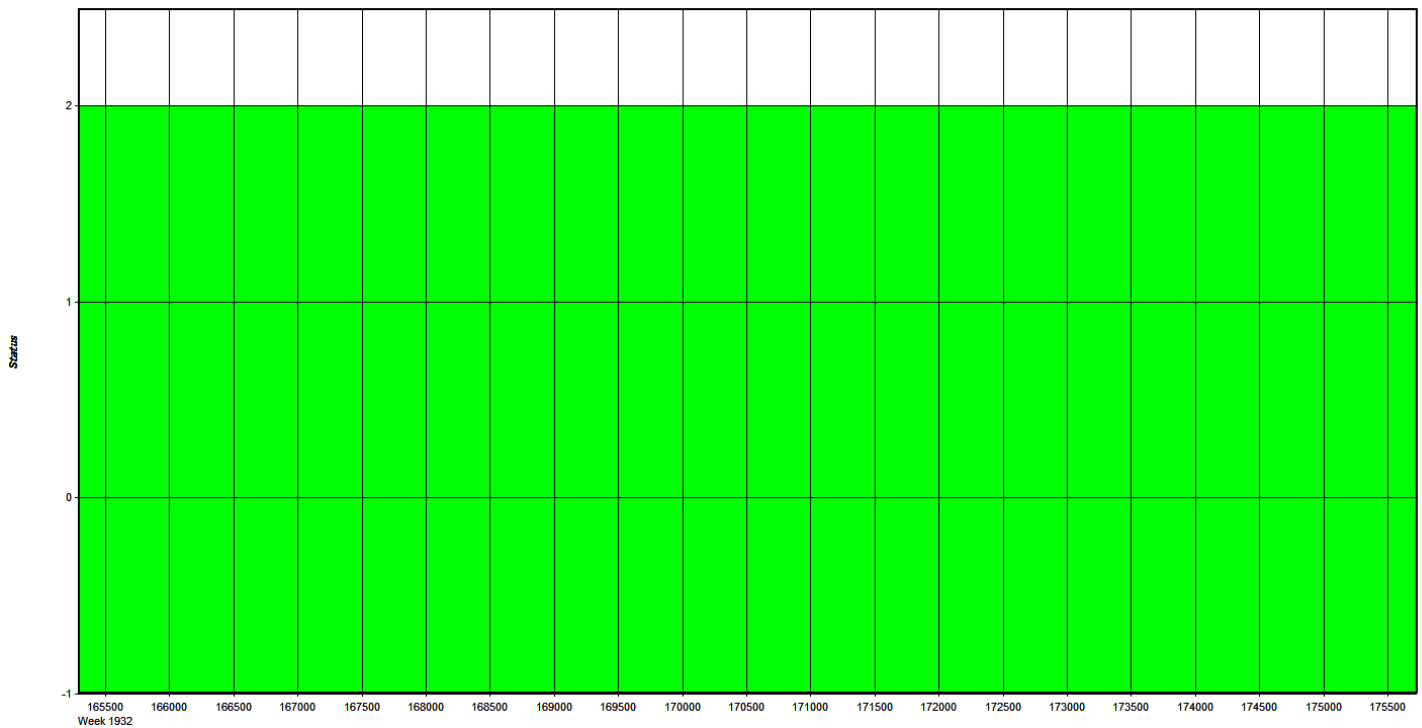


GPS Time (TOW, GMT zone)
— Heading/Azimuth — GPS-COG









GPS Time (TOW, GMT zone)
— Float — Forward Fixed — Reverse Fixed — Fixed (2 or more)

Coordinate/Antenna Settings

Master Remote

Base Station
2: UTAH16-37 Name: UTAH16-37 ☐ Disabled
File: E:\Proc\29083_UTAH\From_Lara_Heitmeyer_1-26-17\Survey_Da

Coordinates
Latitude: North 37 10 13.47031 Compute from PPP
Longitude: West 113 04 55.66964 Enter Grid Values
Ellipsoidal height: 1097.704 m Enter MSL Height
Datum: WGS84 Datum Options
Select From Favorites Add To Favorites Use Average Position

Antenna Height
From station file: TRM55971.00 View STA File
Antenna profile: TRM57971.00 Info
Measured height: 1.800 m
ARP to L1 offset: 0.067 m
Applied height: 1.867 m
Measured to
☒ ARP
☐ L1 Phase Centre
Compute From Slant

OK Cancel

Coordinate/Antenna Settings ? X

Master Remote

Base Station

1: UTAH16_38 Name: UTAH16_38 ☐ Disabled

File: E:\Proc\29083_UTAH\From_Lara_Heitmeyer_1-26-17\Survey_Da

Coordinates

Latitude: North 37 19 35.50688 Compute from PPP

Longitude: West 113 17 08.78469 Enter Grid Values

Ellipsoidal height: 1236.991 m Enter MSL Height

Datum: WGS84 Datum Options

Select From Favorites Add To Favorites Use Average Position

Antenna Height

From station file: TRM55971.00 View STA File

Antenna profile: TRM57971.00 Info

Measured height: 1.500 m

ARP to L1 offset: 0.067 m

Applied height: 1.567 m

Measured to

☒ ARP

☐ L1 Phase Centre

Compute From Slant

OK Cancel

Flight Log

Date: 1/16/2017	Aircraft: N604MD	Sensor: 8239
Project: Utah 2016 LiDAR		Project #: R029083
Flight Mgmt File: FMSL_Utah_WACounty_SN8239		
Pilot: Eric Petersen		Sensor Operator: Scott White

	Flight 1	Flight 2	Flight 3	Flight 4
Wheels Up	1:07:00 PM			
Wheels Down	5:49:00 PM			
Begin Hobbs	4471.2			
End Hobbs	4474.9			
On-line Hobbs: 2.7		Mob Hobbs: 1		

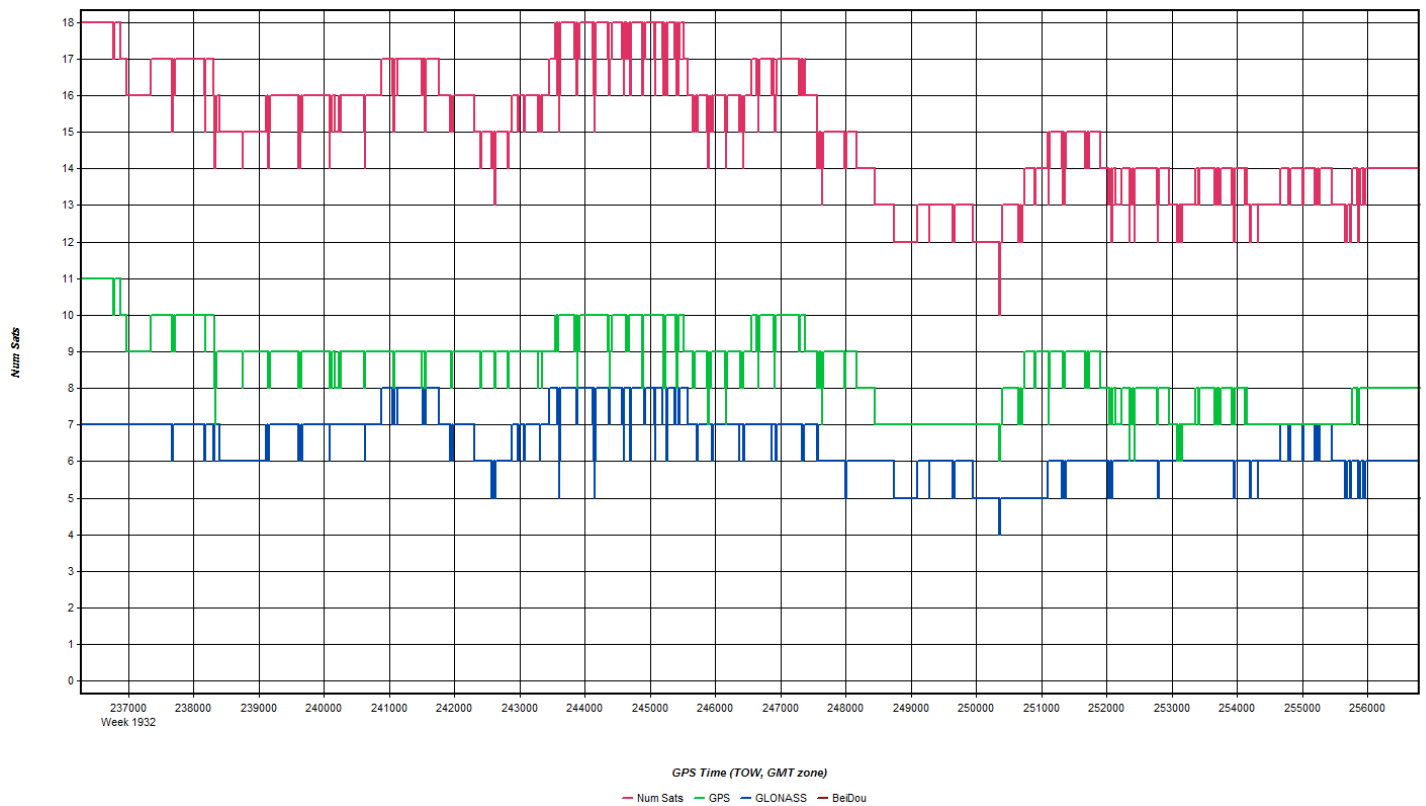
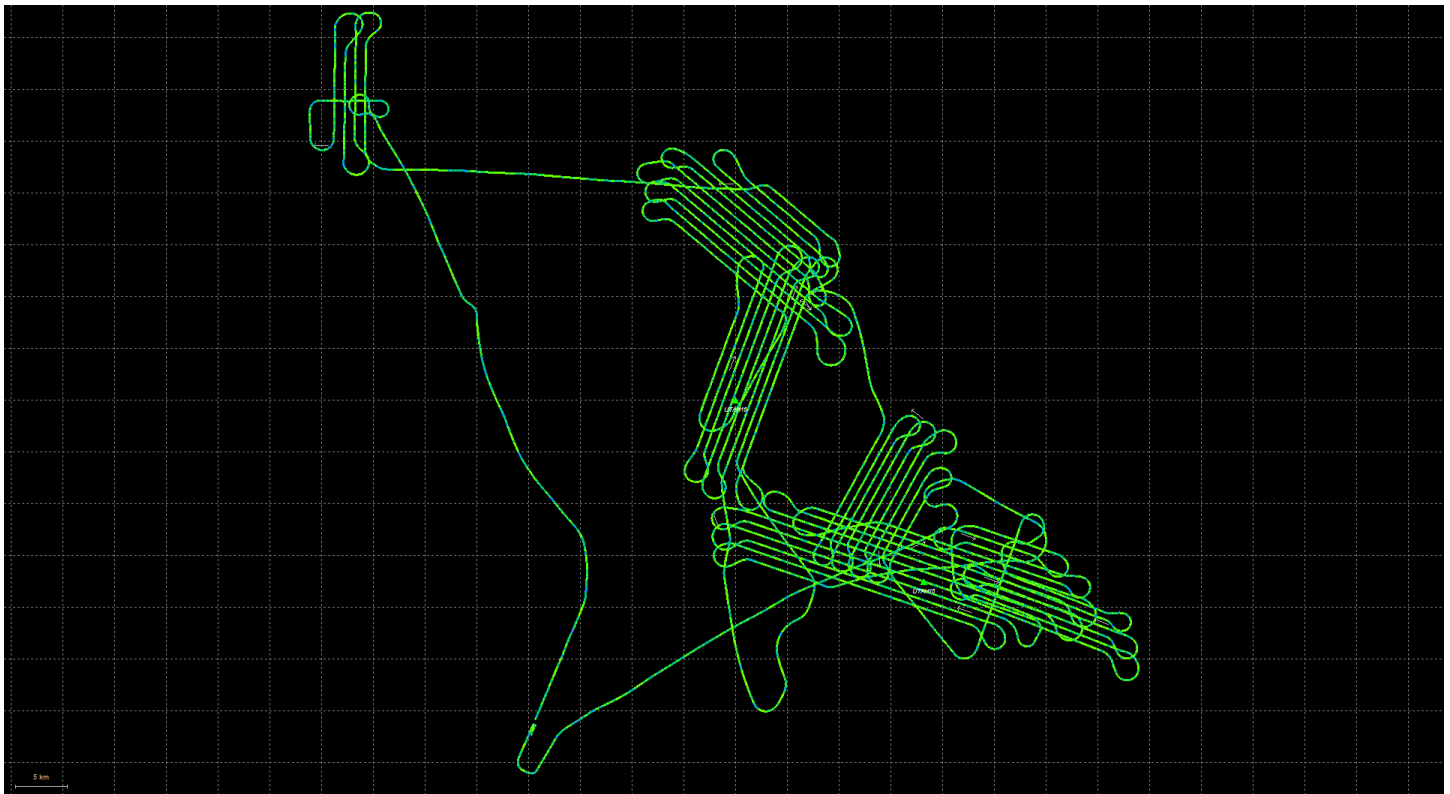
Notes

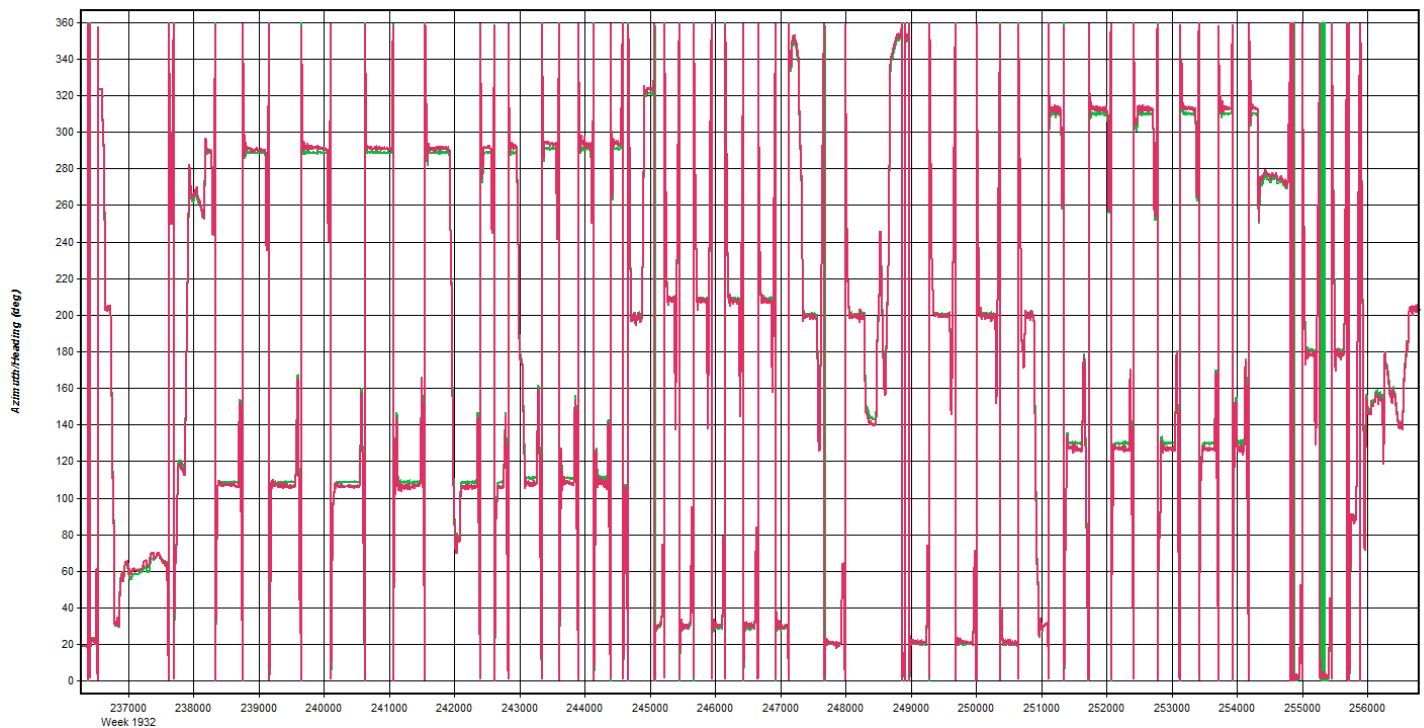
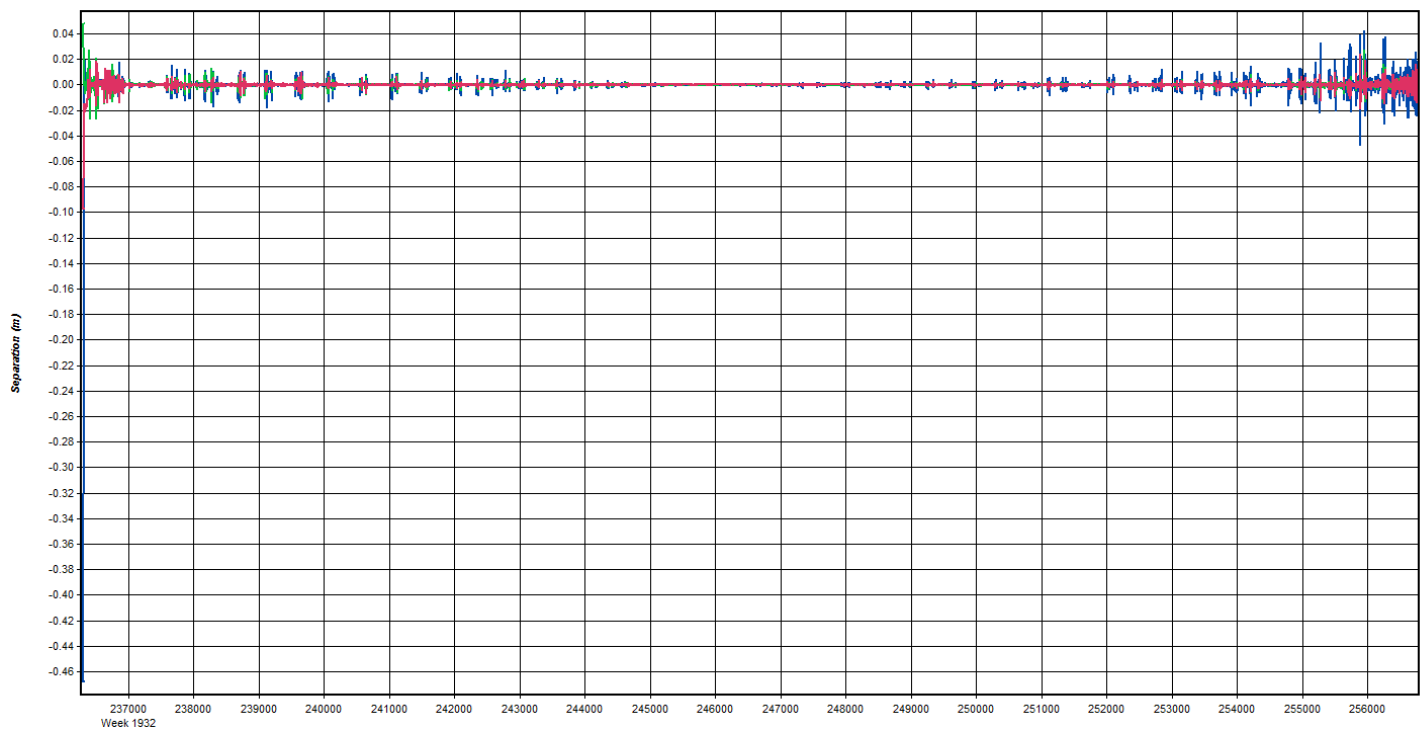
LR was out early and we wired and put our finishing touches on the install. Got 208NR filled up with Os since we are flying lines up to 13,000 feet. Tested the Phase one and POS on the ground and everything seemed to be in working order. Got wheels up and headed over to our AOI. Everything went smooth, and we landed at KSGU right after sunset. Cloudpro/LasOverlap still isn't working properly. Will continue to troubleshoot.

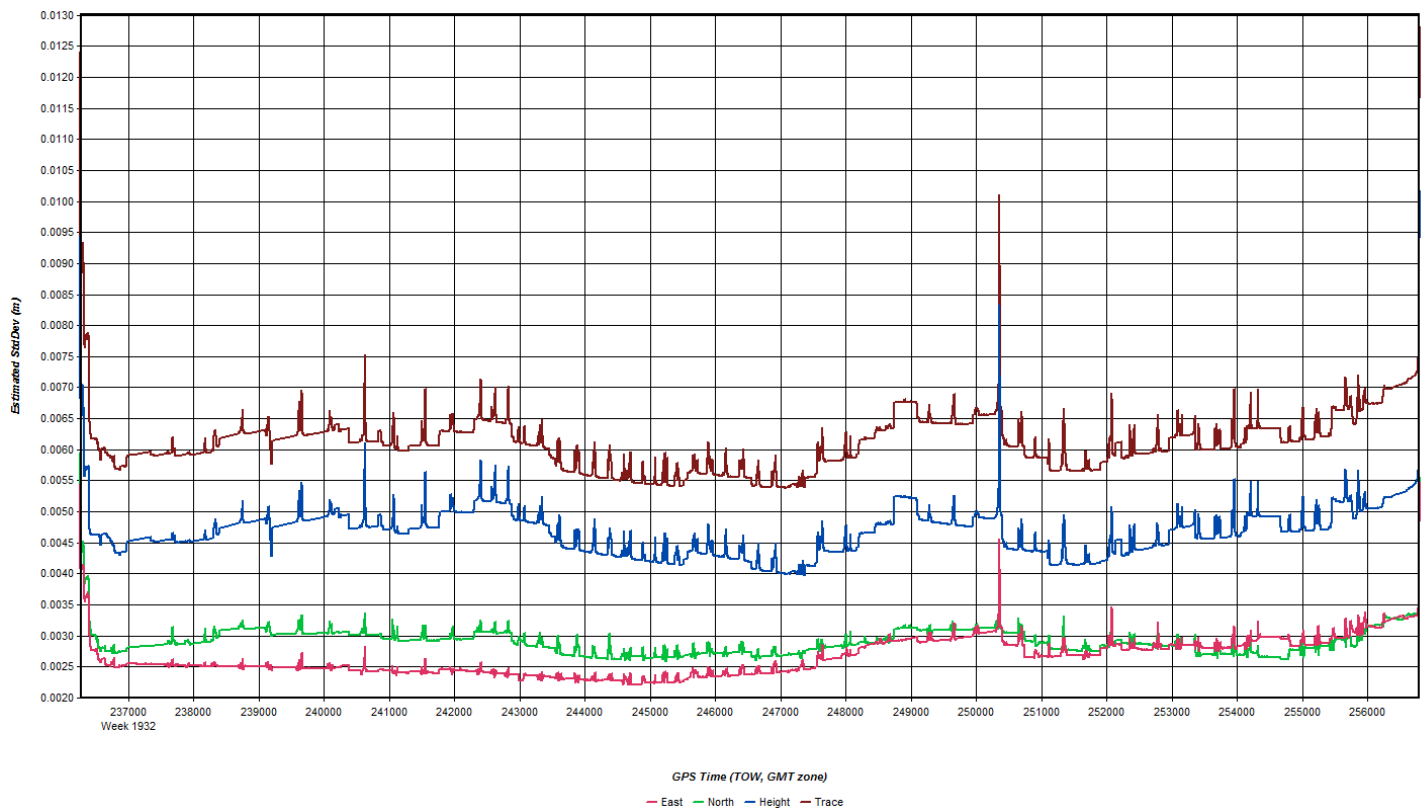
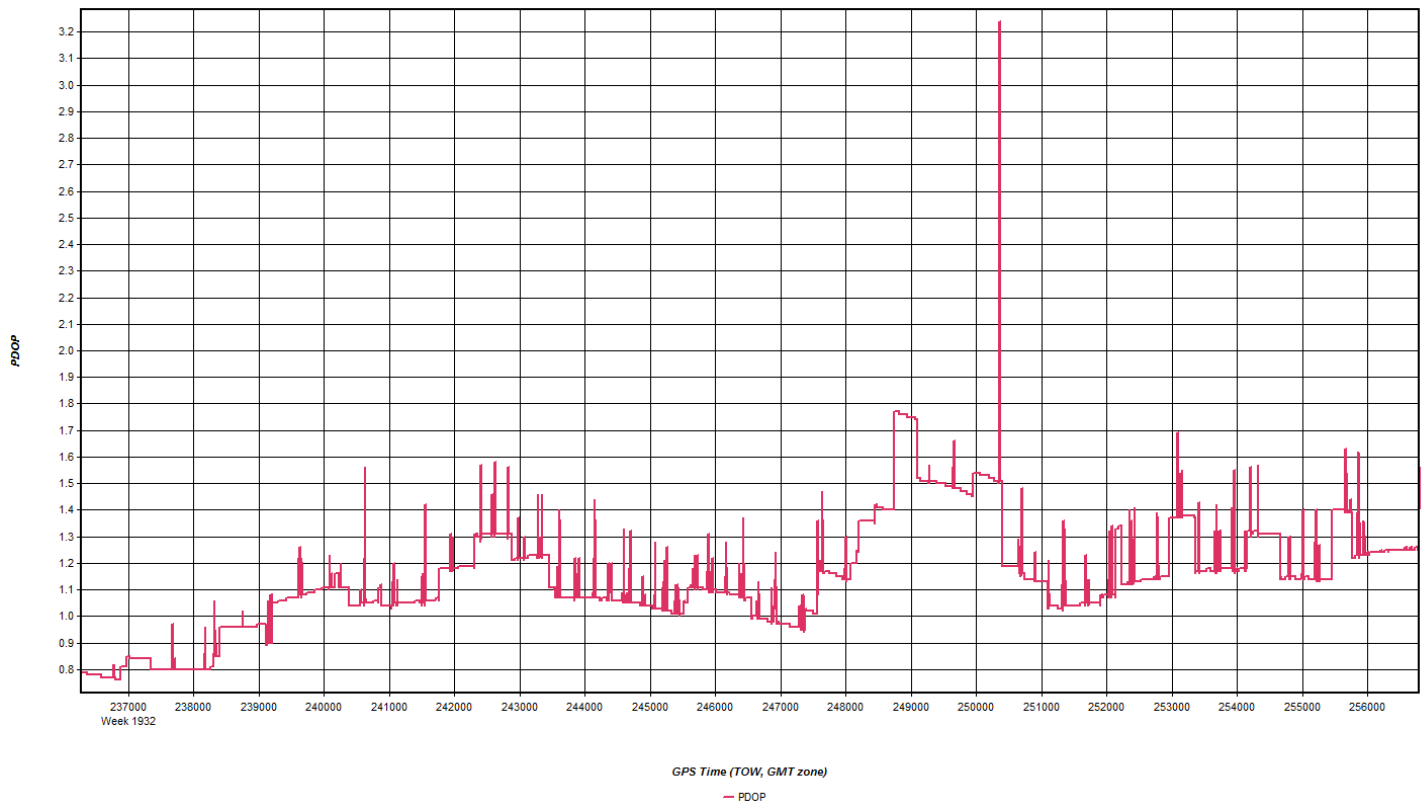
Flt Mgmt File: FMSL_Utah_WACounty_SN8239

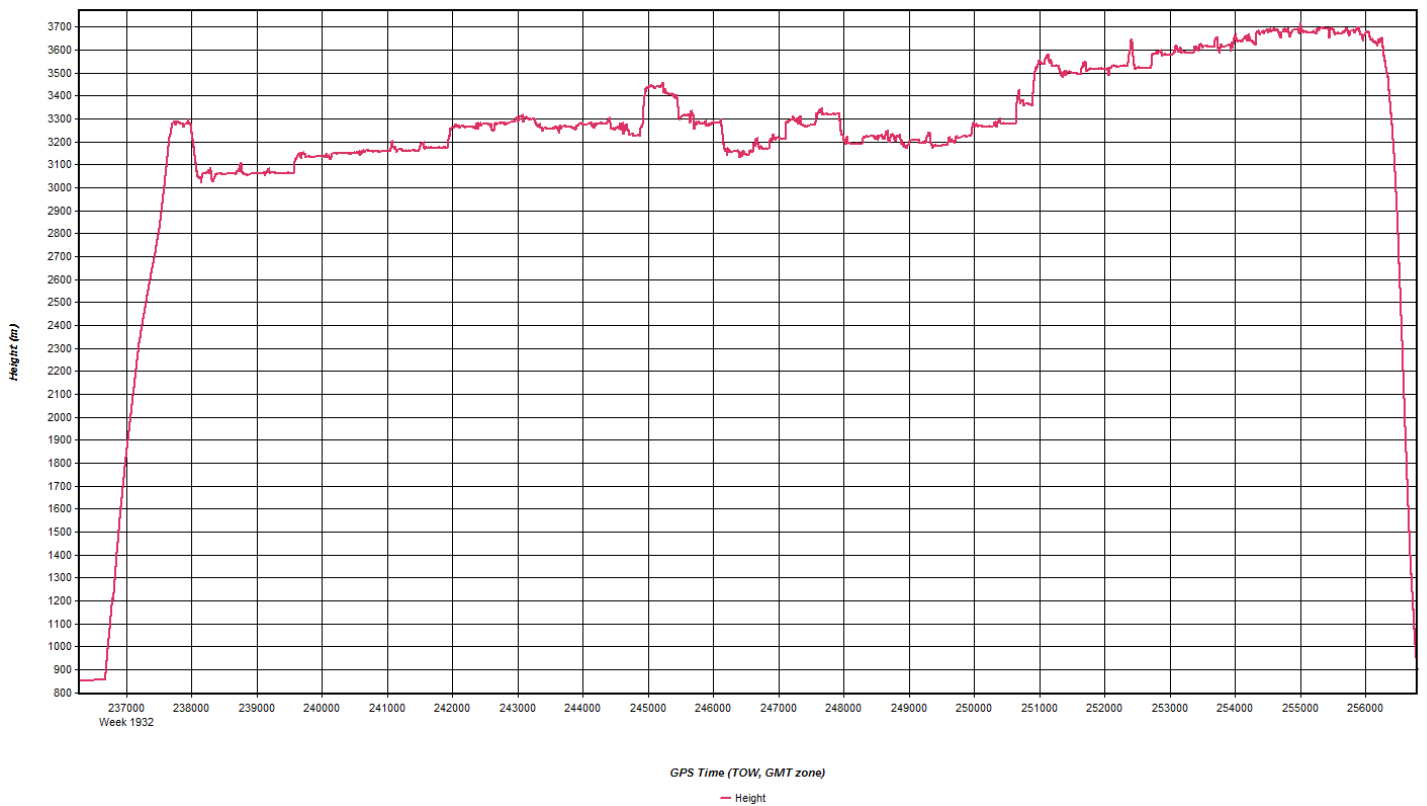
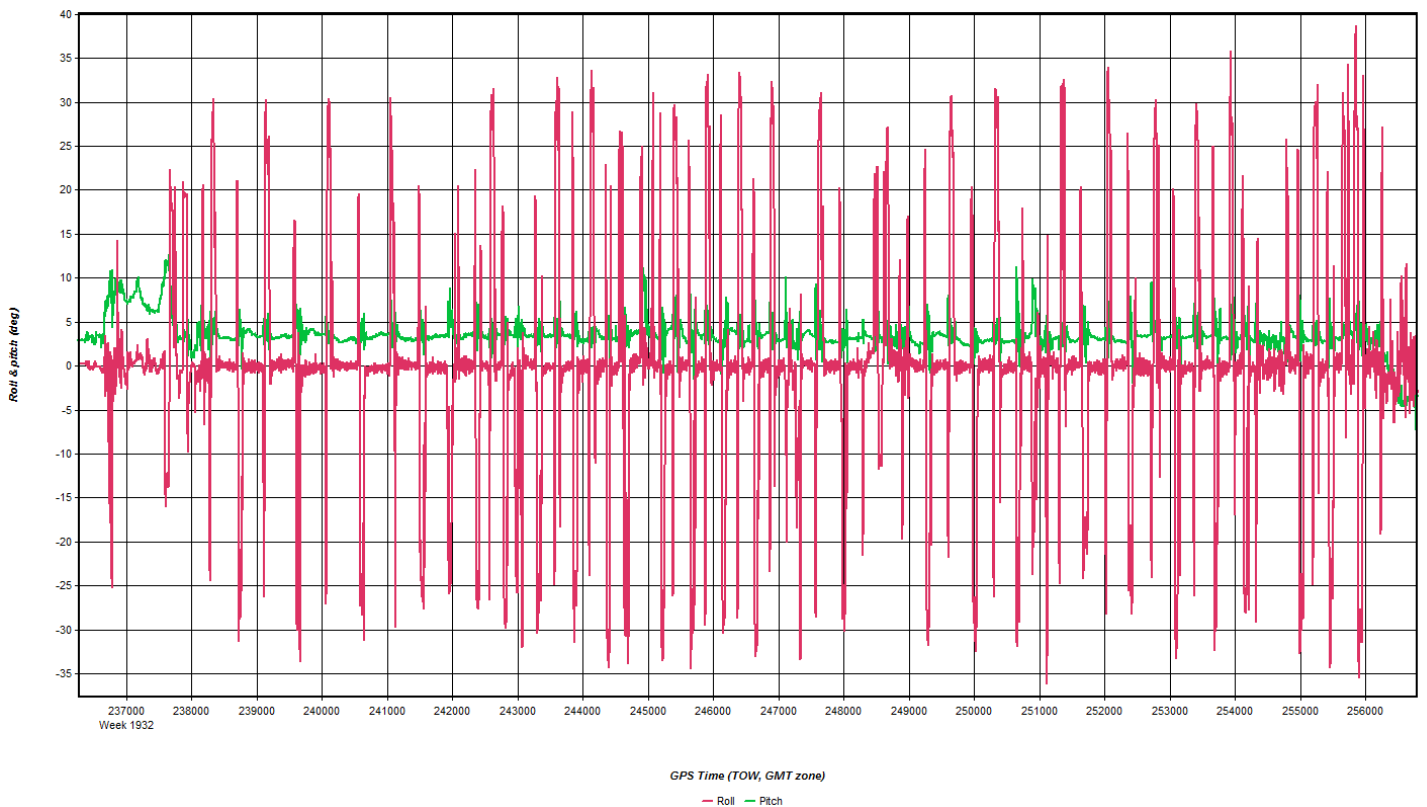
71	10:07:03 PM	1545.542847	10:08:47 PM
72	10:10:56 PM	2043.262451	10:12:40 PM
73	10:14:36 PM	1797.277344	10:16:23 PM
74	10:18:14 PM	2056.122559	10:20:00 PM
75	10:22:02 PM	1767.947144	10:23:50 PM
76	10:25:42 PM	2102.282715	10:27:30 PM
77	10:29:42 PM	1880.231445	10:31:26 PM
78	10:34:06 PM	2014.43689	10:35:51 PM
79	10:38:20 PM	1789.104736	10:41:04 PM
80	10:43:19 PM	2014.935059	10:46:07 PM
81	10:48:16 PM	1870.160522	10:51:07 PM
82	10:53:16 PM	1950.103149	10:56:09 PM
83	10:58:13 PM	1459.966431	11:01:05 PM
84	11:02:55 PM	1920.874634	11:05:44 PM
85	11:08:24 PM	2004.483765	11:10:35 PM
126	11:16:05 PM	2107.072754	11:19:22 PM
125	11:21:32 PM	1914.307617	11:24:51 PM
124	11:26:58 PM	2045.442261	11:30:50 PM
123	11:32:52 PM	1869.517456	11:36:35 PM
123	11:39:02 PM	0	11:42:46 PM
122	11:45:25 PM	1792.422485	11:49:10 PM
121	11:51:29 PM	2096.605957	11:55:17 PM
120	11:57:12 PM	1775.695557	12:00:54 AM
119	12:08:19 AM	0	12:09:51 AM
118	12:12:02 AM	1786.326904	12:13:49 AM
117	12:16:20 AM	2105.2146	12:18:08 AM
116	12:19:50 AM	1651.669434	12:21:37 AM
115	12:23:36 AM	1705.480347	12:24:58 AM
114	12:26:51 AM	1874.776733	12:28:05 AM
ULO01	12:33:39 AM	1958.256592	12:35:07 AM

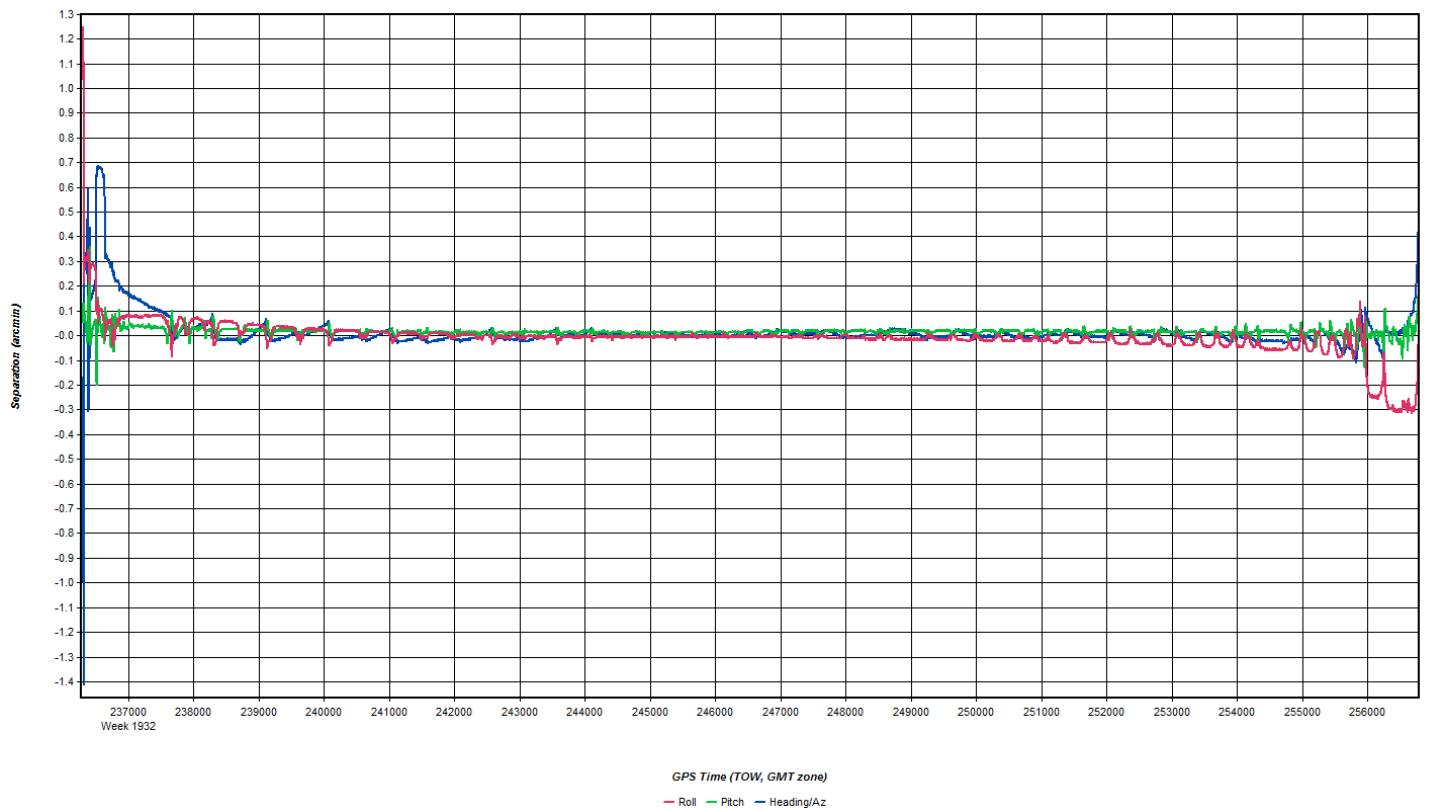
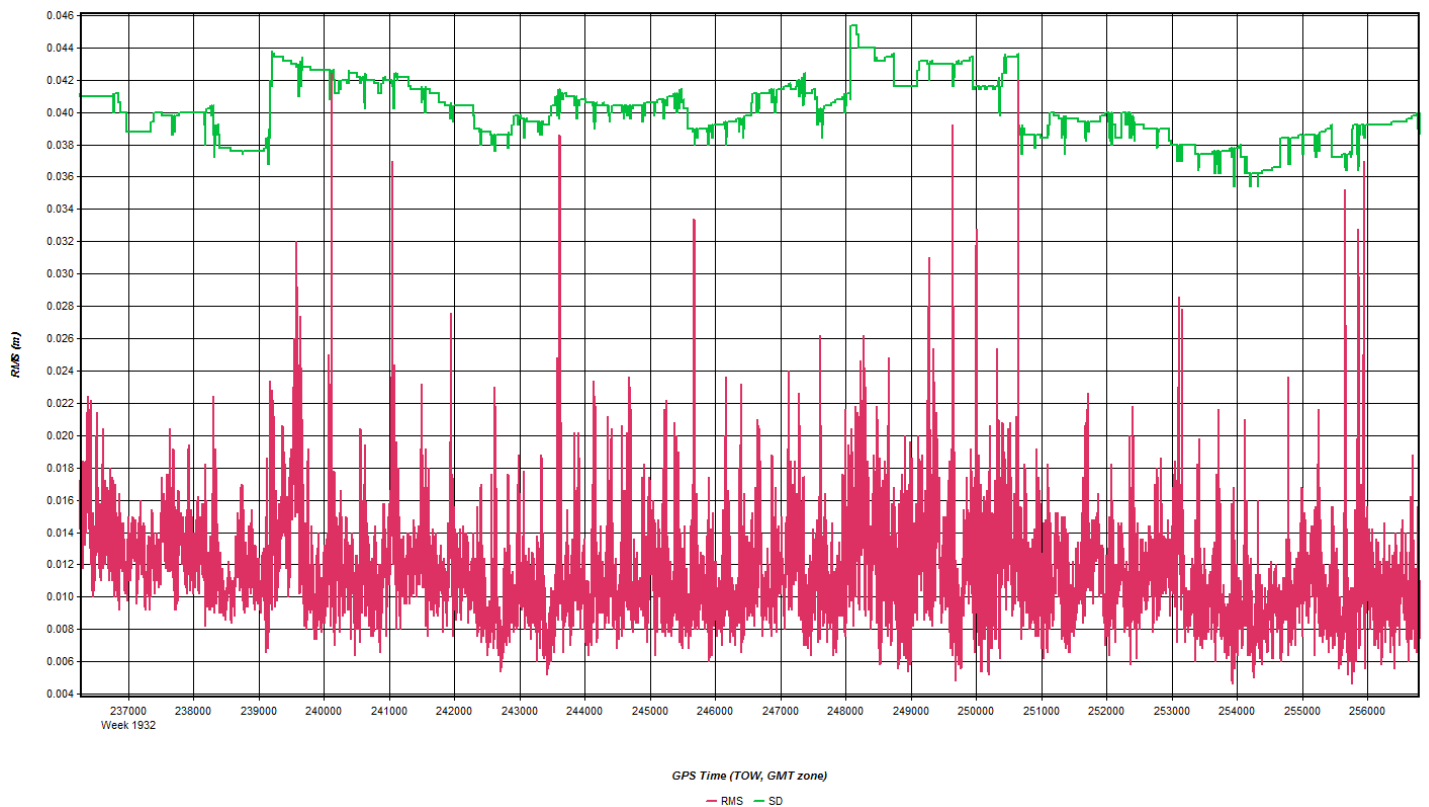
Jan 17, 2017-A (N208NR, SN8239)

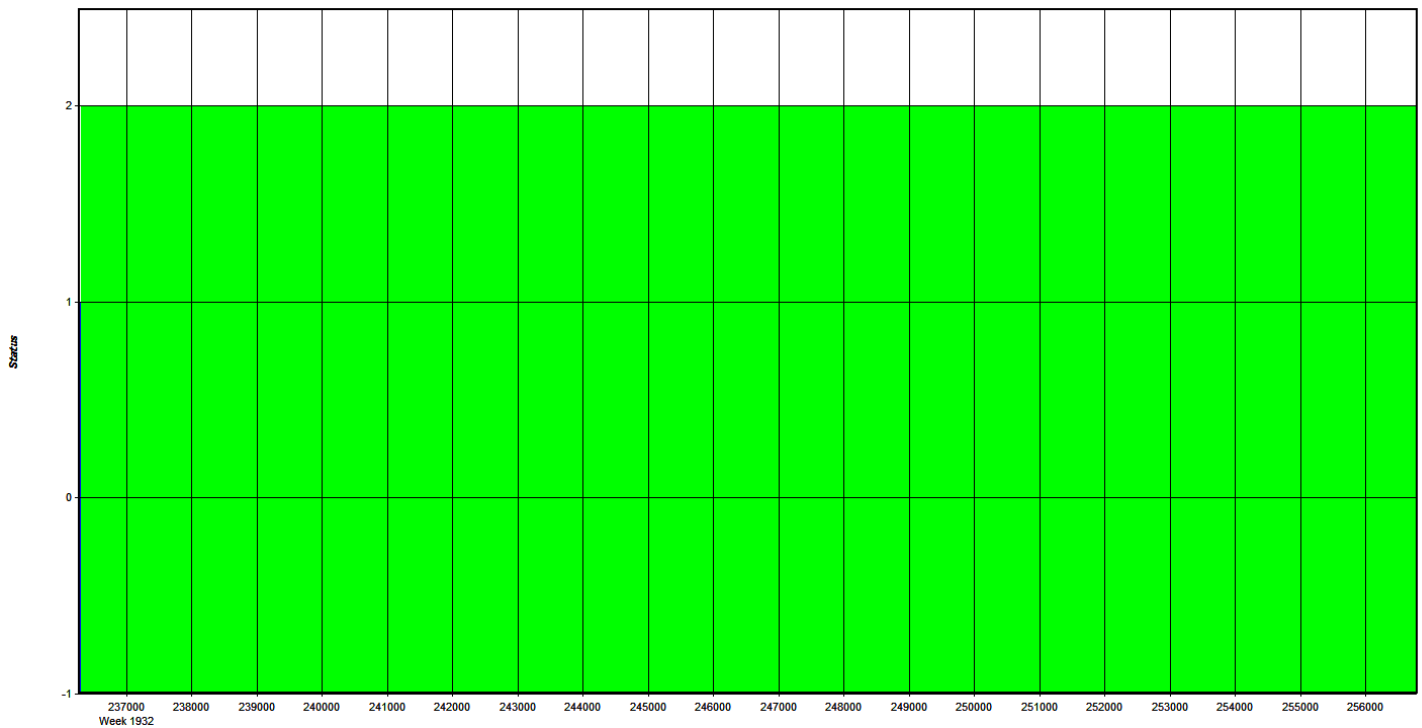












GPS Time (TOW, GMT zone)
— Float — Forward Fixed — Reverse Fixed — Fixed (2 or more)

Coordinate/Antenna Settings

Master Remote

Base Station
2: UTAH16_37 Name: UTAH16_37 ☐ Disabled
File: E:\Proc\29083_UTAH\From_Lara_Heitmeyer_2-16-17\UTAH_2-1

Coordinates
Latitude: North 37 10 13.47031 Compute from PPP
Longitude: West 113 04 55.66964 Enter Grid Values
Ellipsoidal height: 1097.704 m Enter MSL Height
Datum: WGS84 Datum Options
Select From Favorites Add To Favorites Use Average Position

Antenna Height
From station file: TRM55971.00 View STA File
Antenna profile: TRM57971.00 Info
Measured height: 1.800 m
ARP to L1 offset: 0.067 m
Applied height: 1.867 m
Measured to
☒ ARP
☐ L1 Phase Centre
Compute From Slant

OK Cancel

Coordinate/Antenna Settings

Master Remote

Base Station

1: UTAH16_38 Name: UTAH16_38 ☐ Disabled

File: E:\Proc\29083_UTAH\From_Lara_Heitmeyer_2-16-17\UTAH_2-1

Coordinates

Latitude: North 37 19 35.50688 Compute from PPP

Longitude: West 113 17 08.78469 Enter Grid Values

Ellipsoidal height: 1236.991 m Enter MSL Height

Datum: WGS84 Datum Options

Select From Favorites Add To Favorites Use Average Position

Antenna Height

From station file: TRM55971.00 View STA File

Antenna profile: TRM57971.00 Info

Measured height: 1.800 m

ARP to L1 offset: 0.067 m

Applied height: 1.867 m

Measured to

☒ ARP

☐ L1 Phase Centre

Compute From Slant

OK Cancel

Flight Log

Date: 1/17/2017	Aircraft: N604MD	Sensor: 8239
Project: Utah 2016 LiDAR		Project #: R029083
Flight Mgmt File: FMSL_Utah_WACounty_SN8239		
Pilot: Eric Petersen		Sensor Operator: Scott White

	Flight 1	Flight 2	Flight 3	Flight 4
Wheels Up	10:43:00 AM			
Wheels Down	4:22:00 PM			
Begin Hobbs	4474.9			
End Hobbs	4480.5			
On-line Hobbs: 5.4		Mob Hobbs: 0.2		

Notes

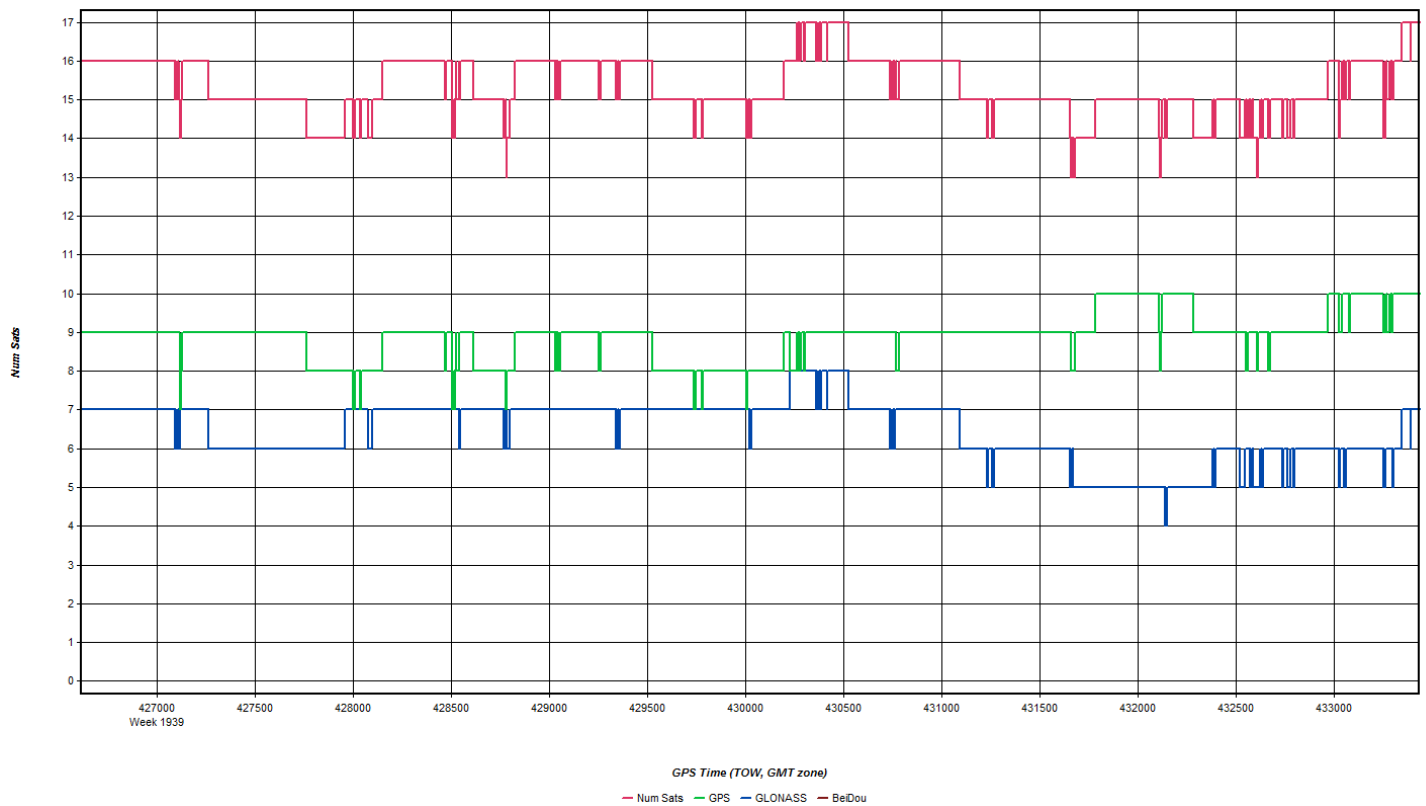
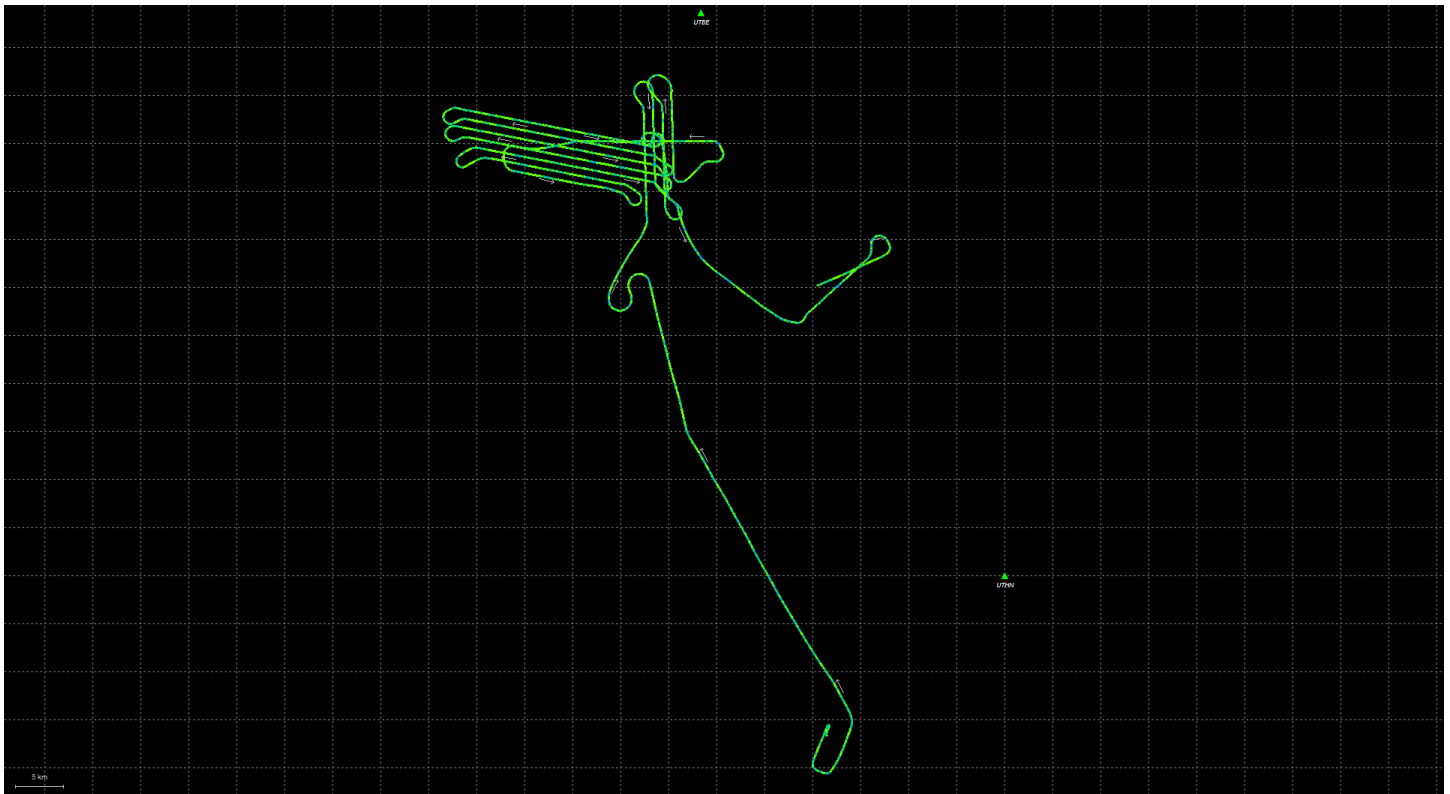
Got a good lift today after some frost melted off 208NR that was present in the morning. We got lucky with snow, with multiple blocks that had snow just outside of the buffered AOI. I flew what was snow free, and made a snow KML and took Pictures of what isn't. Overall we got the most done we have in a day for this project.

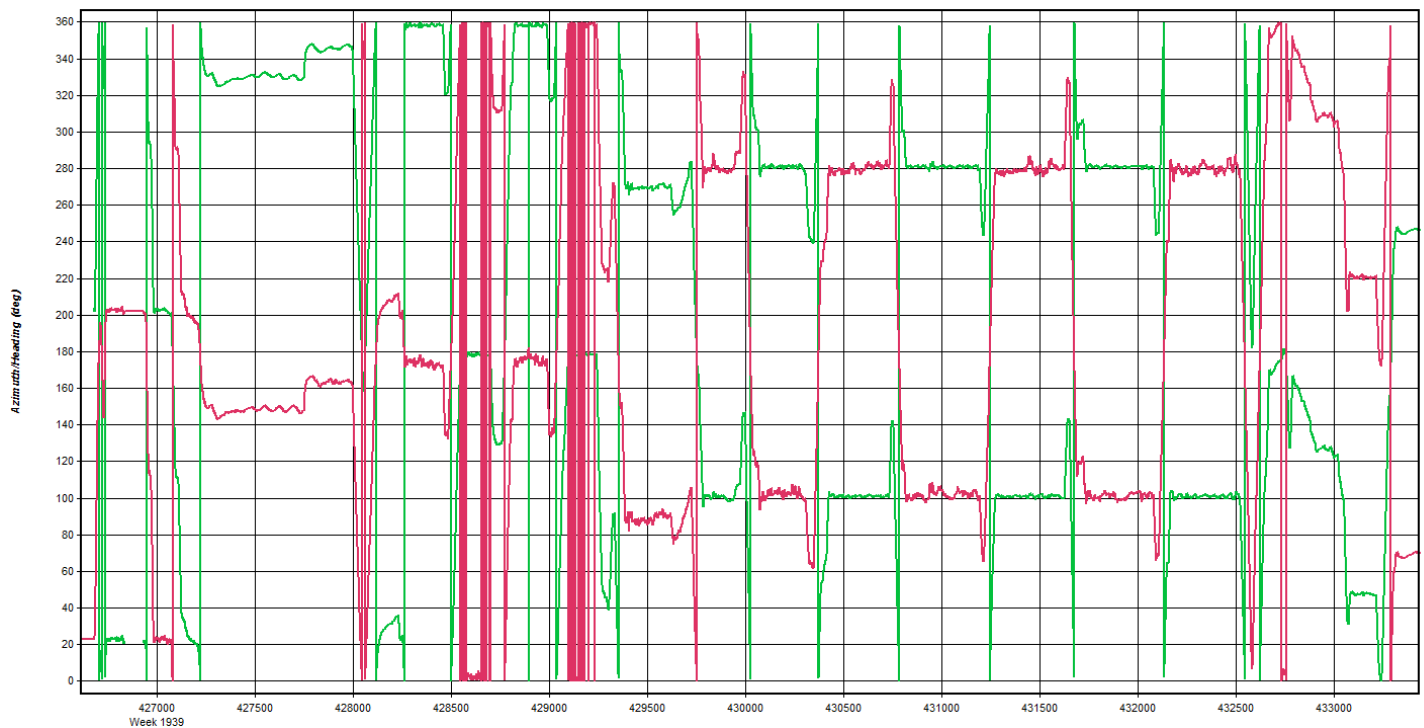
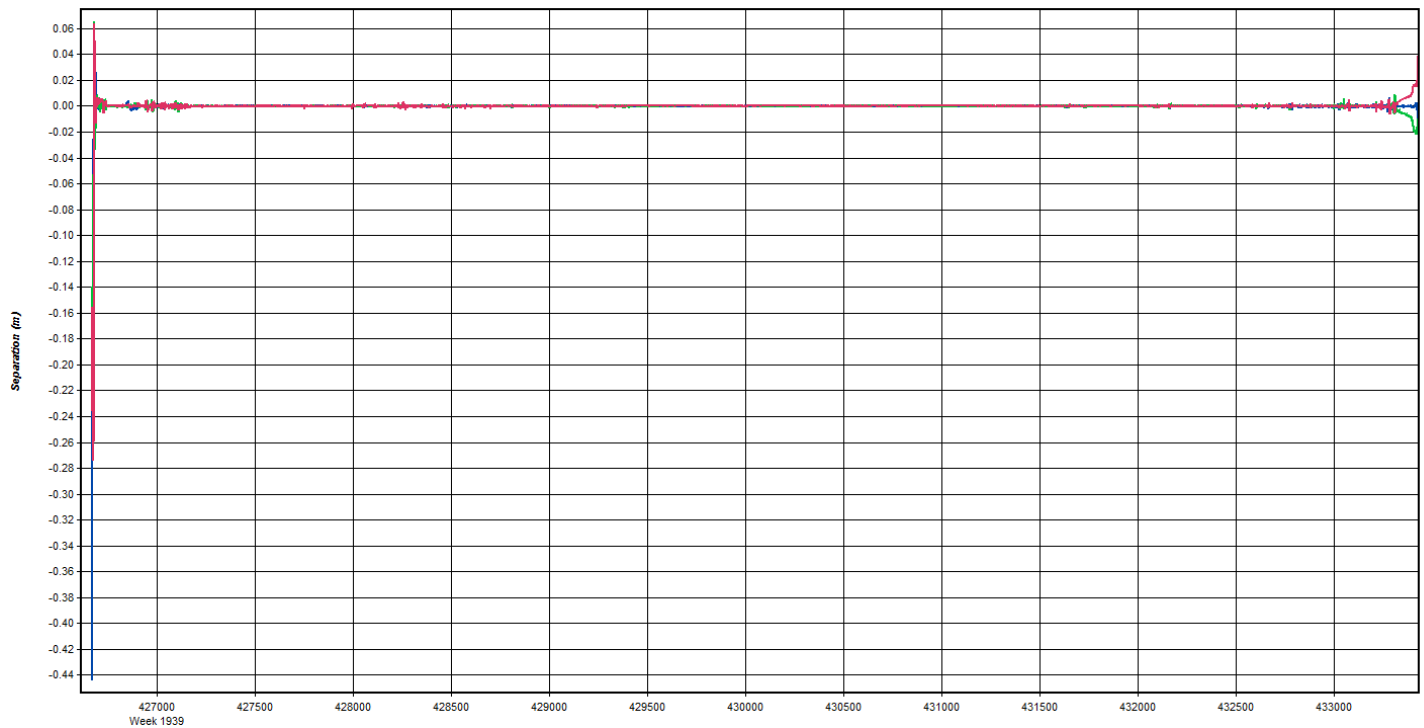
Flt Mgmt File: FMSL_Utah_WACounty_SN8239

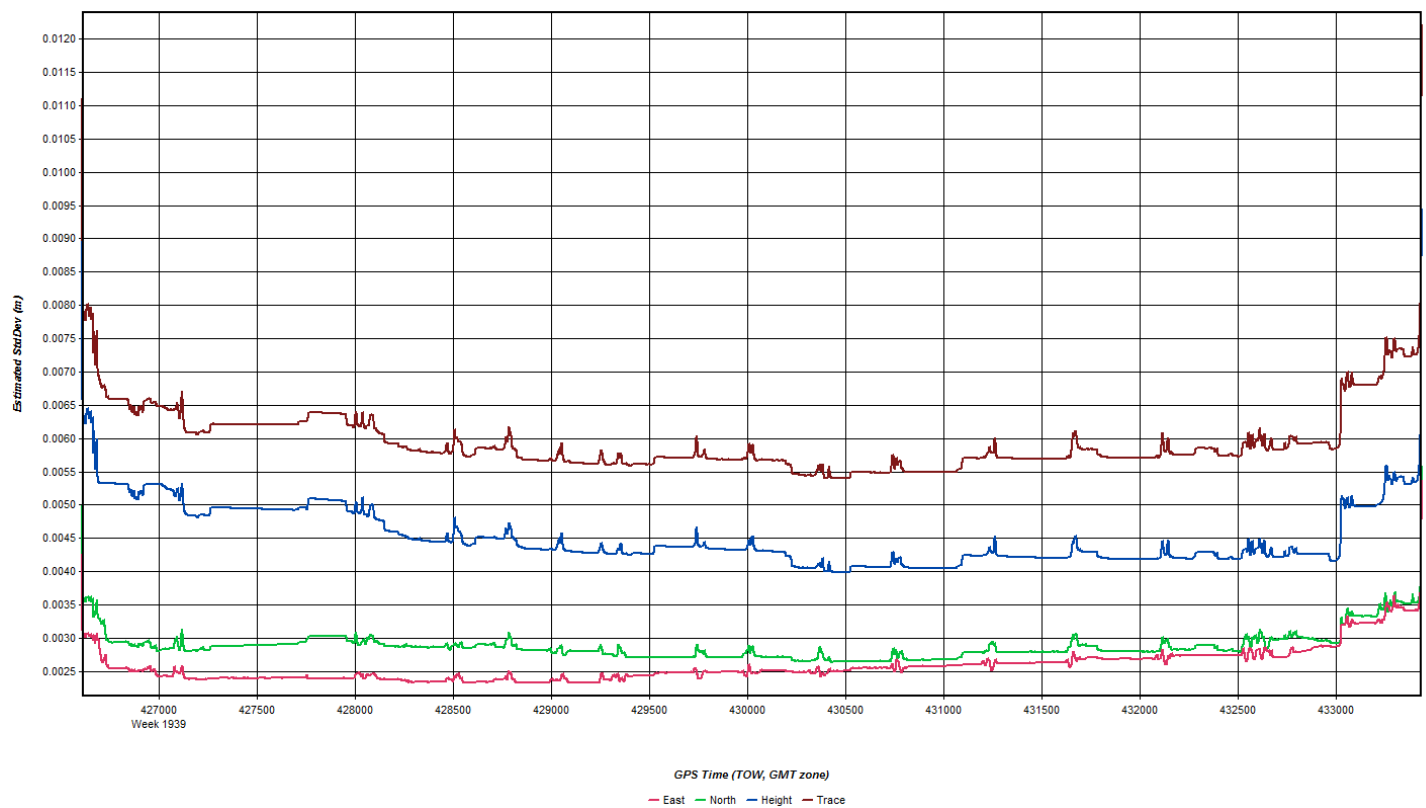
112	6:10:00 PM	0	6:11:00 PM
111	6:12:00 PM	2120.916504	6:17:00 PM
110	6:19:00 PM	1724.387939	6:24:00 PM
109	6:26:00 PM	2108.335205	6:32:00 PM
108	6:34:00 PM	1842.457031	6:40:00 PM
107	6:42:00 PM	2096.730957	6:48:00 PM
106	6:51:00 PM	1564.759277	6:56:00 PM
105	6:58:00 PM	1660.822388	7:04:00 PM
104	7:06:00 PM	1914.840088	7:11:00 PM
113	7:16:00 PM	1531.220215	7:18:00 PM
103	7:21:00 PM	1430.161987	7:22:00 PM
102	7:24:00 PM	1891.166138	7:25:00 PM
101	7:27:00 PM	1926.796143	7:28:00 PM
100	7:31:00 PM	2073.029541	7:33:00 PM
99	7:36:00 PM	1490.03833	7:38:00 PM
98	7:40:00 PM	2138.995605	7:43:00 PM
97	7:45:00 PM	1571.67395	7:47:00 PM
96	7:50:00 PM	2012.883301	7:52:00 PM
95	7:54:00 PM	1475.873779	7:55:00 PM
94	8:04:00 PM	2086.017334	8:05:00 PM
93	8:07:00 PM	1900.590332	8:09:00 PM
92	8:11:00 PM	2115.168701	8:13:00 PM
91	8:15:00 PM	1884.067627	8:17:00 PM
90	8:19:00 PM	2105.510986	8:21:00 PM
89	8:23:00 PM	1699.329224	8:25:00 PM
88	8:27:00 PM	2093.920898	8:29:00 PM
87	8:31:00 PM	1584.920898	8:33:00 PM
86	8:35:00 PM	2147.880371	8:37:00 PM
70	8:42:00 PM	1425.903198	8:45:00 PM
70	8:48:00 PM	2072.453613	8:51:00 PM
69	8:54:00 PM	1649.715332	8:57:00 PM
68	9:10:00 PM	2041.874146	9:13:00 PM
67	9:15:00 PM	1749.58728	9:19:00 PM
66	9:21:00 PM	2096.771729	9:25:00 PM
65	9:27:00 PM	1858.795044	9:31:00 PM
64	9:33:00 PM	1972.563965	9:36:00 PM
63	9:39:00 PM	1859.664795	9:41:00 PM

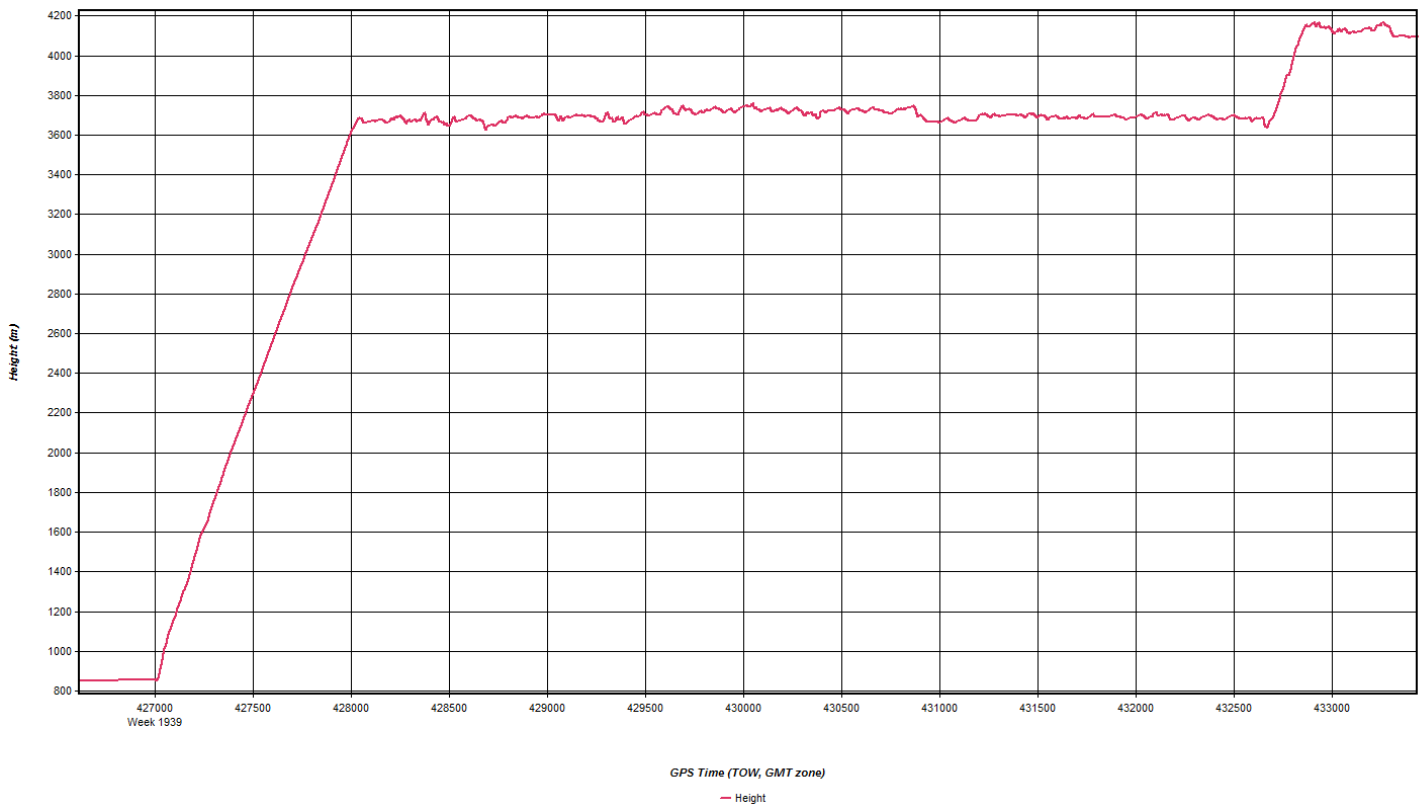
Name	StartTime (UTC)	Start AGL (m)	End Time (UTC)
62	9:45:00 PM	2102.90625	9:48:00 PM
61	9:49:00 PM	1561.720215	9:53:00 PM
60	9:56:00 PM	1680.026367	10:00:00 PM
59	10:01:00 PM	1680.789063	10:05:00 PM
58	10:08:00 PM	1625.091919	10:11:00 PM
57	10:14:00 PM	1808.301025	10:17:00 PM
56	10:19:00 PM	1847.973511	10:22:00 PM
55	10:24:00 PM	1699.771729	10:27:00 PM
54	10:29:00 PM	1932.793701	10:31:00 PM
53	10:33:00 PM	1979.743408	10:34:00 PM
52	10:37:00 PM	1726.783325	10:38:00 PM
191	10:47:00 PM	1977.496704	10:48:00 PM
190	10:51:00 PM	2118.955322	10:52:00 PM
189	10:54:00 PM	2057.638184	10:56:00 PM
188	10:58:00 PM	2081.019531	11:00:00 PM
UL001	7:58:00 PM	0	8:00:00 PM
UL002	11:02:00 PM	2058.72876	11:03:00 PM

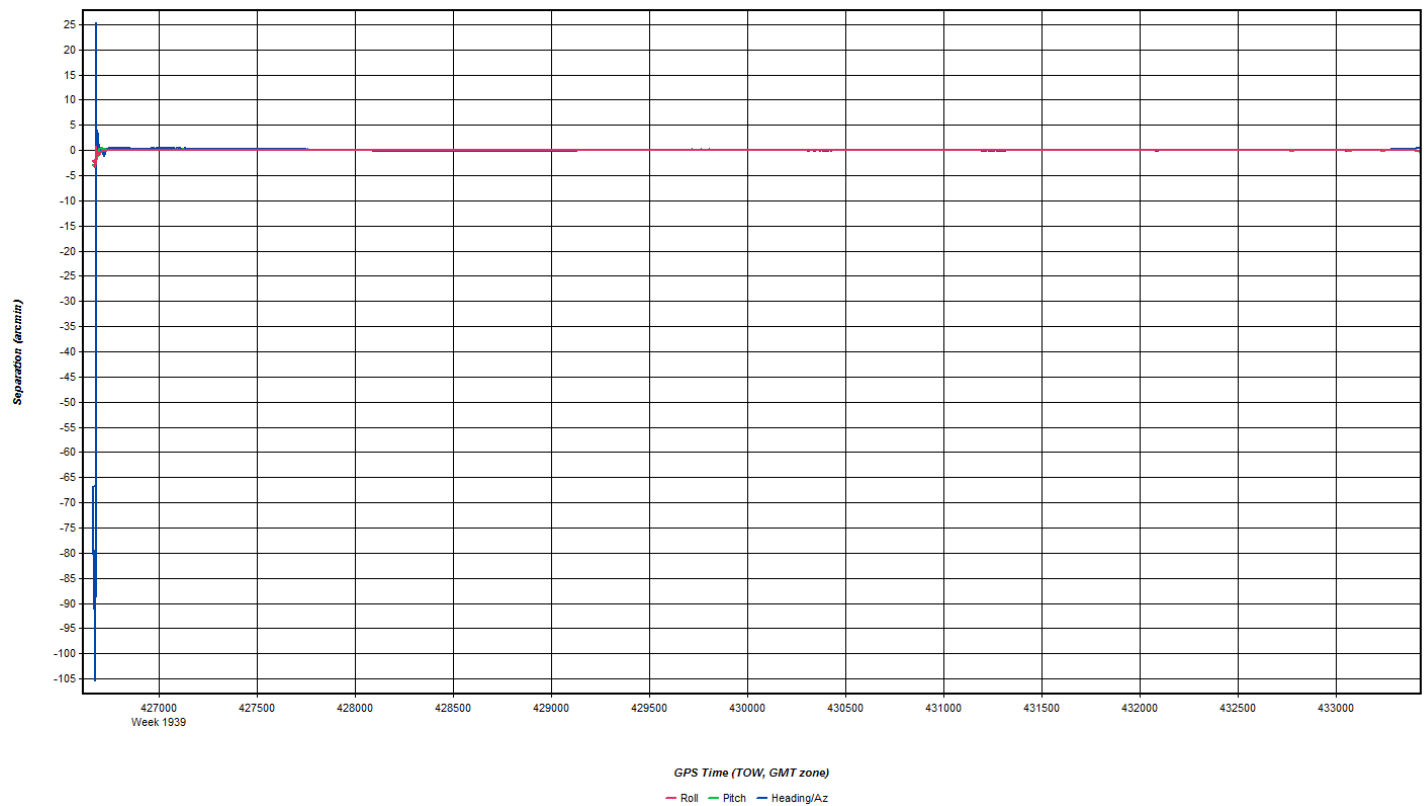
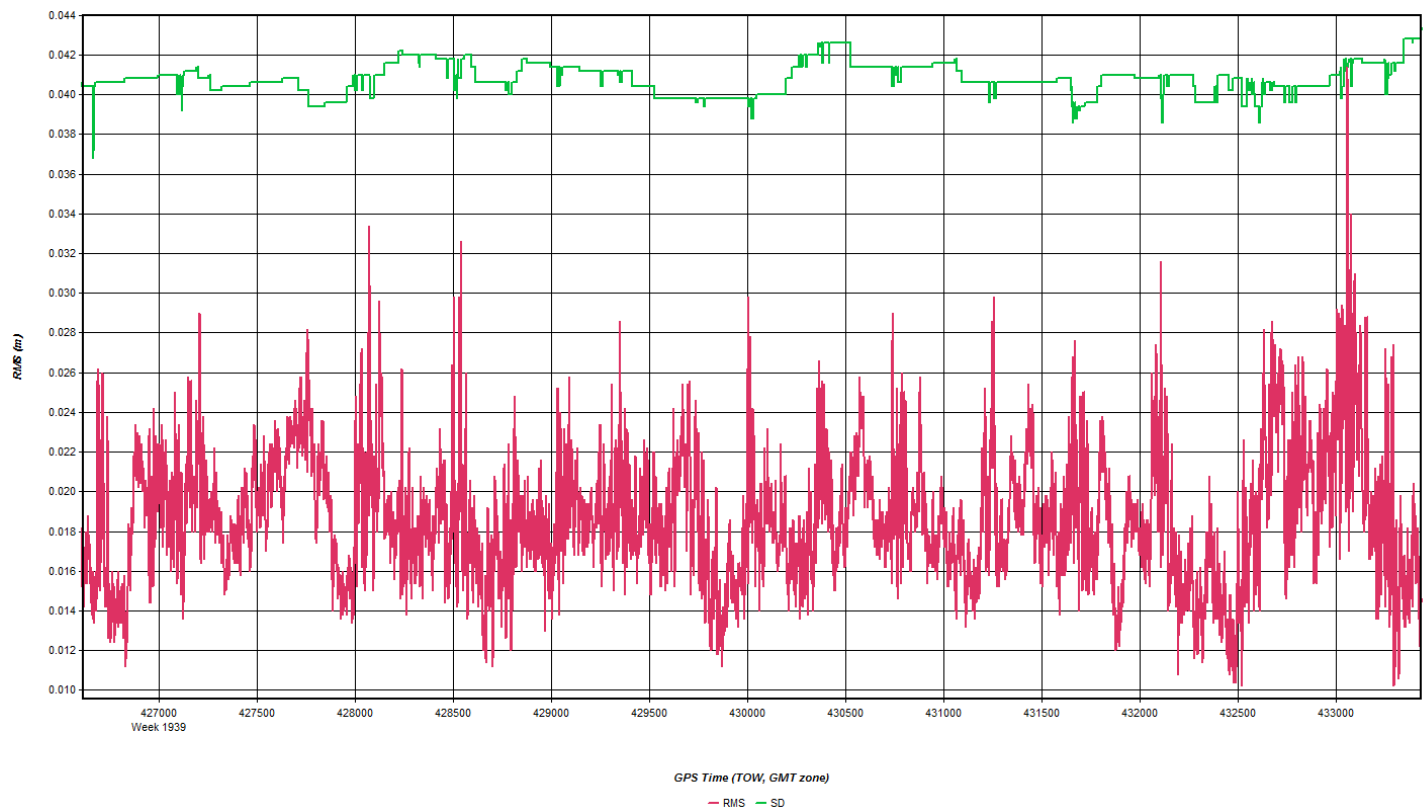
Mar 9, 2017-A (N704MD, SN8121)

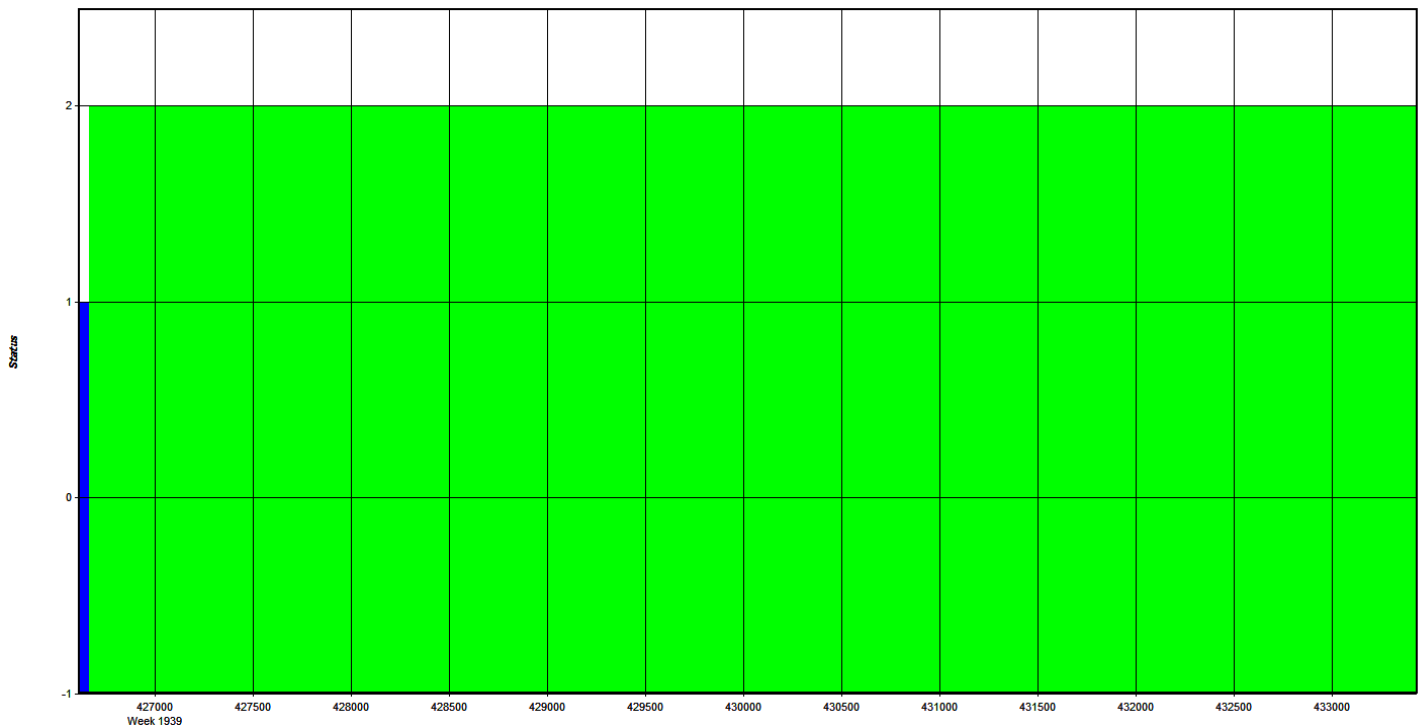












Coordinate/Antenna Settings

Master Remote

Base Station
 2: UTBE Name: UTBE ☐ Disabled
 File: E:\Proc\29083_UTAH\Survey_ftp_4-5-17\Survey\2_Static\JD06i

Coordinates
 Latitude: North 37 42 22.68909 Compute from PPP
 Longitude: West 113 39 06.90893 Enter Grid Values
 Ellipsoidal height: 1562.843 m Enter MSL Height
 Datum: WGS84 Datum Options
 Select From Favorites Add To Favorites Use Average Position

Antenna Height
 From station file: TRM55971.00, NONE View STA File
 Antenna profile: TRM55971.00 Info
 Measured height: 0.000 m
 ARP to L1 offset: 0.067 m
 Applied height: 0.067 m
 Measured to
☒ ARP
☐ L1 Phase Centre
 Compute From Slant

OK Cancel

Coordinate/Antenna Settings

Master Remote

Base Station

1: UTHN Name: UTHN ☐ Disabled

File: E:\Proc\29083_UTAH\Surveyftp_4-5-17\Survey\2_Static\JD06f

Coordinates

Latitude: North 37 11 08.50150 Compute from PPP

Longitude: West 113 17 55.20863 Enter Grid Values

Ellipsoidal height: 1013.602 m Enter MSL Height

Datum: WGS84 Datum Options

Select From Favorites Add To Favorites Use Average Position

Antenna Height

From station file: TRM55971.00, NONE View STA File

Antenna profile: TRM55971.00 Info

Measured height: 0.000 m

ARP to L1 offset: 0.067 m

Applied height: 0.067 m

Measured to

☒ ARP

☐ L1 Phase Centre

Compute From Slant

OK Cancel

Flight Log

Date: 3/9/2017	Aircraft: N704MD	Sensor: 8121
Project: Utah 2016 LiDAR		Project #: R029083
Flight Mgmt File: FMSL_WACounty_8121_speed_redux, FMSL_Utah_WACounty_SN8121_reflief		
Pilot: Eric Petersen		Sensor Operator: Jon Frech

	Flight 1	Flight 2	Flight 3	Flight 4
Wheels Up	9:55:00 AM	3:30:00 PM		
Wheels Down	11:35:00 AM	6:45:00 PM		
Begin Hobbs	11720.2	11721.6		
End Hobbs	11721.6	11724.7		
On-line Hobbs: 2.5		Mob Hobbs: 2		

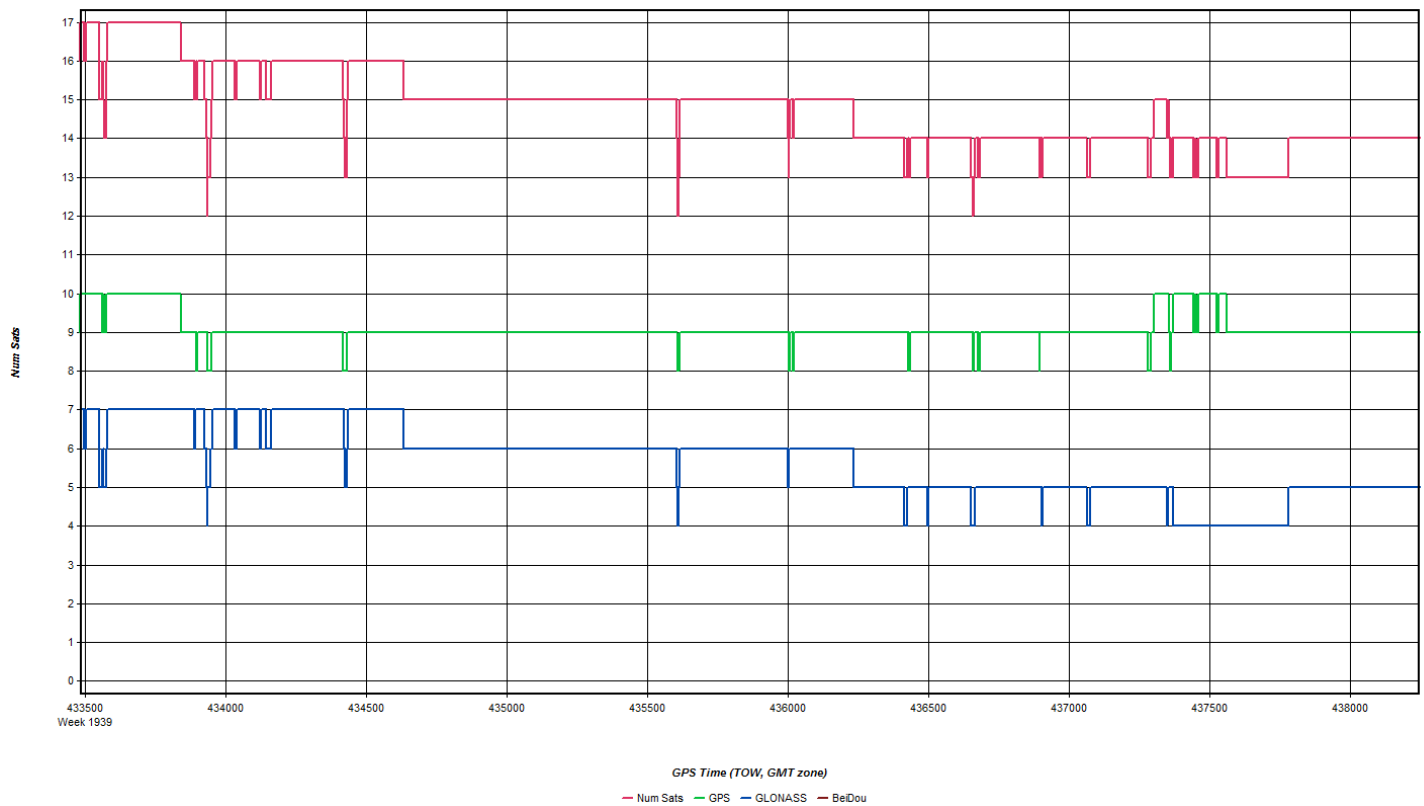
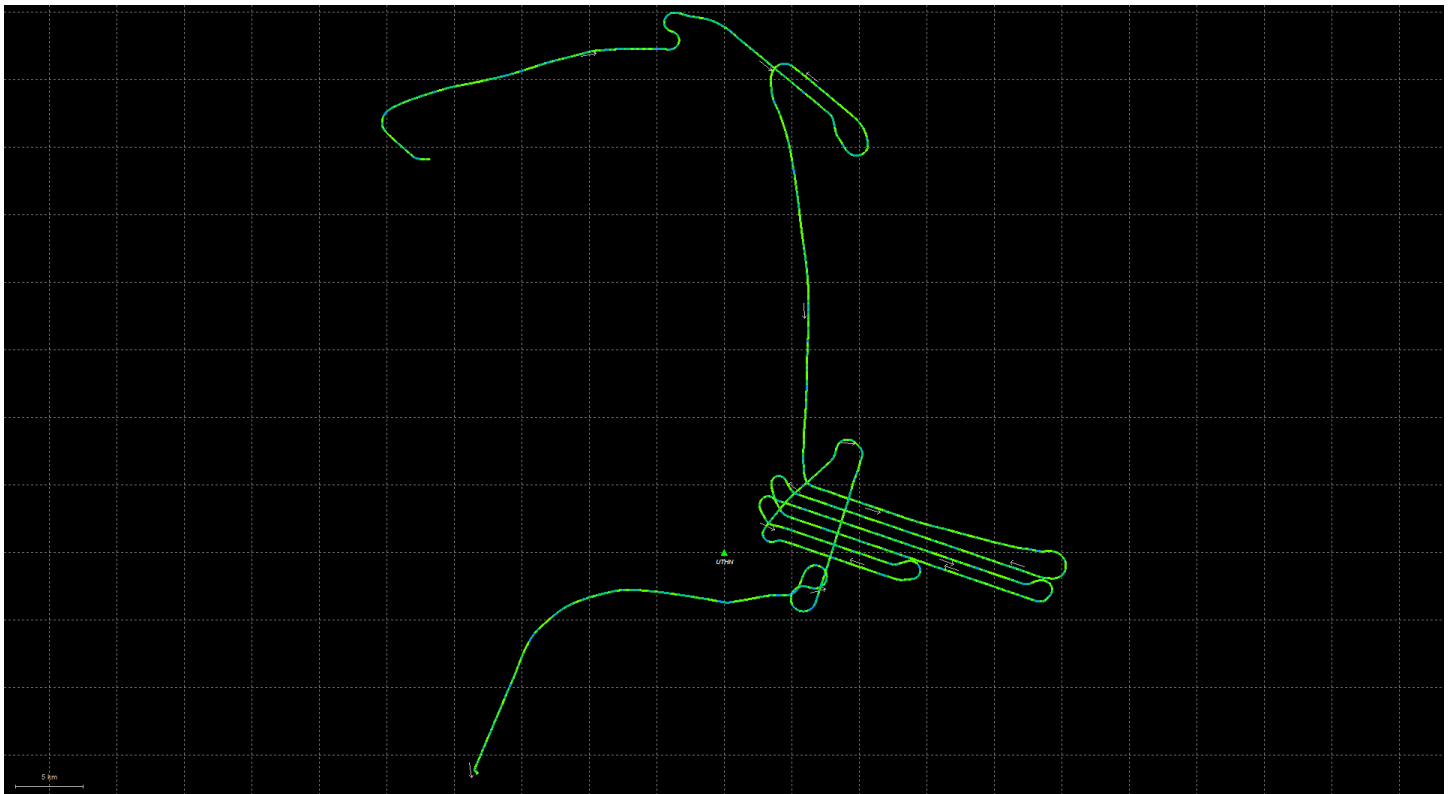
Notes

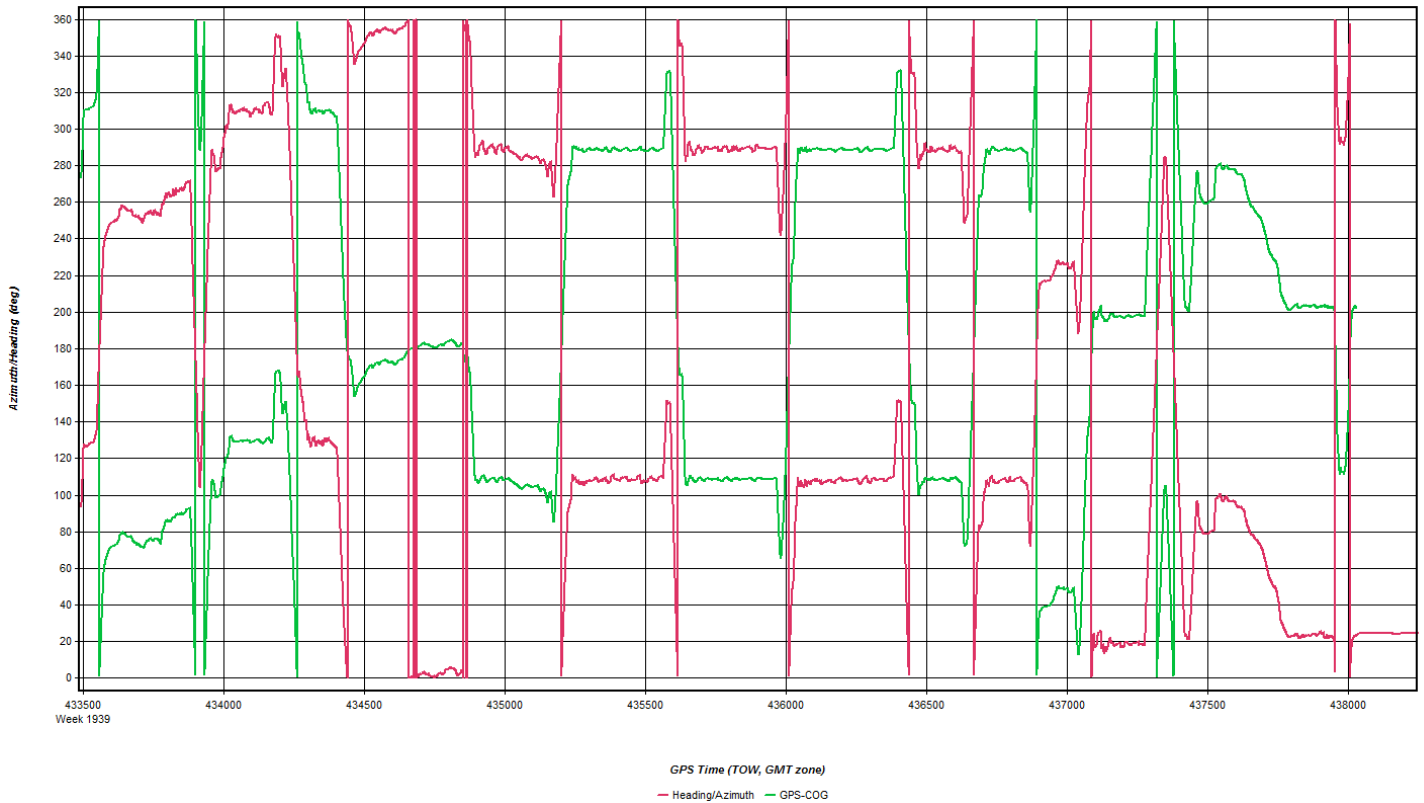
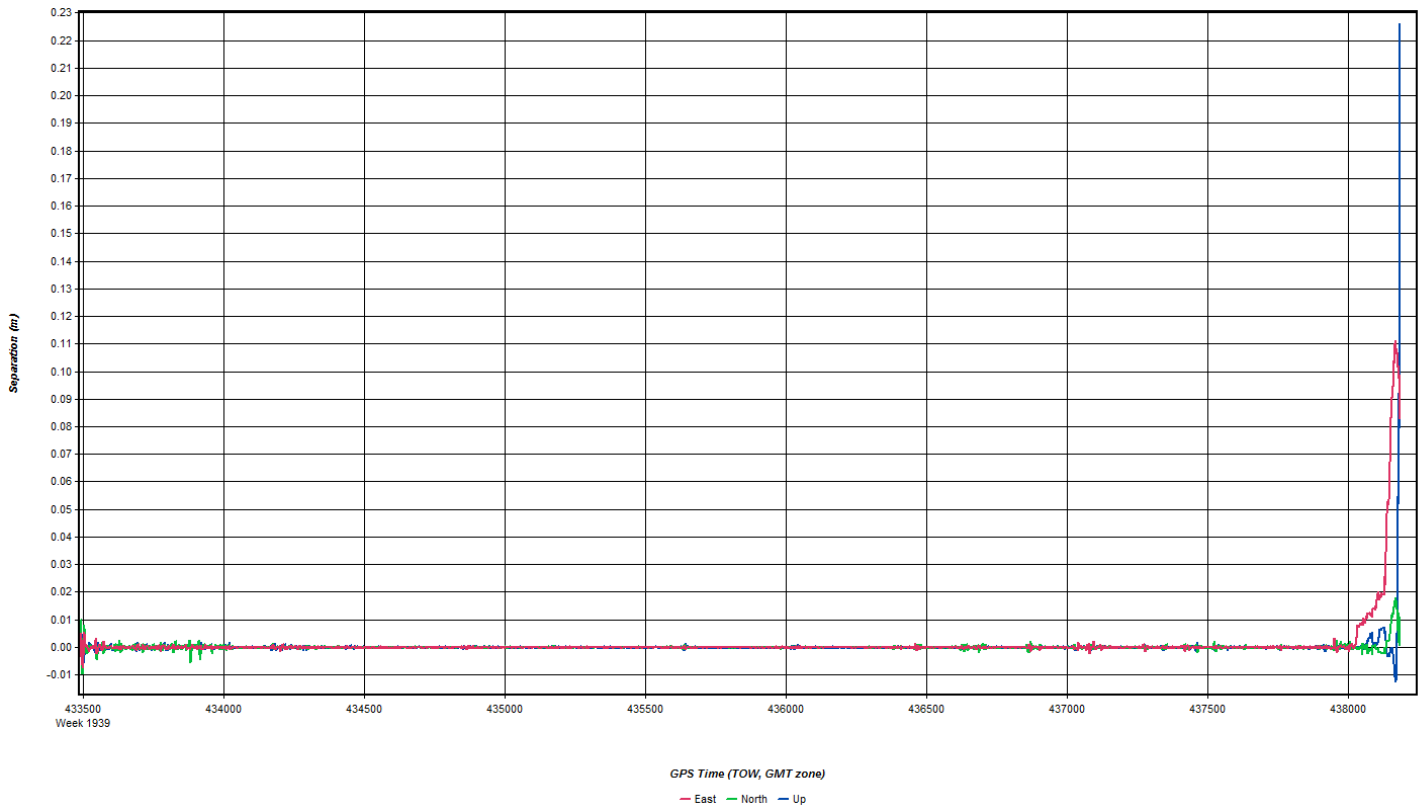
MOB to SGU with ground gear and CPB, disaster finding rental cars, got up for a late flight

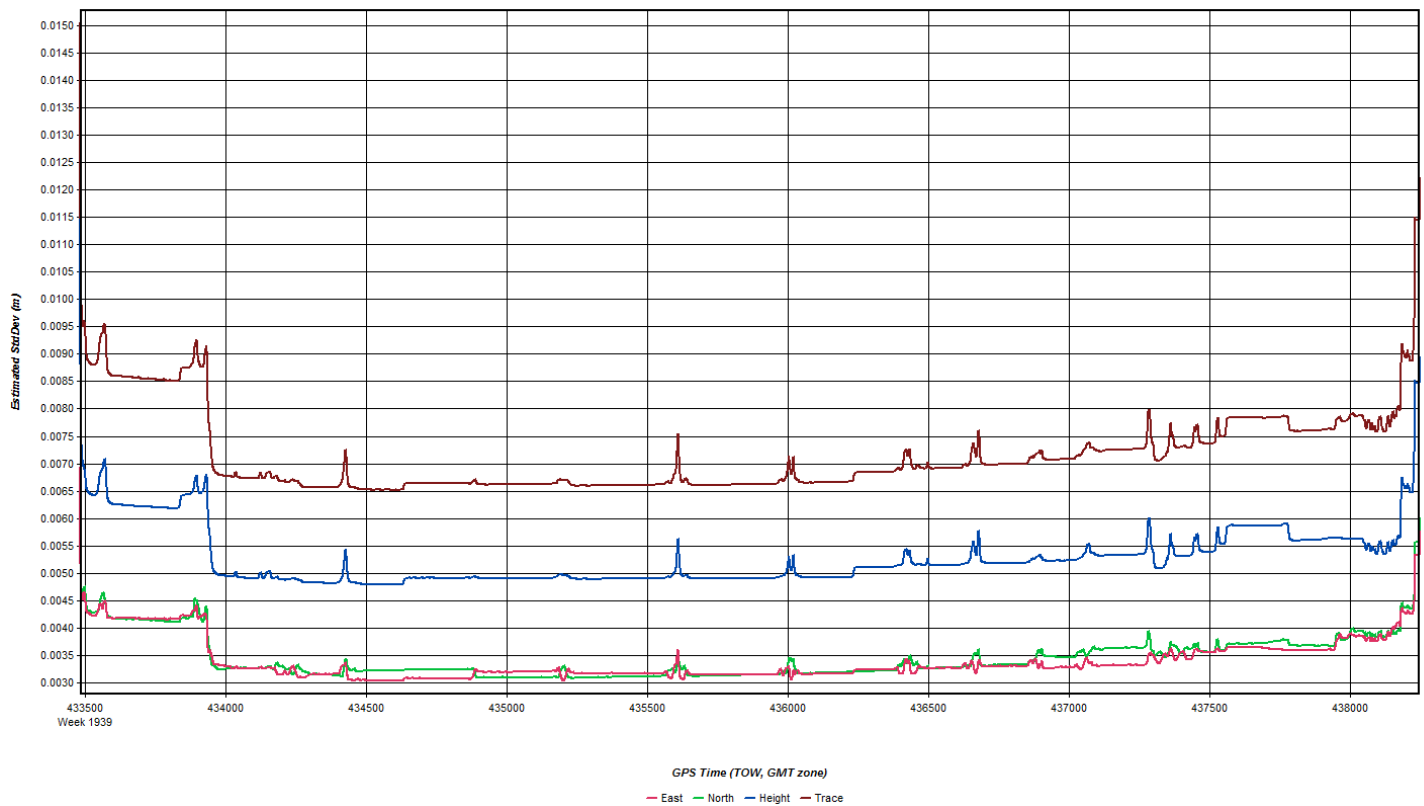
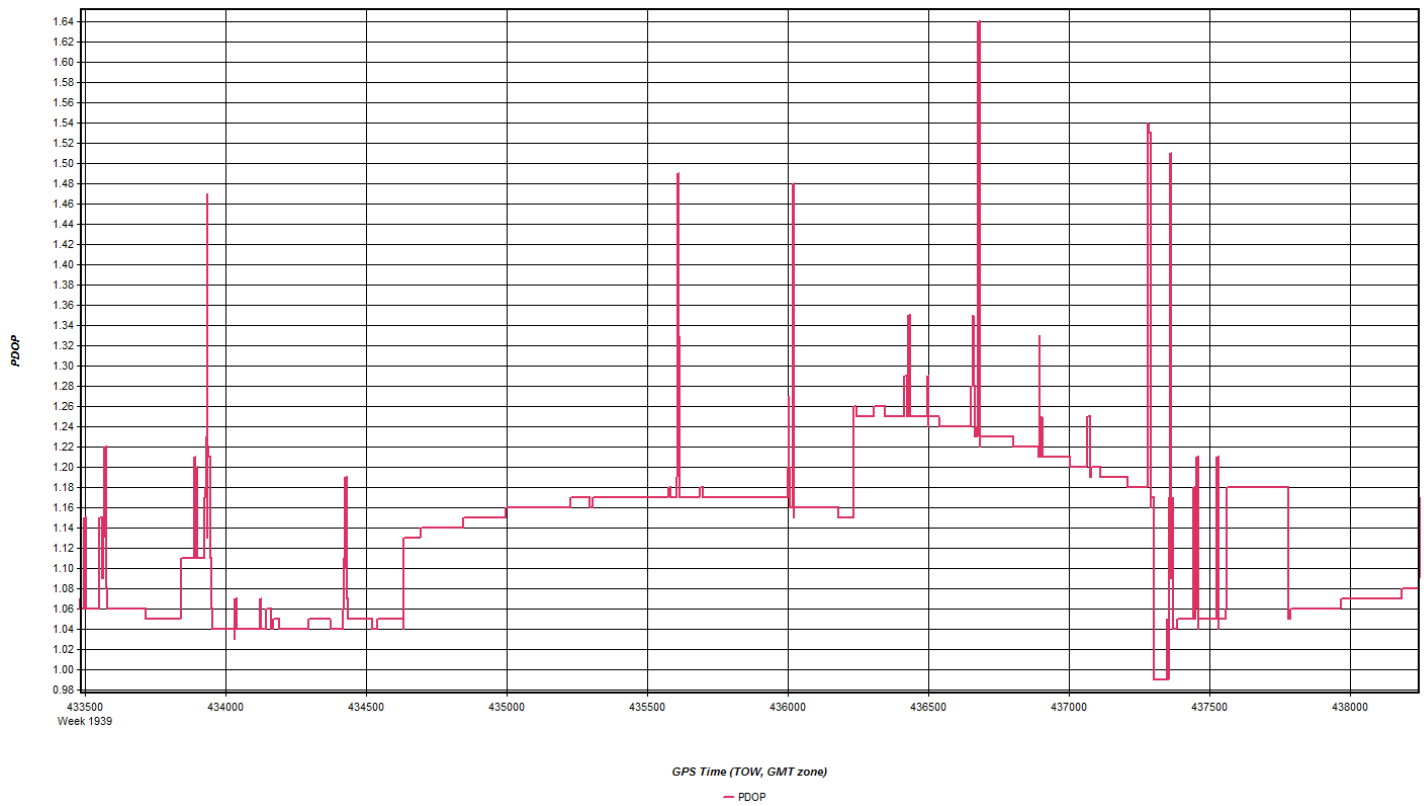
Flt Mgmt File: FMSL_WACounty_8121_speed_redux, FMSL_Utah_WACounty_SN8121_reflies

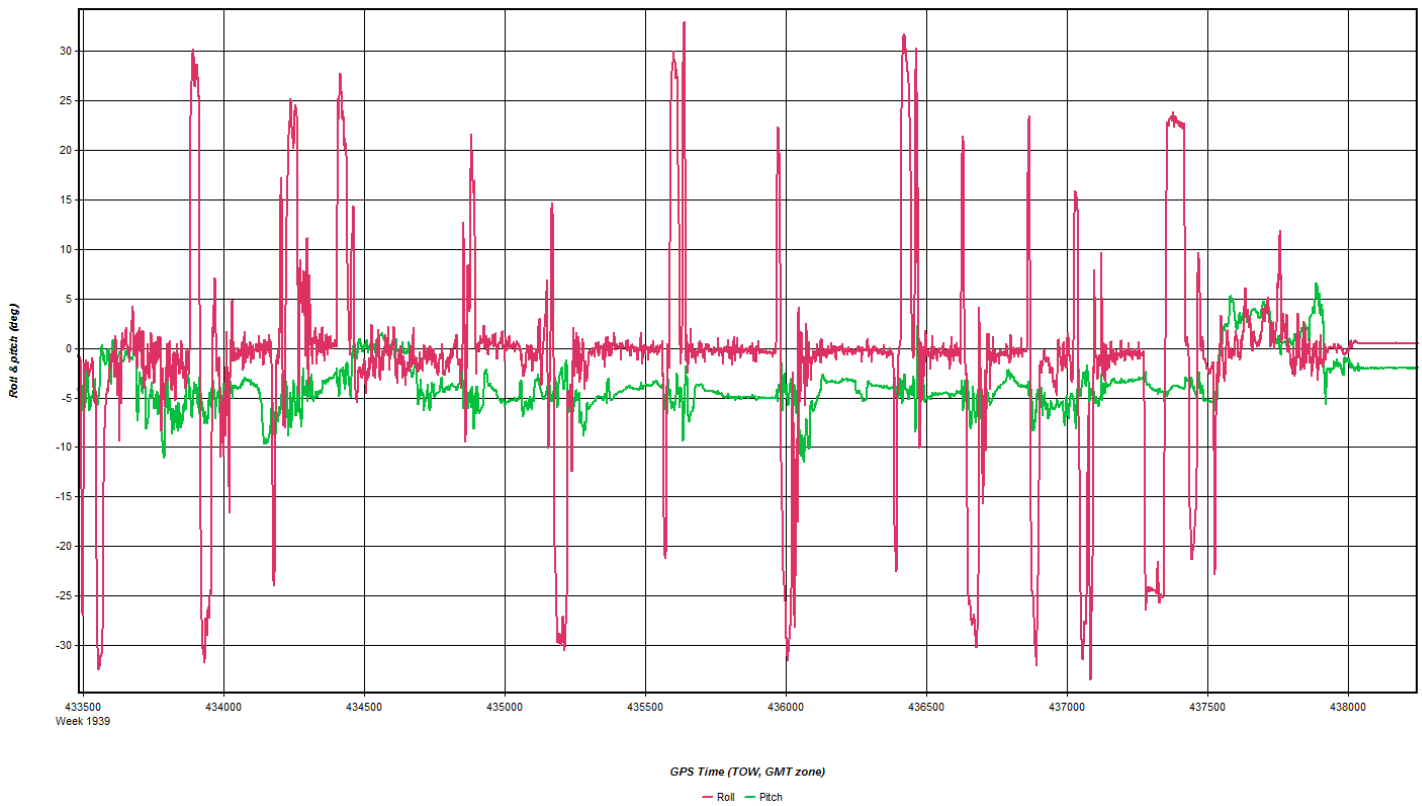
R001	10:58:29 PM	2053.582031	11:00:42 PM
R002	11:02:36 PM	2117.344482	11:04:44 PM
R003	11:07:23 PM	1988.538696	11:09:30 PM
R004	11:11:50 PM	2139.024902	11:13:39 PM
R029	11:16:36 PM	2077.910645	11:19:00 PM
136	11:23:16 PM	2043.16748	11:24:39 PM
135	11:27:42 PM	2044.414551	11:31:04 PM
134	11:33:36 PM	1874.095337	11:38:26 PM
133	11:40:23 PM	2124.749268	11:46:15 PM
132	11:47:54 PM	1948.367676	11:53:24 PM
131	11:55:17 PM	2109.124268	12:00:59 AM
130	12:02:52 AM	1960.753296	12:08:21 AM
111	12:17:45 AM	1961.992676	12:19:39 AM

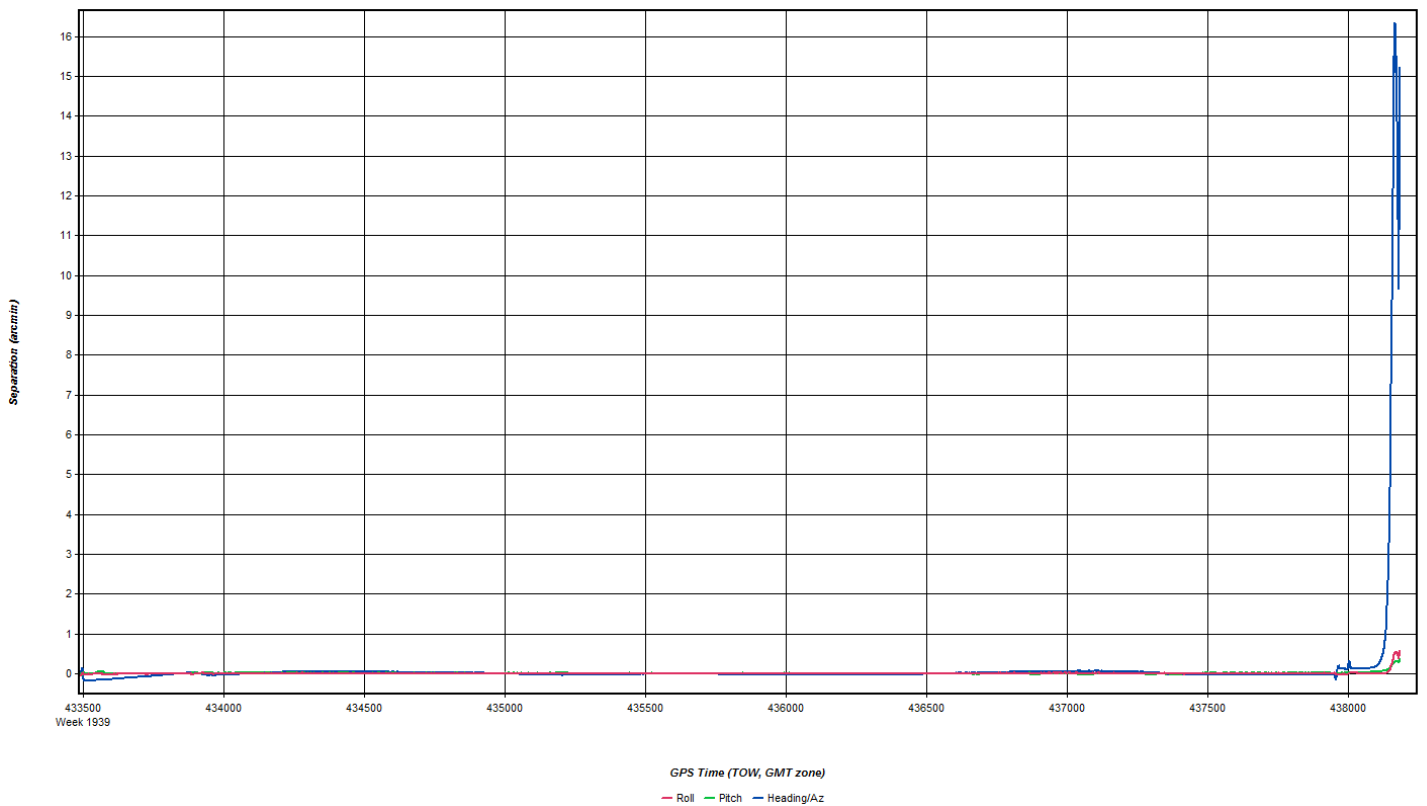
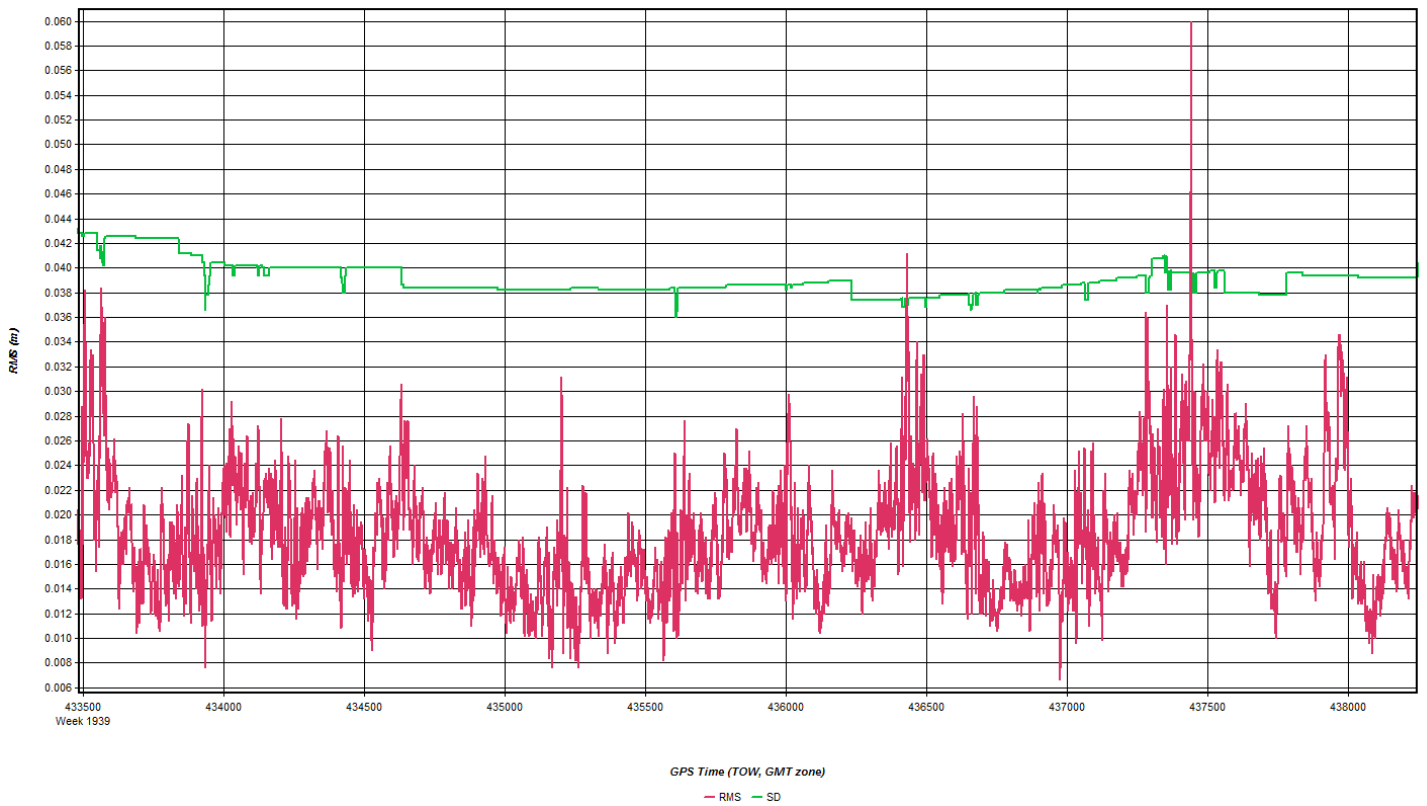
Mar 9, 2017-B (N704MD, SN8121)

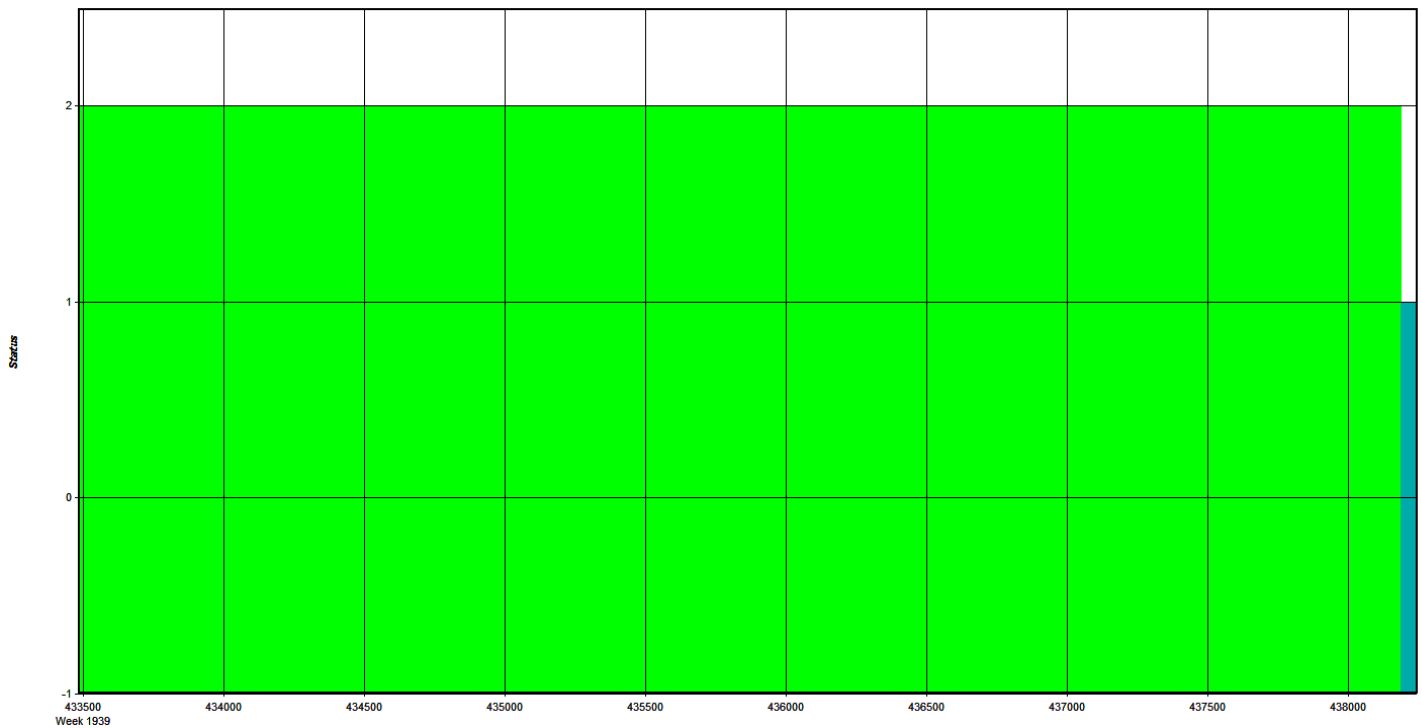












GPS Time (TOW, GMT zone)
 — Float — Forward Fixed — Reverse Fixed — Fixed (2 or more)

Coordinate/Antenna Settings

Master Remote

Base Station

1: UTHN Name: UTHN ☐ Disabled

File: E:\Proc\29083_UTAH\Surveyftp_4-5-17\Survey\2_Static\JD06i

Coordinates

Latitude: North 37 11 08.50150 Compute from PPP

Longitude: West 113 17 55.20863 Enter Grid Values

Ellipsoidal height: 1013.602 m Enter MSL Height

Datum: WGS84 Datum Options

Select From Favorites Add To Favorites Use Average Position

Antenna Height

From station file: TRM55971.00, NONE View STA File

Antenna profile: TRM55971.00 Info

Measured height: 0.000 m

ARP to L1 offset: 0.067 m

Applied height: 0.067 m

Measured to

☒ ARP

☐ L1 Phase Centre

Compute From Slant

OK Cancel

Flight Log

Date: 3/9/2017	Aircraft: N704MD	Sensor: 8121
Project: Utah 2016 LiDAR		Project #: R029083
Flight Mgmt File: FMSL_WACounty_8121_speed_redux, FMSL_Utah_WACounty_SN8121_reflief		
Pilot: Eric Petersen		Sensor Operator: Jon Frech

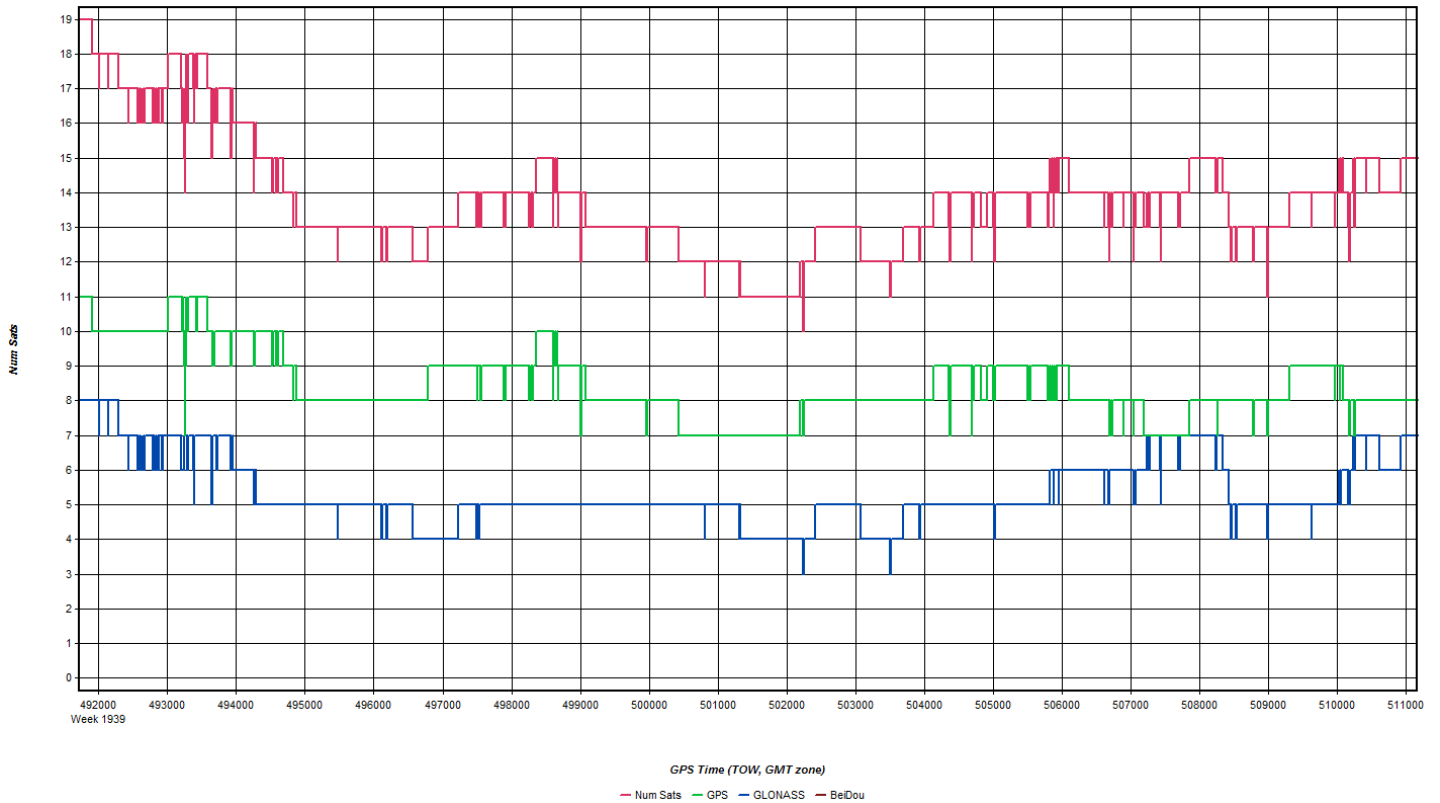
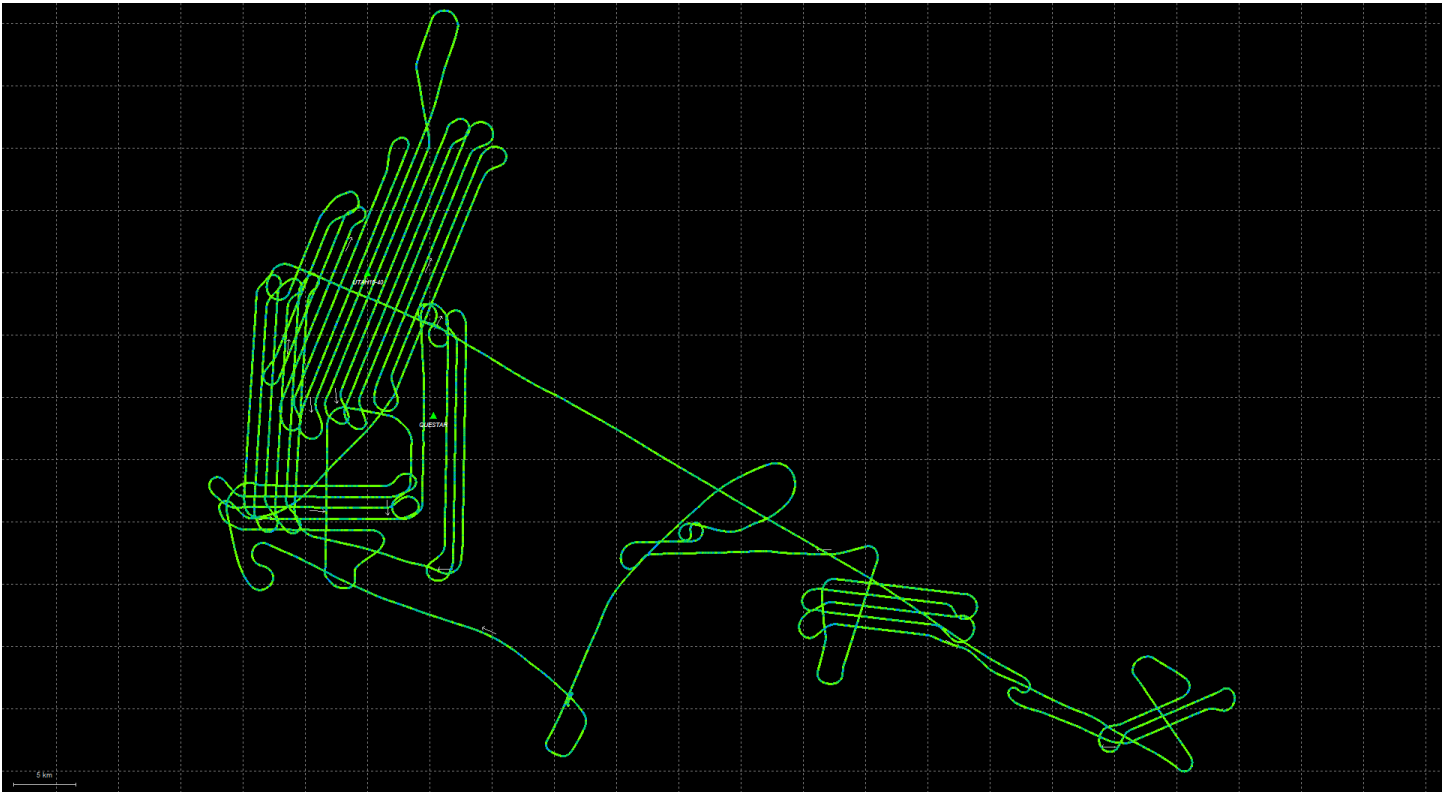
	Flight 1	Flight 2	Flight 3	Flight 4
Wheels Up				
Wheels Down				
Begin Hobbs				
End Hobbs				
On-line Hobbs:		Mob Hobbs:		

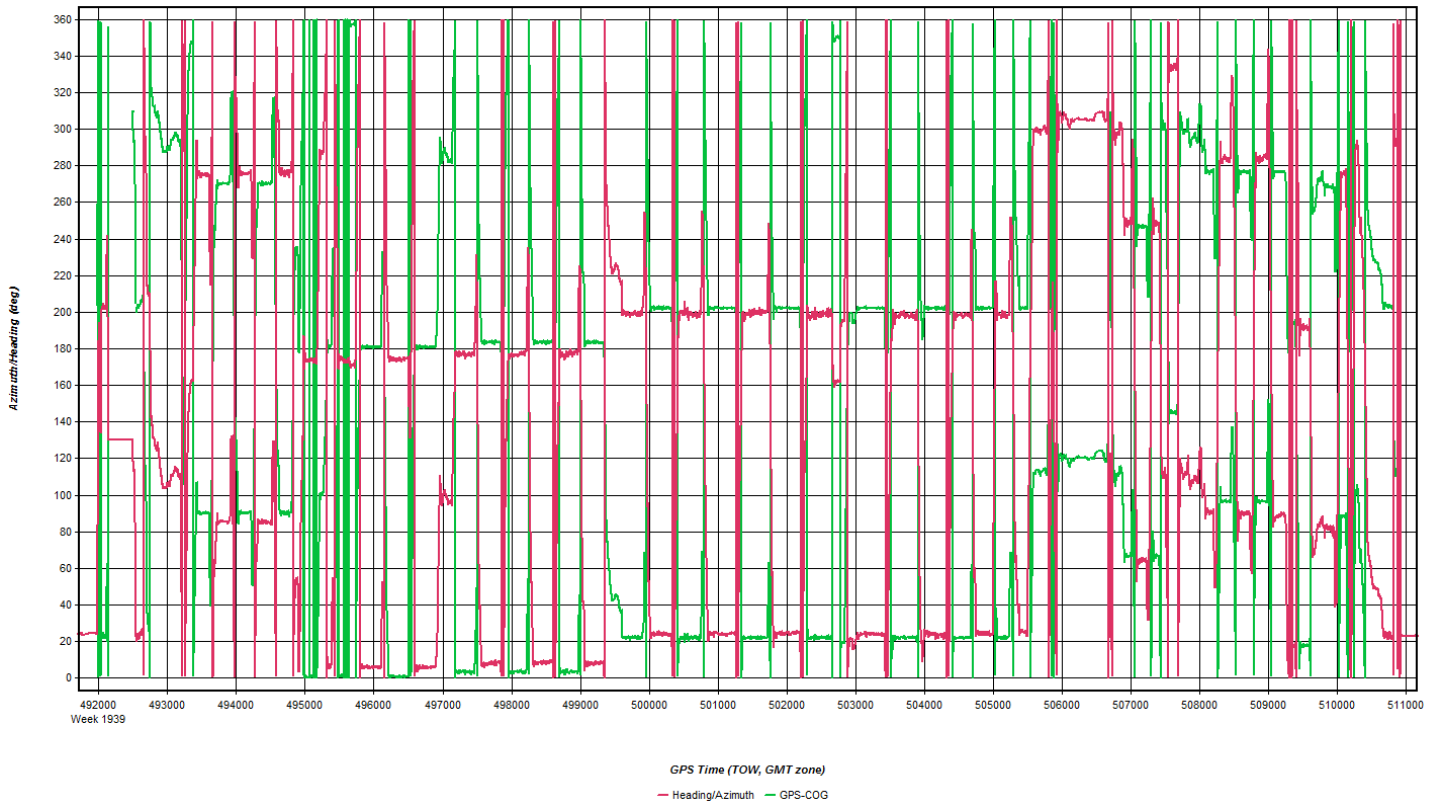
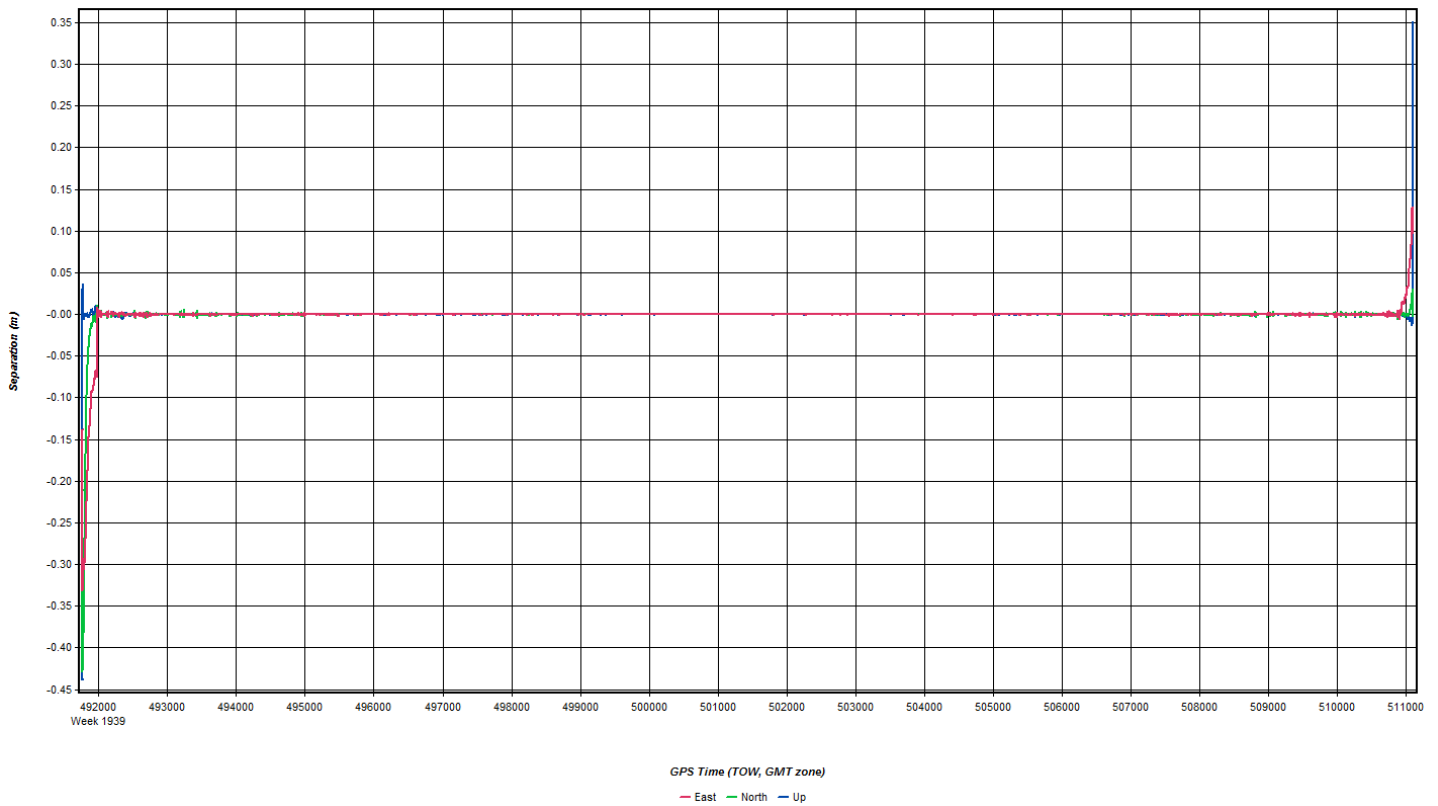
Notes

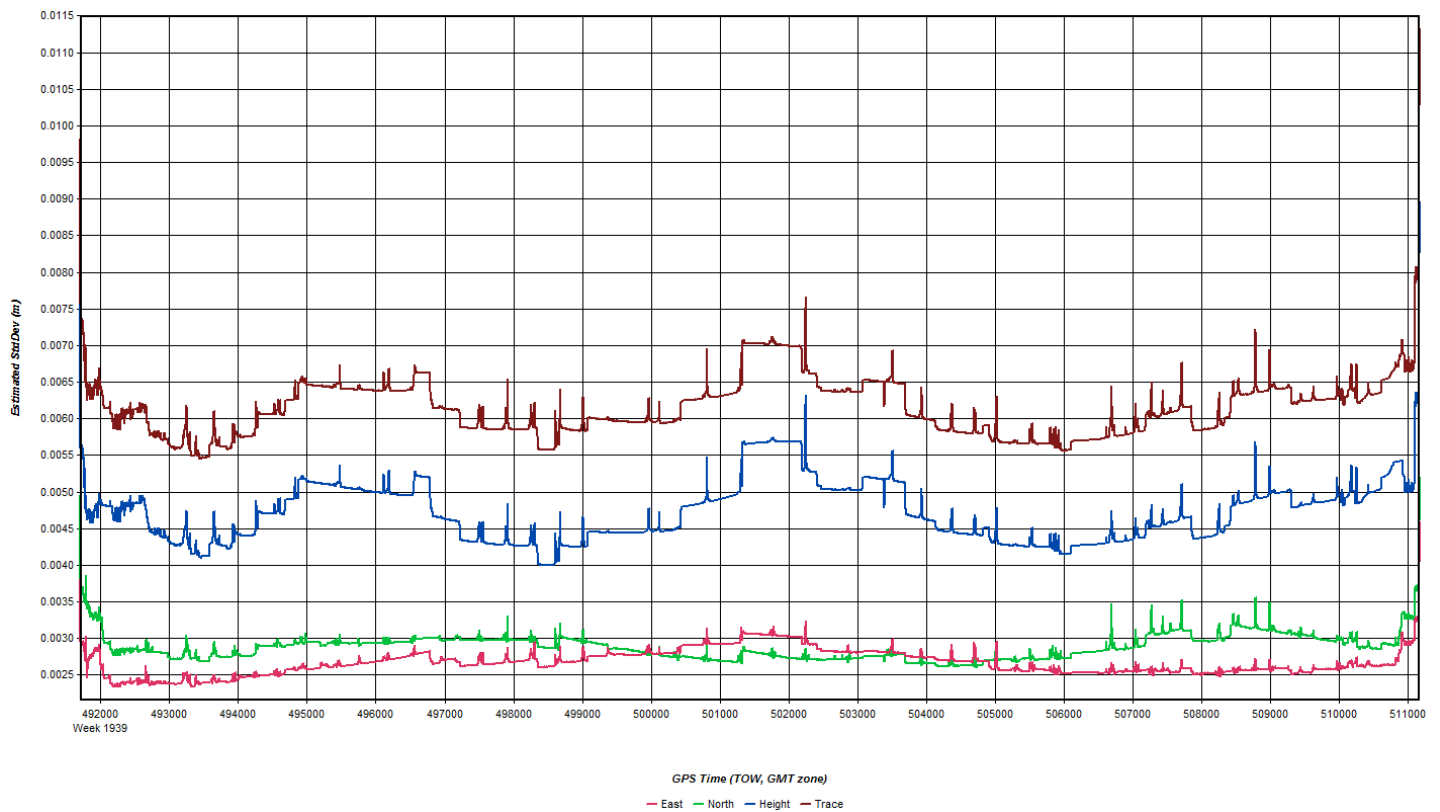
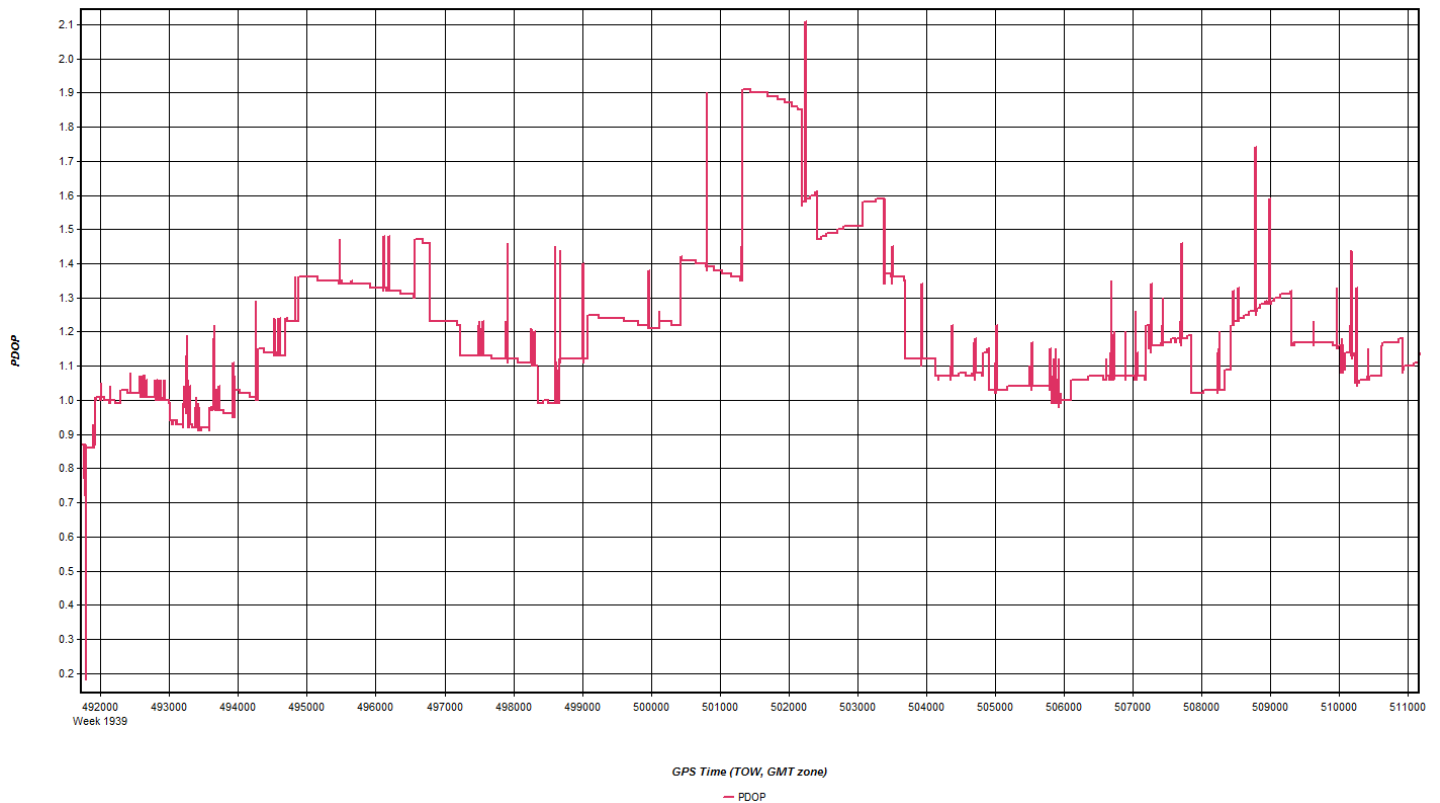
Flt Mgmt File: FMSL_WACounty_8121_speed_redux, FMSL_Utah_WACounty_SN8121_reflies

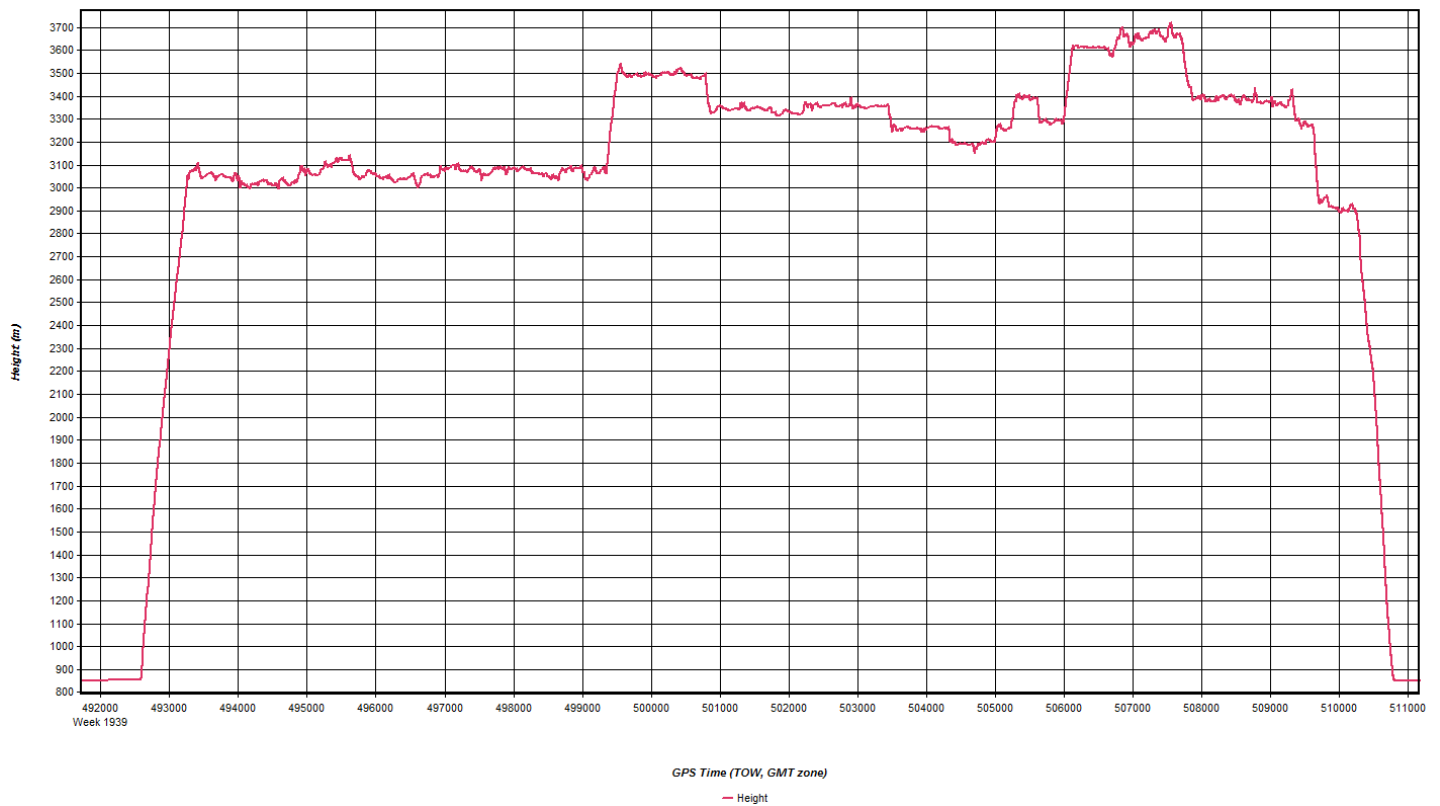
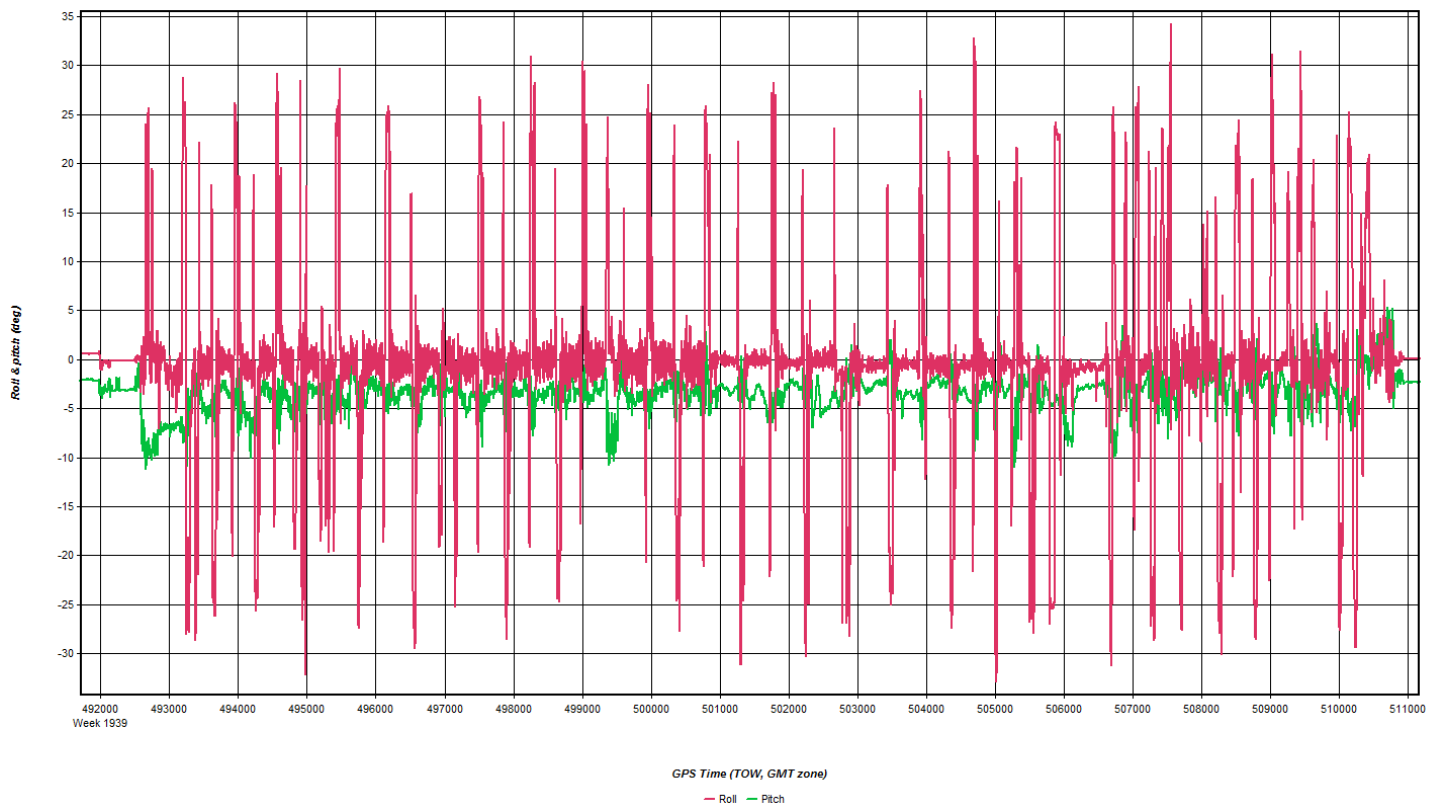
R001	10:58:29 PM	2053.582	11:00:42 PM
R002	11:02:36 PM	2117.344	11:04:44 PM
R003	11:07:23 PM	1988.539	11:09:30 PM
R004	11:11:50 PM	2139.025	11:13:39 PM
R029	11:16:36 PM	2077.911	11:19:00 PM
136	11:23:16 PM	2043.167	11:24:39 PM
135	11:27:42 PM	2044.415	11:31:04 PM
134	11:33:36 PM	1874.095	11:38:26 PM
133	11:40:23 PM	2124.749	11:46:15 PM
132	11:47:54 PM	1948.368	11:53:24 PM
131	11:55:17 PM	2109.124	12:00:59 AM
130	12:02:52 AM	1960.753	12:08:21 AM
111	12:17:45 AM	1961.993	12:19:39 AM

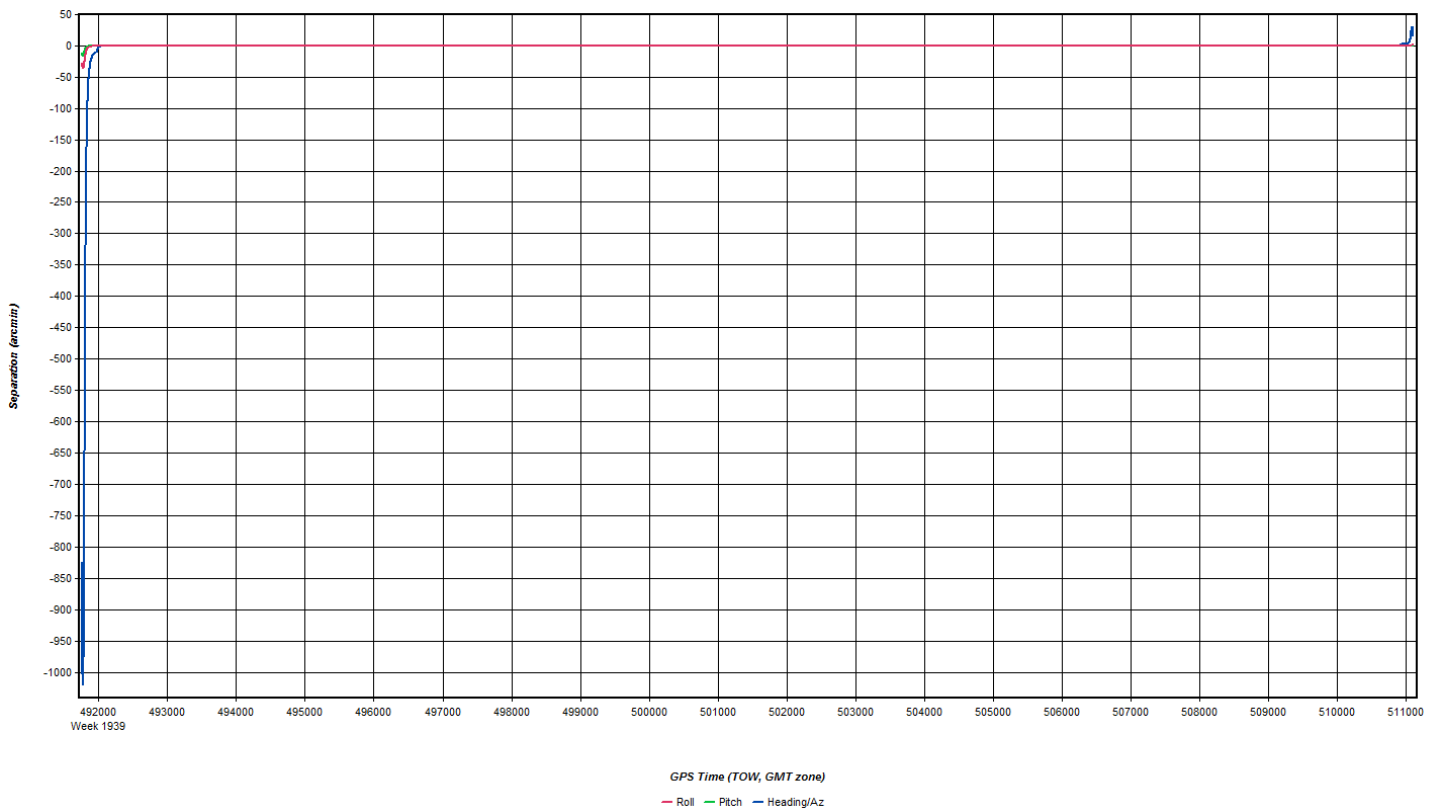
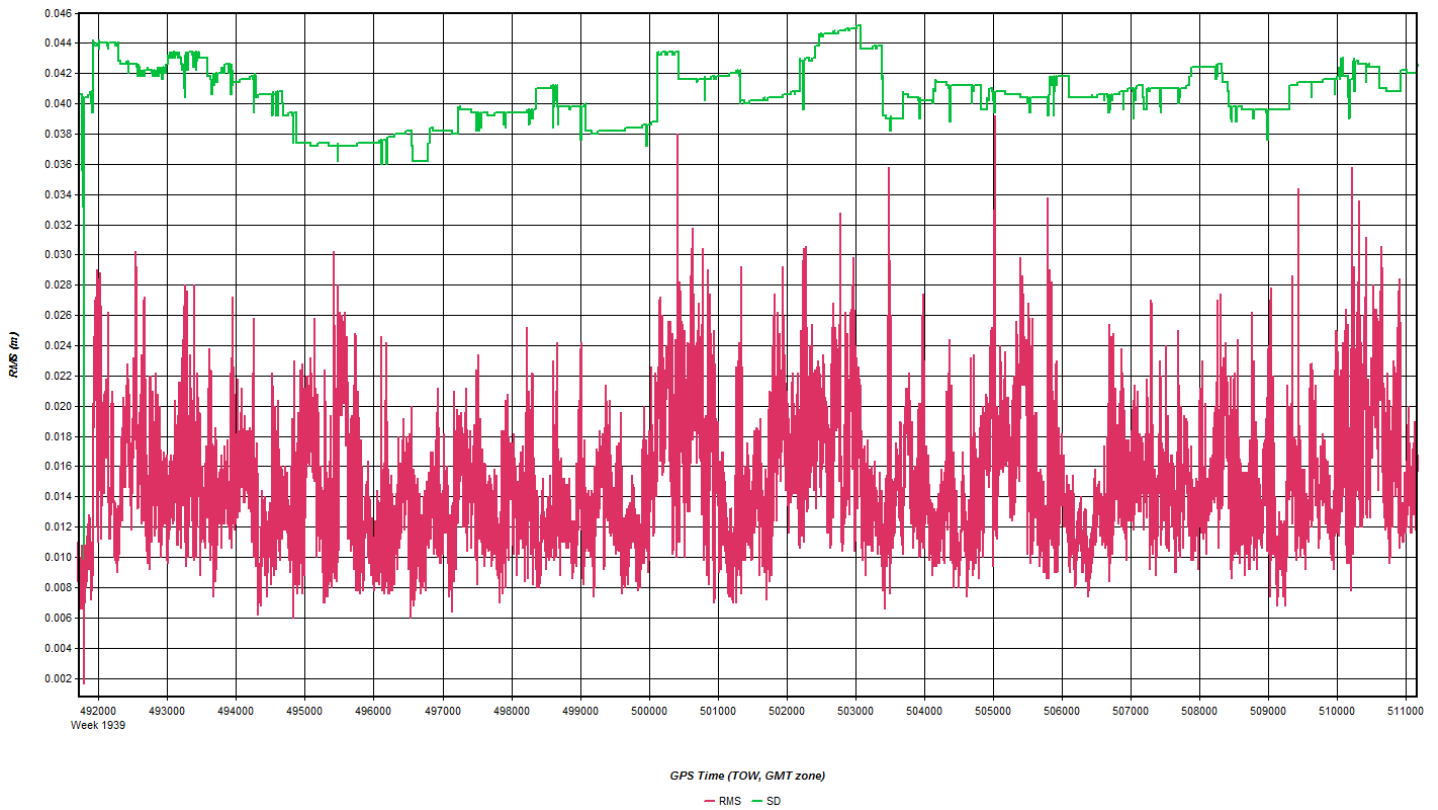
Mar 10, 2017-A (N704MD, SN8121)

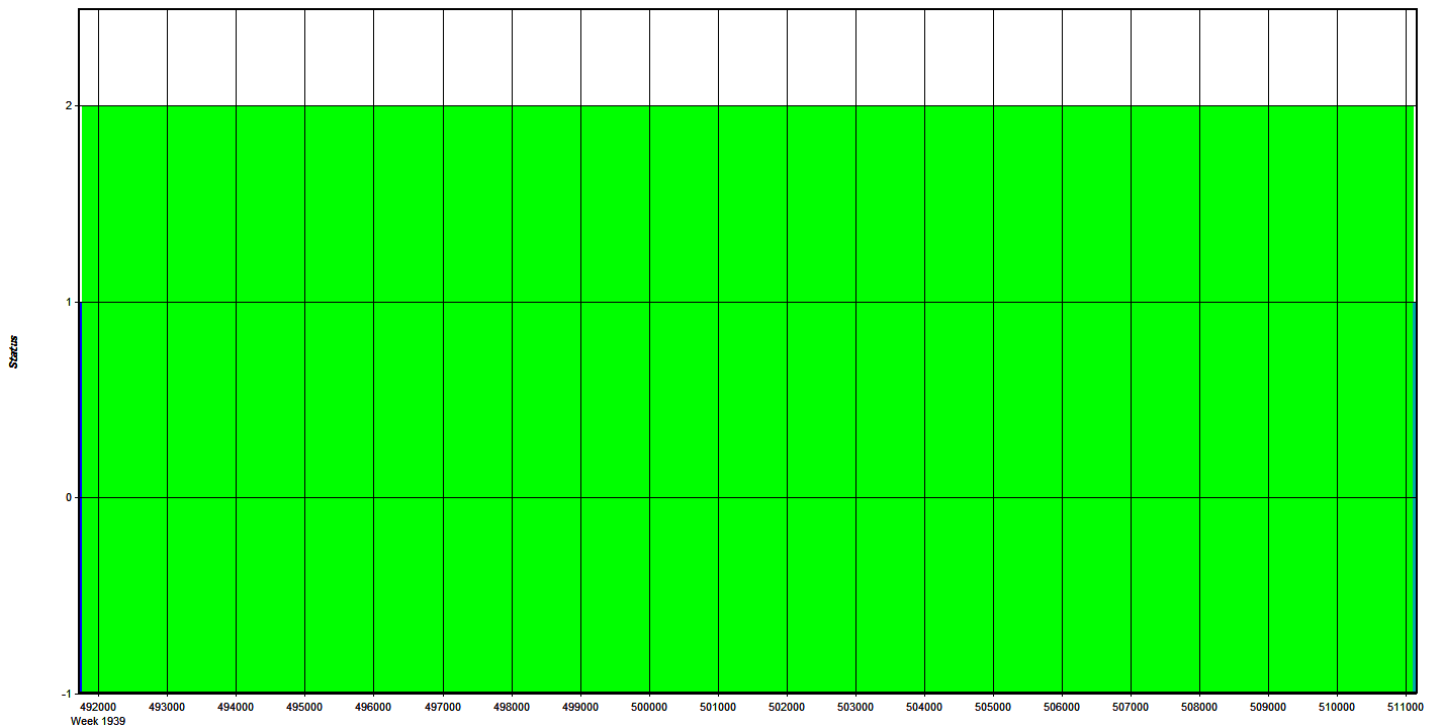












Coordinate/Antenna Settings

Master Remote

Base Station

2: QUESTAR Name: QUESTAR ☐ Disabled

File: E:\Proc\29083_UTAH\Survey_Rtp_4-4-17\29083_Utah_LiDAR_2

Coordinates

Latitude: North 37 14 50.52344 Compute from PPP

Longitude: West 113 37 37.83546 Enter Grid Values

Ellipsoidal height: 1343.736 m Enter MSL Height

Datum: WGS84 Datum Options

Select From Favorites Add To Favorites Use Average Position

Antenna Height

From station file: TRM55971.00, NONE View STA File

Antenna profile: TRM55971.00 Info

Measured height: 1.800 m

ARP to L1 offset: 0.067 m

Applied height: 1.867 m

Measured to

☒ ARP

☐ L1 Phase Centre

Compute From Slant

OK Cancel

Coordinate/Antenna Settings ? X

Master Remote

Base Station

1: UTAH16-40 Name: UTAH16-40 ☐ Disabled

File: E:\Proc\29083_UTAH\Survey_Rtp_4-4-17\29083_Utah_LiDAR_2

Coordinates

Latitude: North 37 20 59.75568 Compute from PPP

Longitude: West 113 41 14.26397 Enter Grid Values

Ellipsoidal height: 1395.663 m Enter MSL Height

Datum: WGS84 Datum Options

Select From Favorites Add To Favorites Use Average Position

Antenna Height

From station file: TRM55971.00, NONE View STA File

Antenna profile: TRM55971.00 Info

Measured height: 1.800 m

ARP to L1 offset: 0.067 m

Applied height: 1.867 m

Measured to

☒ ARP

☐ L1 Phase Centre

Compute From Slant

OK Cancel

Flight Log

Date: 3/10/2017	Aircraft: N704MD	Sensor: 8121
Project: Utah 2016 LiDAR		Project #: R029083
Flight Mgmt File: FMSL_WACounty_8121_speed_redux, FMSL_Utah_WACounty_SN8121_reflies		
Pilot: Eric Petersen		Sensor Operator: Jon Frech

	Flight 1	Flight 2	Flight 3	Flight 4
Wheels Up	9:35:00 AM			
Wheels Down	2:55:00 PM			
Begin Hobbs	11724.7			
End Hobbs	11729.7			
On-line Hobbs: 4.3		Mob Hobbs: 0.7		

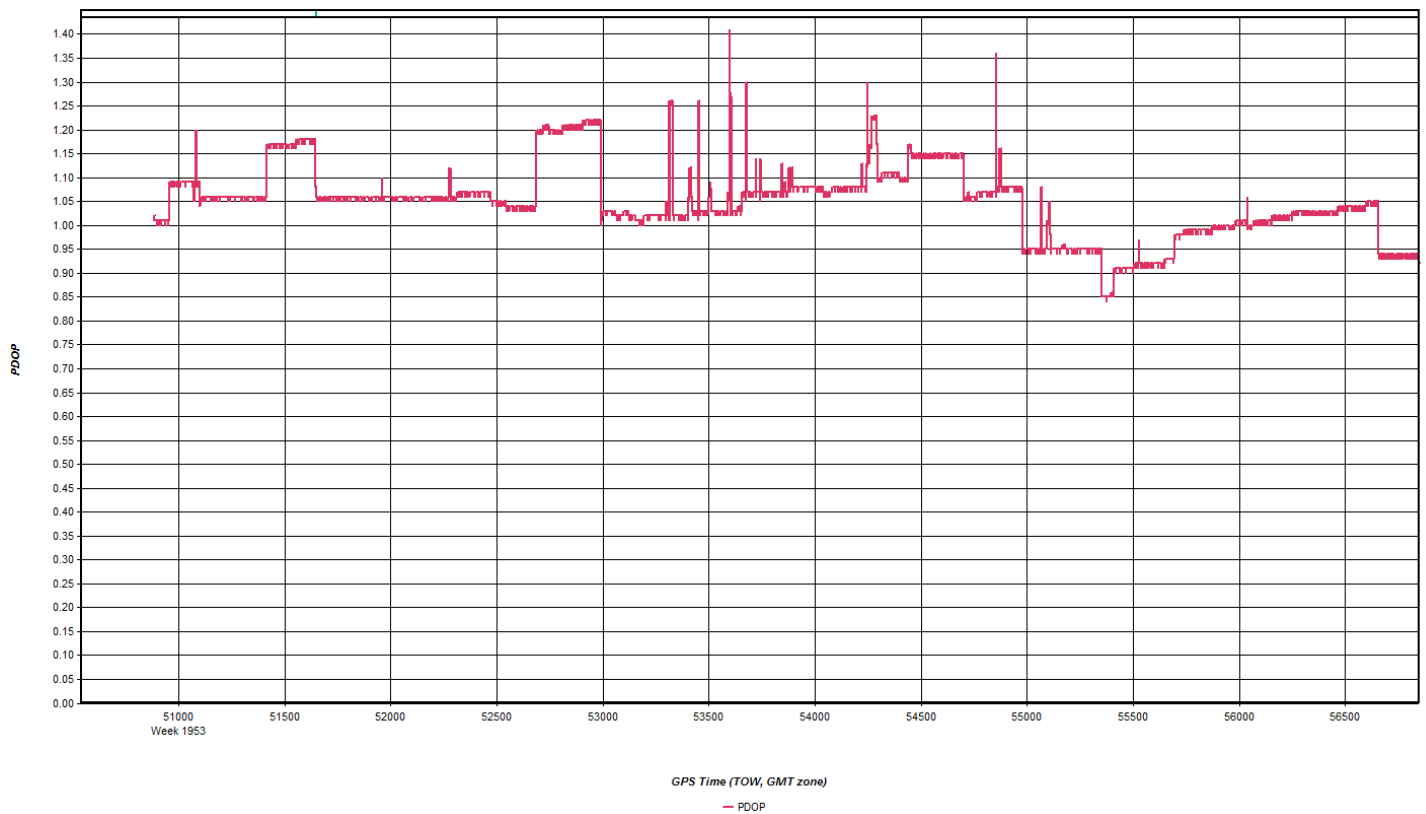
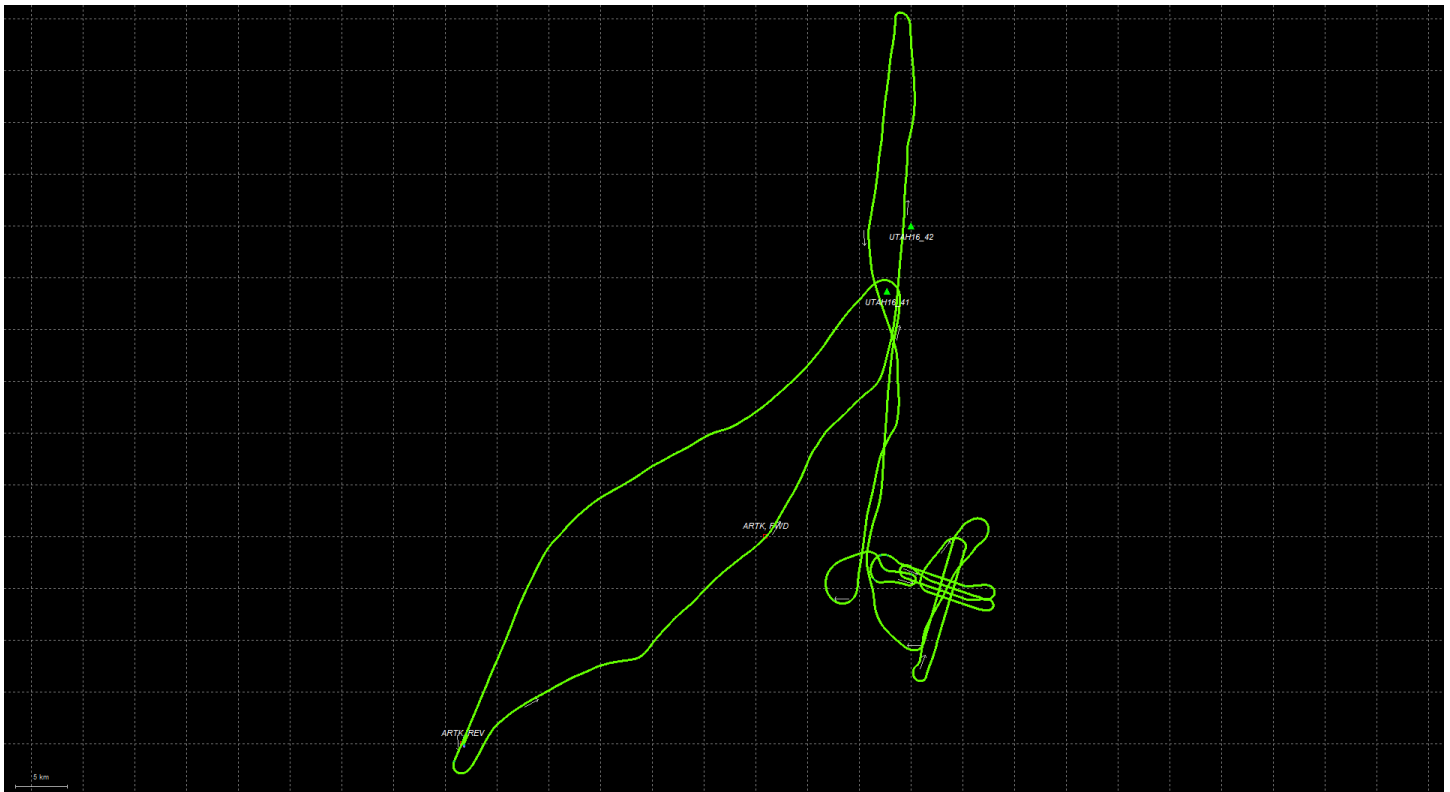
Notes

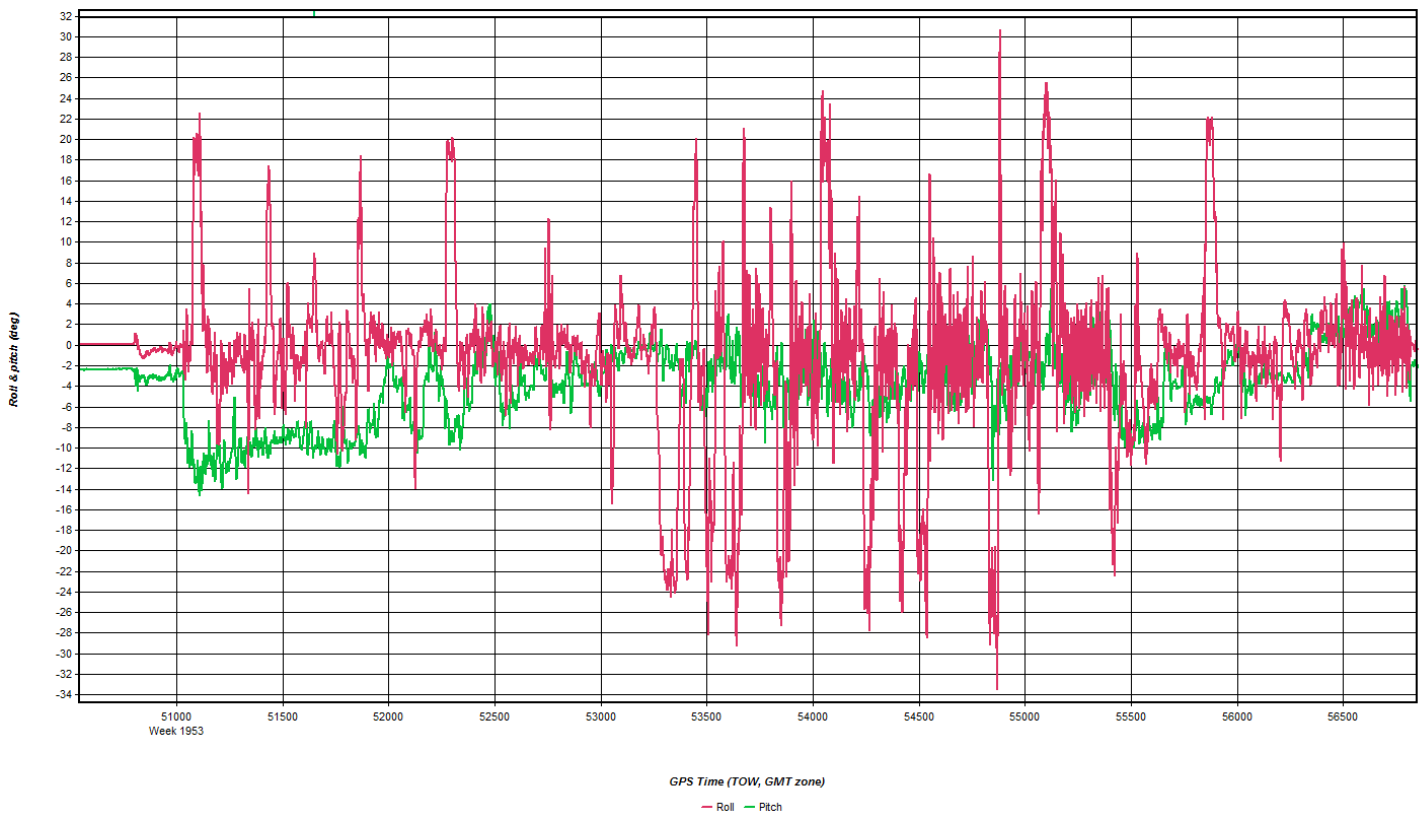
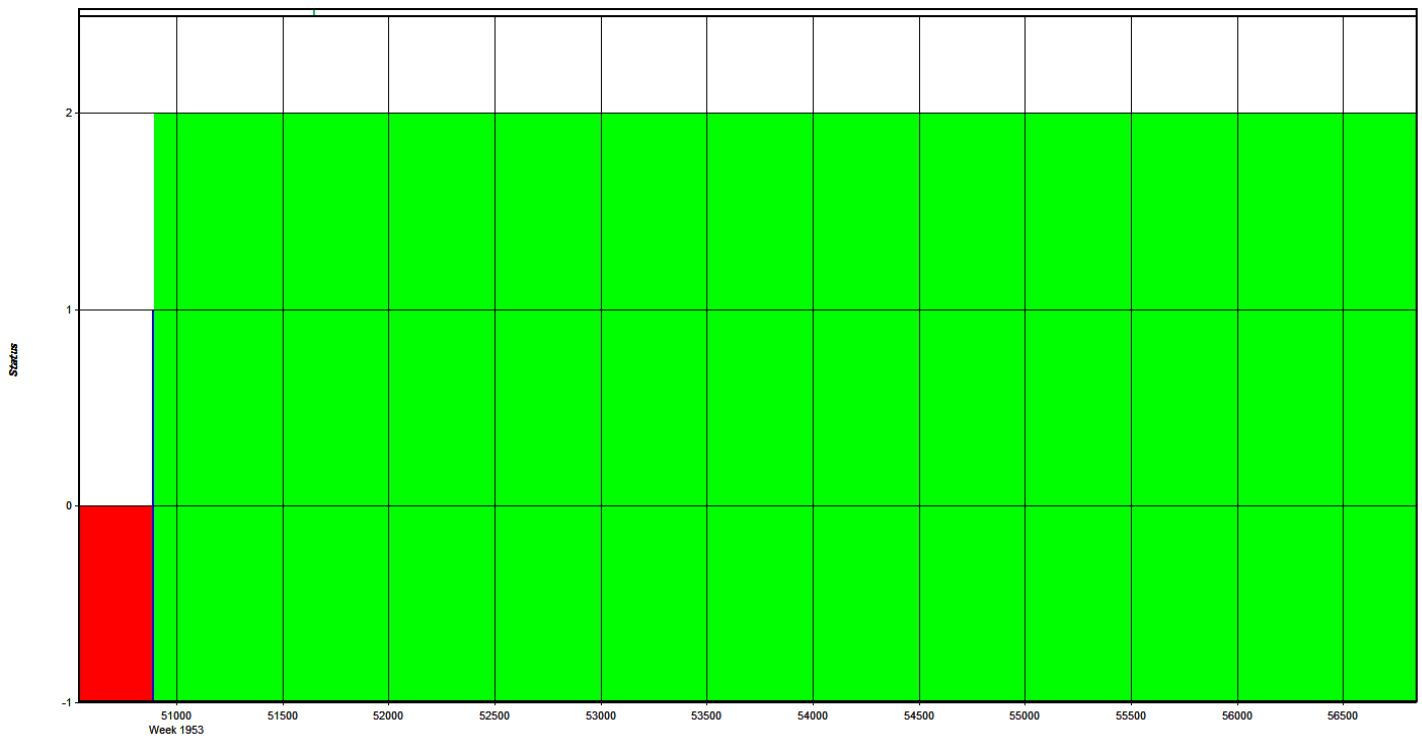
Finished reflies and all snow free areas of washington county

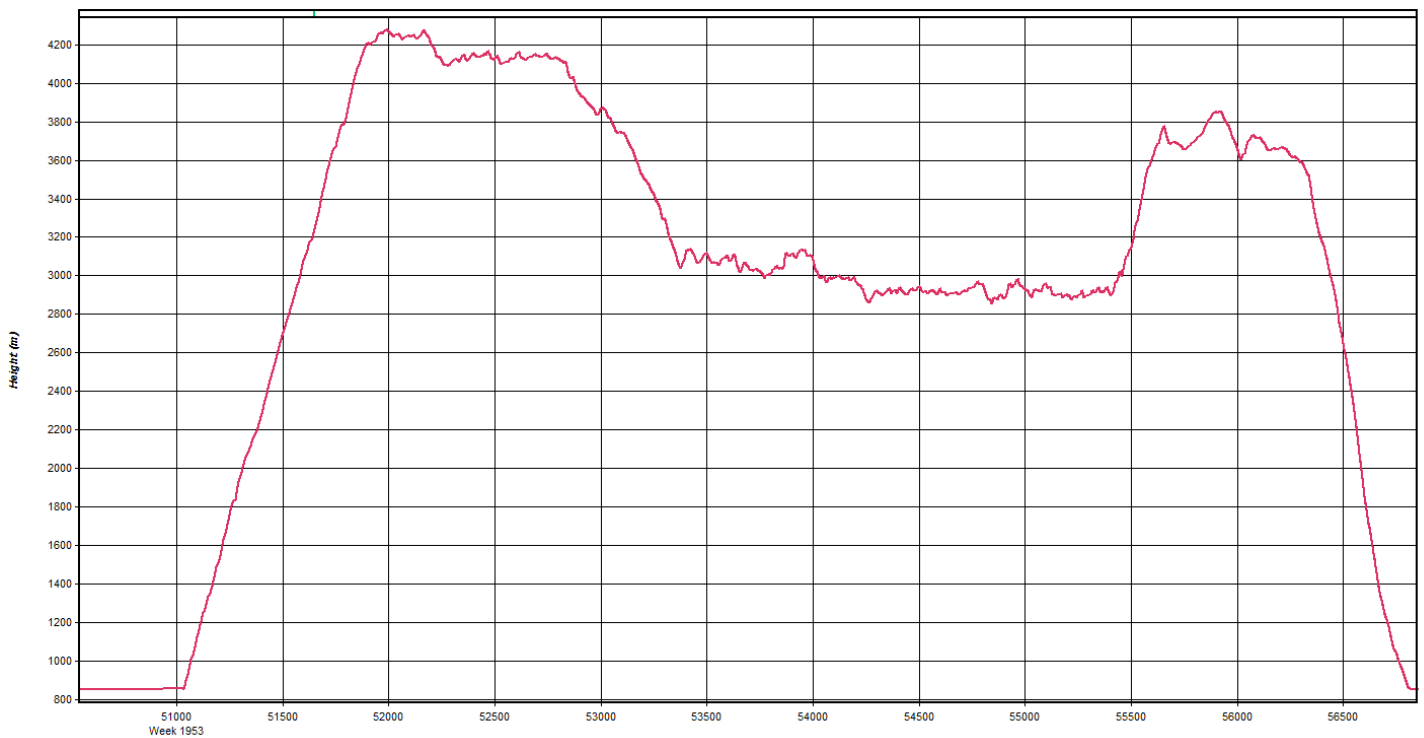
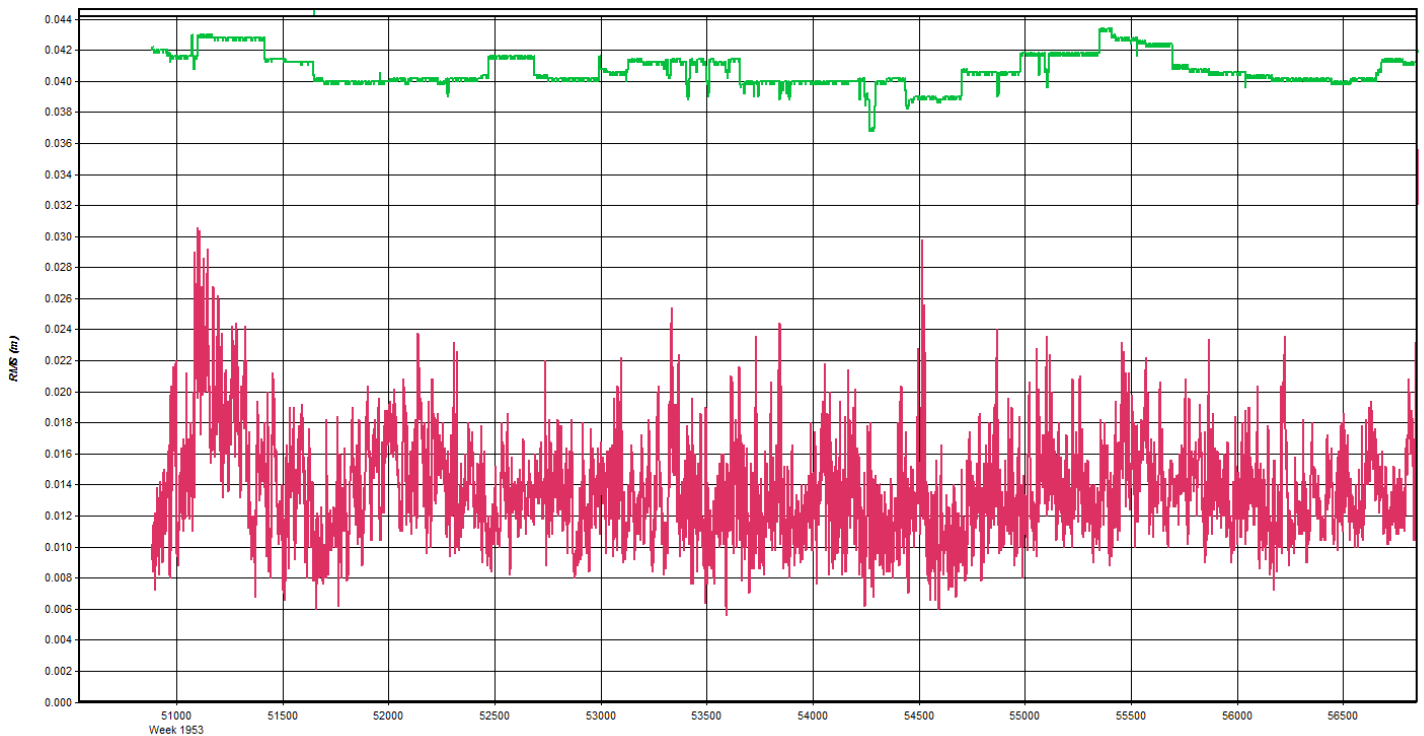
Flt Mgmt File: FMSL_WACounty_8121_speed_redux, FMSL_Utah_
WACounty_SN8121_reflies

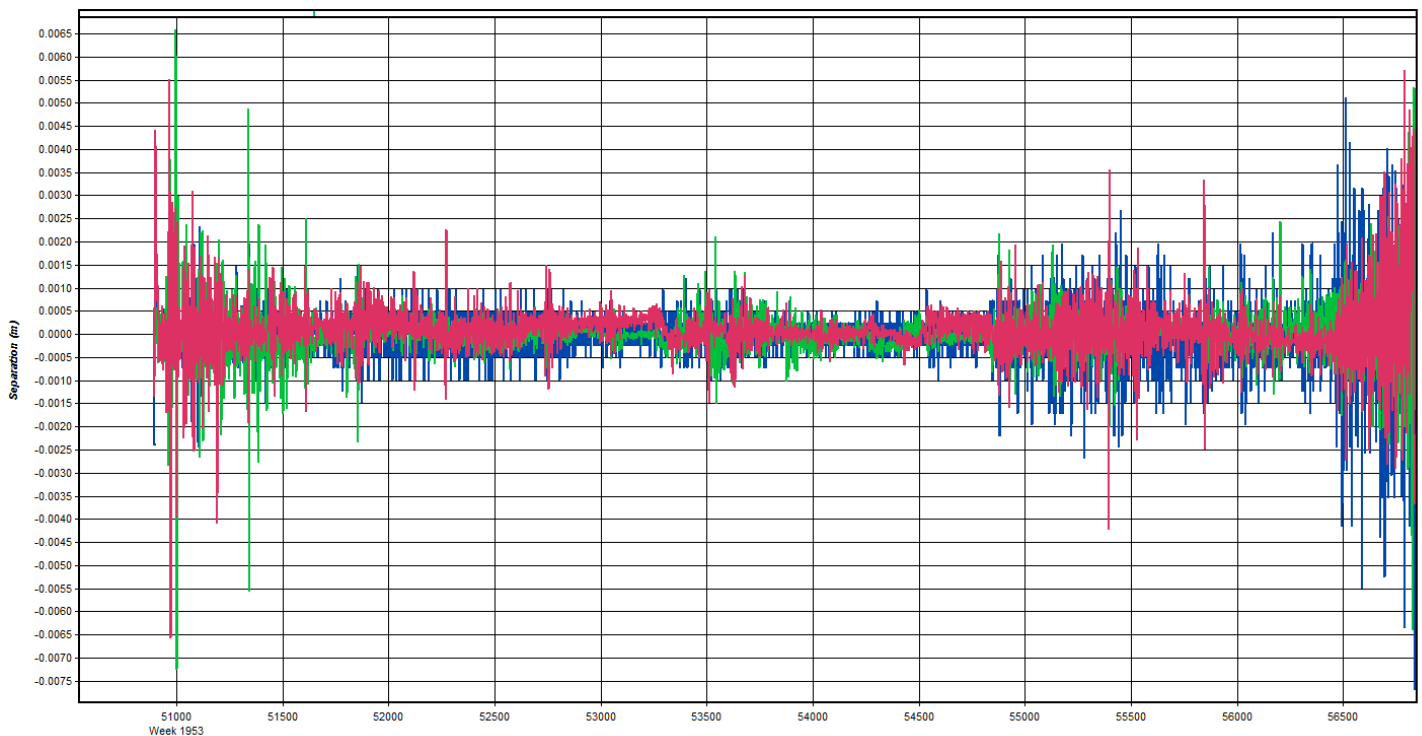
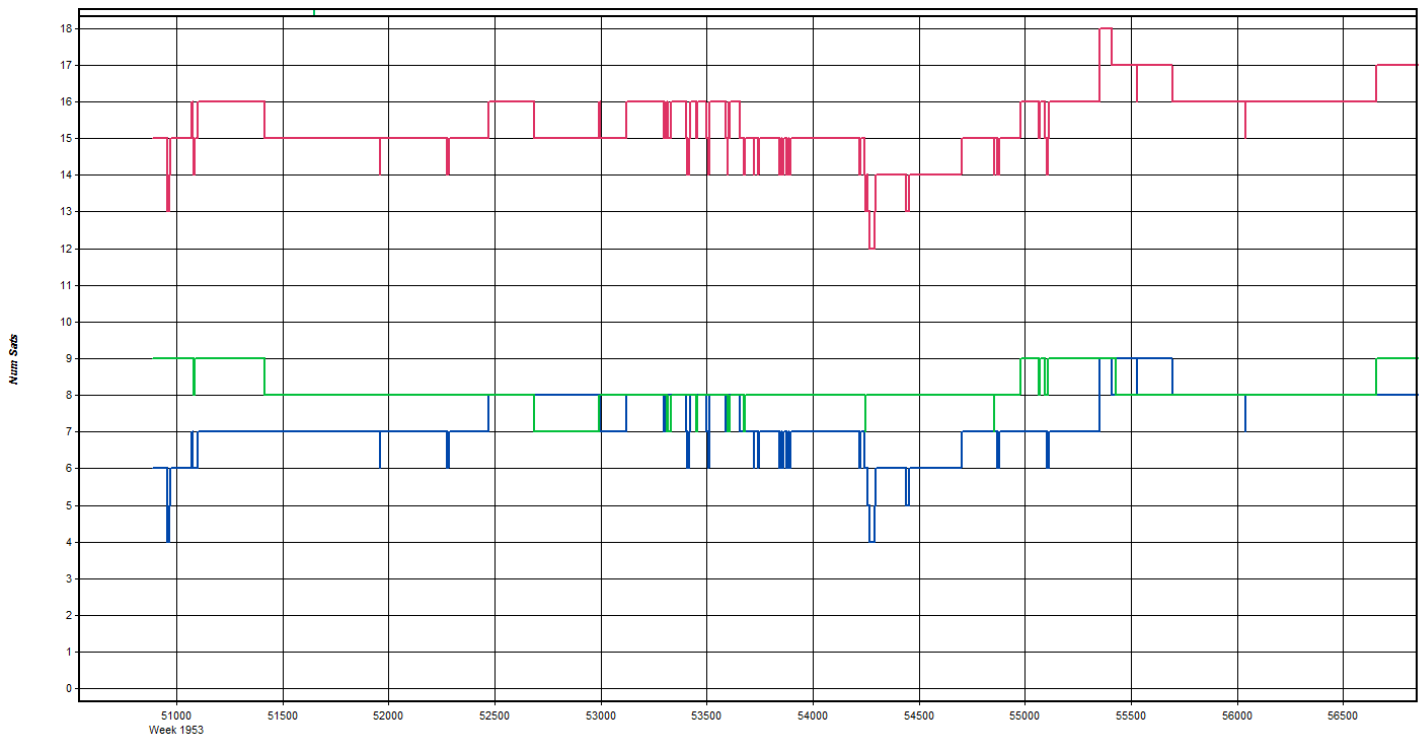
R033	12:35:00 AM	2079.244873	12:35:53 AM
R032	12:38:38 AM	1879.702026	12:39:27 AM
R014	12:48:05 AM	1627.617065	12:50:11 AM
R015	12:54:04 AM	1857.729004	12:59:04 AM
R016	1:00:46 AM	1988.139038	1:05:48 AM
R017	1:07:38 AM	2007.612915	1:12:42 AM
R018	1:14:32 AM	2089.651367	1:16:46 AM
R019	1:18:56 AM	1993.693604	1:20:33 AM
R030	1:24:47 AM	1642.352417	1:27:31 AM

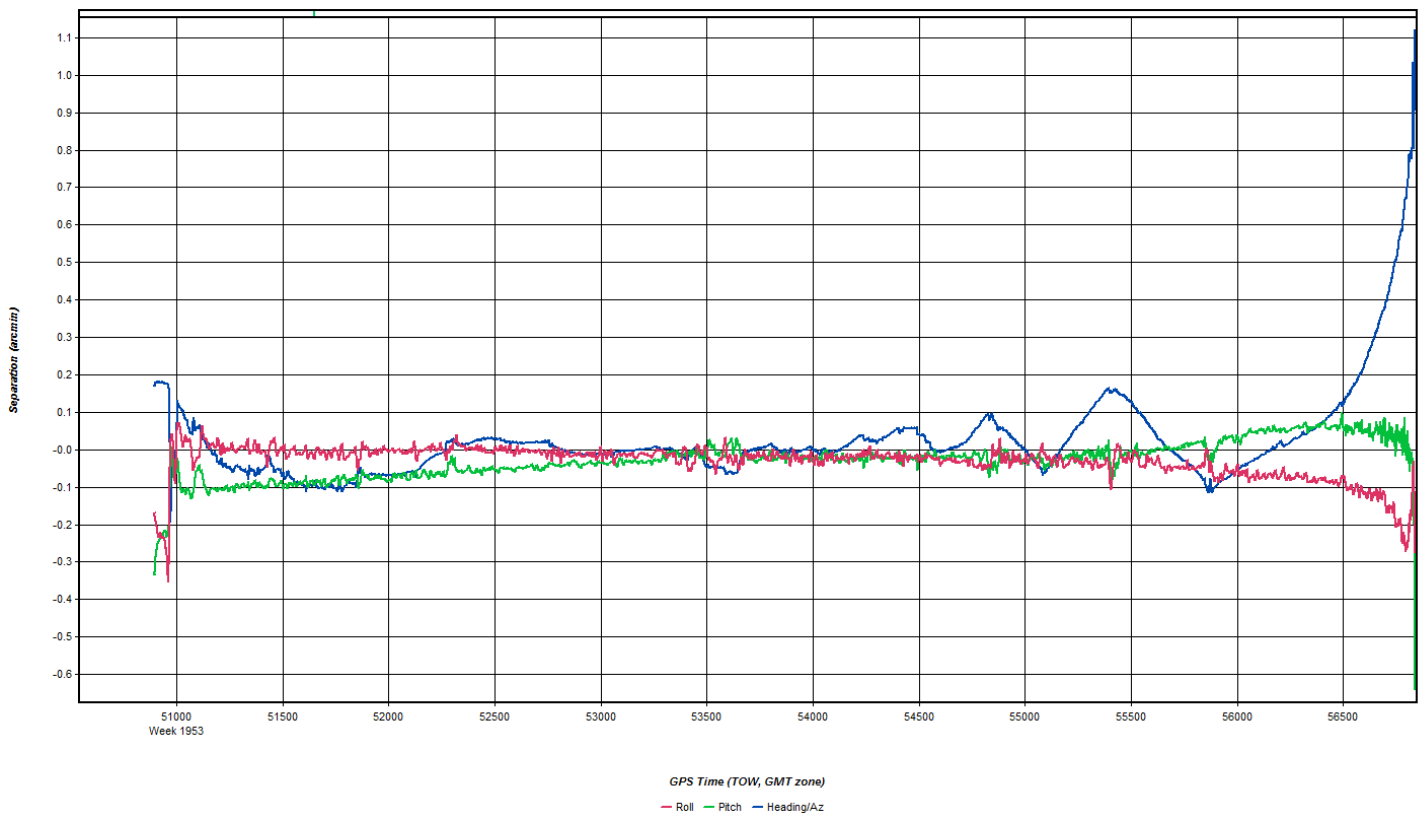
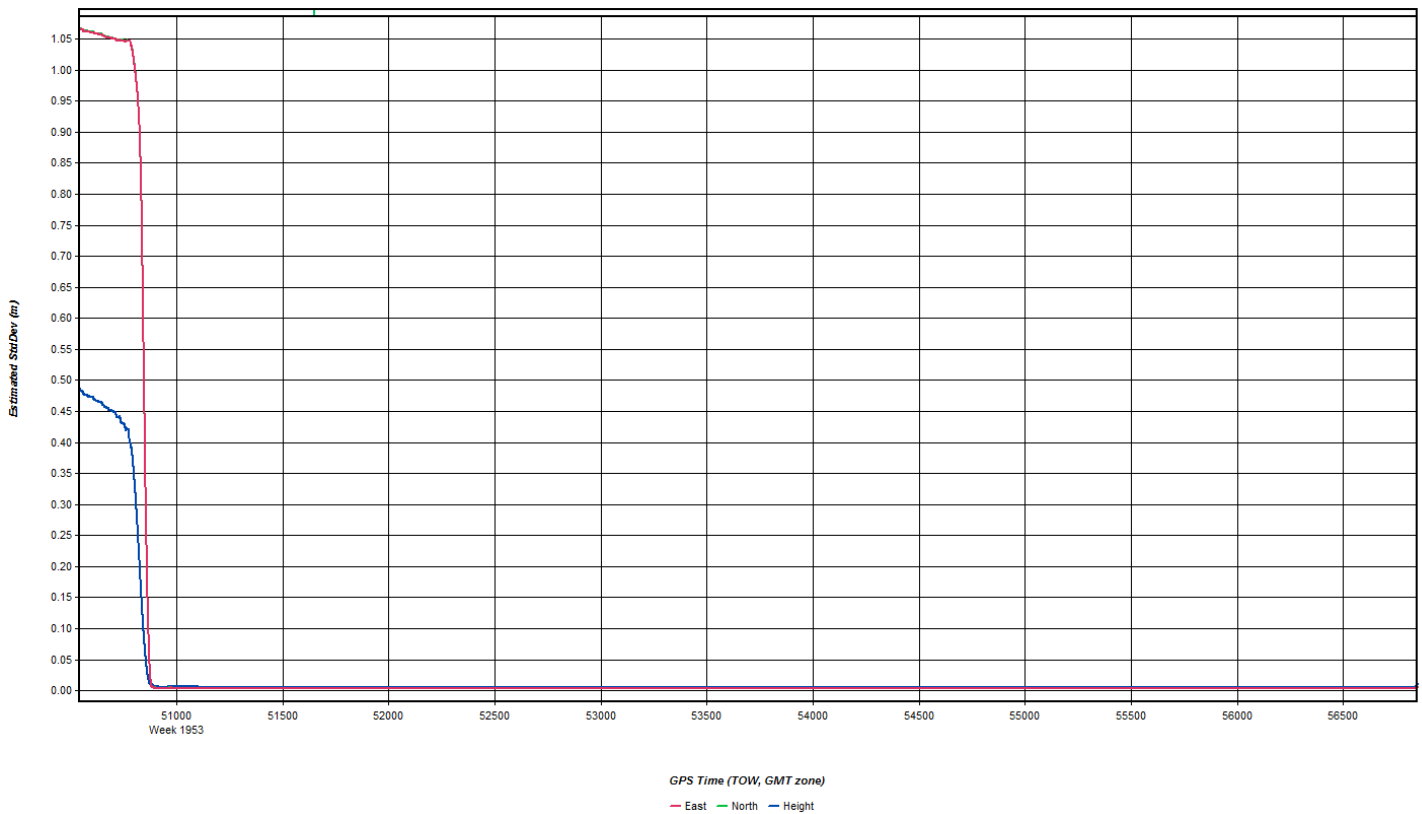
Jun 11, 2017-A (N704MD, SN7161)

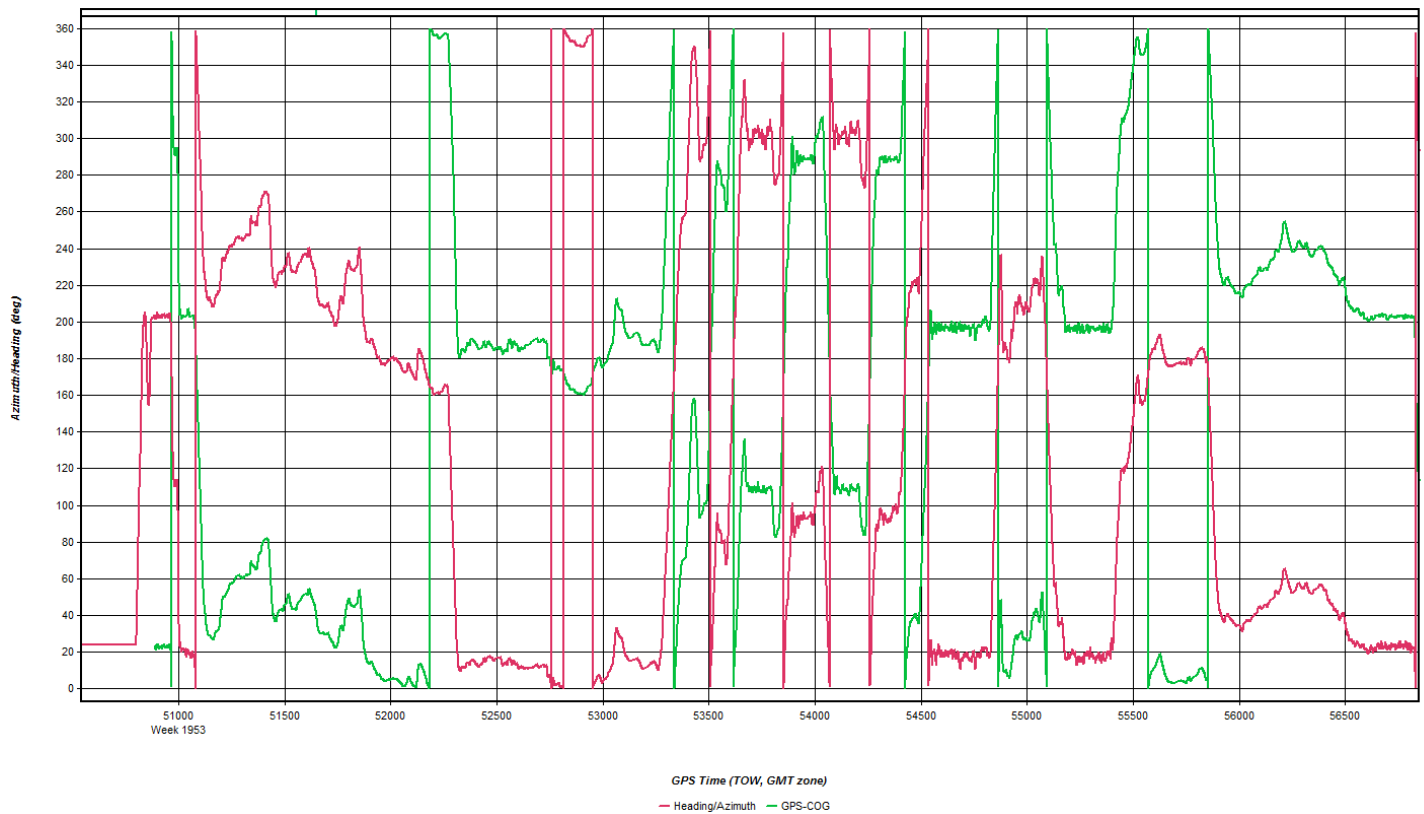












Coordinate/Antenna Settings

Master Remote

Base Station

2: UTAH16_41 Name: UTAH16_41 ☐ Disabled

File: E:\Proc\29083_Utah\29803_Utah_2016\Survey_6-16-17\JD162_7\

Coordinates

Latitude: North 37 25 55.88333 Coord. options

Longitude: West 113 02 40.16813 Save to Favorites

Ellipsoidal height: 2461.055 m

Datum: WGS84 Proc Datum: WGS84

Epoch: year

Antenna Height

From station file: TRM55971.00 View STA File

Antenna profile: TRM55971.00 Info

Measured height: 2.000 m

ARP to L1 offset: 0.067 m

Applied height: 2.067 m

Measured to

☒ ARP

☐ L1 Phase Centre

Compute From Slant

OK Cancel

Coordinate/Antenna Settings ? X

Master Remote

Base Station

1: UTAH16_42 Name: UTAH16_42 ☐ Disabled

File: E:\Proc\29083_Utah\29803_Utah_2016\Survey_6-16-17\JD162_7\

Coordinates

Latitude: North 37 29 17.88107 Coord. options

Longitude: West 113 01 08.69475 Save to Favorites

Ellipsoidal height: 2797.040 m

Datum: WGS84 Proc Datum: WGS84

Epoch: year

Antenna Height

From station file: TRM55971.00 View STA File

Antenna profile: TRM55971.00 Info

Measured height: 2.000 m

ARP to L1 offset: 0.067 m

Applied height: 2.067 m

Measured to

☒ ARP

☐ L1 Phase Centre

Compute From Slant

OK Cancel

Flight Log

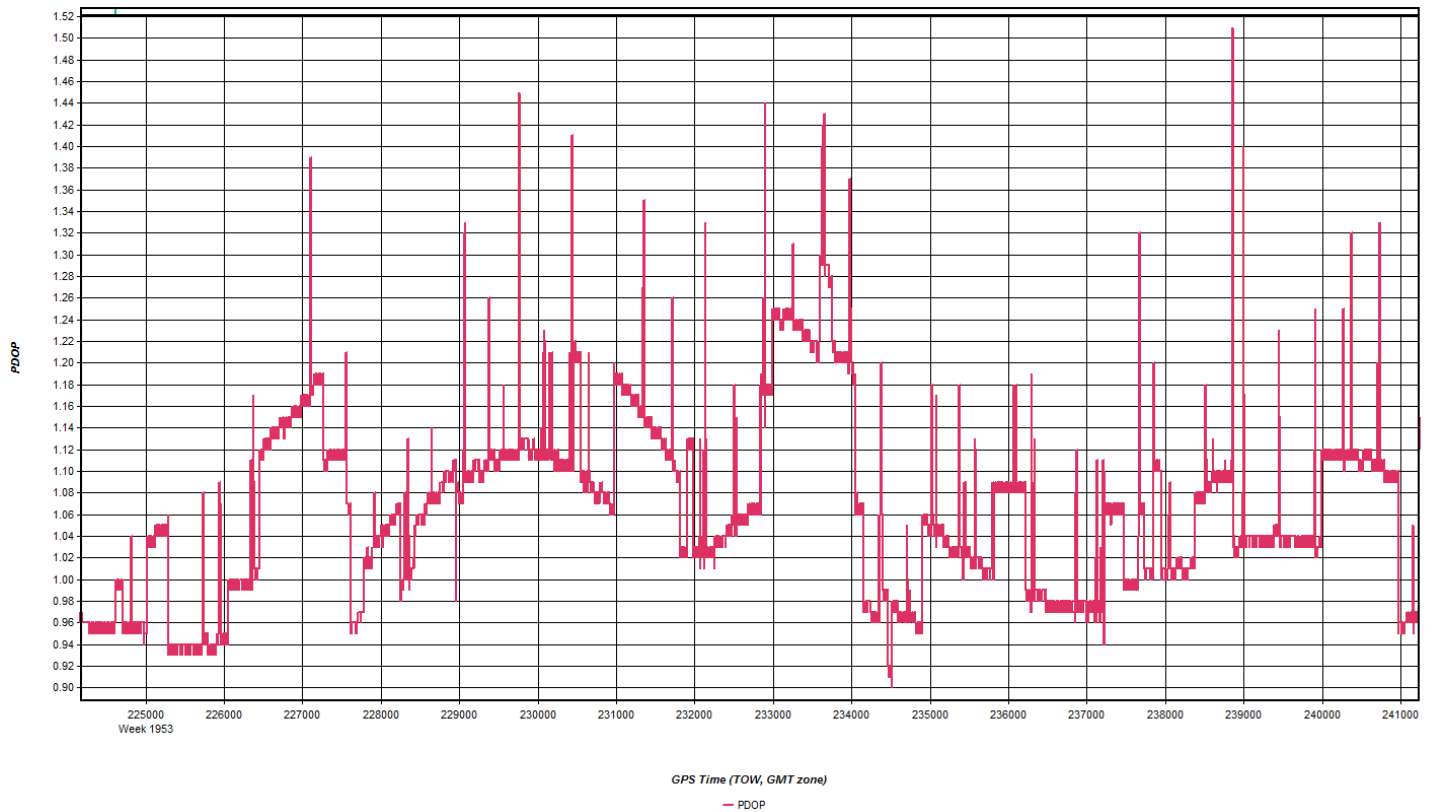
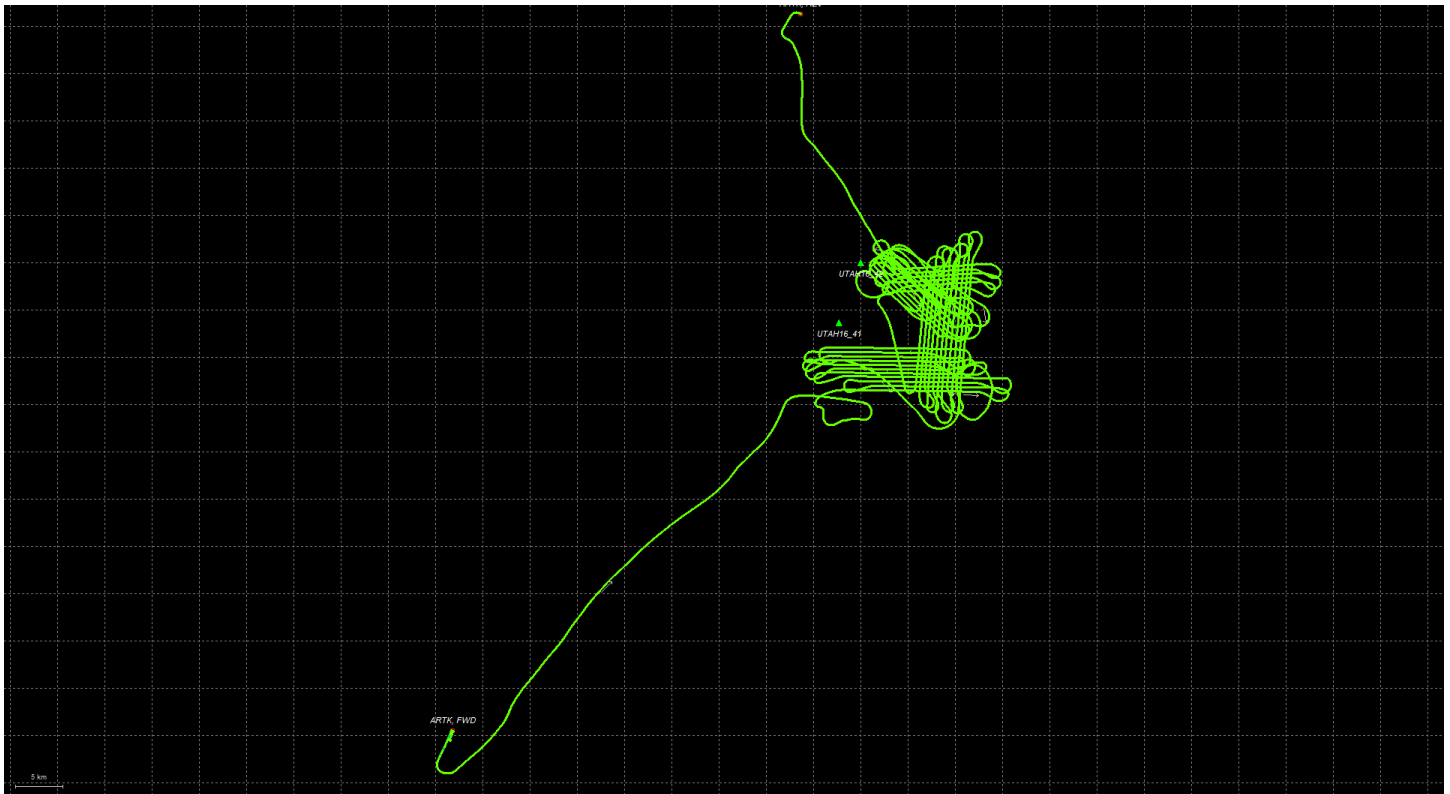
Date: 6/11/2017	Aircraft: N704MD	Sensor: 7161
Project: Utah 2016 LiDAR		Project #: R029083
Flight Mgmt File: FMSL_SN7161_WACounty		
Pilot: Dave Wagner		Sensor Operator: Aaron Mallon

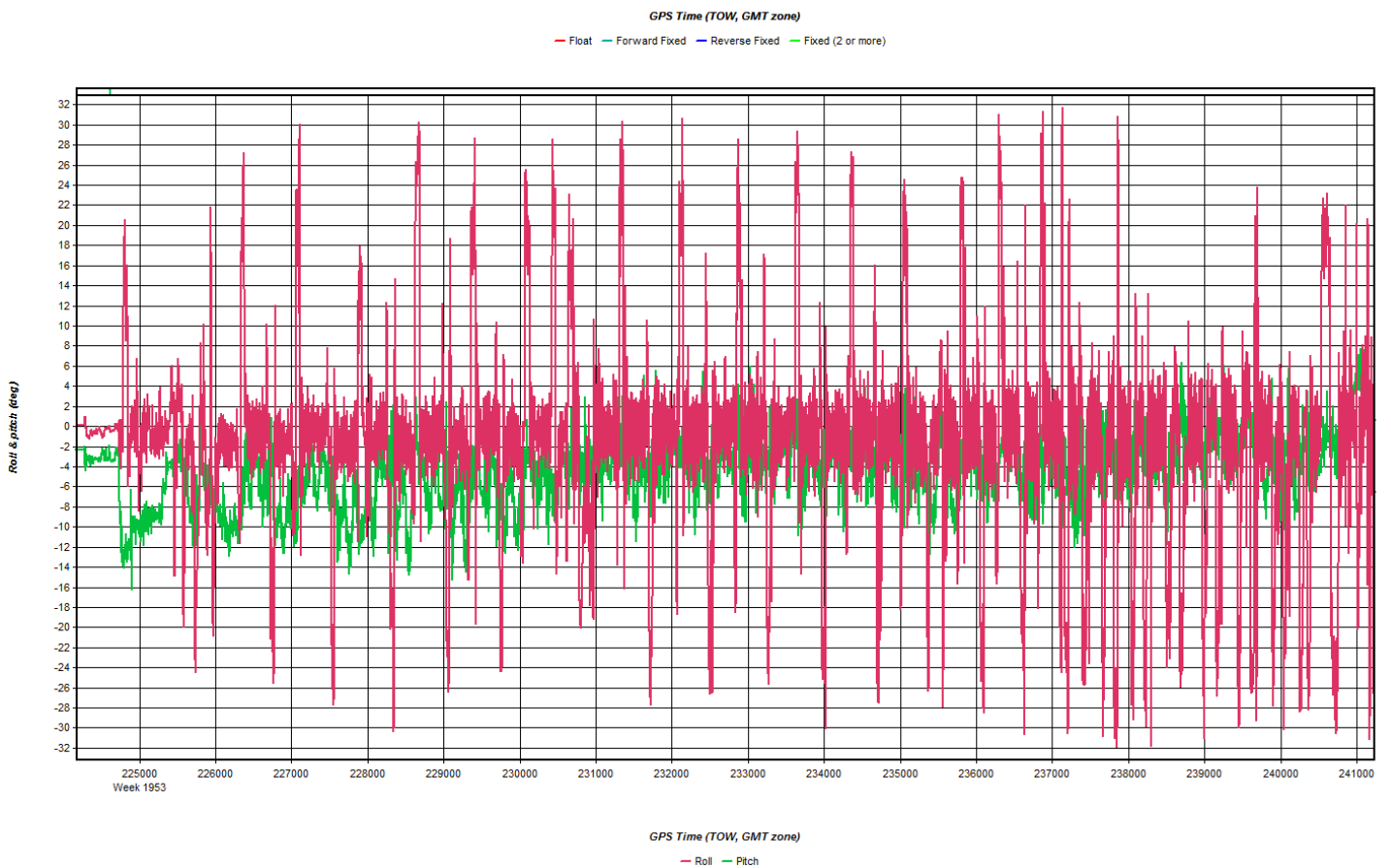
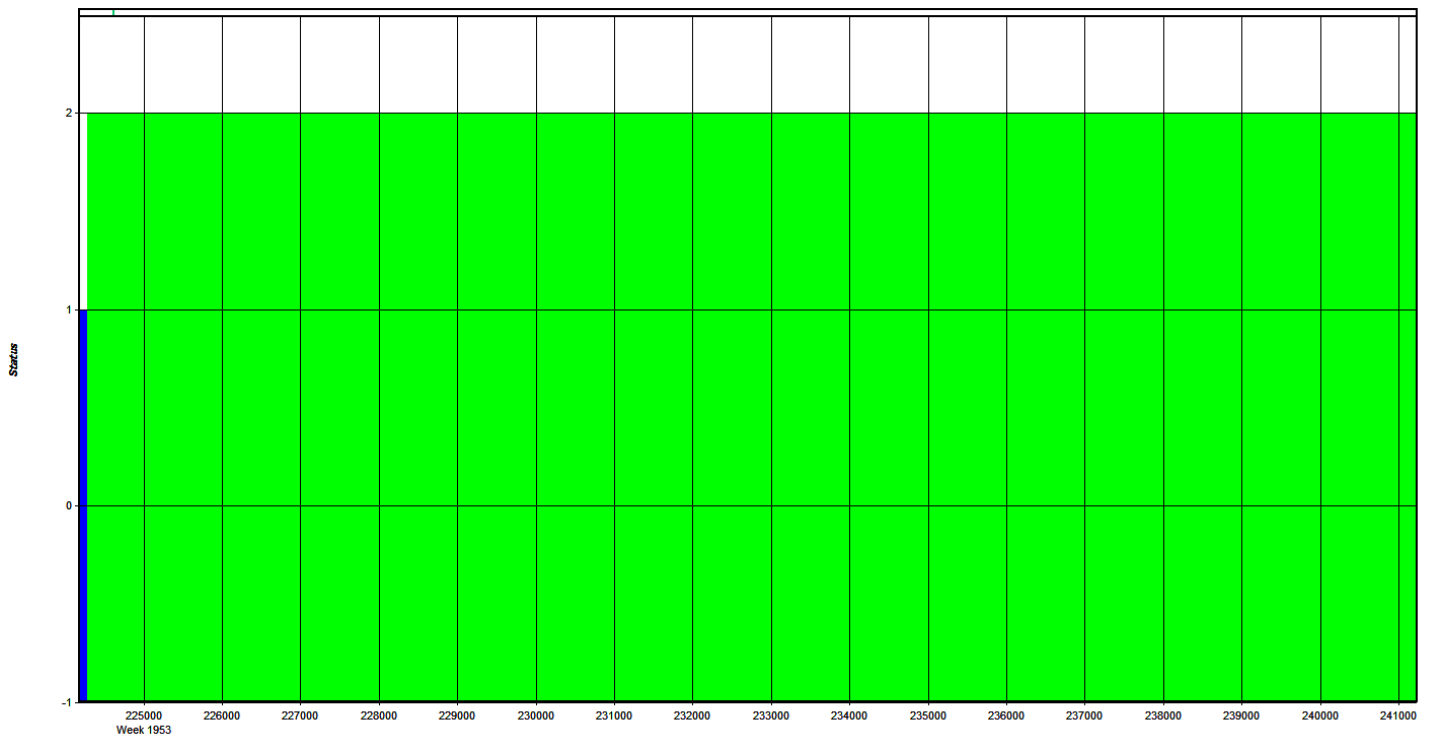
	Flight 1	Flight 2	Flight 3	Flight 4
Wheels Up	8:10:00 AM			
Wheels Down	9:45:00 AM			
Begin Hobbs	11882.5			
End Hobbs	11884.1			
On-line Hobbs: 0.5		Mob Hobbs: 1.1		

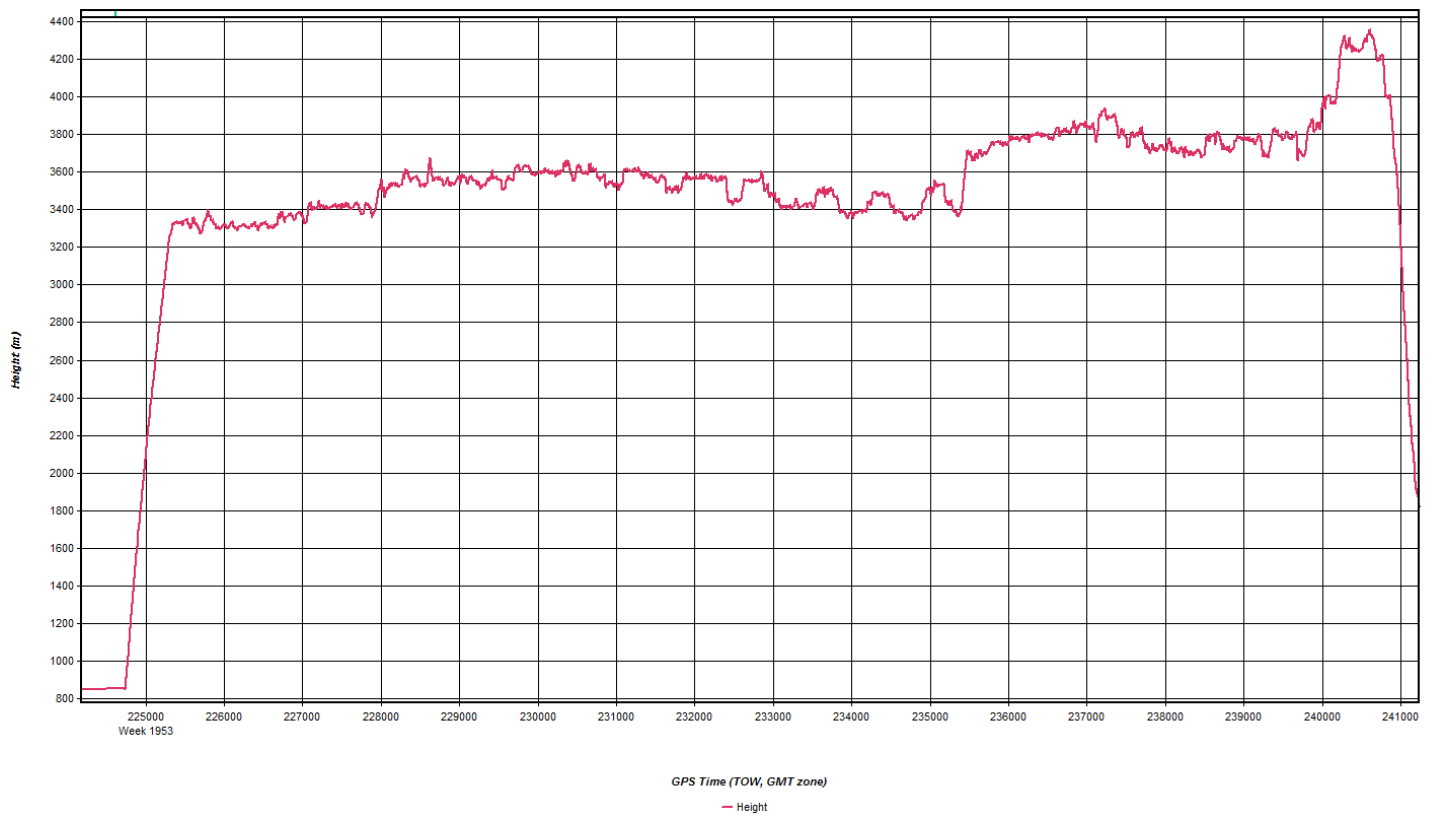
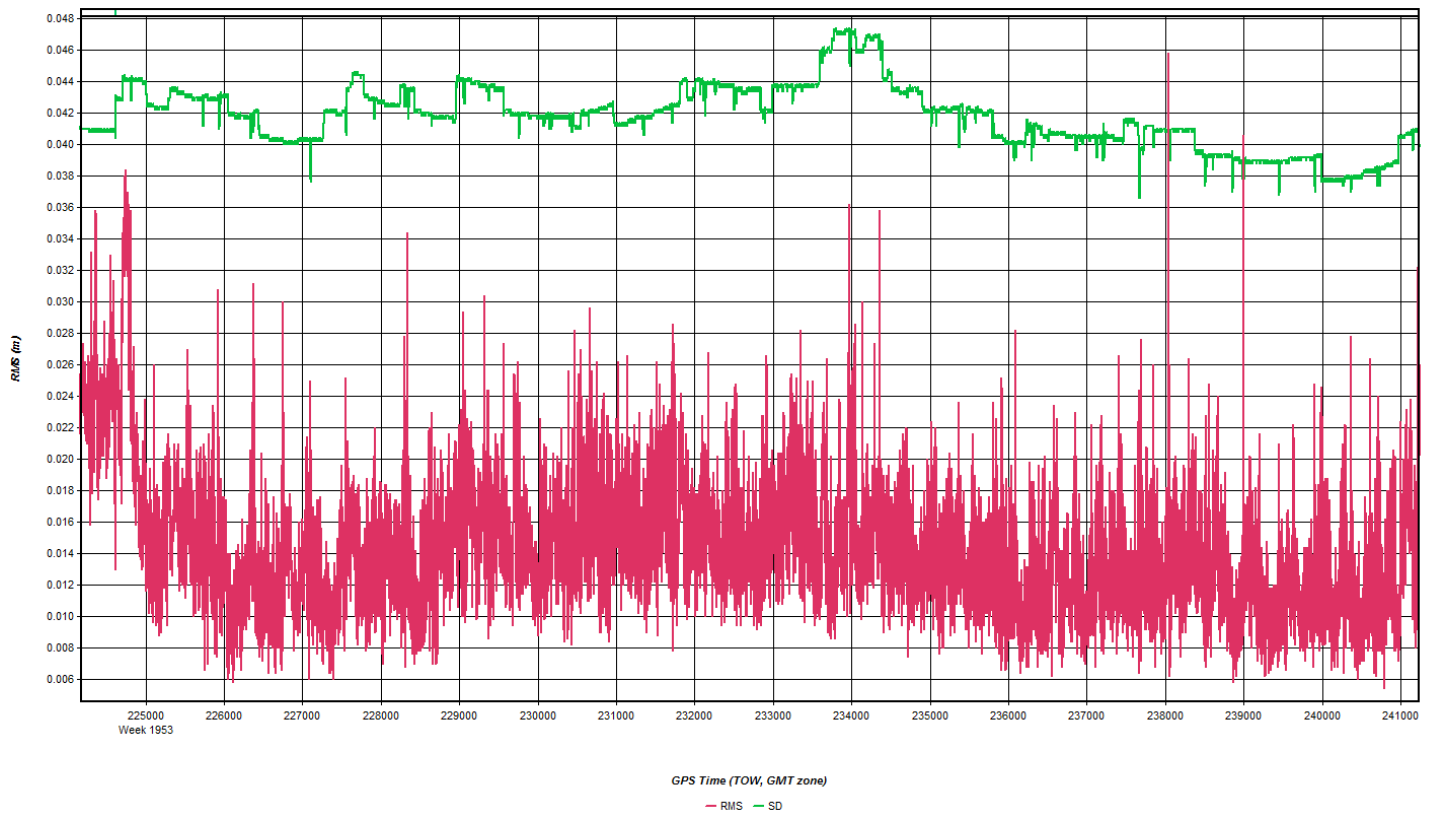
Notes

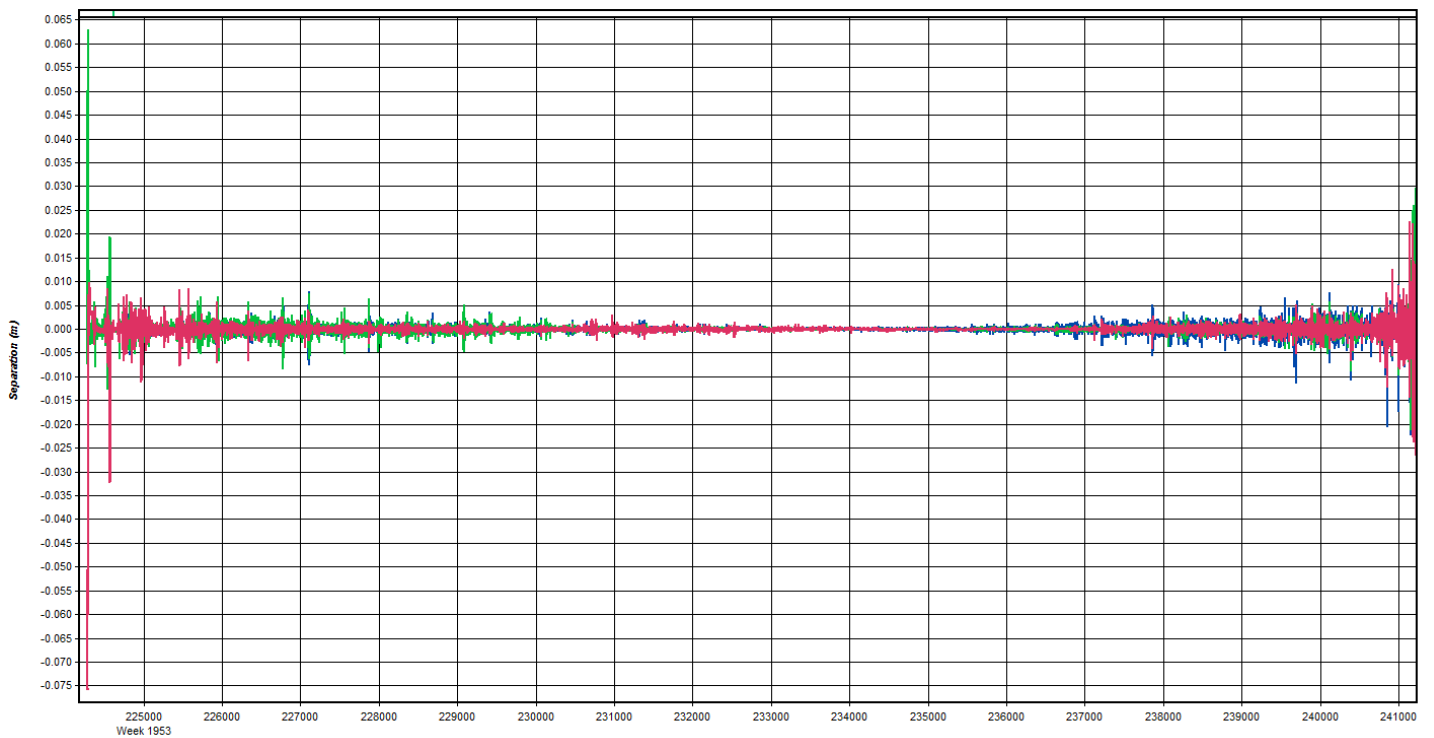
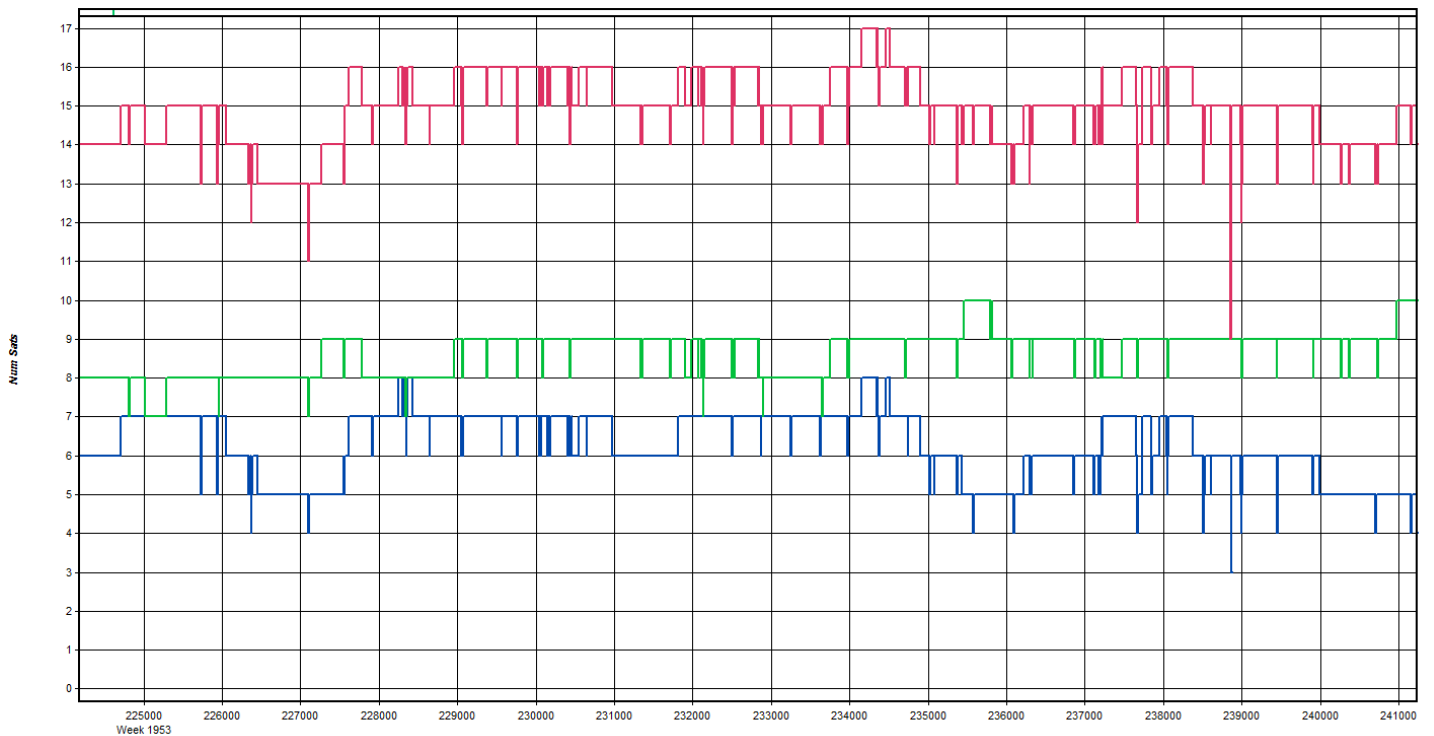
Today we were ready to have wheels up at 0700, however, when we arrived at the airport our plane had not been fueled. We encountered clouds in on area of the AOI and were forced to go fly lines 076-081 off or CORS.

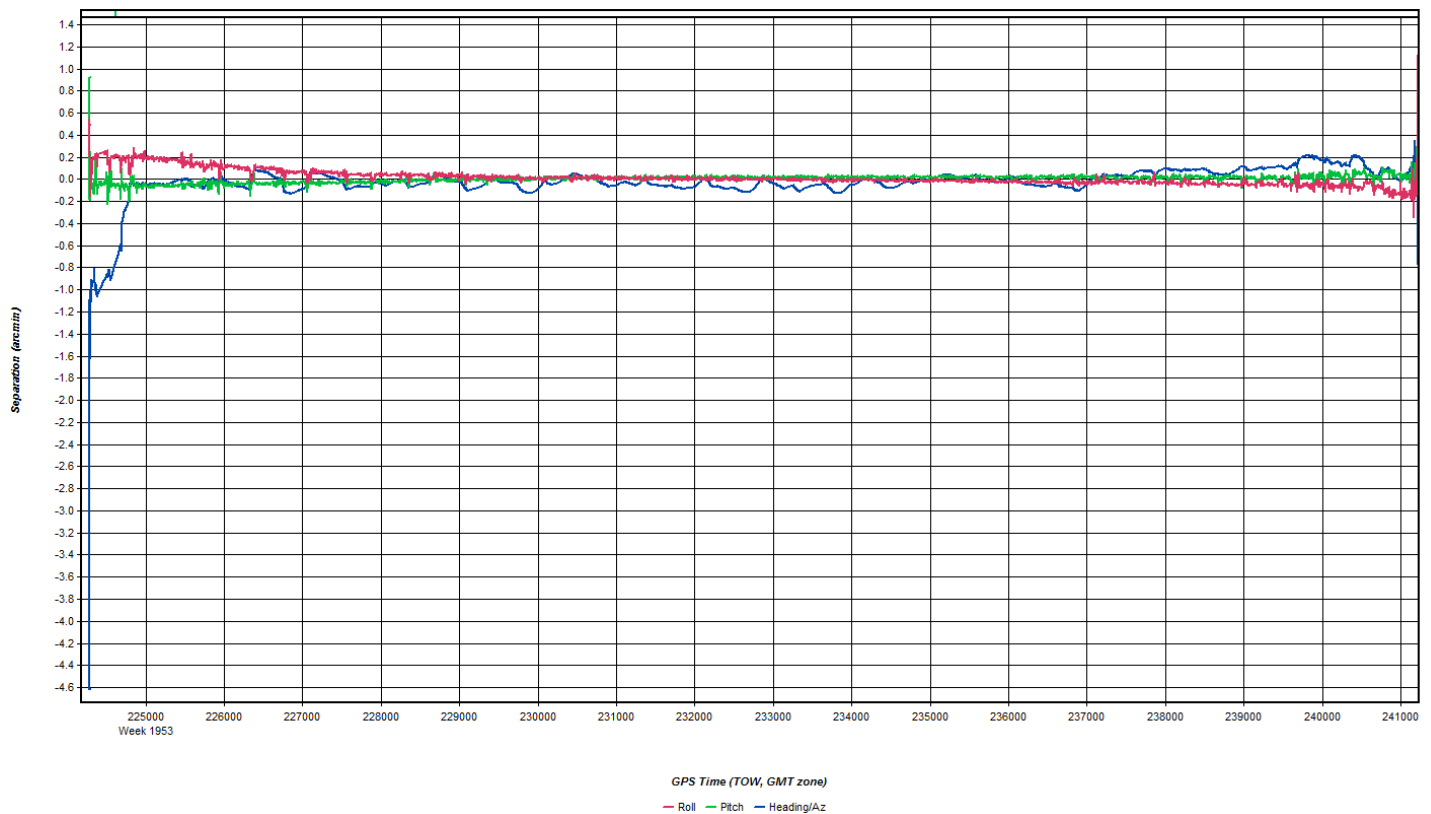
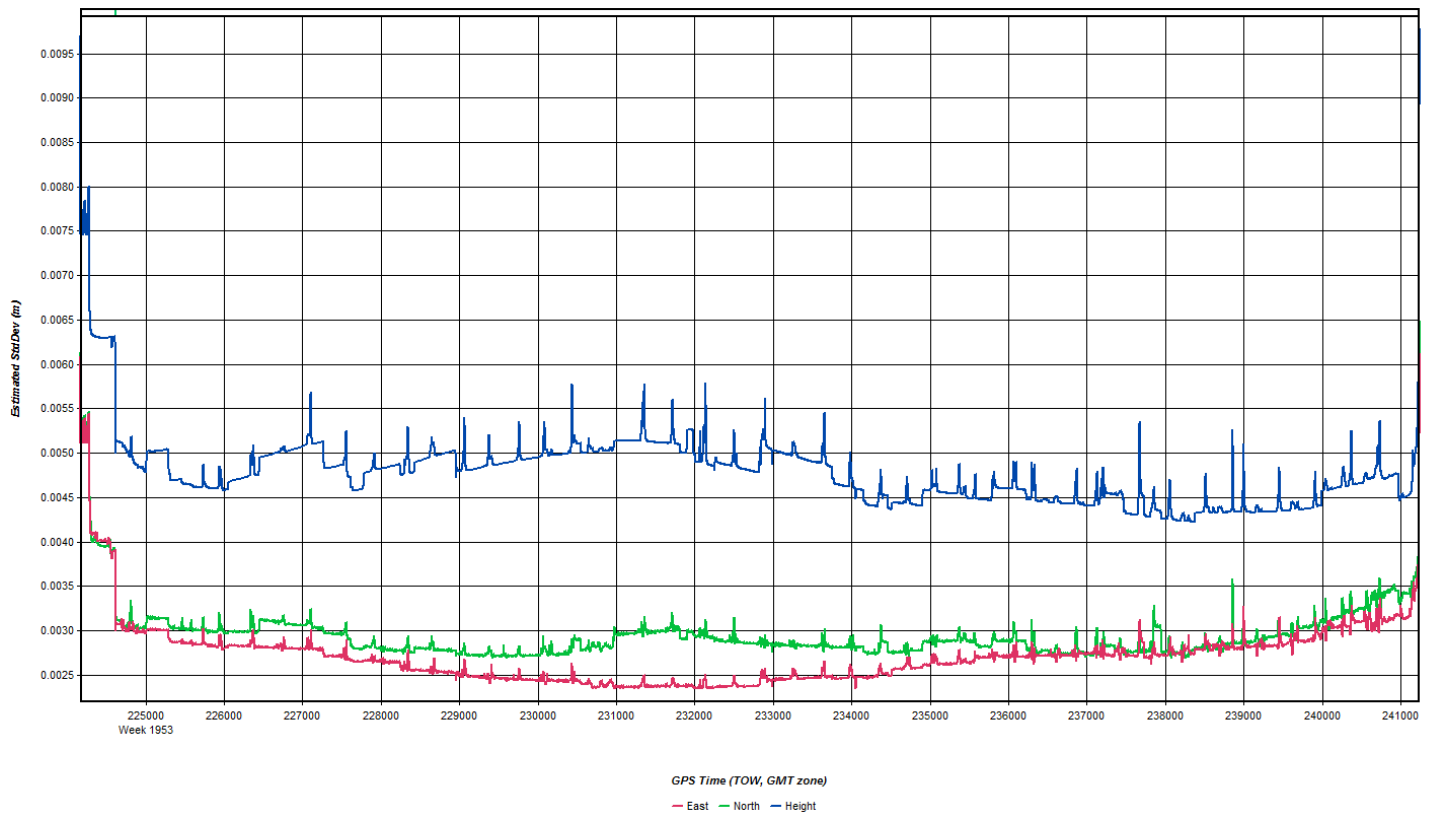
Jun 13, 2017-A (N704MD, SN7161)

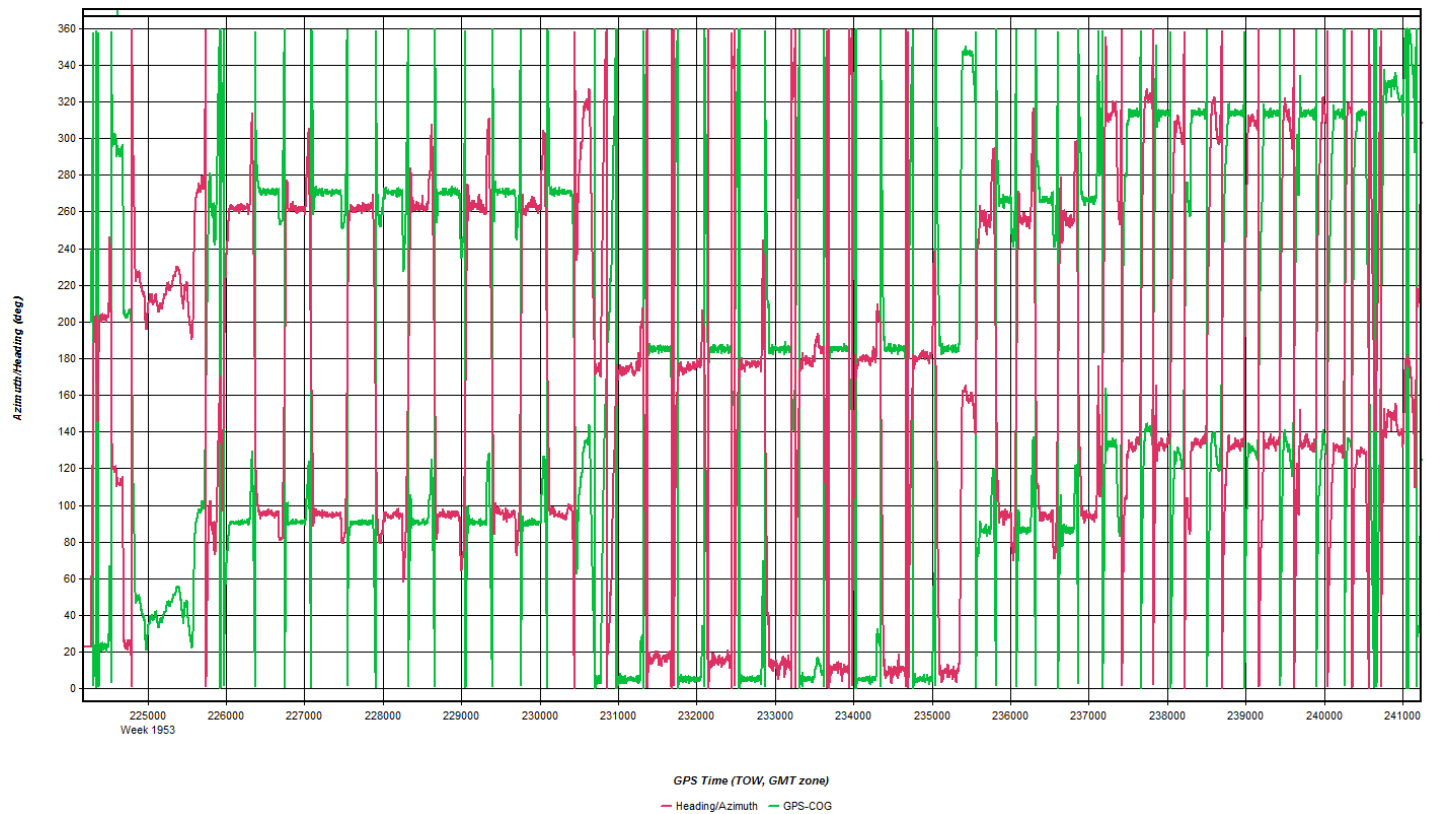












Coordinate/Antenna Settings

Master Remote

Base Station

2: UTAH16_41 Name: UTAH16_41 ☐ Disabled

File: E:\Proc\29083_Utah\29803_Utah_2016\Survey_6-16-17\JD164_7\

Coordinates

Latitude: North 37 25 55.88333 Coord. options

Longitude: West 113 02 40.16813 Save to Favorites

Ellipsoidal height: 2461.055 m

Datum: WGS84 Proc Datum: WGS84

Epoch: year

Antenna Height

From station file: TRM55971.00 View STA File

Antenna profile: TRM55971.00 Info

Measured height: 2.000 m

ARP to L1 offset: 0.067 m

Applied height: 2.067 m

Measured to

☒ ARP

☐ L1 Phase Centre

Compute From Slant

OK Cancel

Coordinate/Antenna Settings ? X

Master Remote

Base Station

1: UTAH16_42 Name: UTAH16_42 ☐ Disabled

File: E:\Proc\29083_Utah\29803_Utah_2016\Survey_6-16-17\JD164_7\

Coordinates

Latitude: North 37 29 17.88107 Coord. options

Longitude: West 113 01 08.69475 Save to Favorites

Ellipsoidal height: 2797.040 m

Datum: WGS84 Proc Datum: WGS84

Epoch: year

Antenna Height

From station file: TRM55971.00 View STA File

Antenna profile: TRM55971.00 Info

Measured height: 1.800 m

ARP to L1 offset: 0.067 m

Applied height: 1.867 m

Measured to

☒ ARP

☐ L1 Phase Centre

Compute From Slant

OK Cancel

Flight Log

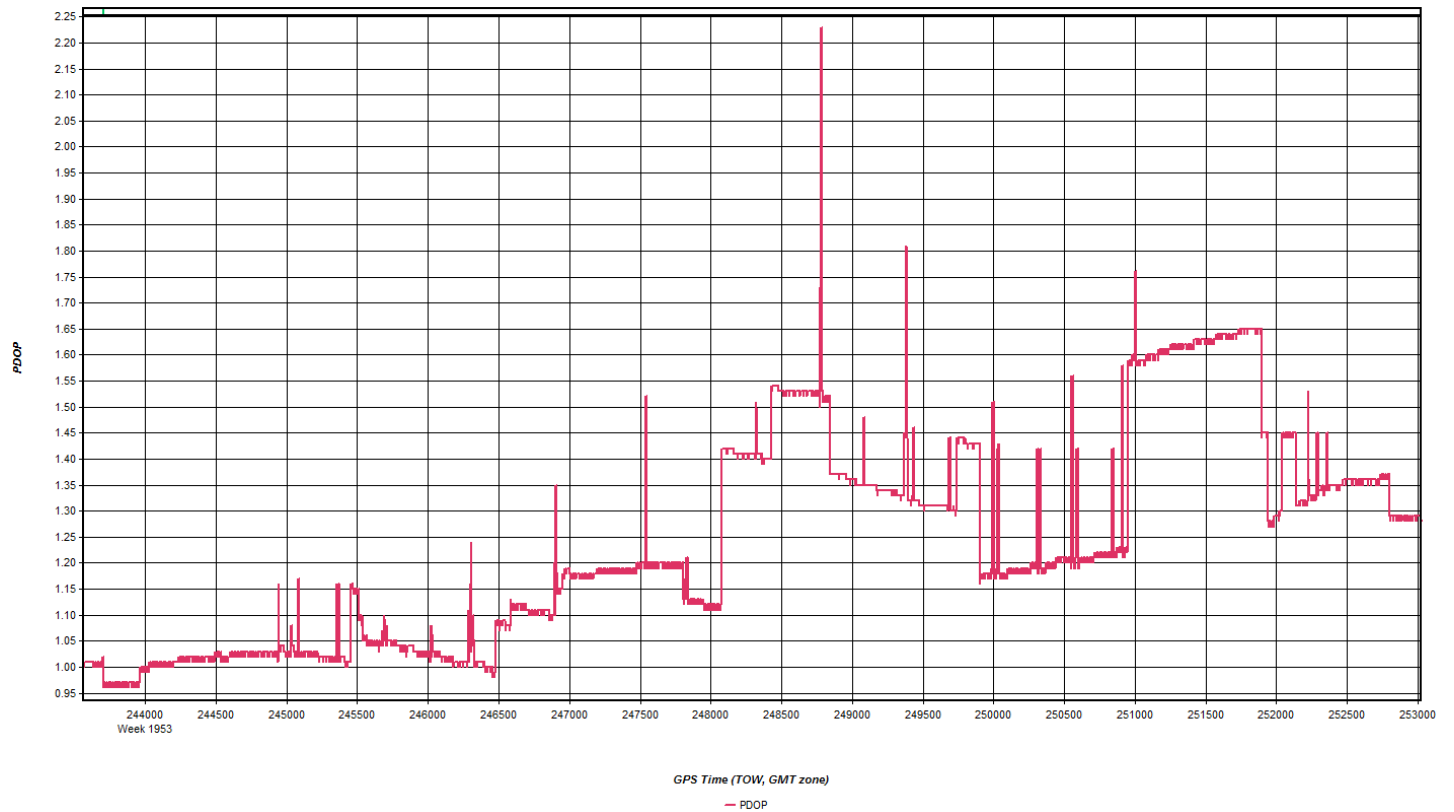
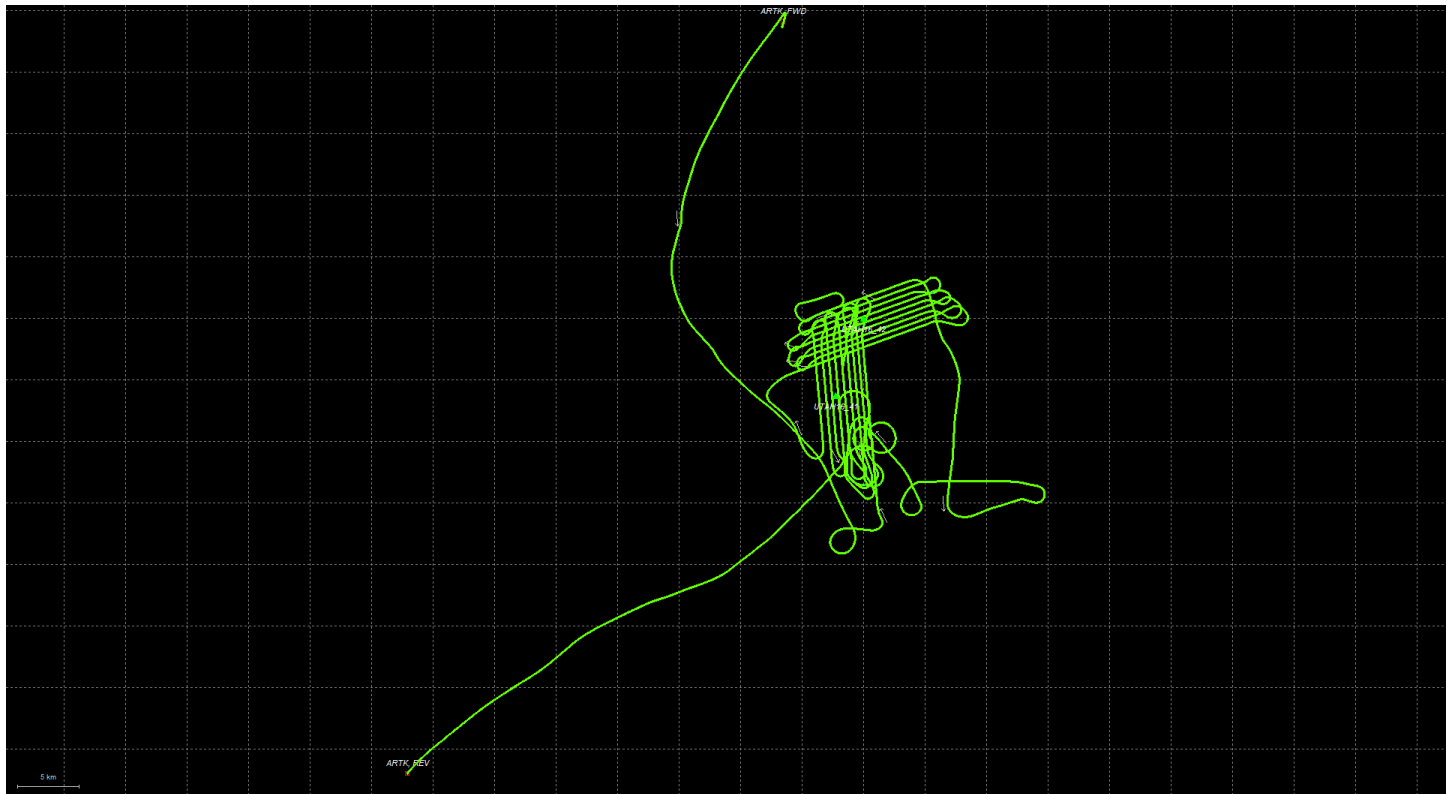
Date: 6/13/2017	Aircraft: N704MD	Sensor: 7161
Project: Utah 2016 LiDAR		Project #: R029083
Flight Mgmt File: FMSL_WACounty_7161		
Pilot: Dave Wagner		Sensor Operator: Drew Johnston

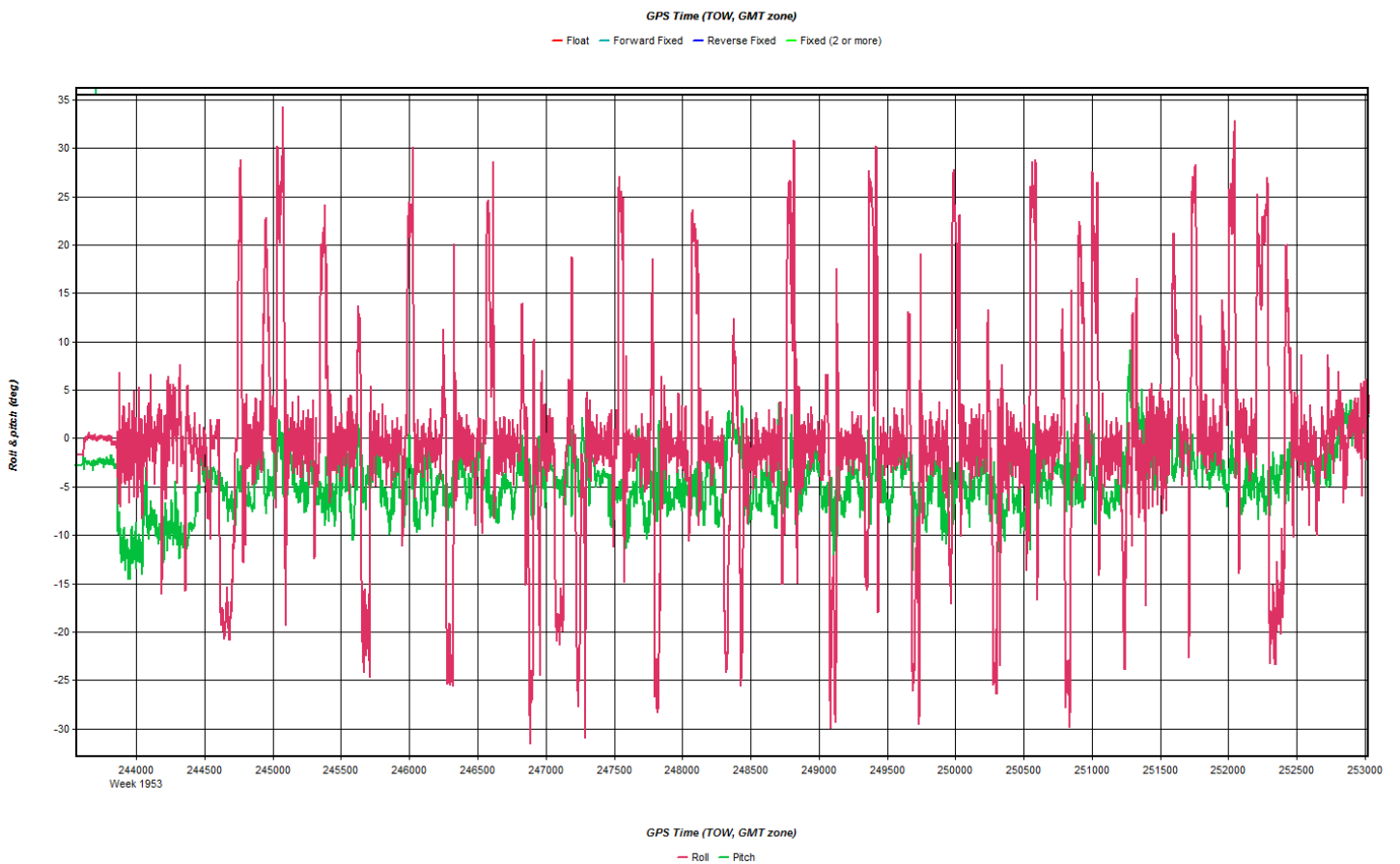
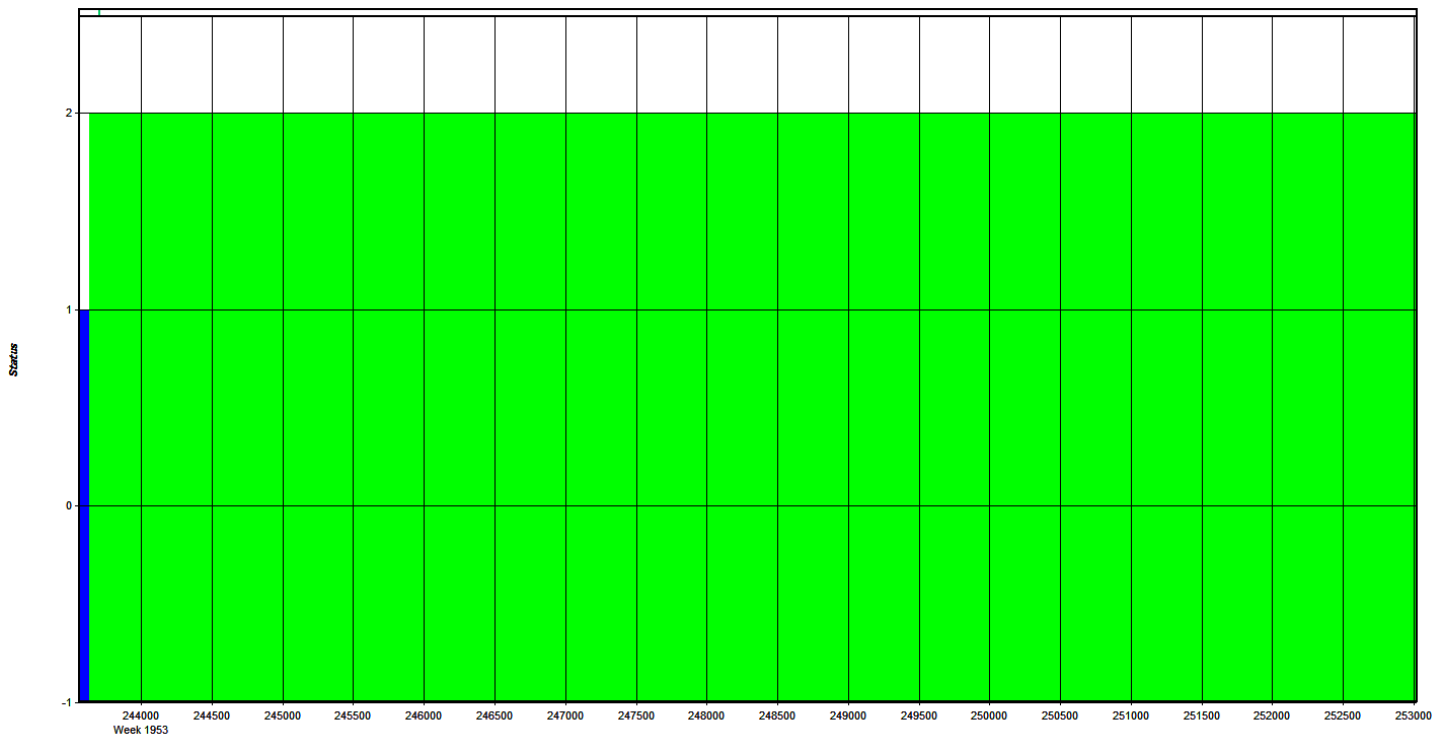
	Flight 1	Flight 2	Flight 3	Flight 4
Wheels Up	8:24:00 AM			
Wheels Down	1:01:00 PM			
Begin Hobbs	1184.1			
End Hobbs	1188.7			
On-line Hobbs: 6		Mob Hobbs: 1.2		

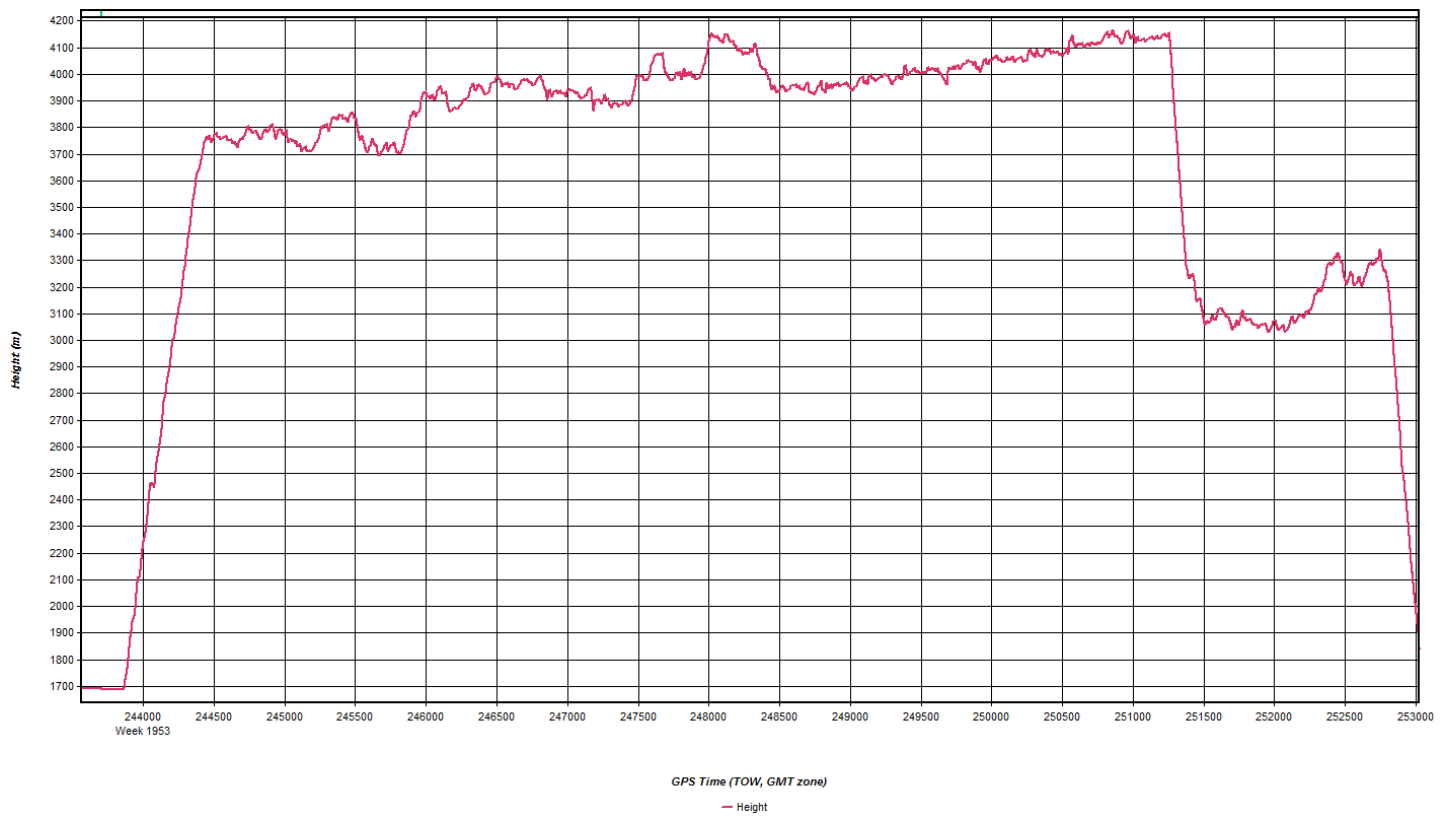
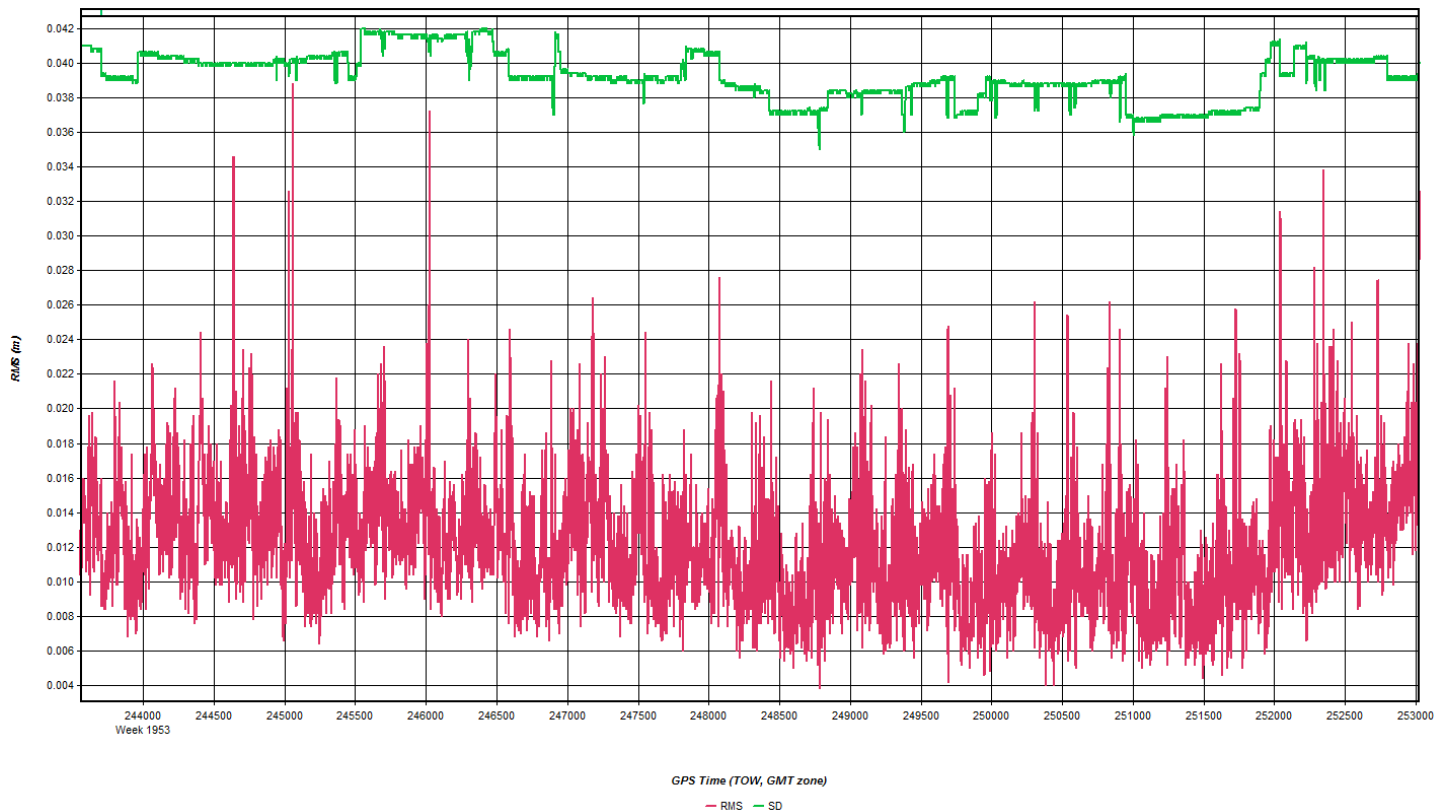
Notes

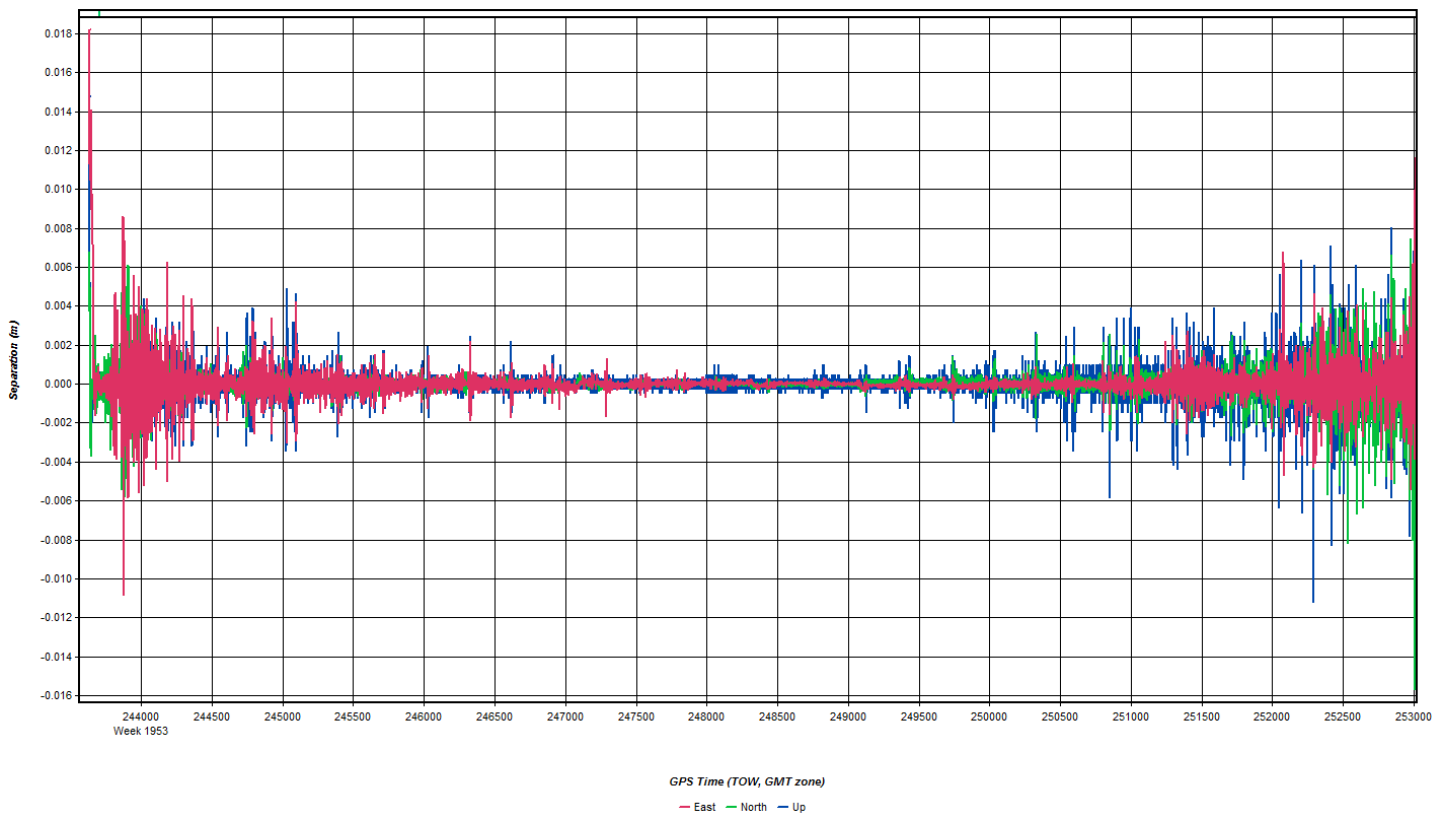
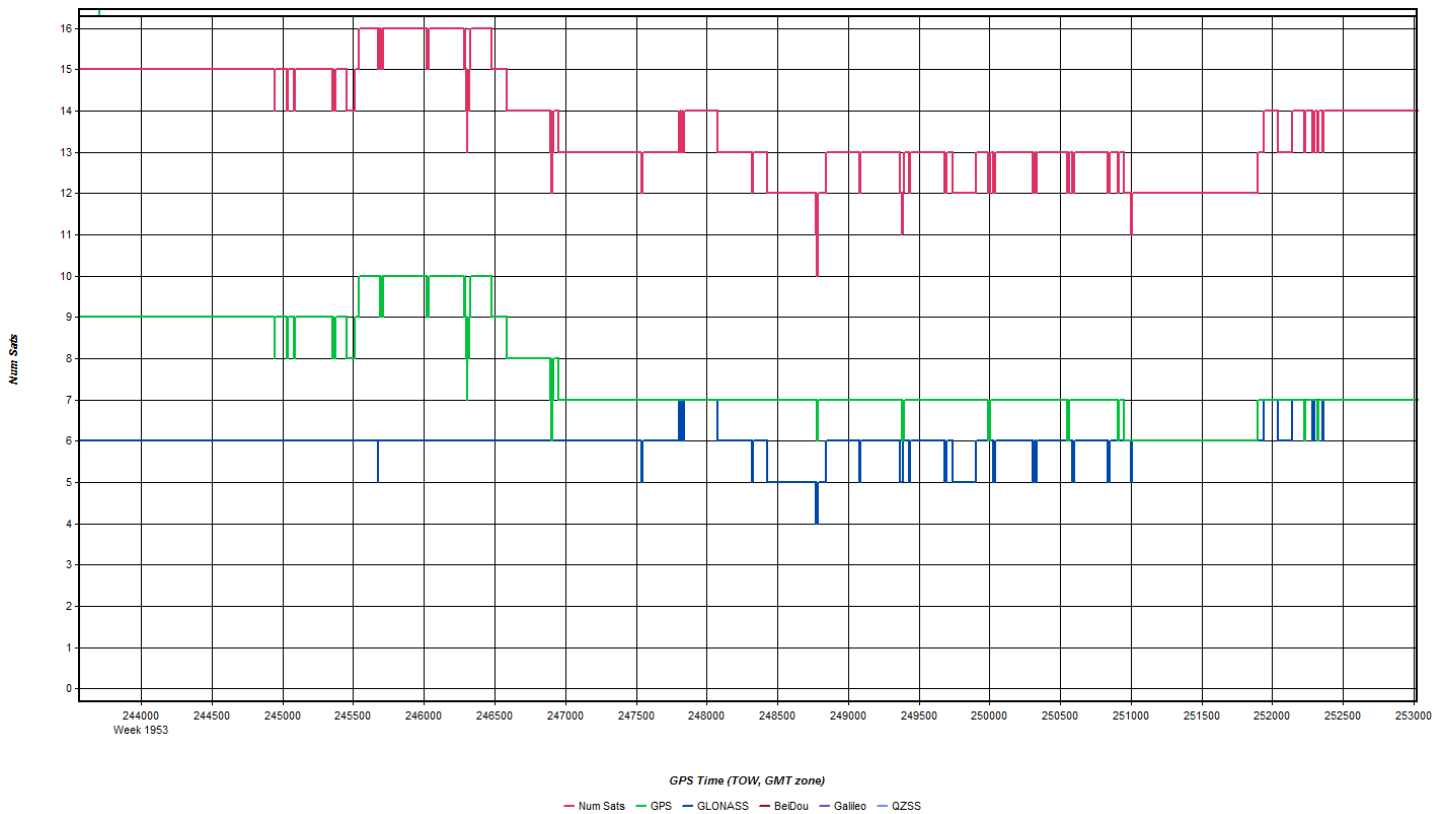
We had many delays/reflies because of the als70 acting up (false ranges shutting off naked eyesafe?), and range violations/dropouts due to the plan/DEM not taking into account the seriousness of the many canyons. The cliffs are very steep, and a side of the swath could be in a very deep trench that wasn't accounted for in the initial planning. We reflew lines that had dropouts, and flew 3 crosslines along the 'trouble' canyons where we had the most issues. We also battled very high winds aloft and turb throughout the day, forcing us to fly a block S-N w/o alternating directions as DW was concerned about stalls. 7.2 is about the max-pain for such flights. Doing a full QL tonight to see how things turned out.

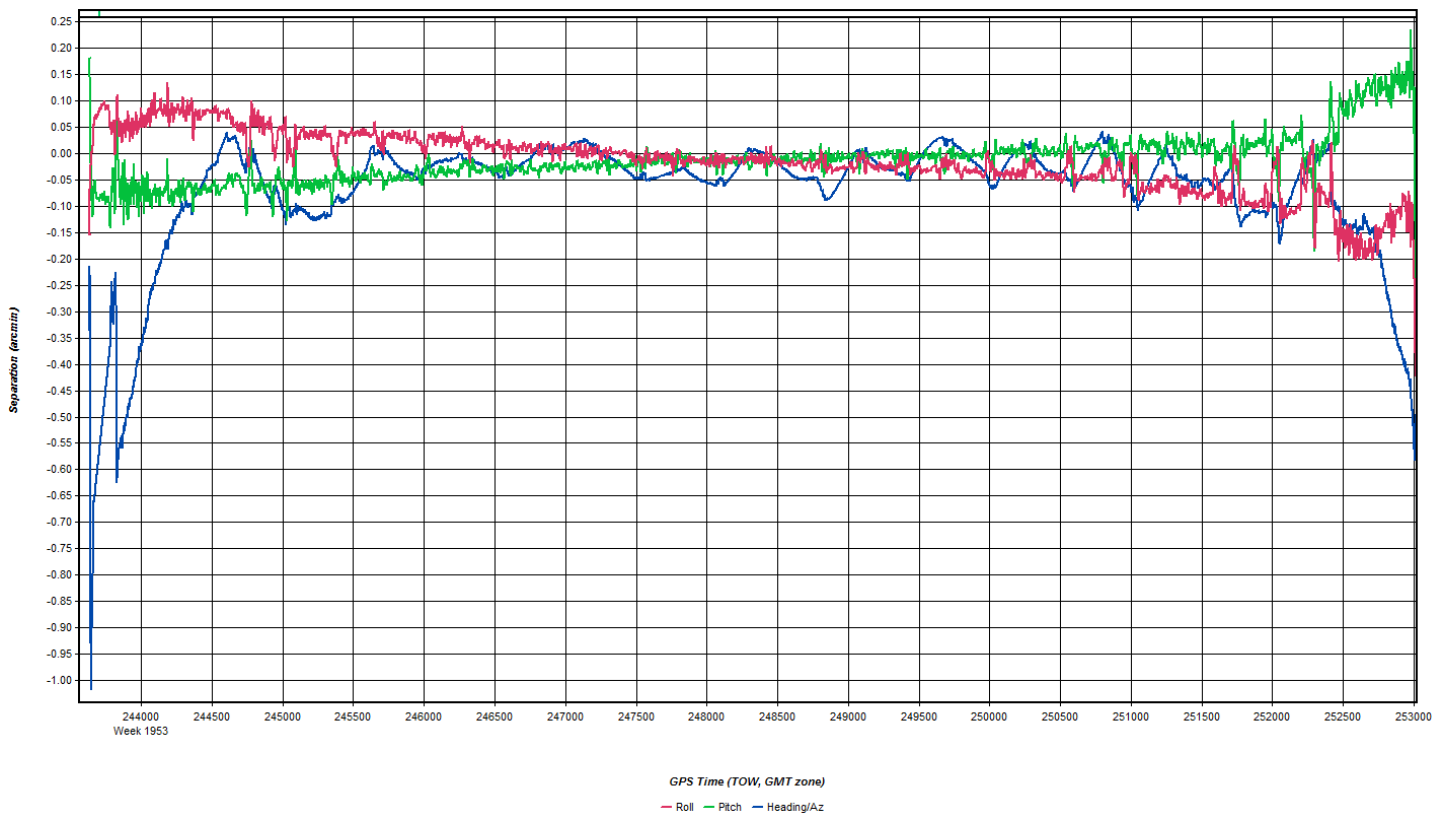
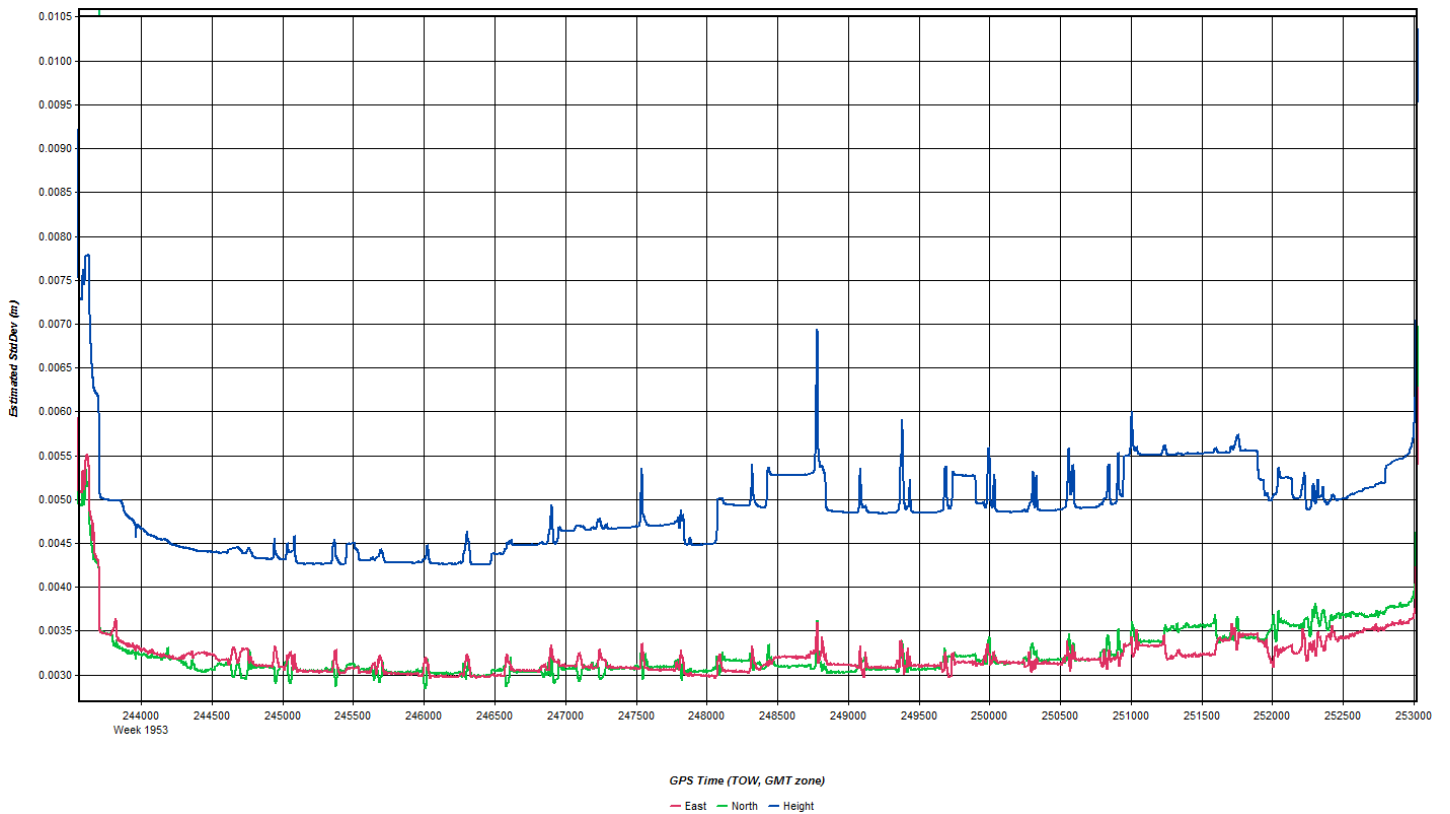
Jun 13, 2017-B (N704MD, SN7161)

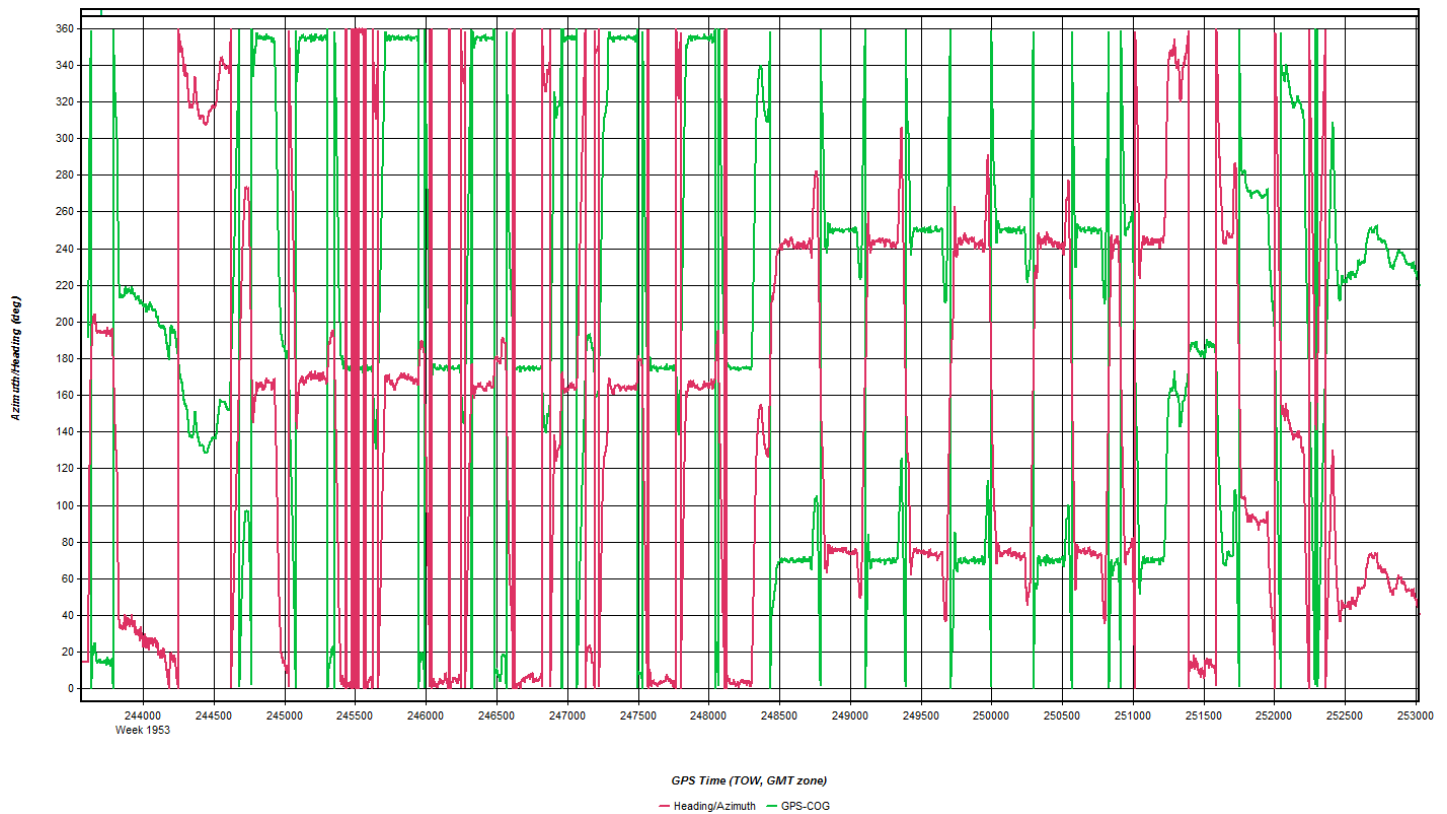












Coordinate/Antenna Settings

Master Remote

Base Station

2: UTAH16_41 Name: UTAH16_41 ☐ Disabled

File: E:\Proc\29083_Utah\29803_Utah_2016\Survey_6-16-17\JD164_7\

Coordinates

Latitude: North 37 25 55.88333 Coord. options

Longitude: West 113 02 40.16813 Save to Favorites

Ellipsoidal height: 2461.055 m

Datum: WGS84 Proc Datum: WGS84

Epoch: year

Antenna Height

From station file: TRM55971.00 View STA File

Antenna profile: TRM55971.00 Info

Measured height: 2.000 m

ARP to L1 offset: 0.067 m

Applied height: 2.067 m

Measured to

☒ ARP

☐ L1 Phase Centre

Compute From Slant

OK Cancel

Coordinate/Antenna Settings ? X

Master Remote

Base Station

1: UTAH16_42 Name: UTAH16_42 ☐ Disabled

File: E:\Proc\29083_Utah\29803_Utah_2016\Survey_6-16-17\JD164_7\

Coordinates

Latitude: North 37 29 17.88107 Coord. options

Longitude: West 113 01 08.69475 Save to Favorites

Ellipsoidal height: 2797.040 m

Datum: WGS84 Proc Datum: WGS84

Epoch: year

Antenna Height

From station file: TRM55971.00 View STA File

Antenna profile: TRM55971.00 Info

Measured height: 1.800 m

ARP to L1 offset: 0.067 m

Applied height: 1.867 m

Measured to

☒ ARP

☐ L1 Phase Centre

Compute From Slant

OK Cancel

Flight Log

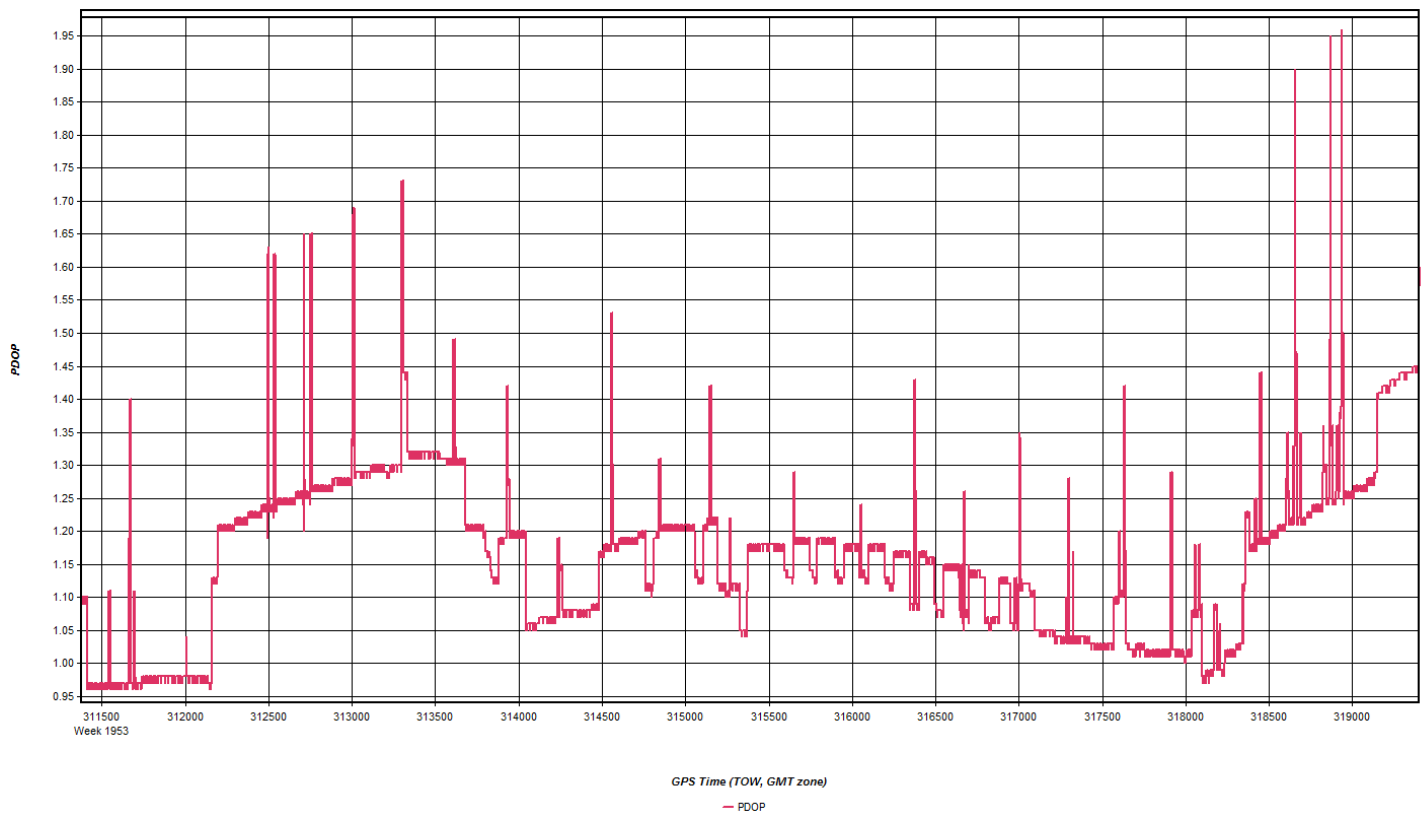
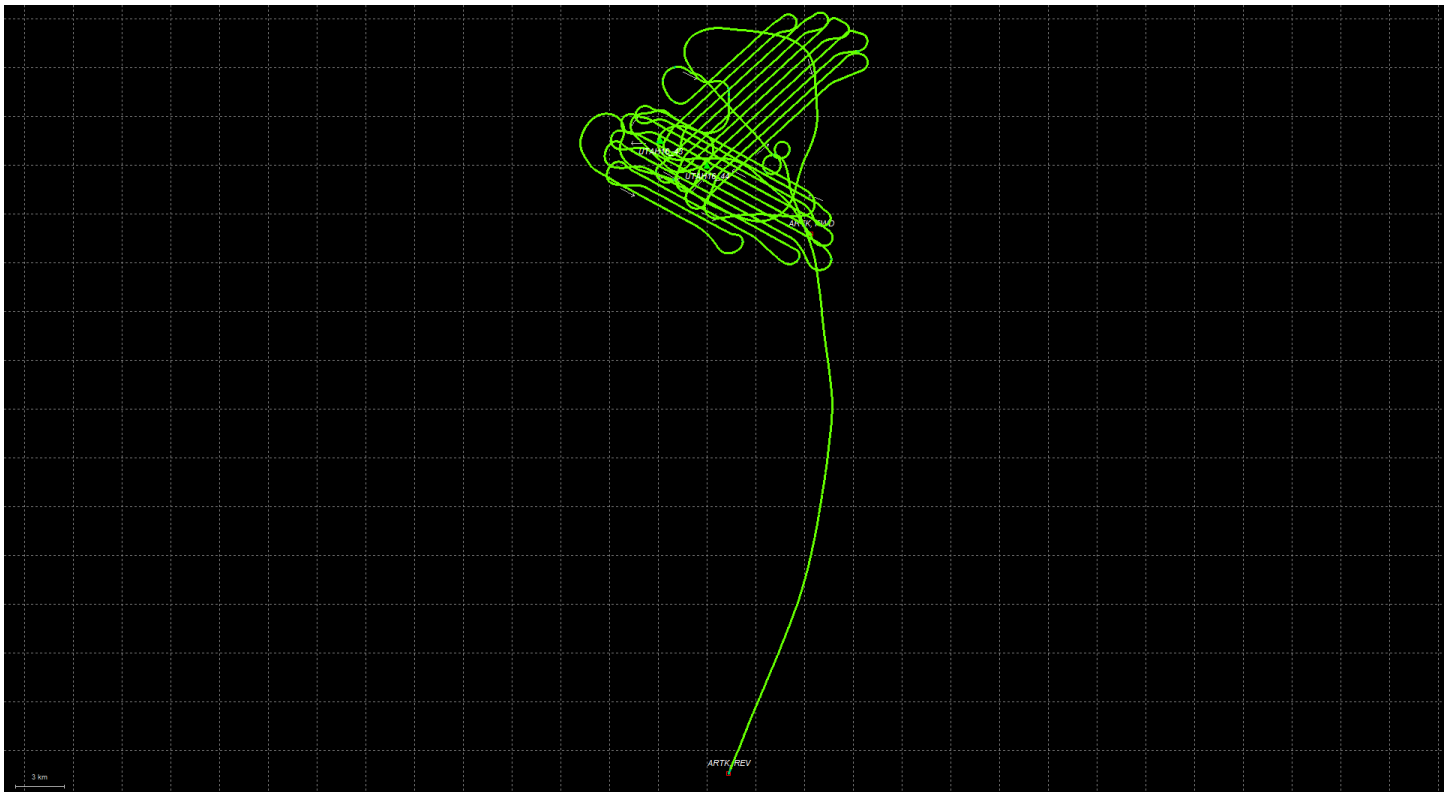
Date: 6/13/2017	Aircraft: N704MD	Sensor: 7161
Project: Utah 2016 LiDAR		Project #: R029083
Flight Mgmt File: FMSL_WACounty_7161		
Pilot: Dave Wagner		Sensor Operator: Drew Johnston

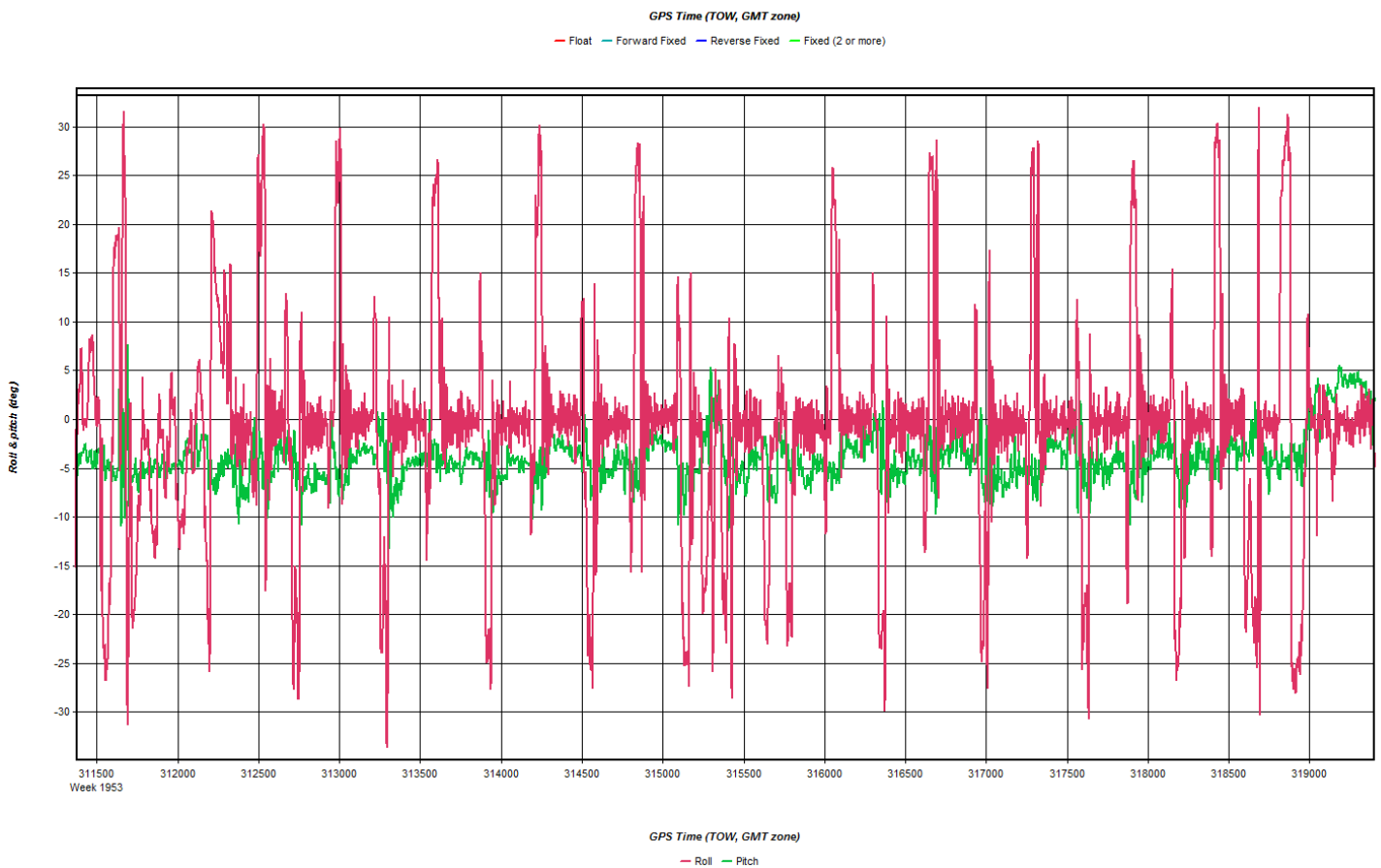
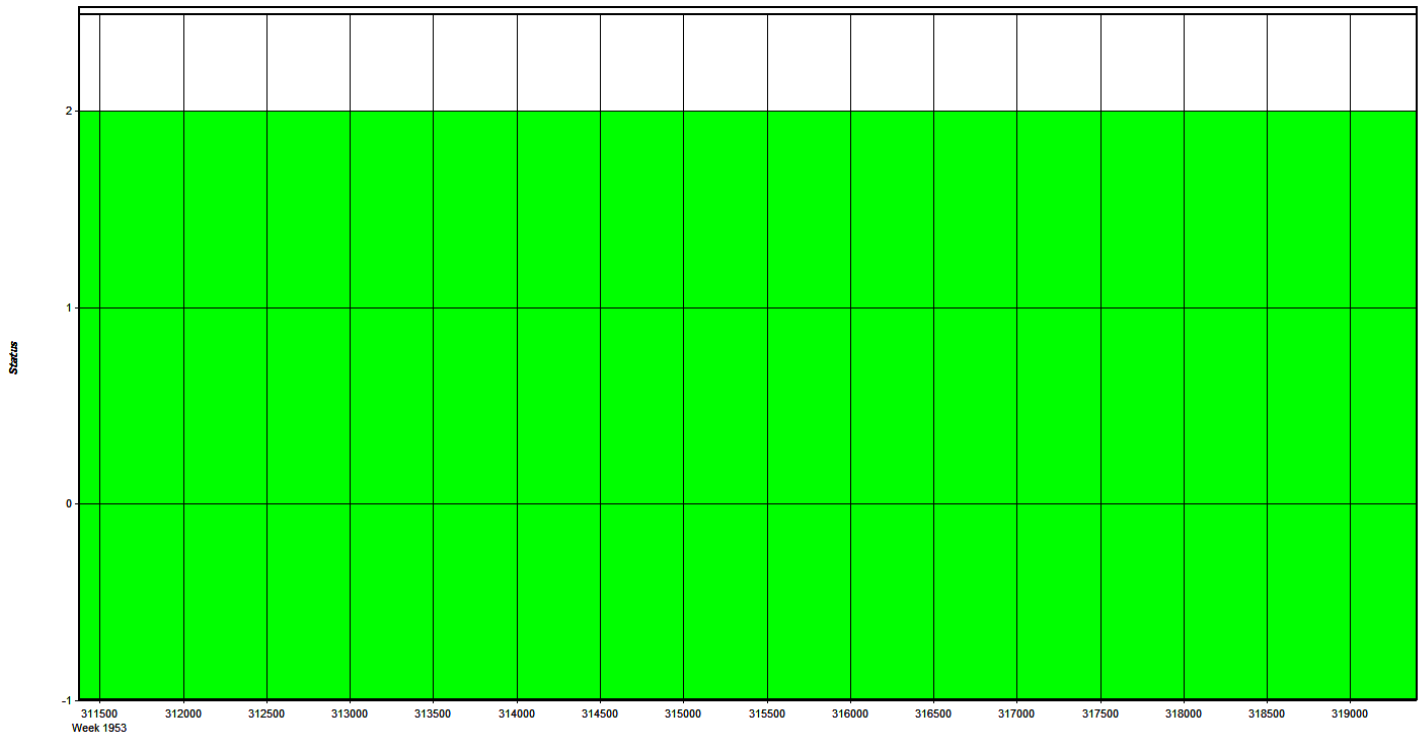
	Flight 1	Flight 2	Flight 3	Flight 4
Wheels Up	8:24:00 AM			
Wheels Down	1:01:00 PM			
Begin Hobbs	1184.1			
End Hobbs	1188.7			
On-line Hobbs: 6		Mob Hobbs: 1.2		

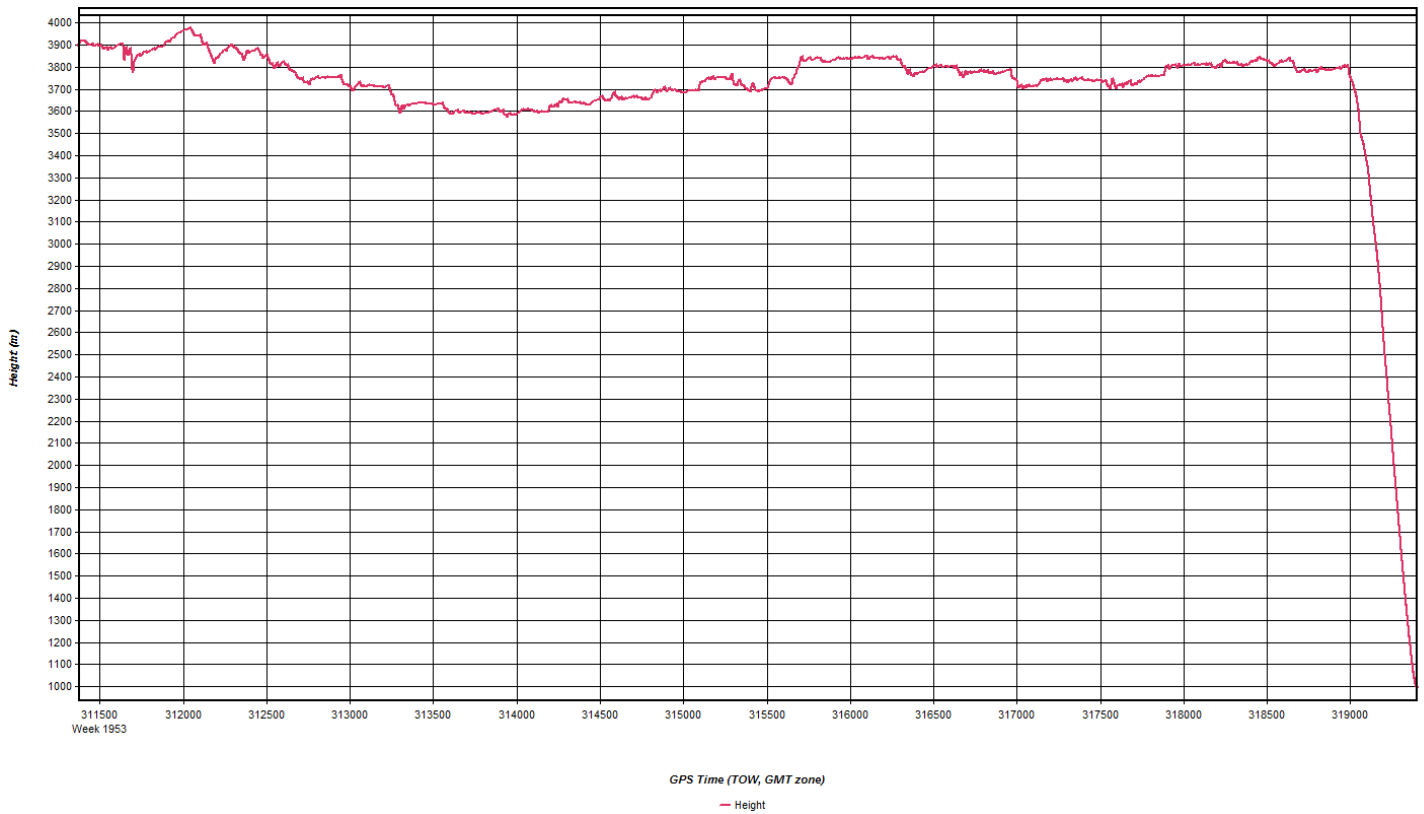
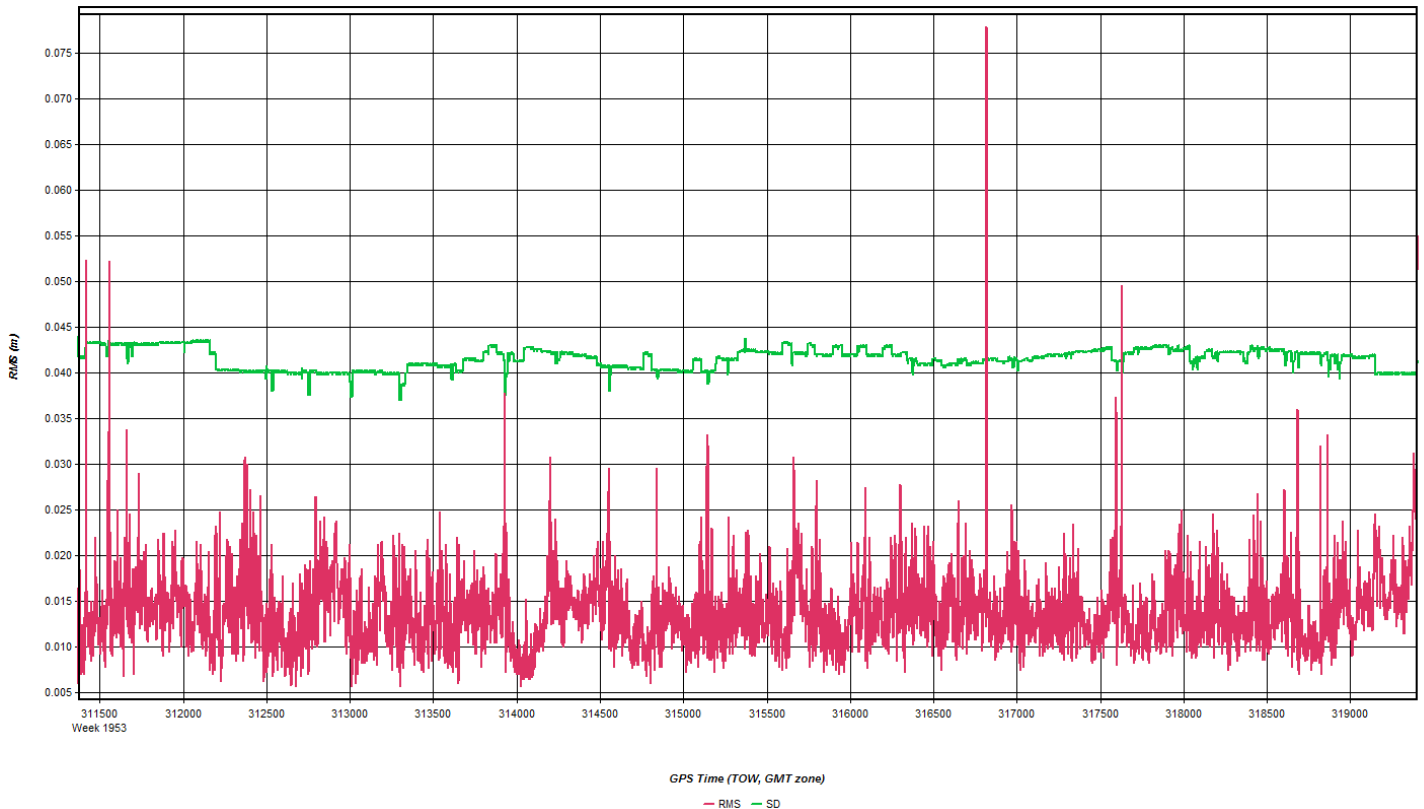
Notes

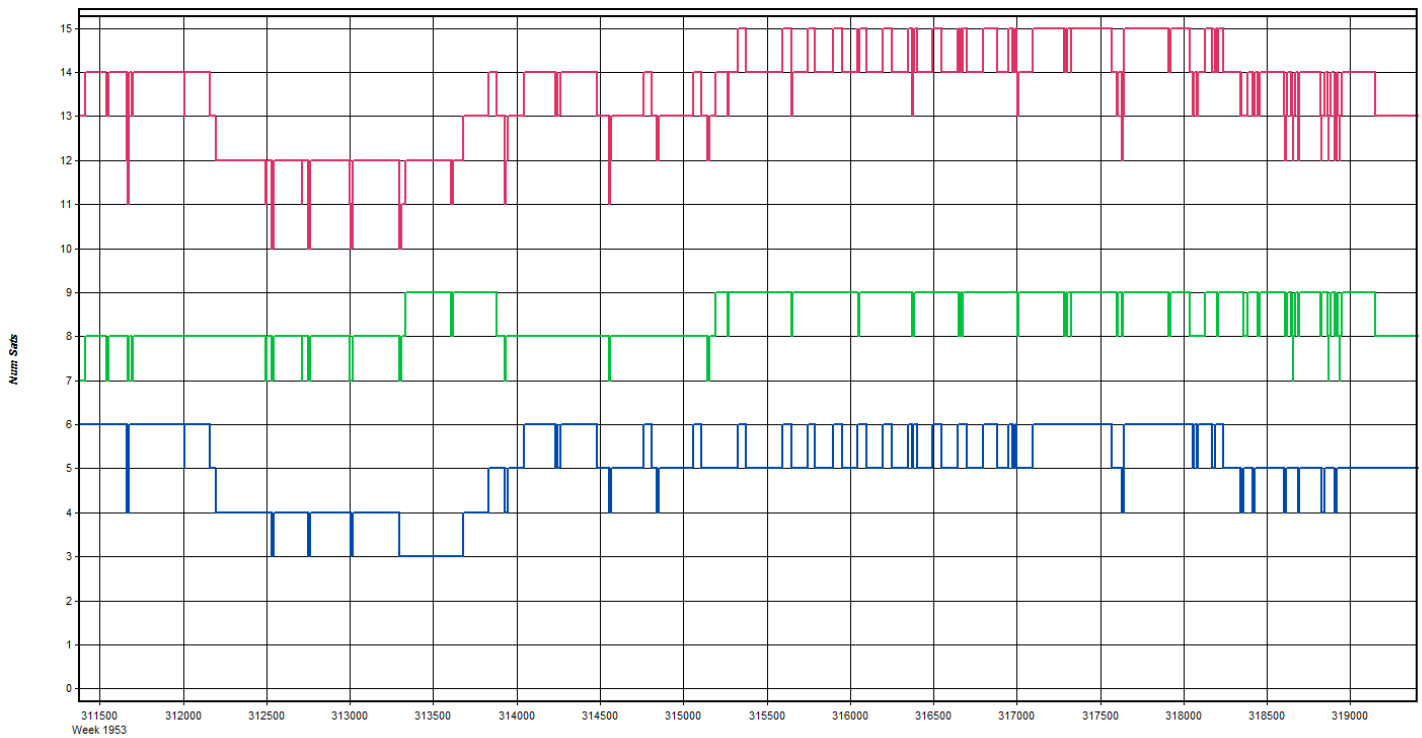
We had many delays/reflies because of the als70 acting up (false ranges shutting off naked eyesafe?), and range violations/dropouts due to the plan/DEM not taking into account the seriousness of the many canyons. The cliffs are very steep, and a side of the swath could be in a very deep trench that wasn't accounted for in the initial planning. We reflew lines that had dropouts, and flew 3 crosslines along the 'trouble' canyons where we had the most issues. We also battled very high winds aloft and turb throughout the day, forcing us to fly a block S-N w/o alternating directions as DW was concerned about stalls. 7.2 is about the max-pain for such flights. Doing a full QL tonight to see how things turned out.

Jun 14, 2017-A (N704MD, SN7161)



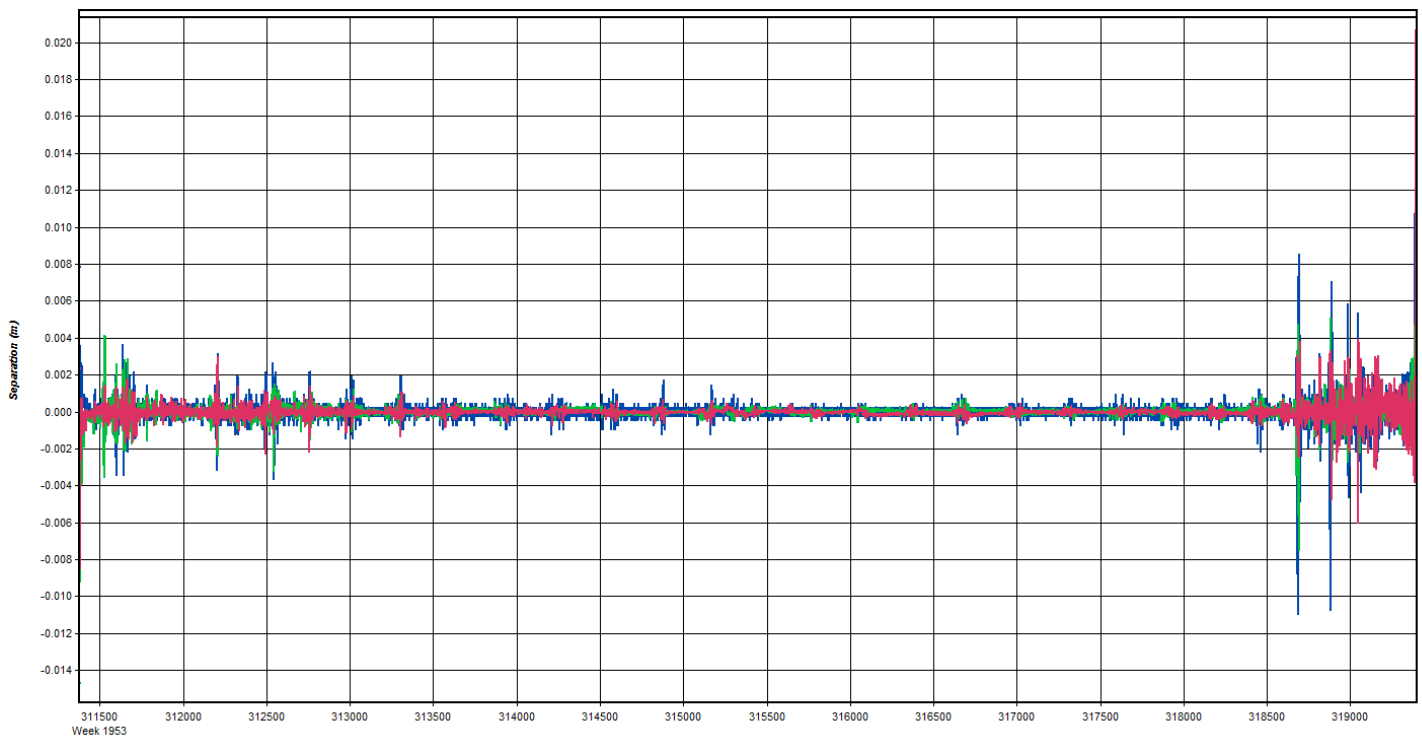






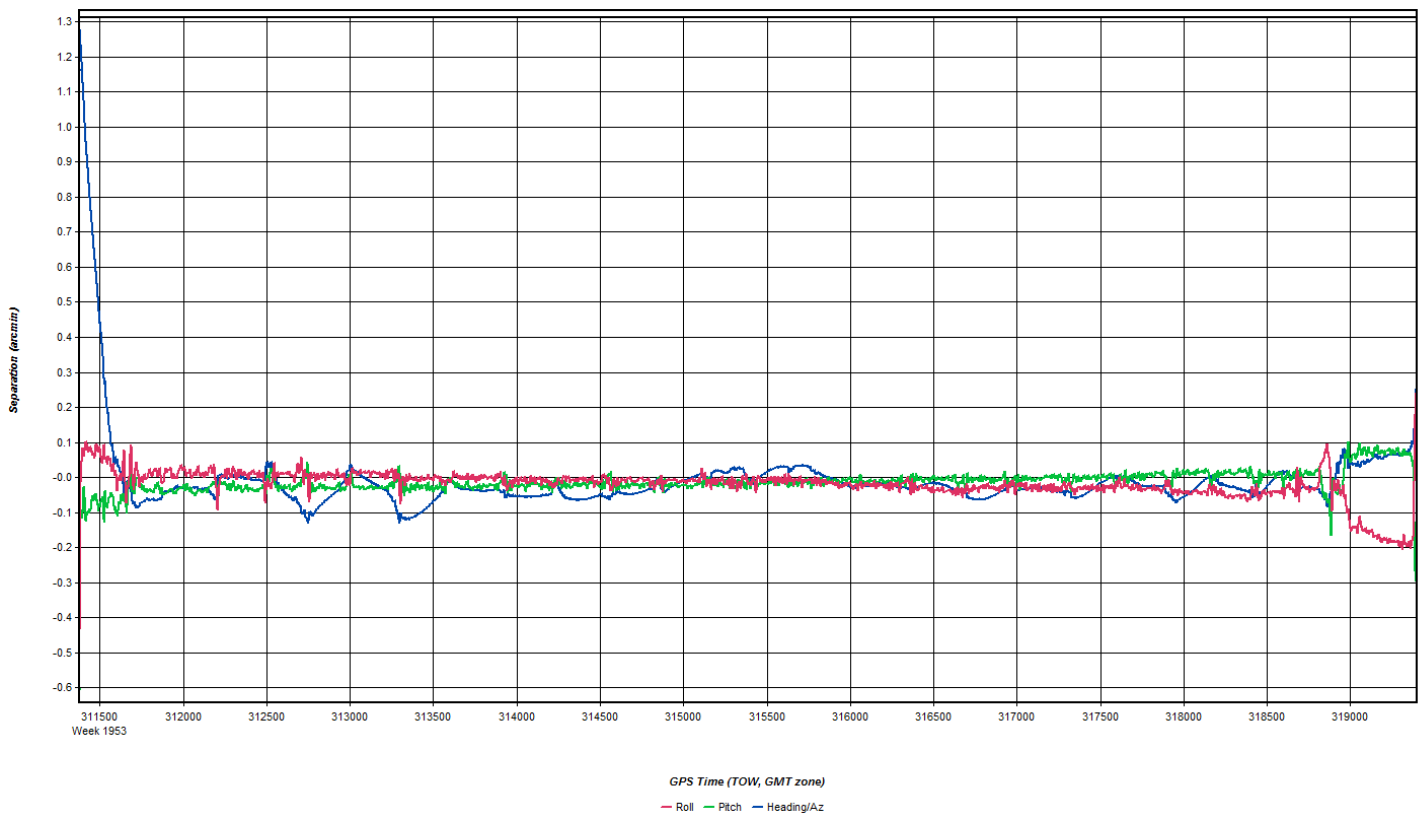
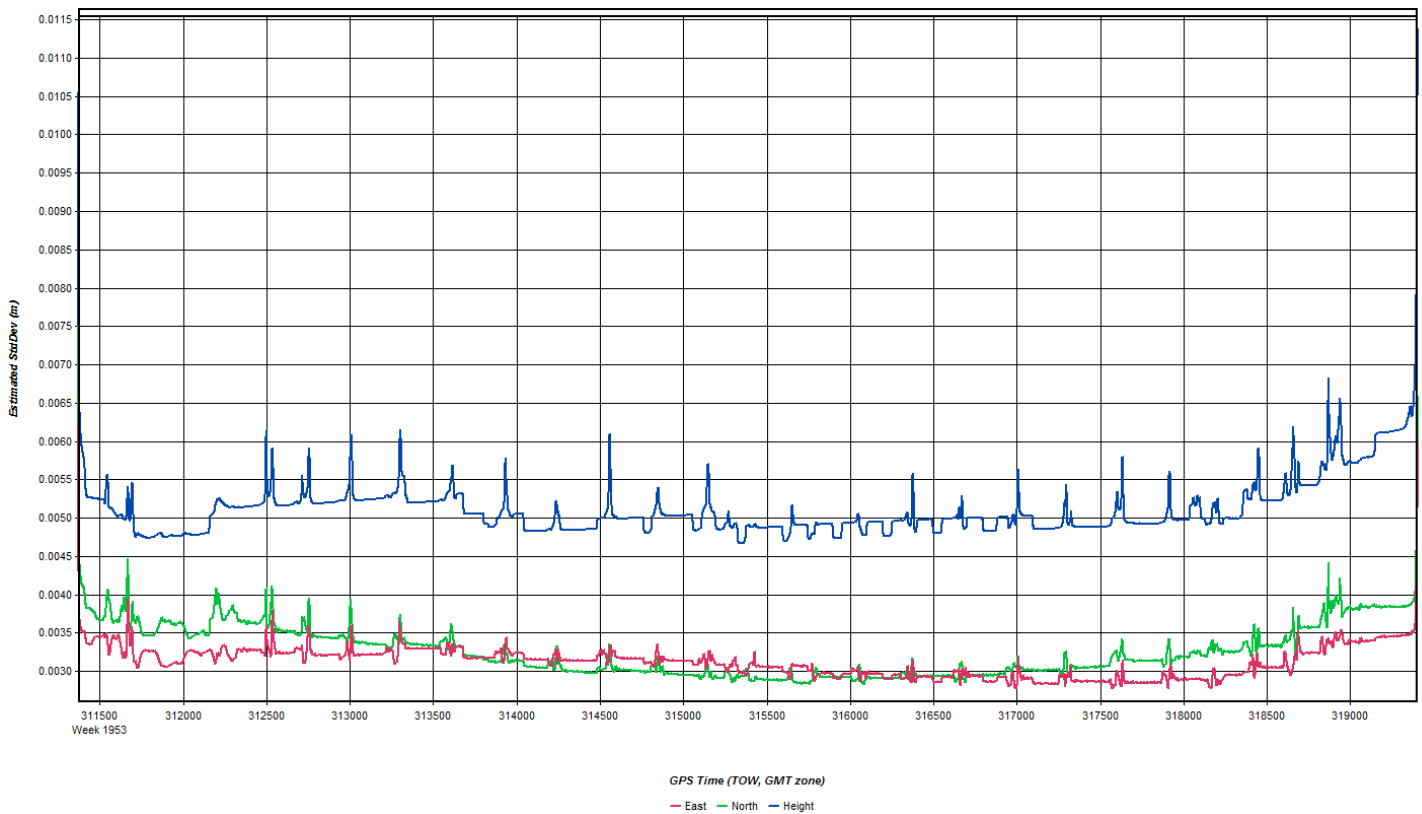
GPS Time (TOW, GMT zone)

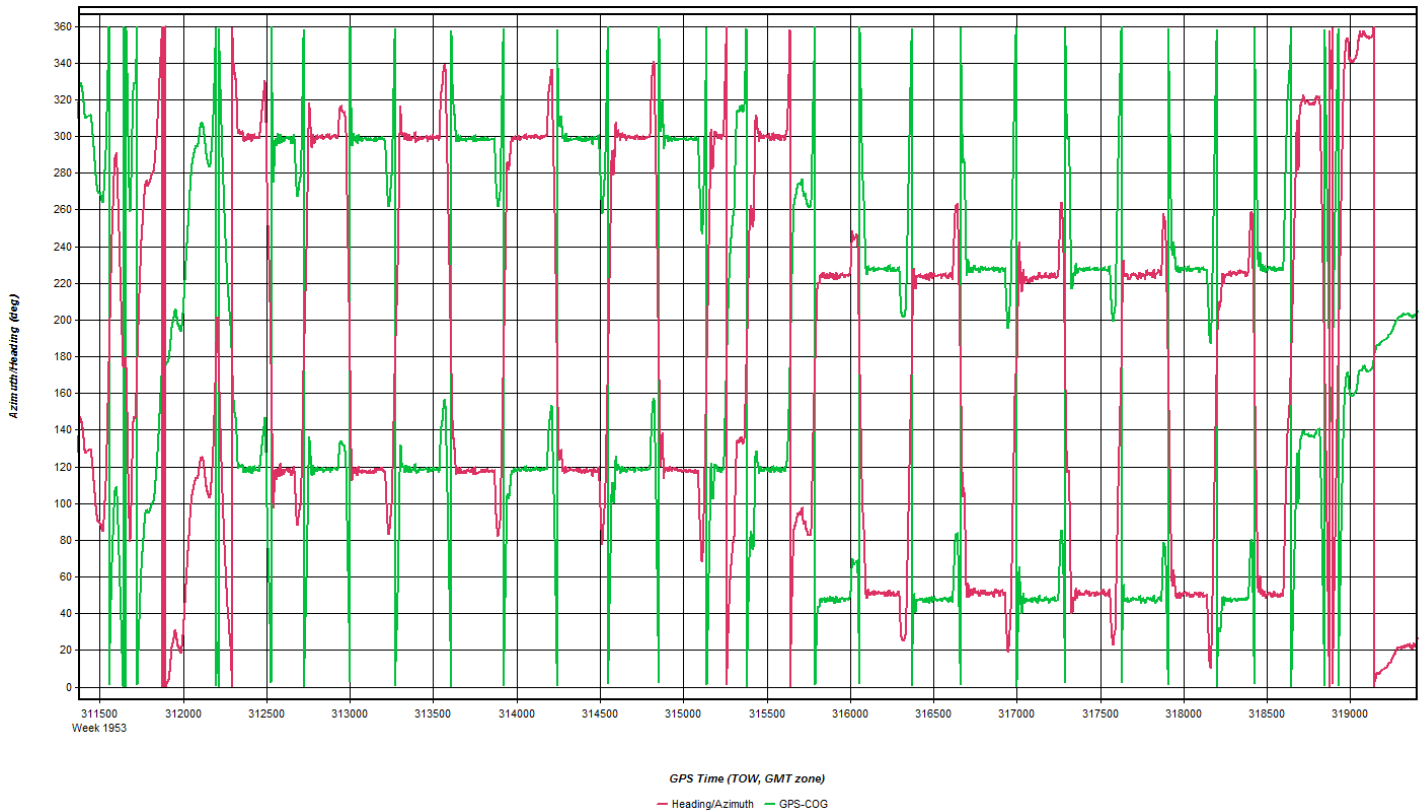
— Num Sats — GPS — GLONASS — BeiDou — Galileo — QZSS



GPS Time (TOW, GMT zone)

— East — North — Up





Coordinate/Antenna Settings

Master Remote

Base Station

2: UTAH16_43 Name: UTAH16_43 ☐ Disabled

File: E:\Proc\29083_Utah\29803_Utah_2016\Survey_6-16-17\JD165_7\

Coordinates

Latitude: North 37 24 43.84132 Coord. options

Longitude: West 113 32 31.51438 Save to Favorites

Ellipsoidal height: 1904.470 m

Datum: WGS84 Proc Datum: WGS84

Epoch: year

Antenna Height

From station file: TRM55971.00 View STA File

Antenna profile: TRM55971.00 Info

Measured height: 2.000 m

ARP to L1 offset: 0.067 m

Applied height: 2.067 m

Measured to

☒ ARP

☐ L1 Phase Centre

Compute From Slant

OK Cancel

Coordinate/Antenna Settings ? X

Master Remote

Base Station

1: UTAH16_44 Name: UTAH16_44 ☐ Disabled

File: E:\Proc\29083_Utah\29803_Utah_2016\Survey_6-16-17\JD165_7\

Coordinates

Latitude: North 37 23 54.45819 Coord. options

Longitude: West 113 30 36.56812 Save to Favorites

Ellipsoidal height: 1961.460 m

Datum: WGS84 Proc Datum: WGS84

Epoch: year

Antenna Height

From station file: TRM55971.00 View STA File

Antenna profile: TRM55971.00 Info

Measured height: 2.000 m

ARP to L1 offset: 0.067 m

Applied height: 2.067 m

Measured to

☒ ARP

☐ L1 Phase Centre

Compute From Slant

OK Cancel

Flight Log

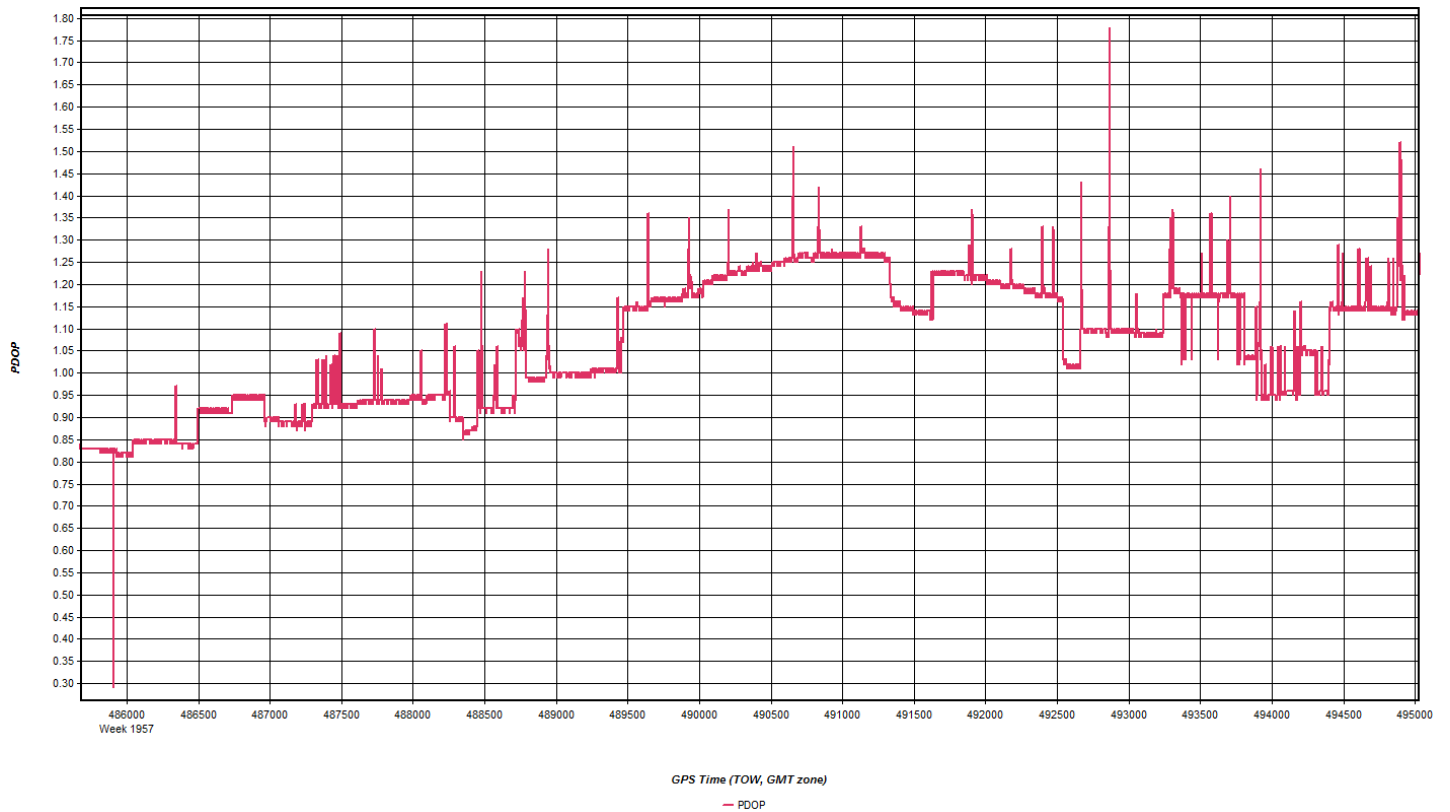
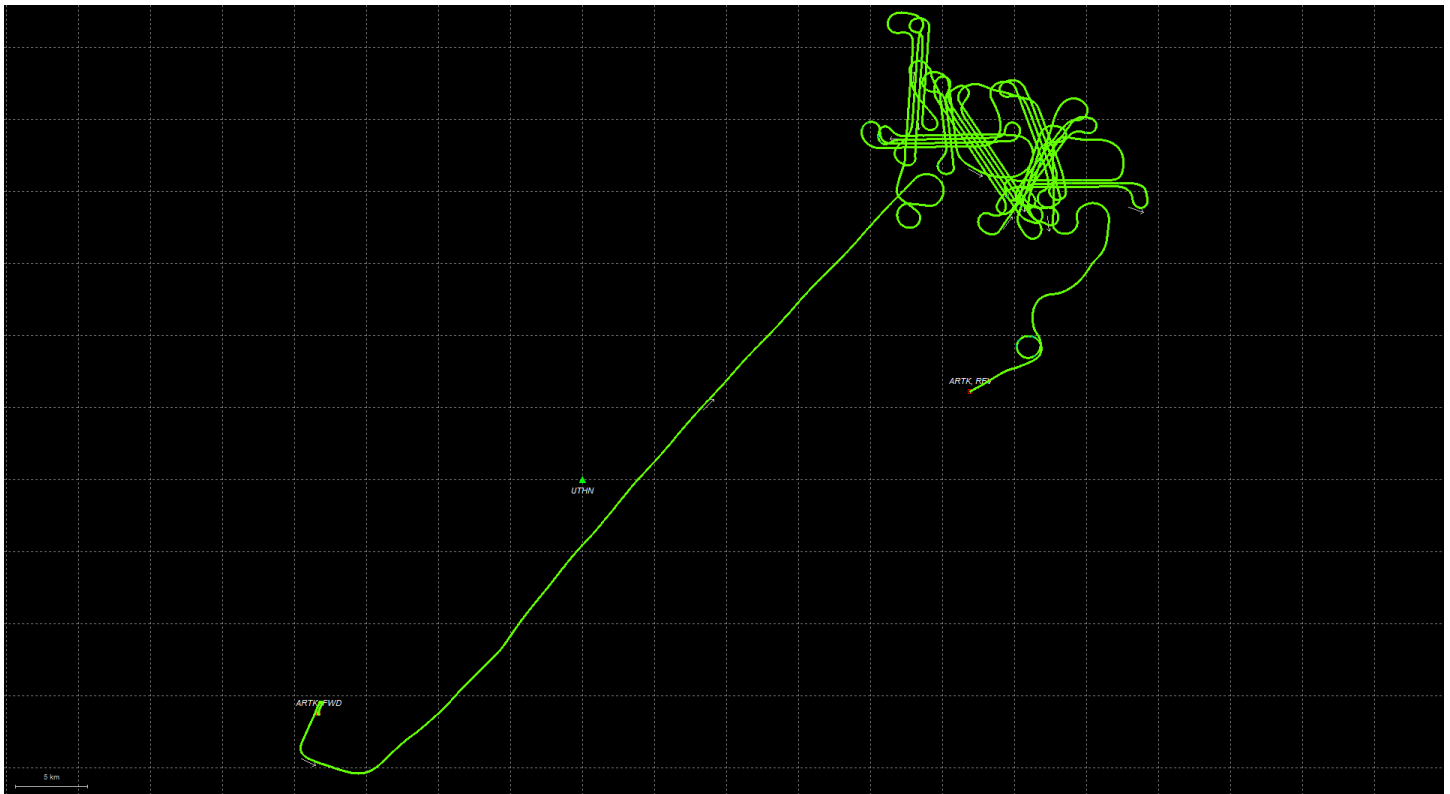
Date: 6/14/2017	Aircraft: 704MD	Sensor: 7161
Project: Utah 2016 LiDAR		Project #: R029083
Flight Mgmt File: FMSL_WACounty_7161		
Pilot: Dave Wagner		Sensor Operator: Drew Johnston

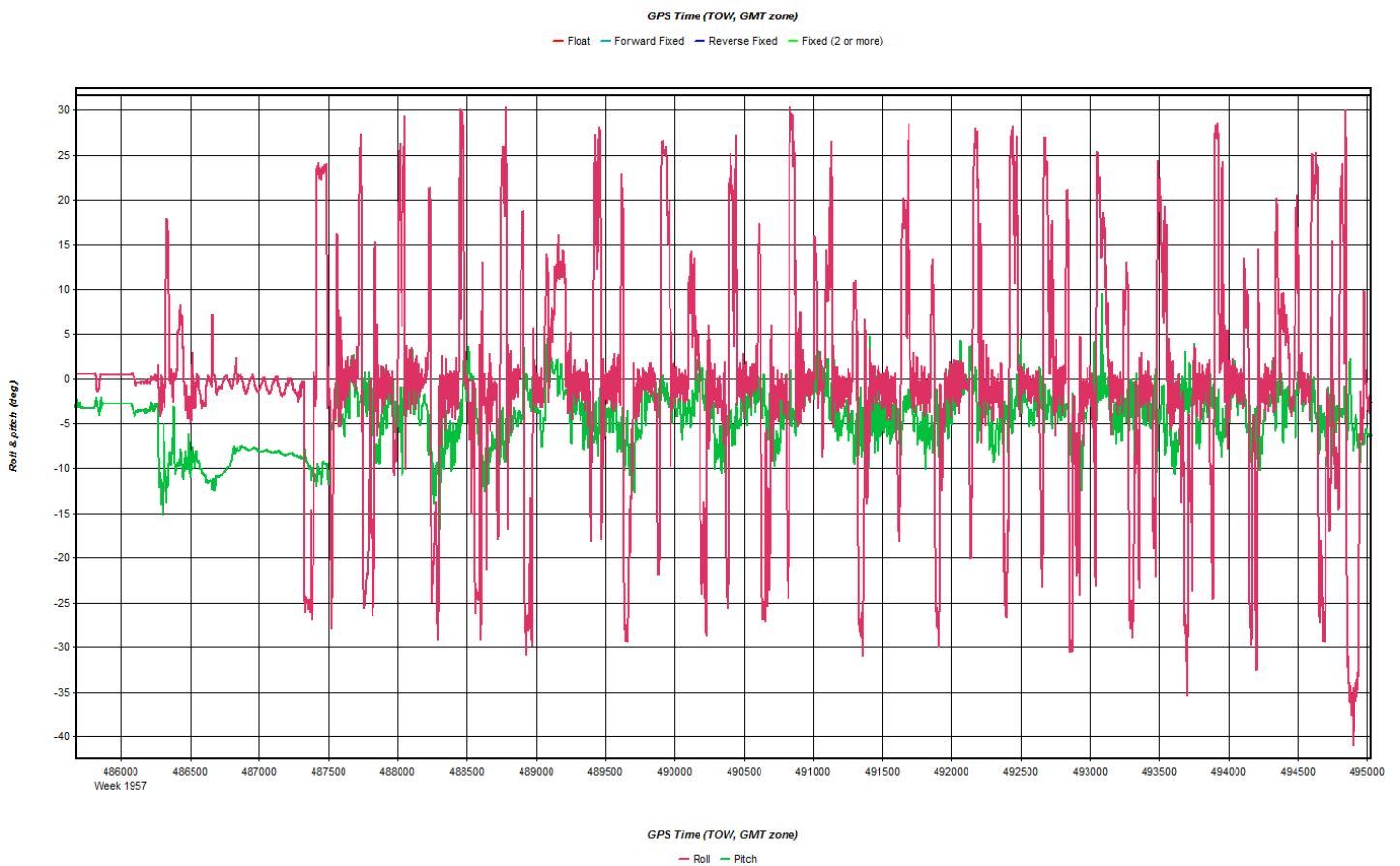
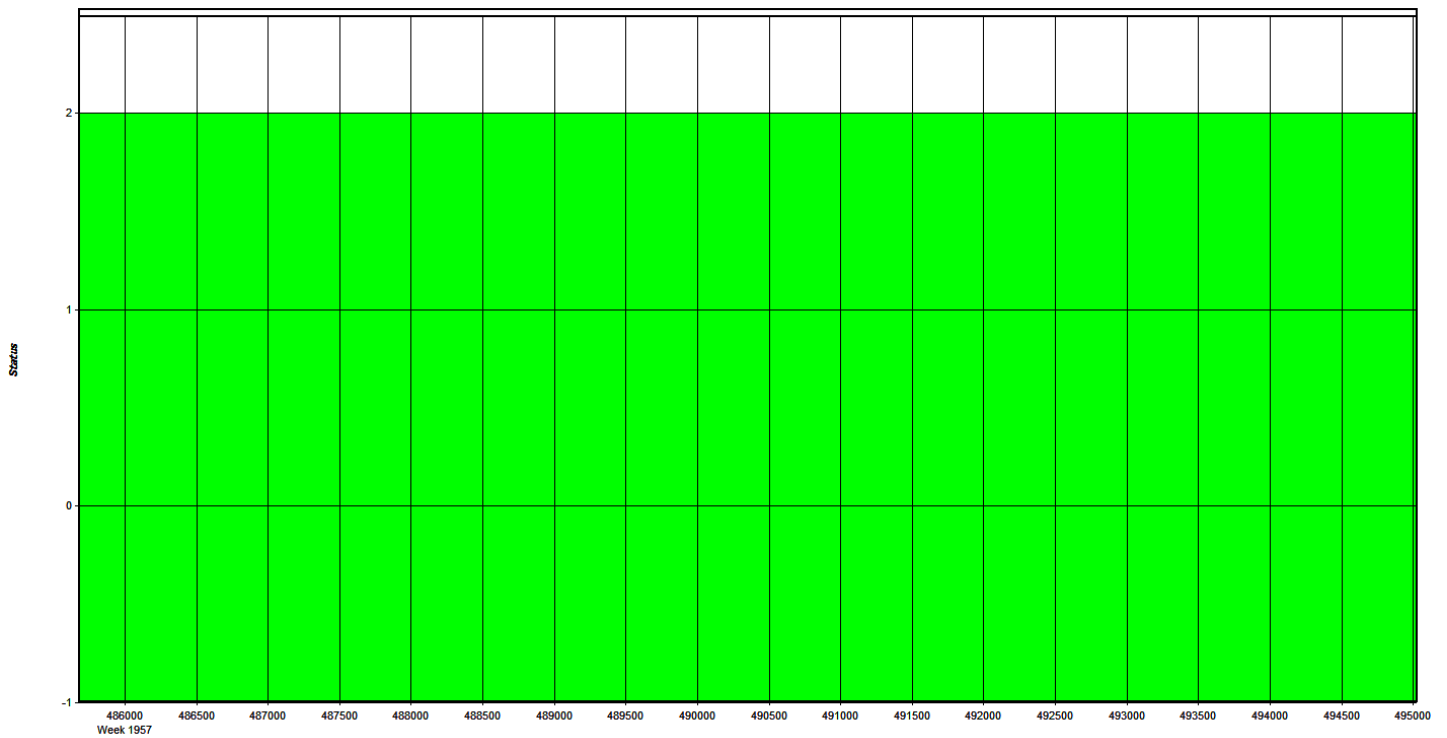
	Flight 1	Flight 2	Flight 3	Flight 4
Wheels Up	8:14:00 PM			
Wheels Down	10:44:00 AM			
Begin Hobbs	1191.3			
End Hobbs	1193.8			
On-line Hobbs: 1.8		Mob Hobbs: 0.7		

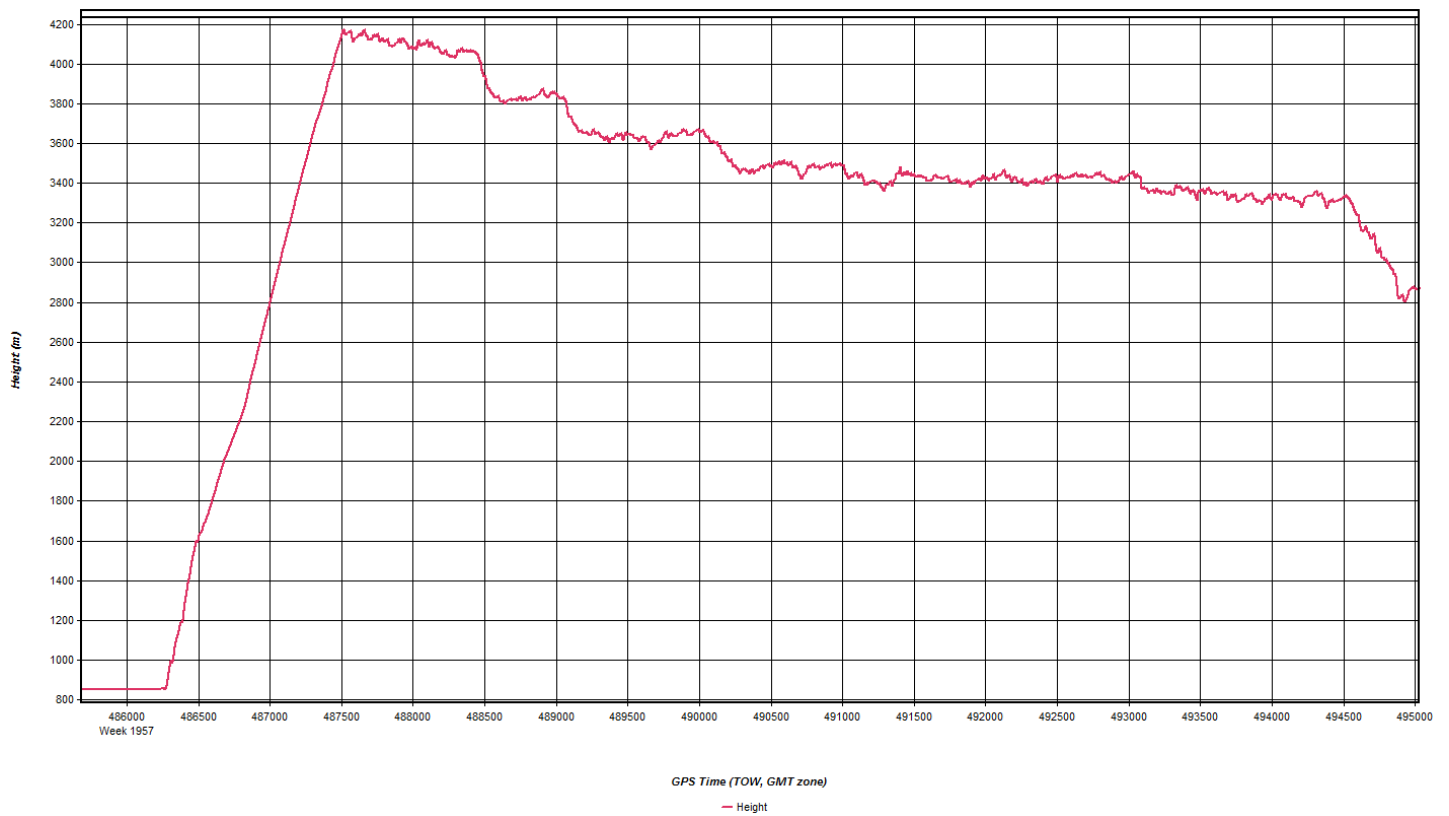
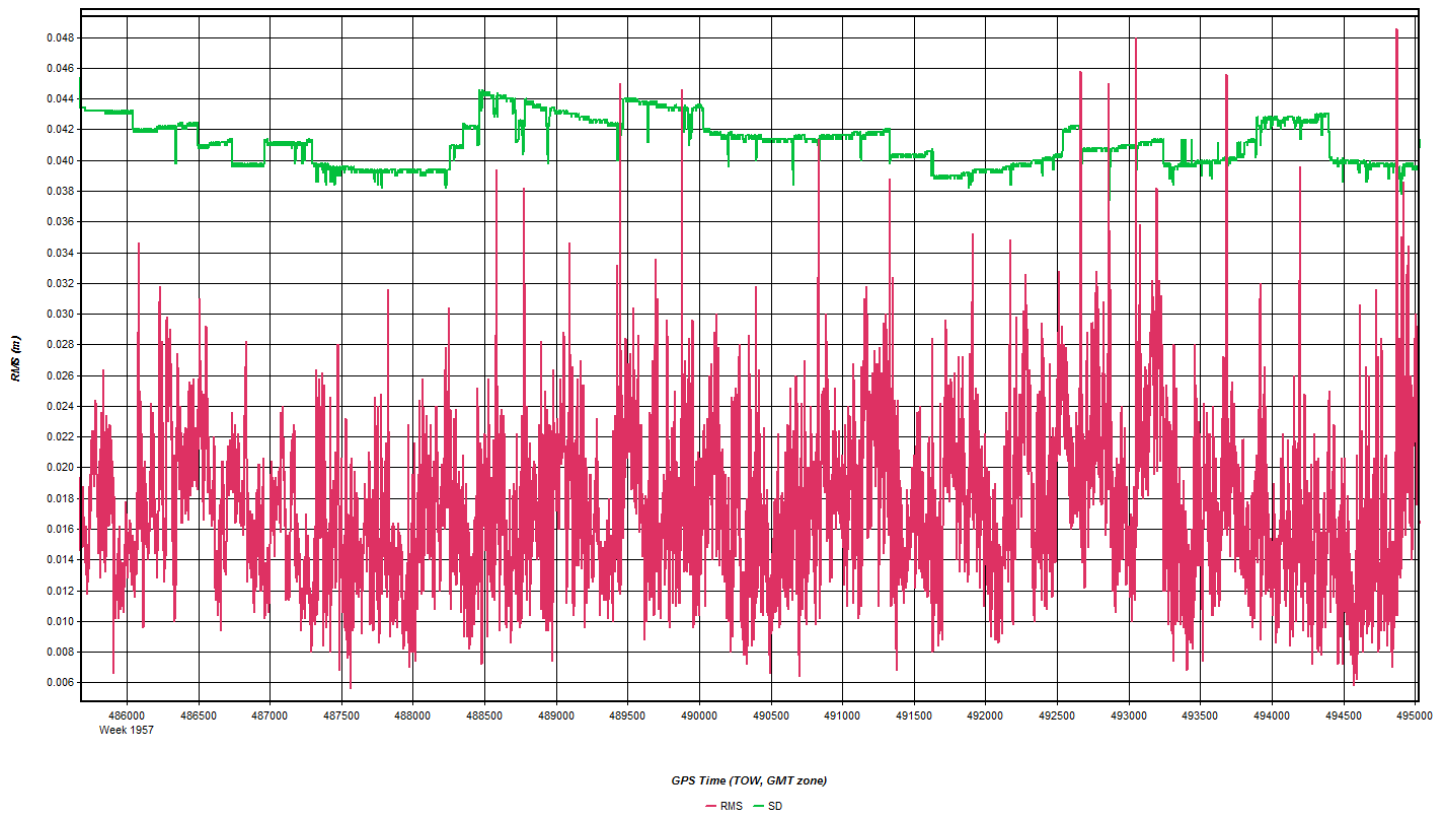
Notes

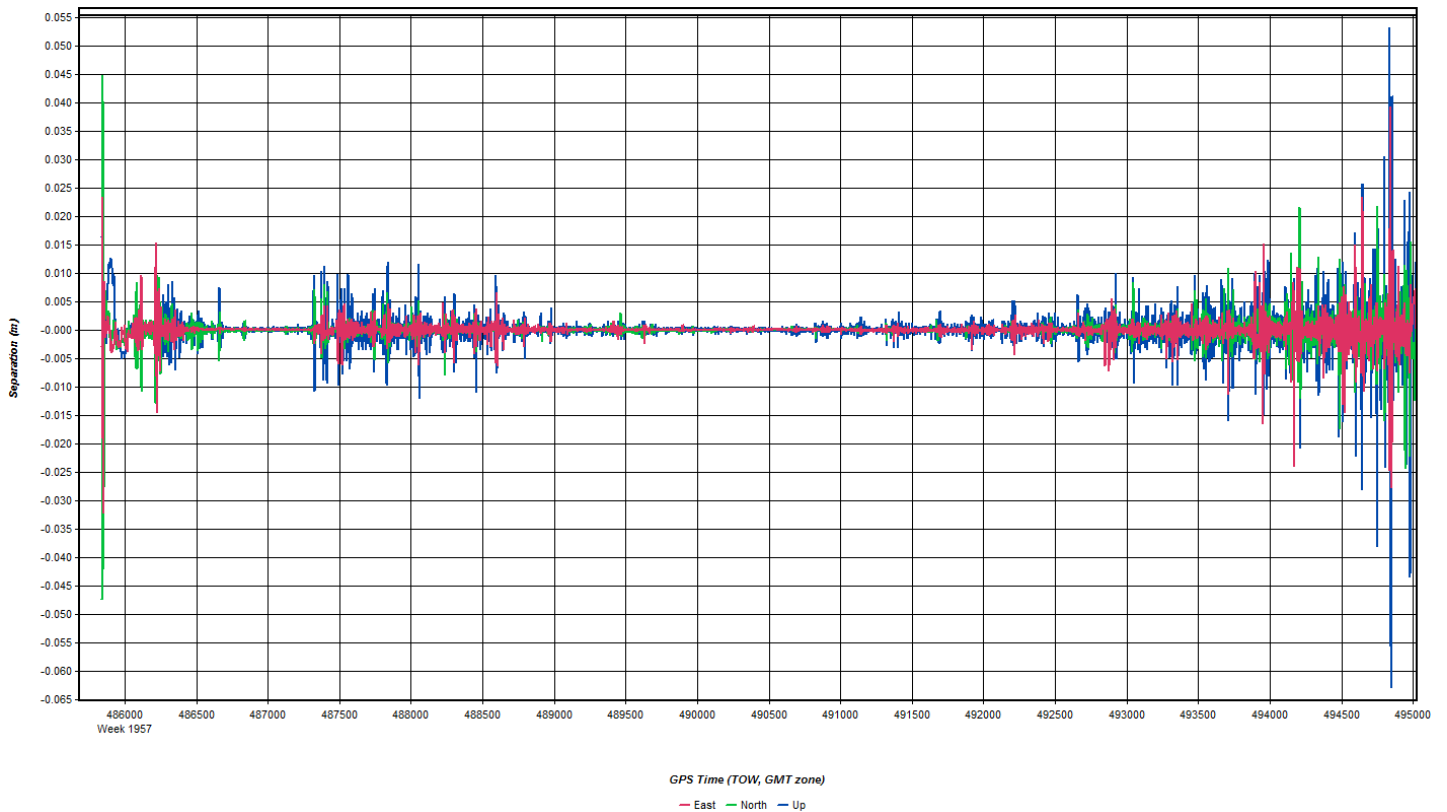
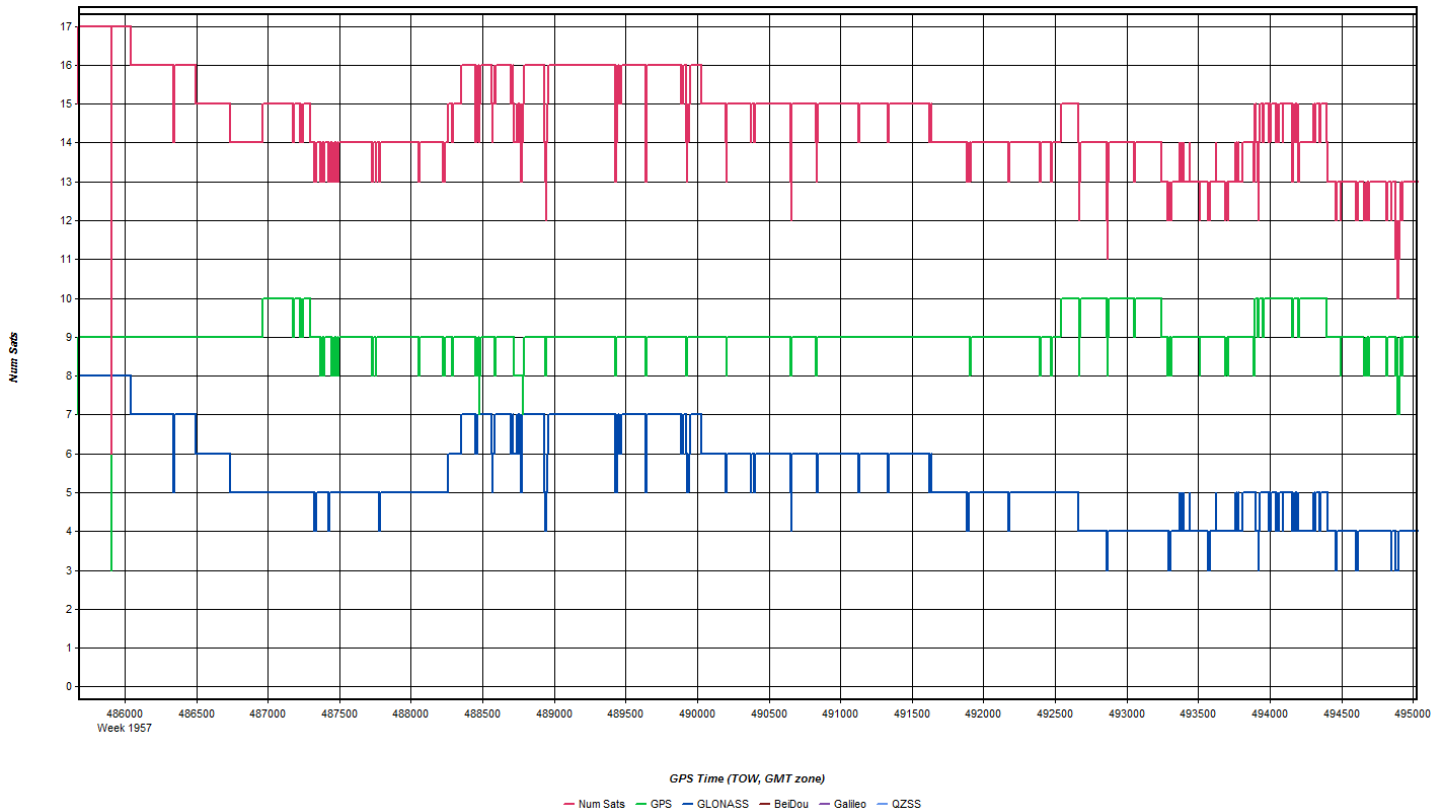
Had a TDC error twice this morning, once at startup and again in the air. In air startup had trouble finding pos. Did a restart, wagged the tail of the plane, ups and downs, and it found itself. 10 minutes, then started ACQ. Northern block east ends of the lines were too high when entering the line, but this had overlap from the block we flew first so we continued on.

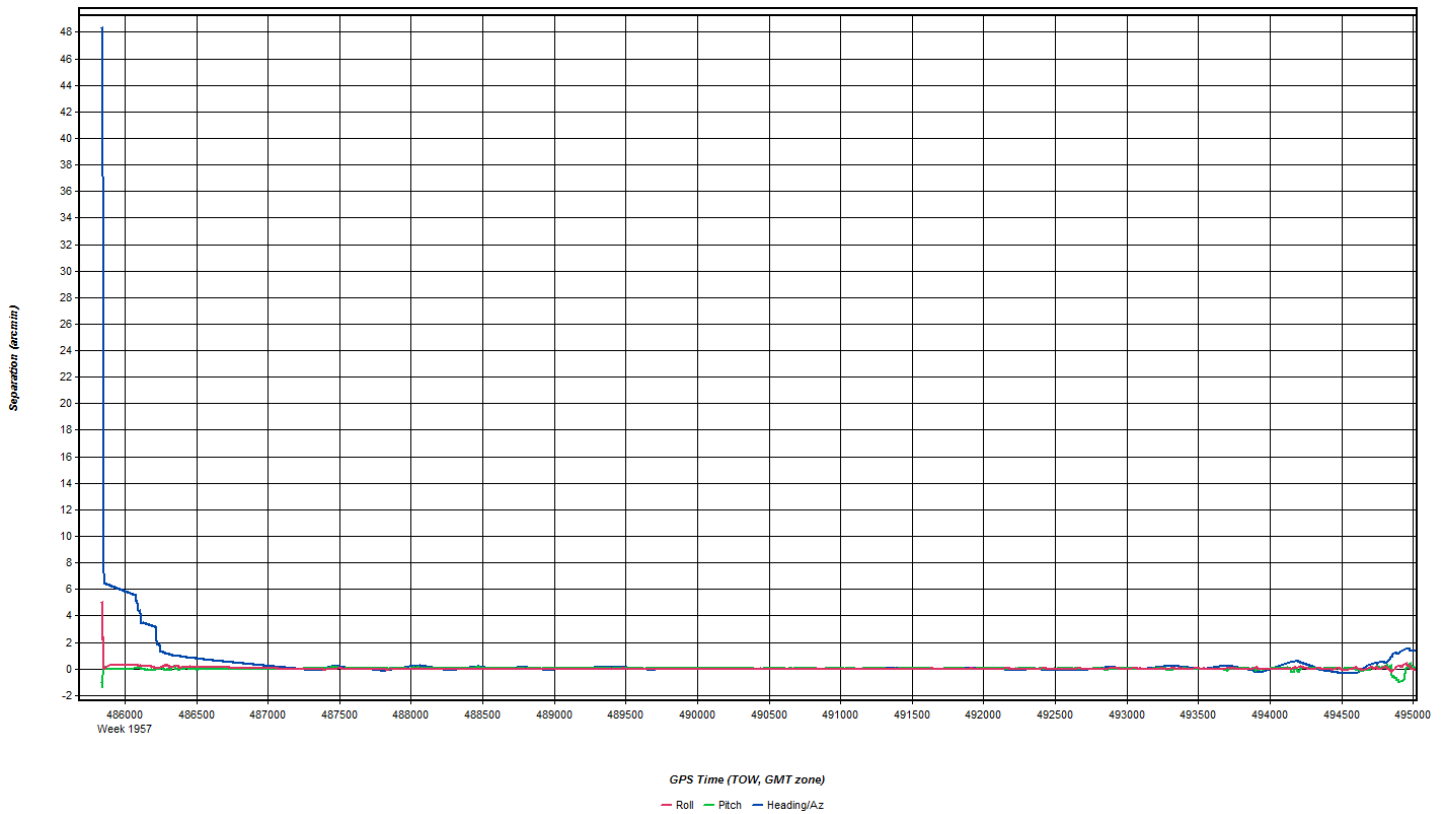
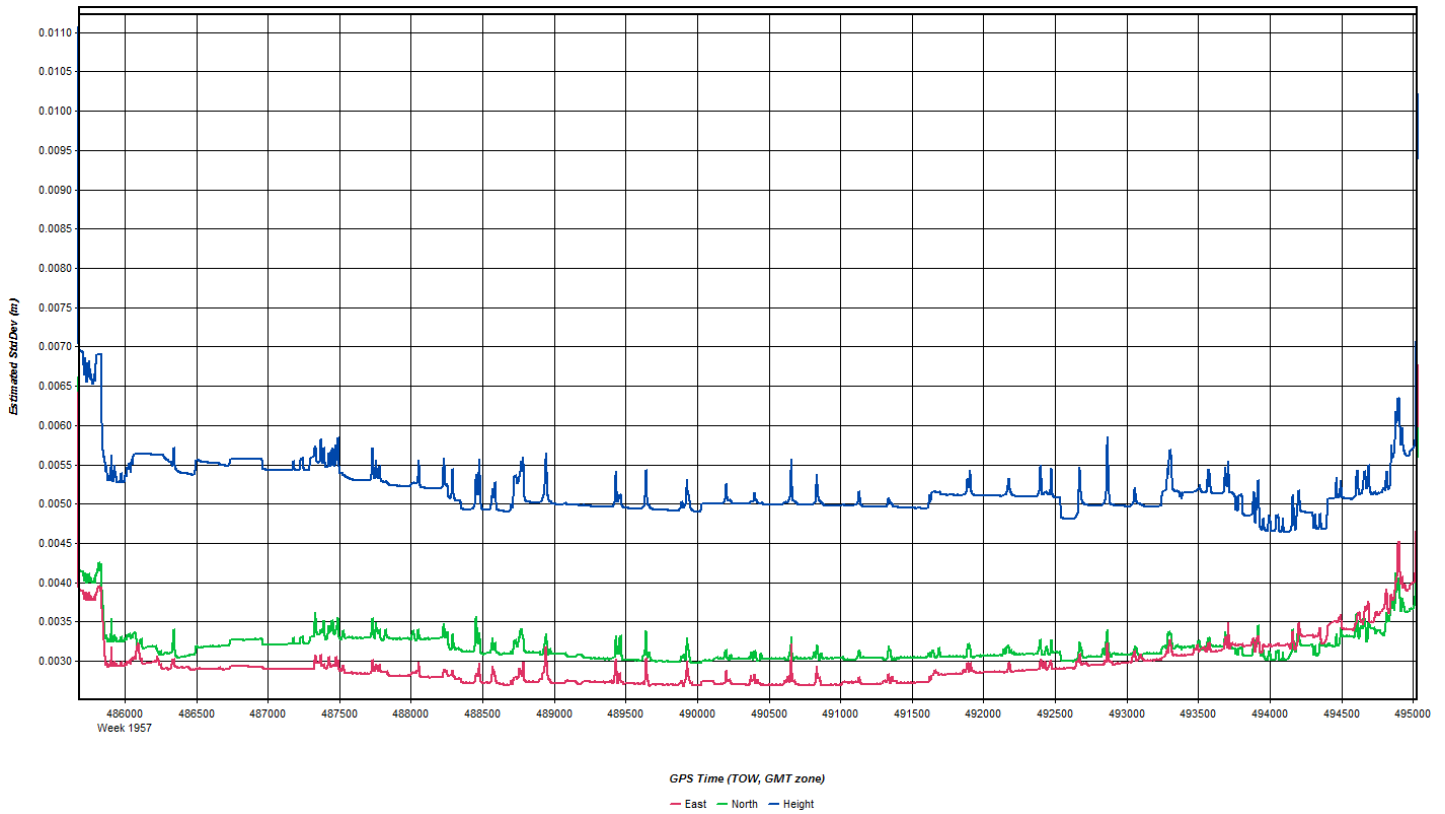
Jul 14, 2017-A (N704MD, SN8239)

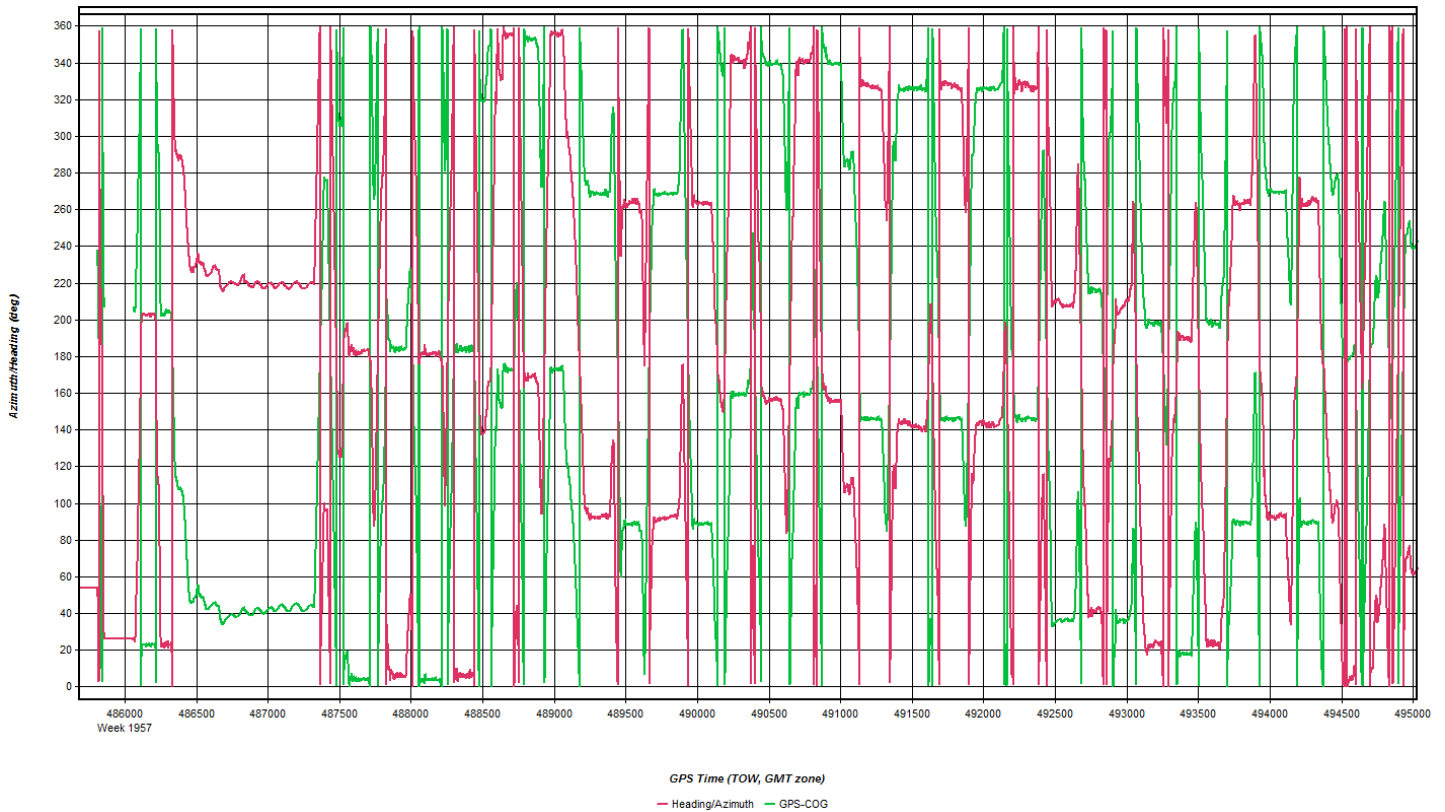












Coordinate/Antenna Settings

Master Remote

Base Station

1: UTHN Name: UTHN ☐ Disabled

File: E:\Proc\29083_Utah\29803_Utah_2016\20170714_FMSL_WACou

Coordinates

Latitude: North 37 11 08.50150 Coord. options

Longitude: West 113 17 55.20863 Save to Favorites

Ellipsoidal height: 1013.602 m

Datum: WGS84 Proc Datum: WGS84

Epoch: year

Antenna Height

From station file: TRM55971.00, NONE View STA File

Antenna profile: TRM55971.00 Info

Measured height: 0.000 m

ARP to L1 offset: 0.067 m

Applied height: 0.067 m

Measured to

☒ ARP

☐ L1 Phase Centre

Compute From Slant

OK Cancel

Flight Log

Date: 7/14/2017	Aircraft: N704MD	Sensor: 8239
Project: Utah 2016 LiDAR		Project #: R029083
Flight Mgmt File: FMSL_WACounty_8239_Canyons_60ovlp		
Pilot: Sean Meyer		Sensor Operator: Drew Johnston

	Flight 1	Flight 2	Flight 3	Flight 4
Wheels Up	9:03:00 AM	3:25:00 PM		
Wheels Down	11:42:00 AM	6:27:00 PM		
Begin Hobbs	1981.7	1984.3		
End Hobbs	1984.3	1987.3		
On-line Hobbs: 2		Mob Hobbs: 3.6		

Notes

Lifted and quickly ran through data before our MOB towards Sheboygan. We are in Westminster, CO for the night.