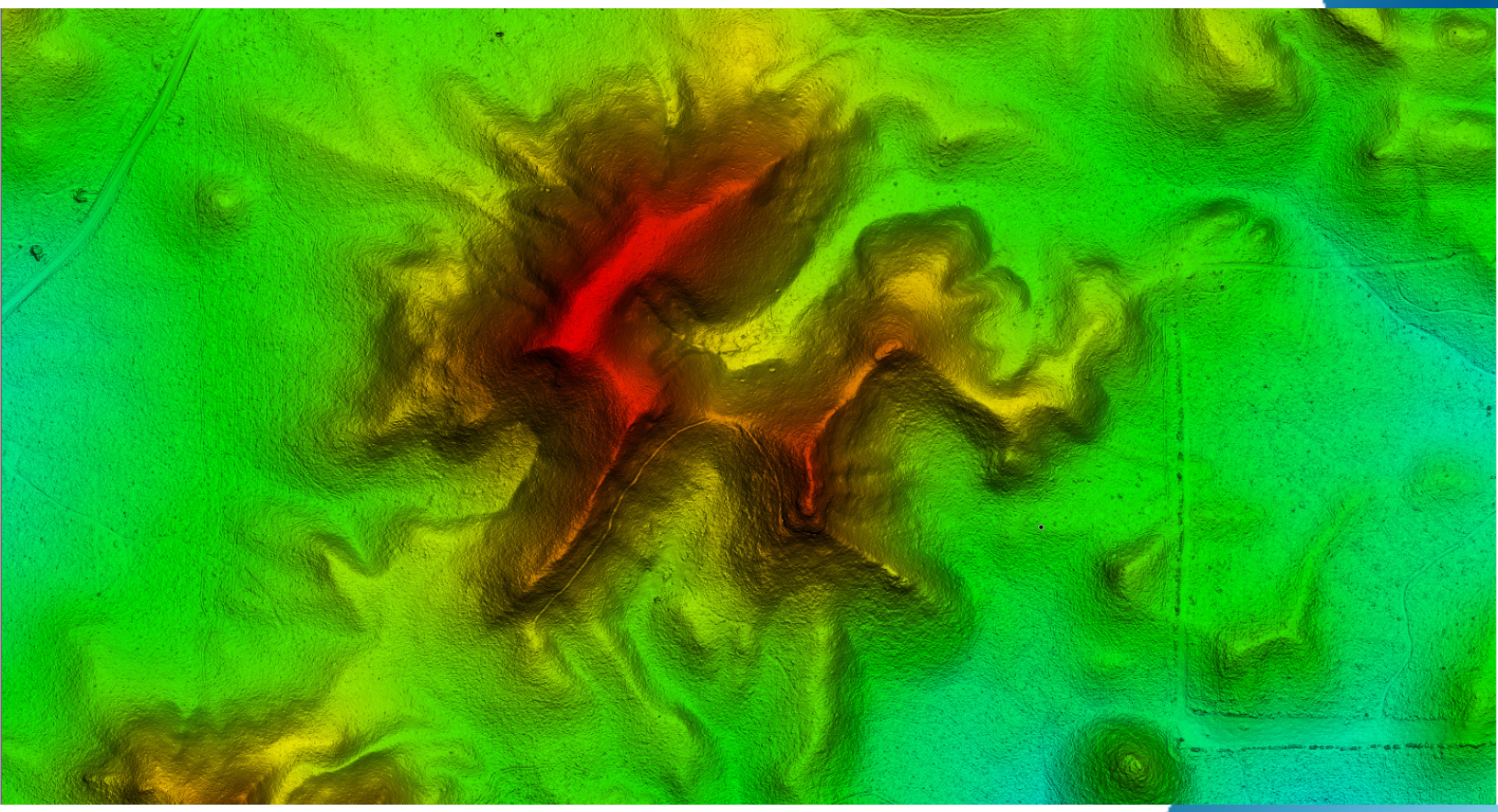
NV5 GEOSPATIAL



WI 12 County B22 Polk LIDAR PROCESSING REPORT

2023

Submitted: August 31, 2023

Project ID: 23011
Work Unit: 300208

Prepared for:

USGS
science for a changing world

Prepared by:

NV5 GEOSPATIAL

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1. Summary / Scope

1.1. Summary

This report contains a summary of the WI 12 County B22 Polk, Work Unit 300208 lidar acquisition task order, issued by USGS under their Contract 140G0221D0012 on March 28, 2022. The task order yielded a work unit area covering 965 square miles over Wisconsin at Quality Level 2. The intent of this document is only to provide specific validation information for the data acquisition/collection, processing, and production of deliverables 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 / m2	2,083 m	58.5°	20%	≤ 10 cm

1.3. Coverage

The work unit boundary covers 965 square miles over Wisconsin. Work unit extents are shown in Figure 1.

1.4. Duration

Lidar data was acquired from May 6, 2022 and May 10, 2022 in 4 total lifts. See “Section: 2.4. Time Period” for more details.

1.5. Issues

There were no issues to report.

WI 12 County B22 Polk Work Unit 300208 Projected Coordinate System: Wisconsin Coordinate Reference System - Polk Horizontal Datum: NAD83 (2011) Vertical Datum: NAVD88 (GEOID 18) Units: Survey Feet	
Lidar Point Cloud	Classified Point Cloud in .LAS 1.4 format
Rasters	• 2-foot Hydro-flattened Bare Earth Digital Elevation Model (DEM) in GeoTIFF format • 2-foot Intensity images in GeoTIFF format • 4-foot Maximum Surface Height Raster • 4-foot Swath Seperation Images
Vectors	Shapefiles (*.shp) • Project Boundary • Lidar Tile Index Geodatabase (*.gdb) • Continuous Hydro-flattened Breaklines • Flightlines Swath
Reports	Reports in PDF format • Focus on Delivery • Survey Report • Processing Report
Metadata	XML Files (*.xml) • Breaklines • Classified Point Cloud • DEM • Intensity Imagery

WI 12 County B22 Polk
Work Unit 300208 Boundary

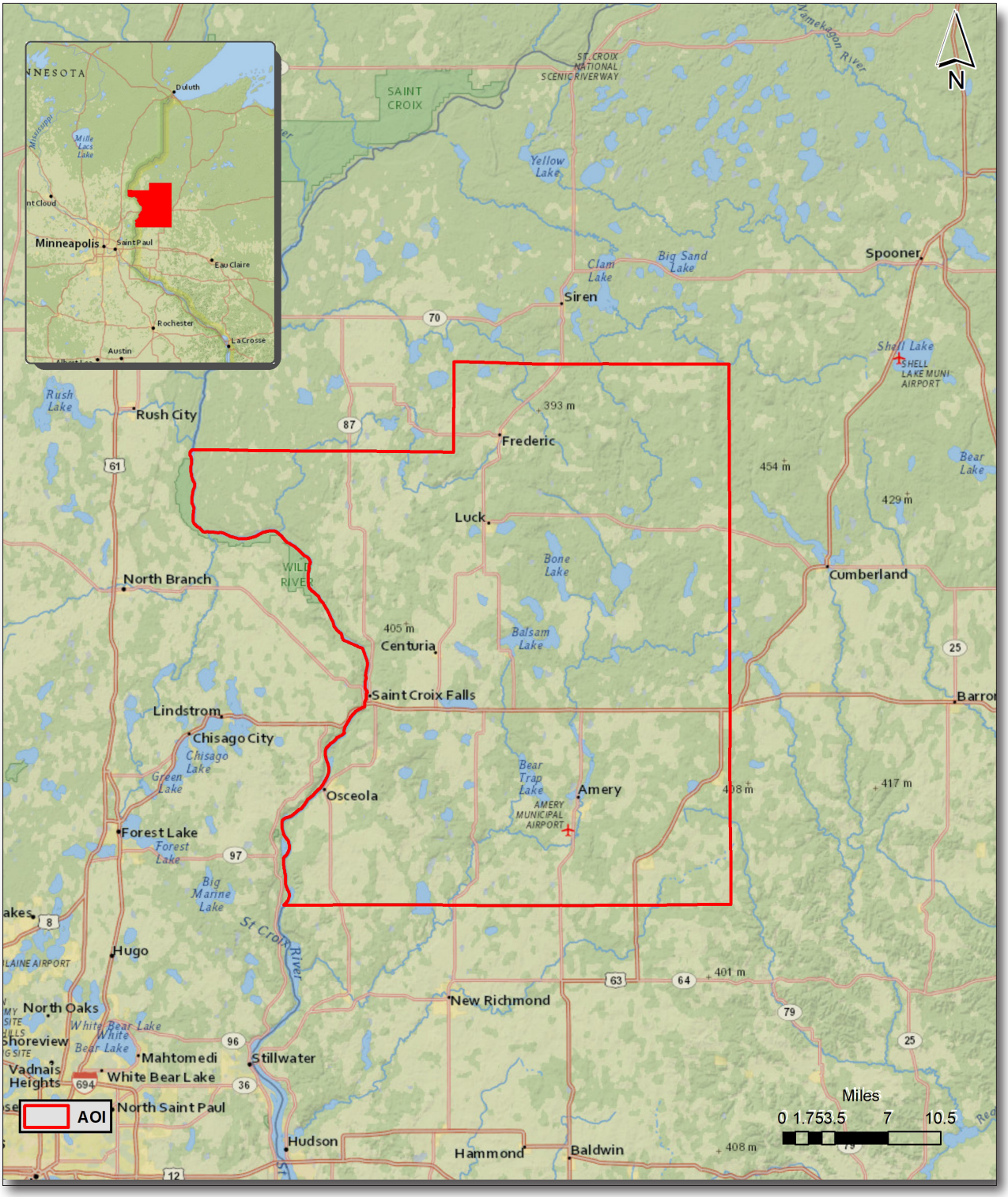


Figure 1. Work Unit Boundary

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 RiPARAMETER planning software.

2.2. Lidar Sensor

NV5 Geospatial utilized Riegl VQ1560ii lidar sensors (Figure 2), serial number(s) 3062 and 3543, for data acquisition.

The Riegl 1560ii system is a dual channel waveform processing airborne scanning system. It has a laser pulse repetition rate of up to 4 MHz resulting in up to 2.66 million measurements per second. The system utilizes a Multi-Pulse in the Air option (MPIA) and an integrated IMU/GNSS unit.

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

Table 2. Lidar System Specifications

		Riegl VQ1560ii (SN3062)	Riegl VQ1560ii (SN3543)
Terrain and Aircraft Scanner	Flying Height	1584 m	1050 m
	Recommended Ground Speed	160 kts	160 kts
Scanner	Field of View	60°	60°
	Scan Rate Setting Used	191 lps	295 Hz
Laser	Laser Pulse Rate Used	2400 kHz	1000 kHz
	Multi Pulse in Air Mode	yes	yes
Coverage	Full Swath Width	1827 m	1846 m
	Line Spacing	1462 m	1477 m
Point Spacing and Density	Average Point Spacing	0.71 m	0.71 m
	Average Point Density	2 pts / m^2	2 pts / m^2

Figure 2. Riegl VQ1560ii Lidar Sensor

2.3. Aircraft

All flights for the project were accomplished through the use of customized aircraft. Plane type and tail numbers are listed below.

Lidar Collection Planes

- Piper PA-31, Tail Number(s): C-GAYY, C-FFRY

These aircraft provided an ideal, stable aerial base for lidar acquisition. These aerial platforms have relatively fast cruise speeds, which are beneficial for project mobilization / demobilization while maintaining relatively slow stall speeds, proving ideal for collection of high-density, consistent data posting using a state-of-the-art lidar system. NV5 Geospatial's operating aircraft can be seen in Figure 3 below.

Figure 3. NV5 Geospatial's Aircraft

2.4. Time Period

Project specific flights were conducted between May 6, 2022 and May 10, 2022. Four aircraft lifts were completed. Accomplished lifts are listed below.

Lift	Start UTC	End UTC
05062022A (SN3543,C-FFRY)	5/06/2022 12:08:18 PM	5/06/2022 5:45:57 PM
05072022A (SN3543,C-FFRY)	5/07/2022 2:04:37 PM	5/07/2022 4:38:25 PM
05102022A (SN3062,C-GAYY)	5/10/2022 3:58:11 PM	5/10/2022 6:59:51 PM
05102022A (SN3543,C-FFRY)	5/10/2022 3:08:14 PM	5/10/2022 7:30:43 PM

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

Applanix + POSPac 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. Applanix POSPac 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.

Each sensor is initially factory calibrated. Further adjustment is performed on each sensor by periodically flying boresight locations and using this data to update boresight values used in data processing. Various proprietary tools and methodologies are used during this process. Once all data has been processed with updated boresight values, FL to FL match is performed by using strip align and other proprietary tools/processes.

Point clouds were created using the RiPROCESS software. The generated point cloud is the mathematical three-dimensional composite of all returns from all laser pulses as determined from the aerial mission. The flight line strips are calibrated using Strip Align software. This process involves correcting for systematic errors remaining in the dataset after the boresight values are applied to the dataset. Corrections are made from line to line as well as from lift to lift in order improve the relative accuracy of the dataset and exceed specifications. Each adjusted flight line channel is merged using proprietary software to form the final flight line strips. The point cloud data is then imported into GeoCue, where they are then cut into a tiled dataset. Automated ground macros are run, and the vertical accuracy of the calibrated point cloud is tested against the surveyed ground control and any bias is validated, and the remaining bias is removed from the data using a TerraScan macro that is run through the GeoCue distributive process.

DEMs and Intensity Images are then generated using proprietary software. In the bare earth surface model, above-ground features are excluded from the data set. Global Mapper is used as a final check of the bare earth dataset.

Finally, proprietary software is used to perform statistical analysis of the LAS files.

Software	Version
Applanix + POSPac	8.6
RiPROCESS	1.8.6
GeoCue	2020.1.22.1
Global Mapper	19.1;20.1
Microstation Connect	10.16.02.34
TerraModeler	21.008
TerraScan	21.016
StripAlign	2.21

3.3. LAS Classification Scheme

The classification classes are determined by Lidar Base Specifications 2021, Revision A 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:

Table 3. LAS Classifications

	Classification Name	Description
1	Processed, but Unclassified	Laser returns that are not included in the bare earth class, or any other project classification
2	Bare earth	Laser returns that are determined to be bare earth using automated and manual cleaning algorithms
7	Low Noise	Laser returns that are often associated with scattering from reflective surfaces, or artificial points below the bare earth surface
9	Water	Laser returns that are found inside of hydro features
17	Bridge Deck	Laser returns falling on bridge decks
18	High Noise	Laser returns that are often associated with birds or artificial points above the bare earth surface
20	Ignored Ground	Bare earth points that fall within the given threshold of a collected hydro feature.
21	Snow	Bare earth points that fall on snow, where identifiable
22	Temporal Exclusion	Points that are excluded due to differences in collection dates

3.4. Classified LAS Processing

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 hydro flattening breaklines were then classified to water (ASPRS Class 9) using proprietary tools. A buffer of 3 feet/1 meter was also used around each hydro flattened feature to classify these ground (ASPRS Class 2) points to Ignored ground (ASPRS Class 20). 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.

Any noise that was identified either through manual review or automated routines was classified to the appropriate class (ASPRS Class 7 and/or ASPRS Class 18) followed by flagging with the withheld bit.

All data was manually reviewed and any remaining artifacts removed using functionality provided by TerraScan and TerraModeler. Global Mapper is used as a final check of the bare earth dataset. GeoCue was then used to create the deliverable industry-standard LAS files for all point cloud data. NV5 Geospatial's 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

Using heads-up digitization, all Lake-Ponds, Double Line Drains, and Islands are manually collected that are within the project size specification. This includes Lake-Ponds greater than 2 acres in size, Double Line Drains with greater than a 100 foot nominal width, and Islands greater than 1 acre in size within a collected hydro feature. Lidar intensity imagery and bare-earth surface models are used to ensure appropriate and complete collection of these features.

Elevation values are assigned to all collected hydro features via NV5 Geospatial's proprietary software. This software sets Lake-Ponds to an appropriate, single elevation to allow for the generation of hydro-flattened digital elevation models (DEM). Double Line Drain elevations are assigned based on lidar elevations and surrounding terrain feature 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 complete, horizontal placement, and vertical variances are reviewed, all breaklines are evaluated for topological consistency and data integrity using a combination of proprietary tools and manual review of hydro-flattened DEMs.

Breaklines are combined into one seamless shapefile, clipped to the project boundary, and imported into an Esri file geodatabase for delivery.

3.6. Hydro-Flattened Raster DEM Processing

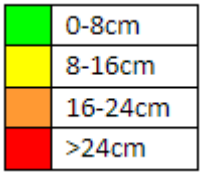
Hydro-Flattened DEMs (topographic) represent a lidar-derived product illustrating the grounded terrain and associated breaklines (as described above) in raster form. NV5 Geospatial's proprietary software was used to take all input sources (bare earth lidar points, bridge and hydro breaklines, etc.) and create a Triangulated Irregular Network (TIN) on a tile-by-tile basis. Data extending past the tile edge is incorporated in this process so that proper triangulation can occur. From the TIN, linear interpolation is used to calculate the cell values for the raster product. The raster product is then clipped back to the tile edge so that no overlapping cells remain across the project area. A 32-bit floating point GeoTIFF DEM was generated for each tile with a pixel size of 2-foot. NV5 Geospatial's proprietary software was used to write appropriate horizontal and vertical projection information as well as applicable header values into the file during product generation. Each DEM is reviewed in Global Mapper to check for any surface anomalies and to ensure a seamless dataset. NV5 Geospatial ensures there are no void or no-data values (-999999) in each derived DEM. This is achieved by using propriety software checking all cell values that fall within the project boundary. NV5 Geospatial uses a proprietary tool called FOCUS on Delivery to check all formatting requirements of the DEMs against what is required before final delivery.

3.7. Intensity Image Processing

Intensity images represent reflectivity values collected by the lidar sensor during acquisition. Proprietary software generates intensity images using first returns and excluding those flagged with a withheld bit. Intensity images are linearly scaled to a value range specific to the project area to standardize the images and reduce differences between individual tiles. Appropriate horizontal projection information as well as applicable header values are written during product generation.

3.8. Swath Separation Raster Processing

Swath Separation Images are rasters that represent the interswath alignment between flight lines and provide a qualitative evaluation of the positional quality of the point cloud. NV5 Geospatial proprietary software generated 4-foot raster images in GeoTIFF format using last returns, excluding points flagged with the withheld bit, and using a point-in-cell algorithm. Images are generated with a 75% intensity opacity and (4) absolute 8-cm intervals, see below for interval coloring. Intensity images are linearly scaled to a value range specific to the project area to standardize the images and reduce differences between individual tiles. Appropriate horizontal projection information as well as applicable header values are written to the file during product generation. NV5 Geospatial uses a proprietary tool called FOCUS on Delivery to check all formatting requirements of the images against what is required before final delivery.



3.9. Maximum Surface Height Raster Processing

Maximum Surface Height rasters (topographic) represent a lidar-derived product illustrating natural and built-up features. NV5 Geospatial's proprietary software was used to take all classified lidar points, excluding those flagged with a withheld bit, and create a raster on a tile-by-tile basis. Data extending past the tile edge is incorporated in this process so that proper gridding can occur. The raster is created by laying a 4-foot DEM cell size over the area and assigning the values to cells by using the maximum lidar point that intersects that grid cell. The raster product is then clipped back to the tile edge so that no overlapping cells remain across the project area. A 32-bit floating point GeoTIFF was then generated for each tile with a pixel size of 4-foot. There is no interpolation type being used in creating the raster product. NV5 Geospatial's proprietary software was used to write appropriate horizontal and vertical projection information as well as applicable header values into the file during product generation. Each maximum surface height raster is reviewed in Global Mapper to check for any anomalies and to ensure a seamless dataset. NV5 Geospatial uses a proprietary tool called FOCUS on Delivery to check all formatting requirements of the DEMs against what is required before final delivery.

3.10. Point Density

The acquisition parameters were designed to acquire an average first-return density of 2 points/m2. First return density describes the density of pulses emitted from the laser that return at least one echo to the system. Multiple returns greater than 1 from a single pulse were not considered in first return density analysis. Some types of surfaces (e.g., breaks in terrain, water, and steep slopes) may have returned fewer pulses than originally emitted by the laser. First returns typically reflect off the highest feature on the landscape within the footprint of the pulse. In forested or urban areas, the highest feature could be a tree, building or power line, while in areas of unobstructed ground, the first return will be the only echo and represents the bare earth surface.

The density of ground-classified lidar returns was also analyzed for this project. Terrain character, land cover, and ground surface reflectivity all influenced the density of ground surface returns. In vegetated areas, fewer pulses may penetrate the canopy, resulting in lower ground density.

The average first-return density of lidar data for the project was 4.5 points/m2) while the average ground classified density was 4.1 points/m2). The statistical and spatial distributions of first return densities and classified ground return densities per 100 m x 100 m cell are portrayed in Figures 4 and 5.

WI 12 County B22 Polk County
Work Unit 300208 First Return Density

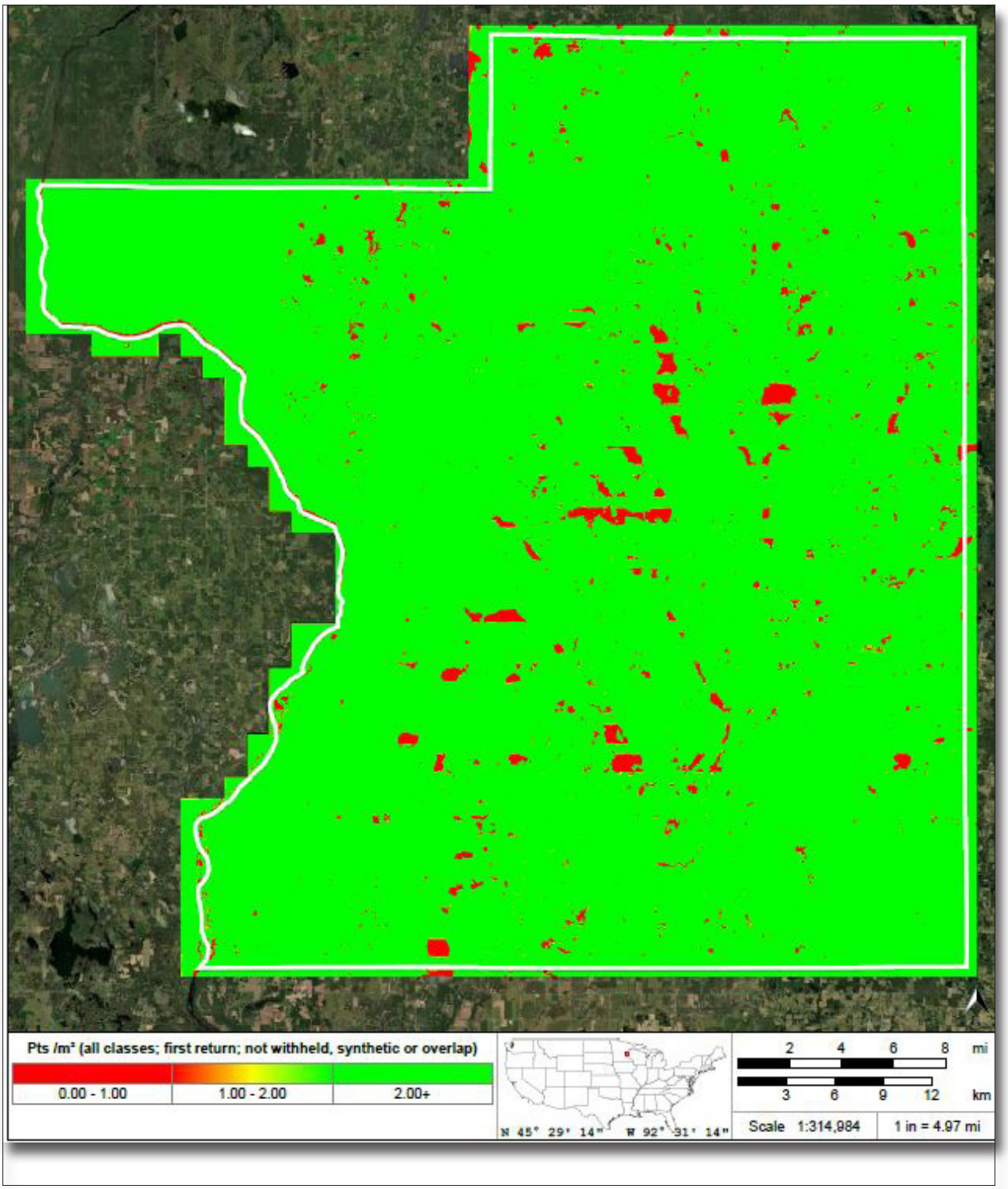


Figure 4. First Return Point Density

WI 12 County B22 Polk County
Work Unit 300208 Ground Density

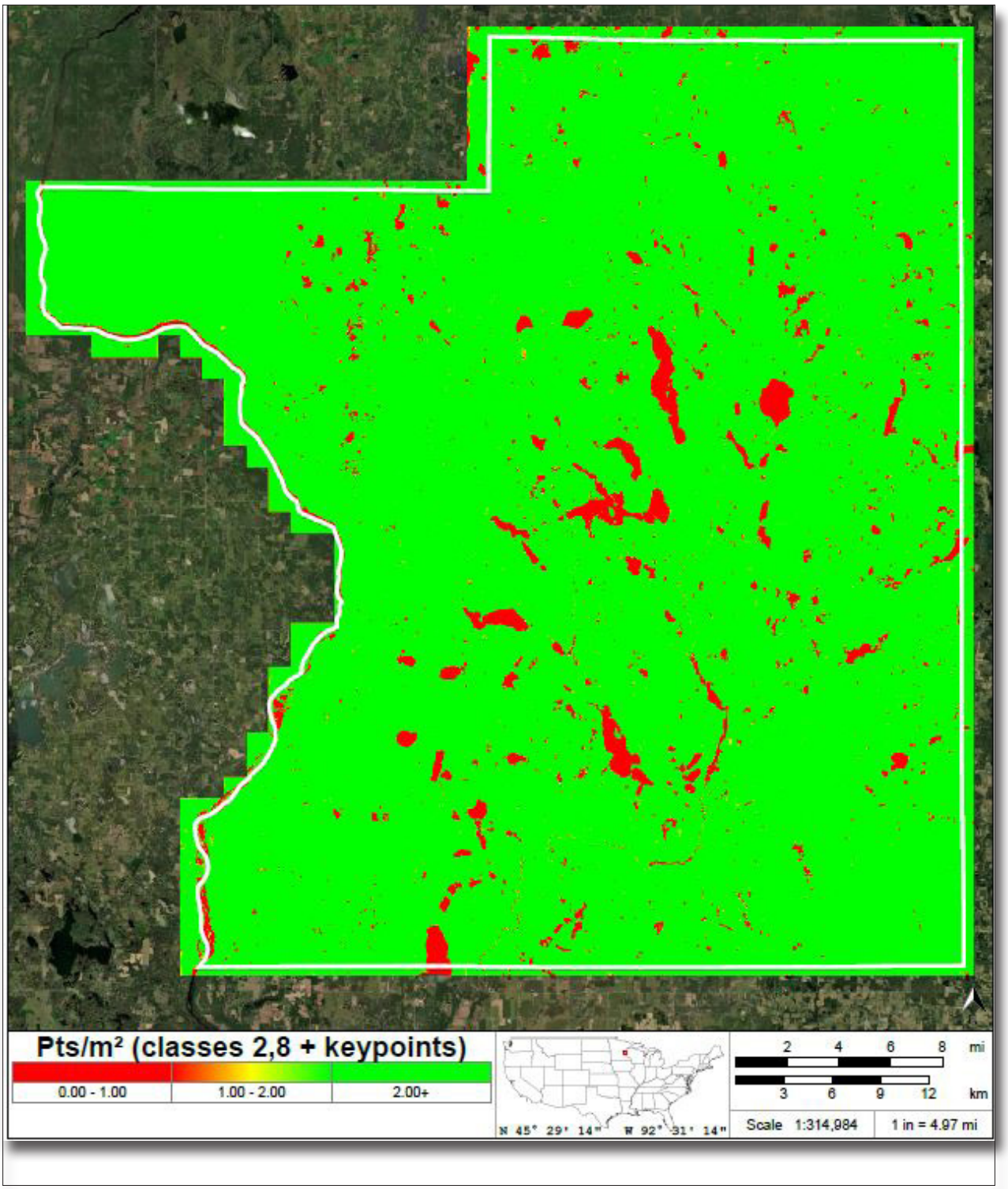


Figure 5. Ground Density

WI 12 County B22 Polk
Work Unit 300208 Tile Layout

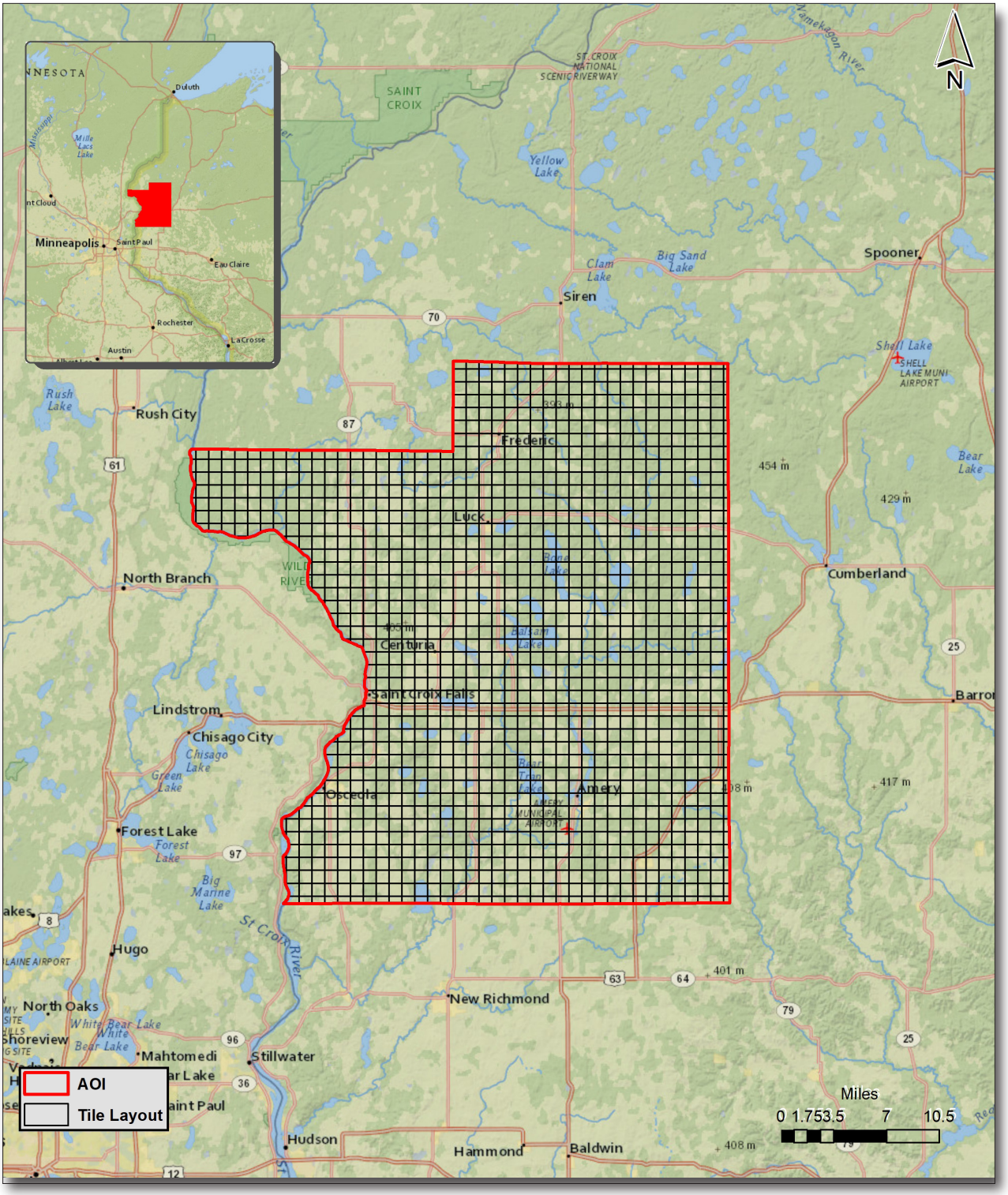


Figure 6. Lidar Tile Layout

4. Project Coverage Verification

A proprietary tool (FOCUS on Flight) produces grid-based polygons of each flightline, depicting exactly where lidar points exist. These swath polygons are reviewed against the project boundary to verify adequate project coverage. Please refer to Figure 5.

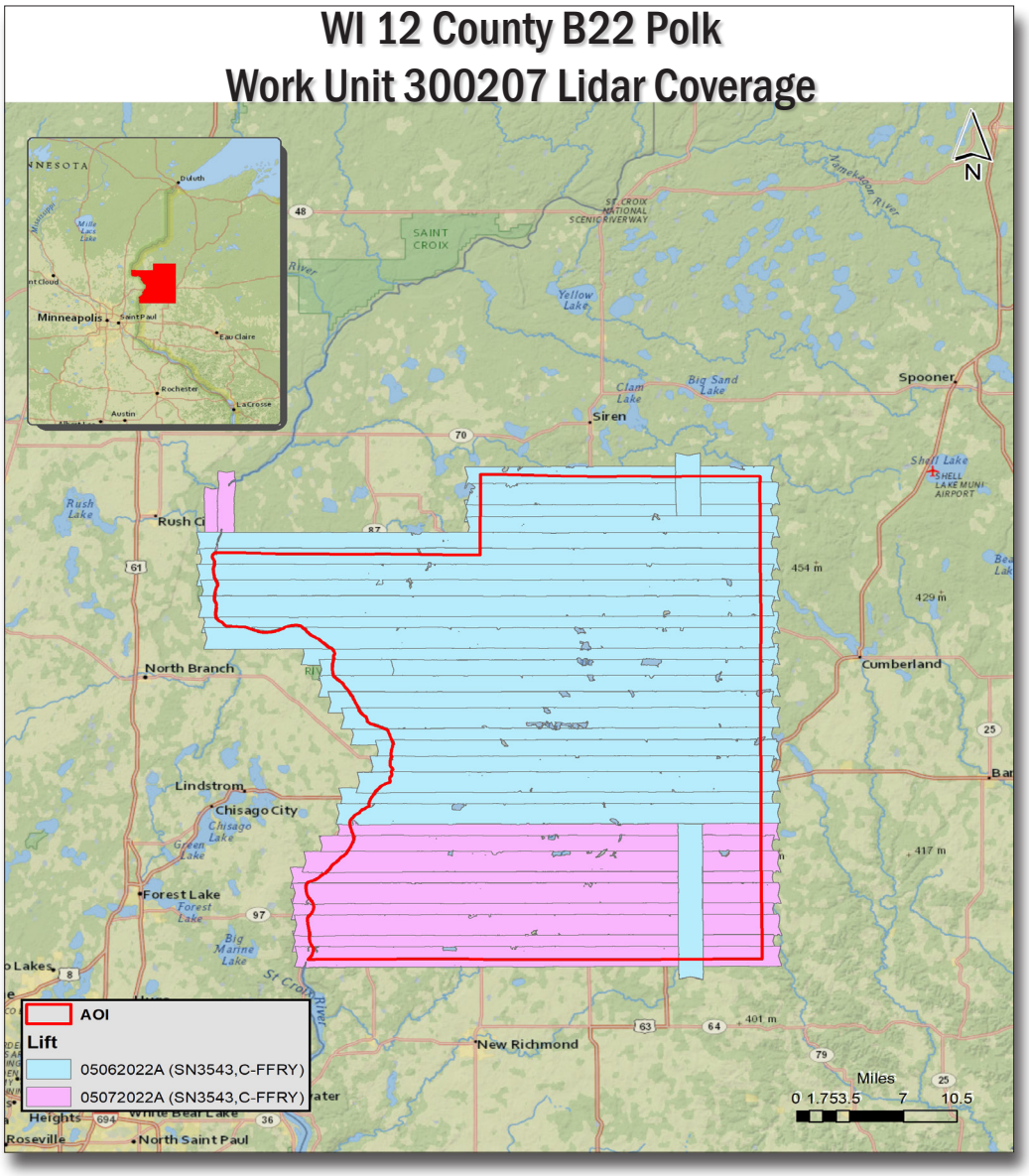


Figure 7. Lidar Coverage

5. Geometric Accuracy

5.1. Horizontal Accuracy

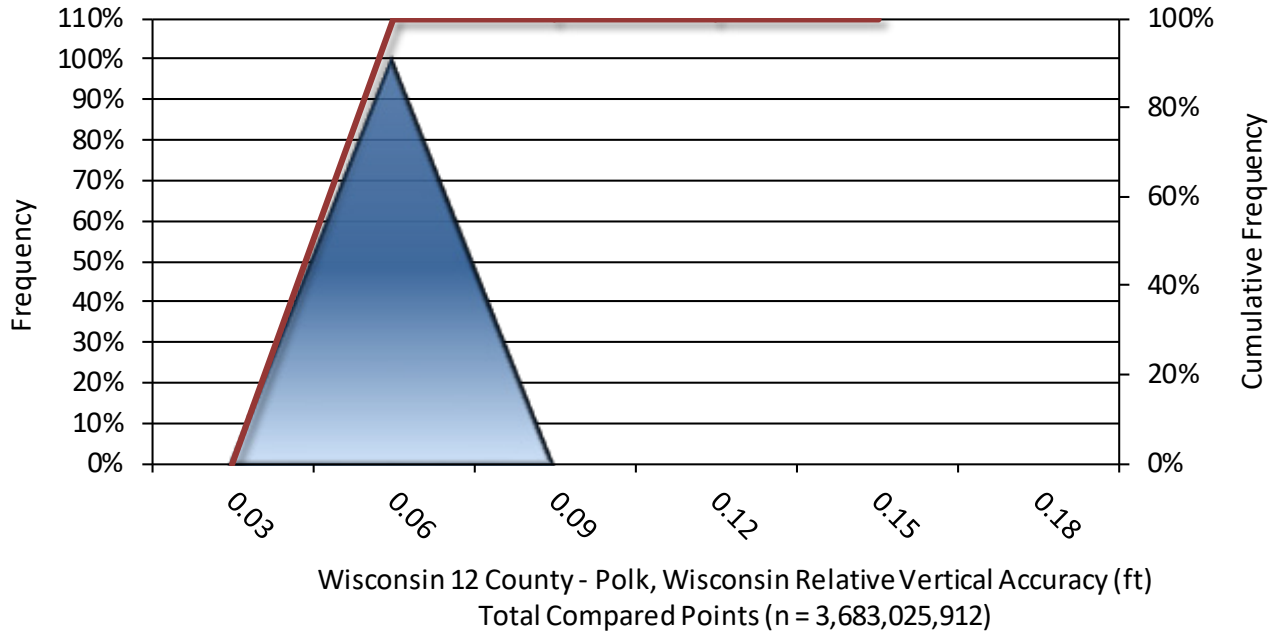
Lidar horizontal accuracy is a function of Global Navigation Satellite System (GNSS) derived positional error, flying altitude, and INS derived attitude error. The obtained $RMSE_r$ value is multiplied by a conversion factor of 1.7308 to yield the horizontal component of the National Standards for Spatial Data Accuracy (NSSDA) reporting standard where a theoretical point will fall within the obtained radius 95% of the time. Based on a flying altitude of 1942 meters, an IMU error of 0.002 decimal degrees, and a GNSS positional error of 0.015 meters, this project was compiled to meet 0.21 meter horizontal accuracy at the 95% confidence level. A summary is shown below.

Horizontal Accuracy	
$RMSE_r$	0.40 ft
	0.12 m
ACC_r	0.69 ft
	0.21 m

5.2. Relative Vertical Accuracy

Relative vertical accuracy refers to the internal consistency of the data set as a whole: the ability to place an object in the same location given multiple flight lines, GPS conditions, and aircraft attitudes. When the lidar system is well calibrated, the swath-to-swath vertical divergence is low (<0.10 meters). The relative vertical accuracy was computed by comparing the ground surface model of each individual flight line with its neighbors in overlapping regions. The average (mean) line to line relative vertical accuracy for the WI 12 County B22 Polk project was 0.053 feet (0.016 meters). A summary is shown below.

Relative Vertical Accuracy	
Sample	32 flight line surfaces
Average	0.053 ft
	0.016 m
Median	0.054 ft
	0.016 m
RMSE	0.054 ft
	0.016 m
Standard Deviation (1σ)	0.002 ft
	0.001 m
1.96σ	0.005 ft
	0.001 m



5.3. Intraswath Precision (Smooth Surface Precision)

Intraswath Precision (smooth surface precision) is the measure of reliability of the lidar point cloud elevations along a planar surface. This measurement is performed on hard surfaces against a single flightline. NV5 digitized several large parking lots as polygons across the project area. These polygons were then used to calculate precision on a single FL basis using the below formula:

Precision = Range – (Slope x Cellsize x 1.414)

Range – Is the difference between the highest and lowest lidar points in each cell
Slope – is the maximum slope of the cell to its 8 neighbors
Cellsize – is set to the ANPS, rounded up to the next integer, and then doubled

NV5 calculated the RMSDz to be 8.2 cm, minimum slope-corrected range to be 0 cm, and the maximum slope-corrected range to be 2.97 cm.

Project Report Appendices

The following section contains the appendices as listed in the WI 12 County B22 Polk Lidar Project Report.

Appendix A

Flight Logs

Julian Day	126	Flight	A

LIDAR Flight Log

Date	May 06, 2022	**Aircraft**	C-FFRY
Project	3237_NV5_WI3DEP_QL2	**Pilot**	Kane G
Location	Eau Claire WI	**Operator**	Daniel. A
Mission Objective			

System	Riegl VQ-1560ii
Unit	43
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T- 8 C
H- 71%
AMLS-278m
Hpa-1013

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	11:28	**Takeoff**	11:46	
Engine Off	18:20	**Landing**	18:10	
Total	6.9 hrs	**Total**	6.4 hrs	

Mission Plan					
AGL Height	2300	m	**Pulse Rate**	500khz/ch	
Target Speed	160	kts	**Scan Rate**	100hz/ch	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	1134	1139
Post Mission	1813	1818

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp _____	
F8			1157	1202				
2032	432212601		1208	1220			120817	
2001	432212602		1227	1234			122753	
2002	432212603		1238	1245			123815	
2003	432212604		1248	1255			124859	
2004	432212605		1259	1306			125955	
2005	432212606		1309	1322			132517	
2006	432212607		1325	1338			132517	
2007	432212608		1342	1354			134214	
2008	432212609		1358	1411			131833	
2009	432212610		1418	1430			141833	
2010	432212611		1434	1447			143410	
2011	432212612		1450	1503			145054	
2012	432212613		1508	1519			150838	
2013	432212614		1522	1529	1530	6.3nm	152231	TCP Error media disconnected

Julian Day	126	Flight	A

LIDAR Flight Log

Date	May 06, 2022	**Aircraft**	C-FFRY
Project	3237_NV5_WI3DEP_QL2	**Pilot**	Kane G
Location	Eau Claire WI	**Operator**	Daniel. A
Mission Objective			

System	Riegl VQ-1560ii
Unit	43
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T- 8 C
H- 71%
AMLS-278m
Hpa-1013

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	11:28	**Takeoff**	11:46	
Engine Off	18:20	**Landing**	18:10	
Total	6.9 hrs	**Total**	6.4 hrs	

Mission Plan					
AGL Height	2300	m	**Pulse Rate**	500khz/ch	
Target Speed	160	kts	**Scan Rate**	100hz/ch	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	1134	1139
Post Mission	1813	1818

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp _____	
Test Strip			1533	1533			153328	
2013	432212615		1536	1541			153601	Refly 6.3nm from the W EOL
2014	432212616		1549	1559			154906	
2015	432212617		1602	1611			160216	
2016	432212618		1615	1624			161520	
2017	432212619		1628	1637			162810	
2018	432212620		1641	1649			164102	
2019	432212621		1700	1709			170014	
2020	432212622		1712	1721			171209	
2021	432212623		1724	1733			172408	
2022	432212624		1736	1745			173620	
F8			1746	1751				

Julian Day	127	Flight	A

LIDAR Flight Log

Date	May 07, 2022	**Aircraft**	C-FFRY
Project	3237_NV5_WI3DEP_QL2	**Pilot**	Kake G
Location	Eau Claire WI	**Operator**	Daniel. A
Mission Objective			

System	Riegl VQ-1560ii
Unit	43
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T- 7 C W-34Knt gusting from the S
H- 75%
AMLS-278m
Hpa-1015

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	11:16	**Takeoff**	11:32	
Engine Off	17:28	**Landing**	17:16	
Total	6.2 hrs	**Total**	5.7 hrs	

Mission Plan					
AGL Height	2300	m	**Pulse Rate**	500 khz/ch	
Target Speed	160	kts	**Scan Rate**	100 hz/ch	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	1122	1127
Post Mission	1719	1724

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp _____	
F8			1345	1359				
2023	432212711		1404	1413			140436	
2024	432212712		1417	1426			141711	
2025	432212713		1429	1439			142934	
2026	432212714		1443	1443			144315	
2027	432212715		1456	1507			145635	
2028	432212716		1510	1520			151039	
2029	432212717		1523	1534			152359	
2030	432212718		1537	1547			153740	
2031	432212719		1550	1601			155043	
Xtie	432212721		1606	1611			160652	
F8			1619	1624				
3122	432212723		1630	1632			163031	
3123	432212724		1635	1638			163541	
Xtie	432212725		1641	1642			164111	

Julian Day	127	Flight	A

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	May 07, 2022	**Aircraft**	C-FFRY
Project	3237_NV5_WI3DEP_QL2	**Pilot**	Kake G
Location	Eau Claire WI	**Operator**	Daniel. A
Mission Objective			

System	Riegl VQ-1560ii
Unit	43
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T- 7 C W-34Knt gusting from the S
H- 75%
AMLS-278m
Hpa-1015

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	11:16	**Takeoff**	11:32	
Engine Off	17:28	**Landing**	17:16	
Total	6.2 hrs	**Total**	5.7 hrs	

Mission Plan					
AGL Height	2300	m	**Pulse Rate**	500 khz/ch	
Target Speed	160	kts	**Scan Rate**	100 hz/ch	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	1122	1127
Post Mission	1719	1724

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp _____	
F8			1642	1647				

Julian Day	130	Flight	A

LIDAR Flight Log

Date	May 10, 2022	**Aircraft**	C-FFRY
Project	3238_NV5_WI3DEP_V3	**Pilot**	Kane G
Location	Eau Claire WI	**Operator**	Daniel. A
Mission Objective			

System	Riegl VQ-1560ii
Unit	43
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T- 16C
H- 82%
AMLS-278m
Hpa-1015

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time					
Engine On	13:57	**Takeoff**	14:12		
Engine Off	20:23	**Landing**	20:11		
Total	6.4 hrs	**Total**	6.0 hrs		

Mission Plan					
AGL Height	1584	m	**Pulse Rate**	1200 khz/ch	
Target Speed	160	kts	**Scan Rate**	186 hz/ch	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	1403	1408
Post Mission	1914	1919

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID	Comments
			Start	End	Time	nmi to End	Time Stamp _____	
F8			1437	1442				
3173	432213001		1447	1504			144722	
3124	432213002		1508	1510			150814	
3125	432213003		1513	1516			151349	
3126	432213004		1519	1522			151942	
3127	432213005		1526	1529			152613	
3128	432213006		1532	1537			153246	
3129	432213007		1541	1546			154101	
3130	432213008		1549	1555			154914	
3131	432213009		1558	1604			155805	
3132	432213010		1607	1614			160729	
3133	432213011		1619	1626			161958	
3134	432213012		1629	1636			162943	
3135	432213013		1644	1651			164433	
3136	432213014		1654	1701			165445	

Julian Day	130	Flight	A

LIDAR Flight Log

Date	May 10, 2022	**Aircraft**	C-FFRY
Project	3238_NV5_WI3DEP_V3	**Pilot**	Kane G
Location	Eau Claire WI	**Operator**	Daniel. A
Mission Objective			

System	Riegl VQ-1560ii
Unit	43
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

T- 16C
H- 82%
AMLS-278m
Hpa-1015

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time					
Engine On	13:57	**Takeoff**	14:12		
Engine Off	20:23	**Landing**	20:11		
Total	6.4 hrs	**Total**	6.0 hrs		

Mission Plan					
AGL Height	1584	m	**Pulse Rate**	1200 khz/ch	
Target Speed	160	kts	**Scan Rate**	186 hz/ch	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	1403	1408
Post Mission	1914	1919

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp _____	Comments
			Start	End	Time	nmi to End		
3137	432213014		1705	1712			170512	
3138	432213015		1715	1722			171530	
3139	432213017		1726	1733			172604	
3140	432213018		1736	1744			173645	
3141	432213019		1748	1756			174831	
3142	432213020		1759	1807			175942	
3143	432213021		1811	1819			181108	
3144	432213022		1822	1829			182259	
3145	432213023		1832	1838			183234	
3146	432213024		1841	1848			18157	
3147	432213025		1851	1858			185151	
3148	432213026		1902	1909			190204	
3149	432213027		1912	1919			191248	
3150	432213028		1923	1930			192315	
F8			1932	1937				

Julian Day	130	Flight	A

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	April 10, 2022	**Aircraft**	C-GAYY
Project	3238_NV5_QL1	**Pilot**	A. Hering
Location	Eau Claire, Wisconsin	**Operator**	B.Eisenbart
Mission Objective			

System	VQ-1560II
Unit	S2223062
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	15:05	**Takeoff**	15:18	
Engine Off	21:38	**Landing**	21:29	
Total	6.6 hrs	**Total**	6.2 hrs	

Mission Plan					
AGL Height	1584	m	**Pulse Rate**	1200 khz/ch	
Target Speed	160	kts	**Scan Rate**	191 lps/ch	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	15:08	15:13
Post Mission	21:31	21:36

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 220510	Comments
			Start	End	Time	nmi to End		
figure 8		-	15:38	15:42			-	
X-TIE	622213030	273°	15:46	15:53			154659	
3151	622213031	001°	15:58	16:05			155811	
3152	622213032	181°	16:09	16:17			160913	
3153	622213033	001°	16:19	16:28			161959	
3154	622213034	181°	16:31	16:40			163152	
3155	622213035	001°	16:43	16:54			164309	
3156	622213036	181°	16:57	17:07			165707	
3157	622213037	001°	17:10	17:21			171031	
3158	622213038	181°	17:23	17:34			172354	
3159	622213039	001°	17:37	17:47			173704	
3160	622213040	181°	17:50	18:01			175037	
3161	622213041	001°	18:03	18:14			180353	
3162	622213042	181°	18:16	18:27			181659	
3163	622213043	001°	18:32	18:44			183217	

Julian Day	130	Flight	A

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	April 10, 2022	**Aircraft**	C-GAYY
Project	3238_NV5_QL1	**Pilot**	A. Hering
Location	Eau Claire, Wisconsin	**Operator**	B.Eisenbart
Mission Objective			

System	VQ-1560II
Unit	S2223062
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	15:05	**Takeoff**	15:18	
Engine Off	21:38	**Landing**	21:29	
Total	6.6 hrs	**Total**	6.2 hrs	

Mission Plan					
AGL Height	1584	m	**Pulse Rate**	1200 khz/ch	
Target Speed	160	kts	**Scan Rate**	191 lps/ch	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	15:08	15:13
Post Mission	21:31	21:36

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 220510	Comments
			Start	End	Time	nmi to End		
3164	622213044	181°	18:47	18:59			184733	
3165	622213045	001°	19:03	19:15			190306	
3166	622213046	181°	19:18	19:30			191816	
3167	622213047	001°	19:33	19:45			193332	
3168	622213048	181°	19:48	20:01			194852	
3169	622213049	001°	20:04	20:16			200409	
3170	622213050	181°	20:19	20:31			201930	
3171	622213051	001°	20:34	20:47			203456	
3172	622213052	181°	20:53	21:01			205306	
figure 8		-	21:02	21:06			-	

Appendix B

SBET and POSPAC Reports

General Information

Mission Information

Project name	05062022A_3543
Processing date	2022-05-09 19:54:44
Mission date	2022-05-06 11:38:07
Mission duration	06:39:25.792
Processing mode	IN-Fusion PP-RTX

Rover Hardware Information

Product	POS AV 610 VER6 HW2.5-12
Serial number	S/N9683
IMU type	57
Receiver type	BD982
Antenna type	AV59

Project File List

Rover Data Files

File name	File type
4322126a.001	POS Data
4322126a.002	POS Data
4322126a.003	POS Data
4322126a.004	POS Data
4322126a.005	POS Data
4322126a.006	POS Data
4322126a.007	POS Data
4322126a.008	POS Data
4322126a.009	POS Data
4322126a.010	POS Data
4322126a.011	POS Data
4322126a.012	POS Data
4322126a.013	POS Data
4322126a.014	POS Data
4322126a.015	POS Data
4322126a.016	POS Data
4322126a.017	POS Data
4322126a.018	POS Data
4322126a.019	POS Data
4322126a.020	POS Data
4322126a.021	POS Data
4322126a.022	POS Data
4322126a.023	POS Data
4322126a.024	POS Data
4322126a.025	POS Data
4322126a.026	POS Data
4322126a.027	POS Data
4322126a.028	POS Data
4322126a.029	POS Data
4322126a.030	POS Data
4322126a.031	POS Data
4322126a.032	POS Data
4322126a.033	POS Data
4322126a.034	POS Data
4322126a.035	POS Data
4322126a.036	POS Data
4322126a.037	POS Data
4322126a.038	POS Data
4322126a.039	POS Data
4322126a.040	POS Data
4322126a.041	POS Data
4322126a.042	POS Data
4322126a.043	POS Data
4322126a.044	POS Data
4322126a.045	POS Data
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4322126a.050	POS Data
4322126a.051	POS Data
4322126a.052	POS Data
4322126a.053	POS Data
4322126a.054	POS Data
4322126a.055	POS Data
4322126a.056	POS Data
4322126a.057	POS Data
4322126a.058	POS Data
4322126a.059	POS Data

File name	File type
4322126a.060	POS Data
4322126a.061	POS Data
4322126a.062	POS Data
4322126a.063	POS Data
4322126a.064	POS Data
4322126a.065	POS Data
4322126a.066	POS Data
4322126a.067	POS Data
4322126a.068	POS Data
4322126a.069	POS Data
4322126a.070	POS Data
4322126a.071	POS Data
4322126a.072	POS Data
4322126a.073	POS Data
4322126a.074	POS Data
4322126a.075	POS Data

Input Files

File Name	File Type
Ephm1260.22g	GLONASS Broadcast Ephemeris
Ephm1260.22n	GPS Broadcast Ephemeris

Output Files

Filename	File type
sbet_05062022A_3543.out	SBET Trajectory File

Rover Data Summary

First raw data file	4322126a.001		
Last raw data file	4322126a.075		
Start GPS week	2208		
Start time	473868.806 (5/6/2022 11:37:48 AM)		
End time	497834.598 (5/6/2022 6:17:14 PM)		
Start of fine alignment	474115.038 (5/6/2022 11:41:55 AM)		
Available subsystems	Primary GNSS, Gimbal, IMU		
POS Event Input	Event 1 Input, Event 2 Input, Event 3 Input		
Correction data	None		
IMU Installation Lever Arms & Mounting Angles			
Gimbal to IMU lever arm (m)	-0.034	-0.010	-0.374
Gimbal to IMU mounting angles (deg)	0.000	0.000	0.000
Gimbal to Primary GNSS lever arm (m)	0.717	-0.178	-1.265
Gimbal to Primary GNSS lever arm std dev (m)	-1.000		
Aircraft to Reference mounting angles (deg)	0.000	0.000	0.000

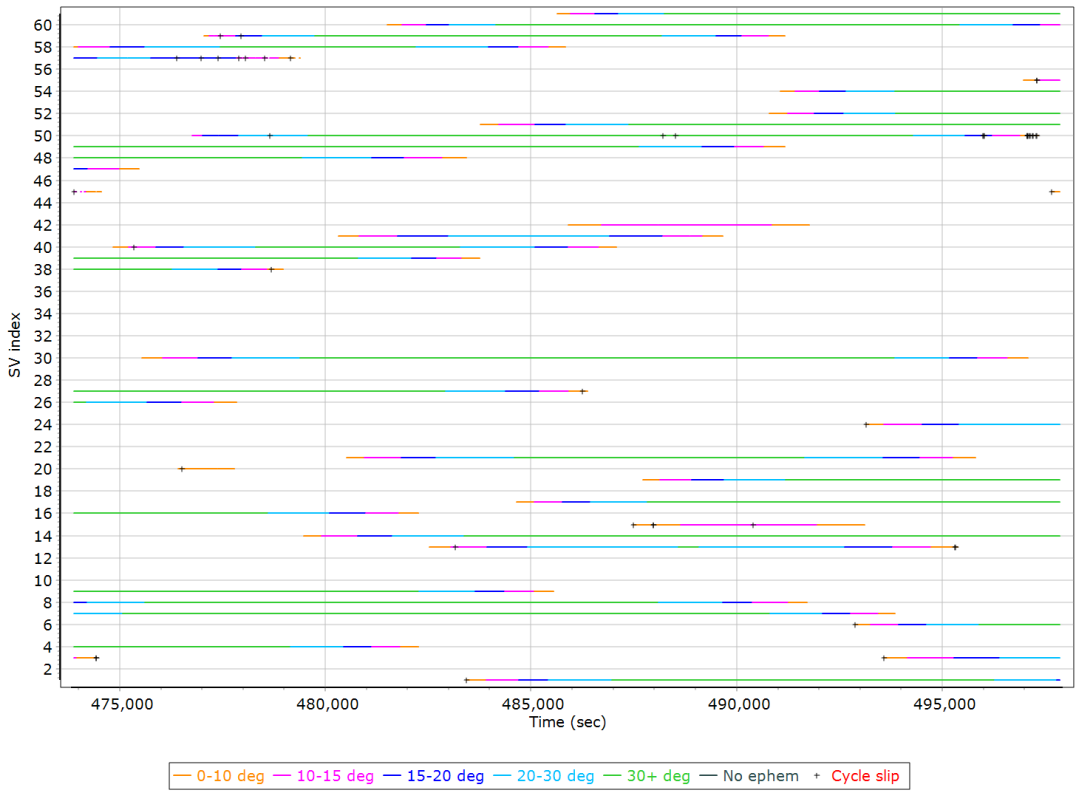
Rover Data QC

Raw IMU Import QC Summary

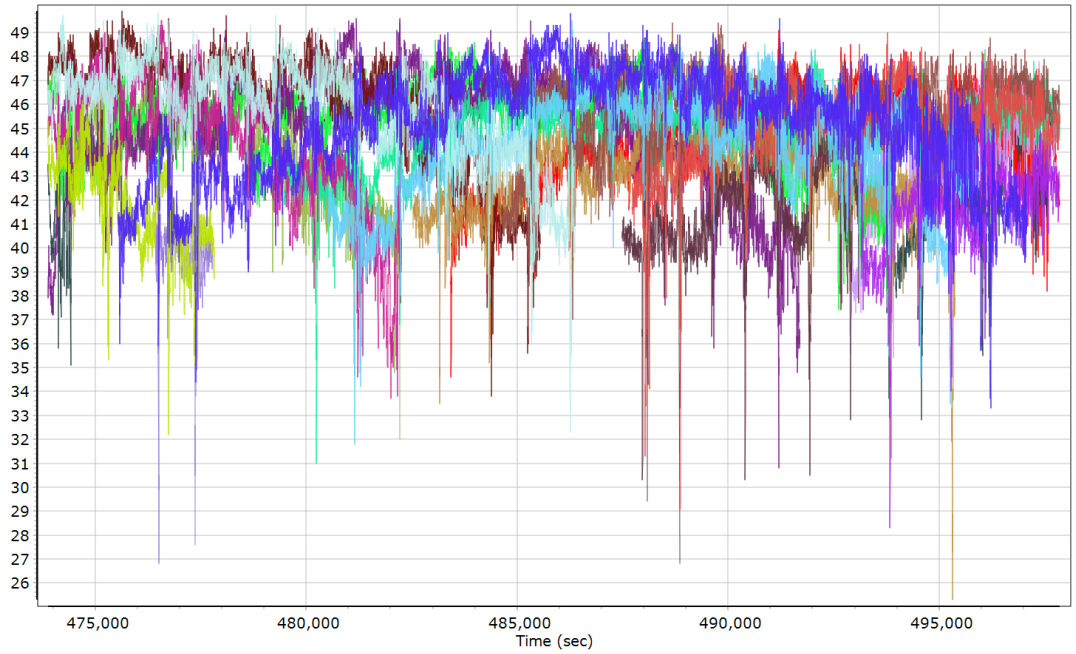
IMU data input file	imu_Mission 1.dat
IMU data check log file	imudt_05062022A_3543.log
IMU Records Processed	4793656
Termination Status	Normal
IMU Anomalies	0

Primary Observables & Satellite Data

GPS/GLONASS L1 Satellite Lock/Elevation

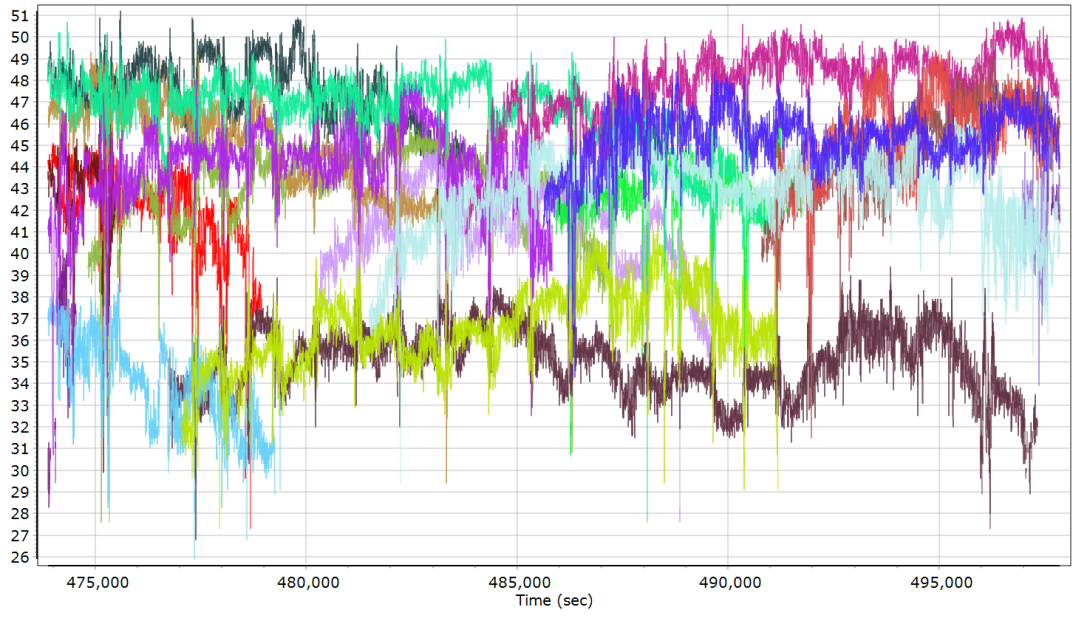


GPS L1 SNR



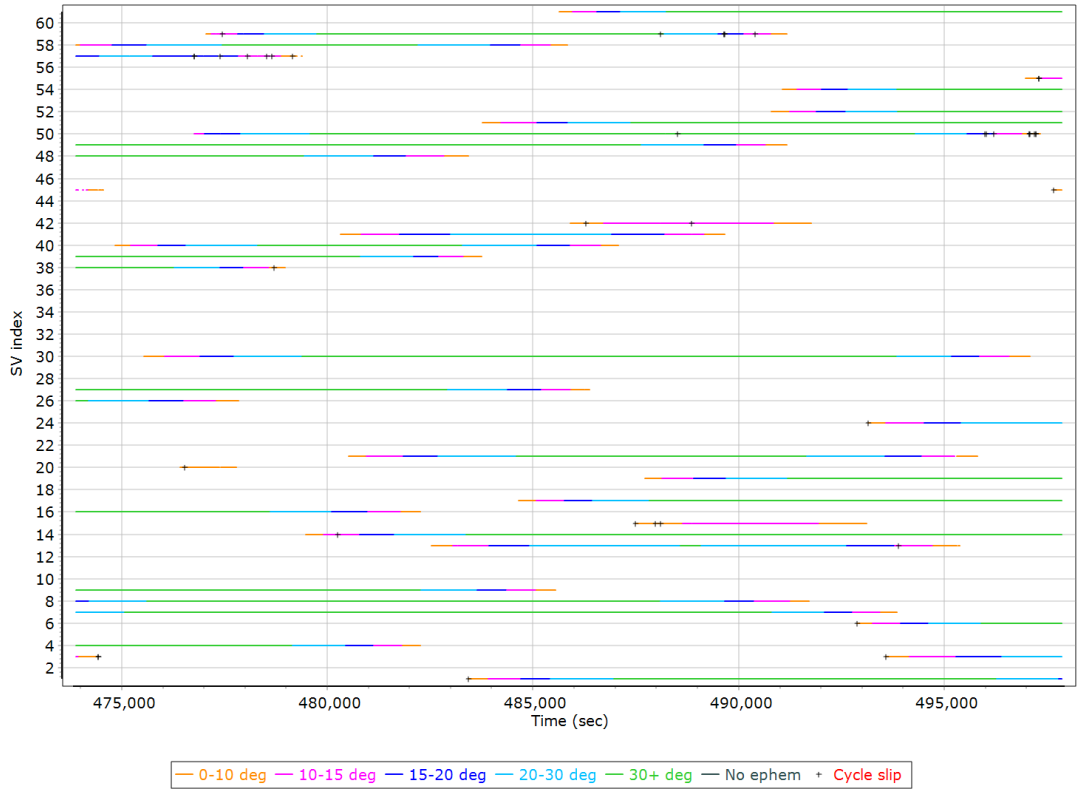
GPS PRN 01 L1 SNR (dB/Hz) GPS PRN 03 L1 SNR (dB/Hz) GPS PRN 04 L1 SNR (dB/Hz) GPS PRN 06 L1 SNR (dB/Hz)
GPS PRN 07 L1 SNR (dB/Hz) GPS PRN 08 L1 SNR (dB/Hz) GPS PRN 09 L1 SNR (dB/Hz) GPS PRN 13 L1 SNR (dB/Hz)
GPS PRN 14 L1 SNR (dB/Hz) GPS PRN 15 L1 SNR (dB/Hz) GPS PRN 16 L1 SNR (dB/Hz) GPS PRN 17 L1 SNR (dB/Hz)
GPS PRN 19 L1 SNR (dB/Hz) GPS PRN 20 L1 SNR (dB/Hz) GPS PRN 21 L1 SNR (dB/Hz) GPS PRN 24 L1 SNR (dB/Hz)
GPS PRN 26 L1 SNR (dB/Hz) GPS PRN 27 L1 SNR (dB/Hz) GPS PRN 30 L1 SNR (dB/Hz)

GLONASS L1 SNR

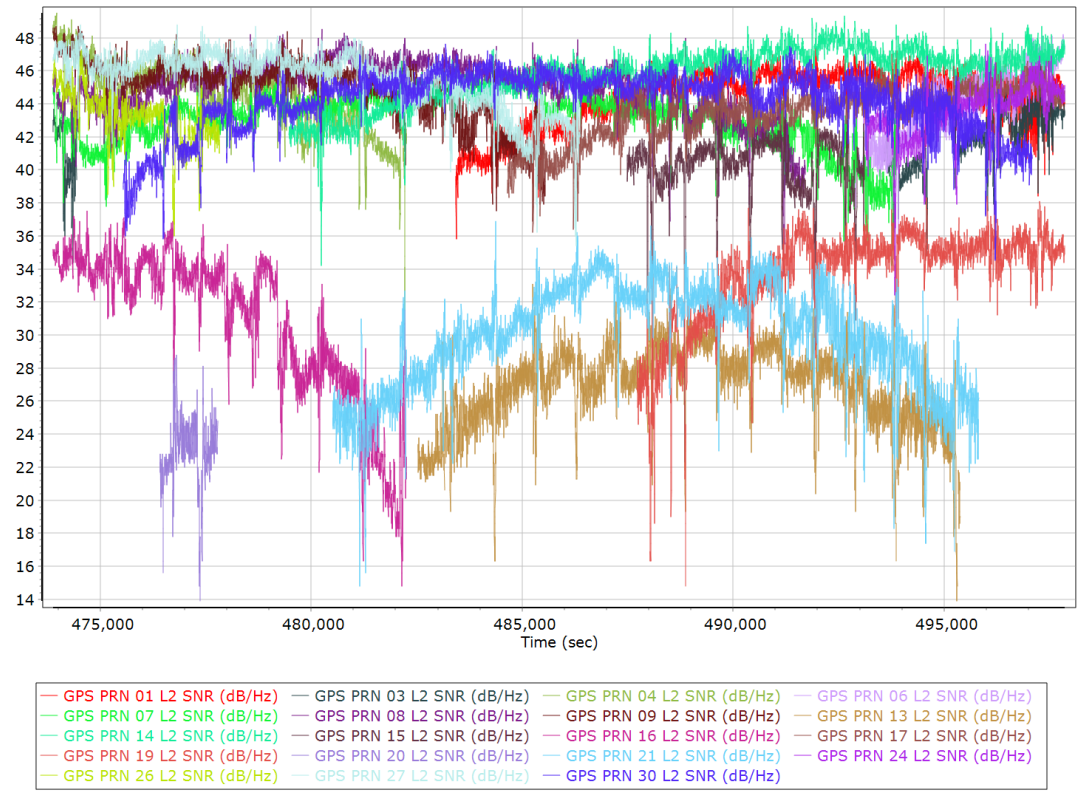


GLONASS 01 L1 SNR (dB/Hz) GLONASS 02 L1 SNR (dB/Hz) GLONASS 03 L1 SNR (dB/Hz)
GLONASS 04 L1 SNR (dB/Hz) GLONASS 05 L1 SNR (dB/Hz) GLONASS 08 L1 SNR (dB/Hz)
GLONASS 10 L1 SNR (dB/Hz) GLONASS 11 L1 SNR (dB/Hz) GLONASS 12 L1 SNR (dB/Hz)
GLONASS 13 L1 SNR (dB/Hz) GLONASS 14 L1 SNR (dB/Hz) GLONASS 15 L1 SNR (dB/Hz)
GLONASS 17 L1 SNR (dB/Hz) GLONASS 18 L1 SNR (dB/Hz) GLONASS 20 L1 SNR (dB/Hz)
GLONASS 21 L1 SNR (dB/Hz) GLONASS 22 L1 SNR (dB/Hz) GLONASS 23 L1 SNR (dB/Hz)
GLONASS 24 L1 SNR (dB/Hz)

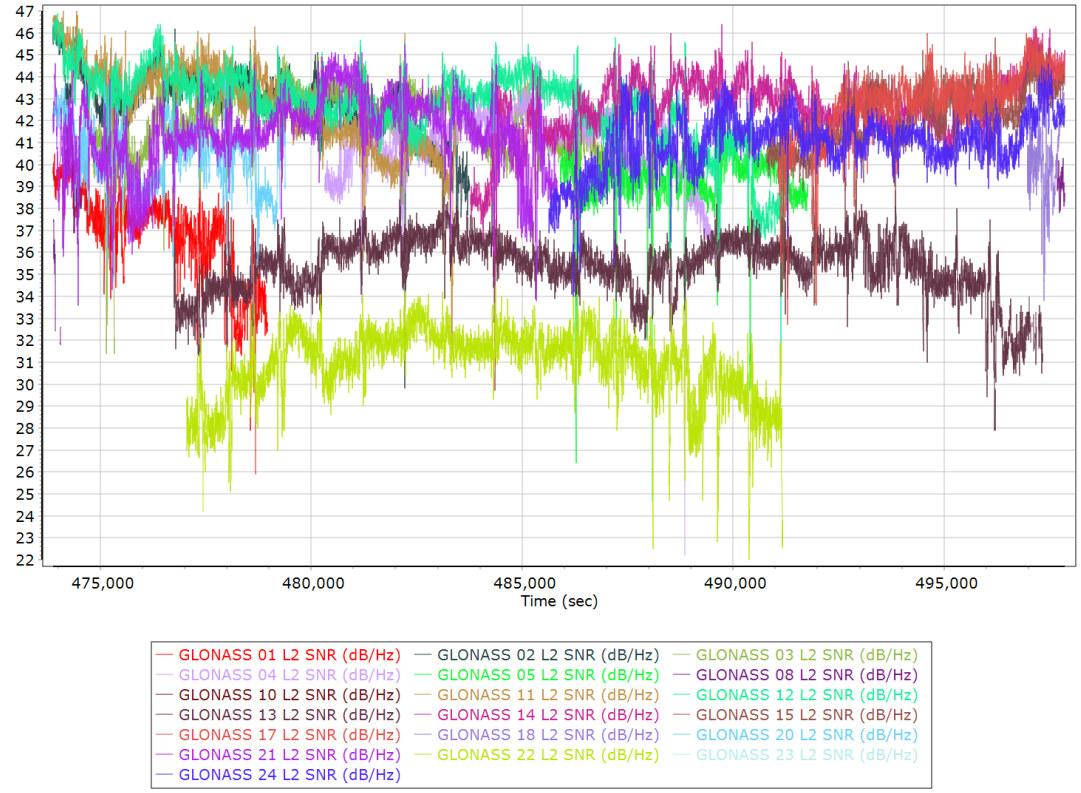
GPS/GLONASS L2 Satellite Lock/Elevation



GPS L2 SNR

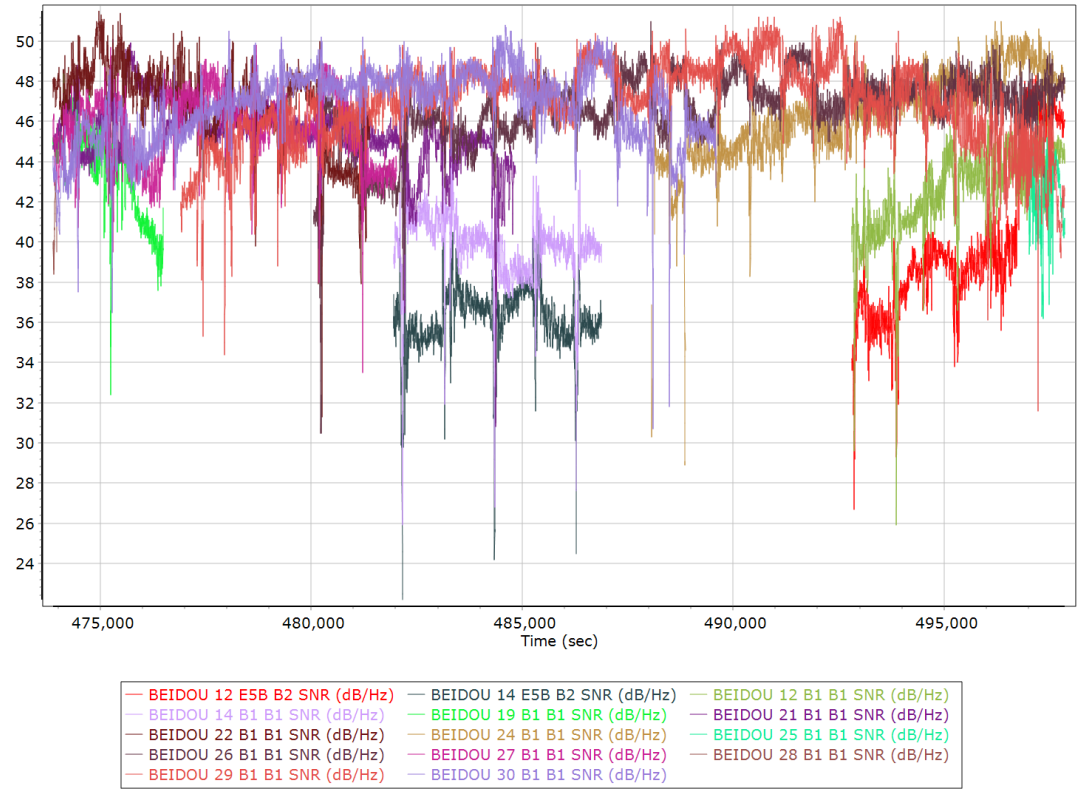


GLONASS L2 SNR

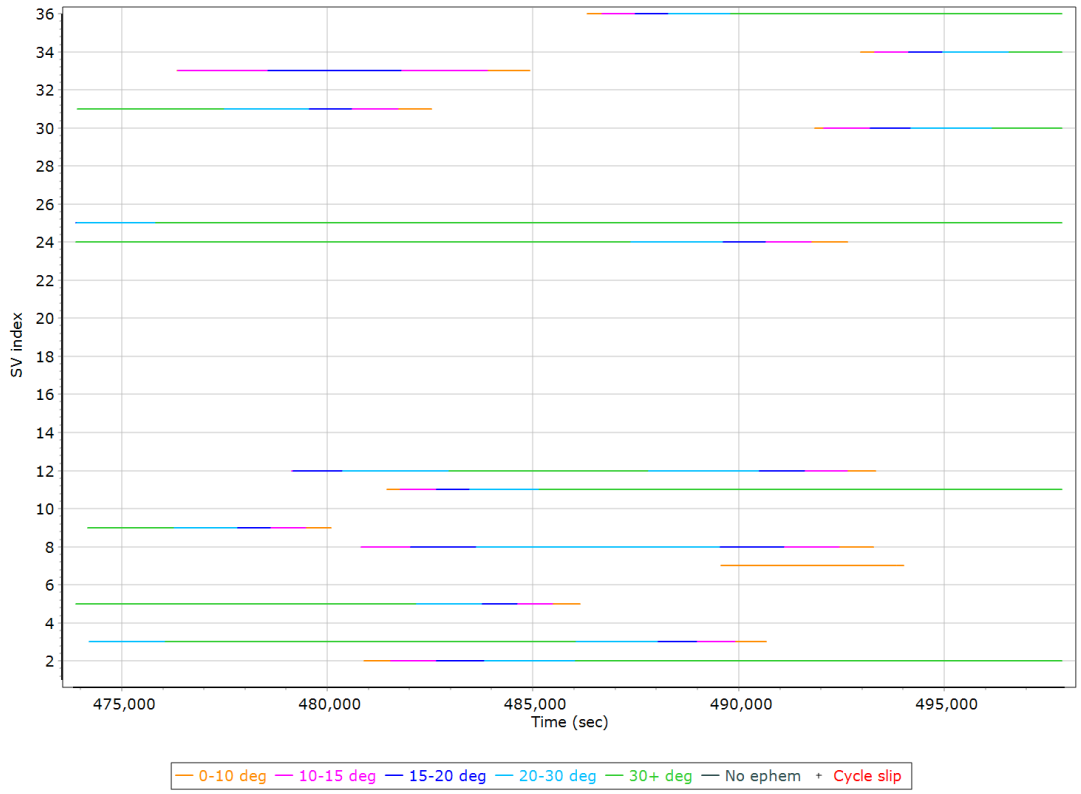


BEIDOU Satellite Lock/Elevation

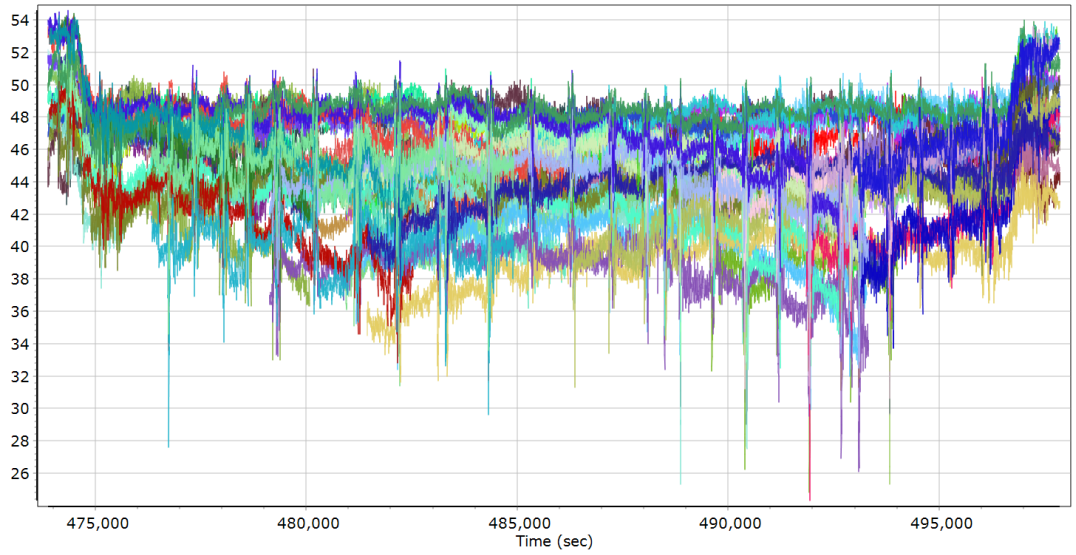
BEIDOU SNR



GALILEO Satellite Lock/Elevation



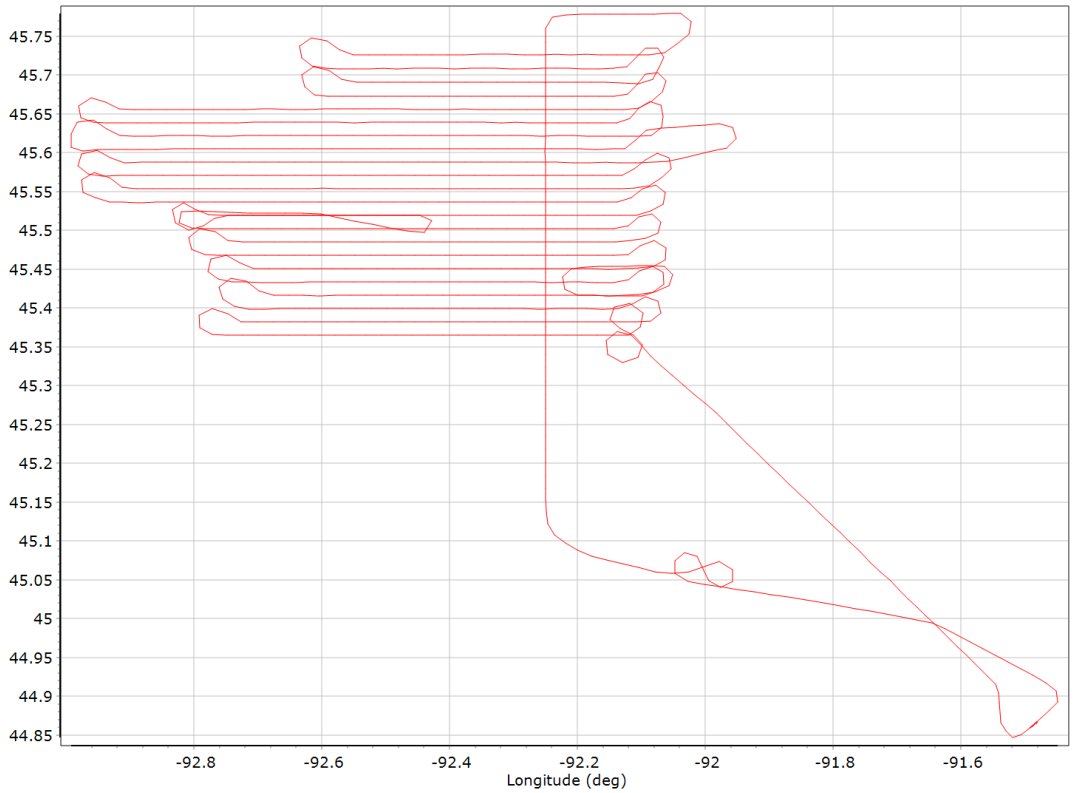
GALILEO SNR



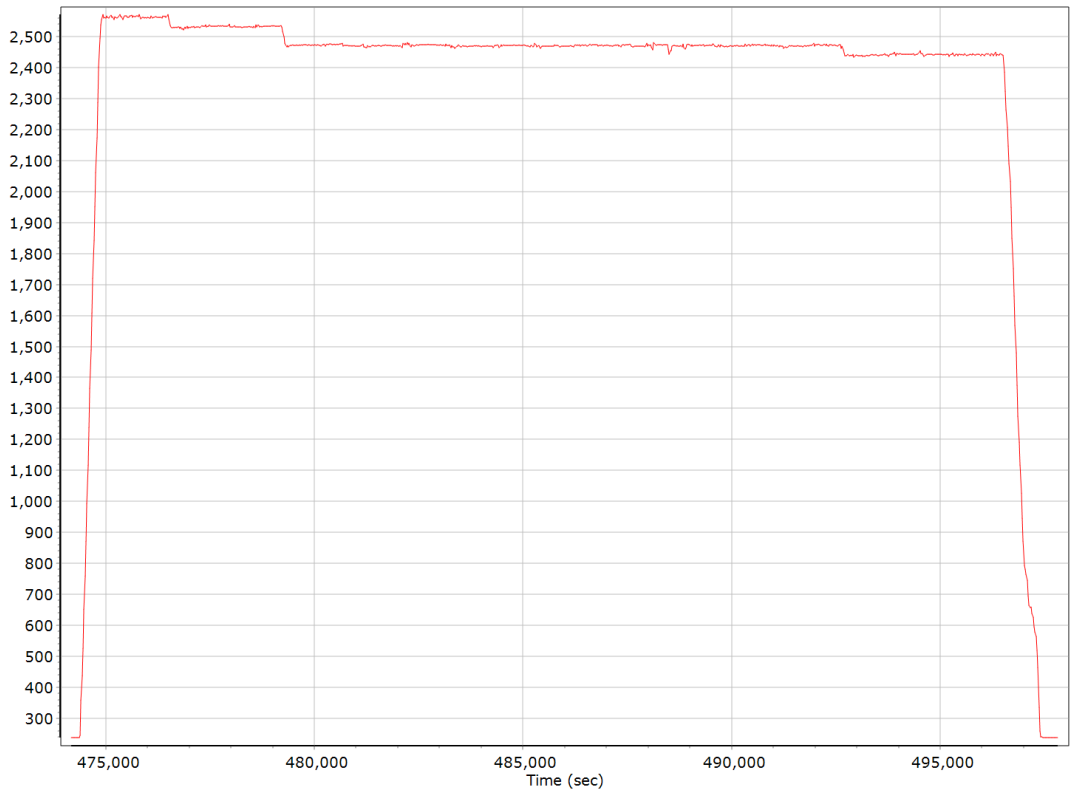
GALILEO 02 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 03 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 05 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 07 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 08 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 09 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 11 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 12 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 24 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 25 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 30 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 31 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 33 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 34 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 36 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 02 L5E5A BPSK10_PD SNR (dB/Hz)
GALILEO 03 L5E5A BPSK10_PD SNR (dB/Hz)
GALILEO 05 L5E5A BPSK10_PD SNR (dB/Hz)
GALILEO 07 L5E5A BPSK10_PD SNR (dB/Hz)
GALILEO 08 L5E5A BPSK10_PD SNR (dB/Hz)

Smoothed Trajectory Information

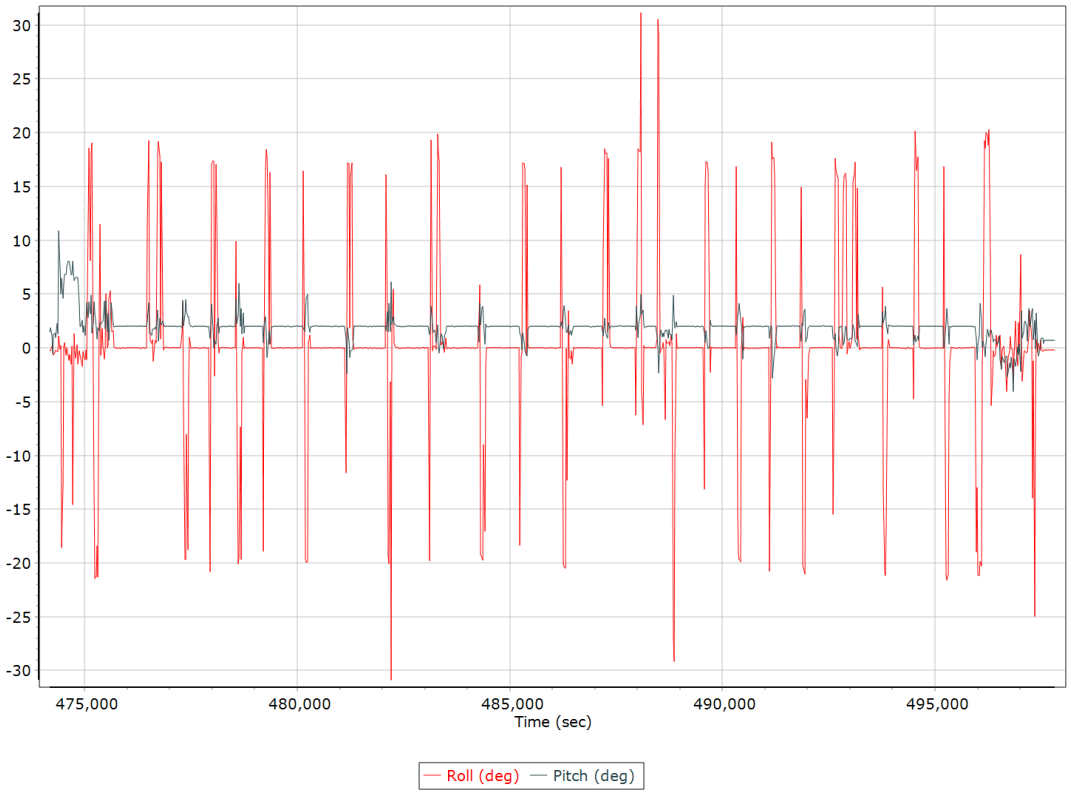
Top View



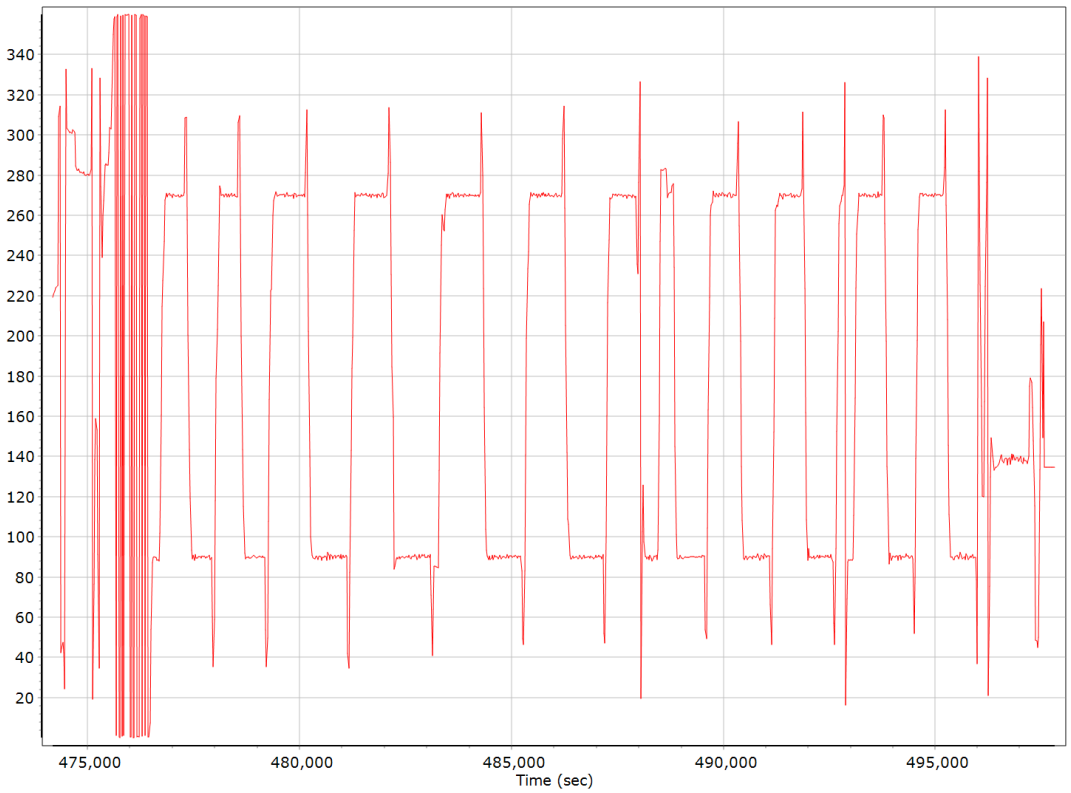
Altitude



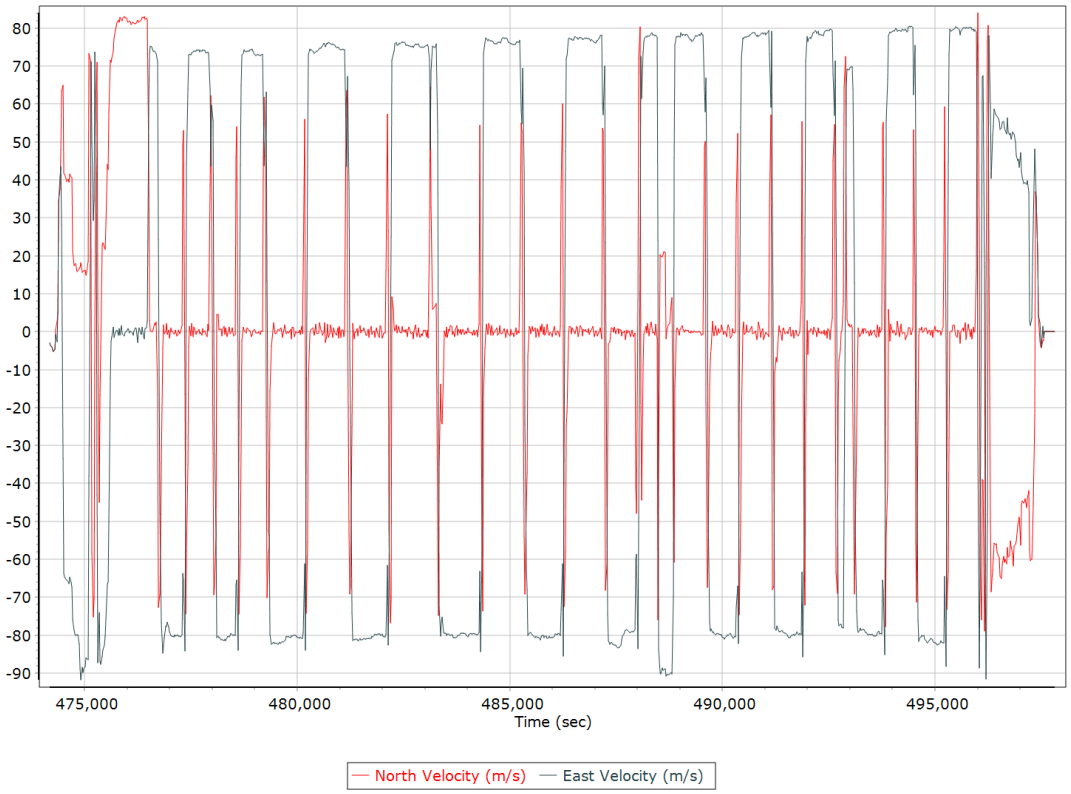
Roll/Pitch



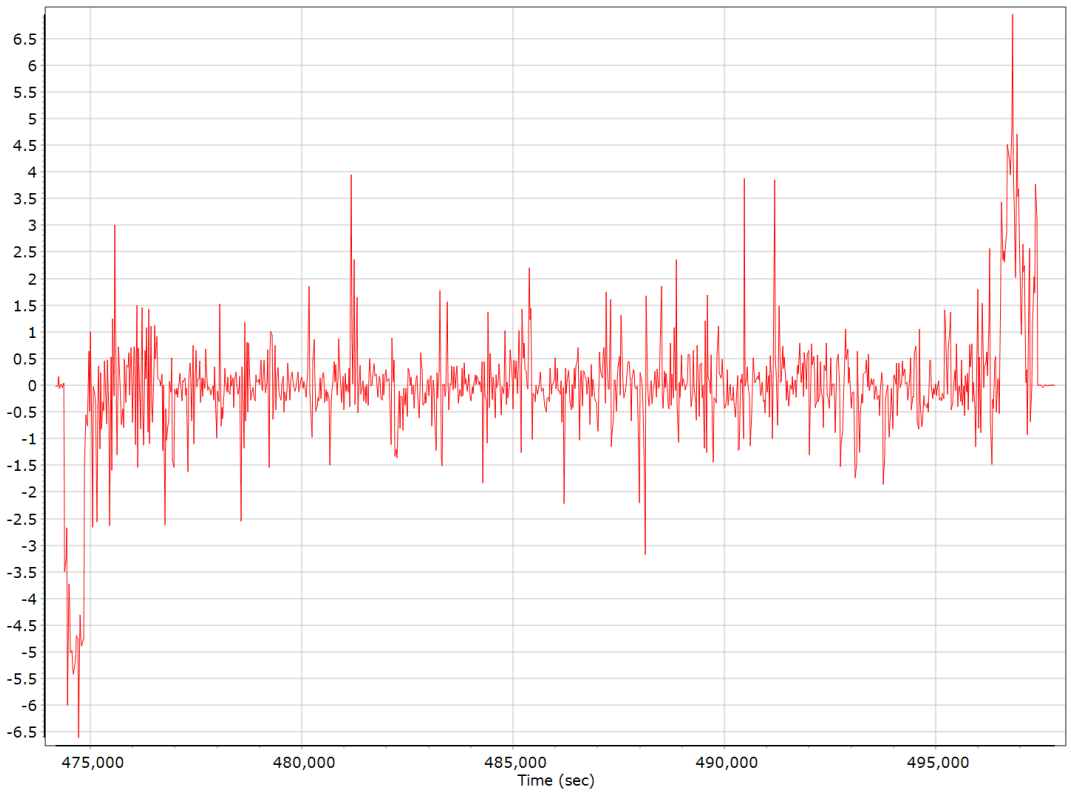
Heading



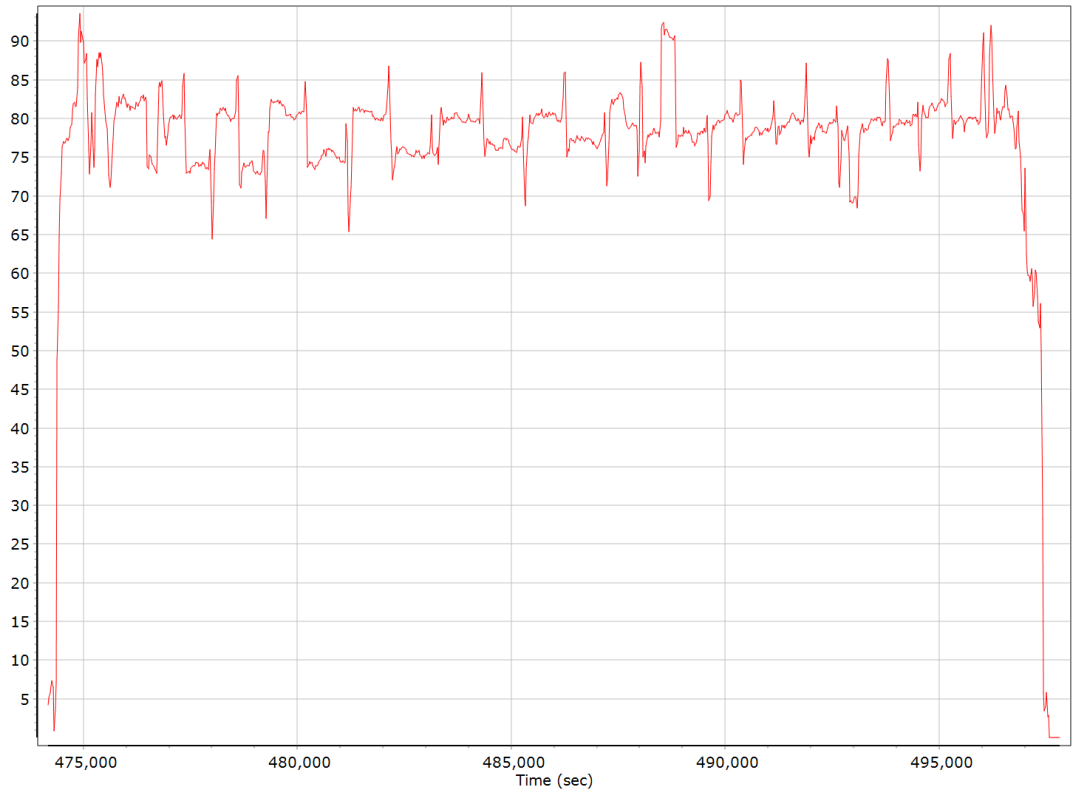
North/East Velocity



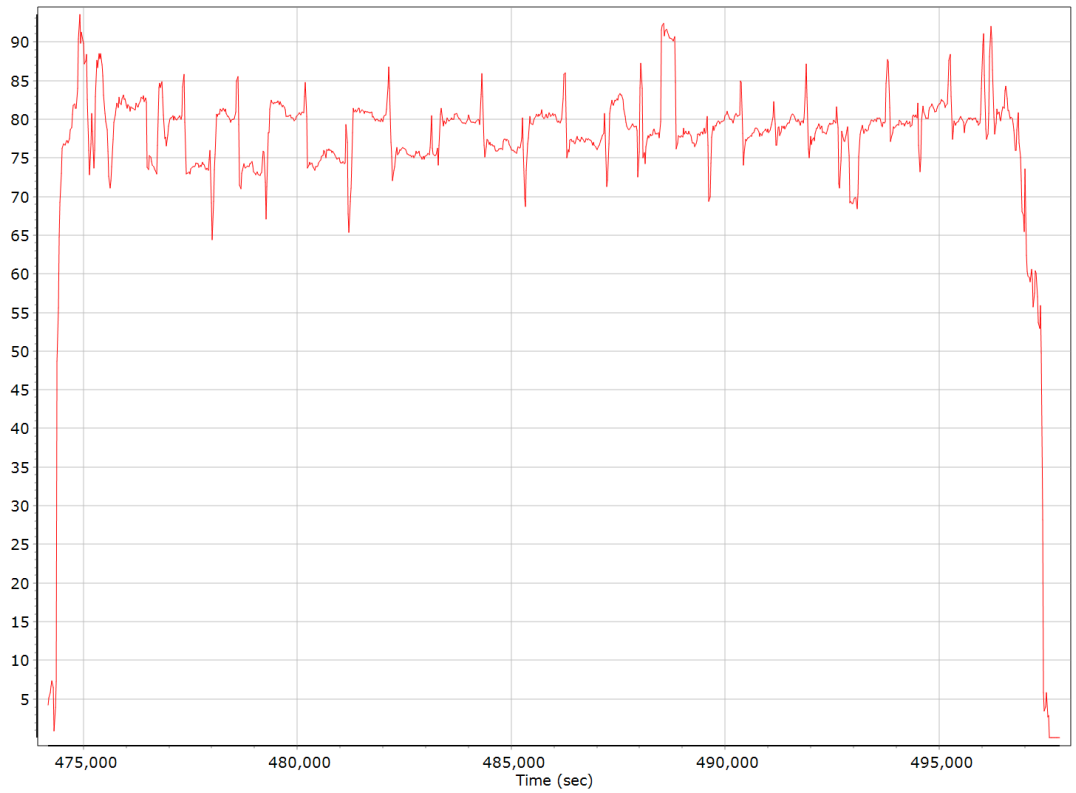
Down Velocity



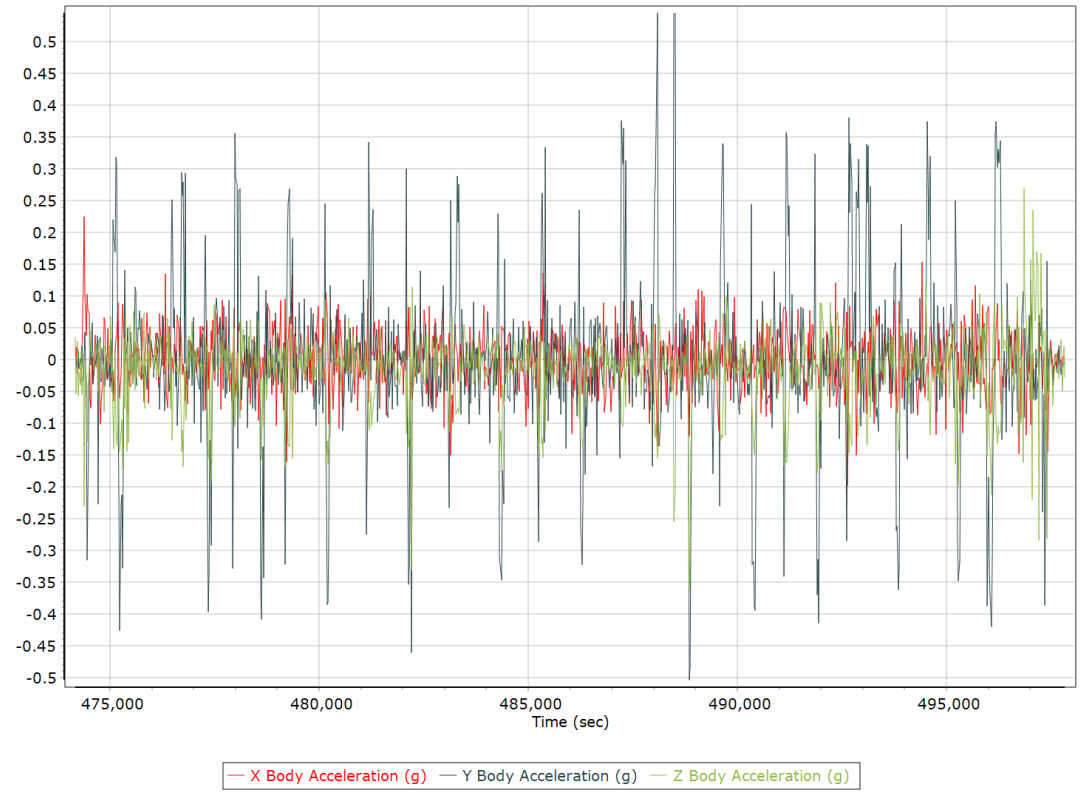
Total Speed



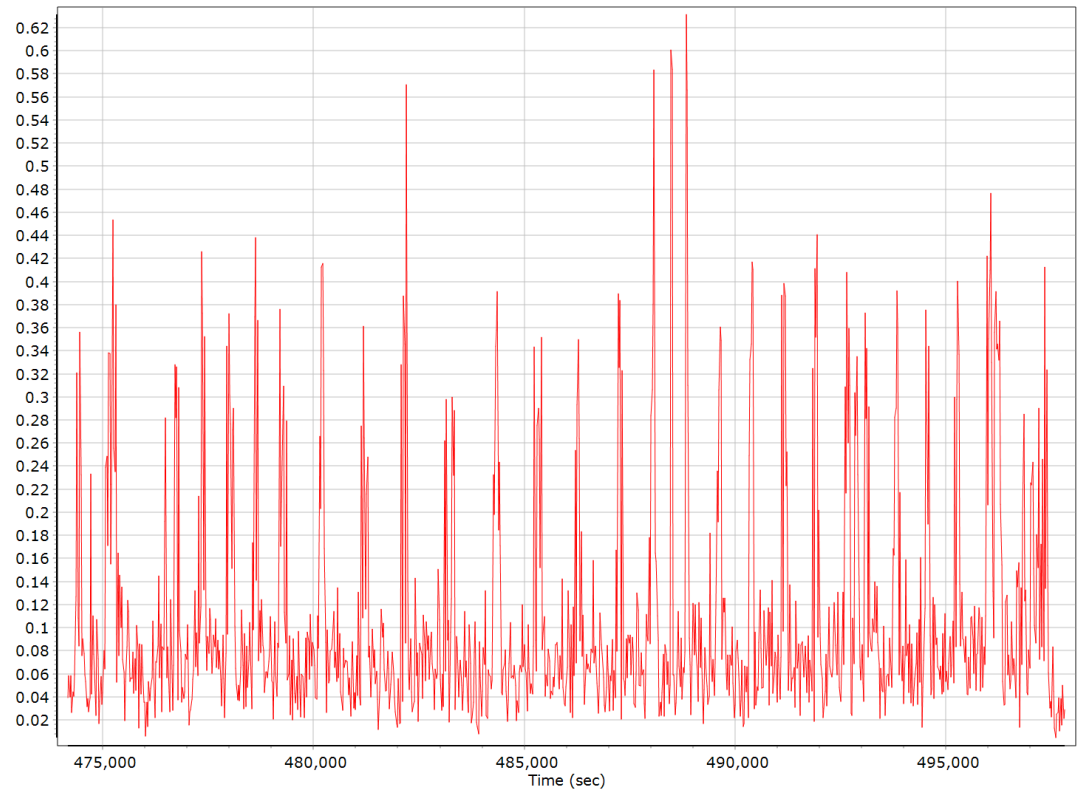
Ground Speed



Body Acceleration



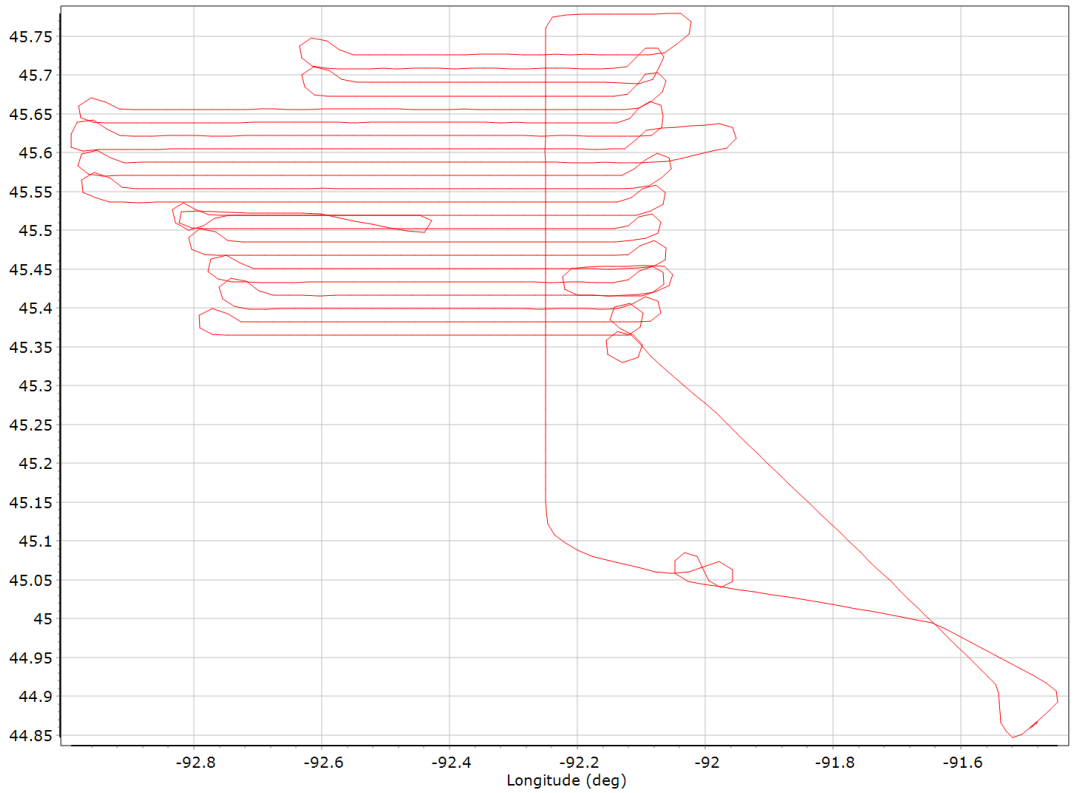
Total Body Acceleration



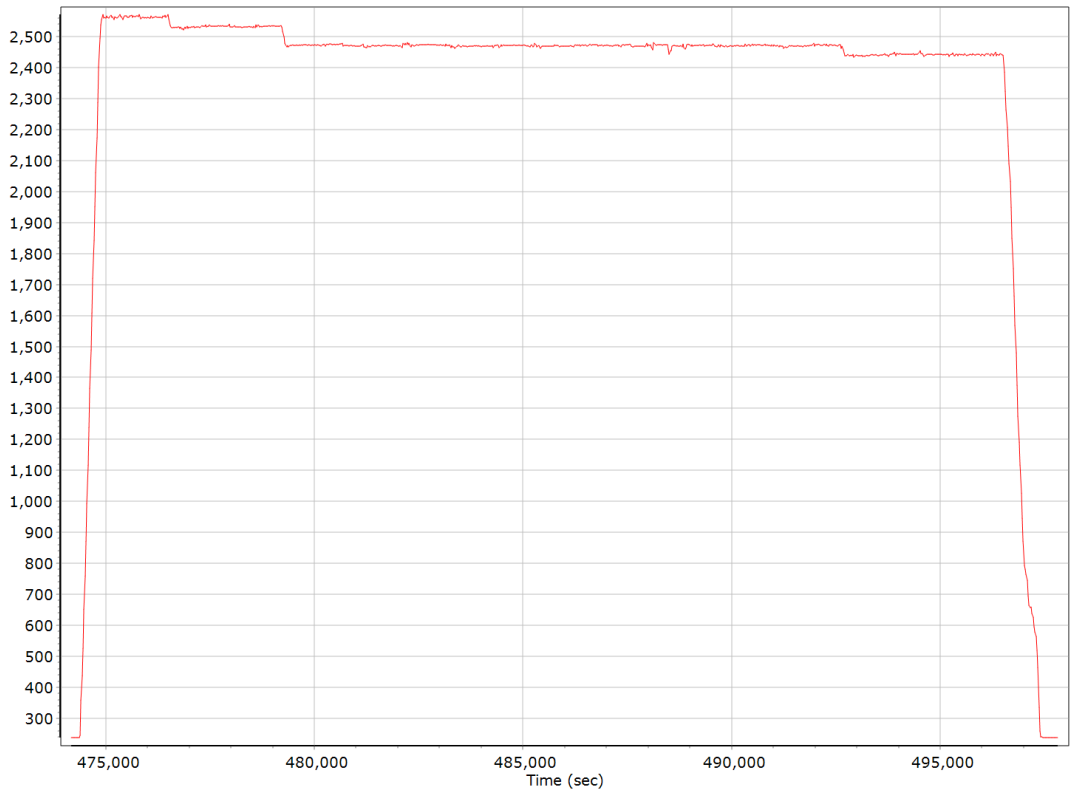
Body Angular Rate

Forward Processed Trajectory Information

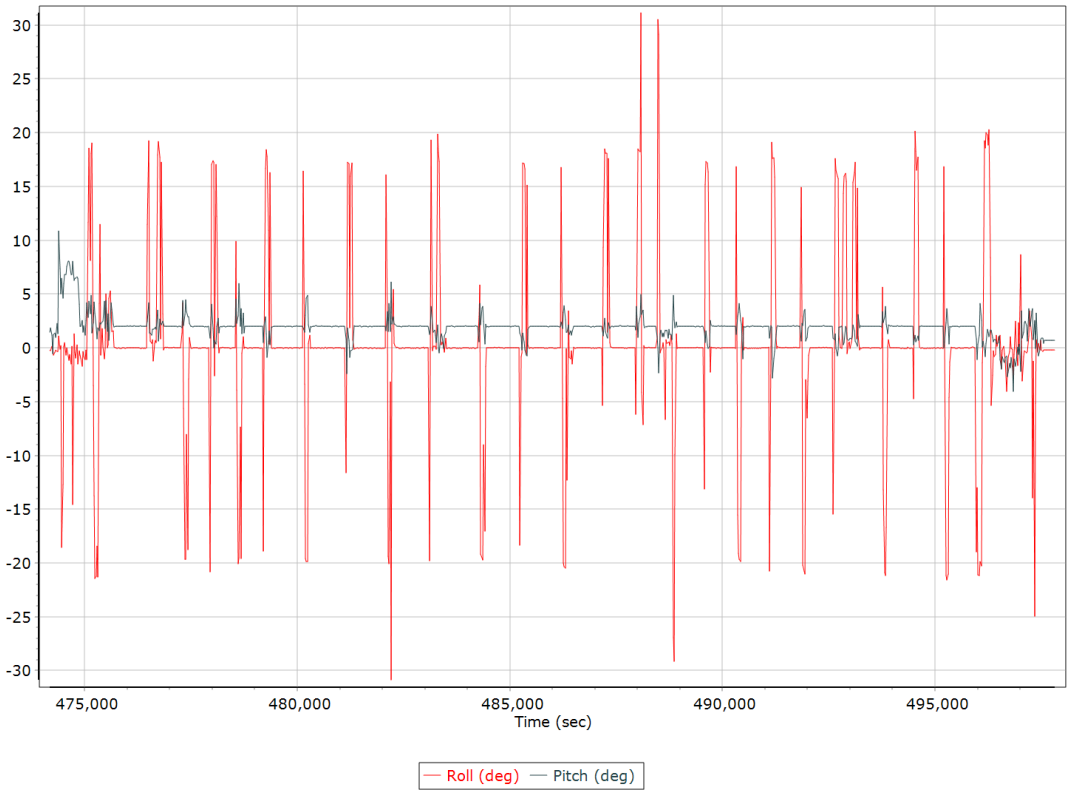
Top View



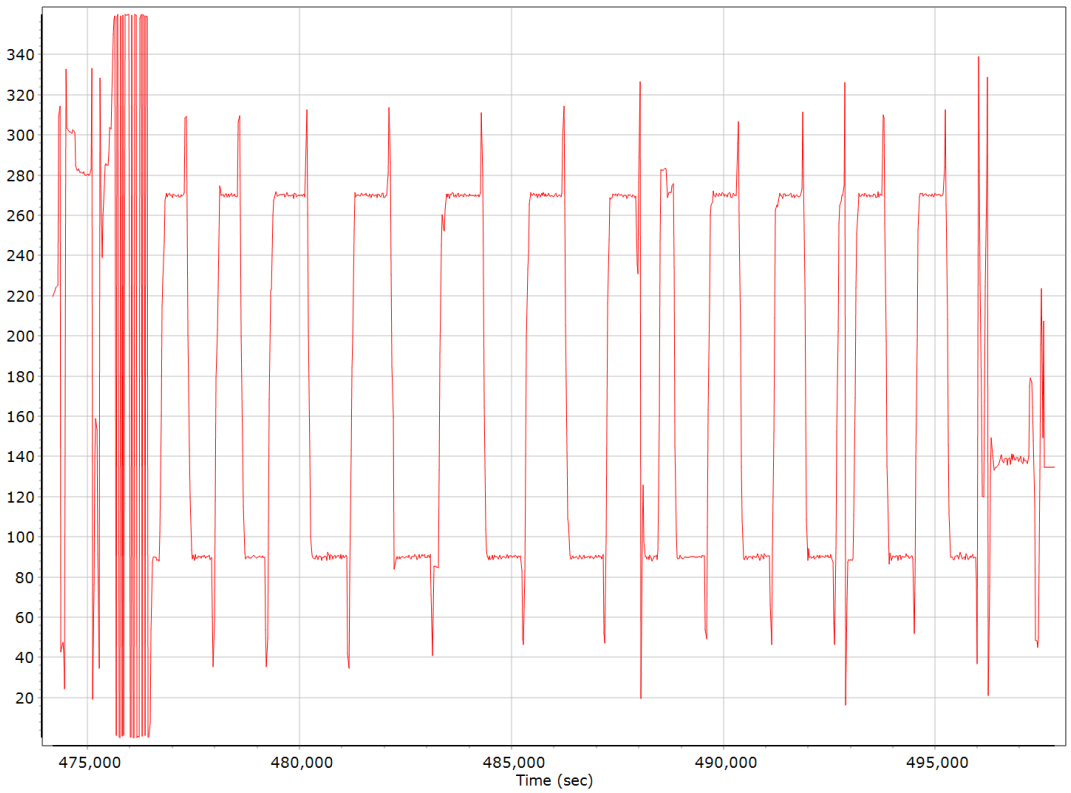
Altitude



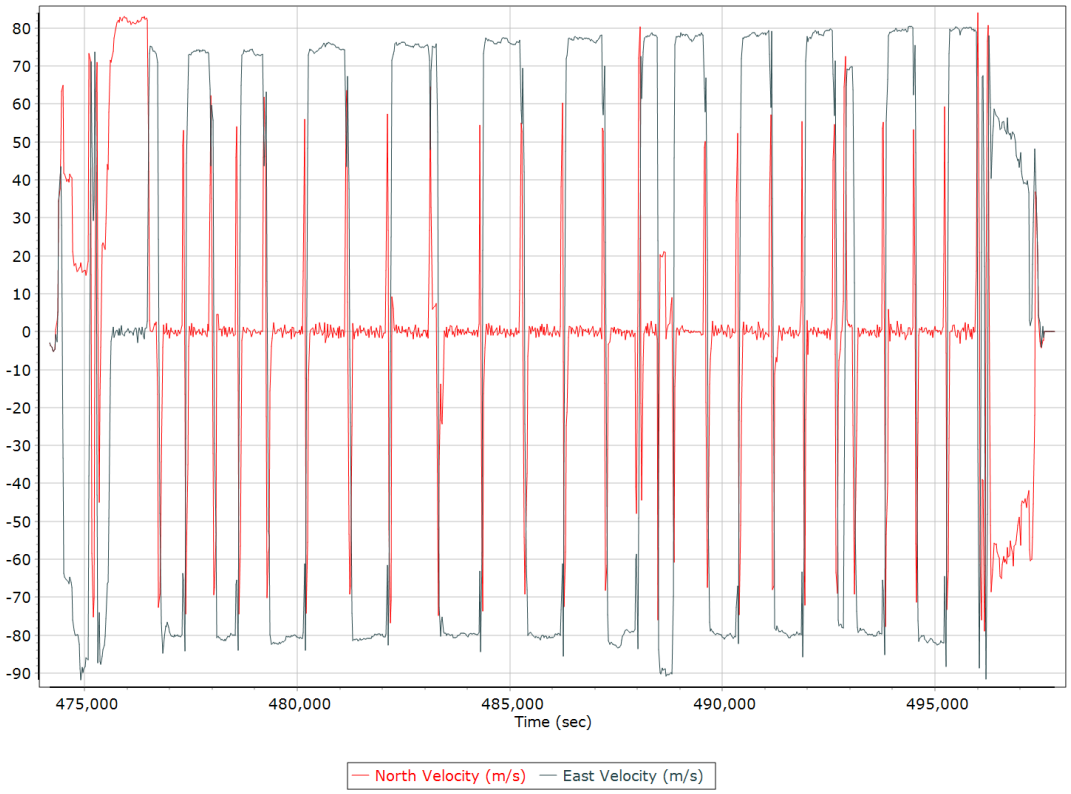
Roll/Pitch



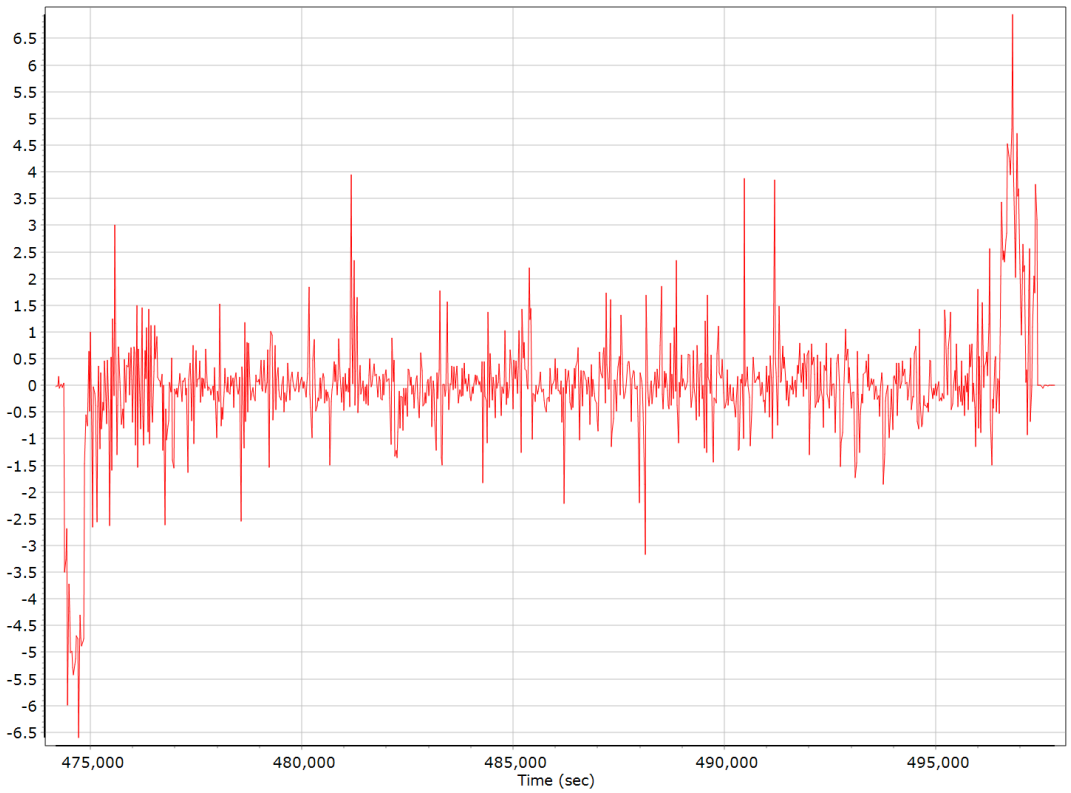
Heading



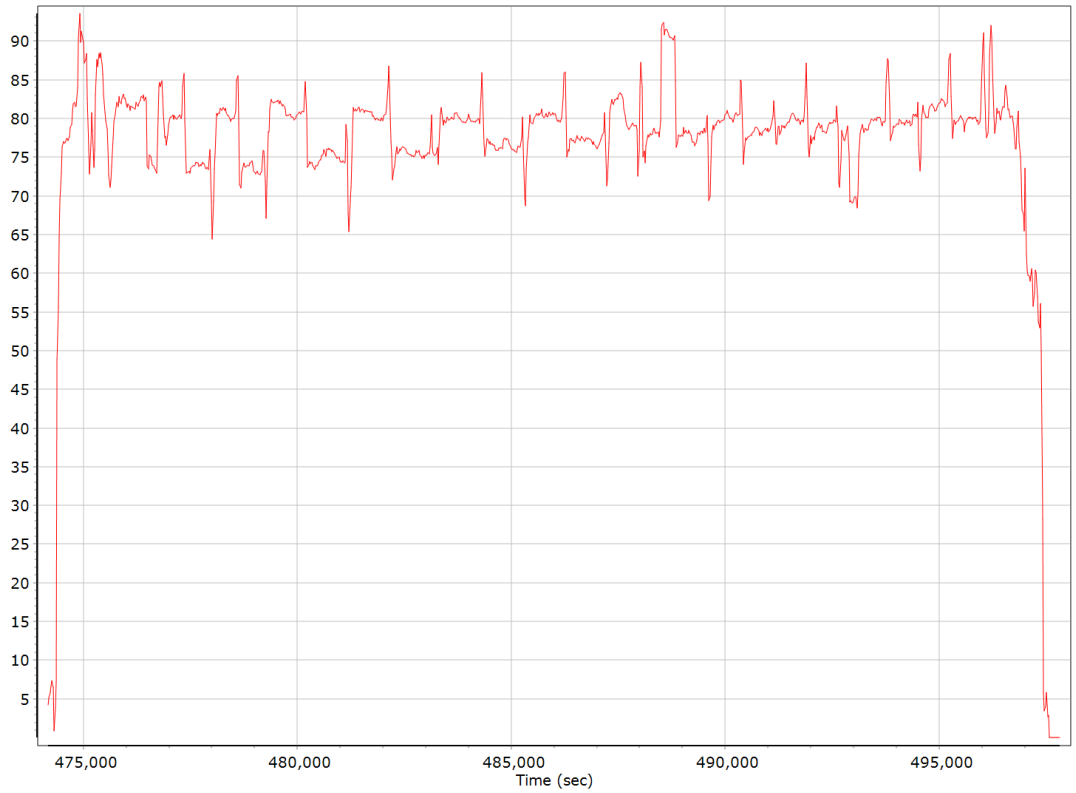
North/East Velocity



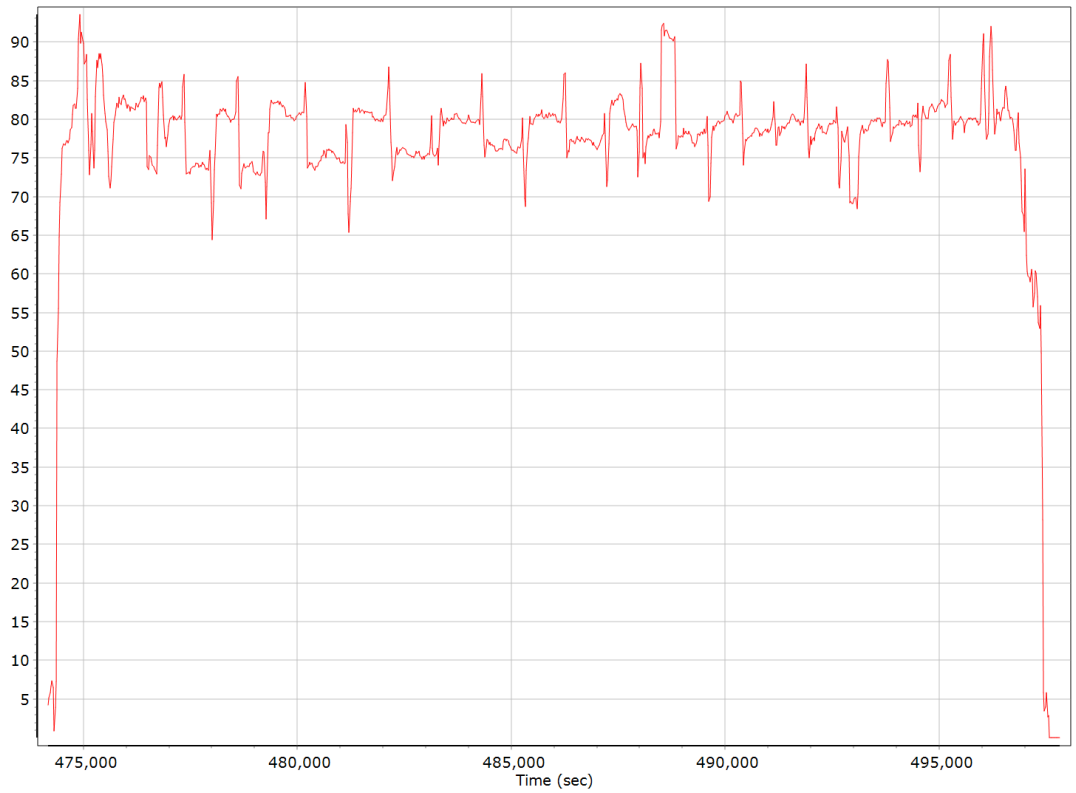
Down Velocity



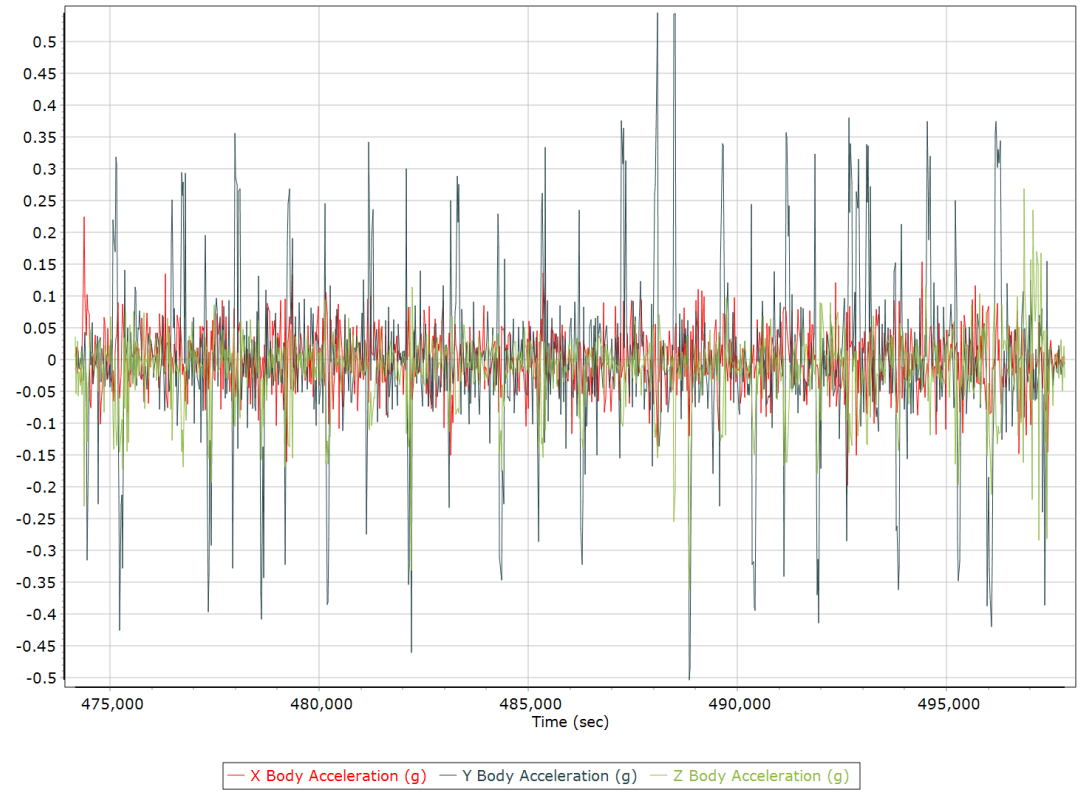
Total Speed



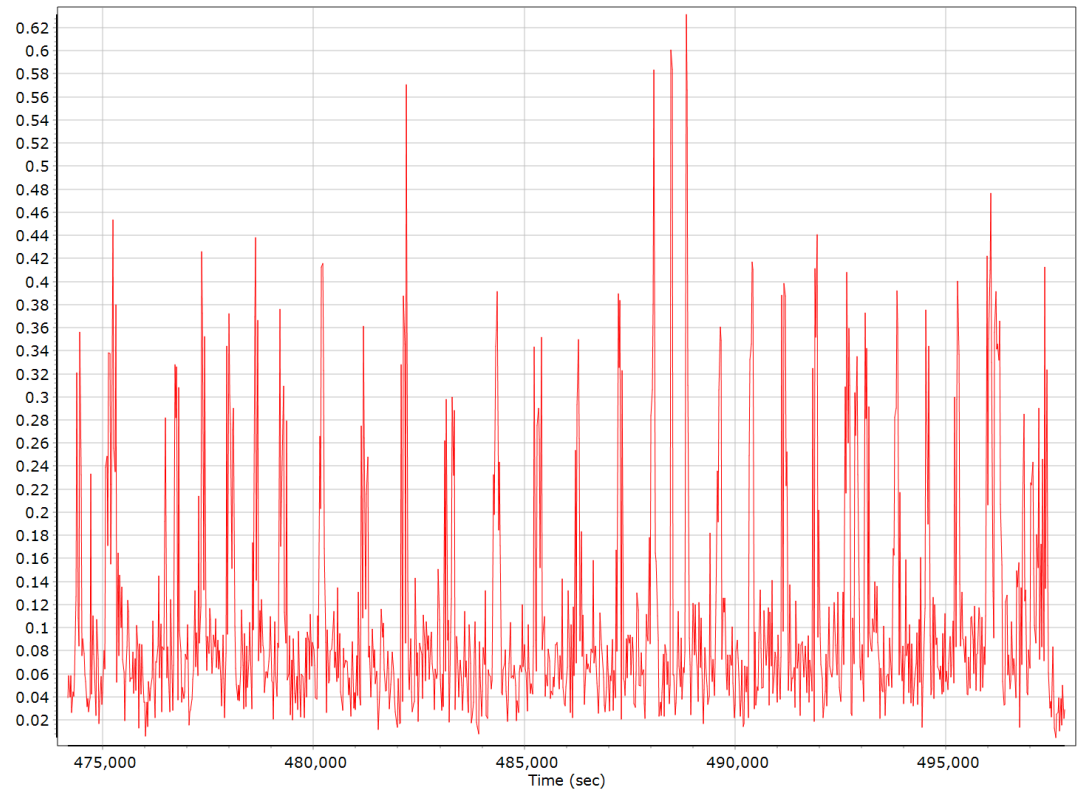
Ground Speed



Body Acceleration



Total Body Acceleration



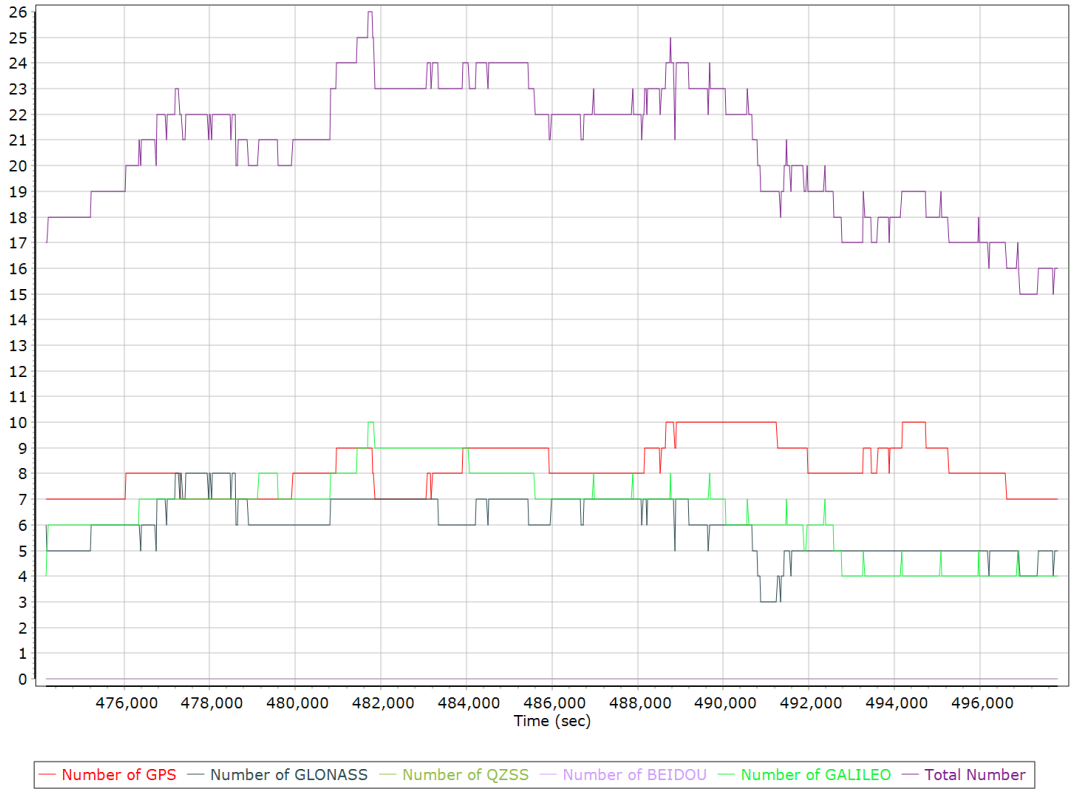
Body Angular Rate

GNSS QC

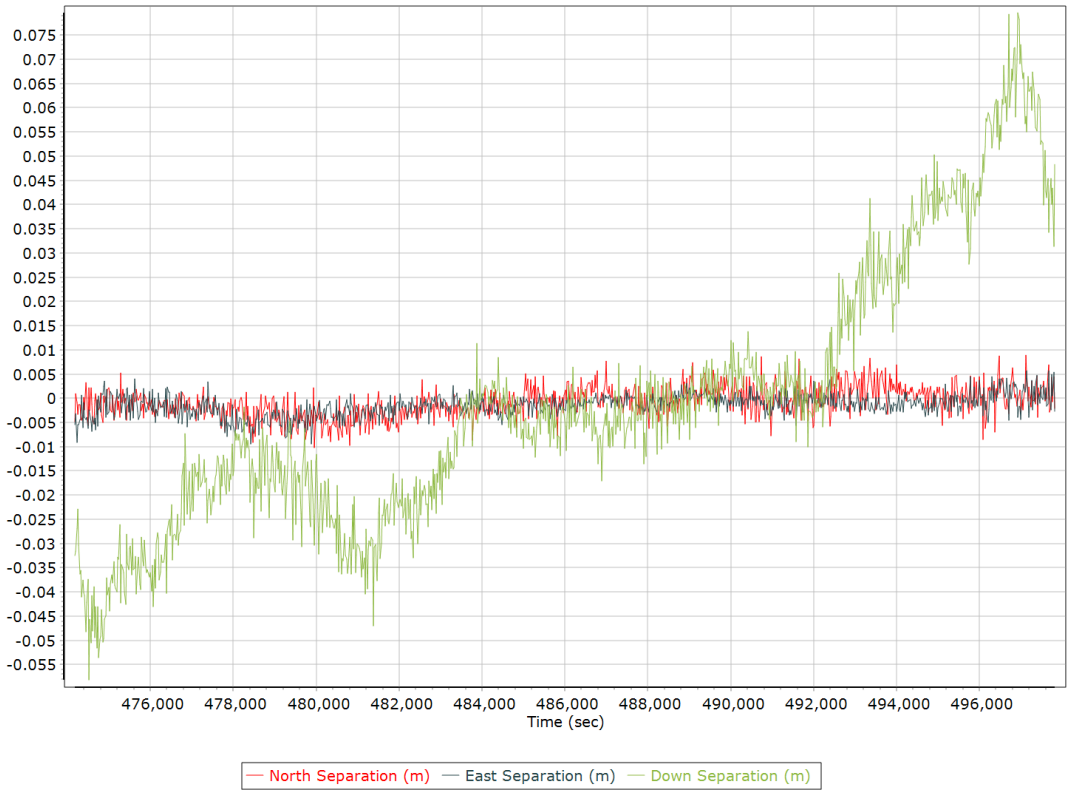
GNSS QC Statistics

Statistics	Min	Max	Mean
Baseline length (km)	0.00	0.00	
Number of GPS SV	7	10	8
Number of GLONASS SV	3	8	6
Number of QZSS SV	0	0	0
Number of BEIDOU SV	0	0	0
Number of GALILEO SV	3	10	6
Total number of SV	15	26	21
PDOP	0.94	1.77	1.18
QC Solution Gaps	0.00	0.00	
Solution Type	Fixed	Float	No solution
Epoch (sec)	23945.00	0.00	0.00
Percentage	100.00	0.00	0.00

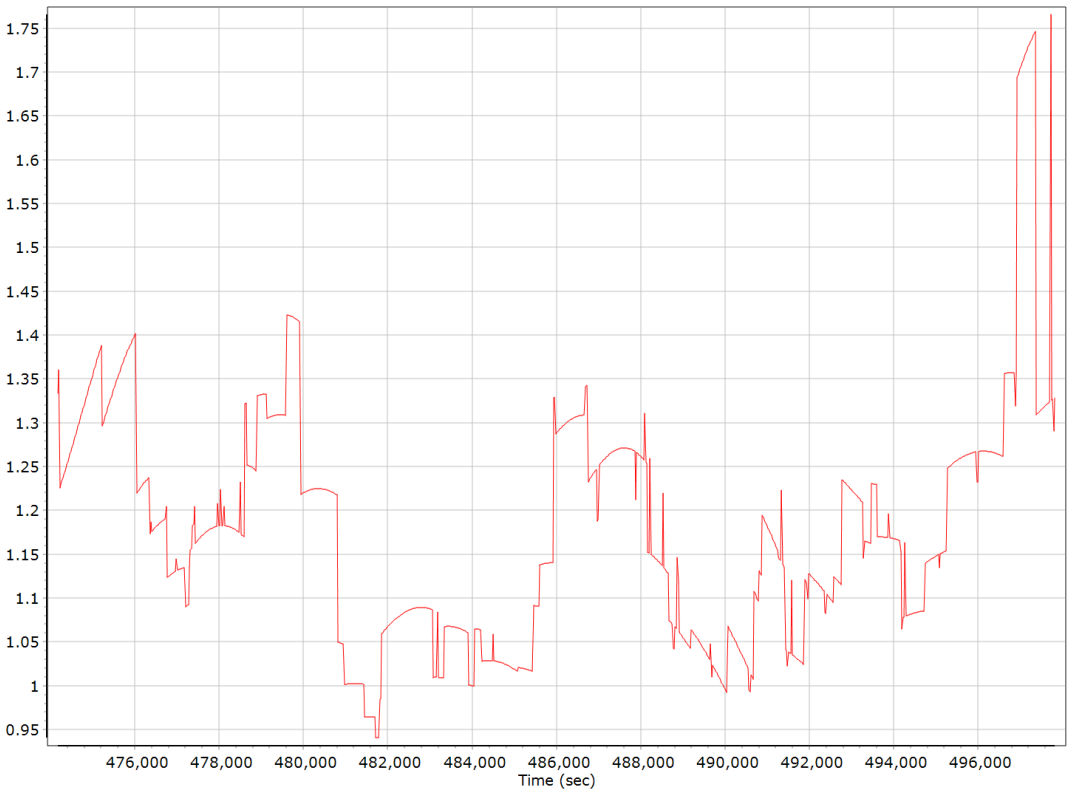
Num SVs in solution



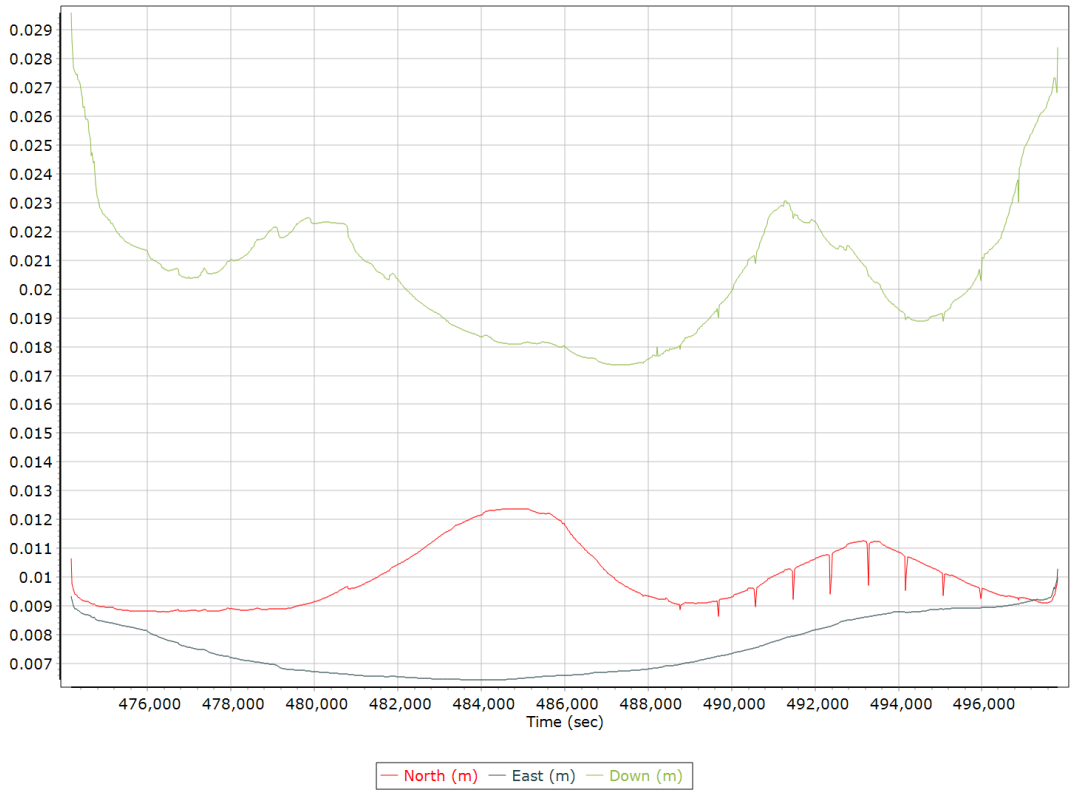
Forward/Reverse Separation



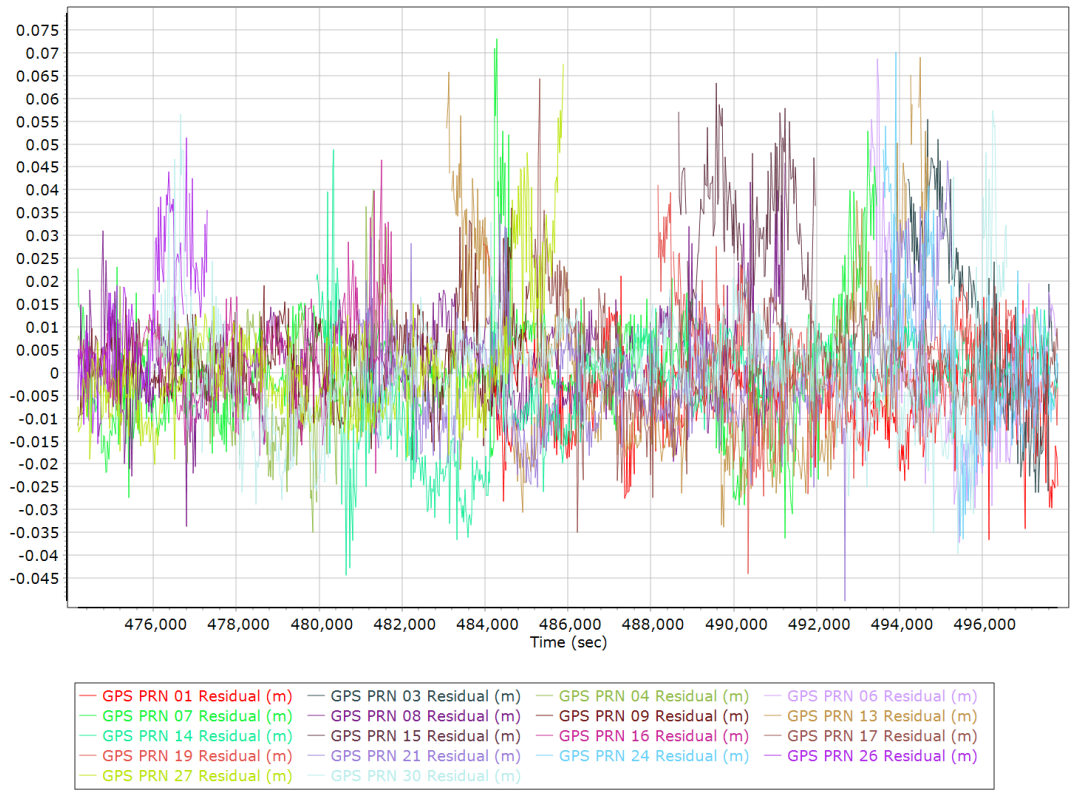
PDOP



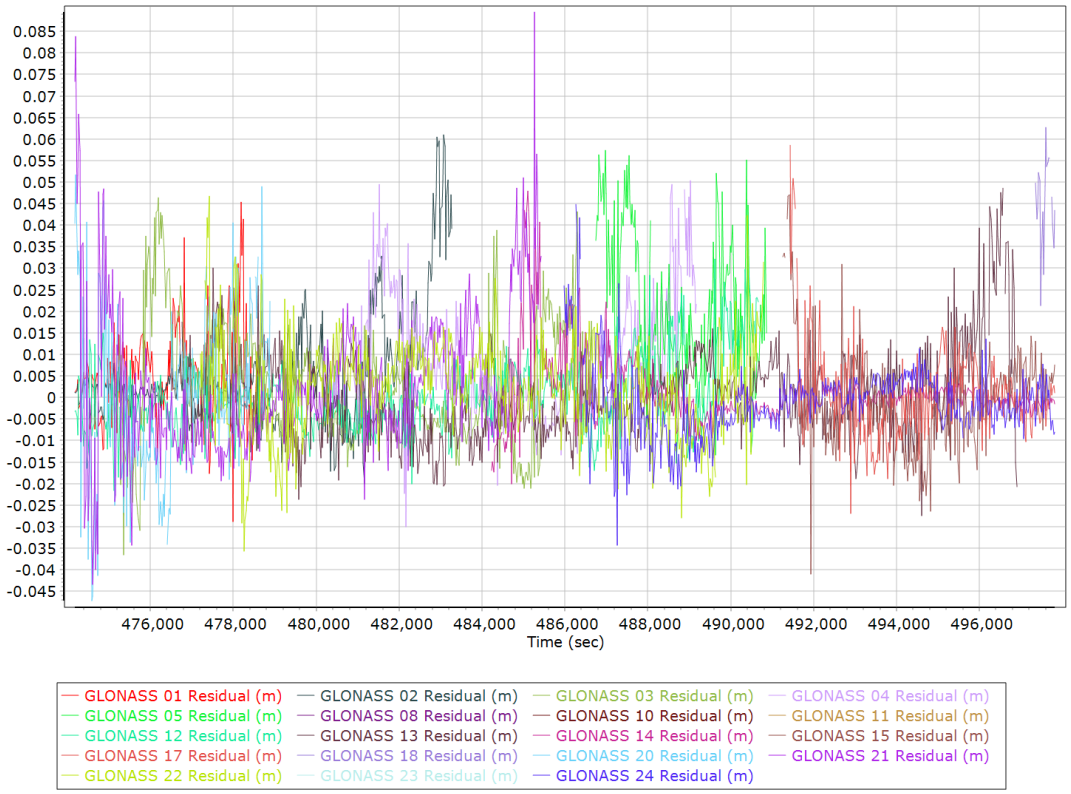
Estimated Position Accuracy



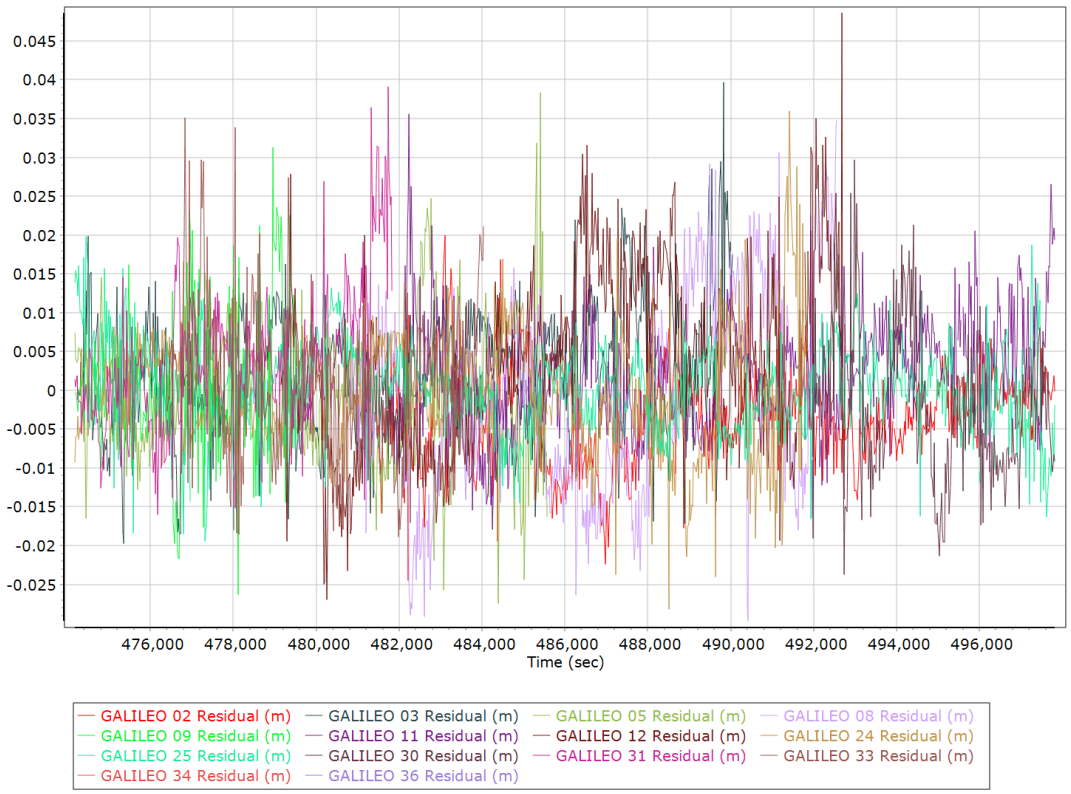
GPS Residuals



GLONASS Residuals



GALILEO Residuals



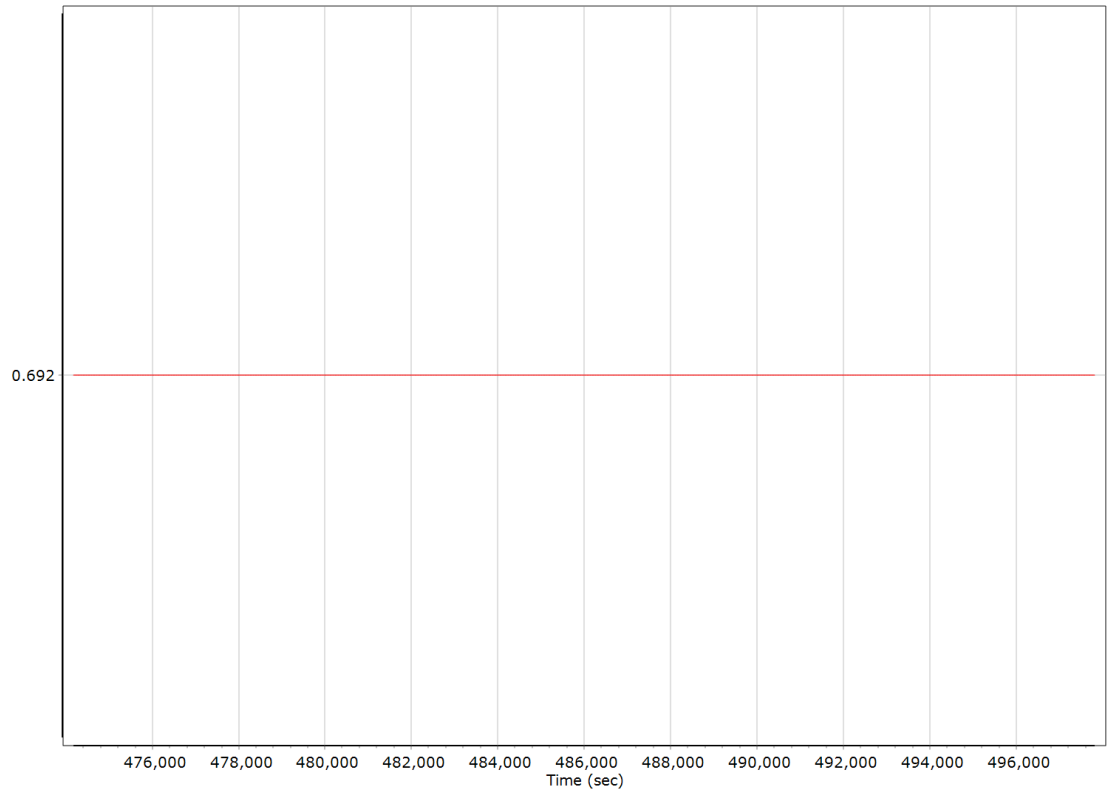
GNSS-Inertial Processor Configuration

Processing mode	IN-Fusion PP-RTX		
Stabilized mount	True		
Processing start time	473869.000 (5/6/2022 11:37:49 AM)		
Processing end time	497842.000 (5/6/2022 6:17:22 PM)		
Initial attitude source	Real-Time VNAV/RNAV Attitude		
IMU Sensor Context	Processing with Onboard IMU		
Gimbal to IMU lever arm (m)	-0.034	-0.010	-0.374
Gimbal to IMU mounting angles (deg)	0.000	0.000	0.000
Gimbal to Primary GNSS lever arm (m)	0.692	-0.181	-1.276
Gimbal to Primary GNSS lever arm std dev (m)	0.030	0.030	0.030
Aircraft to Reference mounting angles (deg)	0.000	0.000	0.000

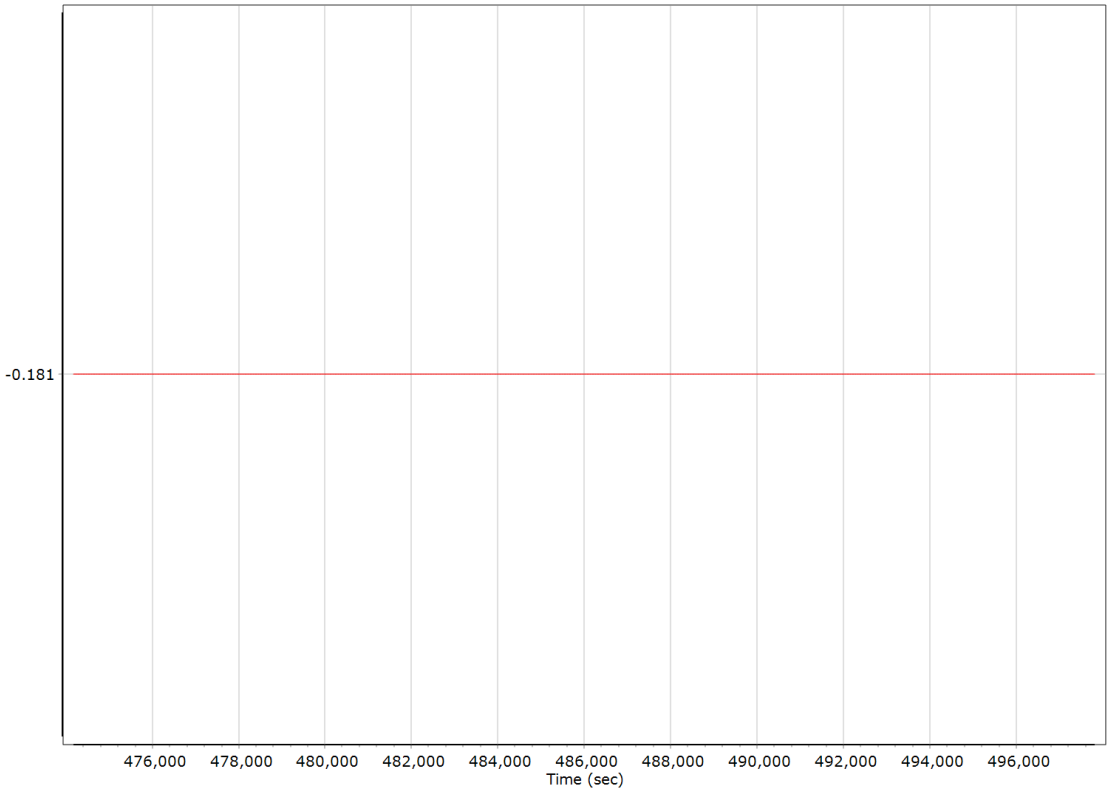
Calibrated Installation Parameters

Reference-Primary GNSS Lever Arm (m)

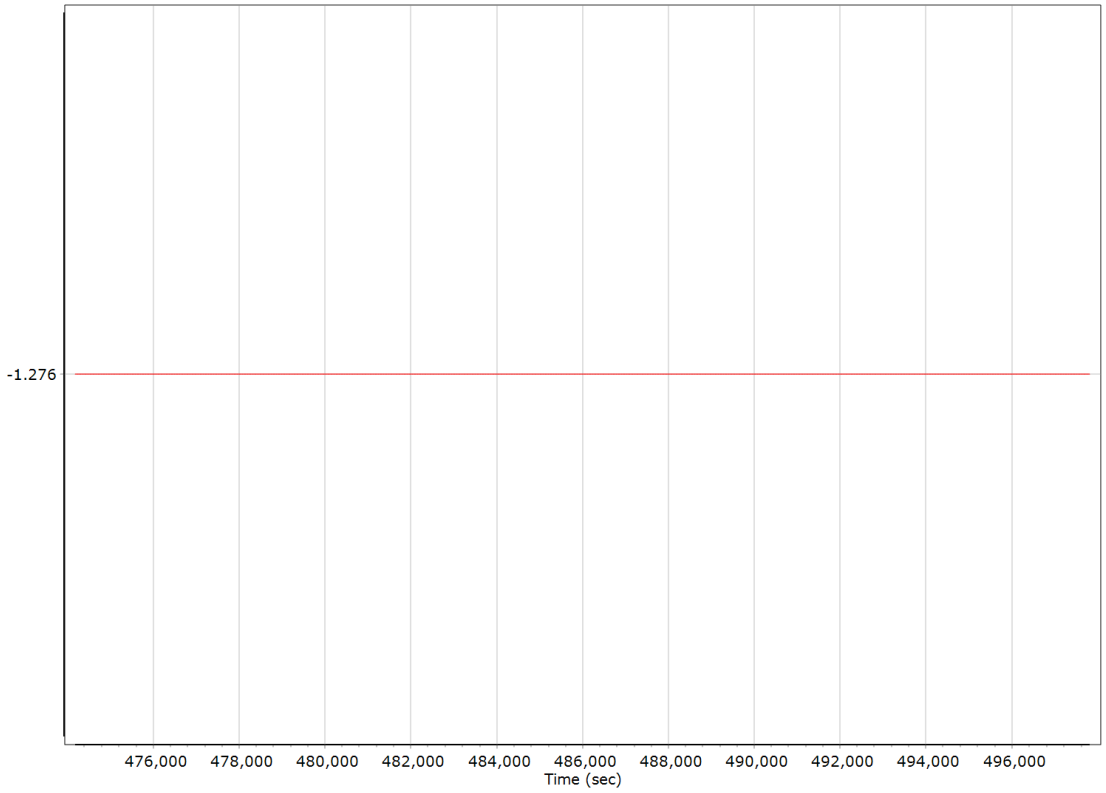
X Reference-Primary GNSS Lever Arm (m)



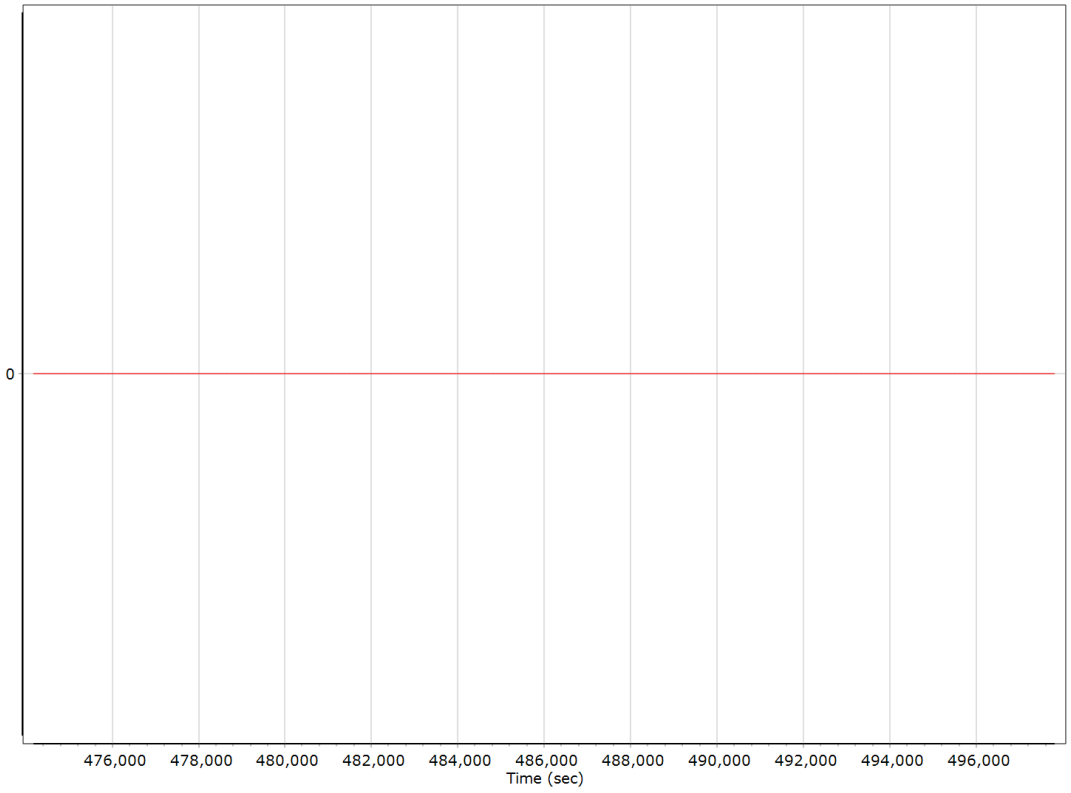
Y Reference-Primary GNSS Lever Arm (m)



Z Reference-Primary GNSS Lever Arm (m)



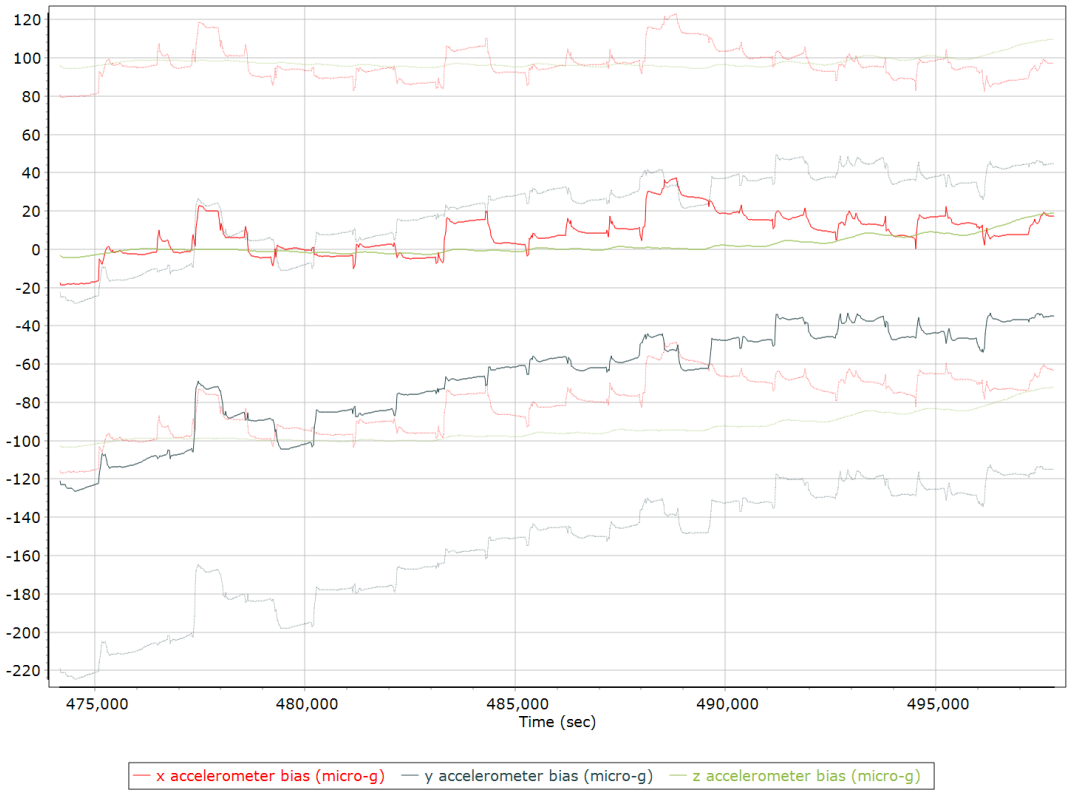
Reference-Primary GNSS Lever Arm Figure of Merit



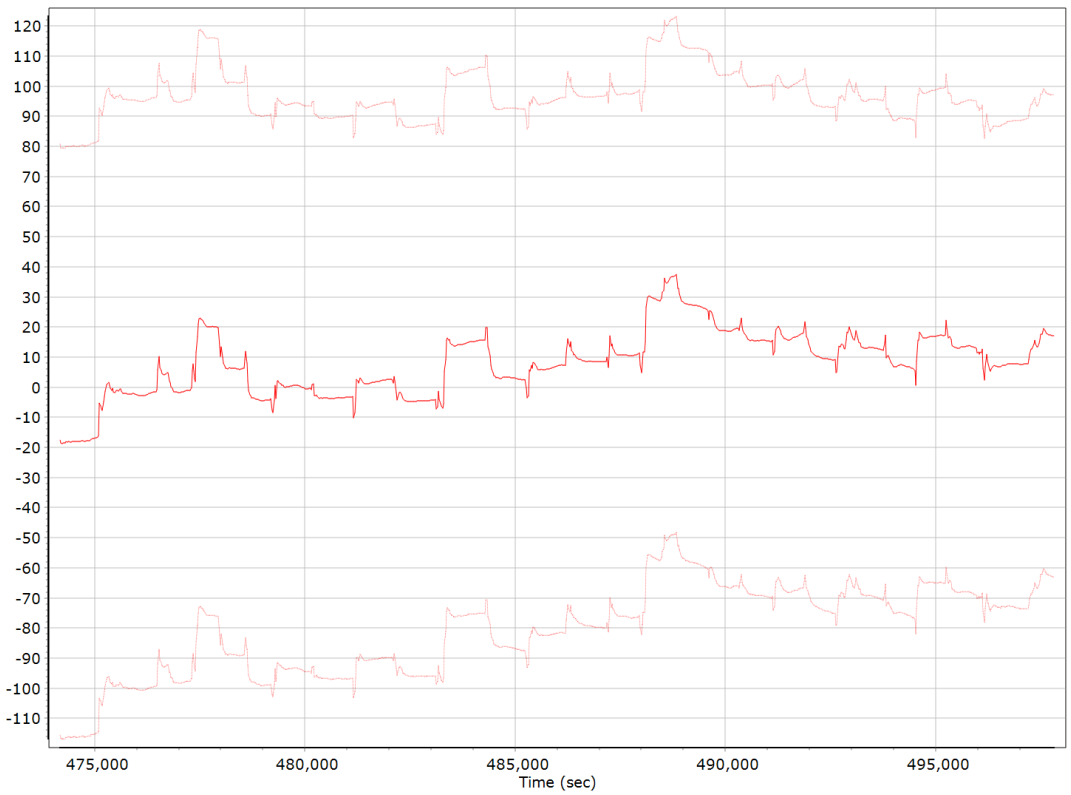
IN-Fusion QC

Forward Processed Estimated Errors, Reference Frame

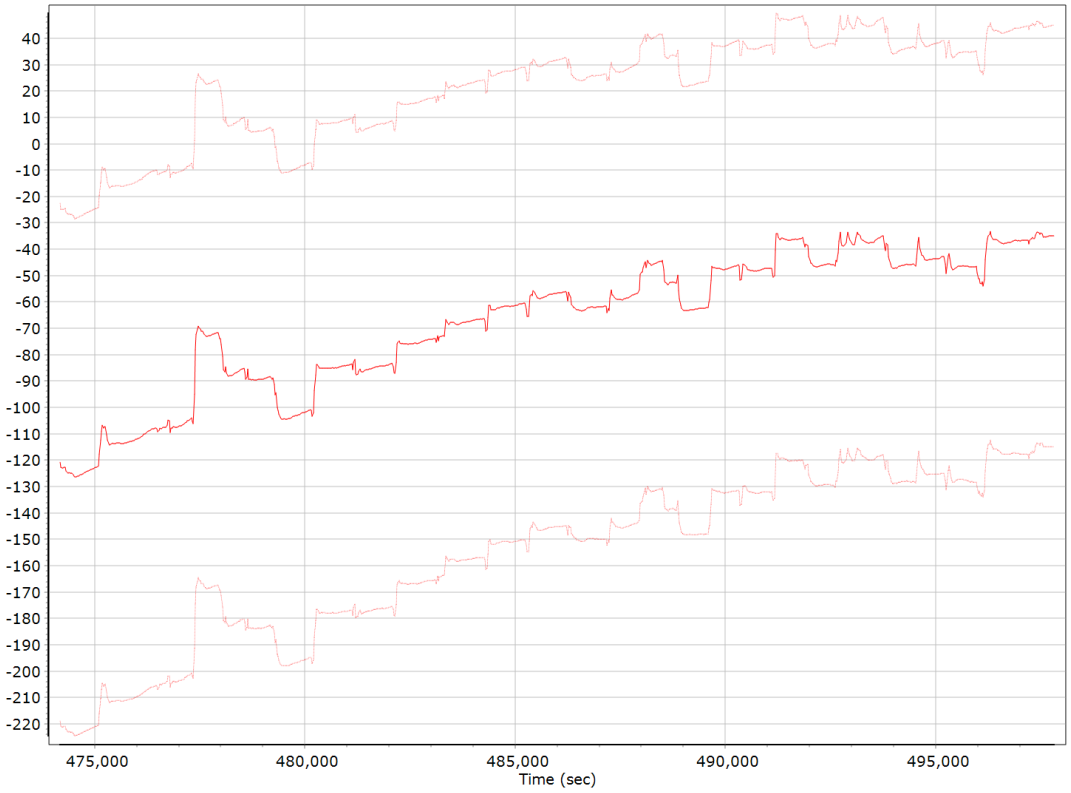
Accelerometer Bias (micro-g)



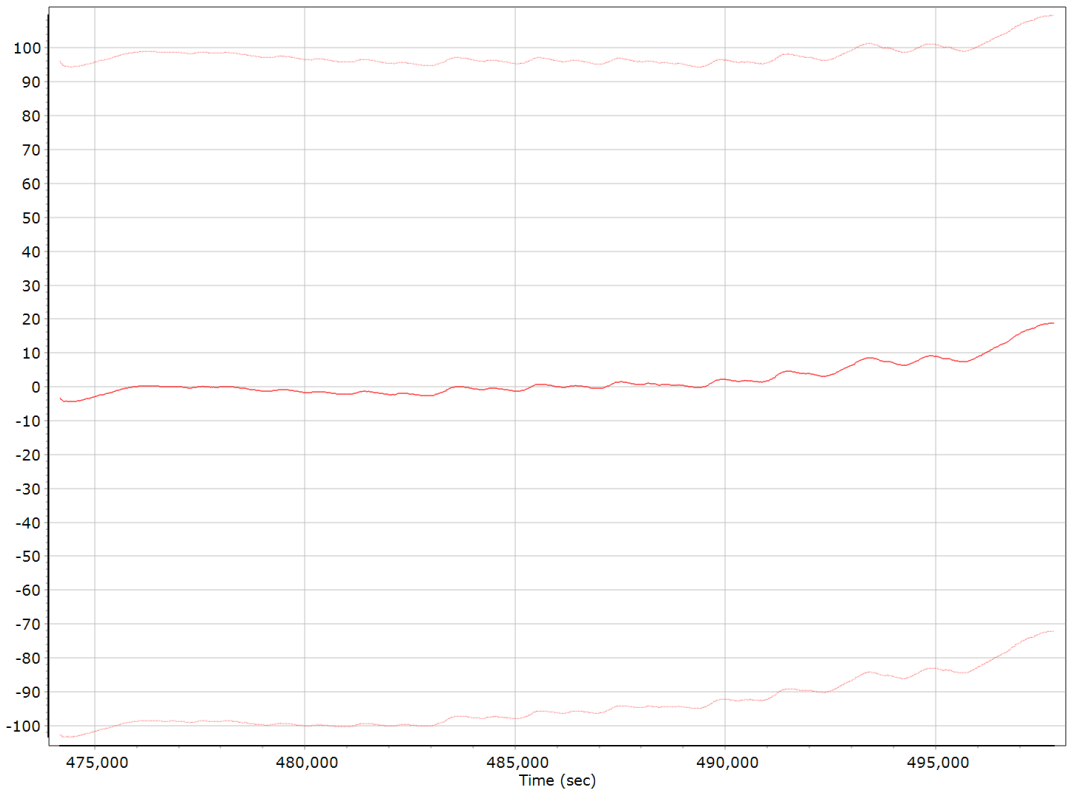
X Accelerometer Bias (micro-g)



Y Accelerometer Bias (micro-g)



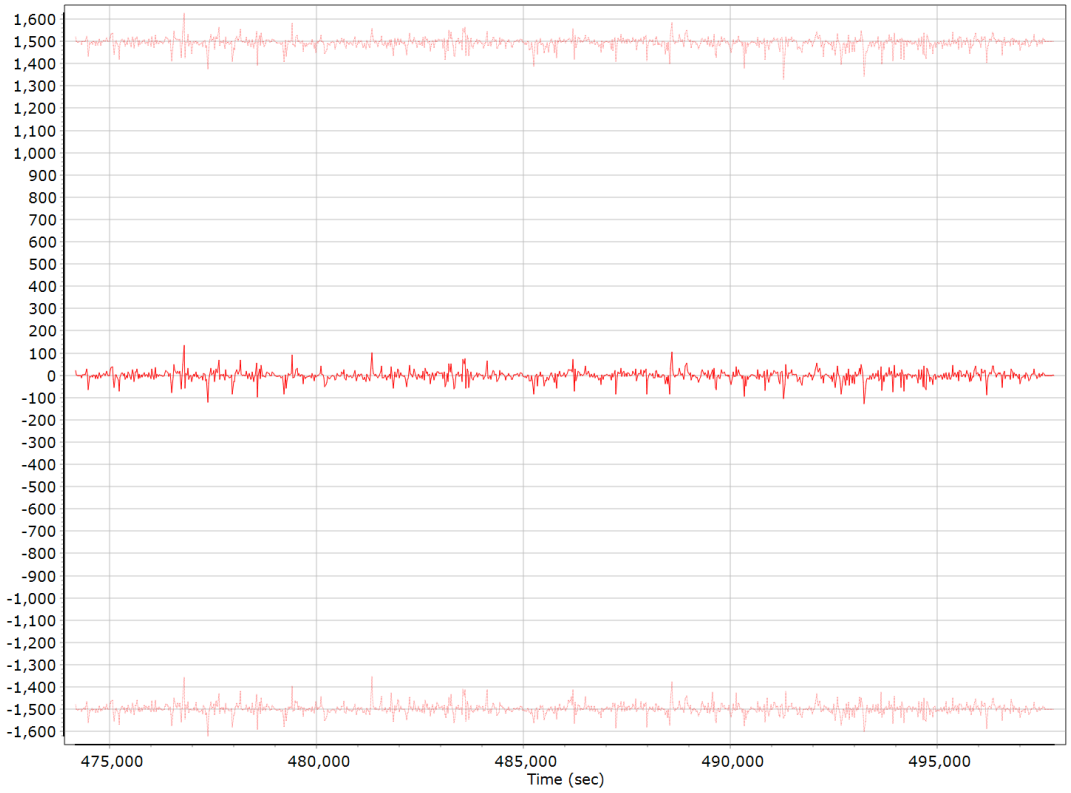
Z Accelerometer Bias (micro-g)



Accelerometer Scale Error (ppm)

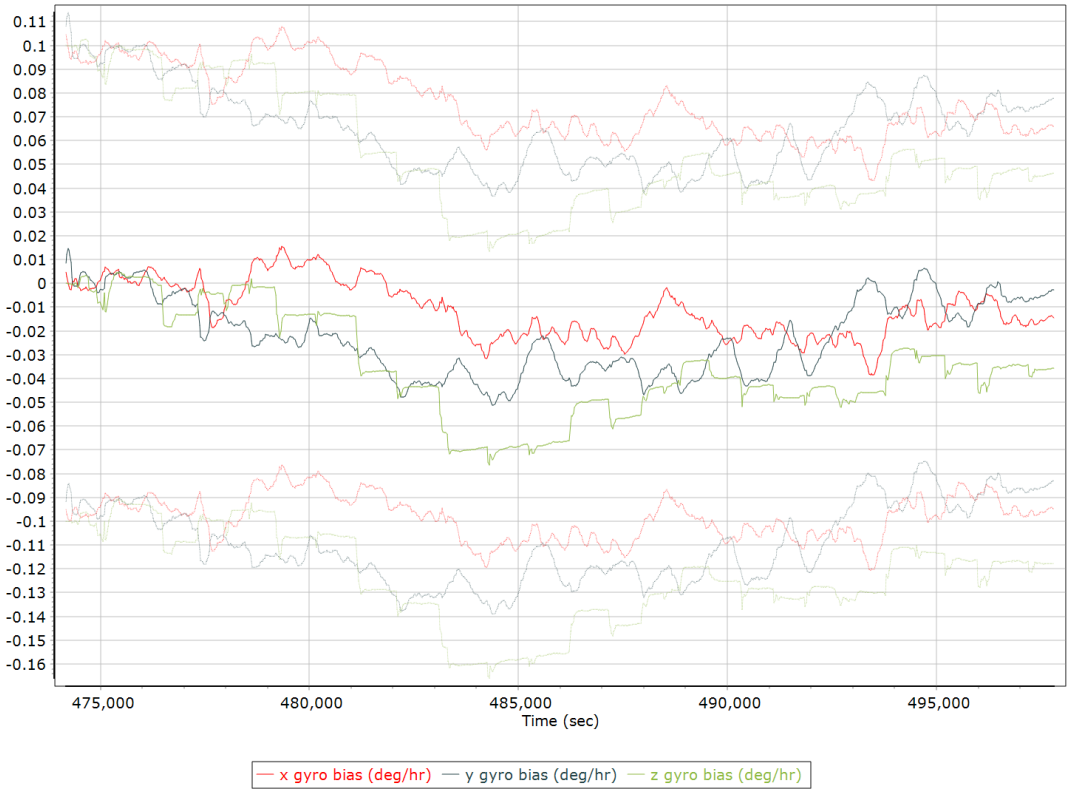
X Accelerometer Scale Error (ppm)

Y Accelerometer Scale Error (ppm)

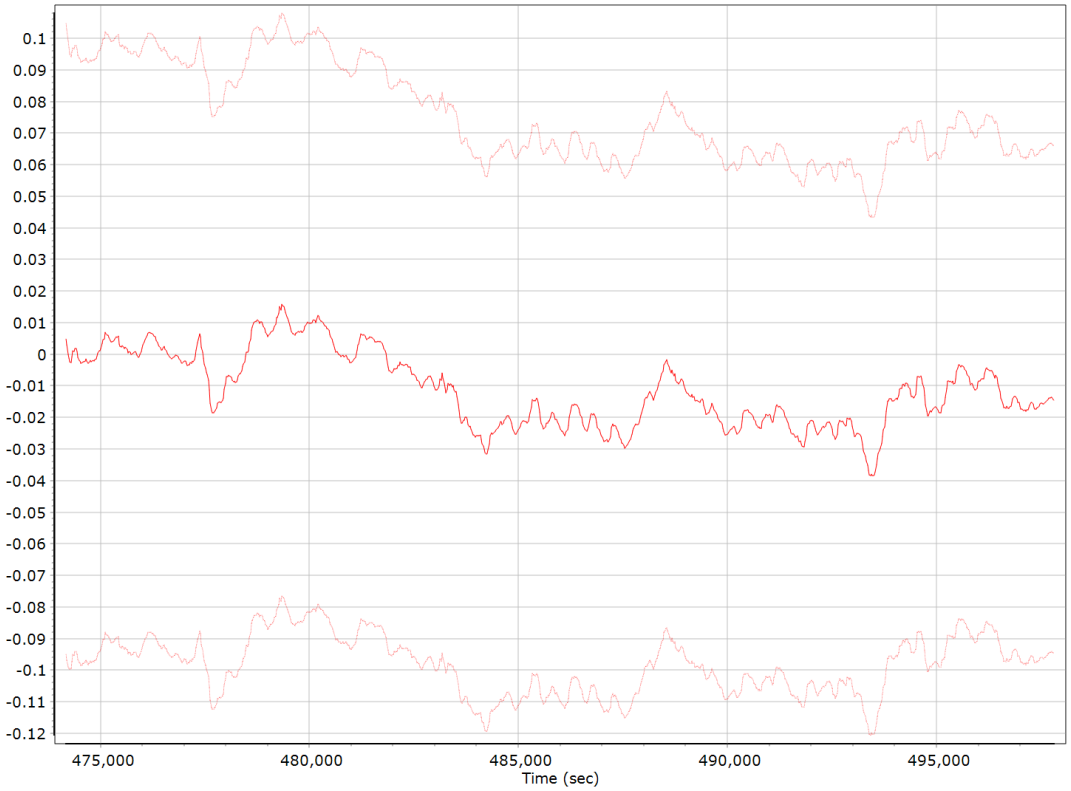


Z Accelerometer Scale Error (ppm)

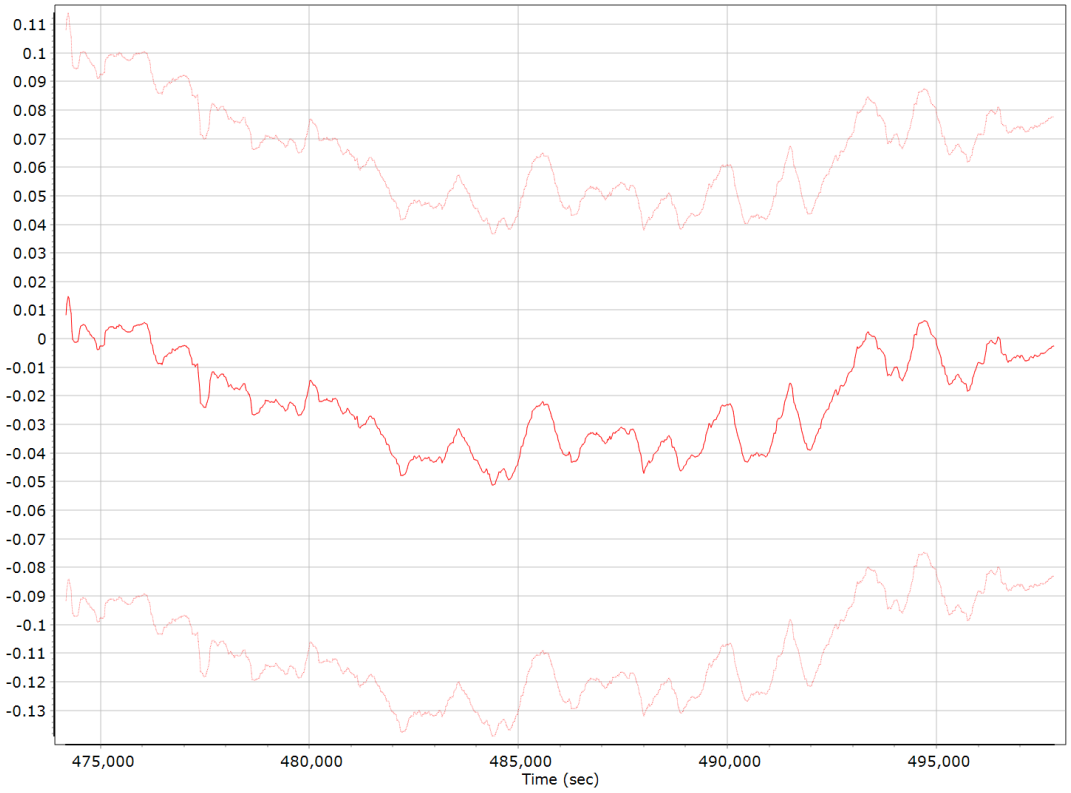
Gyro Bias (deg/h)



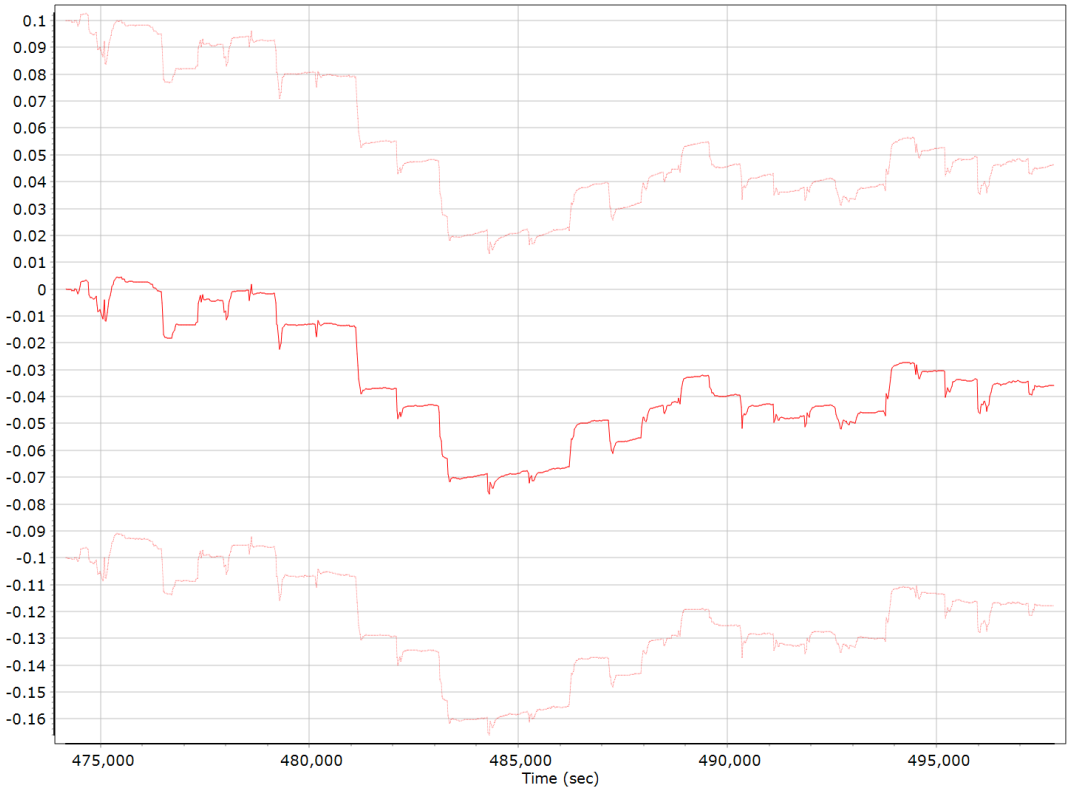
X Gyro Bias (deg/h)



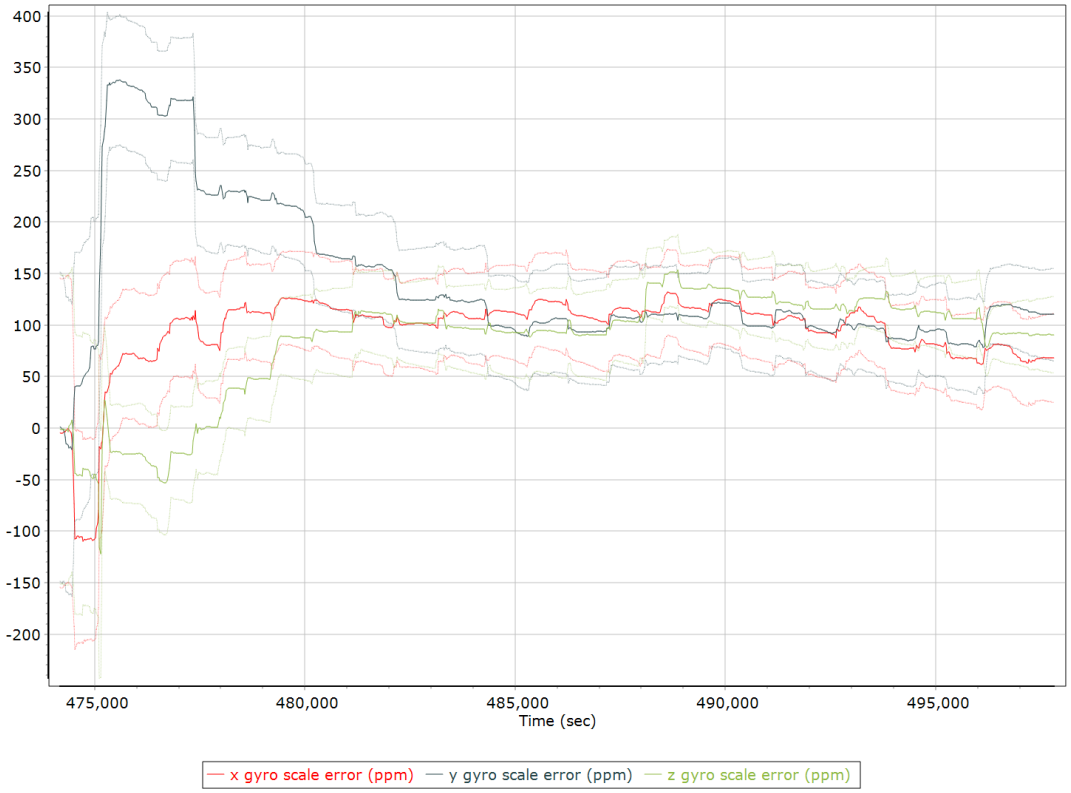
Y Gyro Bias (deg/h)



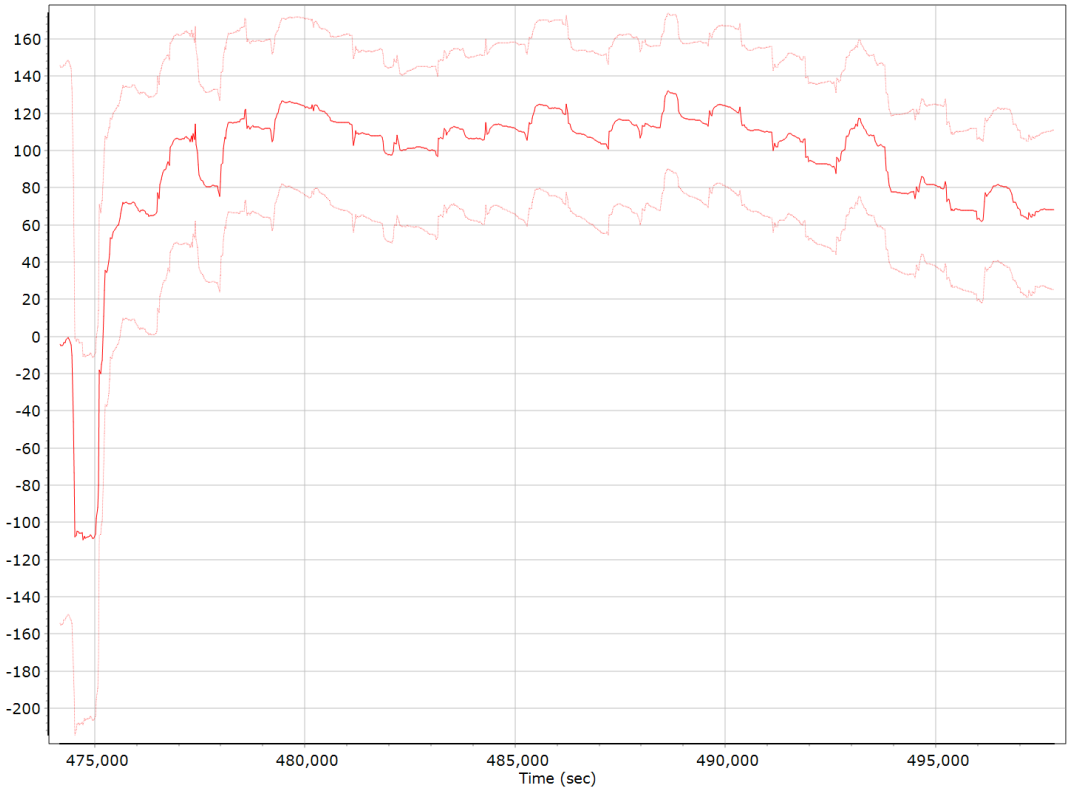
Z Gyro Bias (deg/h)



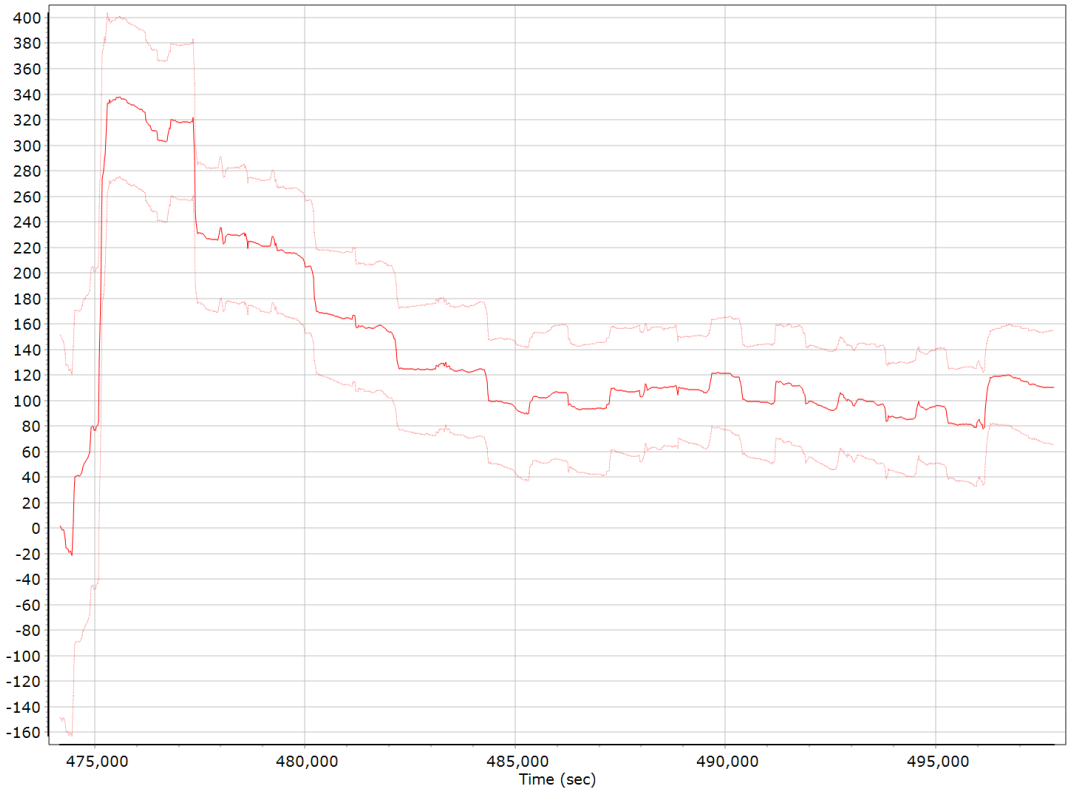
Gyro Scale Error (ppm)



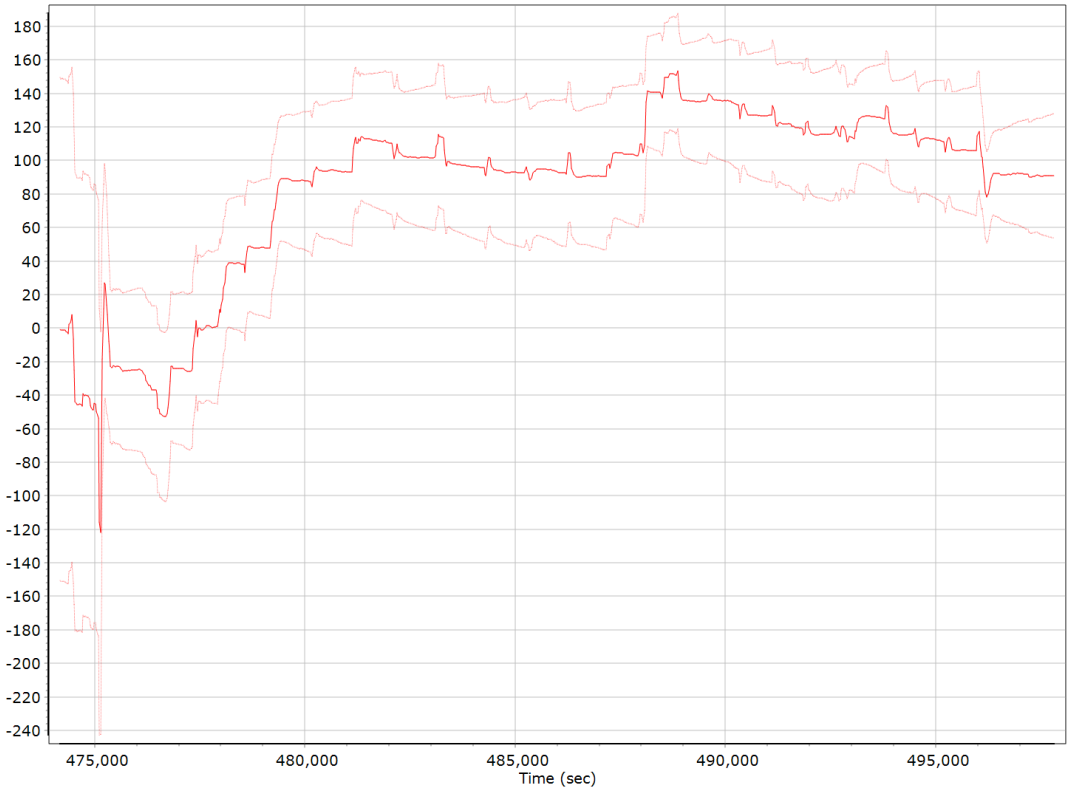
X Gyro Scale Error (ppm)



Y Gyro Scale Error (ppm)

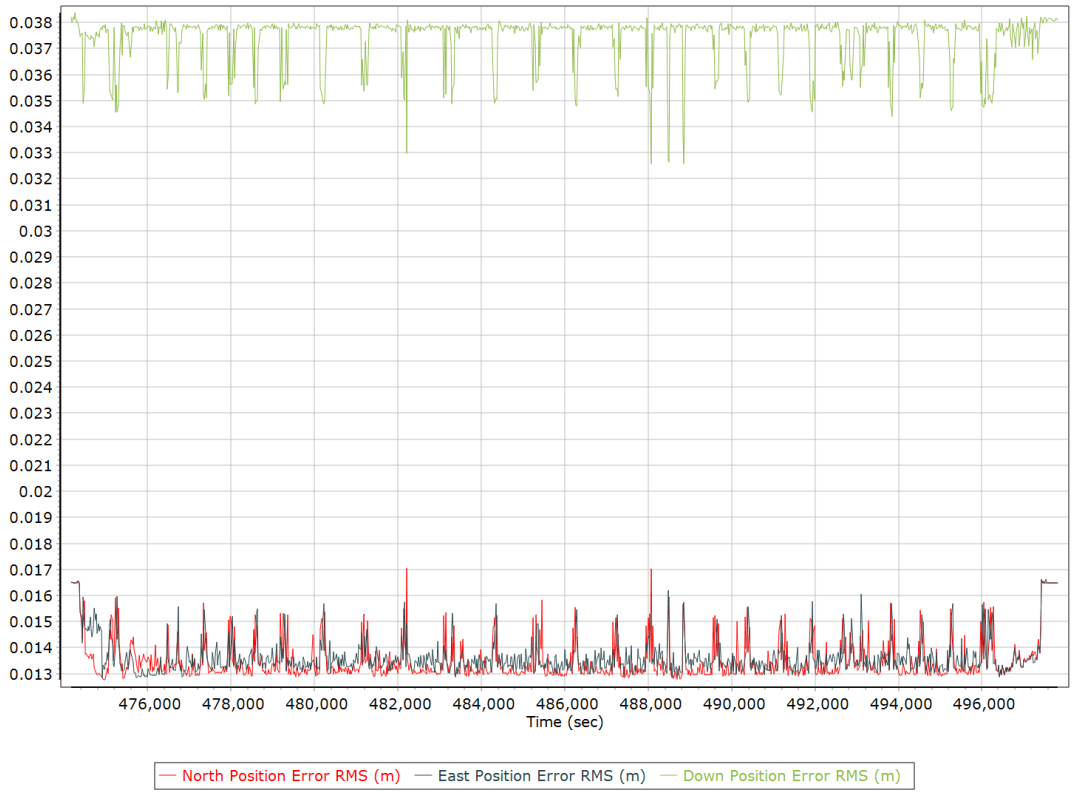


Z Gyro Scale Error (ppm)

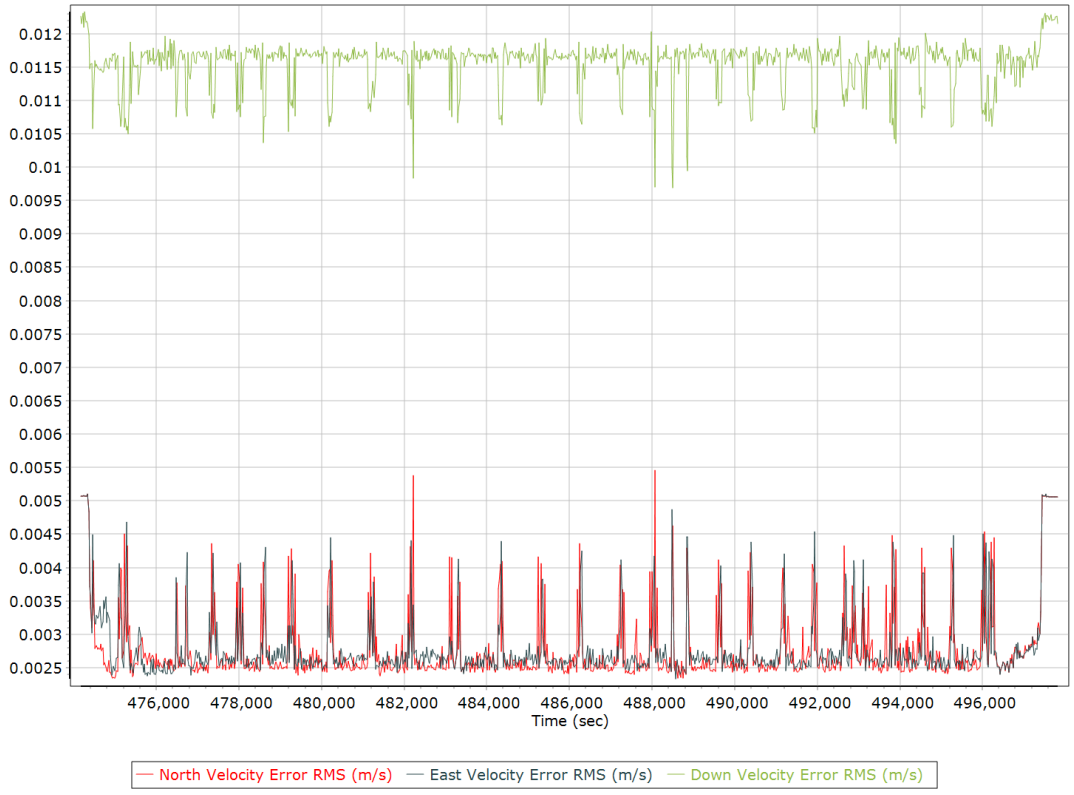


Smoothed Performance Metrics

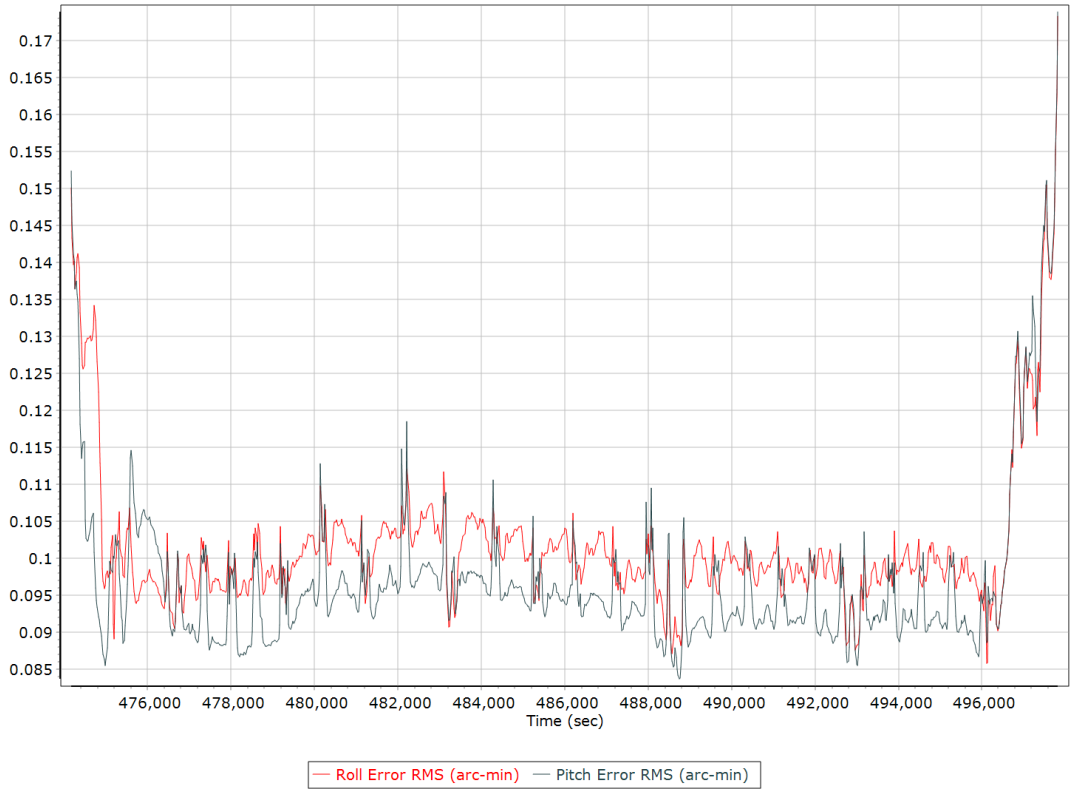
Position Error RMS (m)



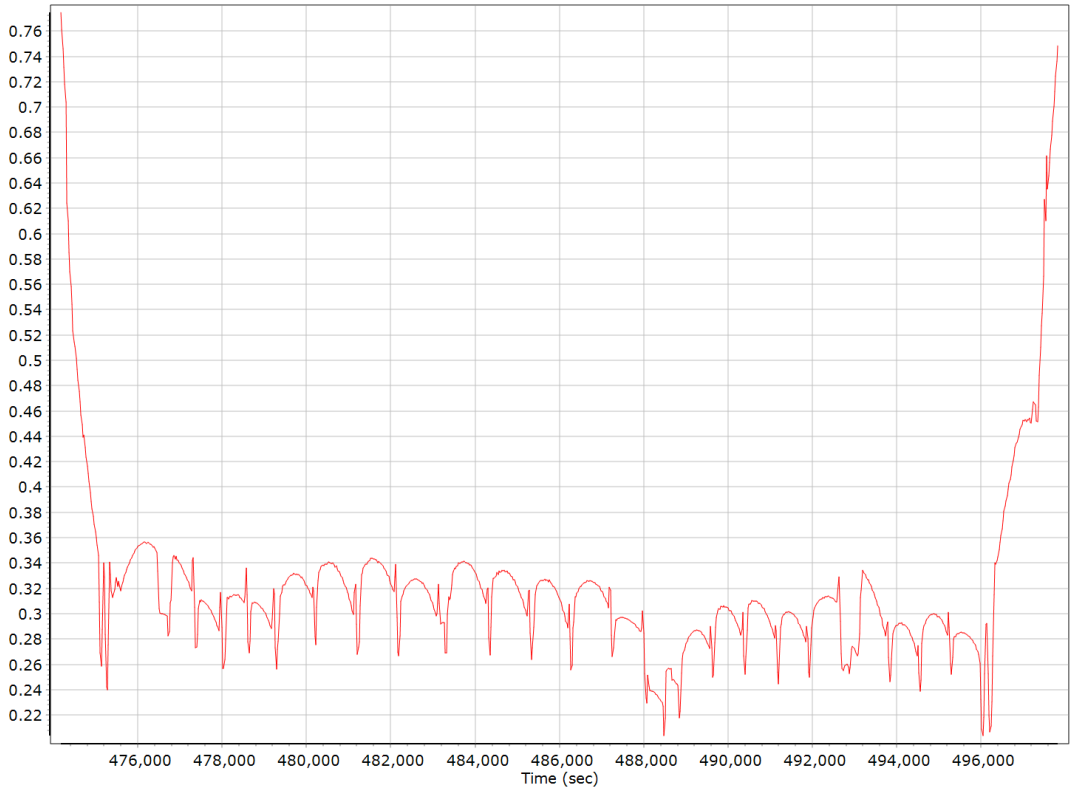
Velocity Error RMS (m/s)



Roll/Pitch Error RMS (arc-min)

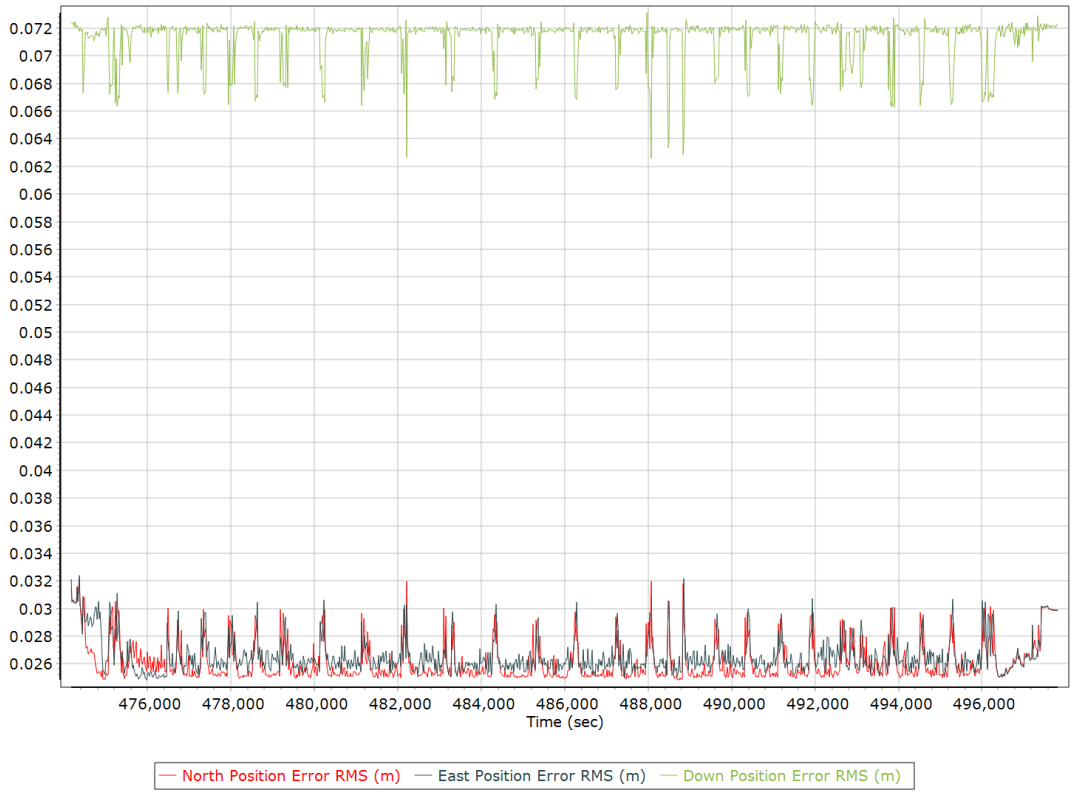


Heading Error RMS (arc-min)

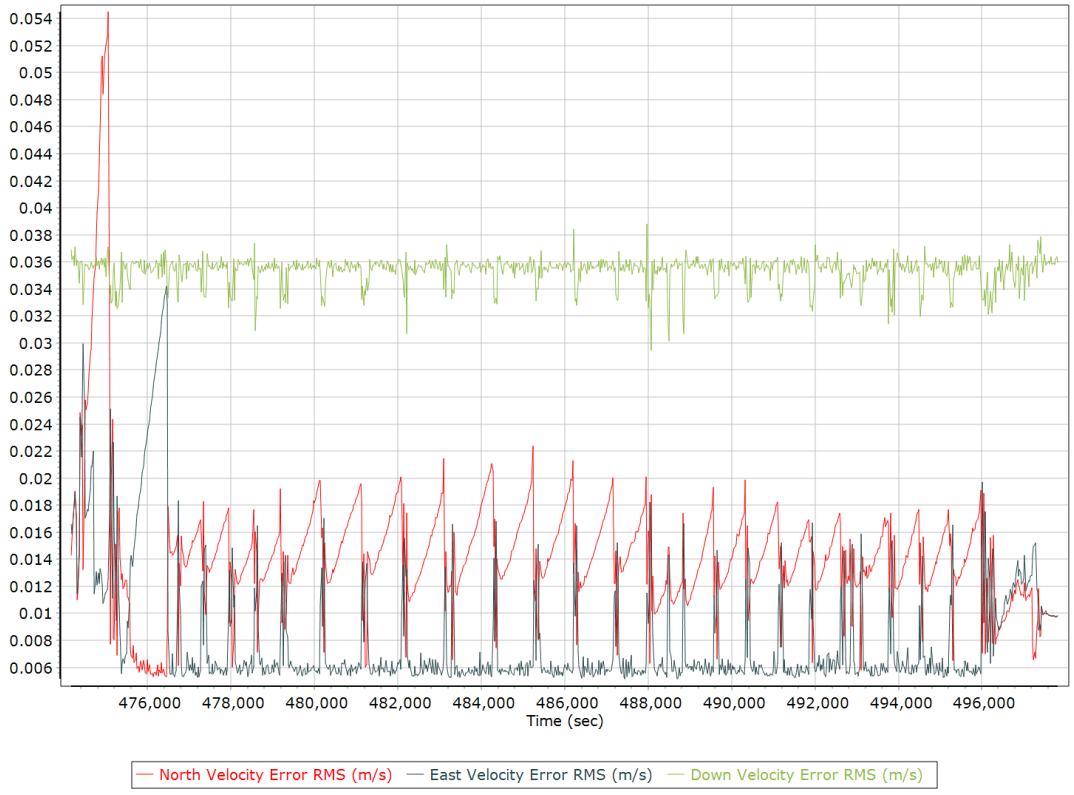


Forward Processed Performance Metrics

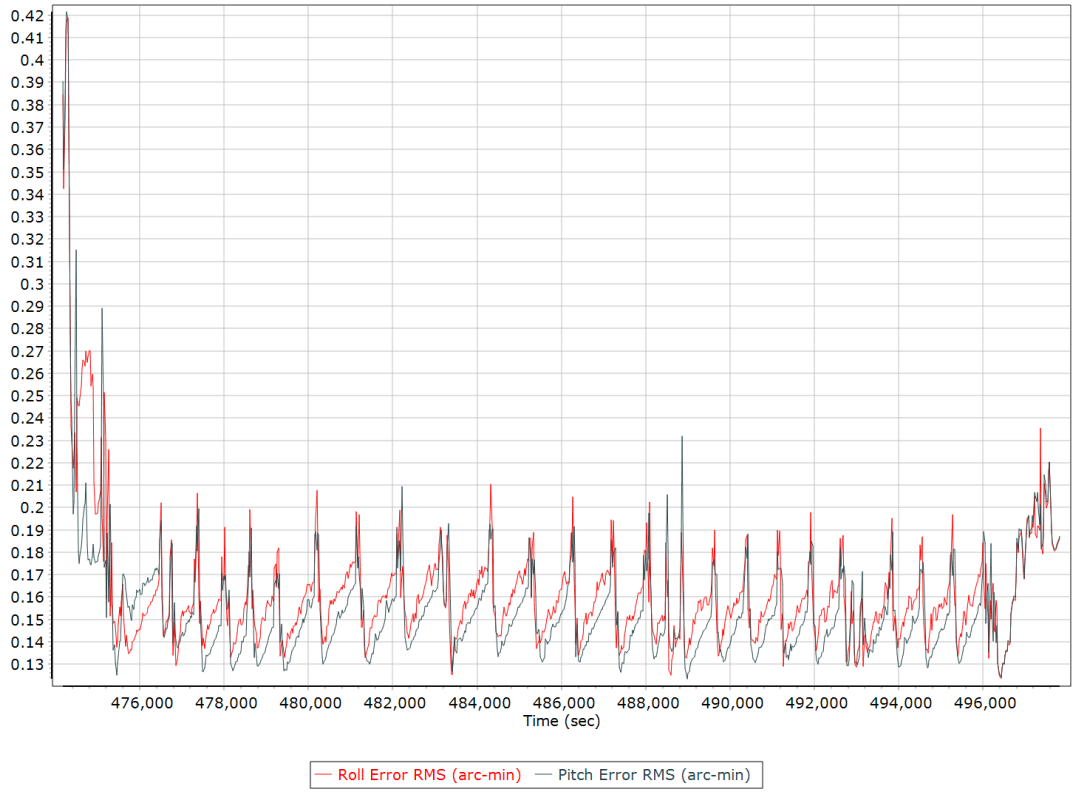
Position Error RMS (m)



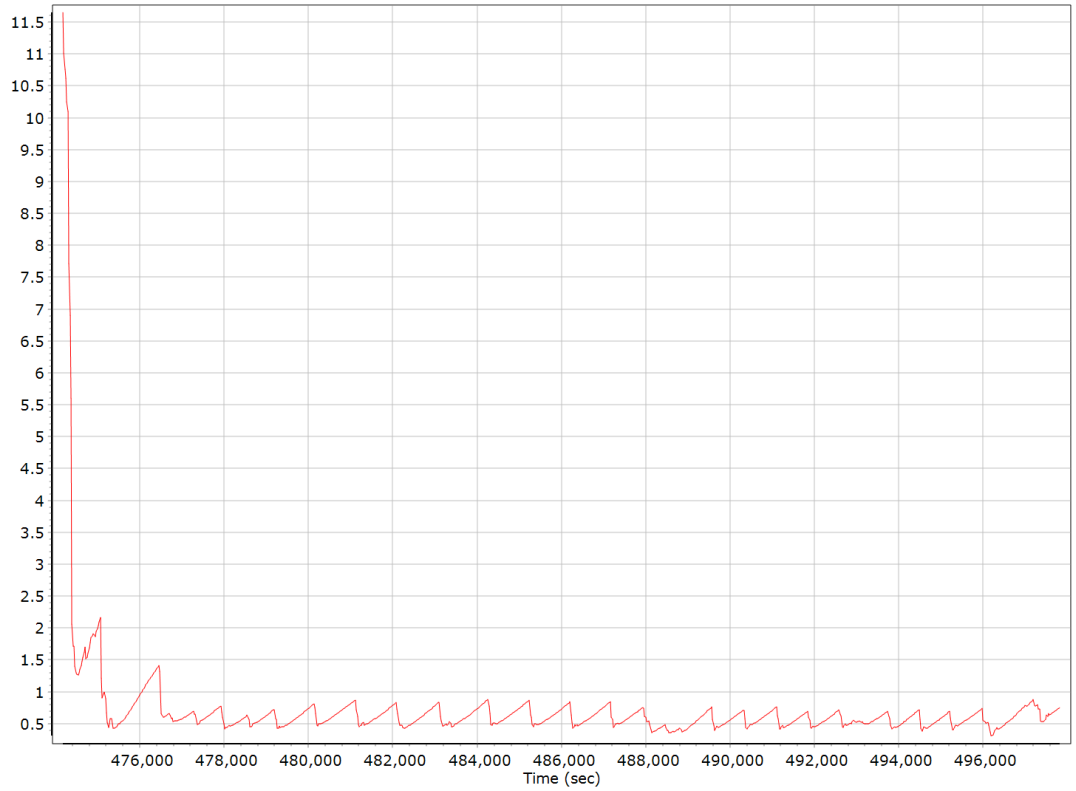
Velocity Error RMS (m/s)



Roll/Pitch Error RMS (arc-min)

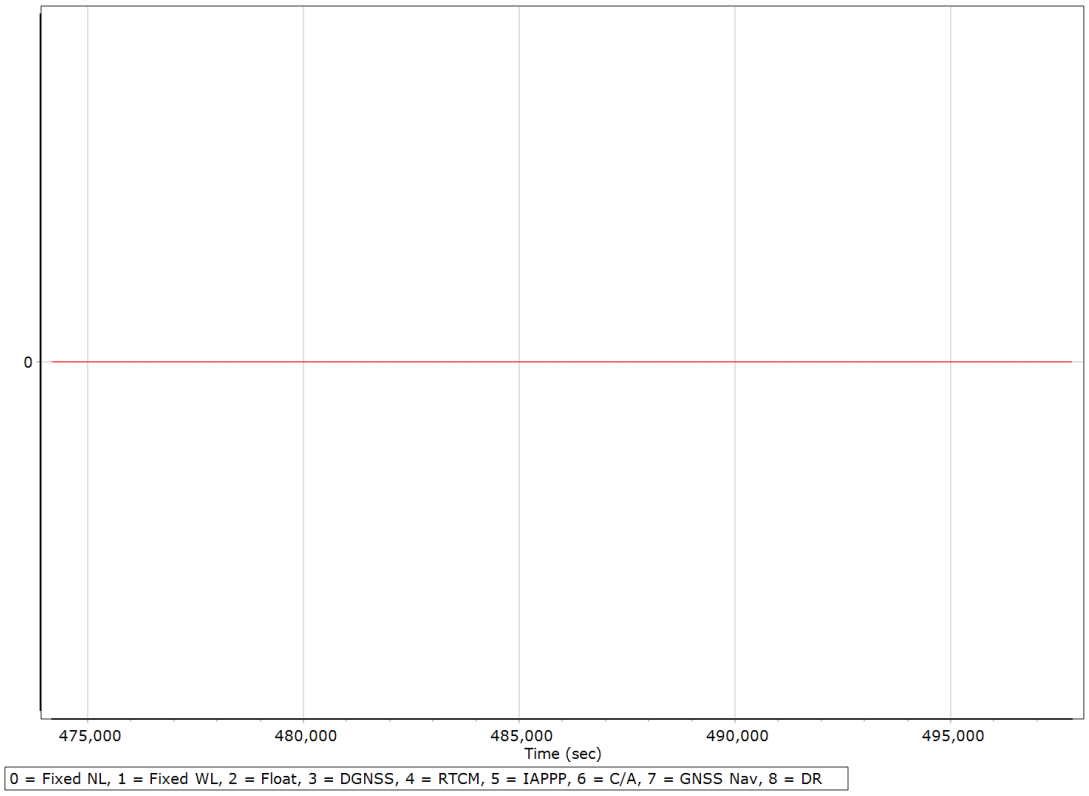


Heading Error RMS (arc-min)

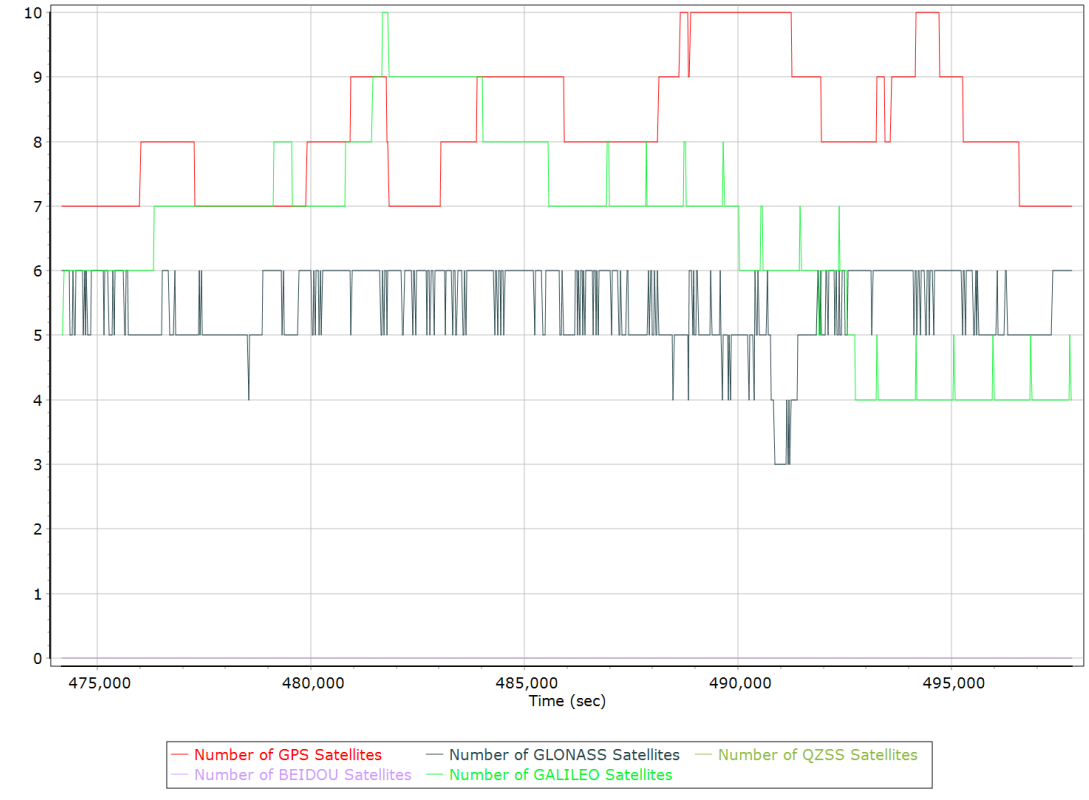


Forward Processed Solution Status

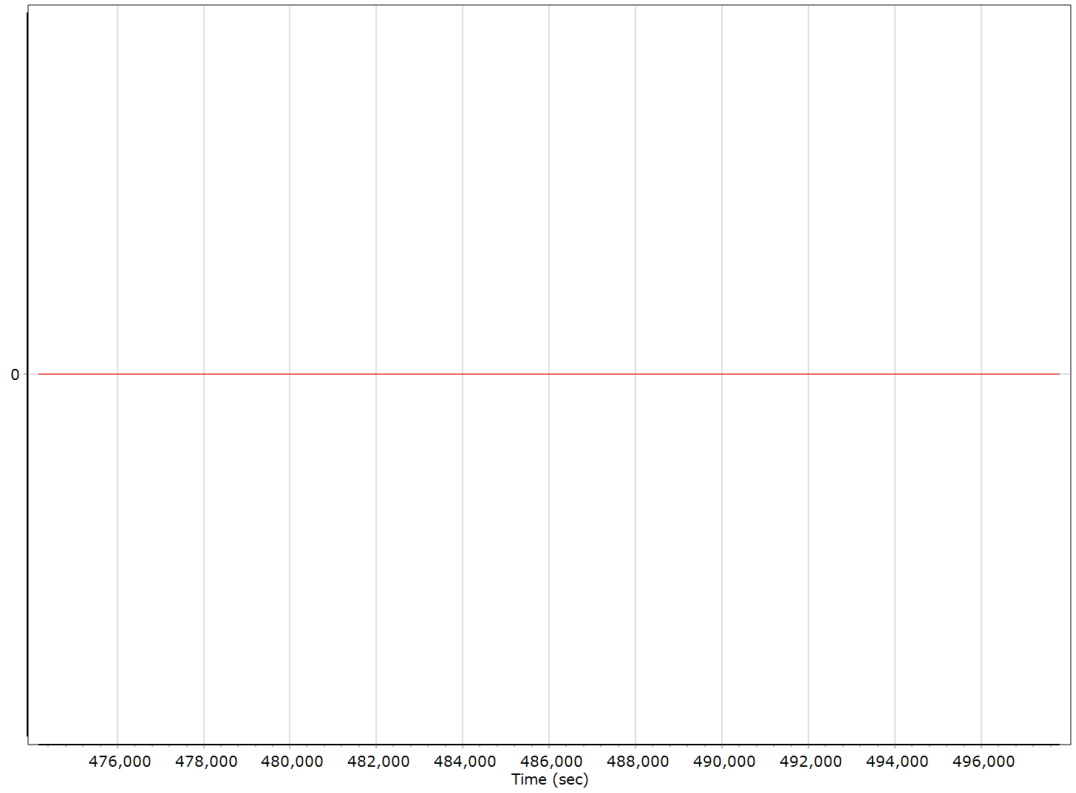
Processing Mode



Number of Satellites



Baseline Length



General Information

Mission Information

Project name	05072022A_3543
Processing date	2022-05-10 17:37:15
Mission date	2022-05-07 11:22:57
Mission duration	06:01:45.262
Processing mode	IN-Fusion PP-RTX

Rover Hardware Information

Product	POS AV 610 VER6 HW2.5-12
Serial number	S/N9683
IMU type	57
Receiver type	BD982
Antenna type	AV59

Project File List

Rover Data Files

File name	File type
220507_112238_INS-GPS_1.raw	POS Data

Input Files

File Name	File Type
Ephm1270.22g	GLONASS Broadcast Ephemeris
Ephm1270.22n	GPS Broadcast Ephemeris

Output Files

Filename	File type
sbet_05072022A_3543.out	SBET Trajectory File

Rover Data Summary

First raw data file	220507_112238_INS-GPS_1.raw		
Last raw data file	220507_112238_INS-GPS_1.raw		
Start GPS week	2208		
Start time	559358.612 (5/7/2022 11:22:38 AM)		
End time	581063.874 (5/7/2022 5:24:23 PM)		
Start of fine alignment	559714.700 (5/7/2022 11:28:34 AM)		
Available subsystems	Primary GNSS, Gimbal, IMU		
POS Event Input	None		
Correction data	None		
IMU Installation Lever Arms & Mounting Angles			
Gimbal to IMU lever arm (m)	-0.034	-0.010	-0.374
Gimbal to IMU mounting angles (deg)	0.000	0.000	0.000
Gimbal to Primary GNSS lever arm (m)	0.717	-0.178	-1.265
Gimbal to Primary GNSS lever arm std dev (m)	-1.000		
Aircraft to Reference mounting angles (deg)	0.000	0.000	0.000

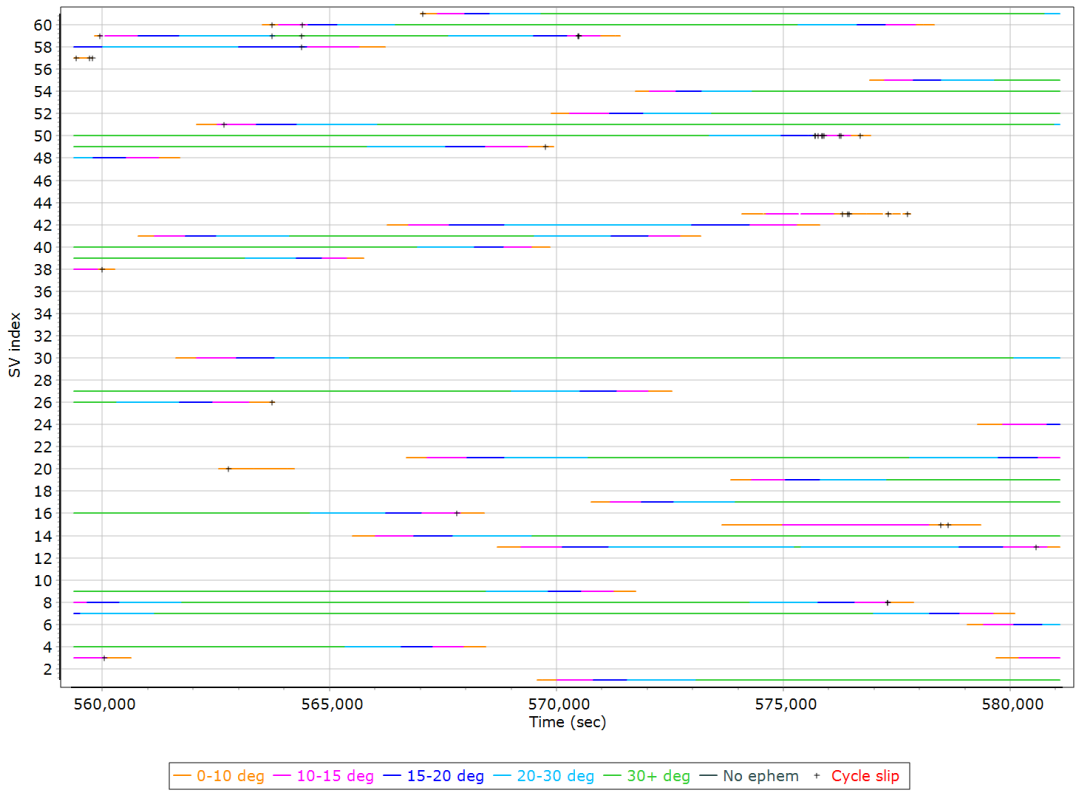
Rover Data QC

Raw IMU Import QC Summary

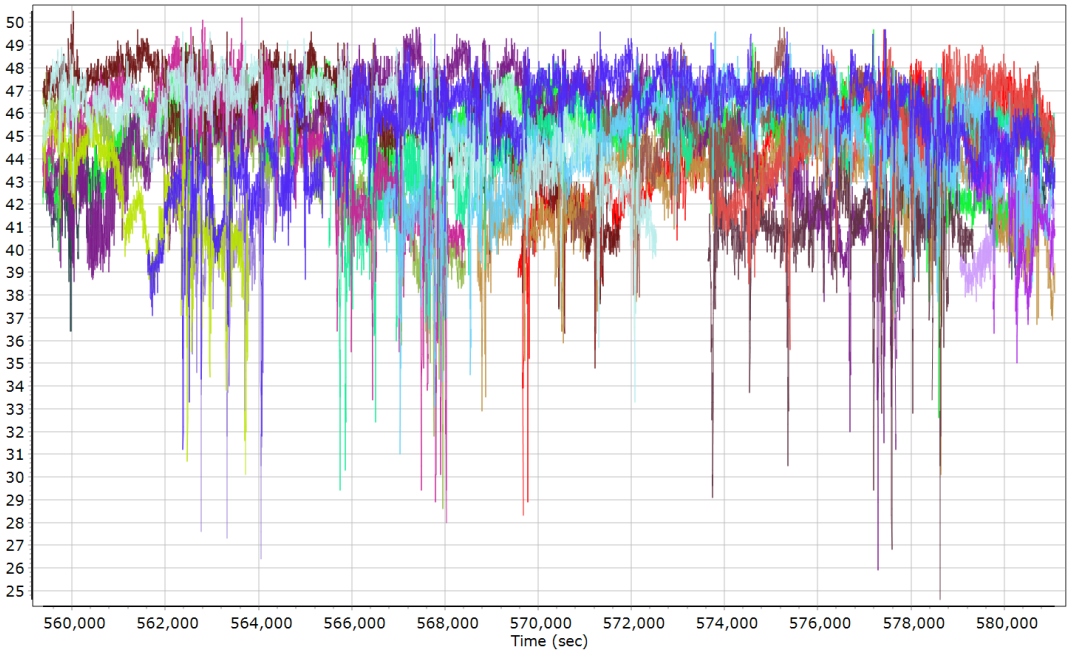
IMU data input file	imu_Mission 1.dat
IMU data check log file	imudt_05072022A_3543.log
IMU Records Processed	4340440
Termination Status	Normal
IMU Anomalies	0

Primary Observables & Satellite Data

GPS/GLONASS L1 Satellite Lock/Elevation

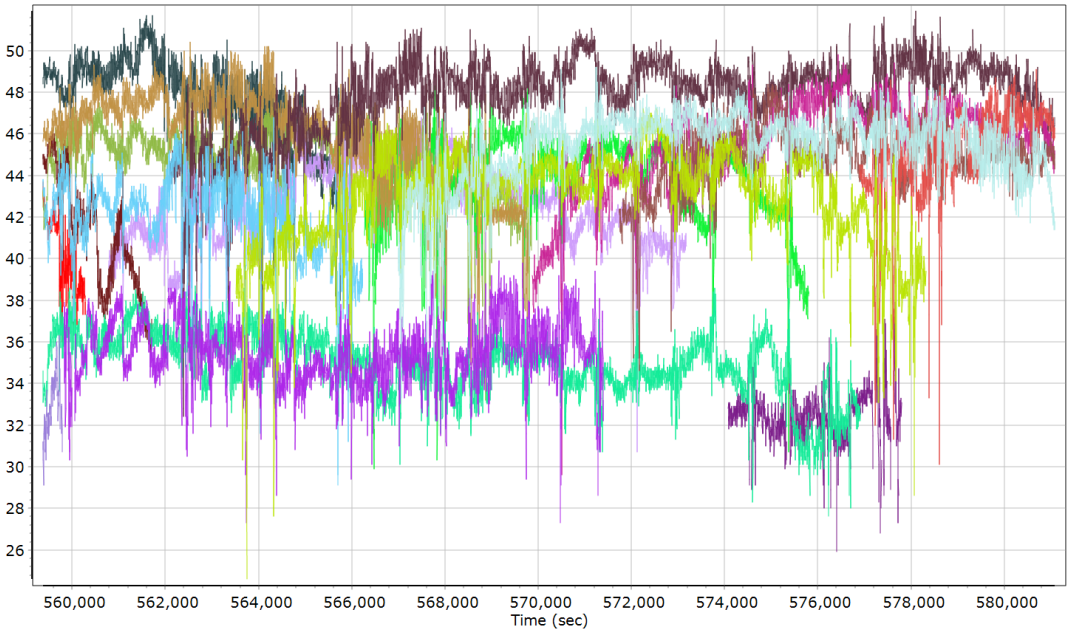


GPS L1 SNR



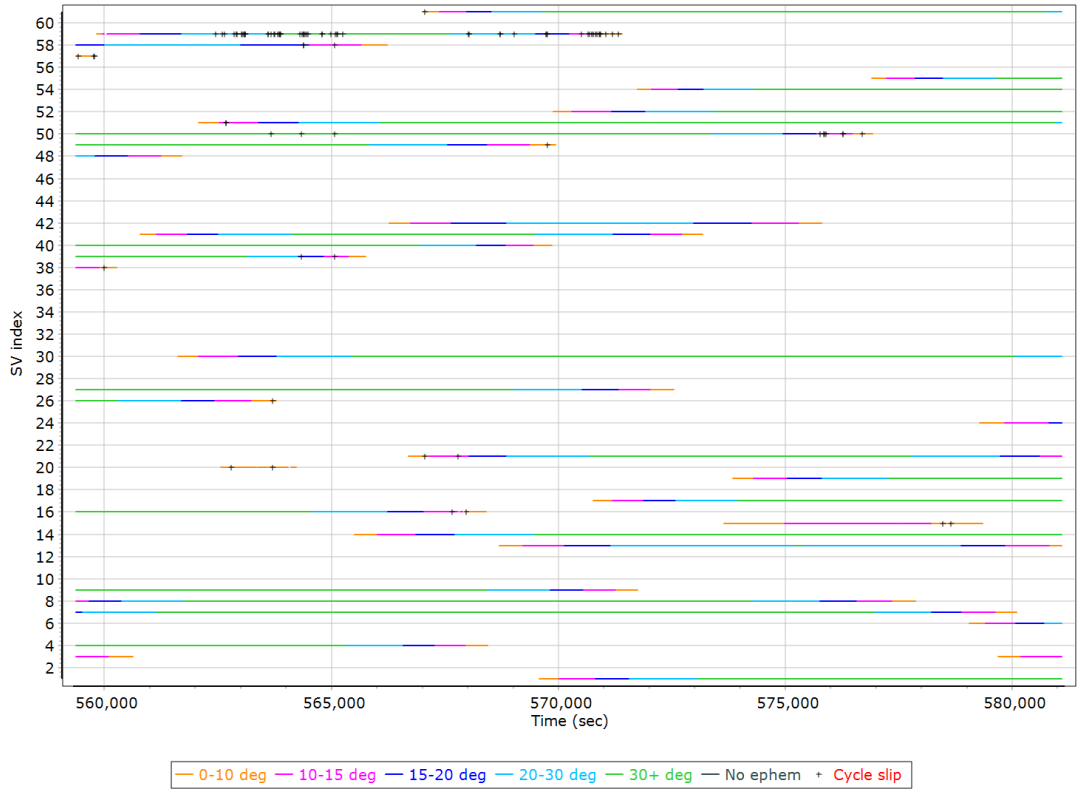
GPS PRN 01 L1 SNR (dB/Hz) GPS PRN 03 L1 SNR (dB/Hz) GPS PRN 04 L1 SNR (dB/Hz) GPS PRN 06 L1 SNR (dB/Hz)
GPS PRN 07 L1 SNR (dB/Hz) GPS PRN 08 L1 SNR (dB/Hz) GPS PRN 09 L1 SNR (dB/Hz) GPS PRN 13 L1 SNR (dB/Hz)
GPS PRN 14 L1 SNR (dB/Hz) GPS PRN 15 L1 SNR (dB/Hz) GPS PRN 16 L1 SNR (dB/Hz) GPS PRN 17 L1 SNR (dB/Hz)
GPS PRN 19 L1 SNR (dB/Hz) GPS PRN 20 L1 SNR (dB/Hz) GPS PRN 21 L1 SNR (dB/Hz) GPS PRN 24 L1 SNR (dB/Hz)
GPS PRN 26 L1 SNR (dB/Hz) GPS PRN 27 L1 SNR (dB/Hz) GPS PRN 30 L1 SNR (dB/Hz)

GLONASS L1 SNR

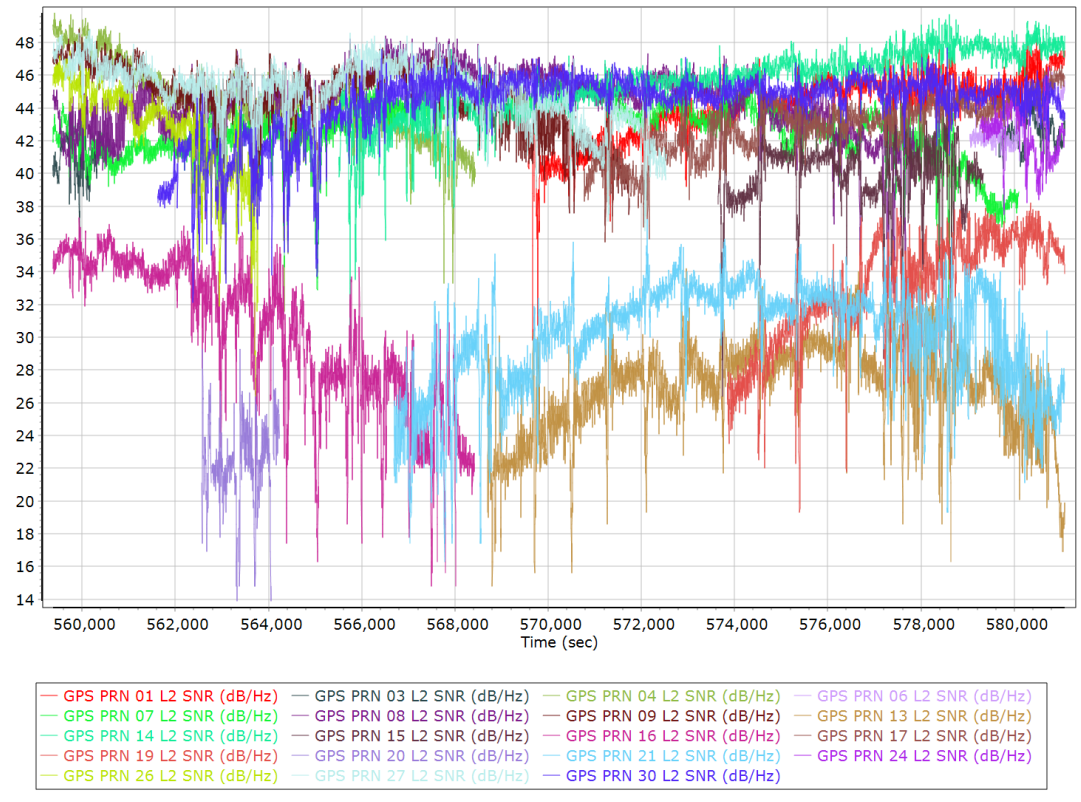


GLONASS 01 L1 SNR (dB/Hz) GLONASS 02 L1 SNR (dB/Hz) GLONASS 03 L1 SNR (dB/Hz)
GLONASS 04 L1 SNR (dB/Hz) GLONASS 05 L1 SNR (dB/Hz) GLONASS 06 L1 SNR (dB/Hz)
GLONASS 11 L1 SNR (dB/Hz) GLONASS 12 L1 SNR (dB/Hz) GLONASS 13 L1 SNR (dB/Hz)
GLONASS 14 L1 SNR (dB/Hz) GLONASS 15 L1 SNR (dB/Hz) GLONASS 17 L1 SNR (dB/Hz)
GLONASS 18 L1 SNR (dB/Hz) GLONASS 20 L1 SNR (dB/Hz) GLONASS 21 L1 SNR (dB/Hz)
GLONASS 22 L1 SNR (dB/Hz) GLONASS 23 L1 SNR (dB/Hz) GLONASS 24 L1 SNR (dB/Hz)

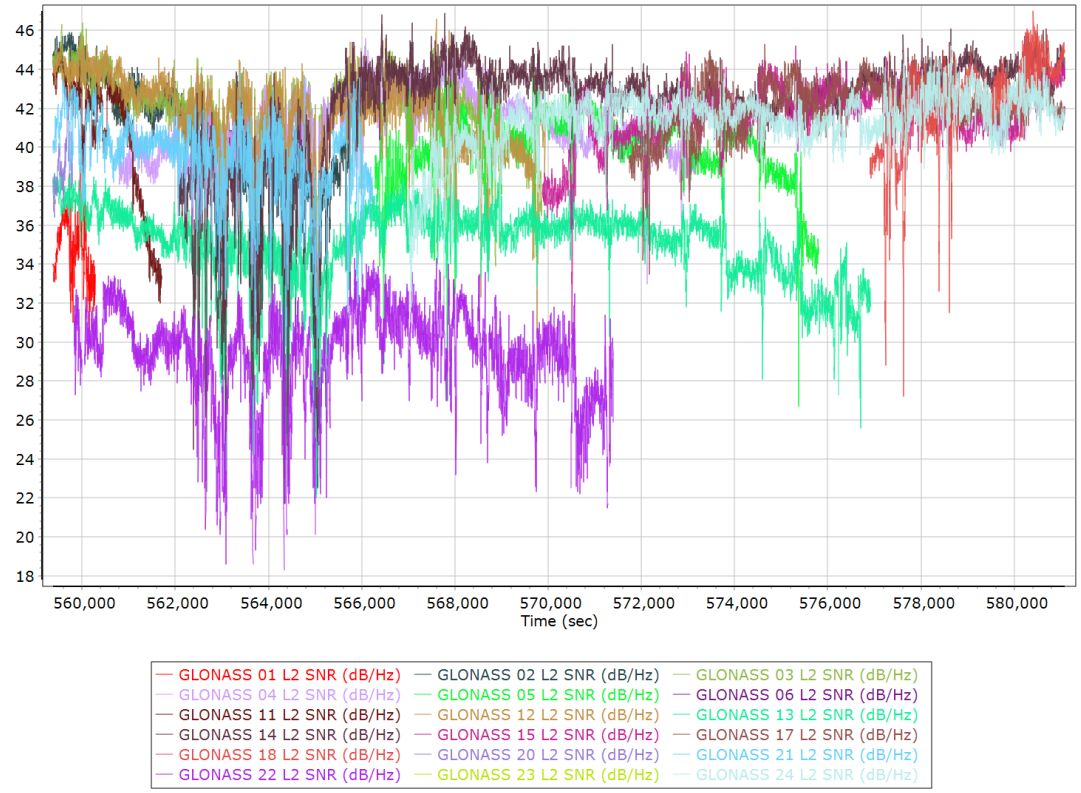
GPS/GLONASS L2 Satellite Lock/Elevation



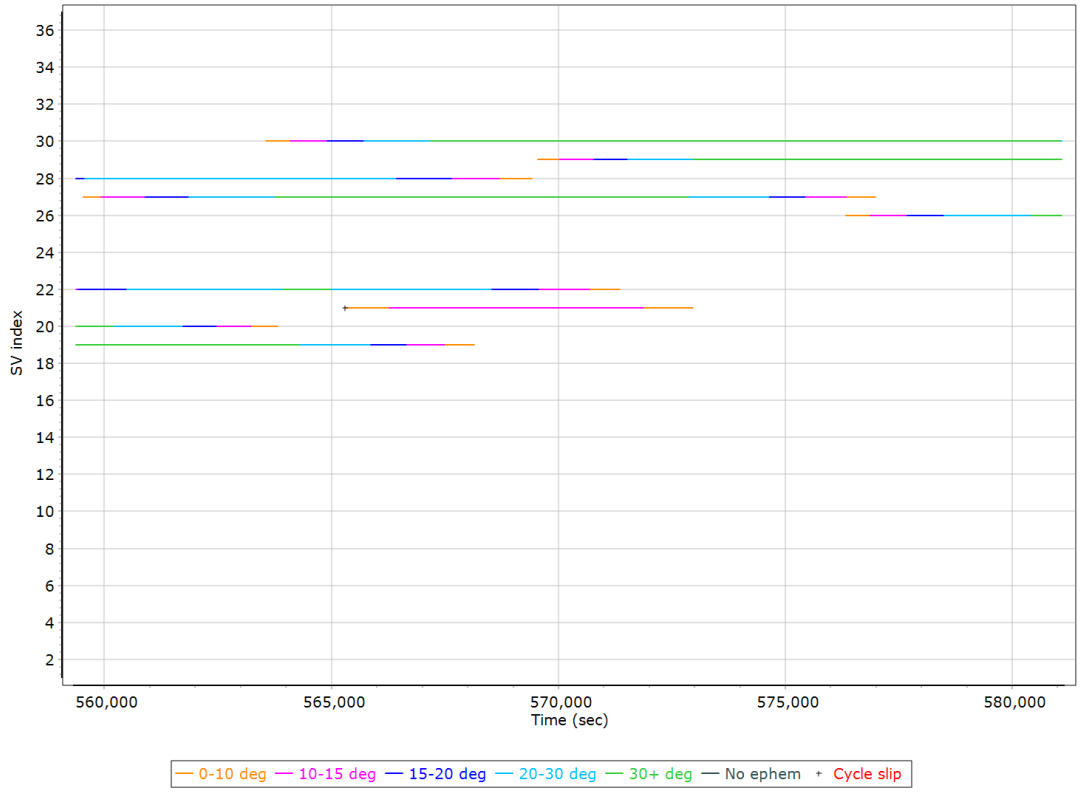
GPS L2 SNR



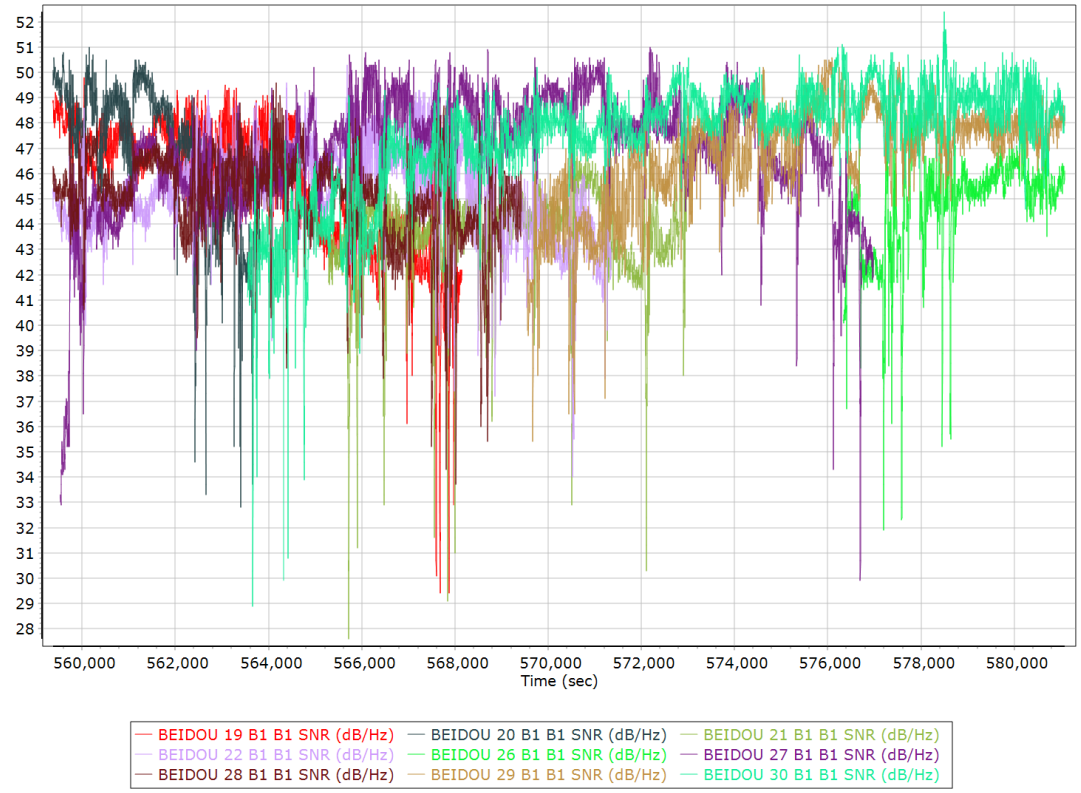
GLONASS L2 SNR



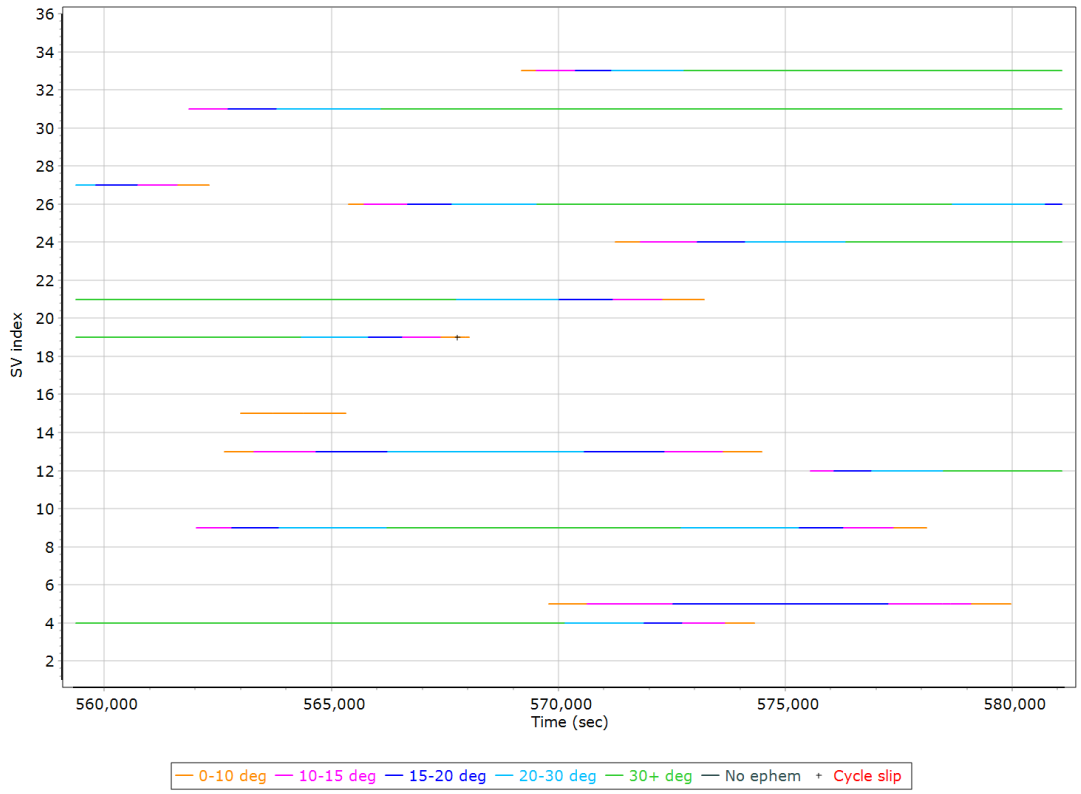
BEIDOU Satellite Lock/Elevation



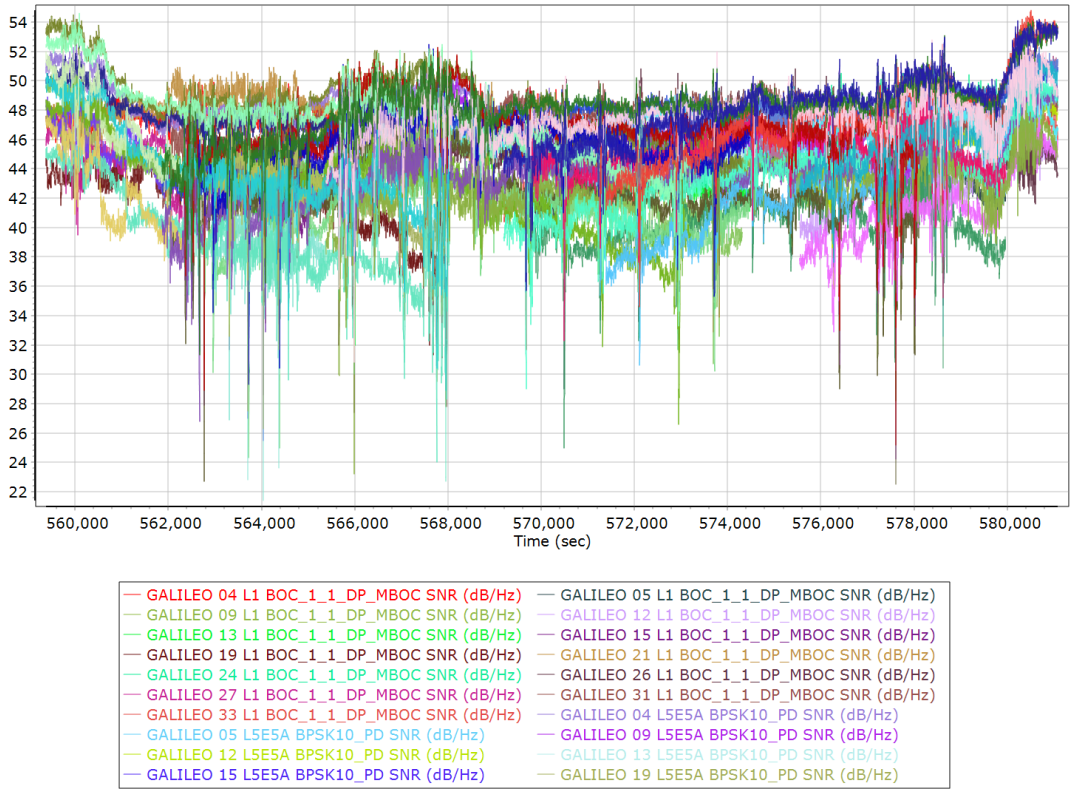
BEIDOU SNR



GALILEO Satellite Lock/Elevation

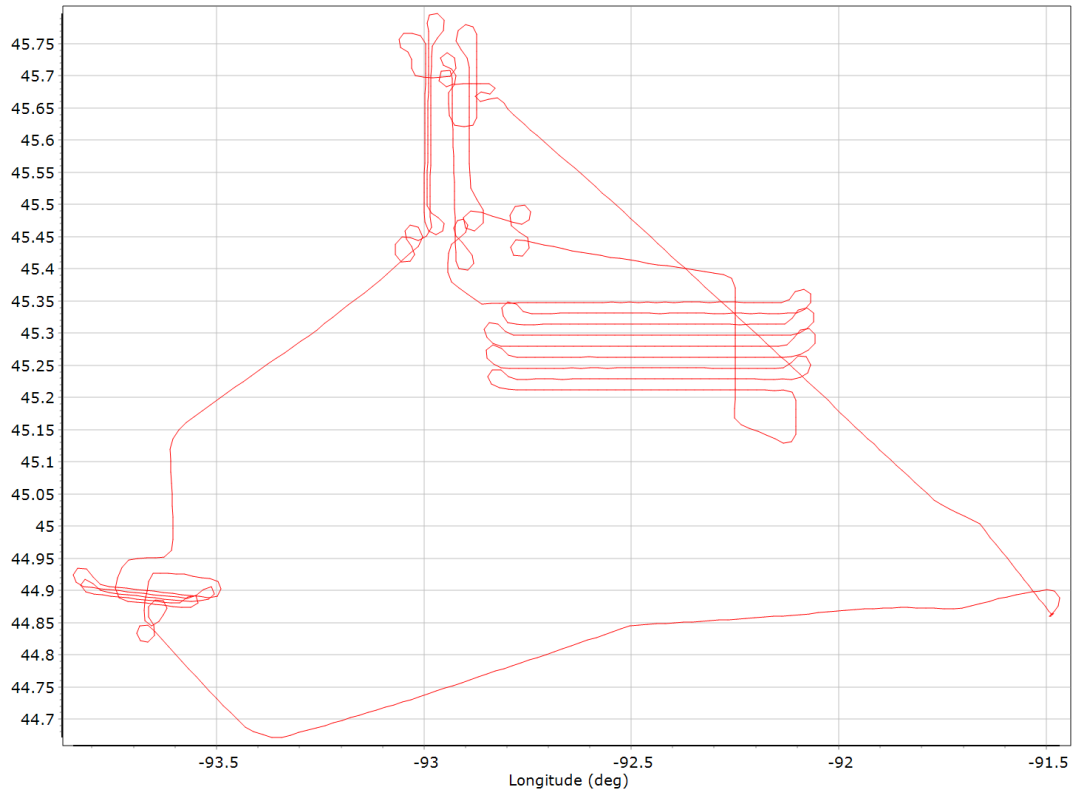


GALILEO SNR

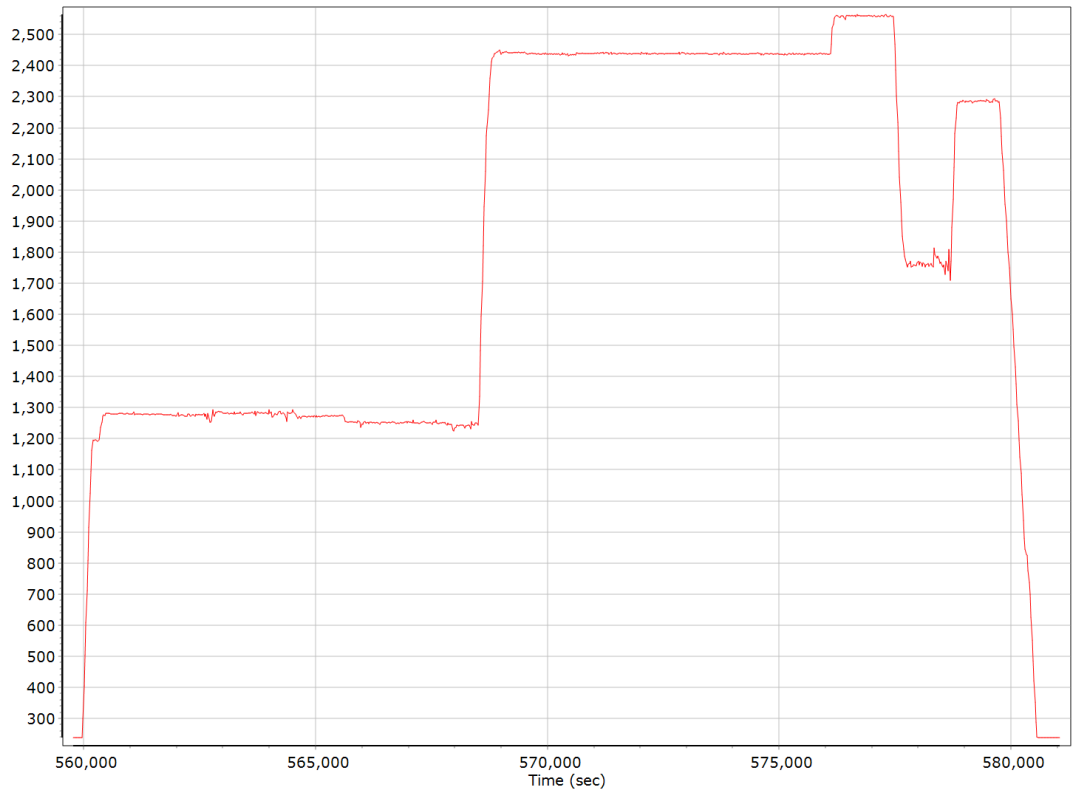

54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
560,000
562,000
564,000
566,000
568,000
570,000
572,000
574,000
576,000
578,000
580,000
Time (sec)
GALILEO 04 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 05 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 09 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 12 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 13 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 15 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 19 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 21 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 24 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 26 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 27 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 31 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 33 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 04 L5E5A BPSK10_PD SNR (dB/Hz)
GALILEO 05 L5E5A BPSK10_PD SNR (dB/Hz)
GALILEO 09 L5E5A BPSK10_PD SNR (dB/Hz)
GALILEO 12 L5E5A BPSK10_PD SNR (dB/Hz)
GALILEO 13 L5E5A BPSK10_PD SNR (dB/Hz)
GALILEO 15 L5E5A BPSK10_PD SNR (dB/Hz)
GALILEO 19 L5E5A BPSK10_PD SNR (dB/Hz)

Smoothed Trajectory Information

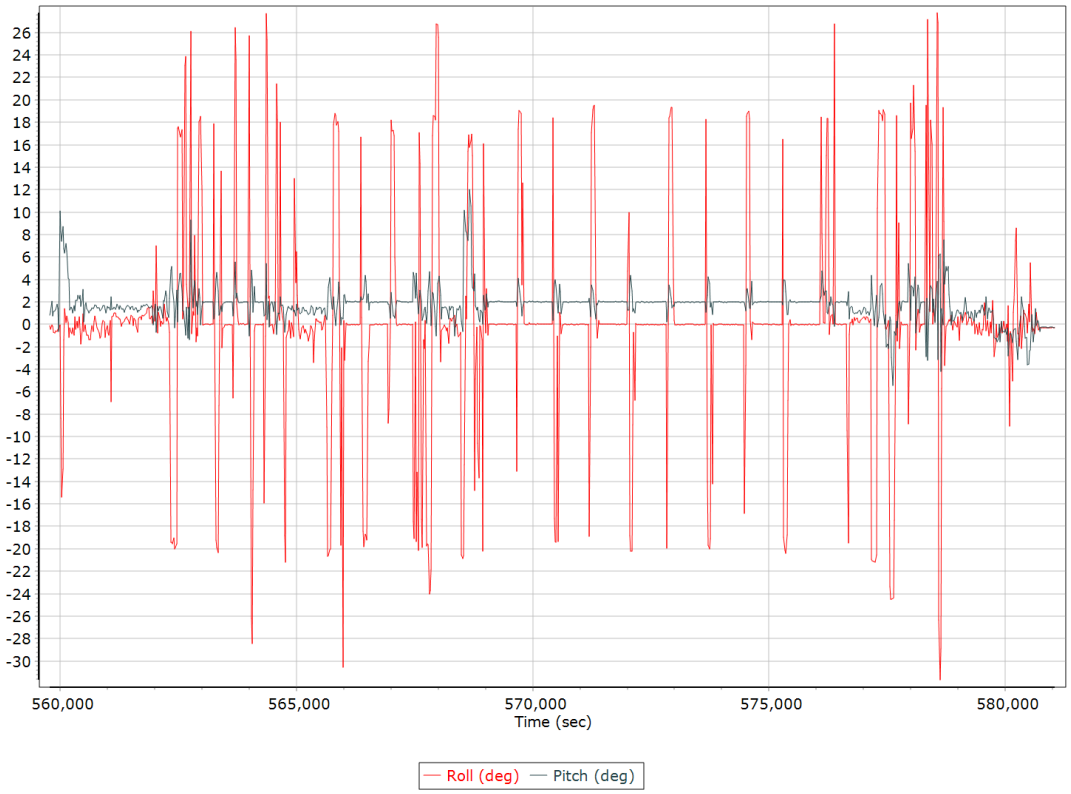
Top View



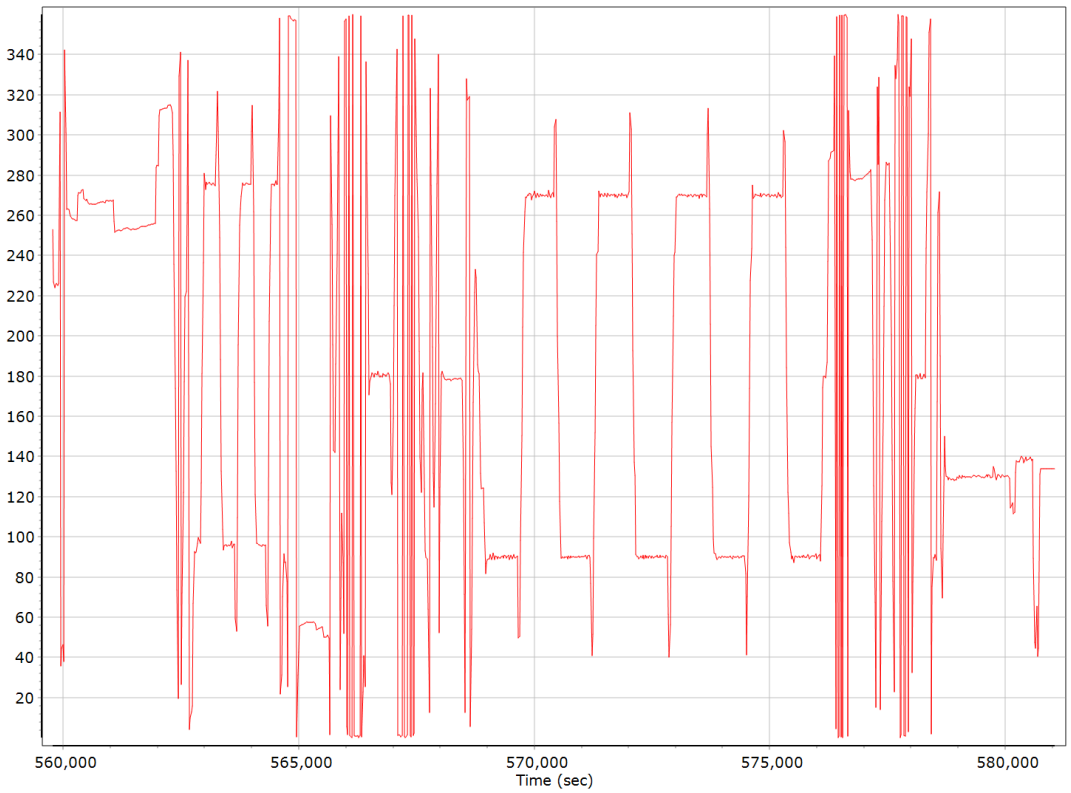
Altitude



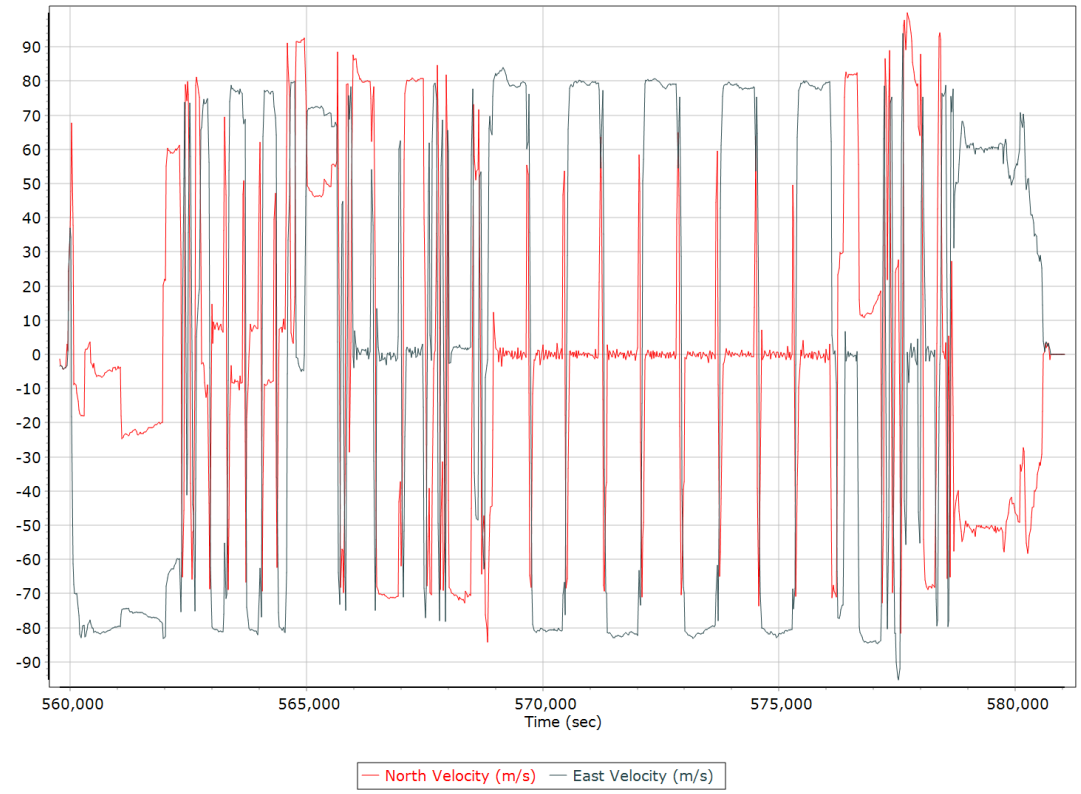
Roll/Pitch



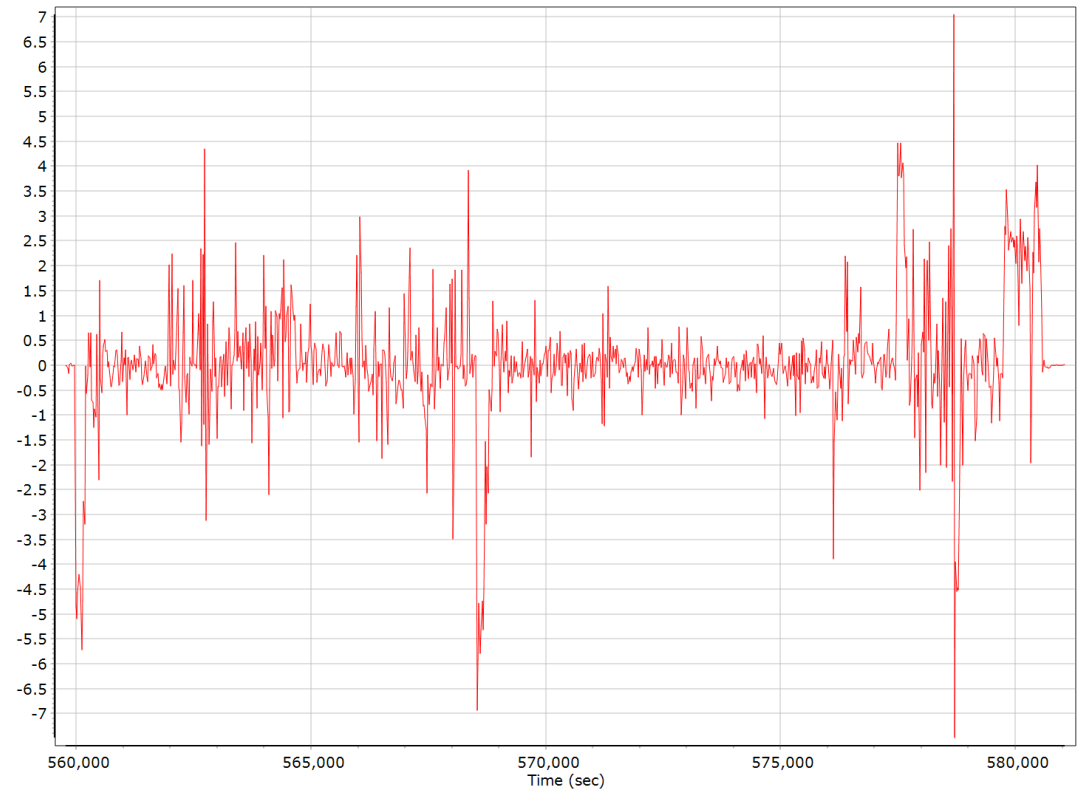
Heading



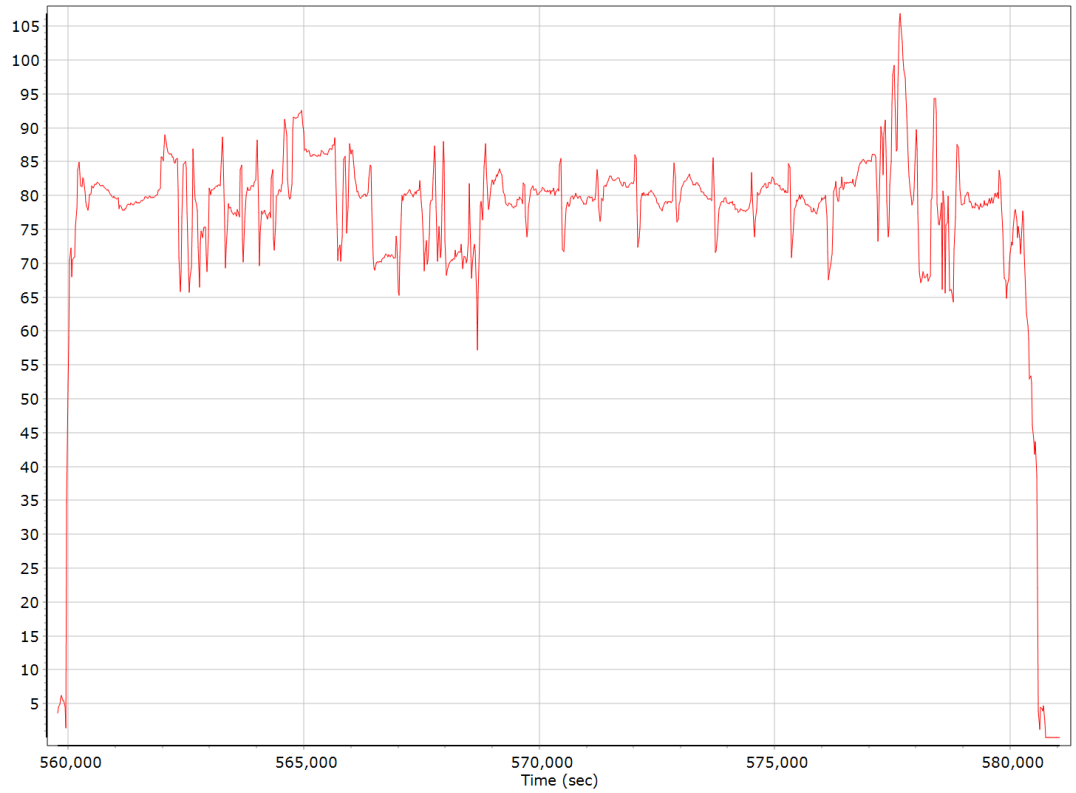
North/East Velocity



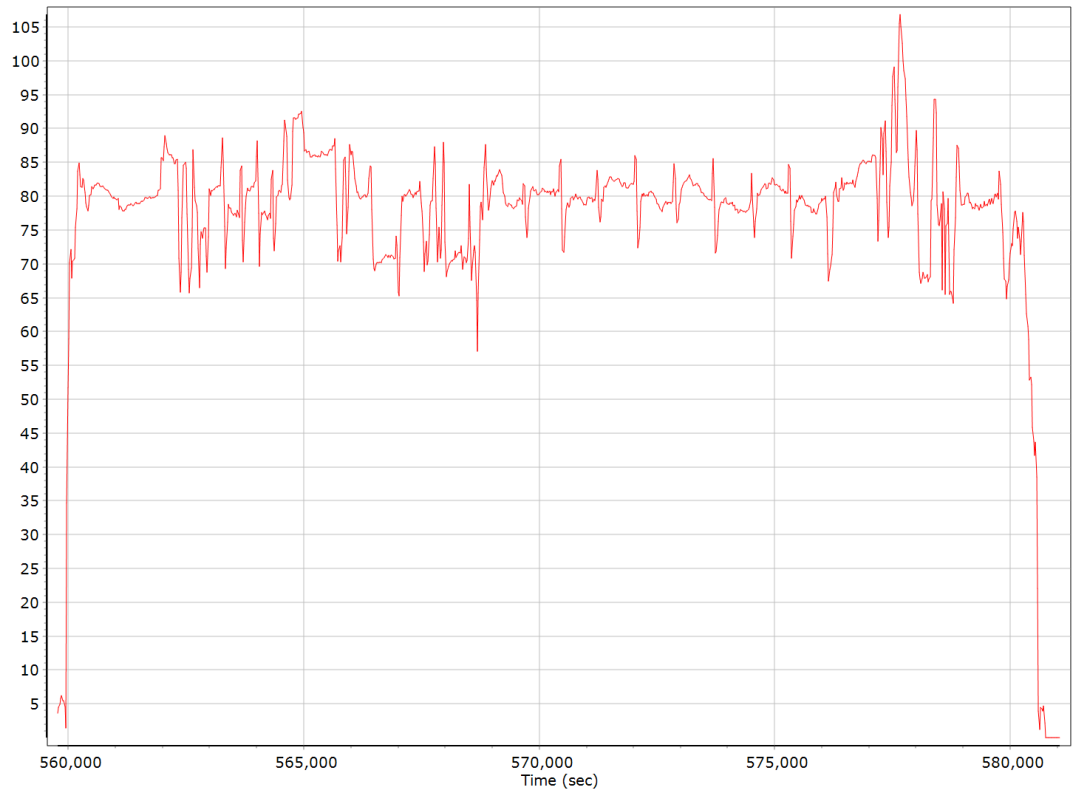
Down Velocity



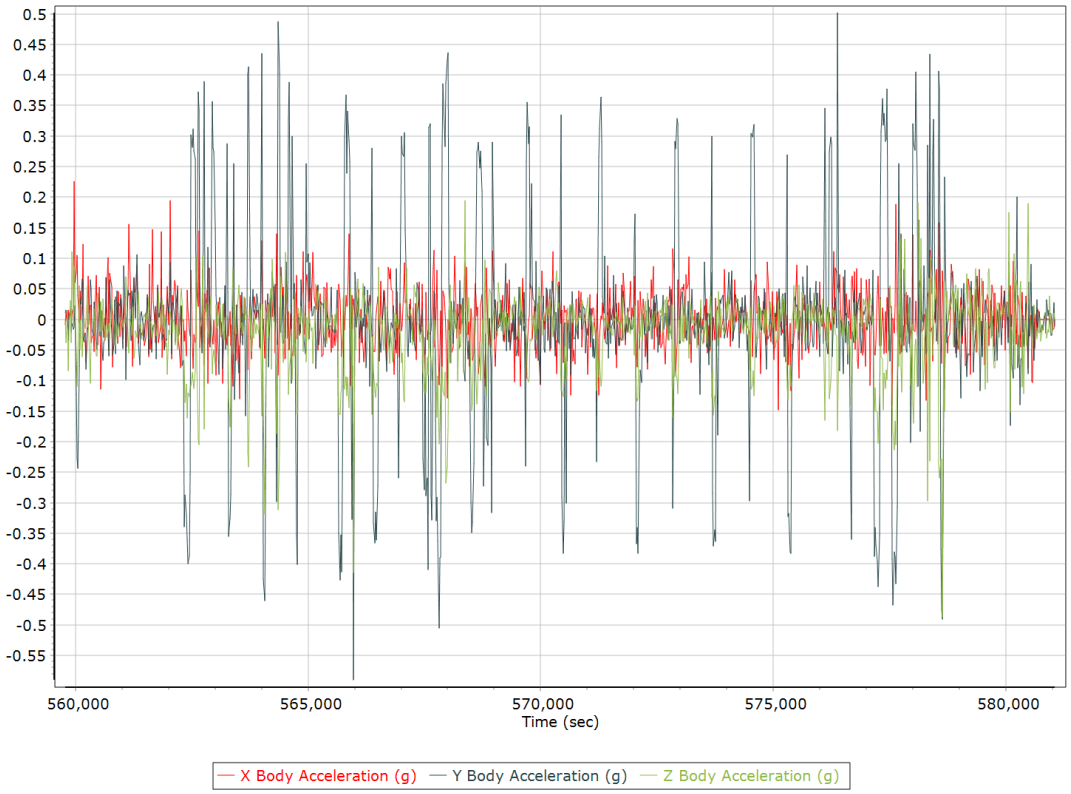
Total Speed



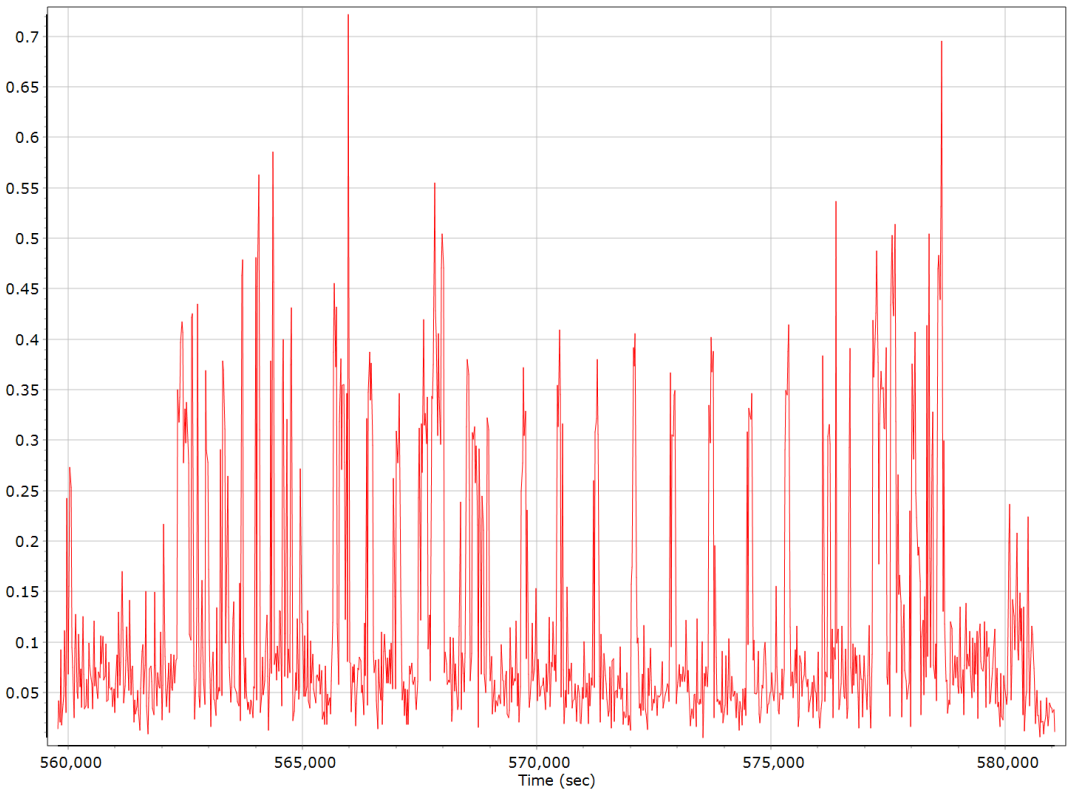
Ground Speed



Body Acceleration



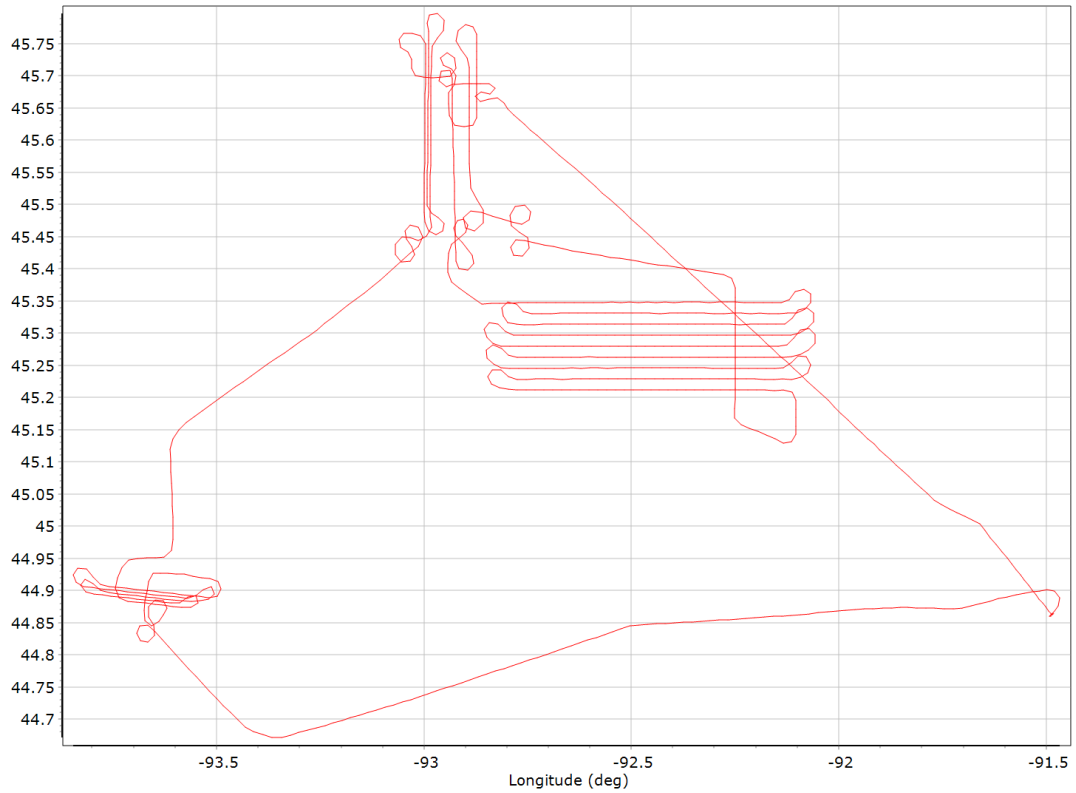
Total Body Acceleration



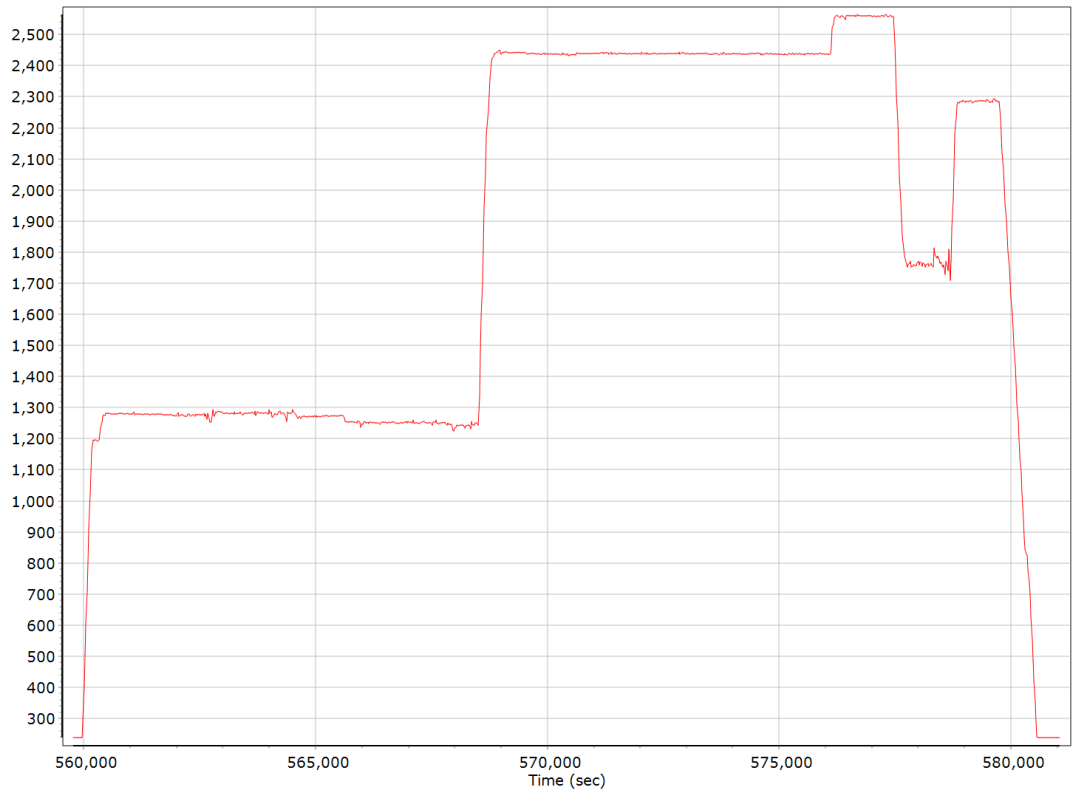
Body Angular Rate

Forward Processed Trajectory Information

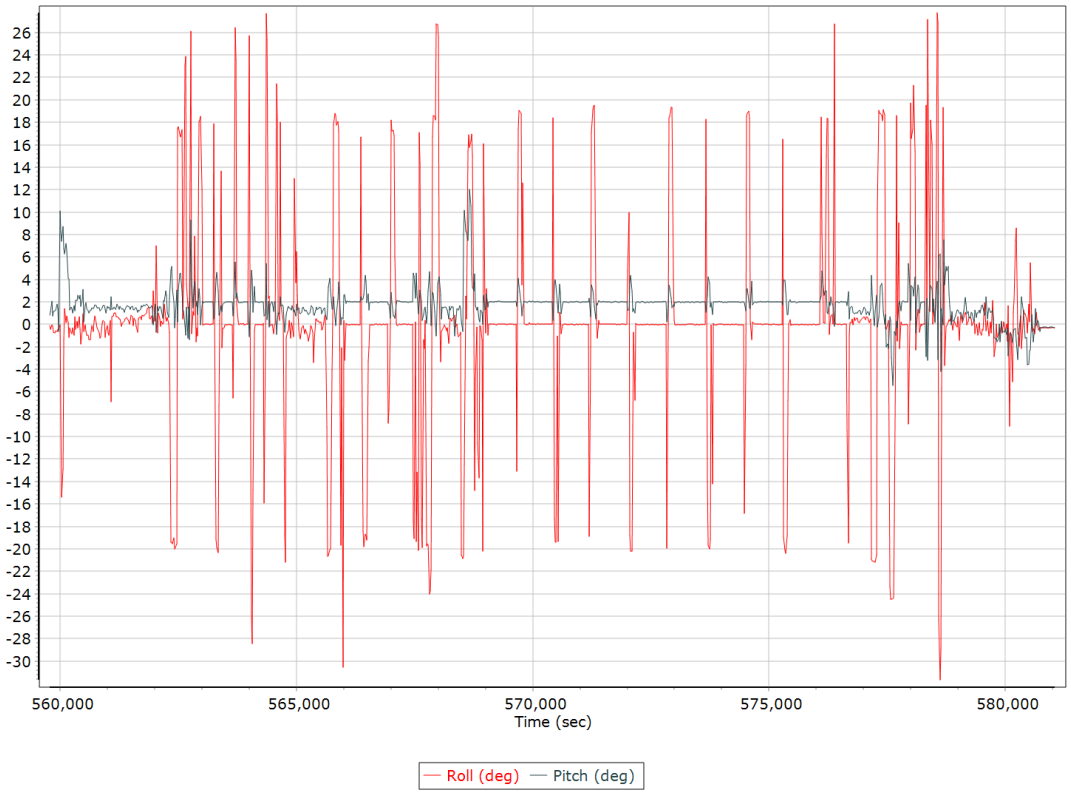
Top View



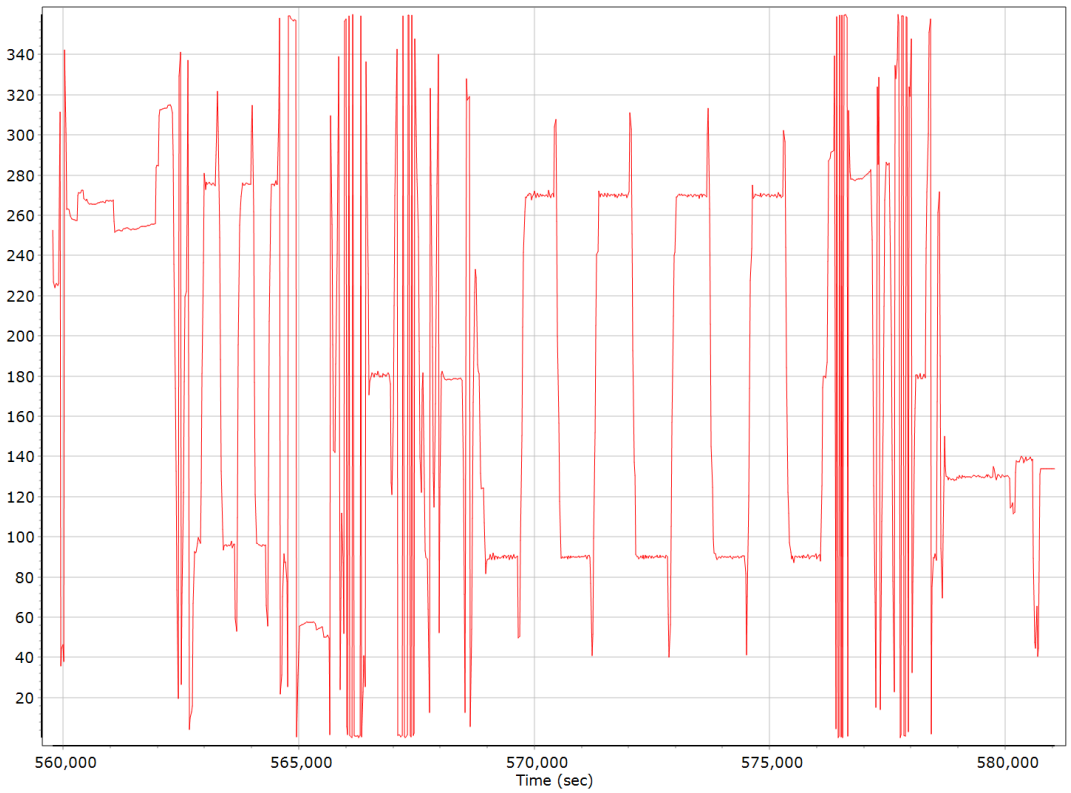
Altitude



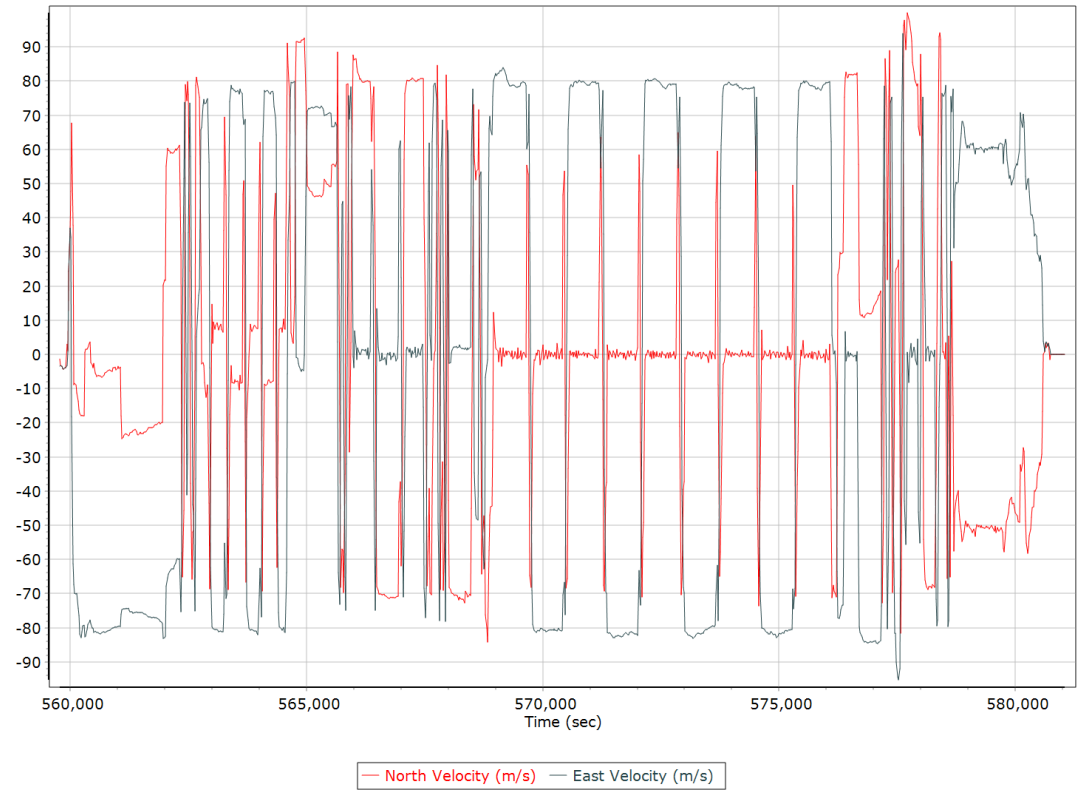
Roll/Pitch



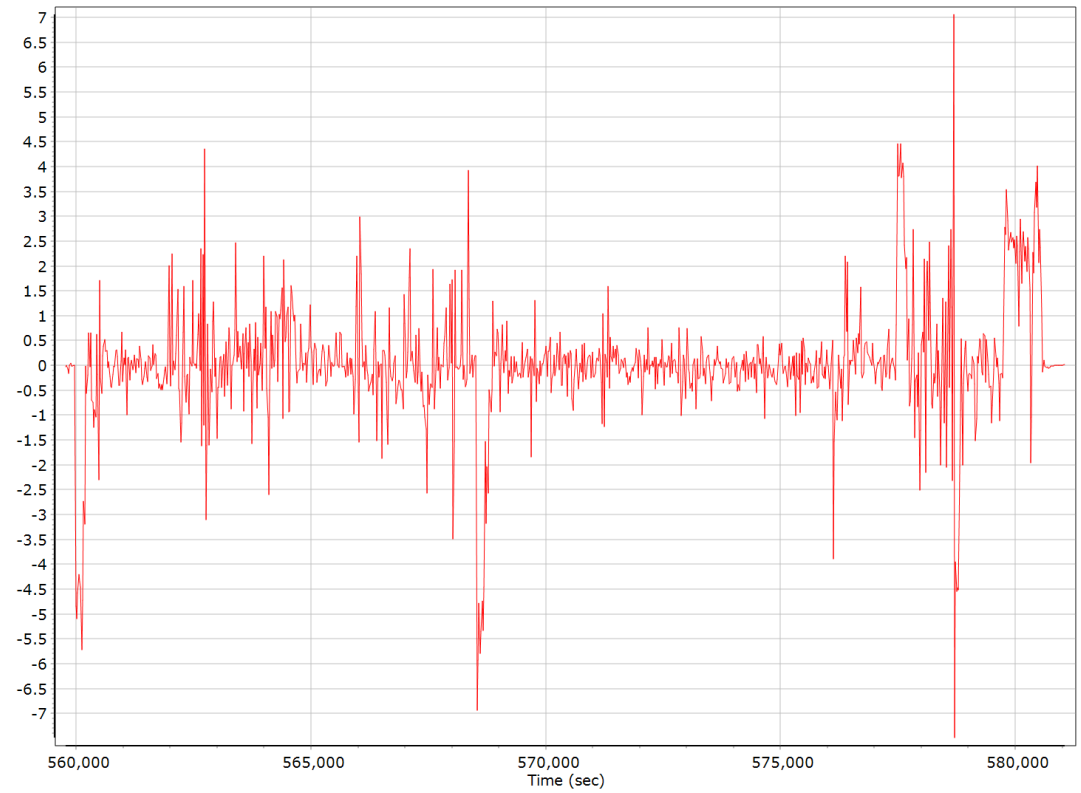
Heading



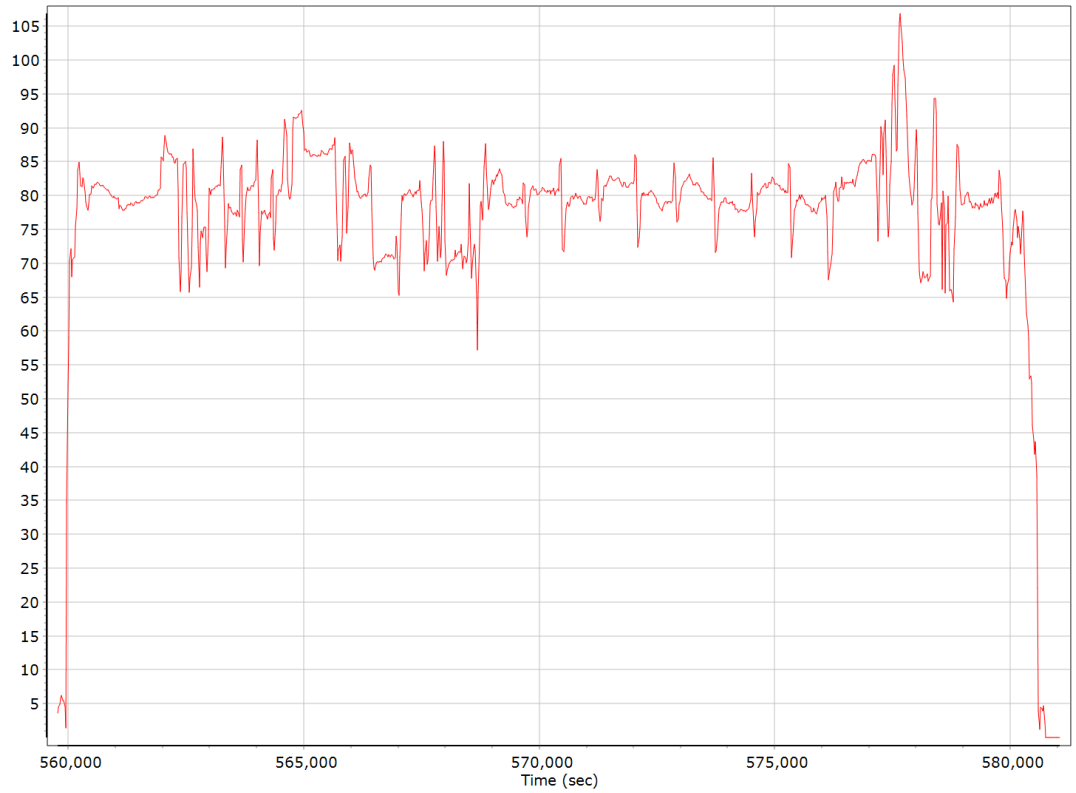
North/East Velocity



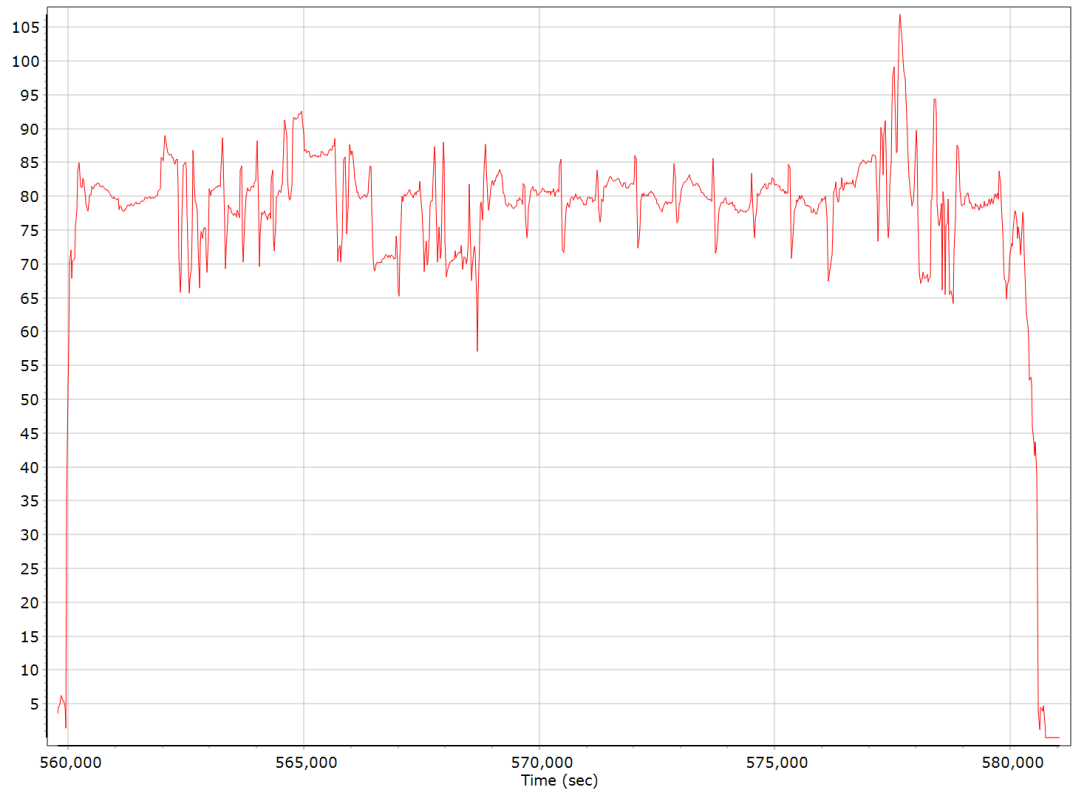
Down Velocity



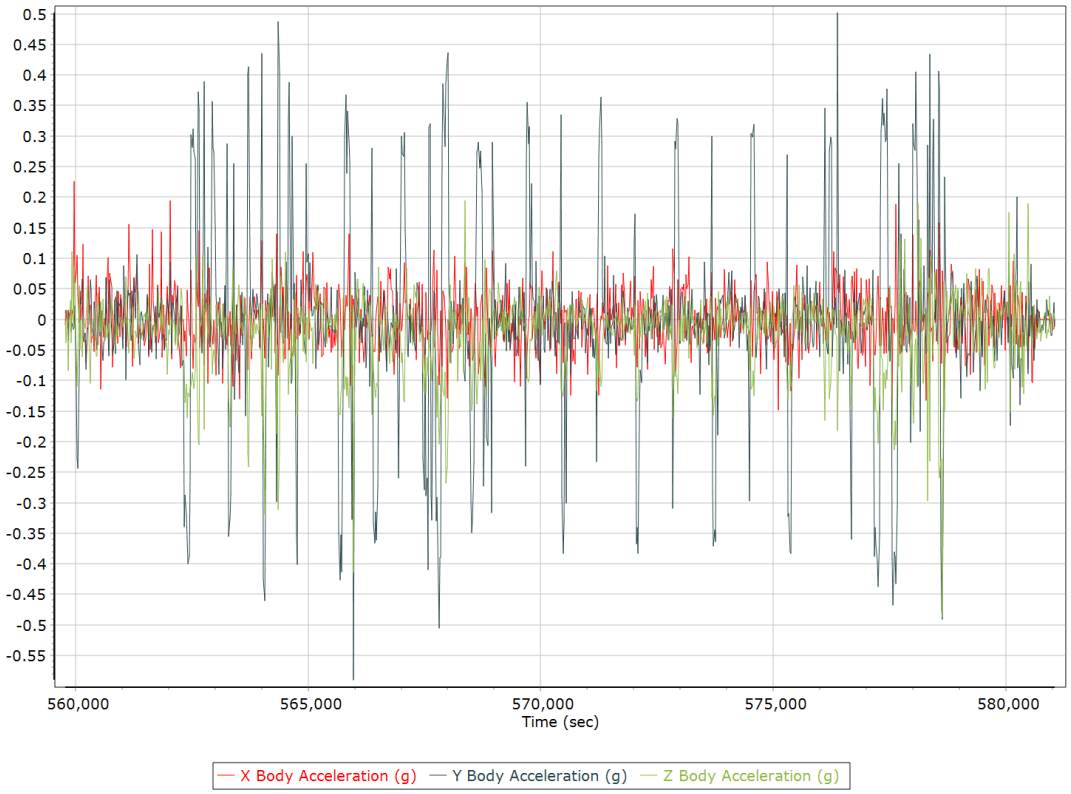
Total Speed



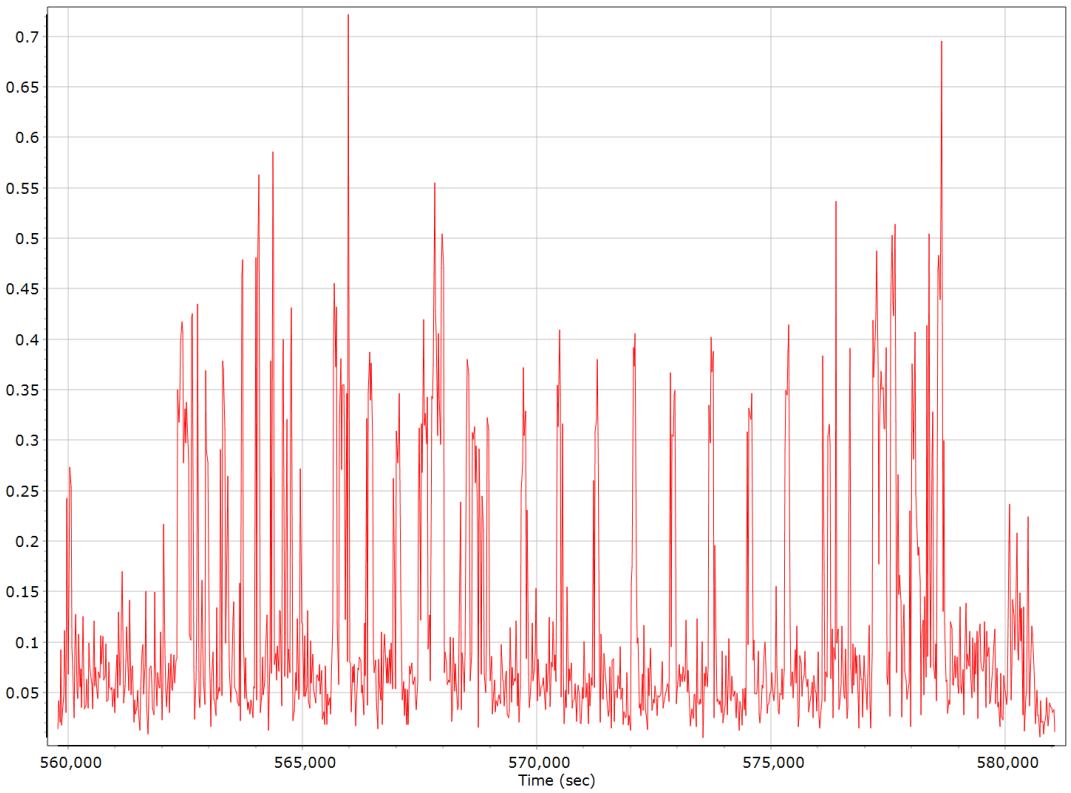
Ground Speed



Body Acceleration



Total Body Acceleration



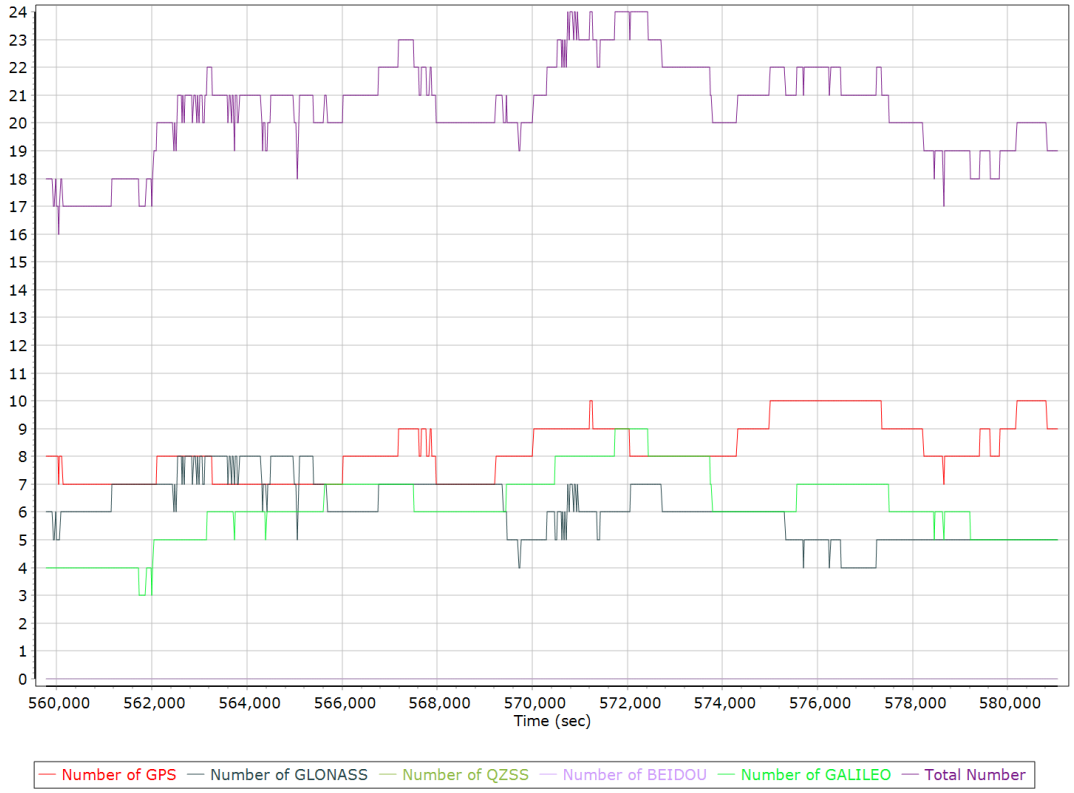
Body Angular Rate

GNSS QC

GNSS QC Statistics

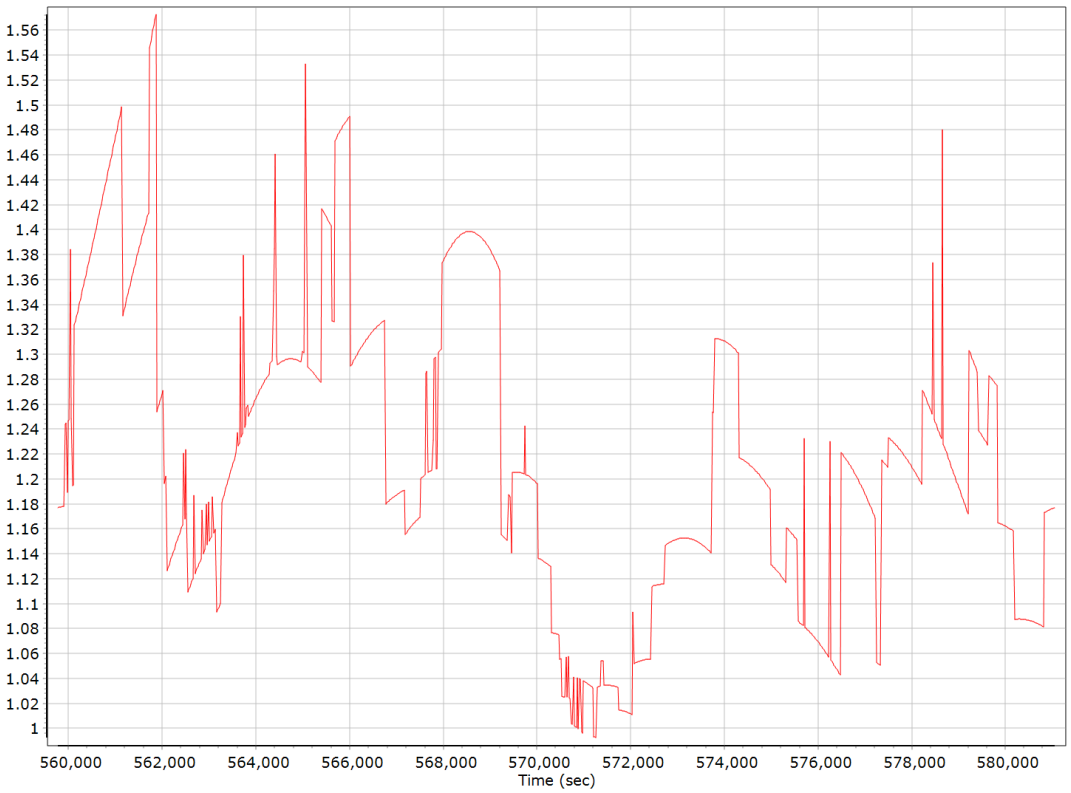
Statistics	Min	Max	Mean
Baseline length (km)	0.00	0.00	
Number of GPS SV	7	10	8
Number of GLONASS SV	3	8	6
Number of QZSS SV	0	0	0
Number of BEIDOU SV	0	0	0
Number of GALILEO SV	3	9	6
Total number of SV	16	24	21
PDOP	0.99	1.78	1.22
QC Solution Gaps	0.00	0.00	
Solution Type	Fixed	Float	No solution
Epoch (sec)	21669.00	0.00	0.00
Percentage	100.00	0.00	0.00

Num SVs in solution

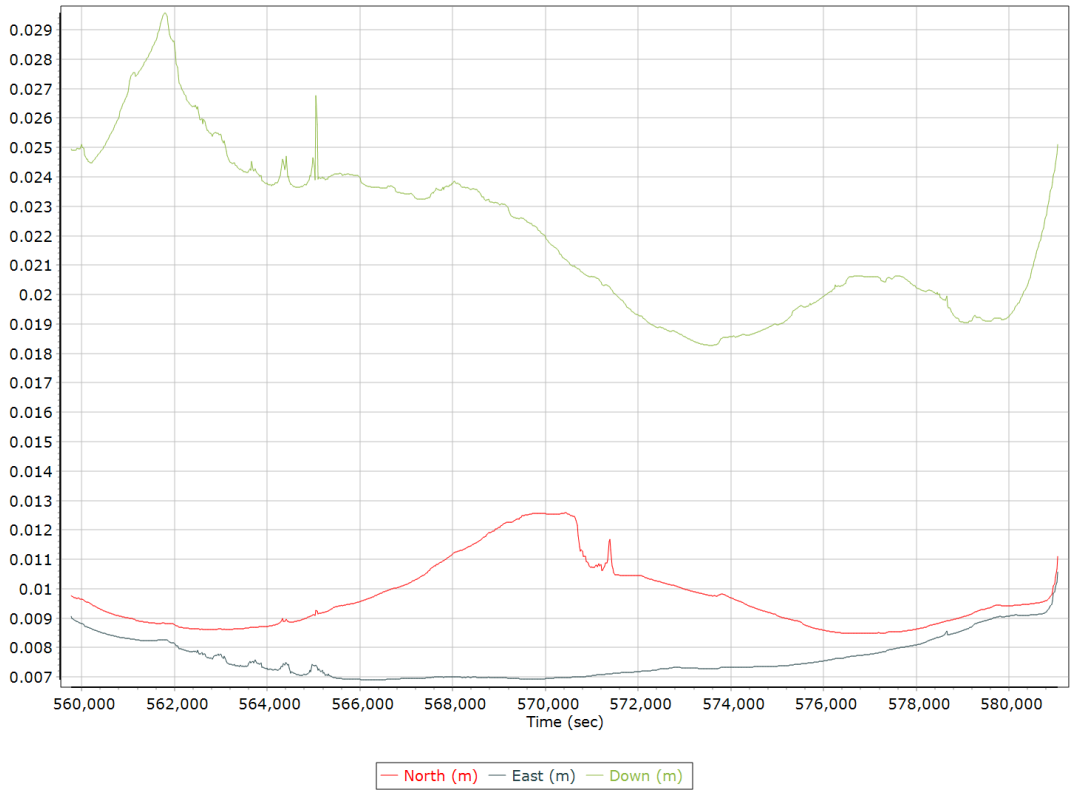


Forward/Reverse Separation

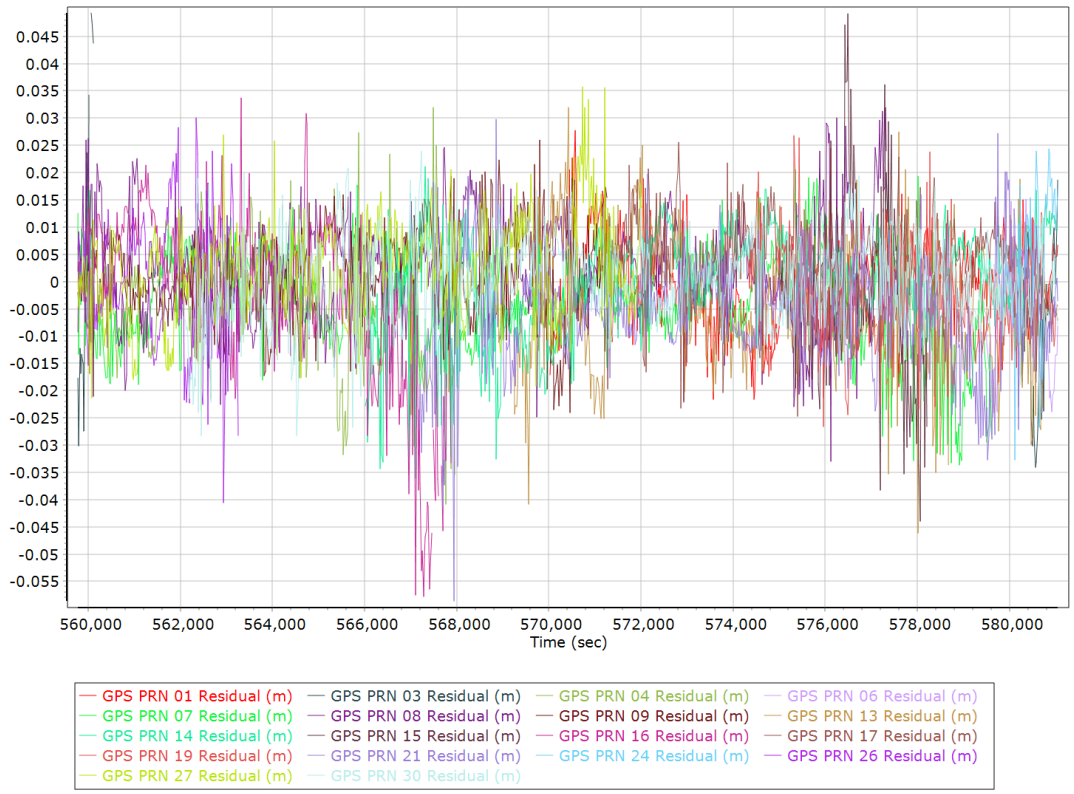
PDOP



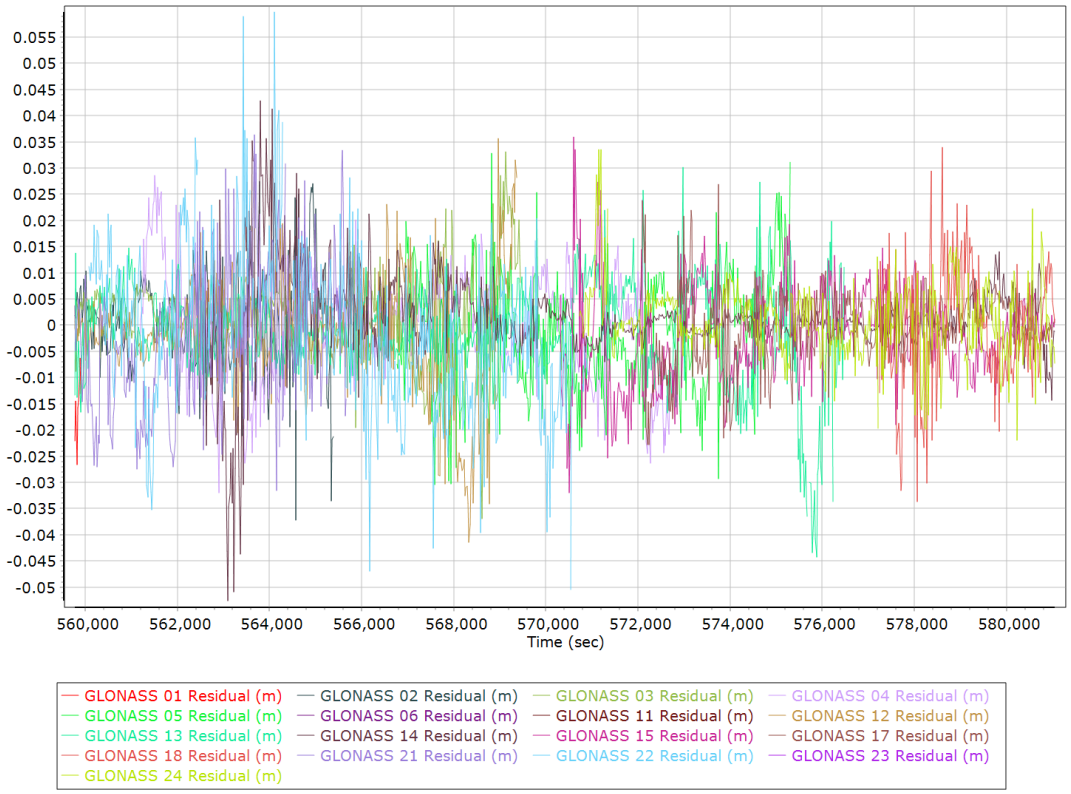
Estimated Position Accuracy



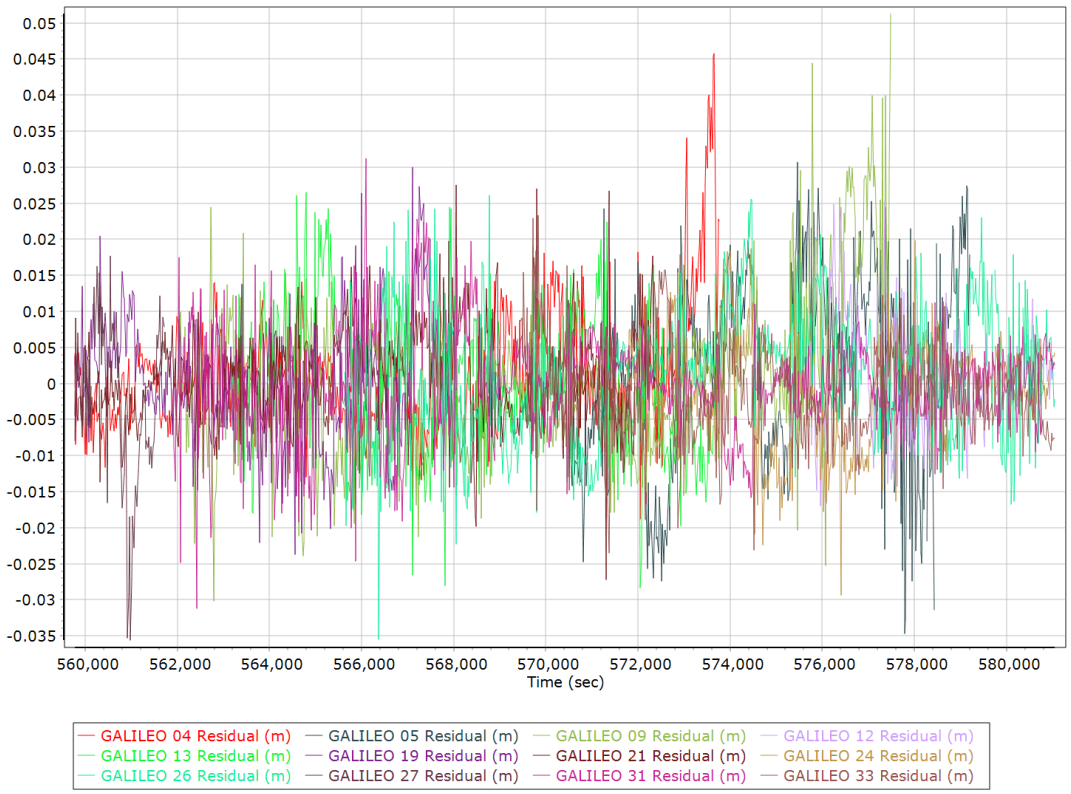
GPS Residuals



GLONASS Residuals



GALILEO Residuals



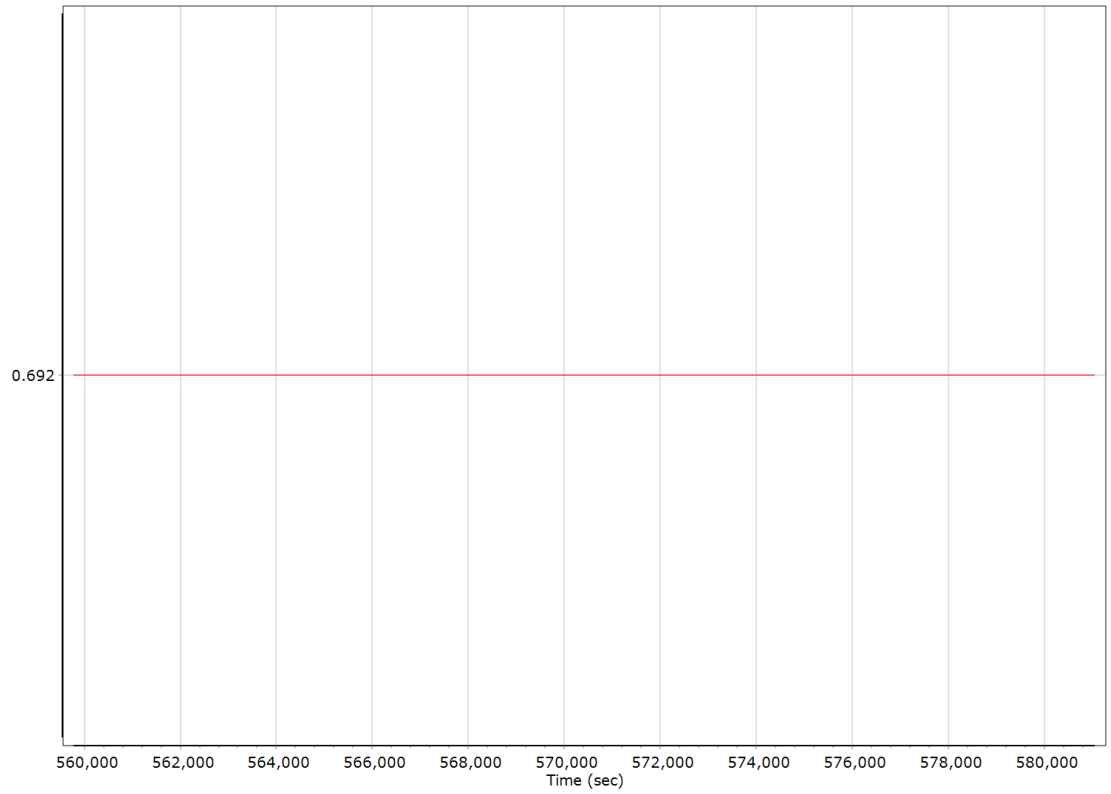
GNSS-Inertial Processor Configuration

Processing mode	IN-Fusion PP-RTX		
Stabilized mount	True		
Processing start time	559359.000 (5/7/2022 11:22:39 AM)		
Processing end time	581065.000 (5/7/2022 5:24:25 PM)		
Initial attitude source	Real-Time VNAV/RNAV Attitude		
IMU Sensor Context	Processing with Onboard IMU		
Gimbal to IMU lever arm (m)	-0.034	-0.010	-0.374
Gimbal to IMU mounting angles (deg)	0.000	0.000	0.000
Gimbal to Primary GNSS lever arm (m)	0.692	-0.181	-1.276
Gimbal to Primary GNSS lever arm std dev (m)	0.030	0.030	0.030
Aircraft to Reference mounting angles (deg)	0.000	0.000	0.000

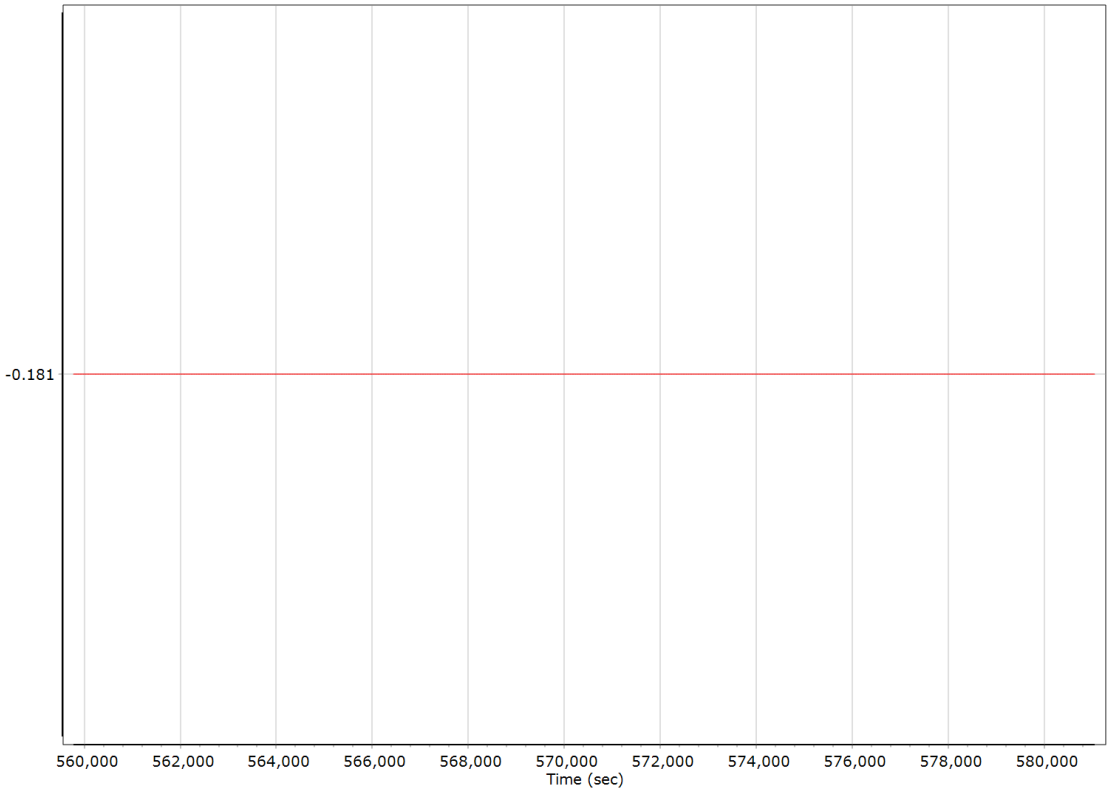
Calibrated Installation Parameters

Reference-Primary GNSS Lever Arm (m)

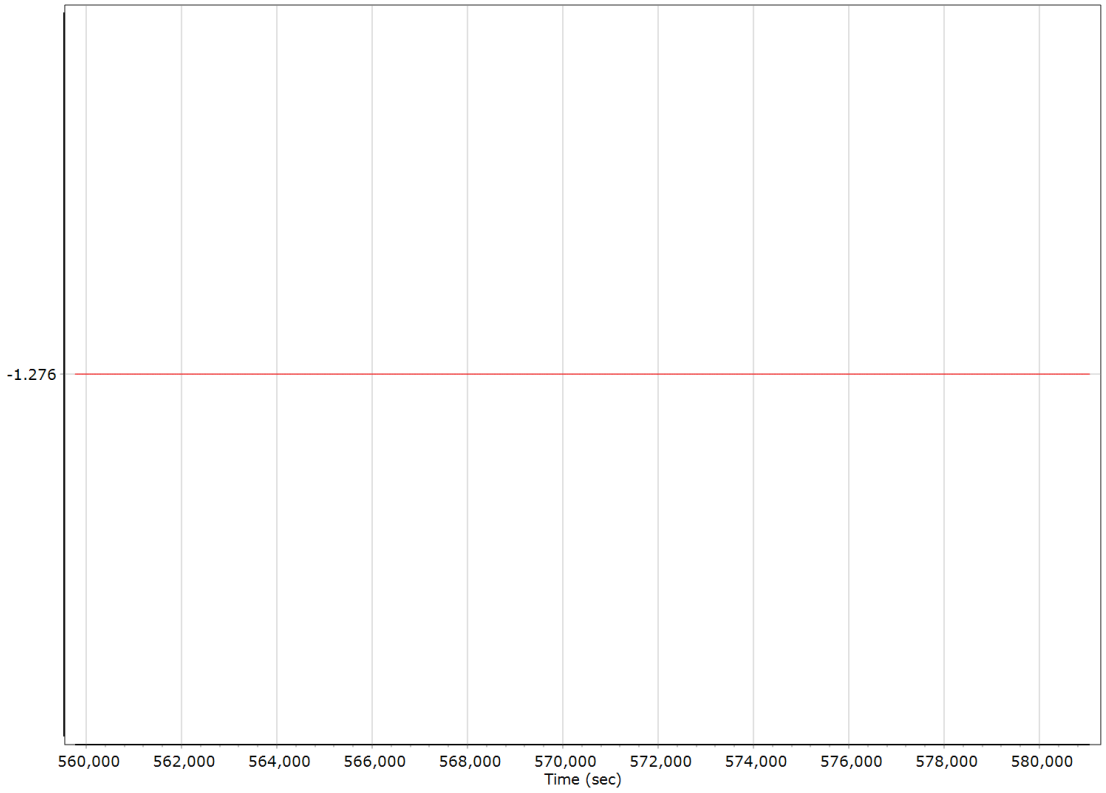
X Reference-Primary GNSS Lever Arm (m)



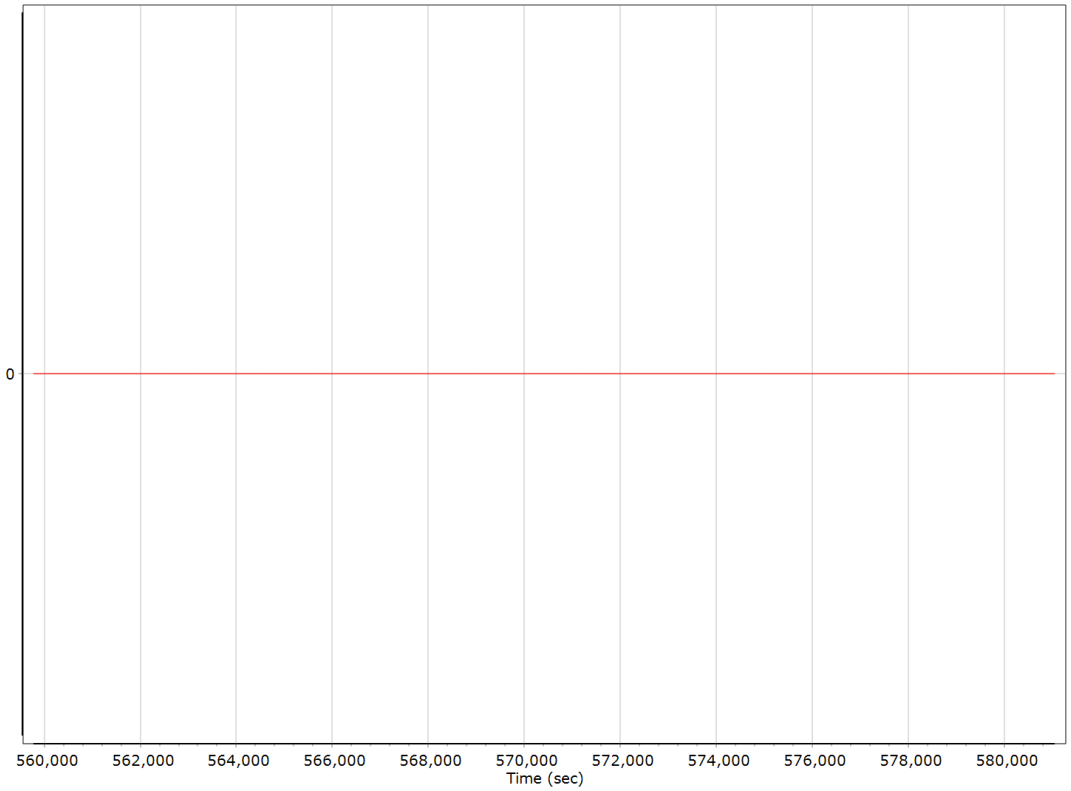
Y Reference-Primary GNSS Lever Arm (m)



Z Reference-Primary GNSS Lever Arm (m)



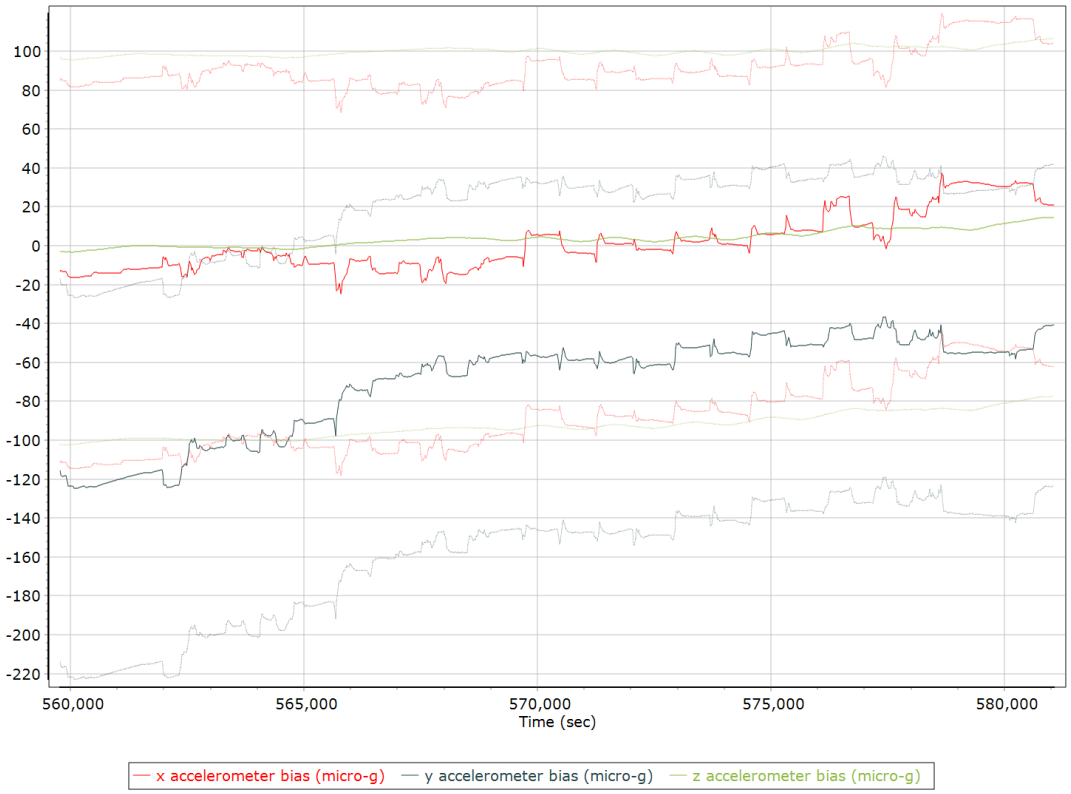
Reference-Primary GNSS Lever Arm Figure of Merit



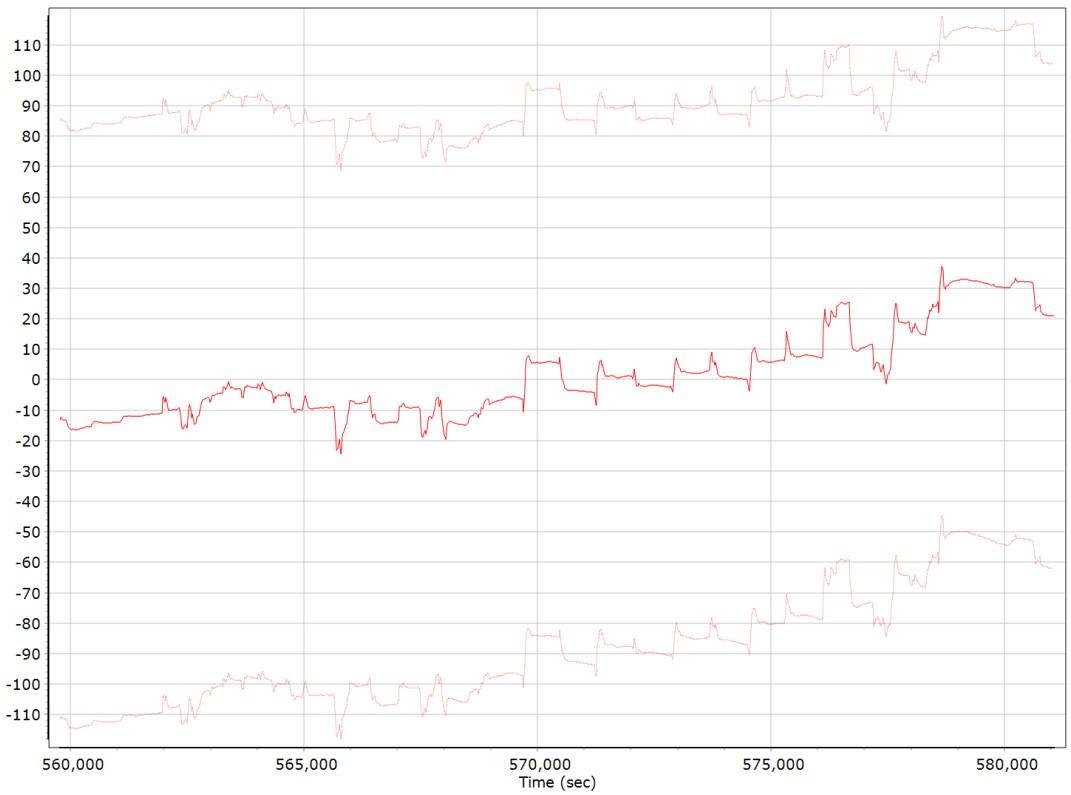
IN-Fusion QC

Forward Processed Estimated Errors, Reference Frame

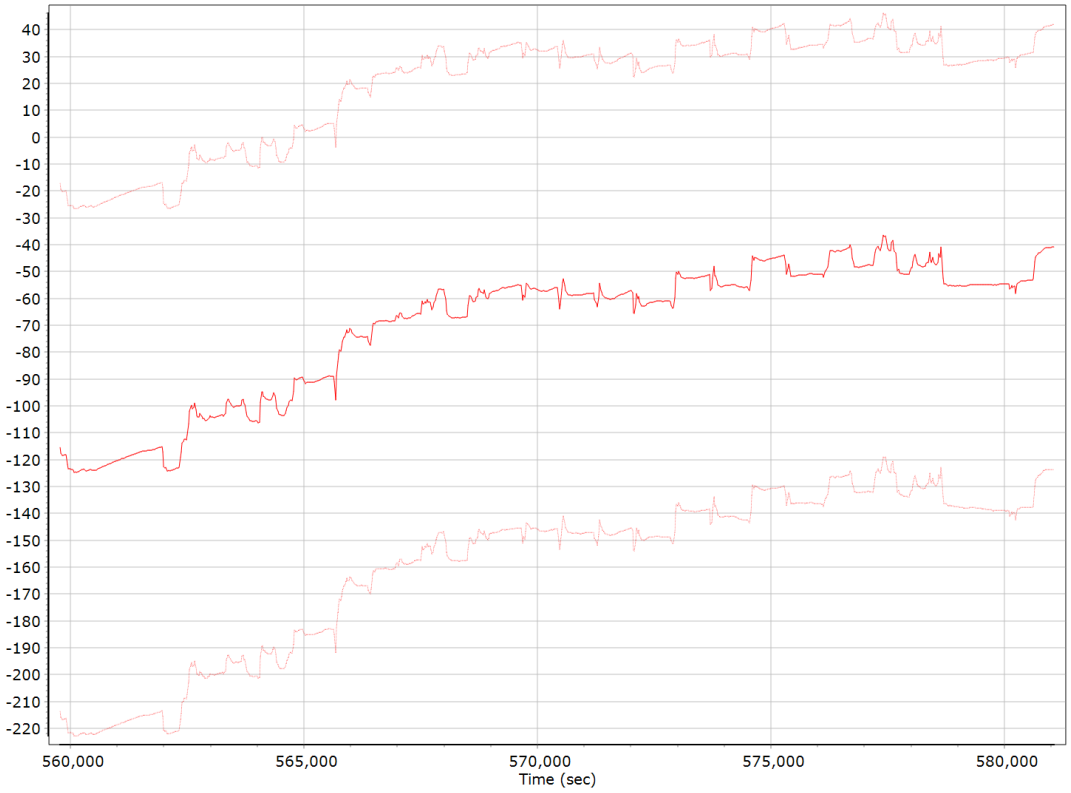
Accelerometer Bias (micro-g)



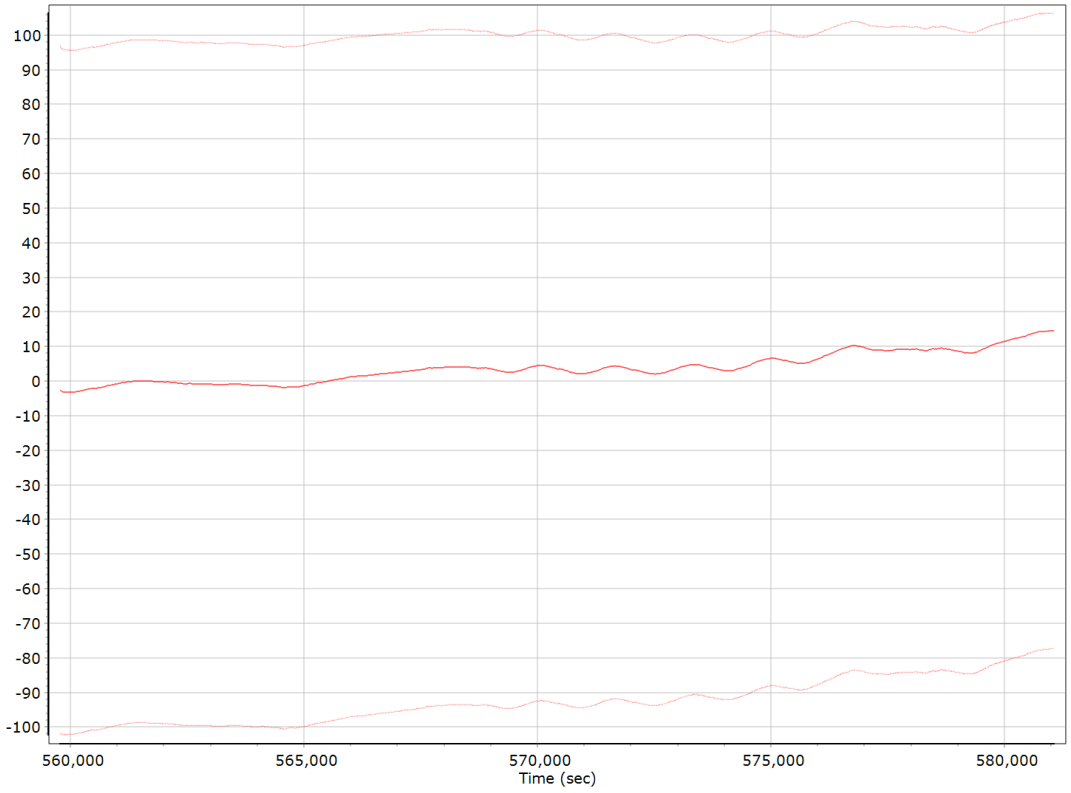
X Accelerometer Bias (micro-g)



Y Accelerometer Bias (micro-g)



Z Accelerometer Bias (micro-g)



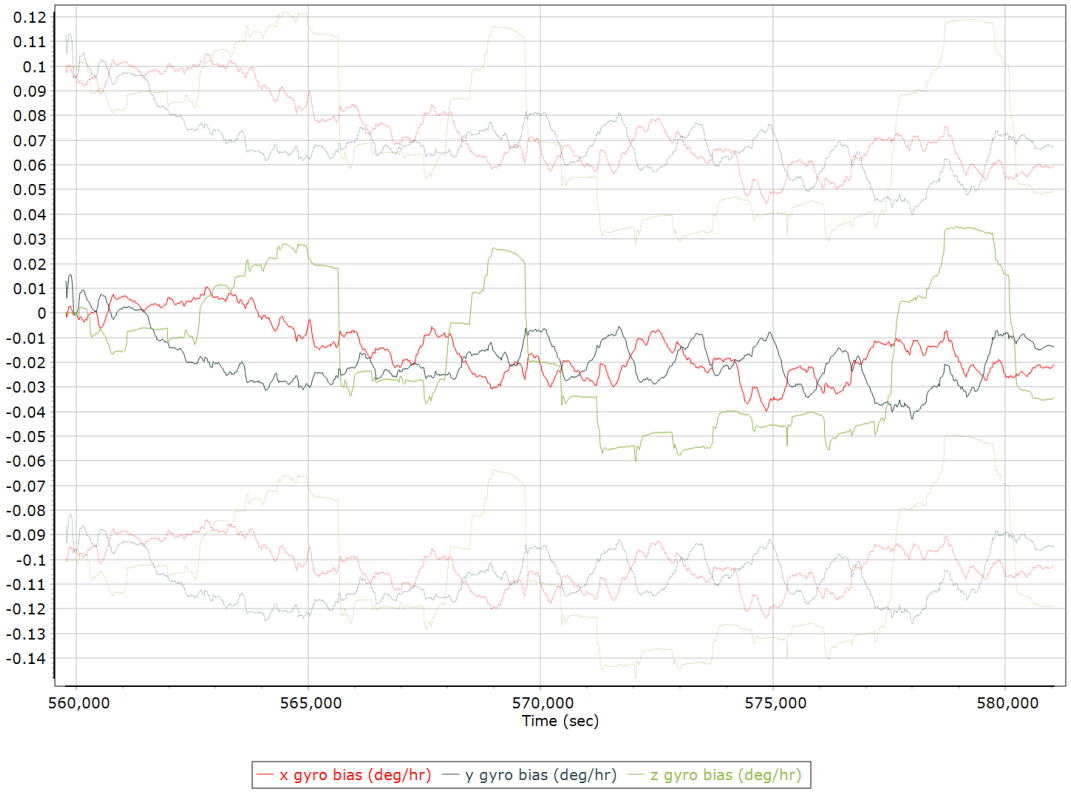
Accelerometer Scale Error (ppm)

X Accelerometer Scale Error (ppm)

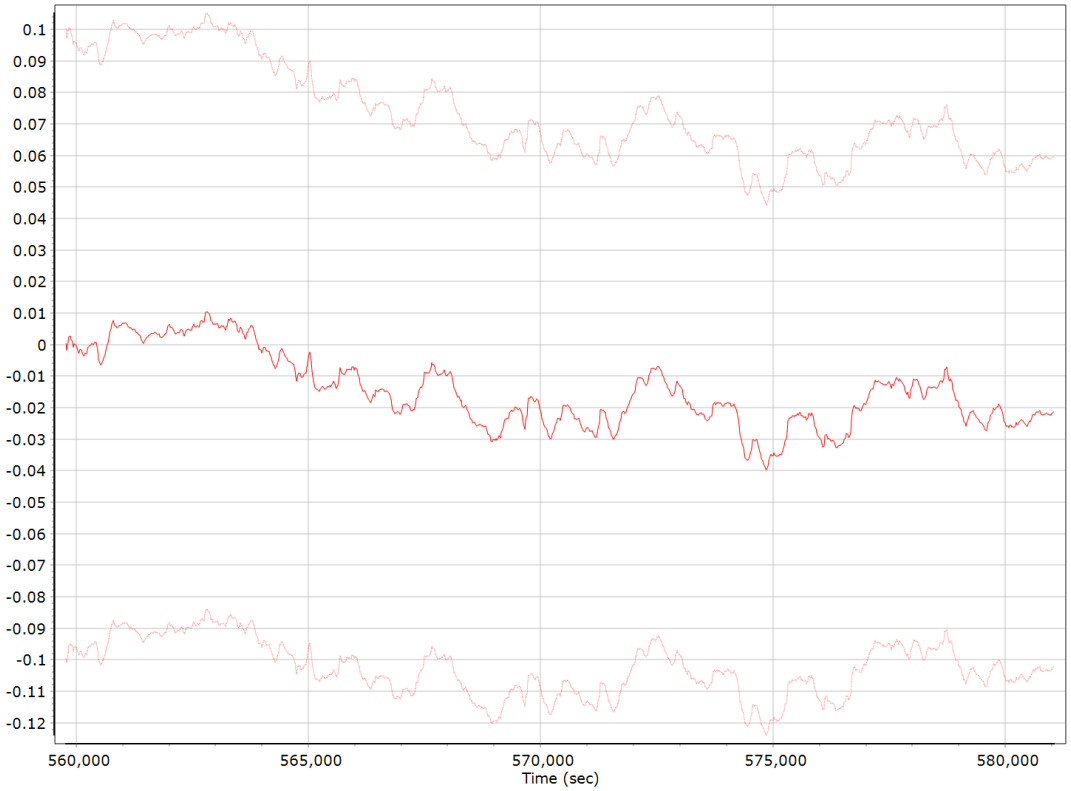
Y Accelerometer Scale Error (ppm)

Z Accelerometer Scale Error (ppm)

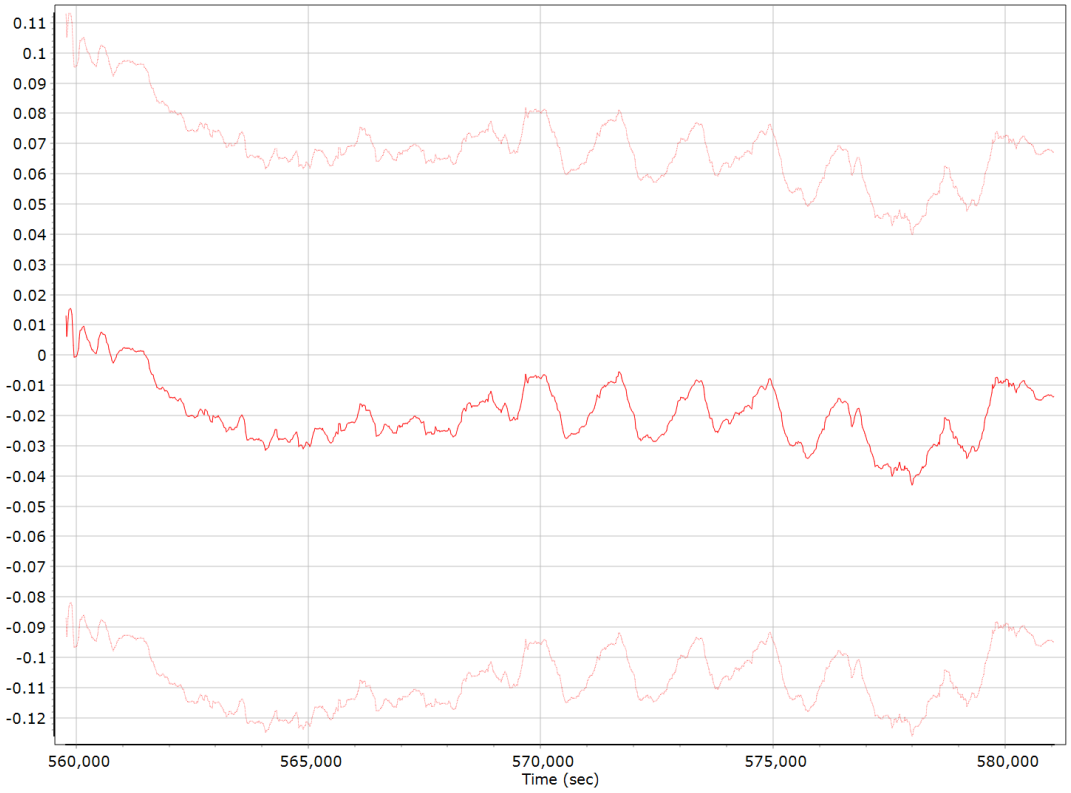
Gyro Bias (deg/h)



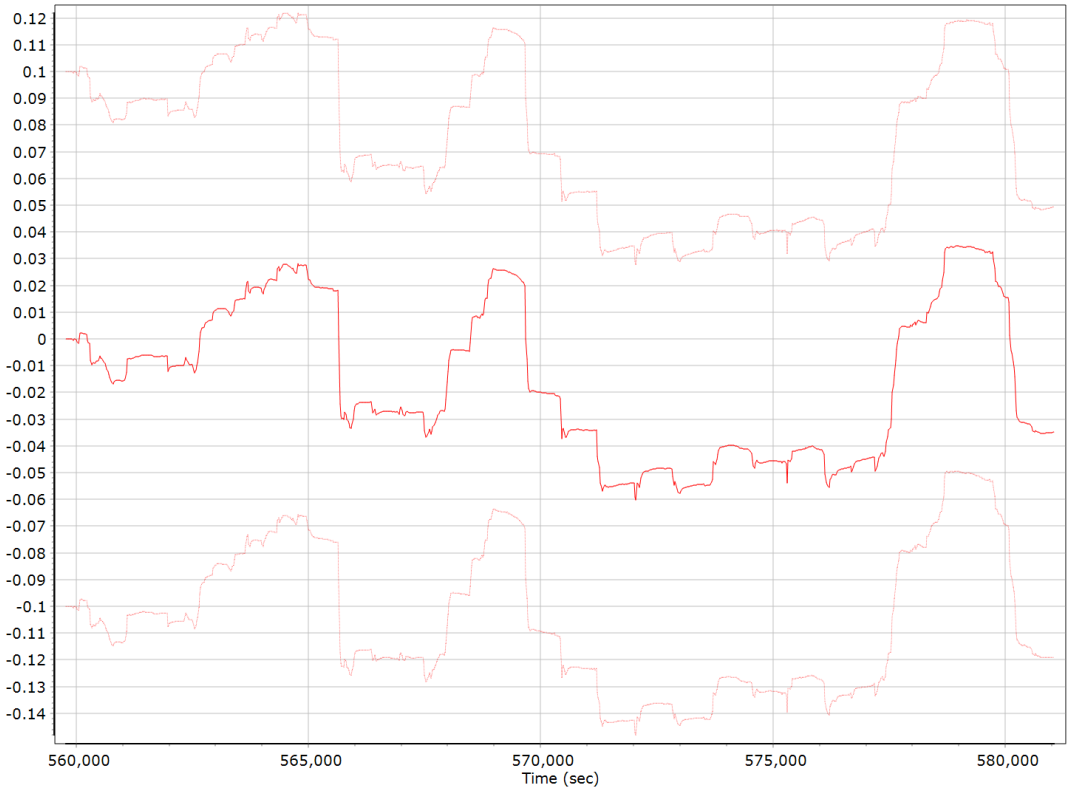
X Gyro Bias (deg/h)



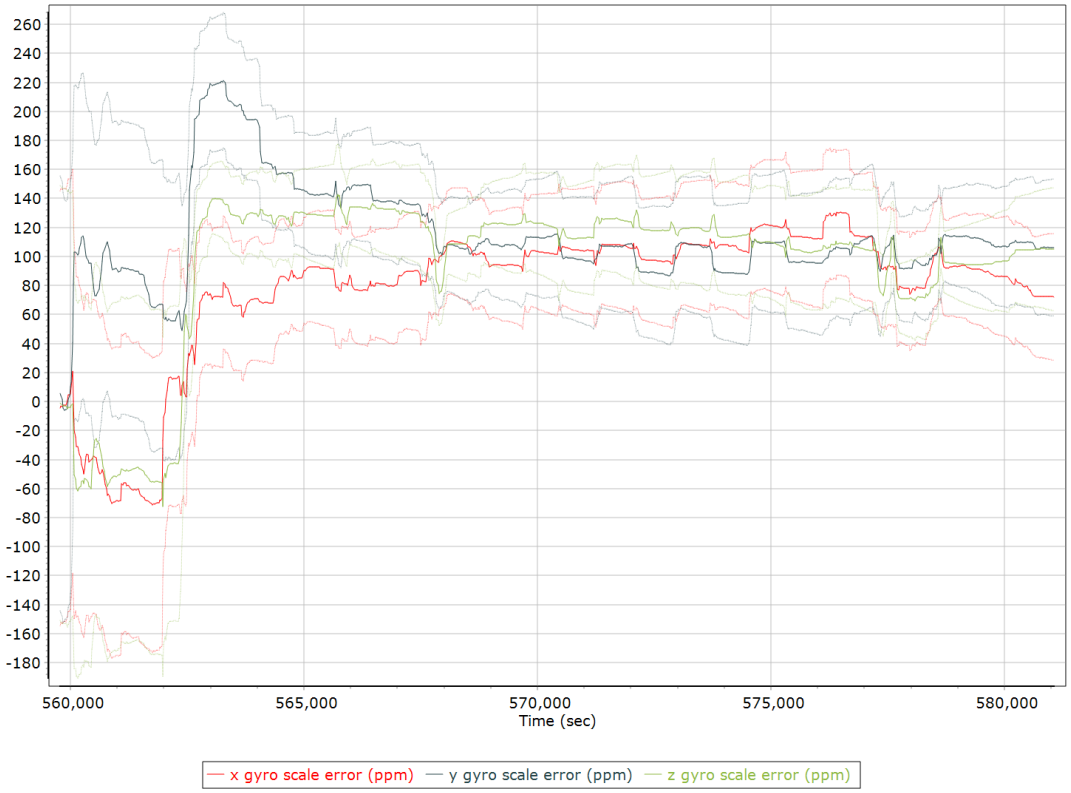
Y Gyro Bias (deg/h)



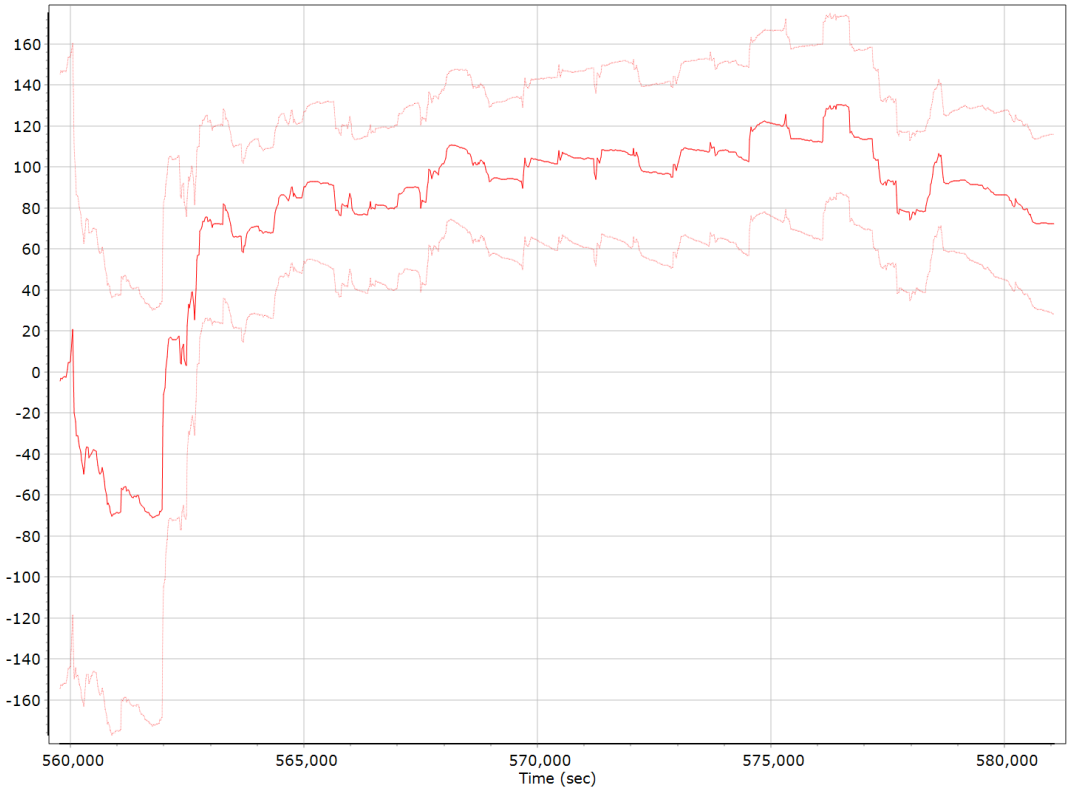
Z Gyro Bias (deg/h)



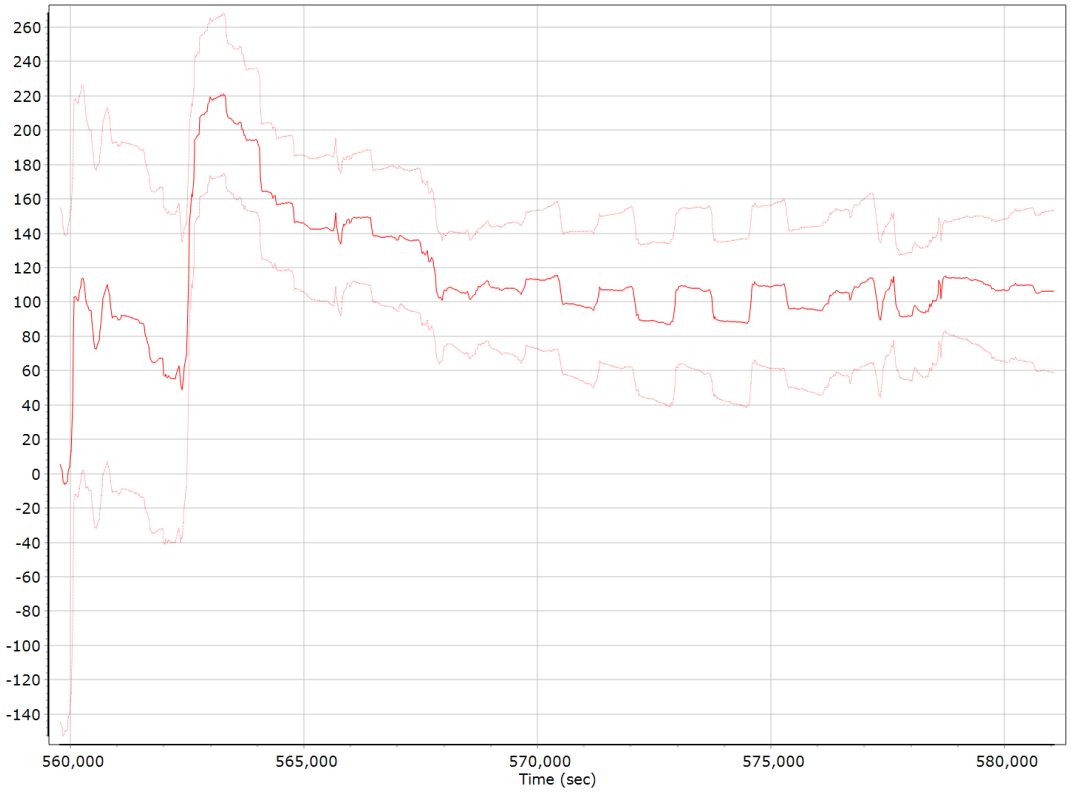
Gyro Scale Error (ppm)



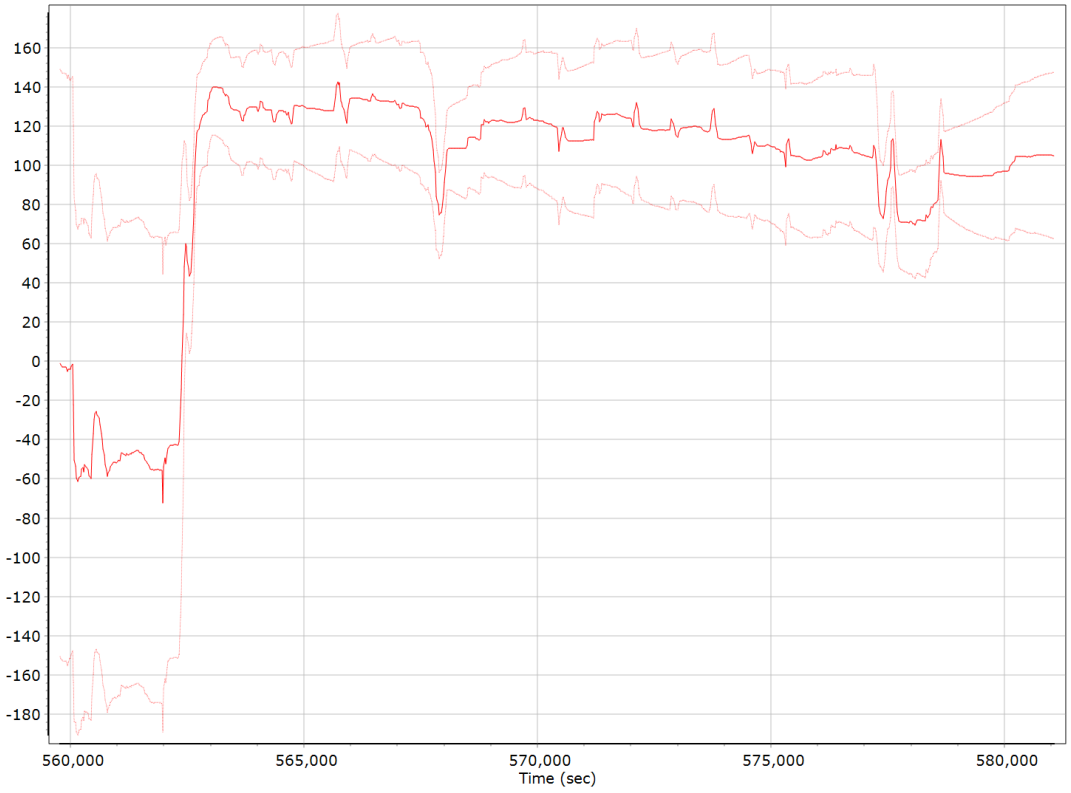
X Gyro Scale Error (ppm)



Y Gyro Scale Error (ppm)

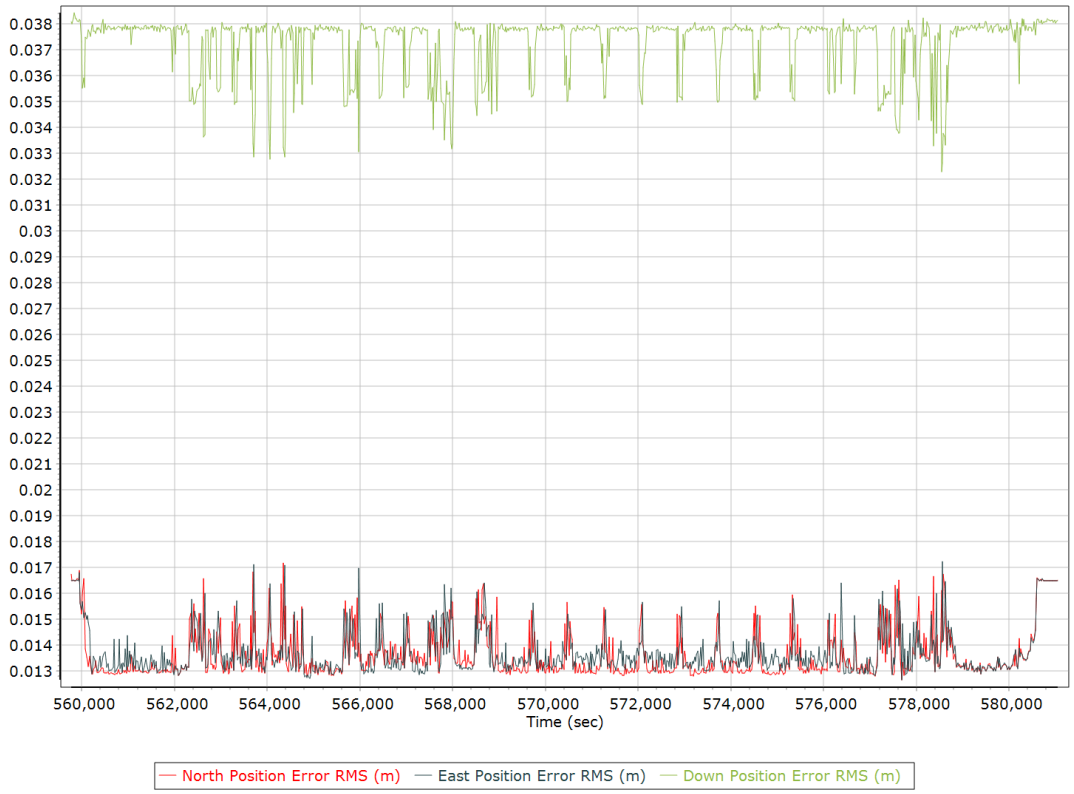


Z Gyro Scale Error (ppm)

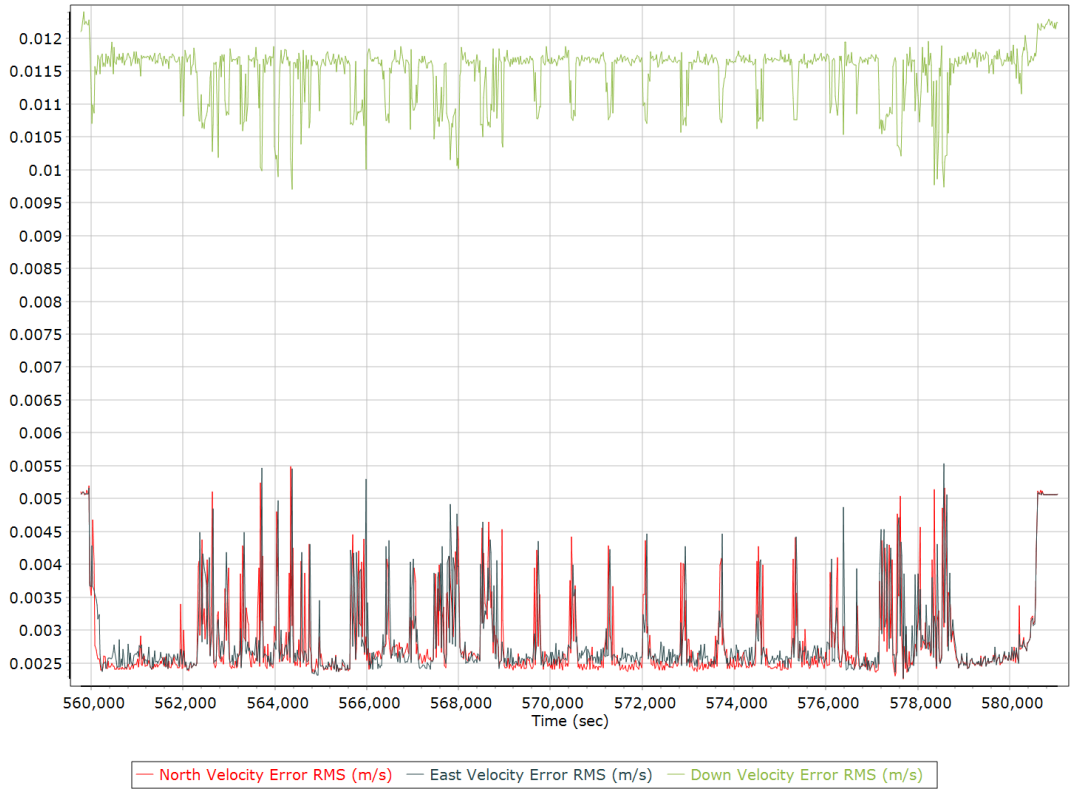


Smoothed Performance Metrics

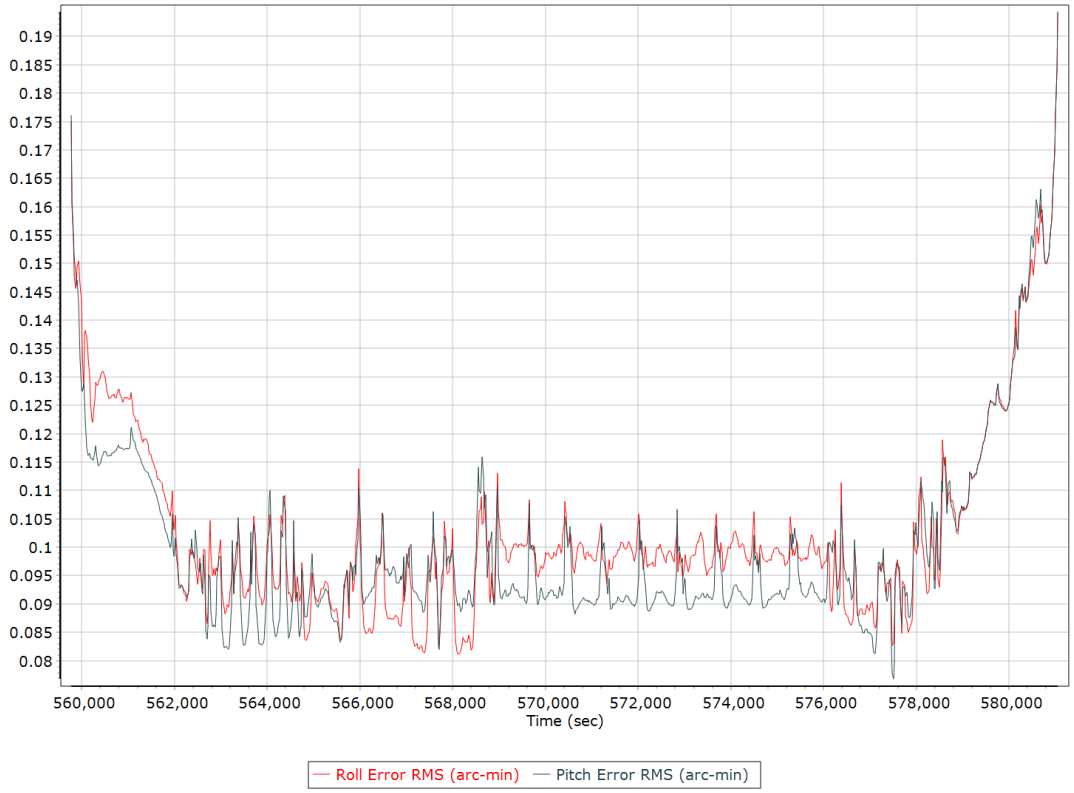
Position Error RMS (m)



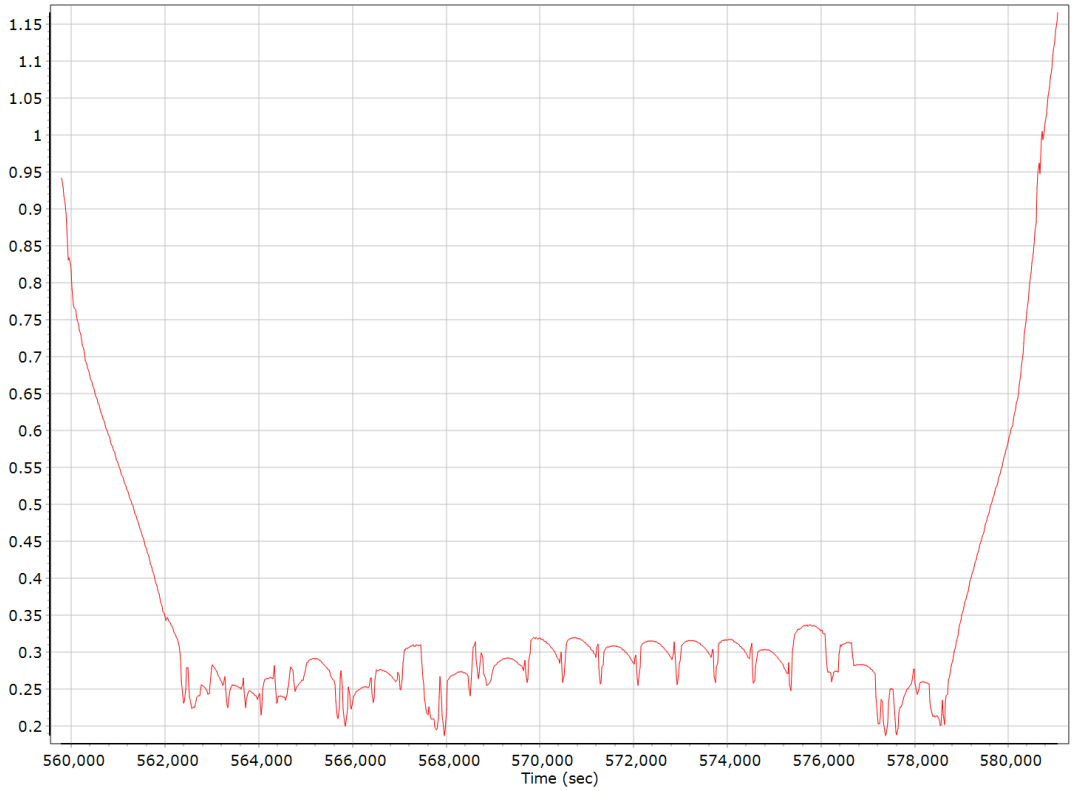
Velocity Error RMS (m/s)



Roll/Pitch Error RMS (arc-min)

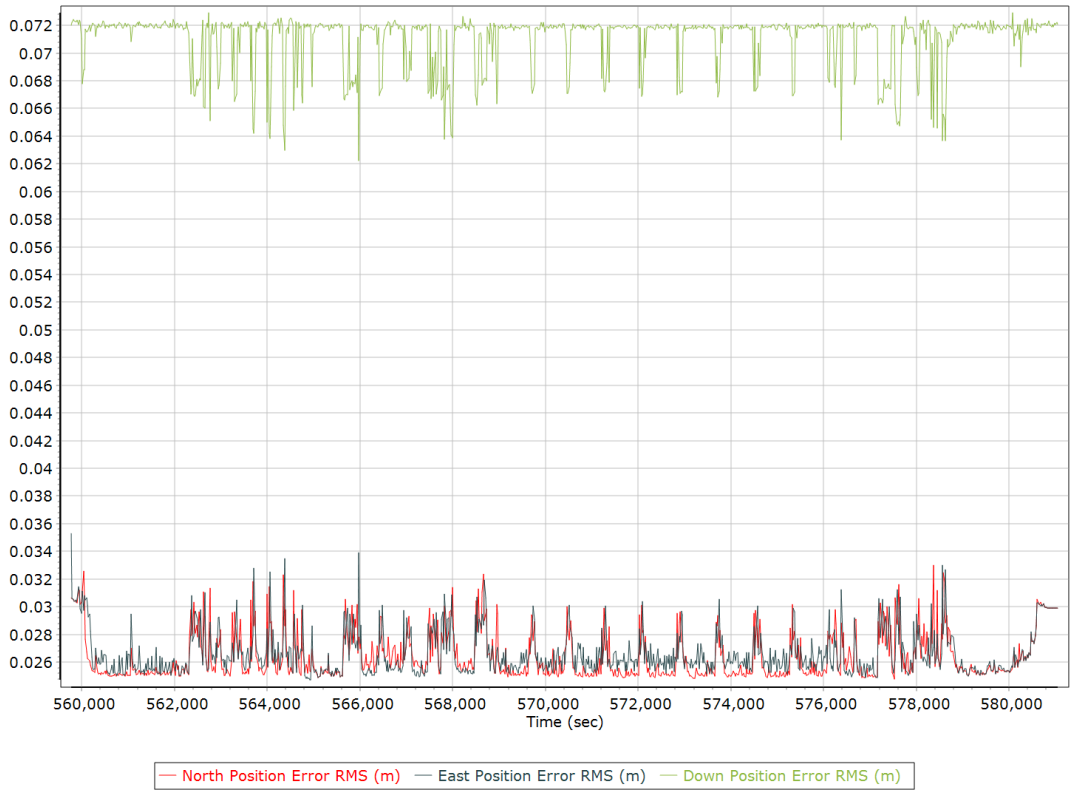


Heading Error RMS (arc-min)



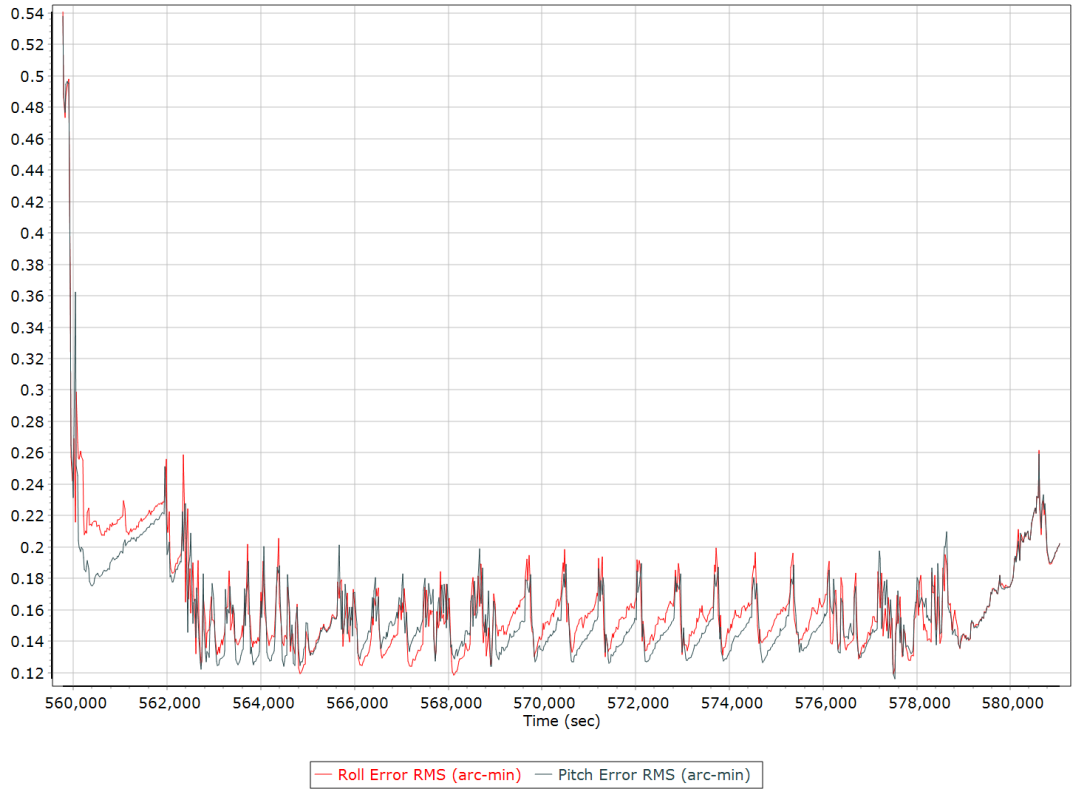
Forward Processed Performance Metrics

Position Error RMS (m)

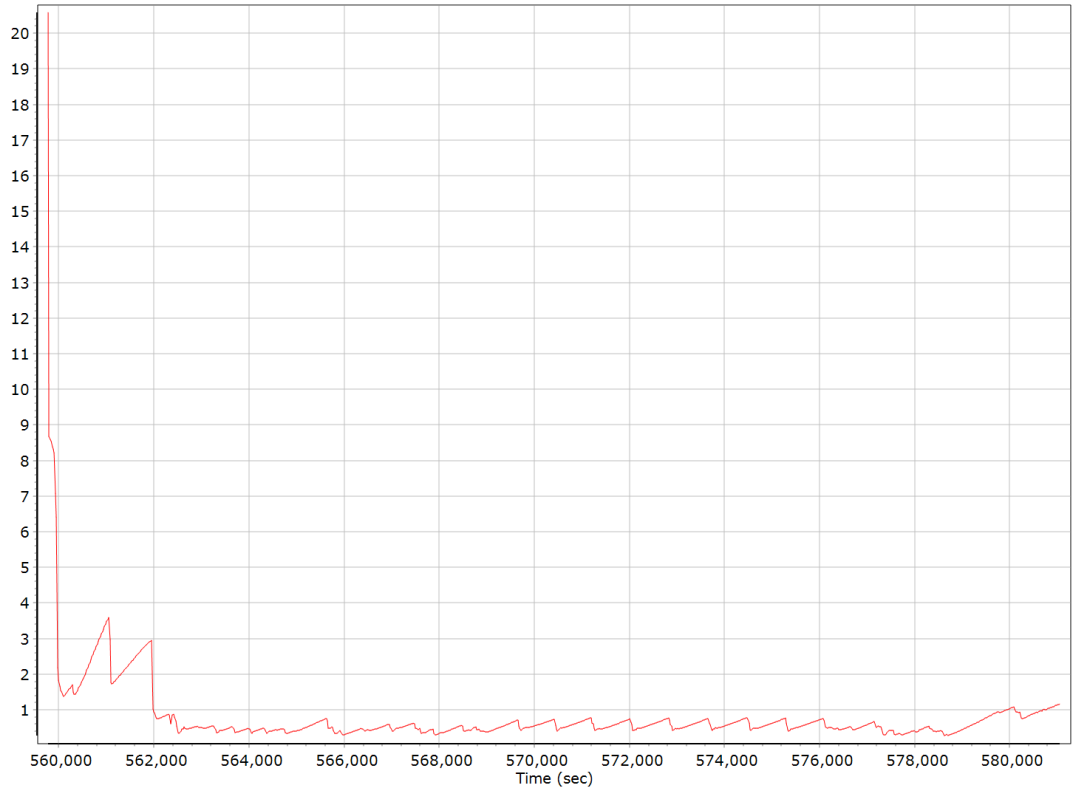


Velocity Error RMS (m/s)

Roll/Pitch Error RMS (arc-min)

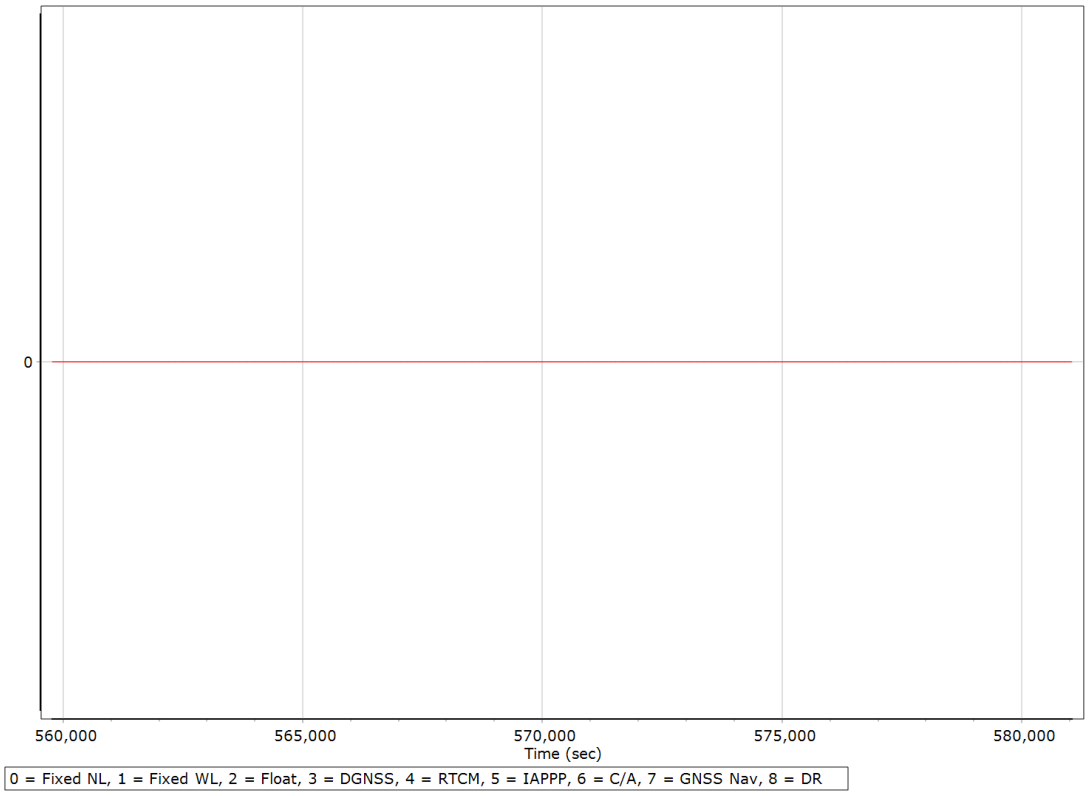


Heading Error RMS (arc-min)

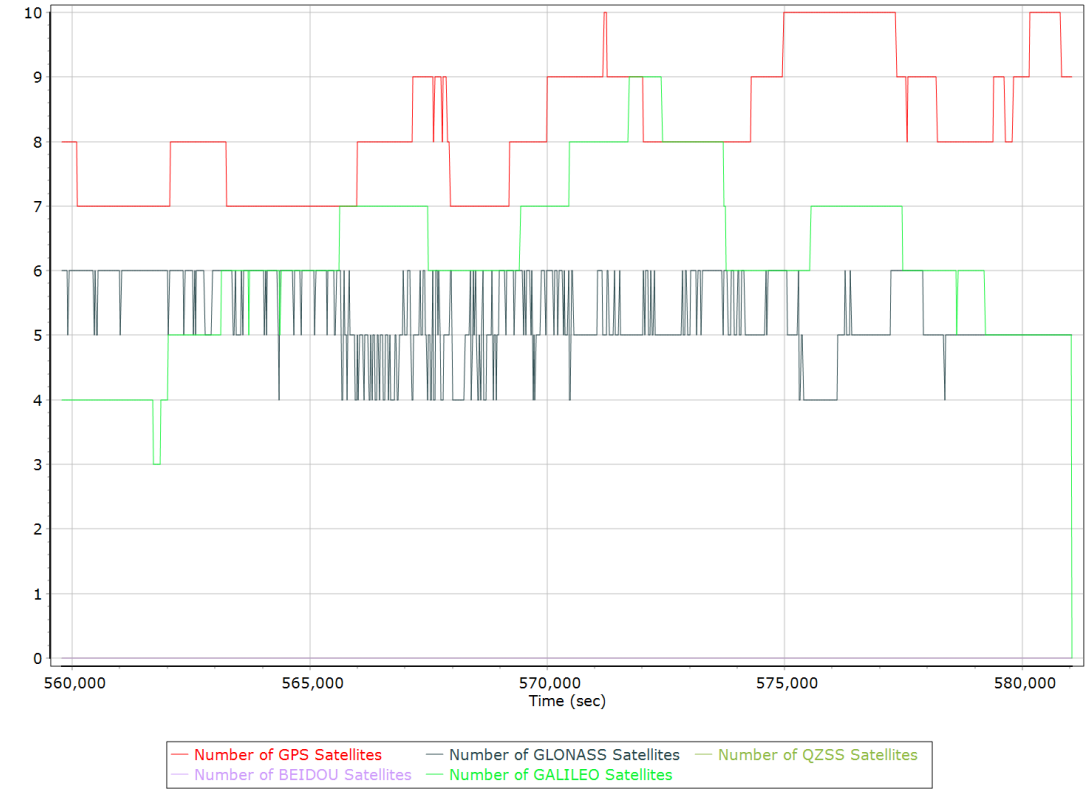


Forward Processed Solution Status

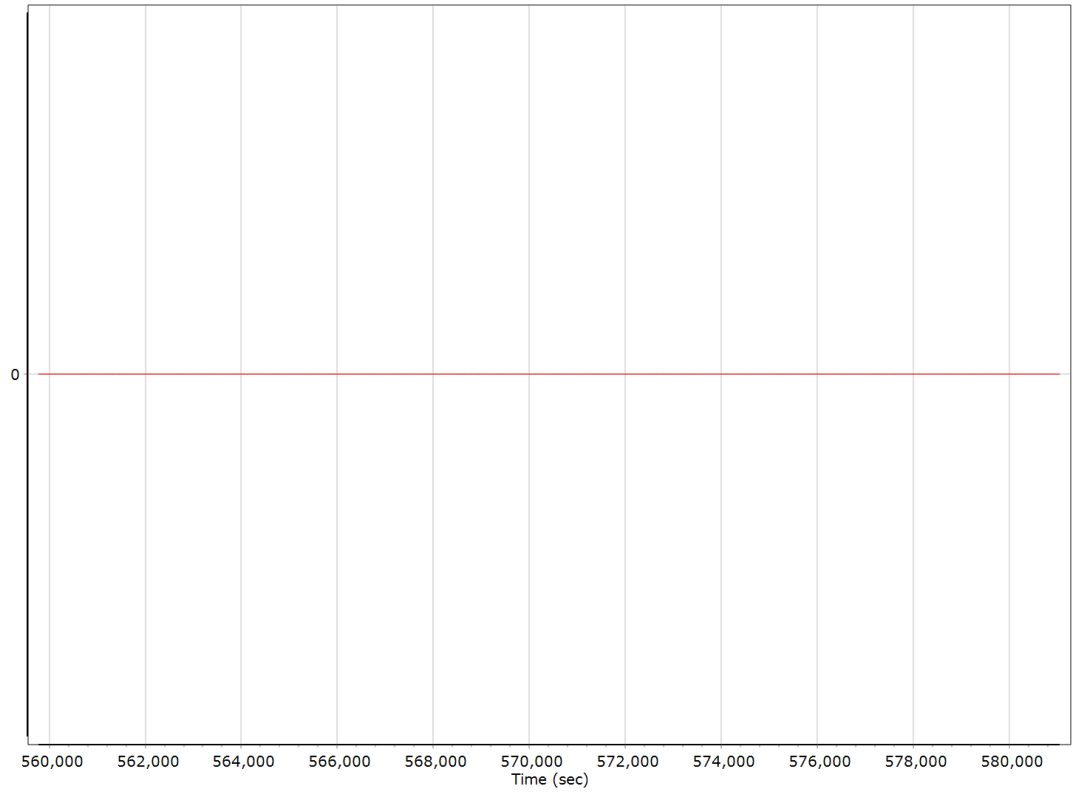
Processing Mode



Number of Satellites



Baseline Length



General Information

Mission Information

Project name	05102022A_3062
Processing date	2022-05-12 20:43:29
Mission date	2022-05-10 15:08:21
Mission duration	06:28:05.653
Processing mode	IN-Fusion PP-RTX

Rover Hardware Information

Product	POS AV 610 VER6 HW2.5-12
Serial number	S/N8708
IMU type	57
Receiver type	BD982
Antenna type	AV59

Project File List

Rover Data Files

File name	File type
6222130.000	POS Data
6222130.001	POS Data
6222130.002	POS Data
6222130.003	POS Data
6222130.004	POS Data
6222130.005	POS Data
6222130.006	POS Data
6222130.007	POS Data
6222130.008	POS Data
6222130.009	POS Data
6222130.010	POS Data
6222130.011	POS Data
6222130.012	POS Data
6222130.013	POS Data
6222130.014	POS Data
6222130.015	POS Data
6222130.016	POS Data
6222130.017	POS Data
6222130.018	POS Data
6222130.019	POS Data
6222130.020	POS Data
6222130.021	POS Data
6222130.022	POS Data
6222130.023	POS Data
6222130.024	POS Data
6222130.025	POS Data
6222130.026	POS Data
6222130.027	POS Data
6222130.028	POS Data
6222130.029	POS Data
6222130.030	POS Data
6222130.031	POS Data
6222130.032	POS Data
6222130.033	POS Data
6222130.034	POS Data
6222130.035	POS Data
6222130.036	POS Data
6222130.037	POS Data
6222130.038	POS Data
6222130.039	POS Data
6222130.040	POS Data
6222130.041	POS Data
6222130.042	POS Data
6222130.043	POS Data
6222130.044	POS Data
6222130.045	POS Data
6222130.046	POS Data
6222130.047	POS Data
6222130.048	POS Data
6222130.049	POS Data
6222130.050	POS Data
6222130.051	POS Data
6222130.052	POS Data

Input Files

File Name	File Type
Ephm1300.22g	GLONASS Broadcast Ephemeris
Ephm1300.22n	GPS Broadcast Ephemeris

Output Files

Filename	File type
sbet_05102022A_3062.out	SBET Trajectory File

Rover Data Summary

First raw data file	6222130.000		
Last raw data file	6222130.052		
Start GPS week	2209		
Start time	227282.848 (5/10/2022 3:08:02 PM)		
End time	250568.501 (5/10/2022 9:36:08 PM)		
Start of fine alignment	227681.960 (5/10/2022 3:14:41 PM)		
Available subsystems	Primary GNSS, Gimbal, IMU		
POS Event Input	None		
Correction data	None		
IMU Installation Lever Arms & Mounting Angles			
Gimbal to IMU lever arm (m)	0.000	0.000	0.000
Gimbal to IMU mounting angles (deg)	0.000	0.000	0.000
Gimbal to Primary GNSS lever arm (m)	0.142	-0.236	-1.269
Gimbal to Primary GNSS lever arm std dev (m)	-1.000		
Aircraft to Reference mounting angles (deg)	0.000	0.000	0.000

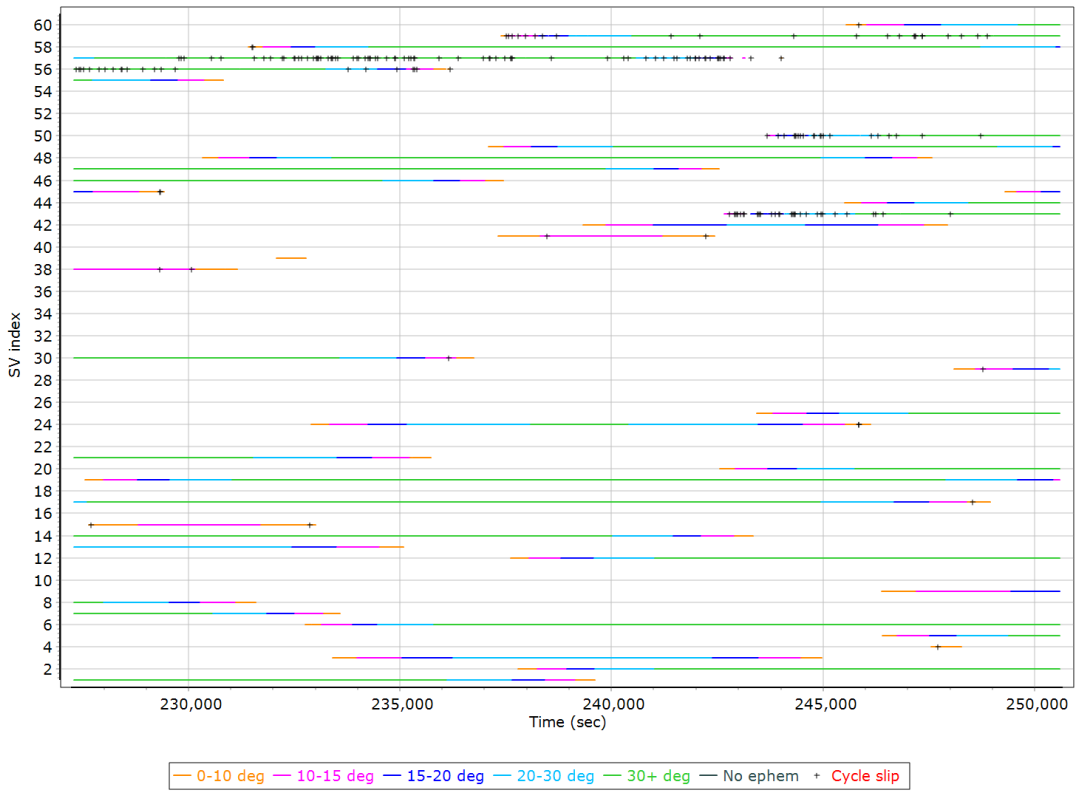
Rover Data QC

Raw IMU Import QC Summary

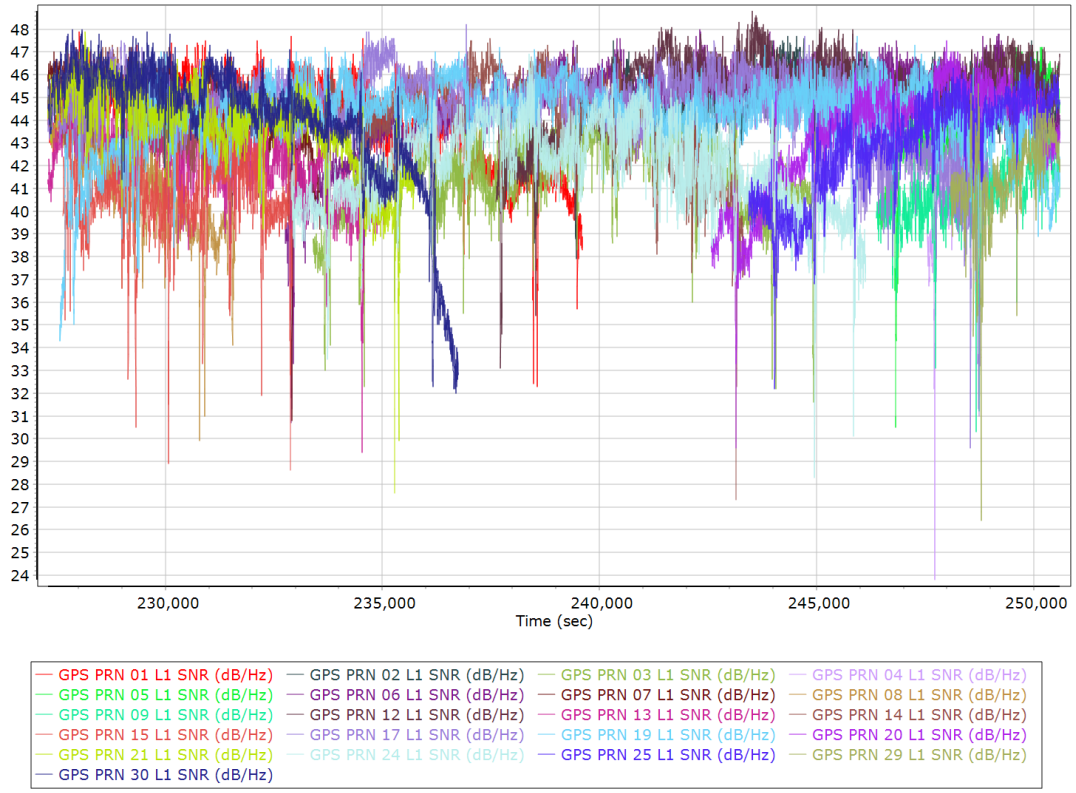
IMU data input file	imu_Mission 1.dat
IMU data check log file	imudt_05102022A_3062.log
IMU Records Processed	4658015
Termination Status	Normal
IMU Anomalies	0

Primary Observables & Satellite Data

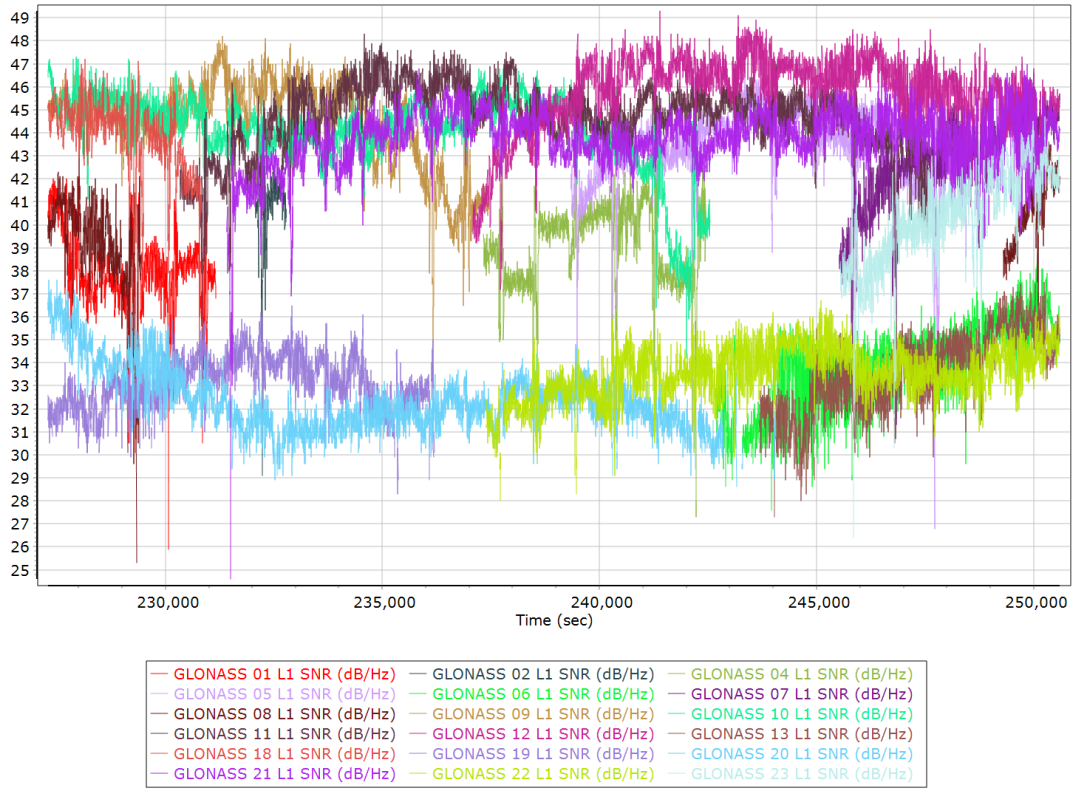
GPS/GLONASS L1 Satellite Lock/Elevation



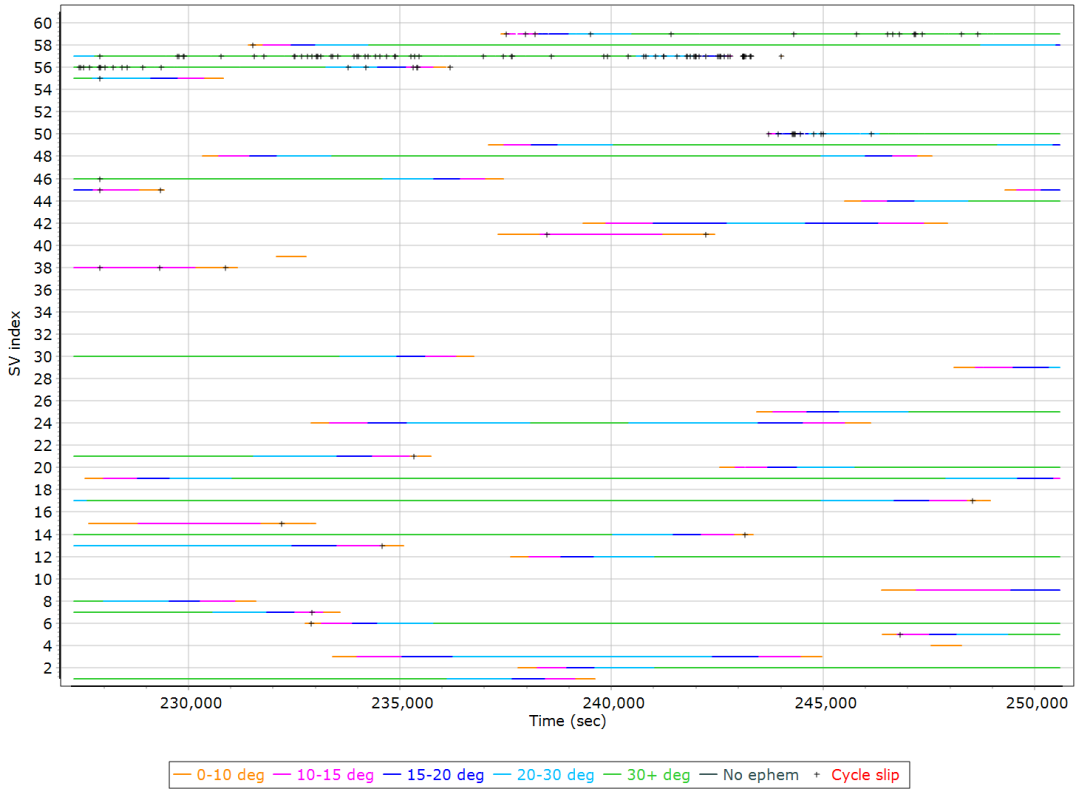
GPS L1 SNR



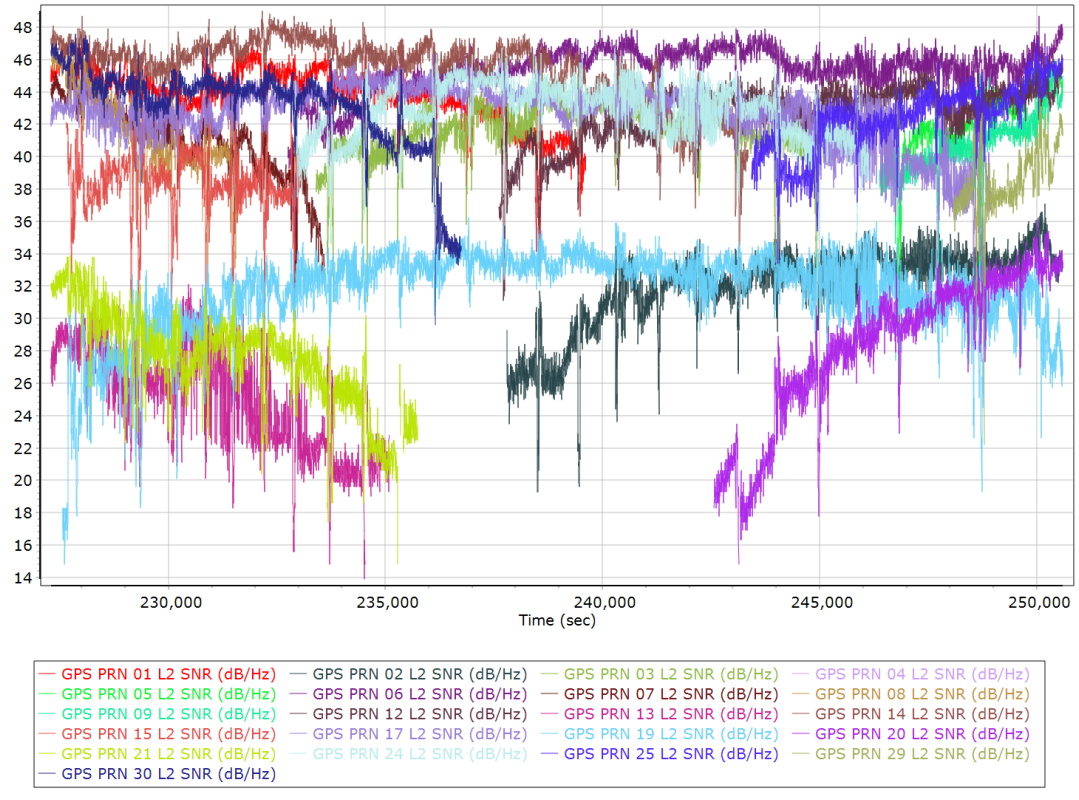
GLONASS L1 SNR



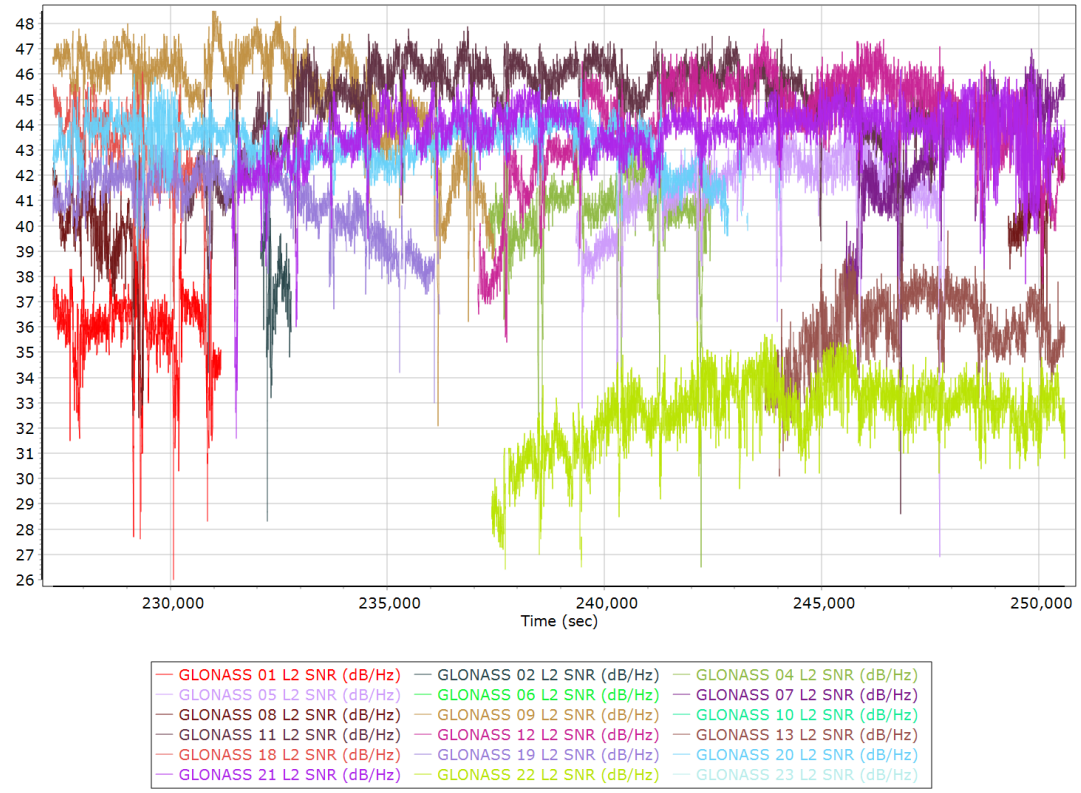
GPS/GLONASS L2 Satellite Lock/Elevation



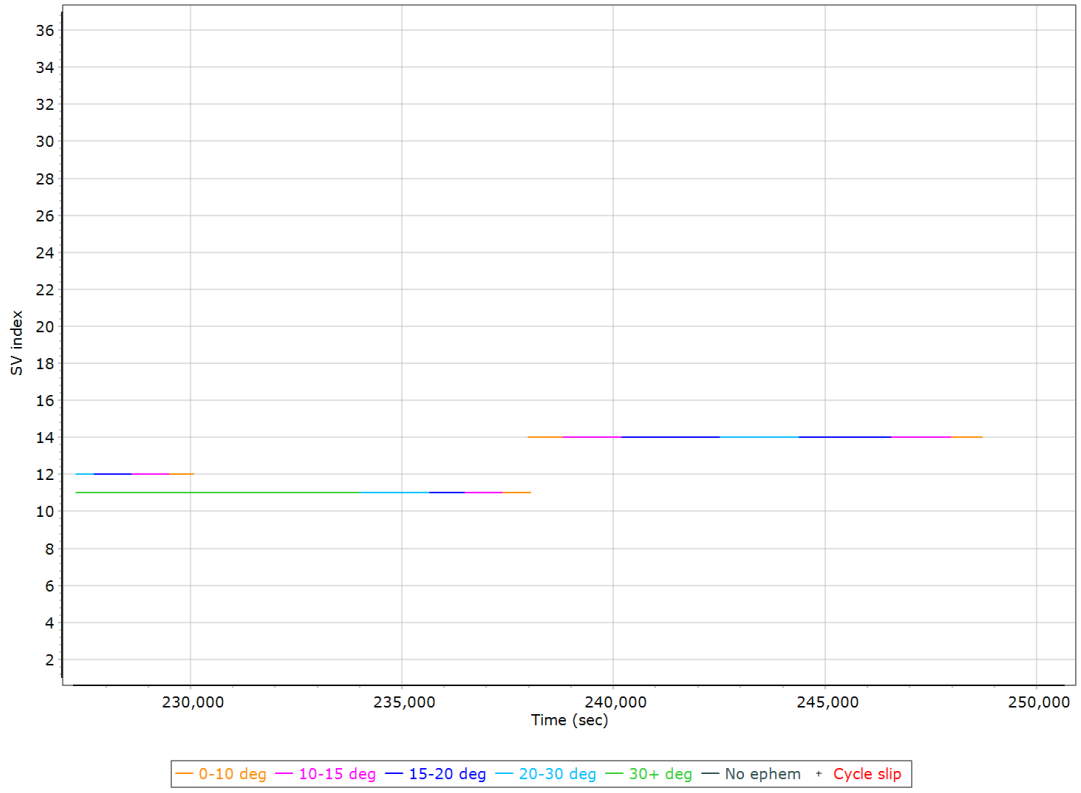
GPS L2 SNR



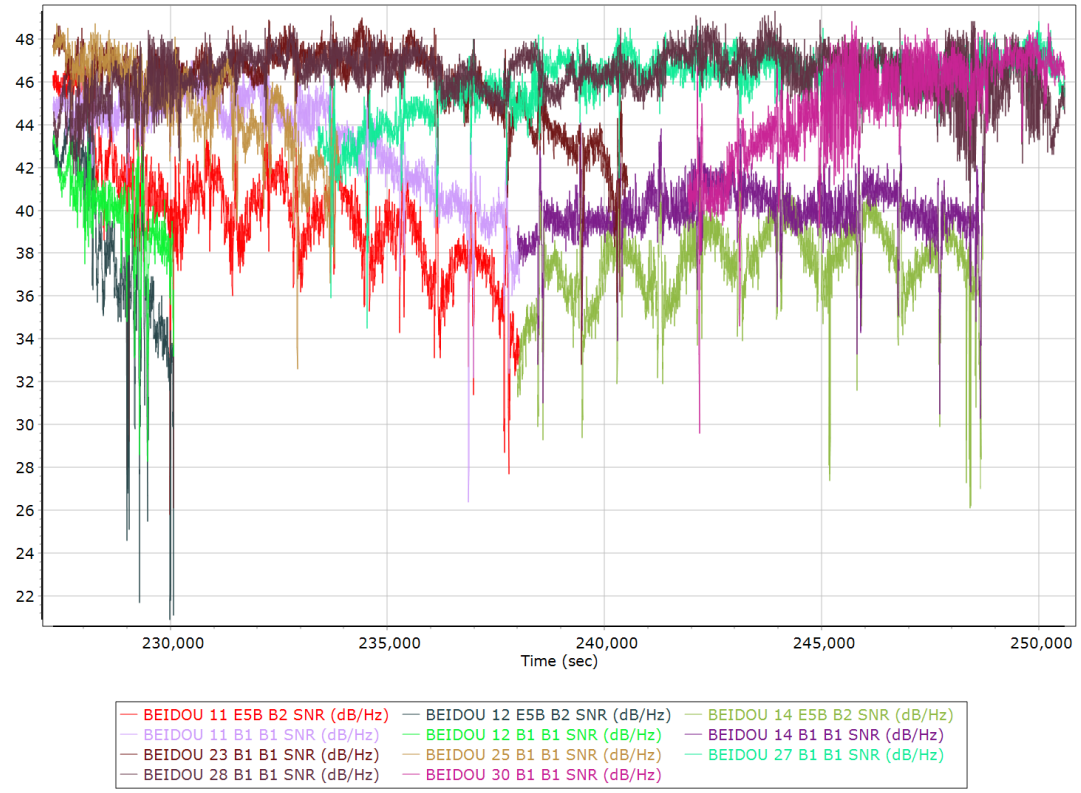
GLONASS L2 SNR



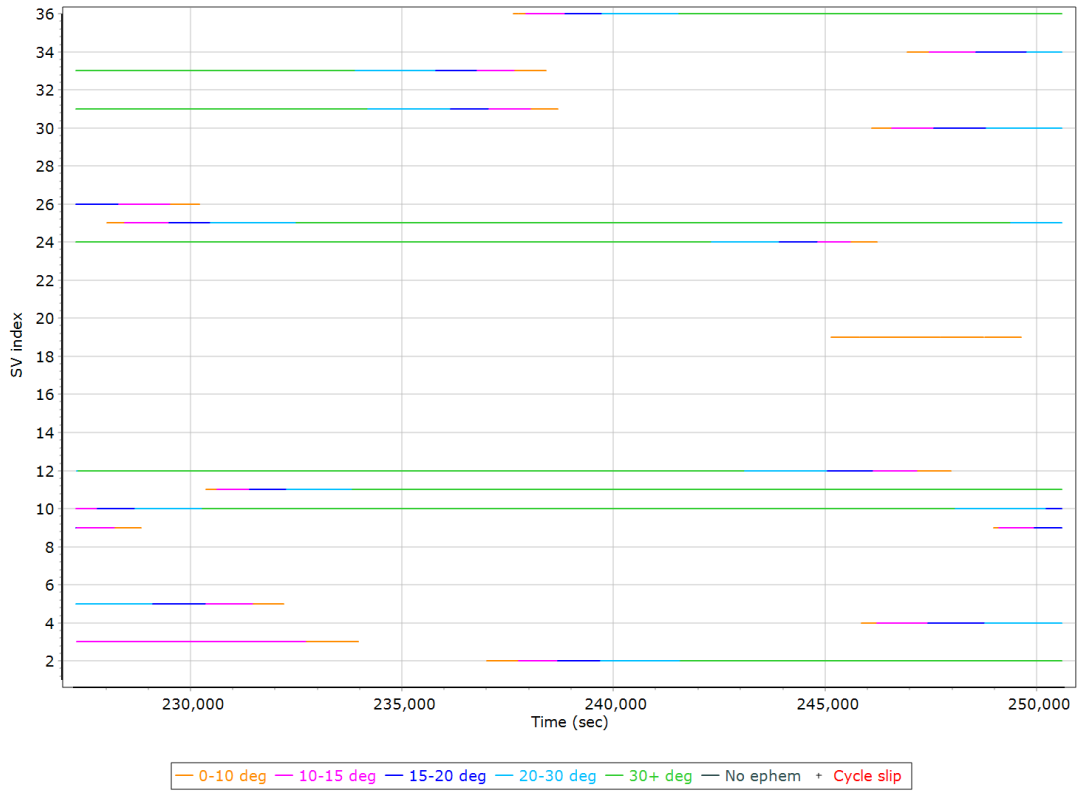
BEIDOU Satellite Lock/Elevation



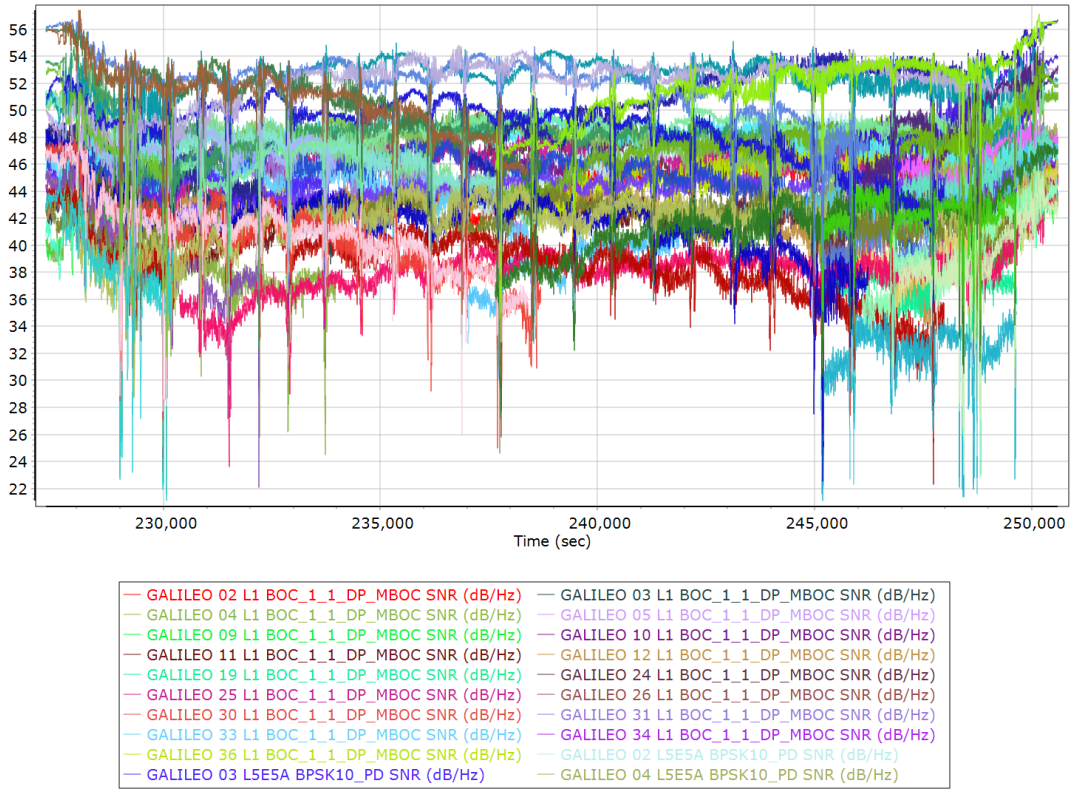
BEIDOU SNR



GALILEO Satellite Lock/Elevation

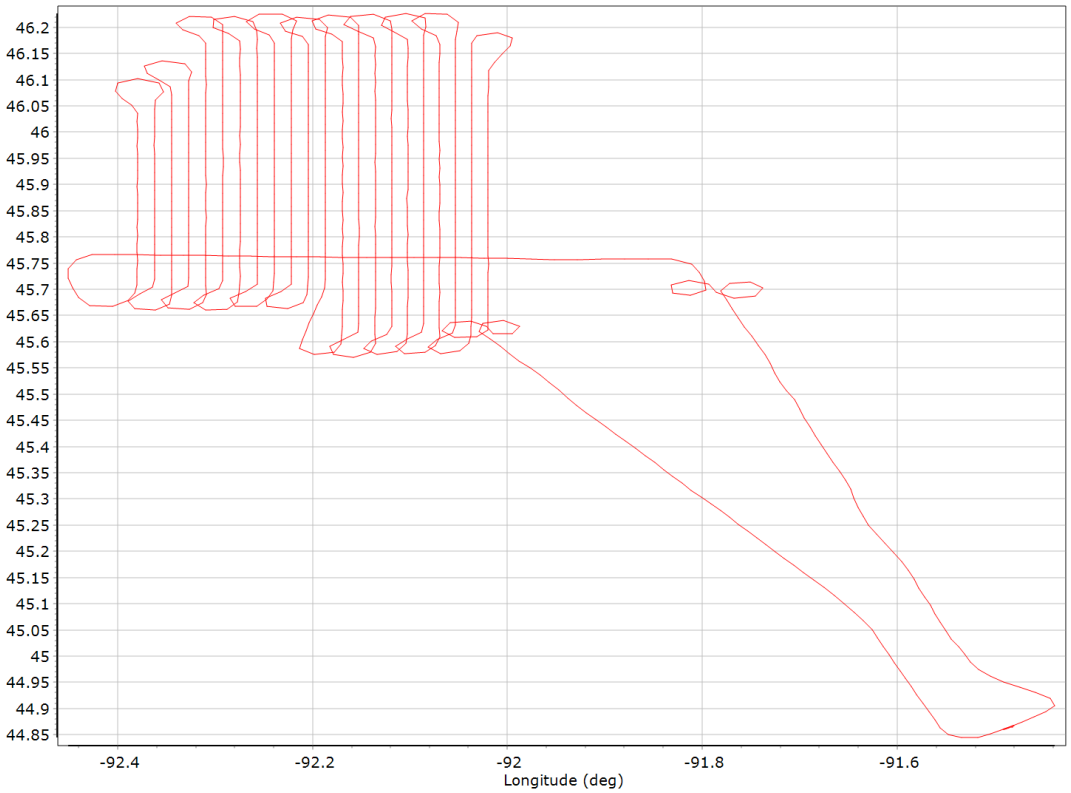


GALILEO SNR

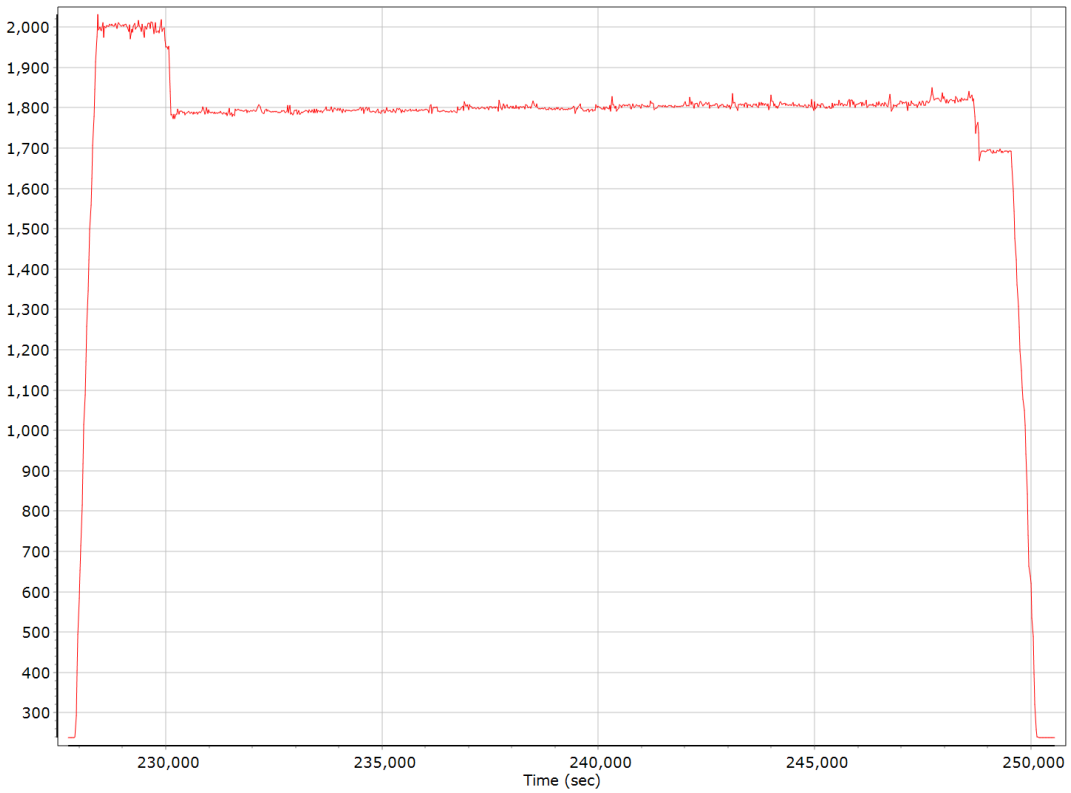

56
54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
230,000
235,000
240,000
245,000
250,000
Time (sec)
GALILEO 02 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 03 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 04 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 05 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 09 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 10 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 11 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 12 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 19 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 24 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 25 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 26 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 30 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 31 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 33 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 34 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 36 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 02 L5E5A BPSK10_PD SNR (dB/Hz)
GALILEO 03 L5E5A BPSK10_PD SNR (dB/Hz)
GALILEO 04 L5E5A BPSK10_PD SNR (dB/Hz)

Smoothed Trajectory Information

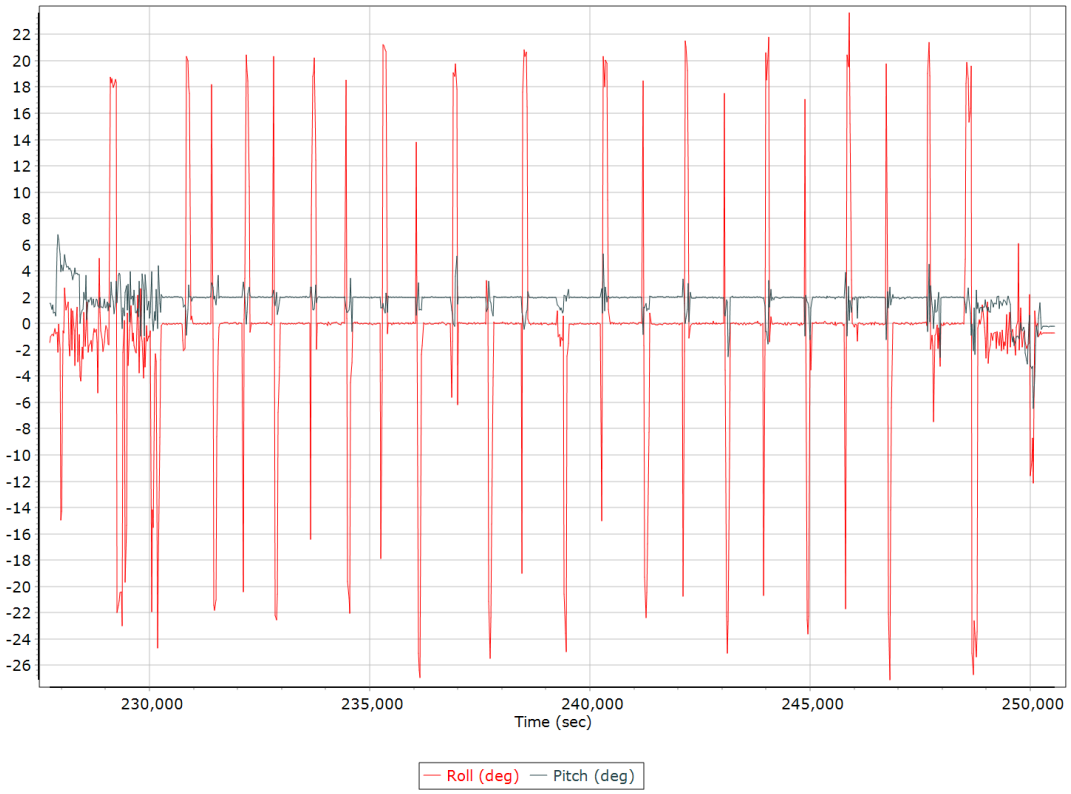
Top View



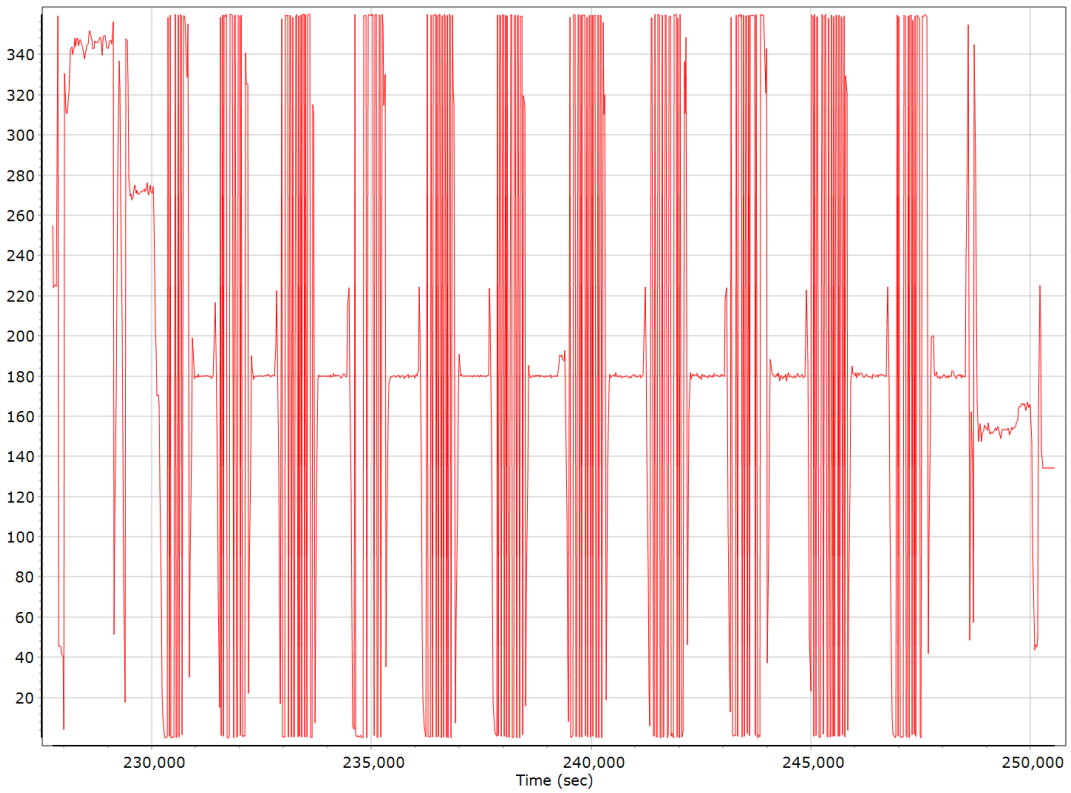
Altitude



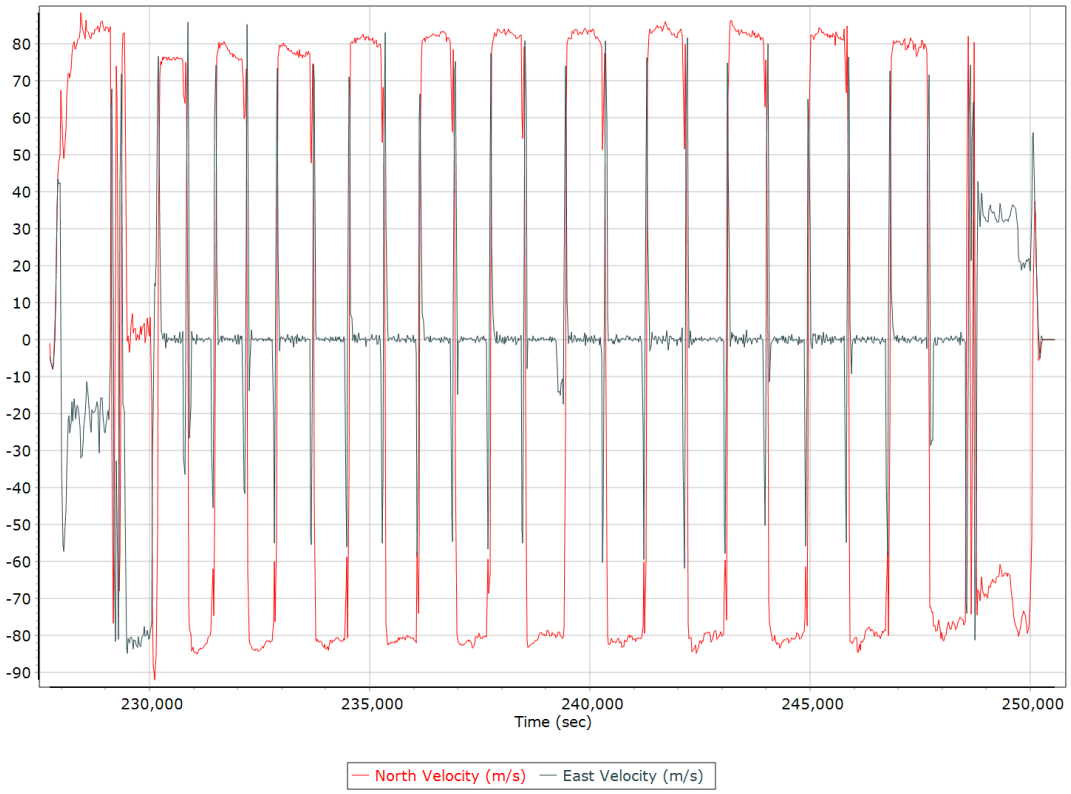
Roll/Pitch



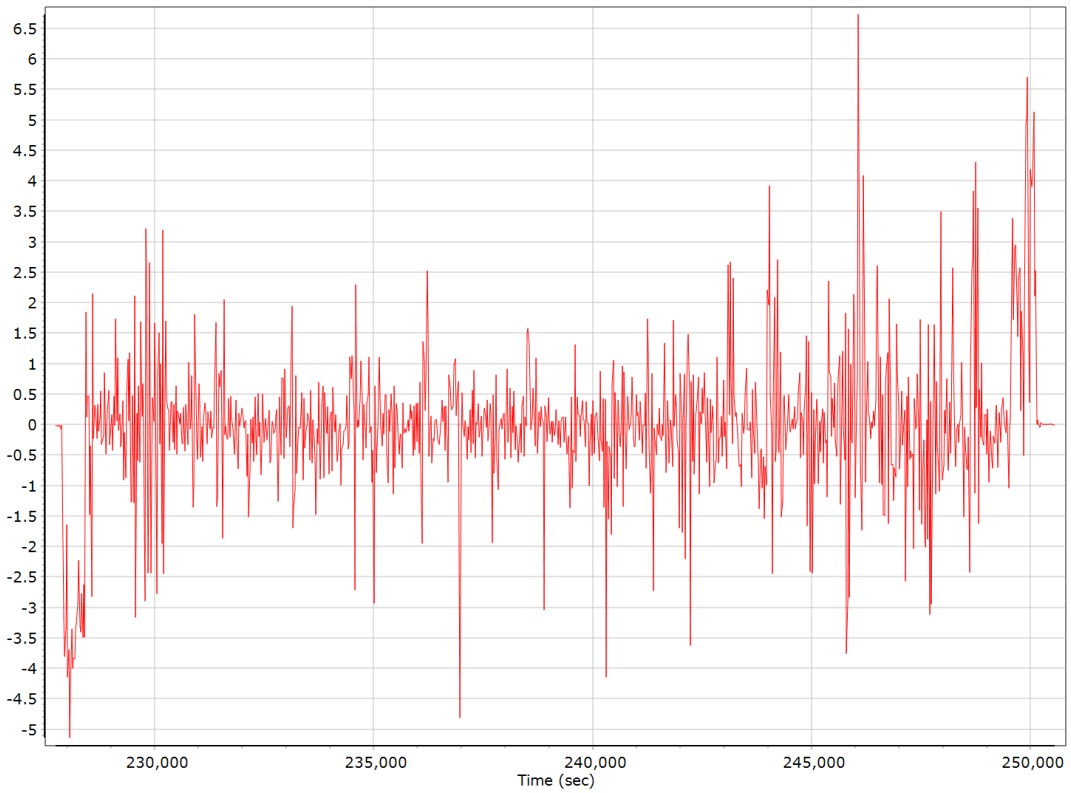
Heading



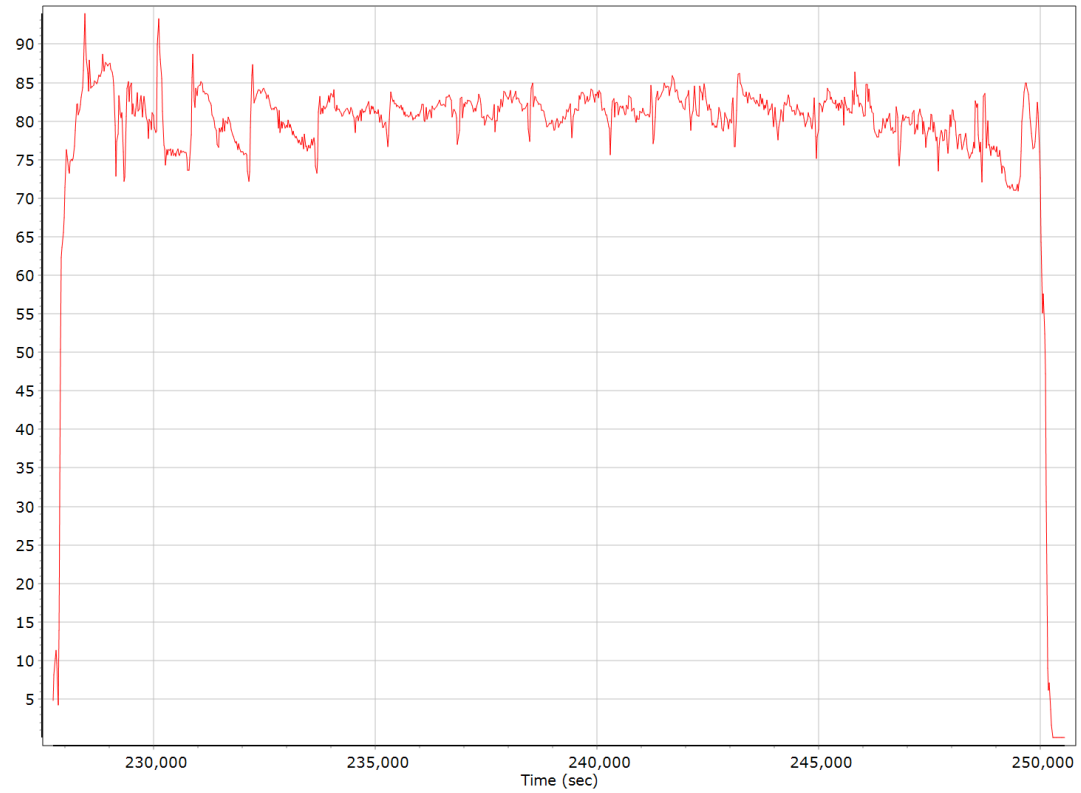
North/East Velocity



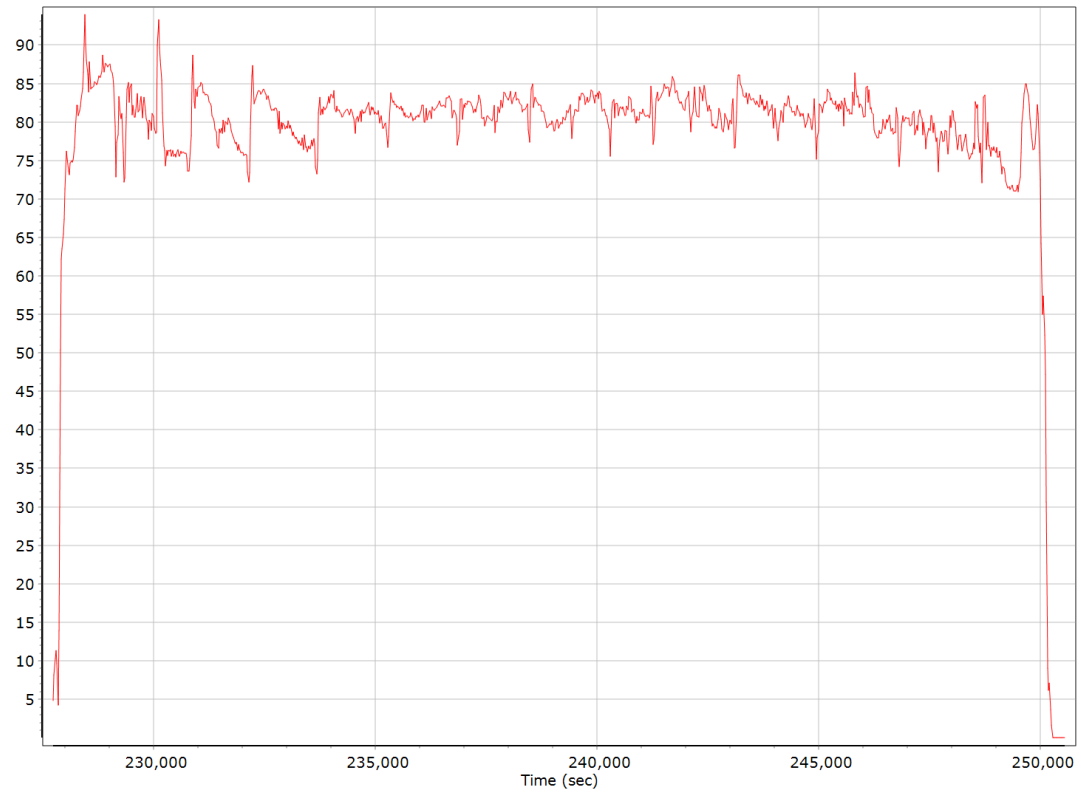
Down Velocity



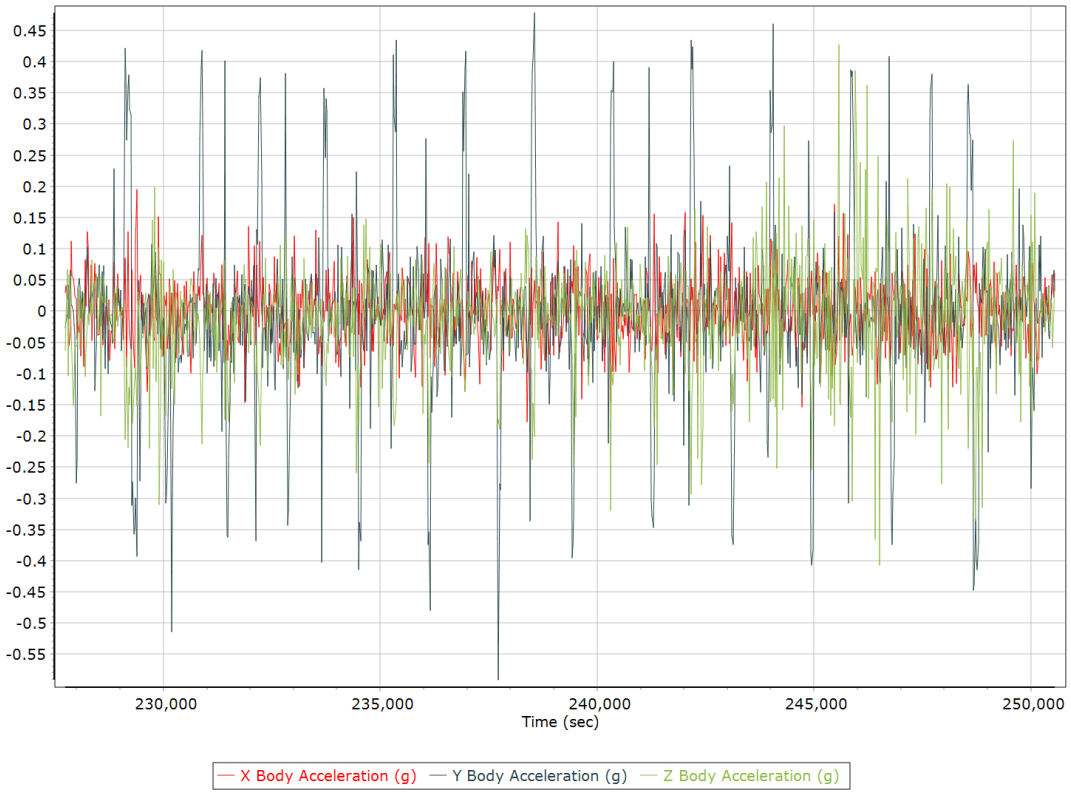
Total Speed



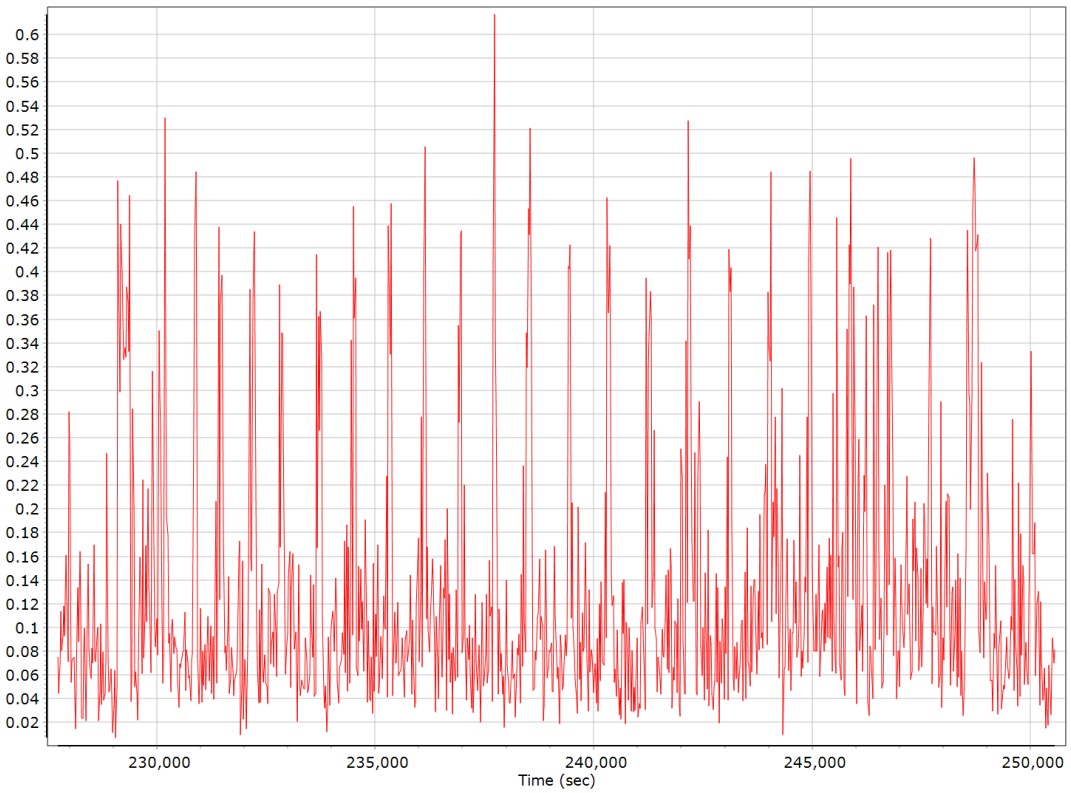
Ground Speed



Body Acceleration



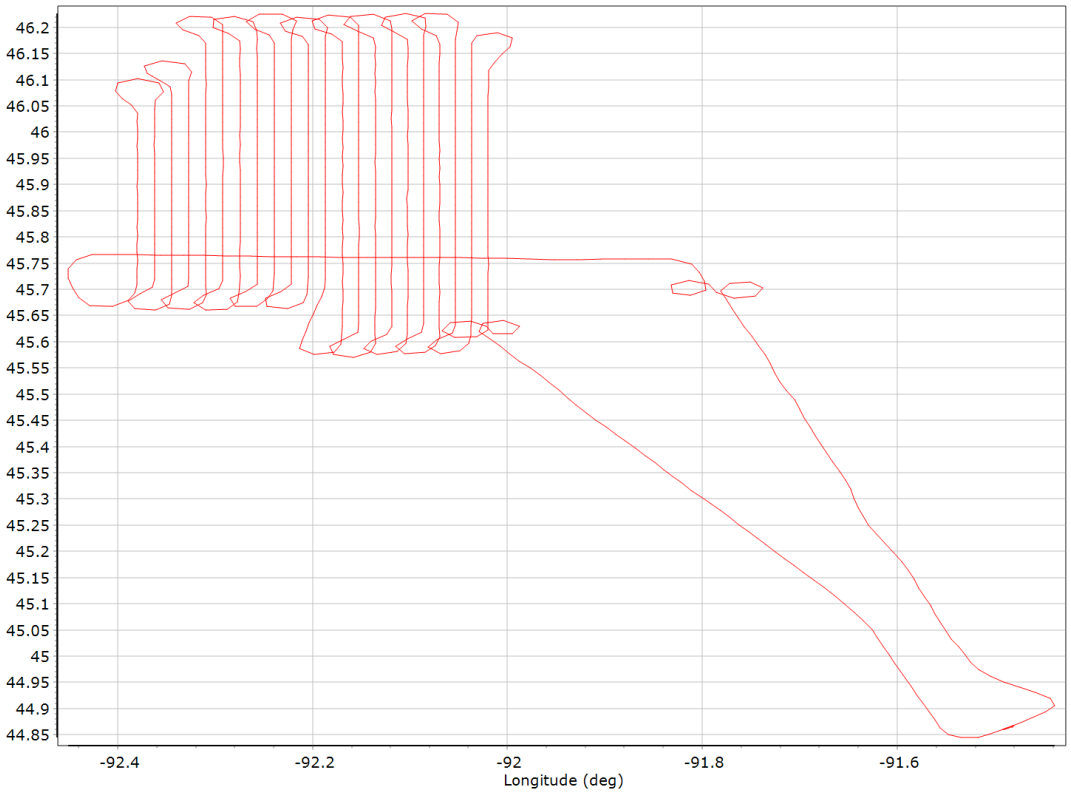
Total Body Acceleration



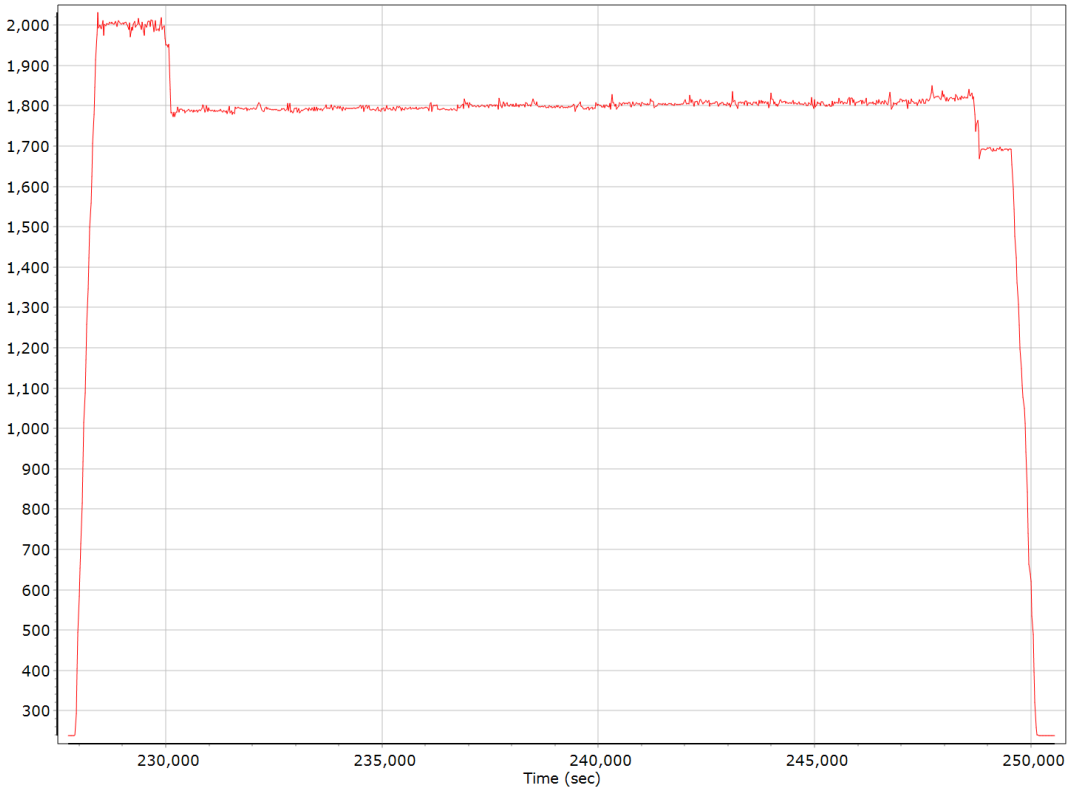
Body Angular Rate

Forward Processed Trajectory Information

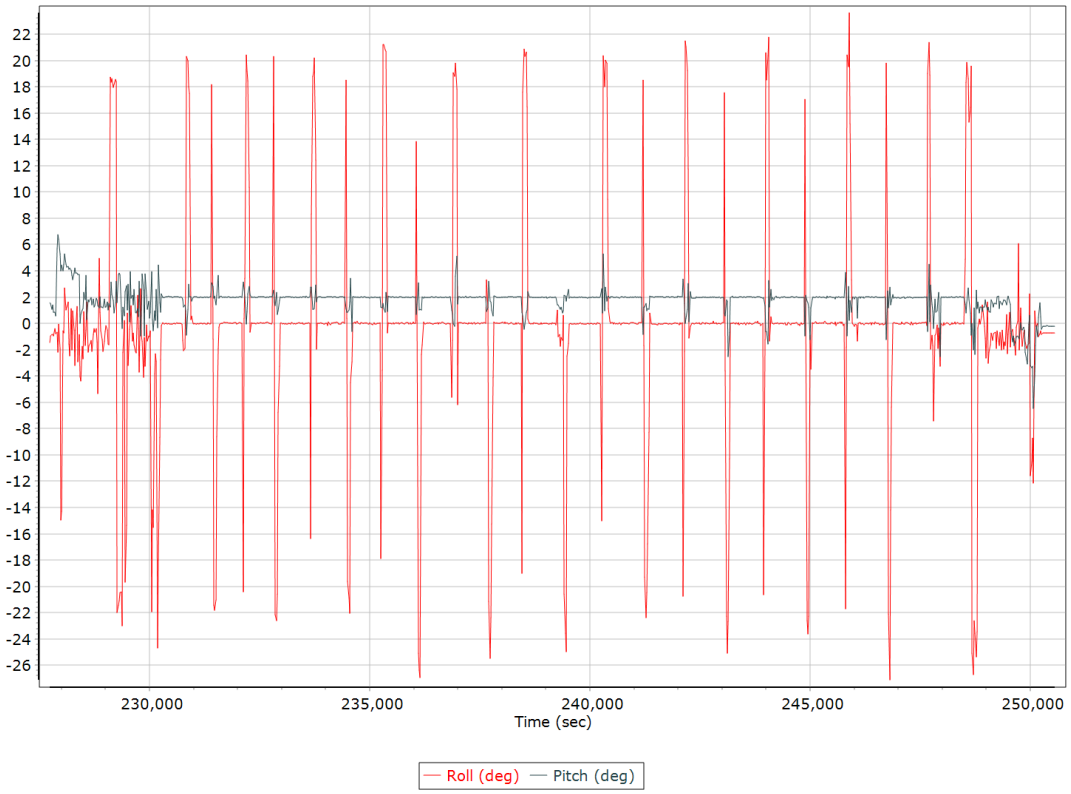
Top View



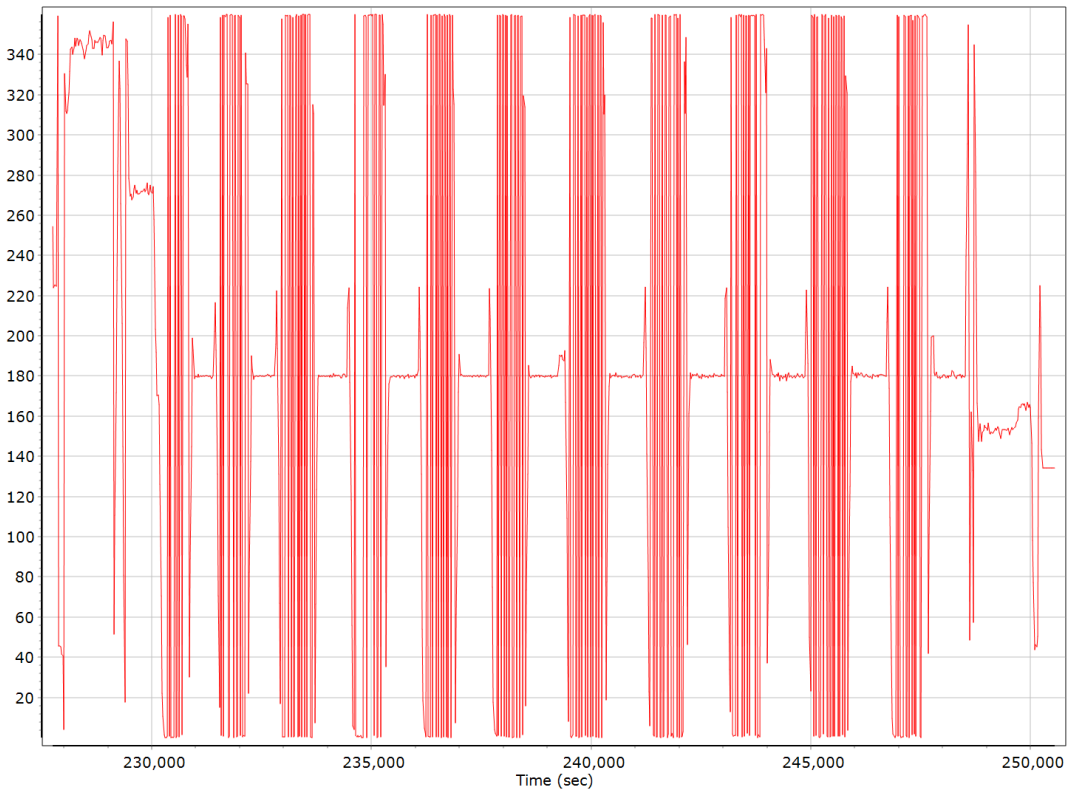
Altitude



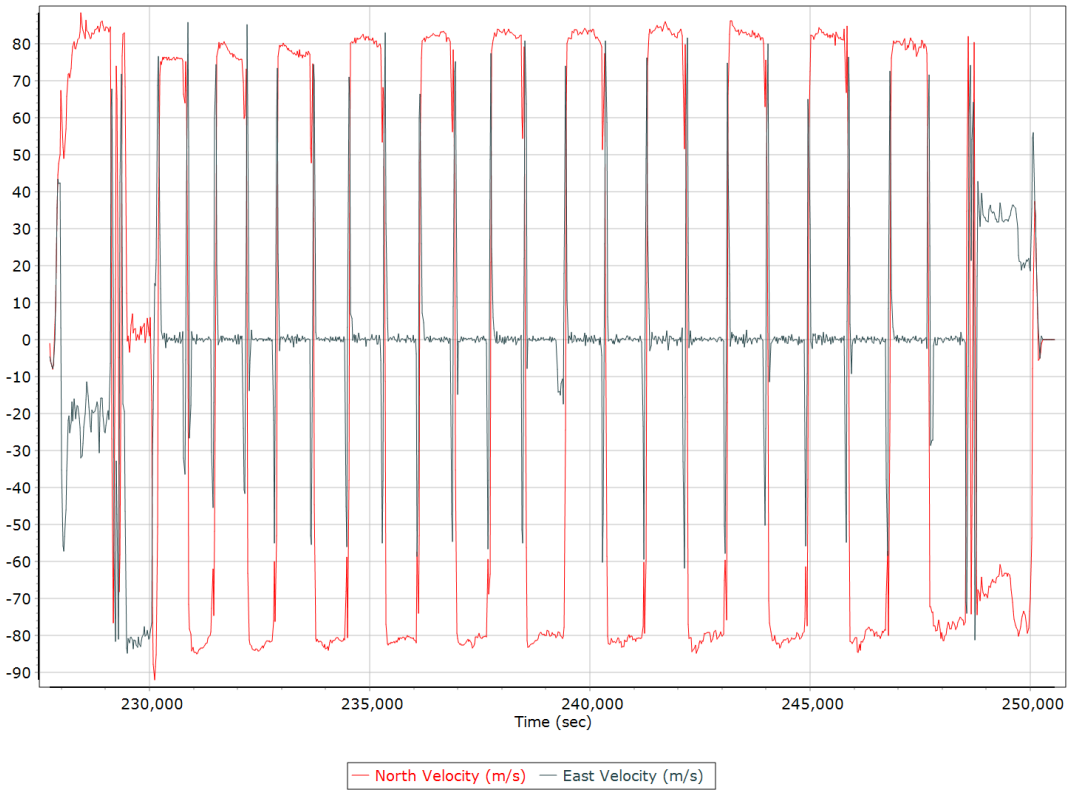
Roll/Pitch



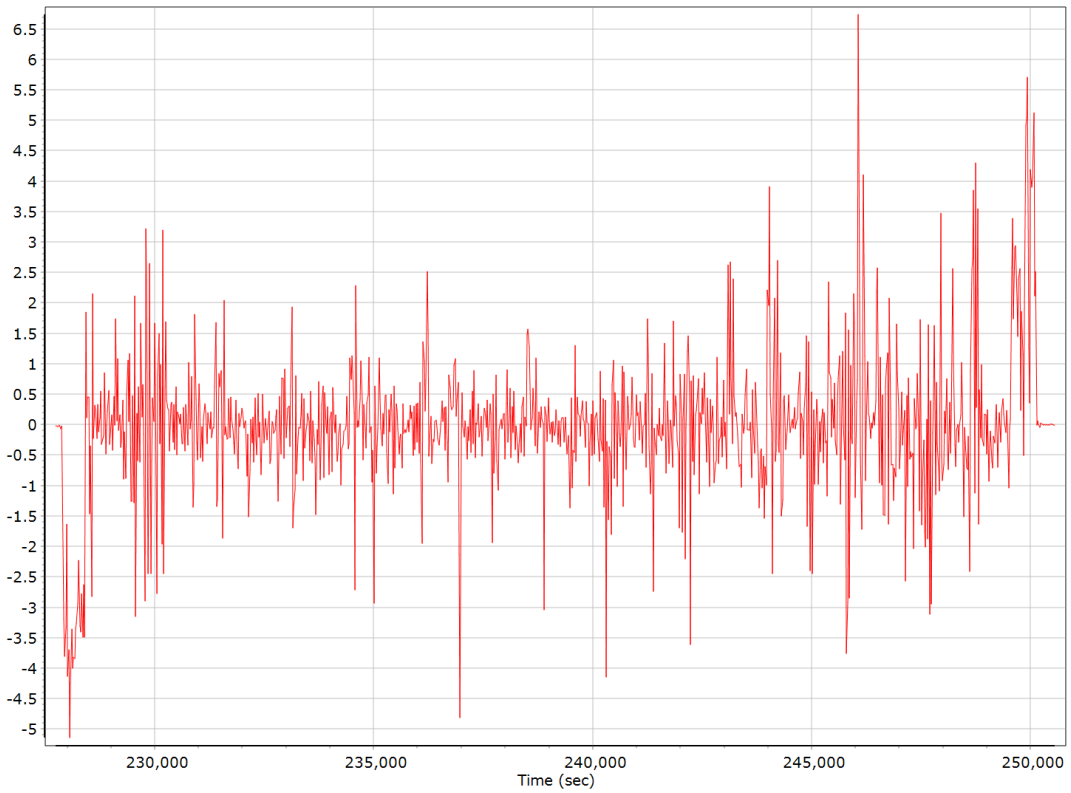
Heading



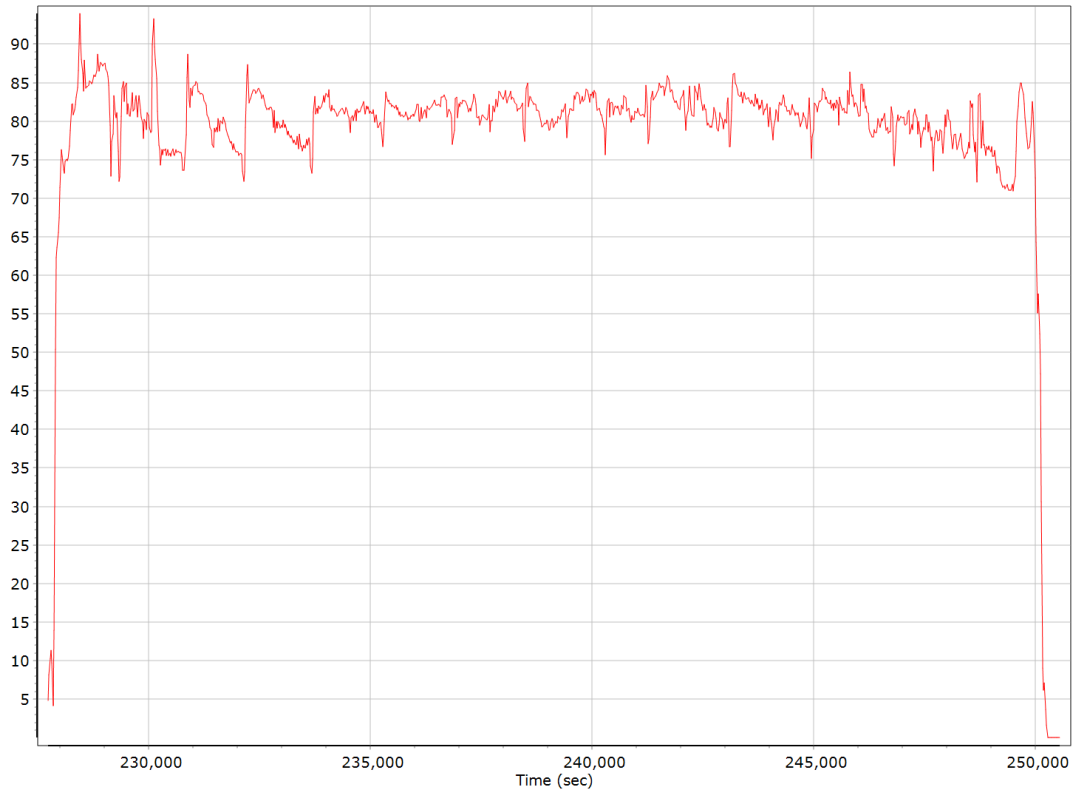
North/East Velocity



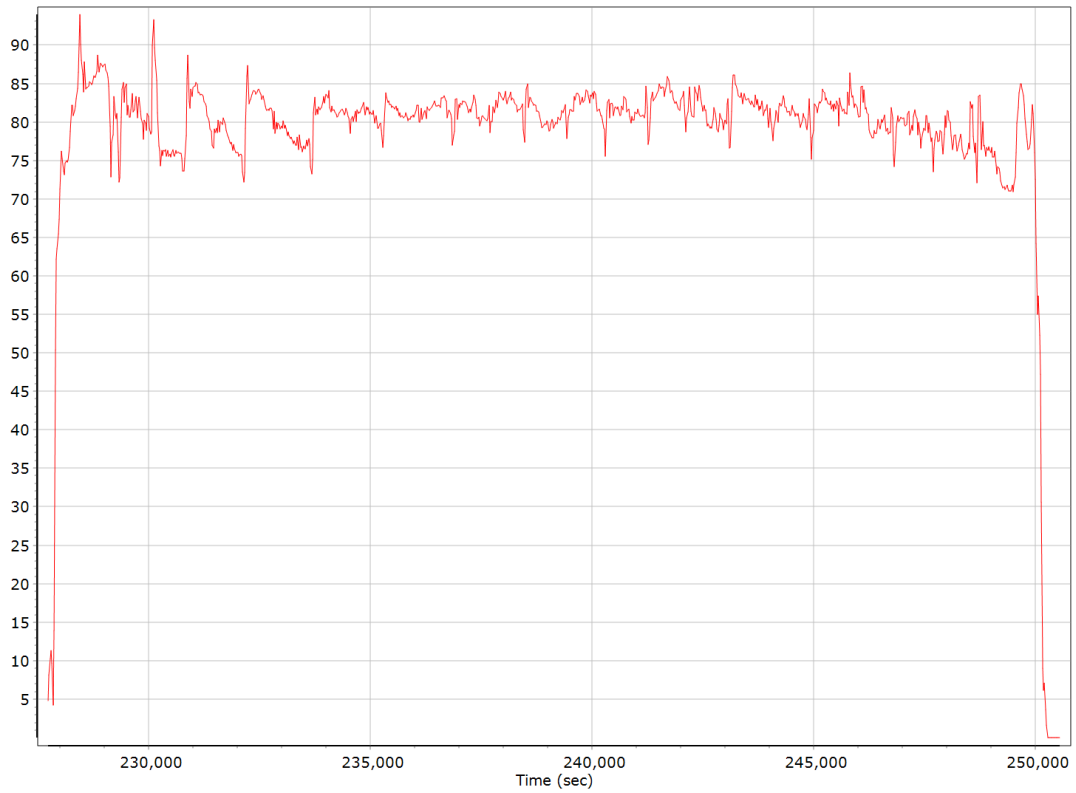
Down Velocity



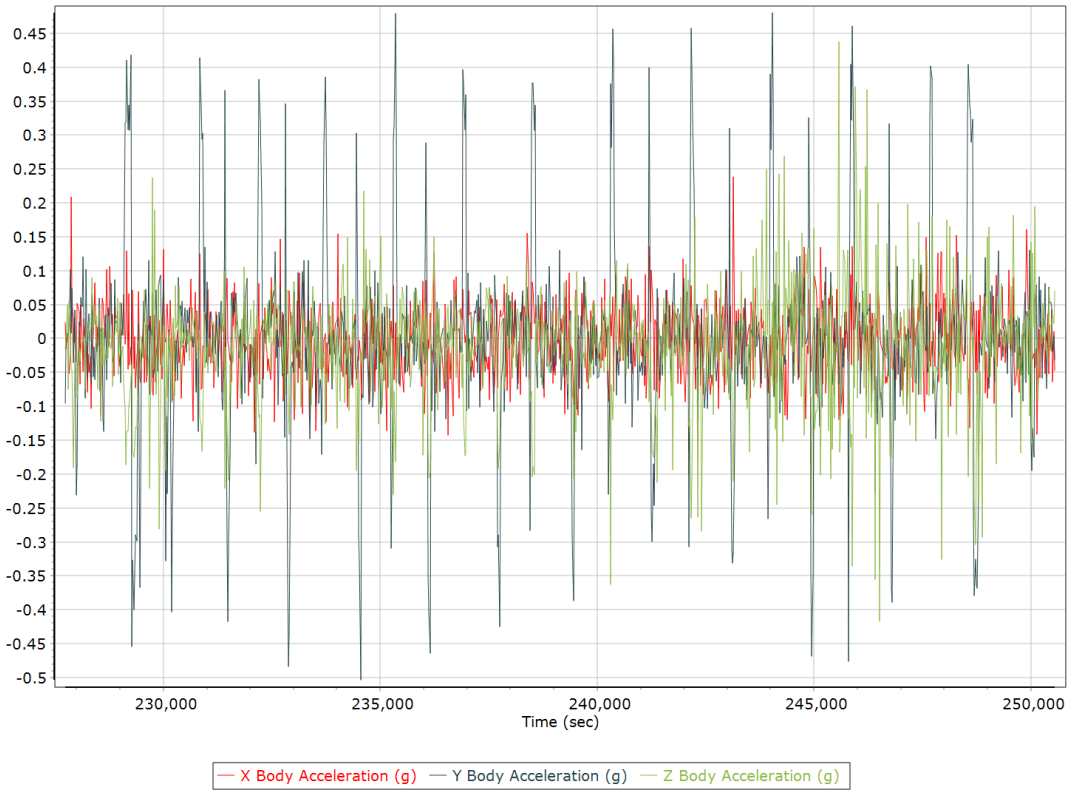
Total Speed



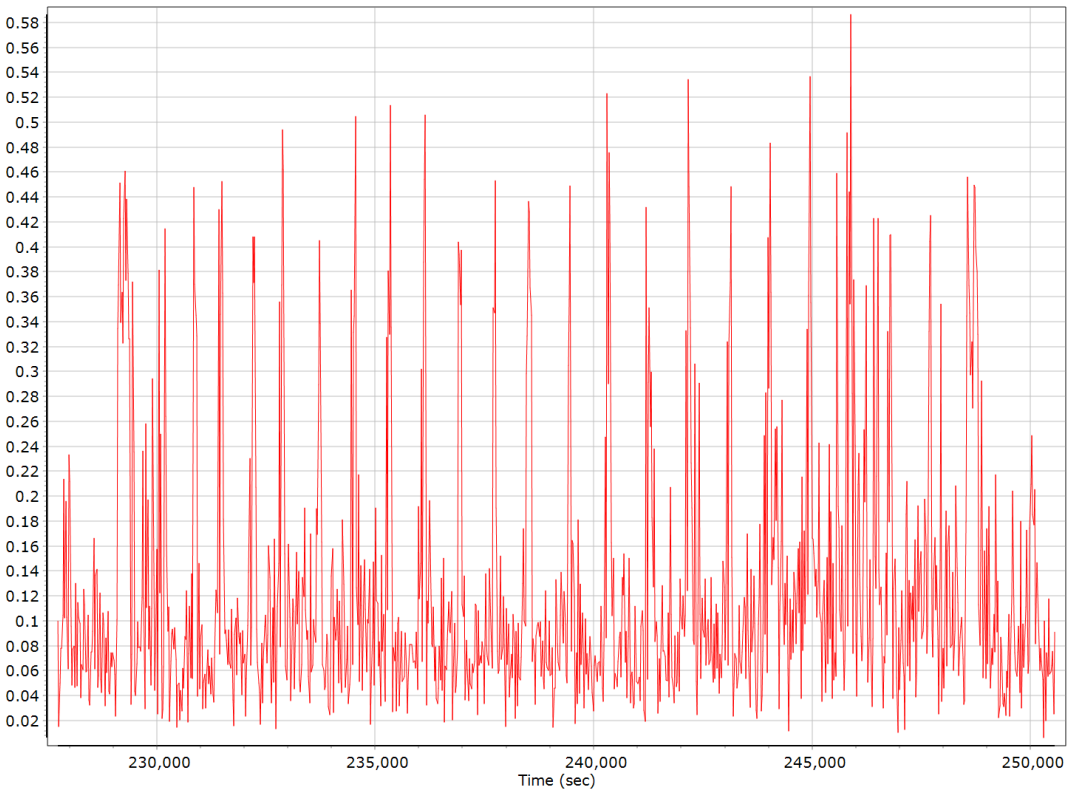
Ground Speed



Body Acceleration



Total Body Acceleration



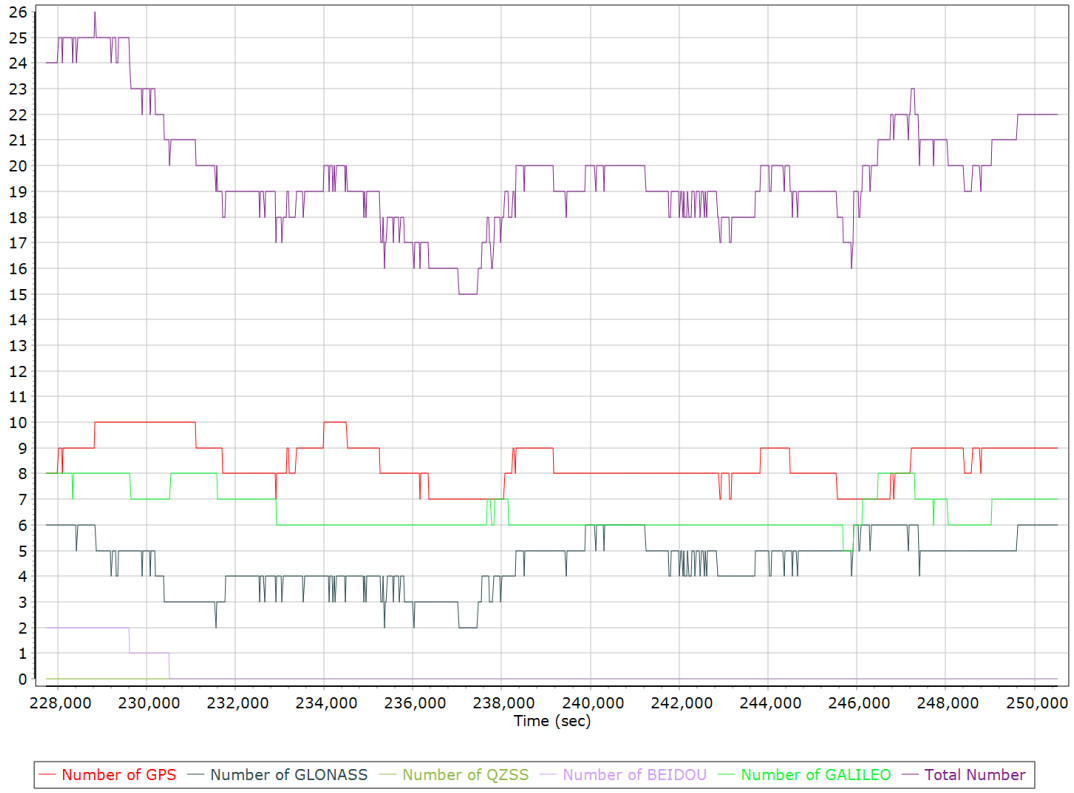
Body Angular Rate

GNSS QC

GNSS QC Statistics

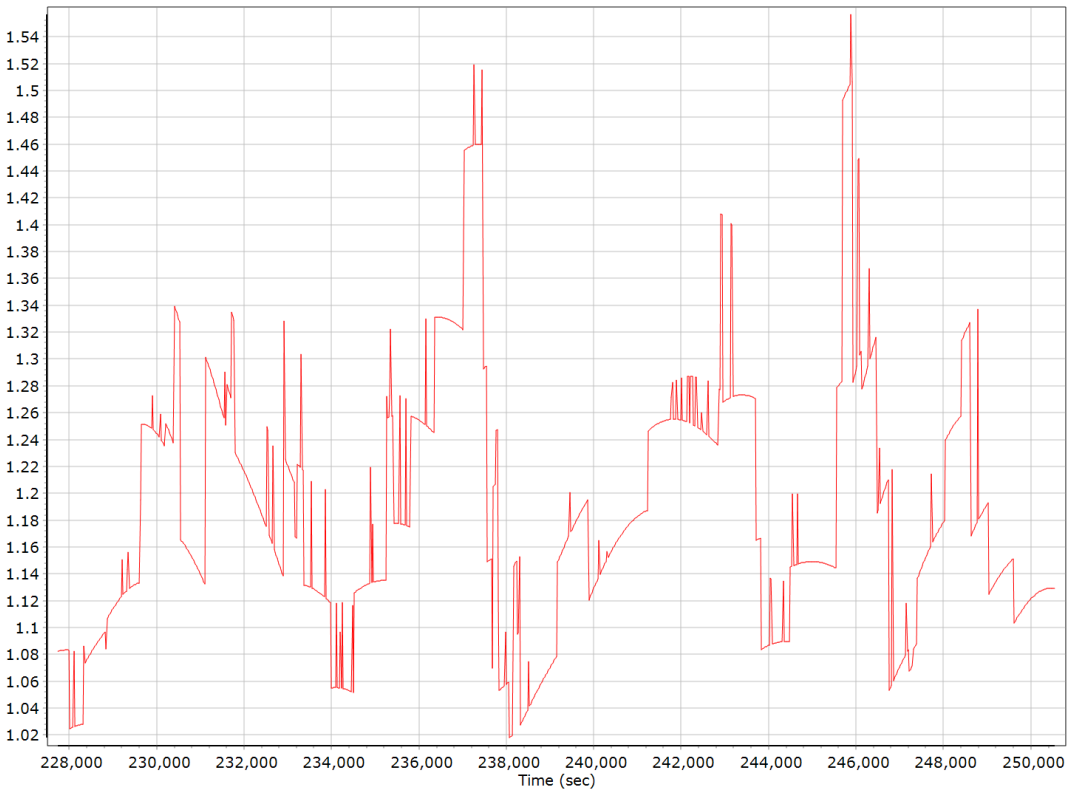
Statistics	Min	Max	Mean
Baseline length (km)	0.00	0.00	
Number of GPS SV	4	10	8
Number of GLONASS SV	0	6	5
Number of QZSS SV	0	0	0
Number of BEIDOU SV	0	2	0
Number of GALILEO SV	2	8	7
Total number of SV	11	26	20
PDOP	1.02	2.34	1.19
QC Solution Gaps	1.00	1.00	
Solution Type	Fixed	Float	No solution
Epoch (sec)	23205.00	0.00	33.00
Percentage	99.86	0.00	0.14

Num SVs in solution

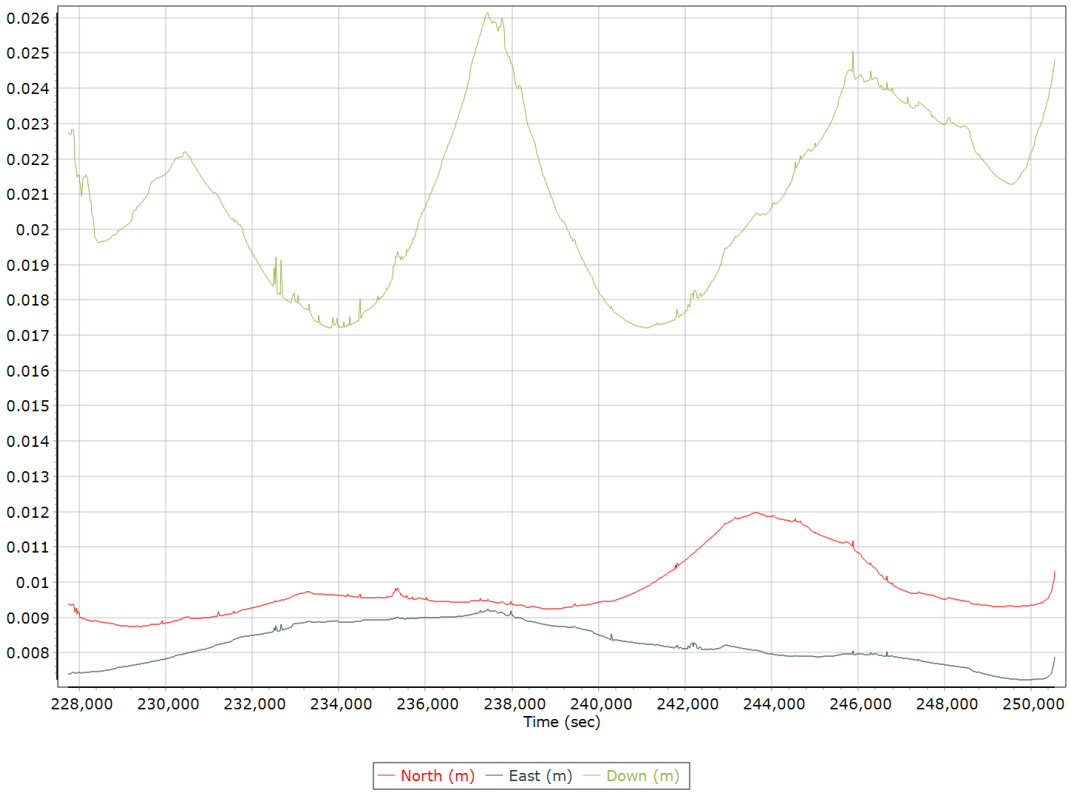


Forward/Reverse Separation

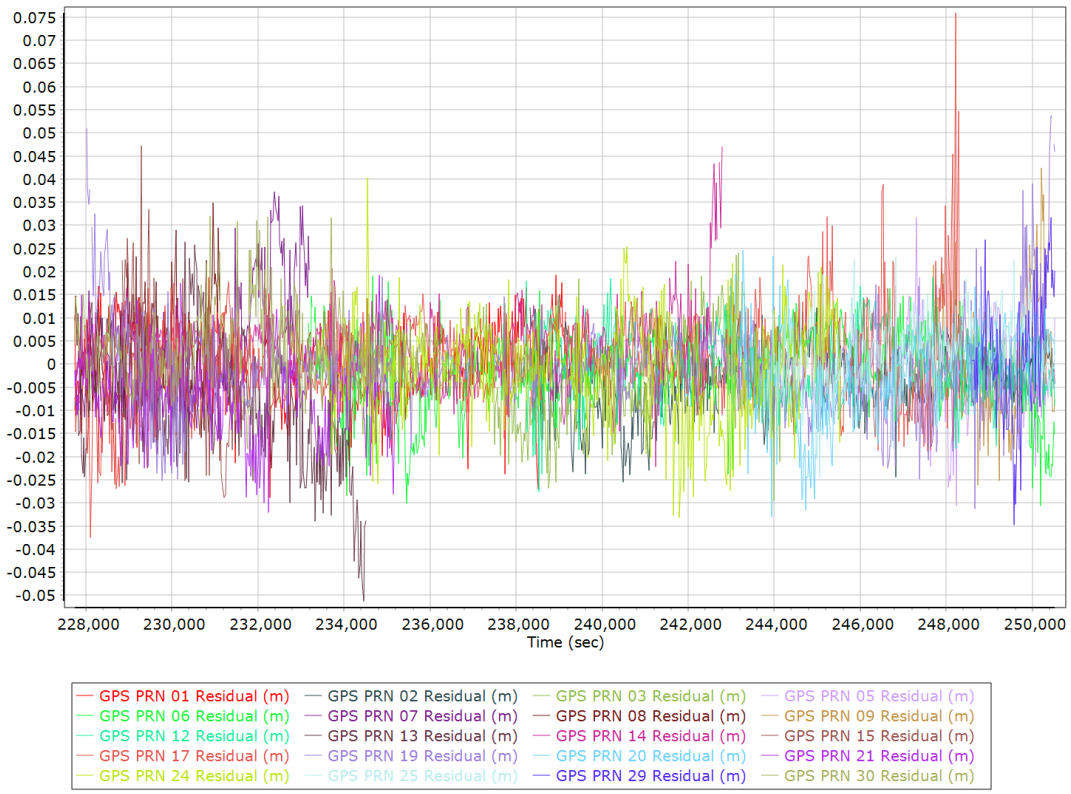
PDOP



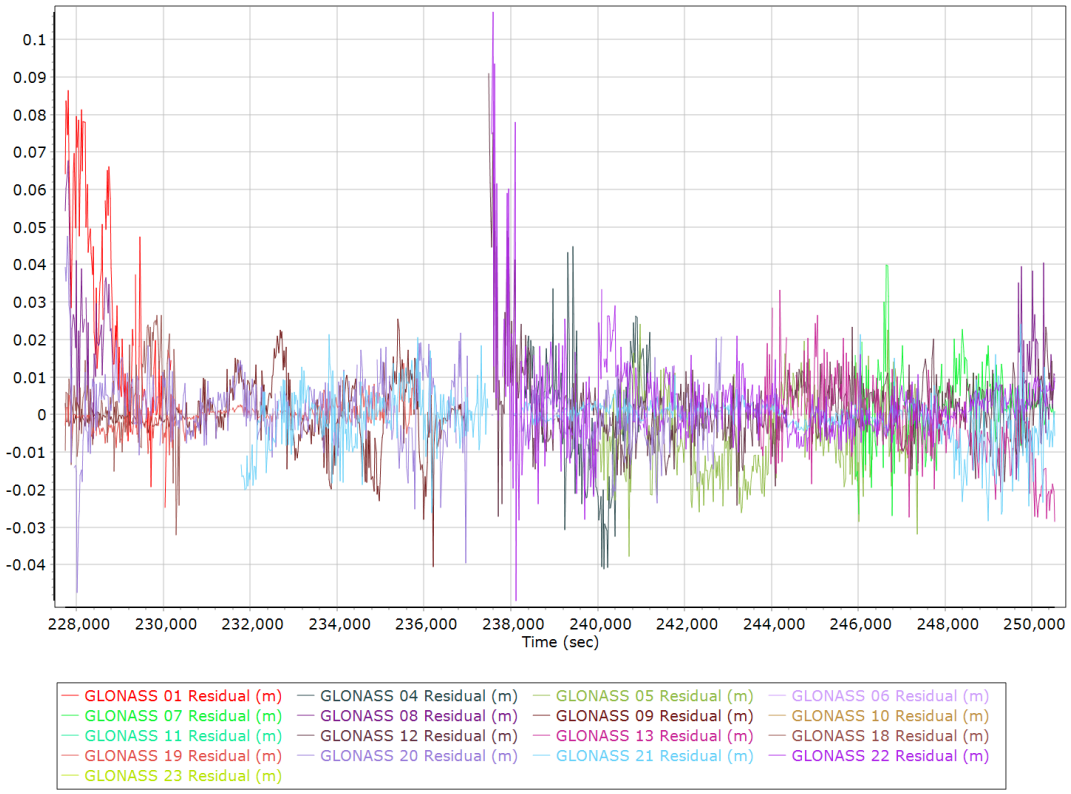
Estimated Position Accuracy



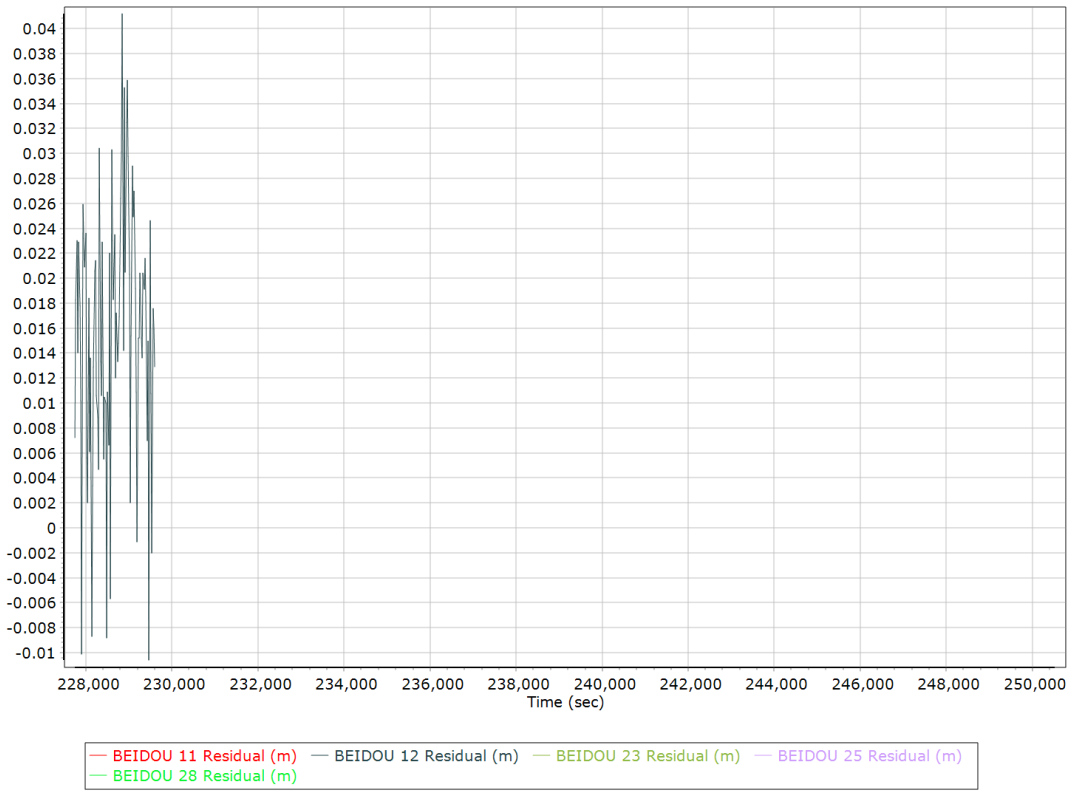
GPS Residuals



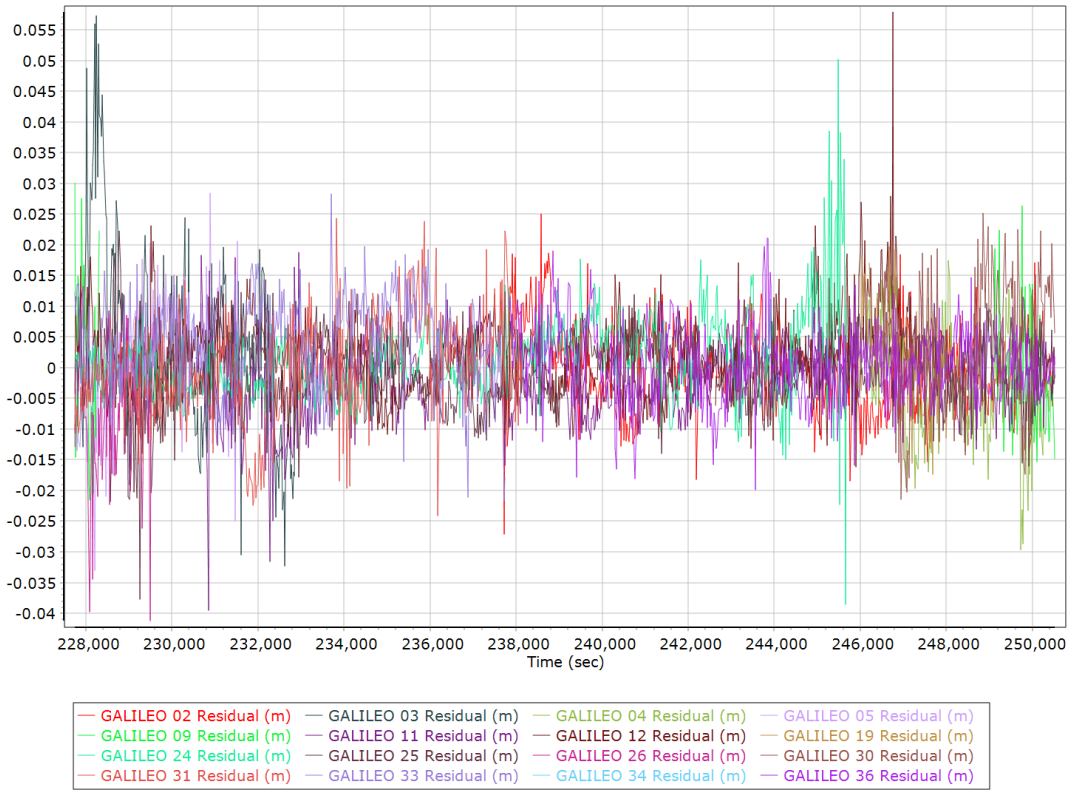
GLONASS Residuals



BEIDOU Residuals



GALILEO Residuals



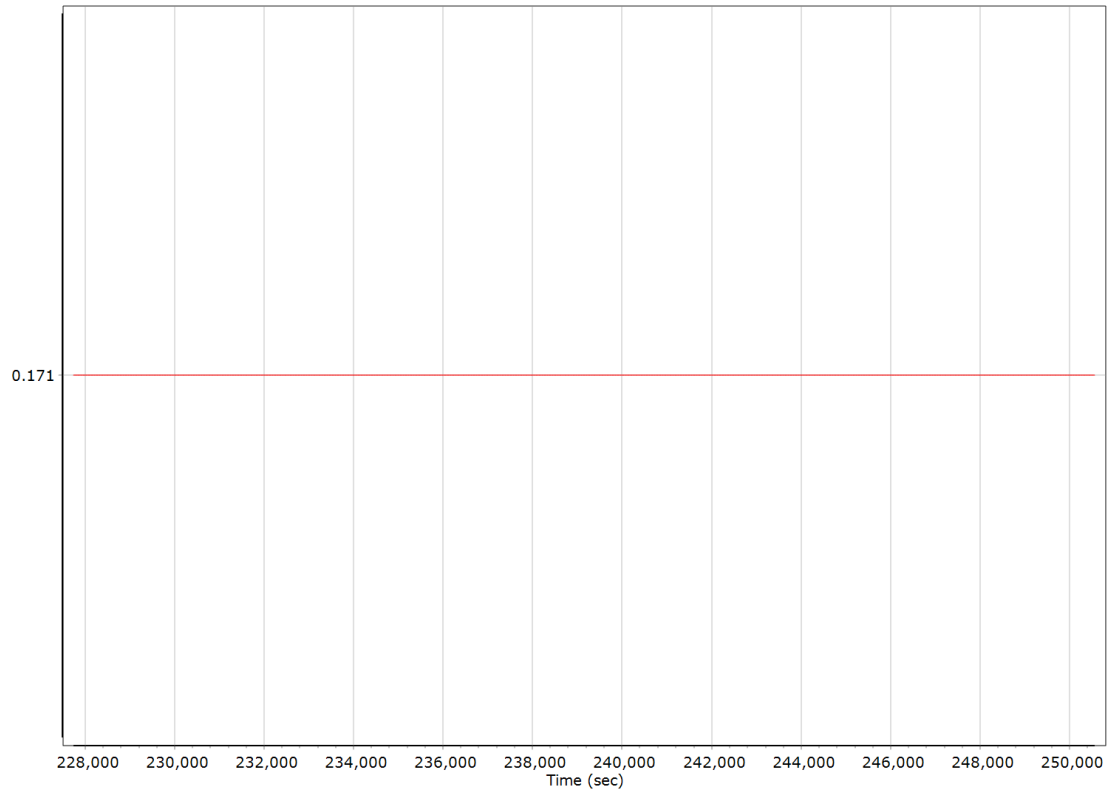
GNSS-Inertial Processor Configuration

Processing mode	IN-Fusion PP-RTX		
Stabilized mount	True		
Processing start time	227283.000 (5/10/2022 3:08:03 PM)		
Processing end time	250578.000 (5/10/2022 9:36:18 PM)		
Initial attitude source	Real-Time VNAV/RNAV Attitude		
IMU Sensor Context	Processing with Onboard IMU		
Gimbal to IMU lever arm (m)	0.000	0.000	0.000
Gimbal to IMU mounting angles (deg)	0.000	0.000	0.000
Gimbal to Primary GNSS lever arm (m)	0.171	-0.238	-1.273
Gimbal to Primary GNSS lever arm std dev (m)	0.030	0.030	0.030
Aircraft to Reference mounting angles (deg)	0.000	0.000	0.000

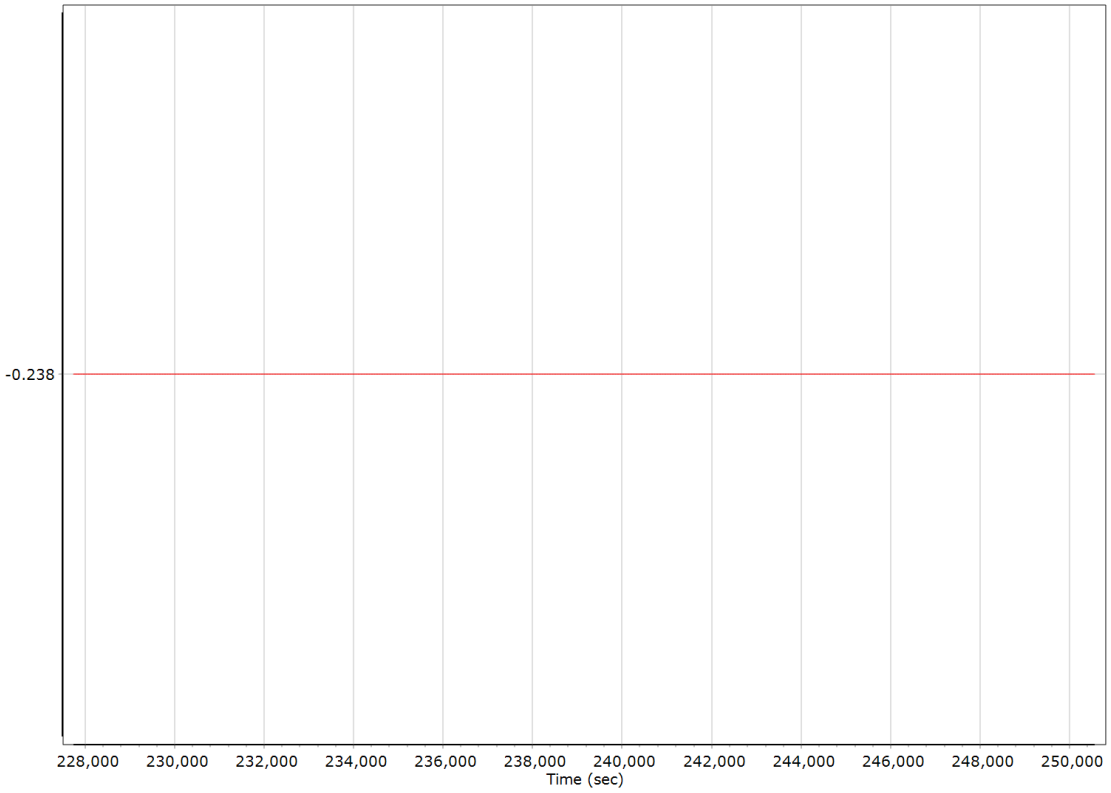
Calibrated Installation Parameters

Reference-Primary GNSS Lever Arm (m)

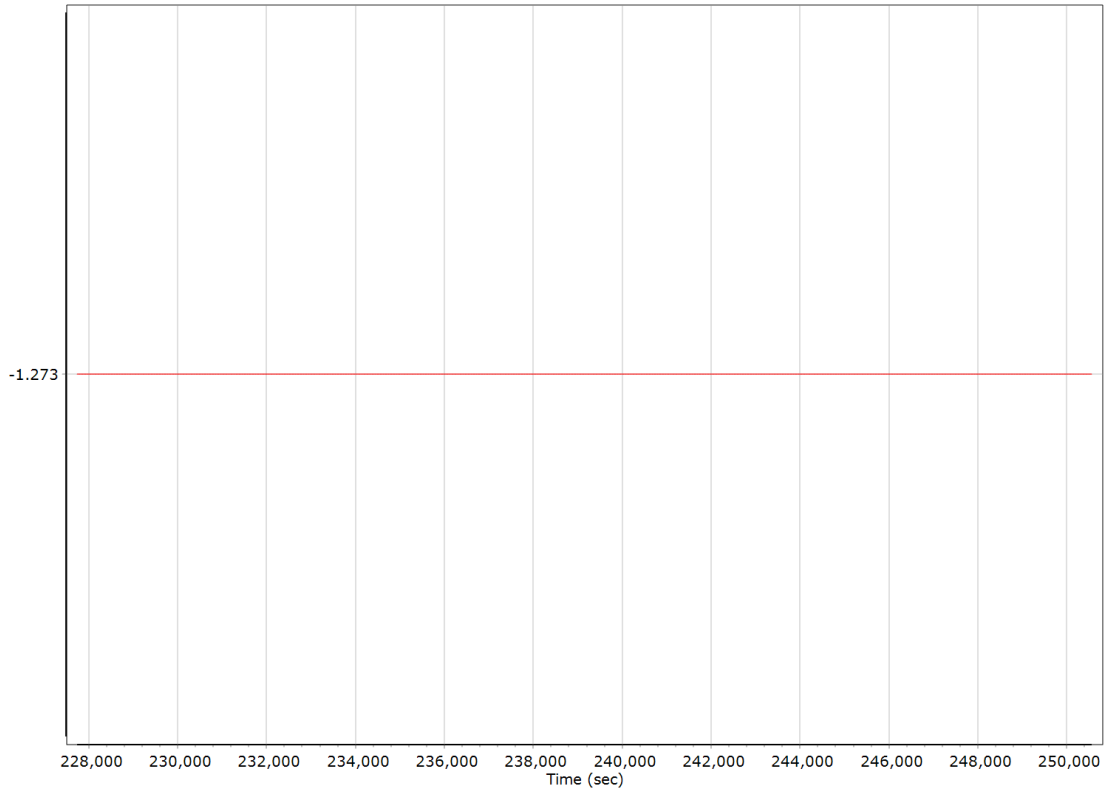
X Reference-Primary GNSS Lever Arm (m)



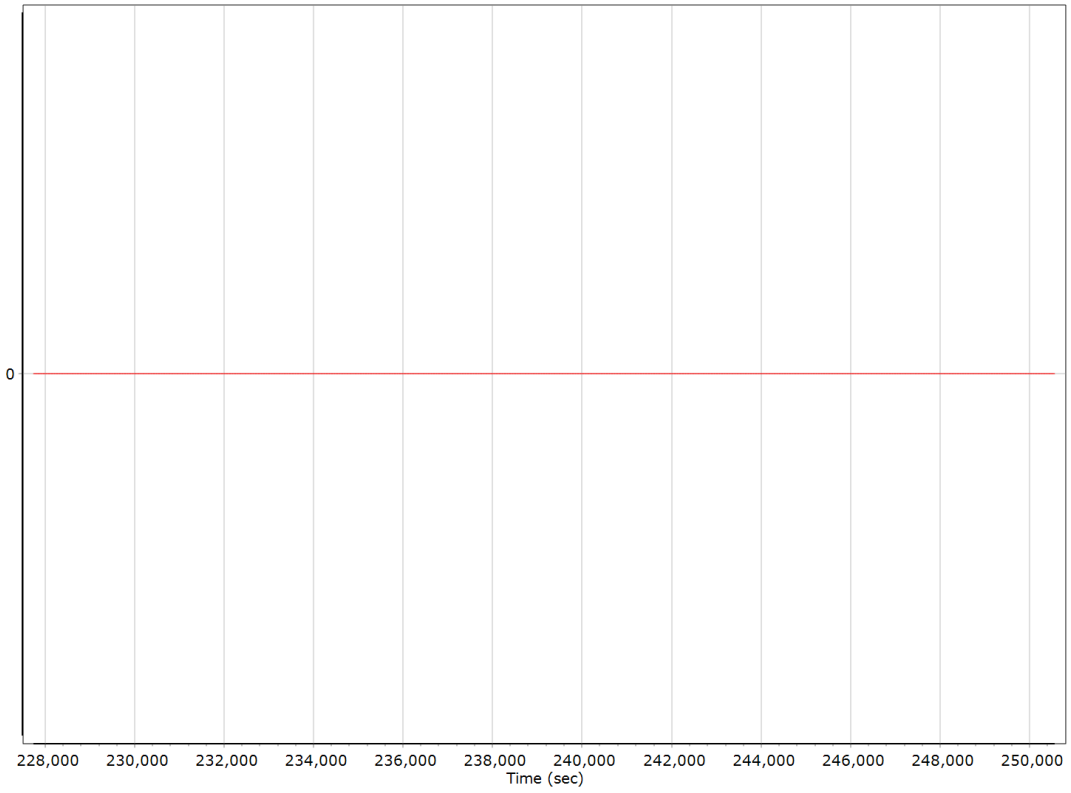
Y Reference-Primary GNSS Lever Arm (m)



Z Reference-Primary GNSS Lever Arm (m)



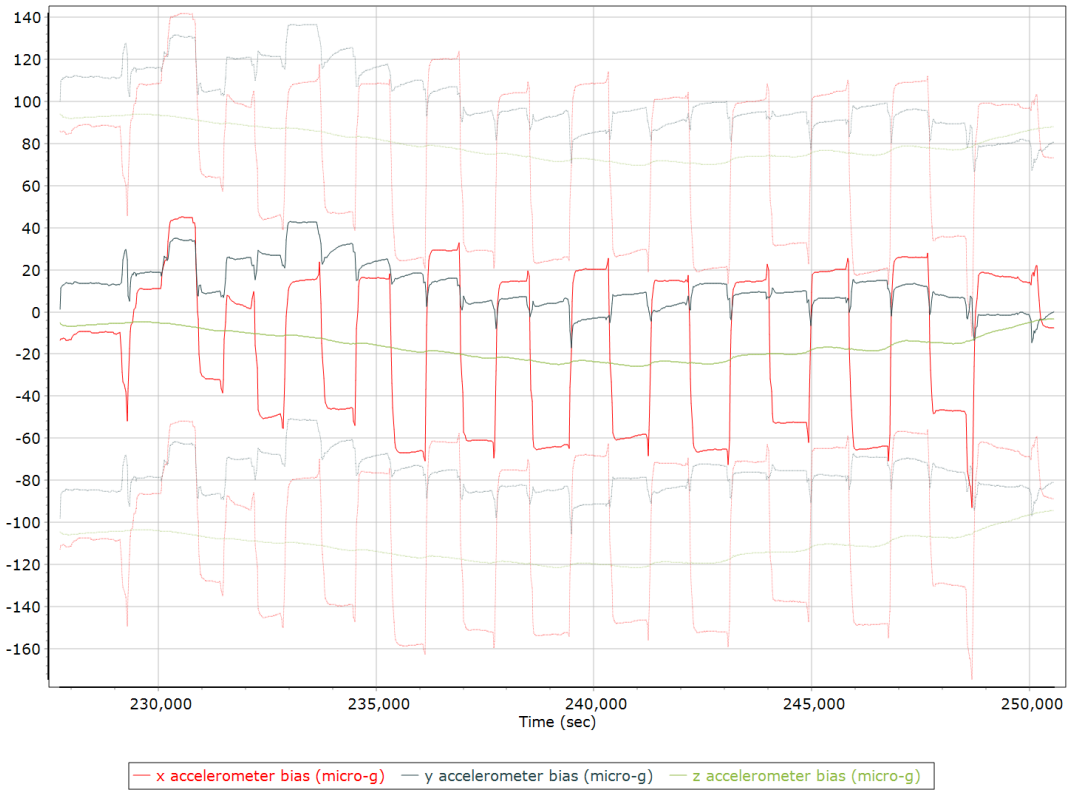
Reference-Primary GNSS Lever Arm Figure of Merit



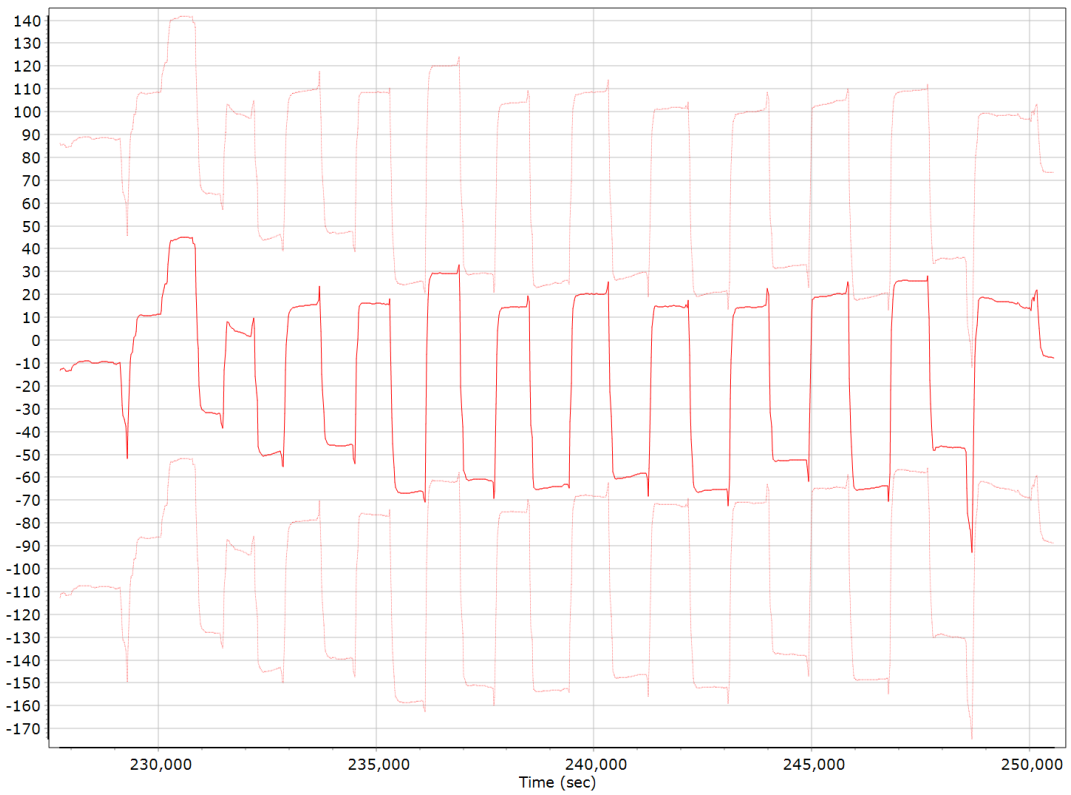
IN-Fusion QC

Forward Processed Estimated Errors, Reference Frame

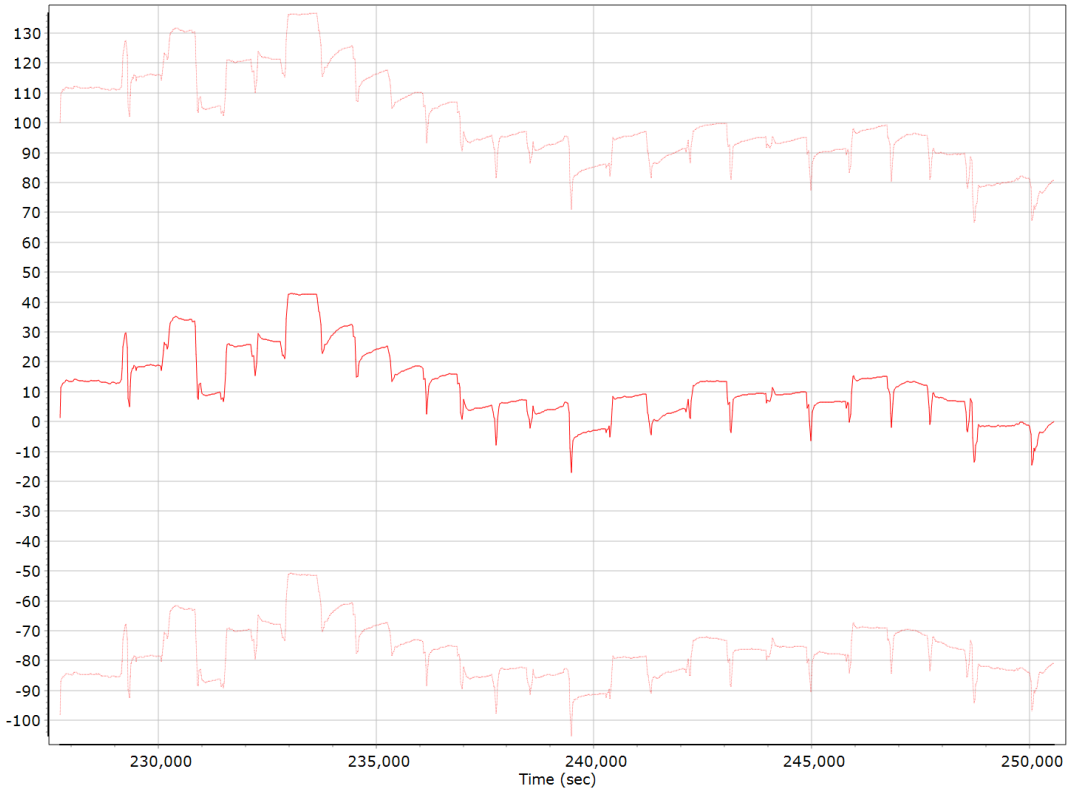
Accelerometer Bias (micro-g)



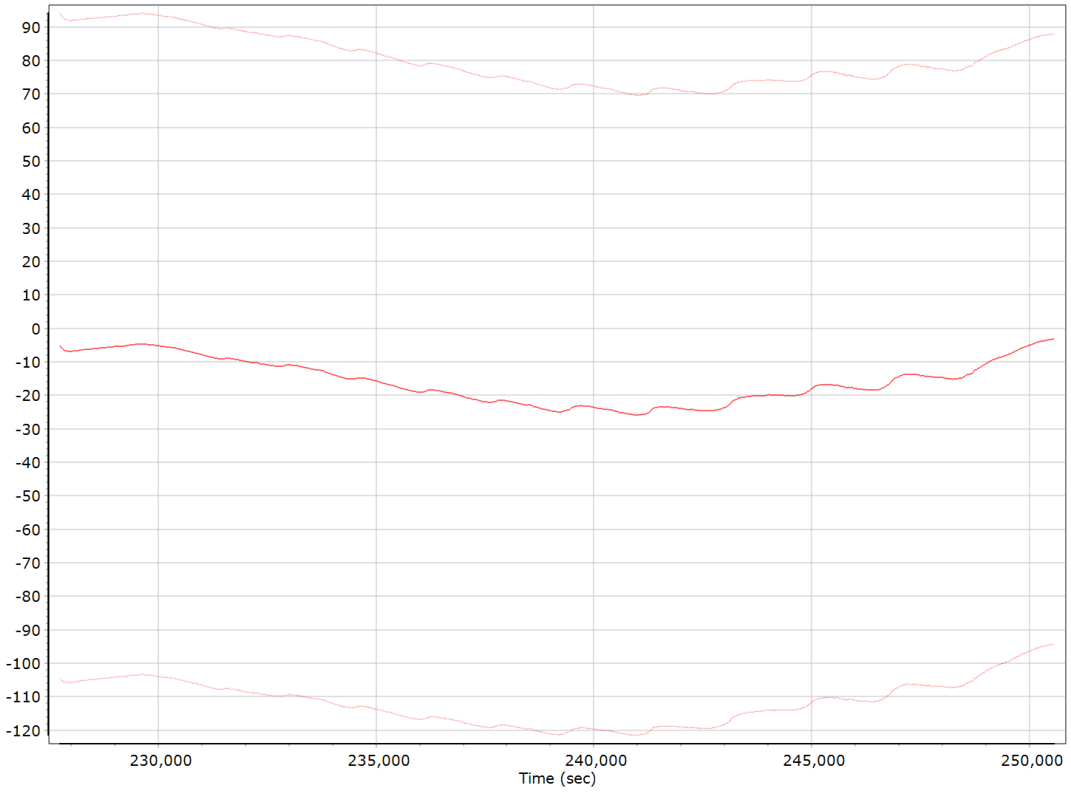
X Accelerometer Bias (micro-g)



Y Accelerometer Bias (micro-g)



Z Accelerometer Bias (micro-g)

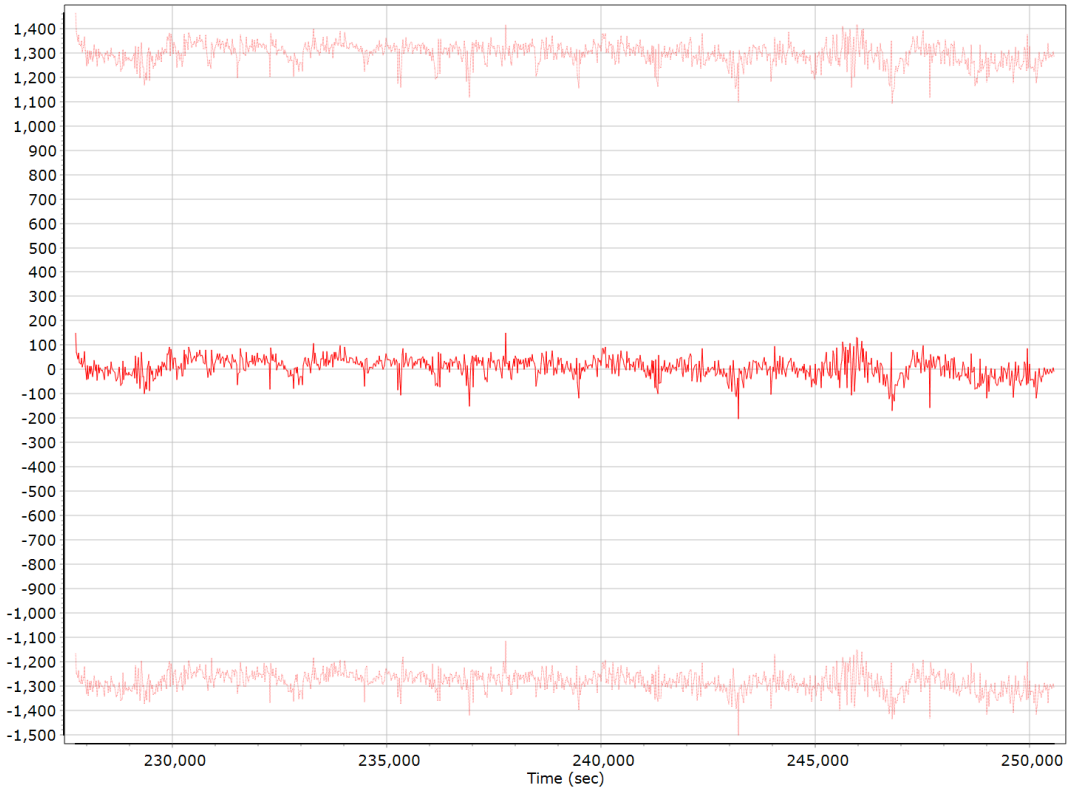


Accelerometer Scale Error (ppm)

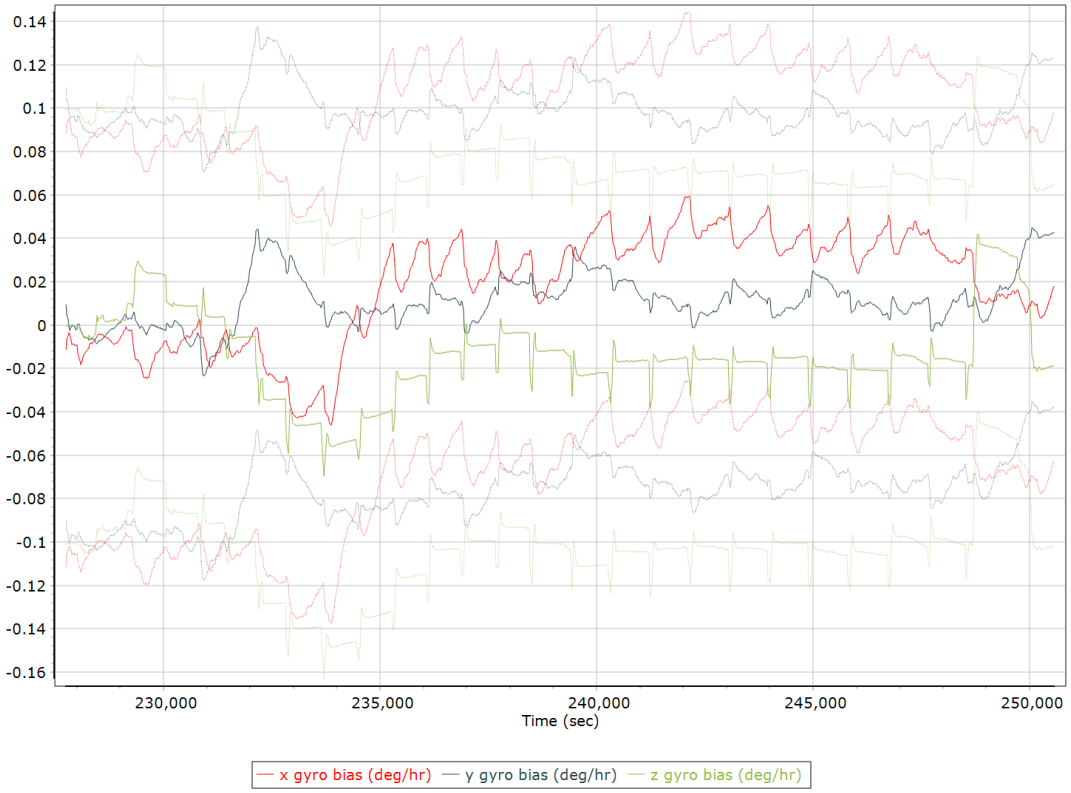
X Accelerometer Scale Error (ppm)

Y Accelerometer Scale Error (ppm)

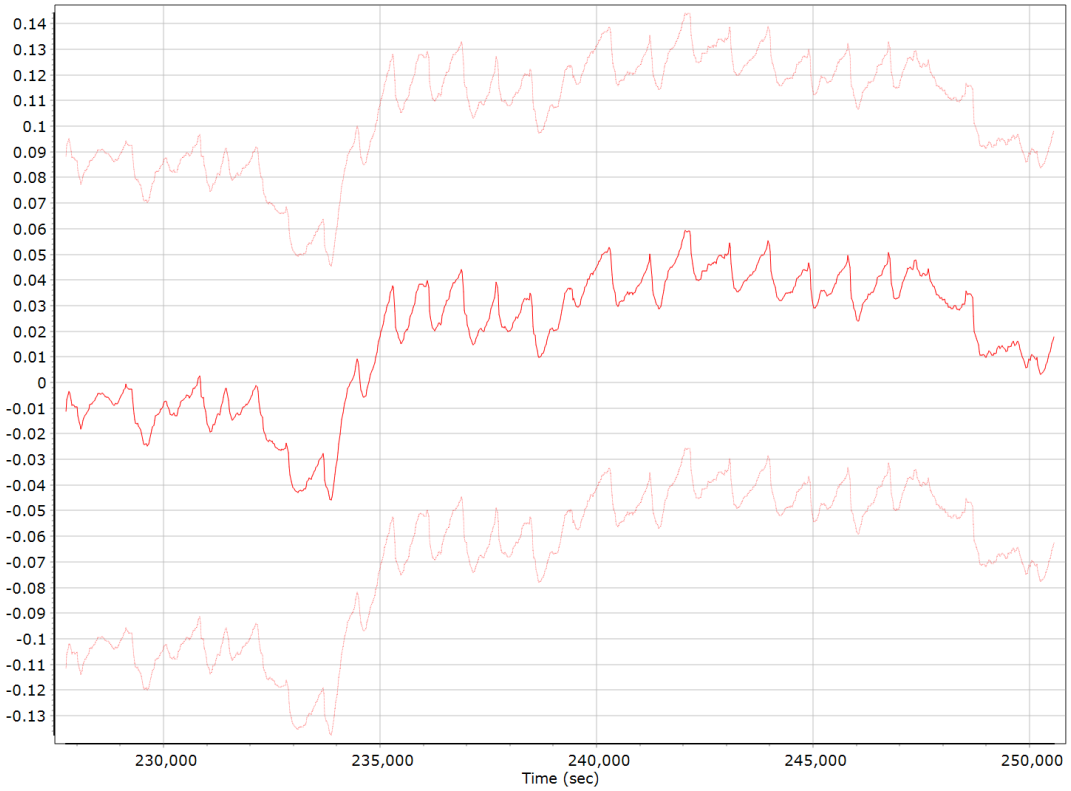
Z Accelerometer Scale Error (ppm)



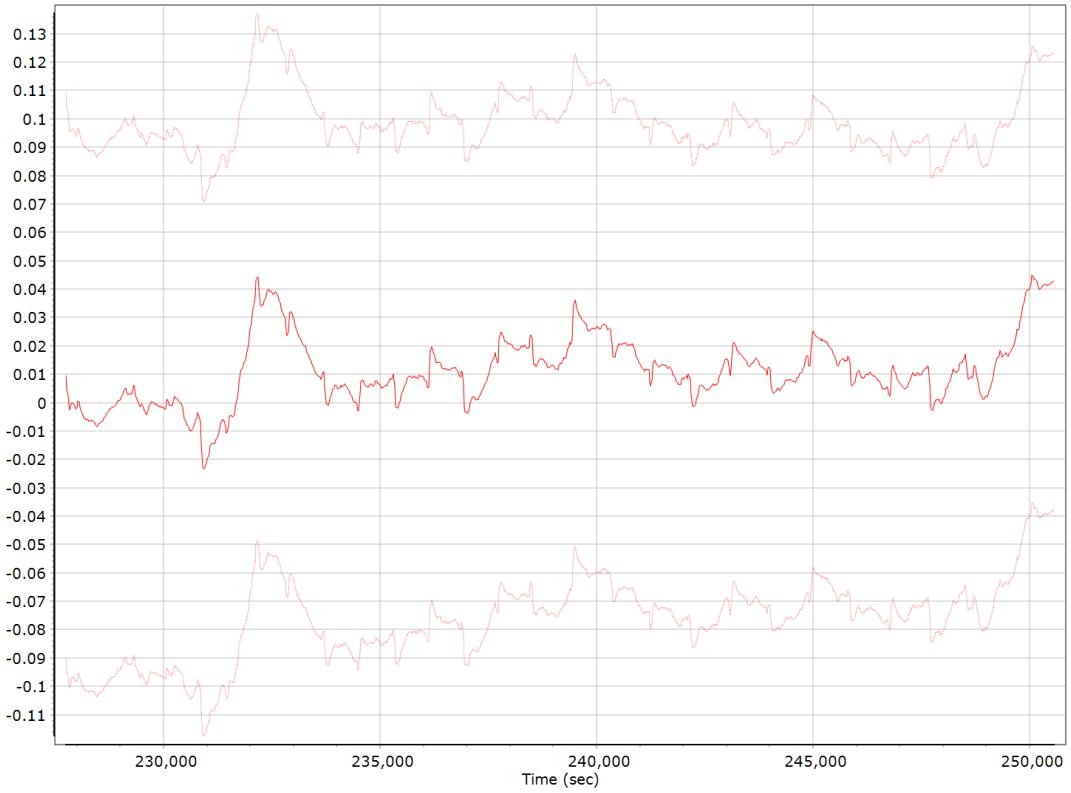
Gyro Bias (deg/h)



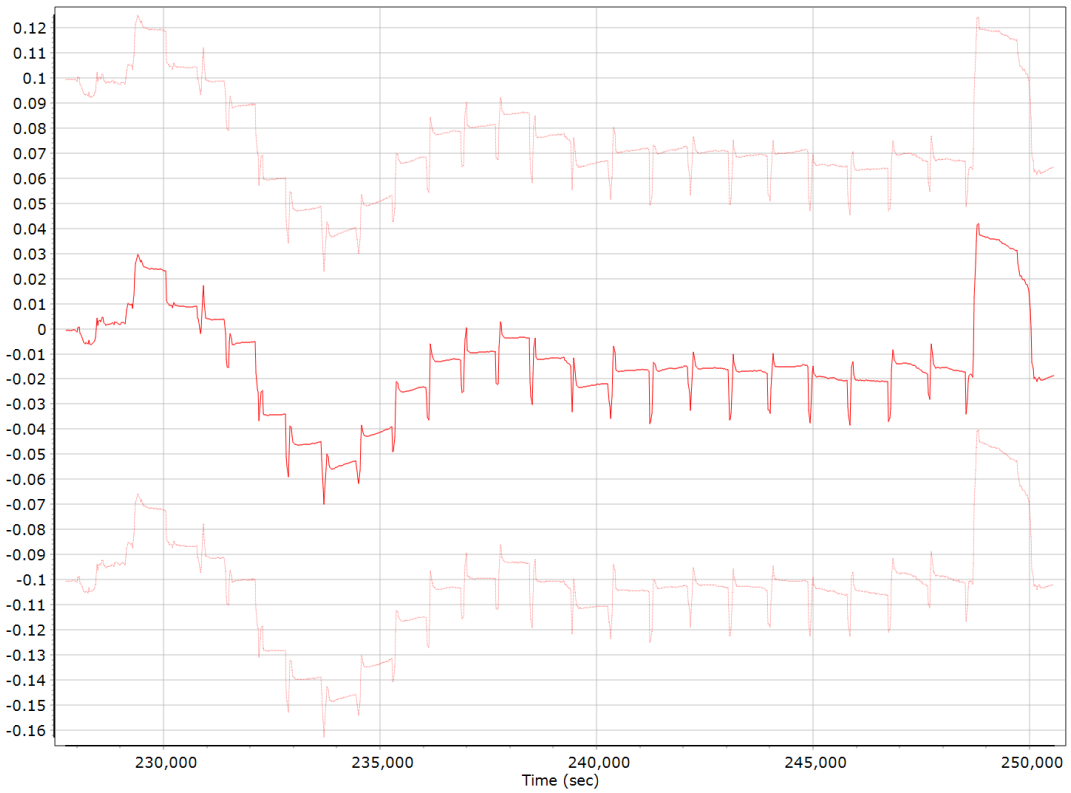
X Gyro Bias (deg/h)



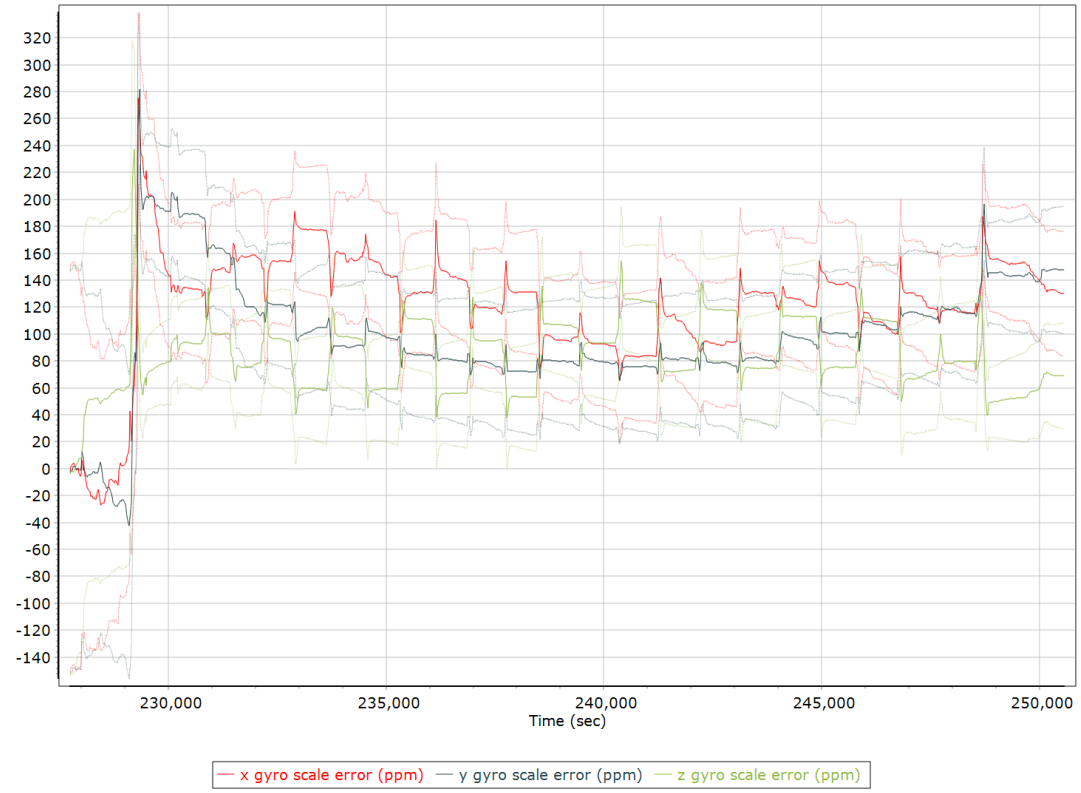
Y Gyro Bias (deg/h)



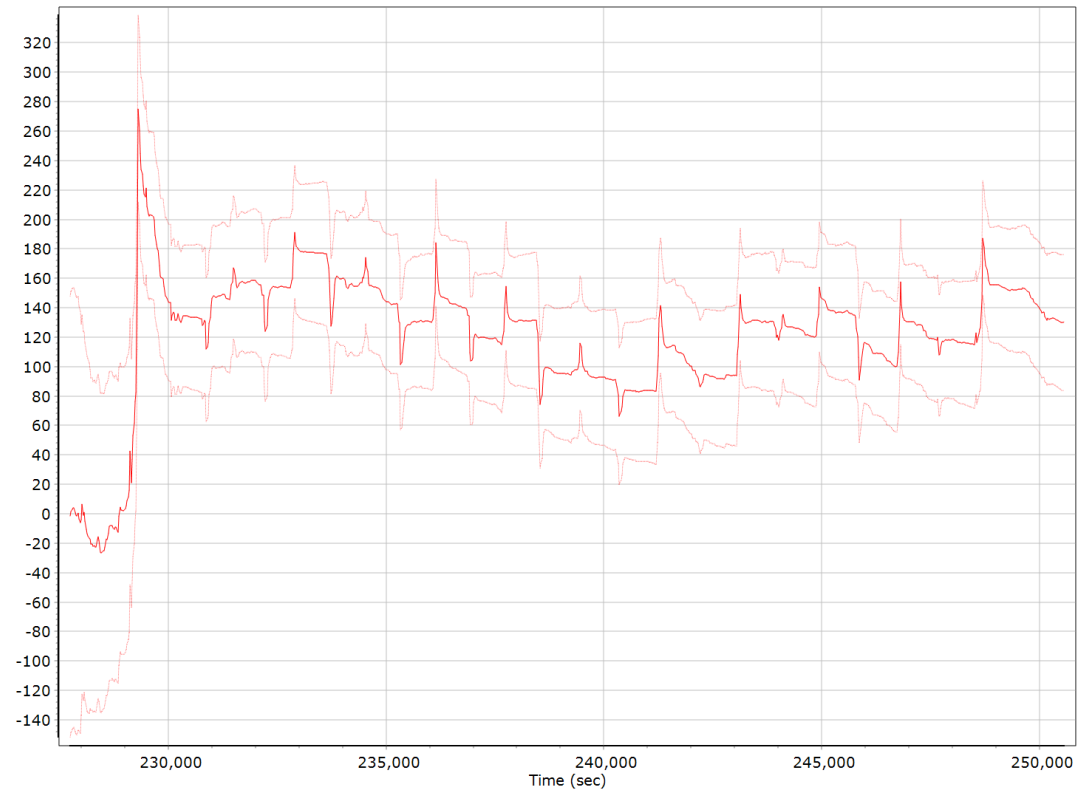
Z Gyro Bias (deg/h)



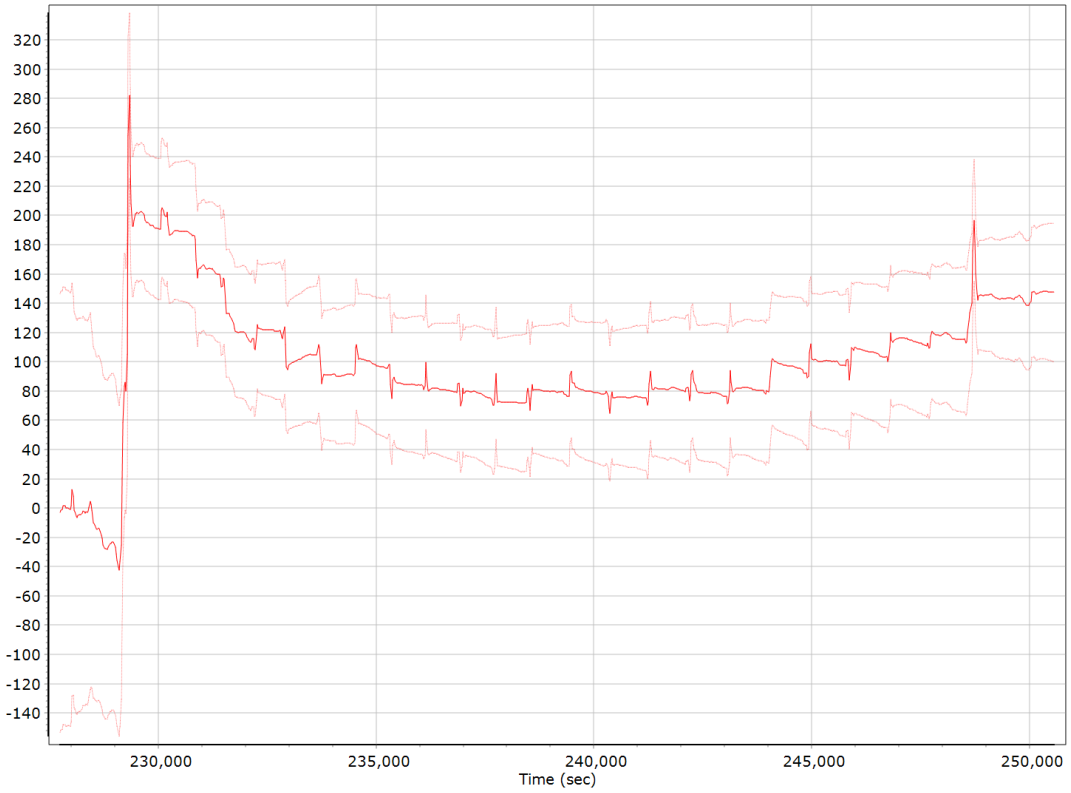
Gyro Scale Error (ppm)



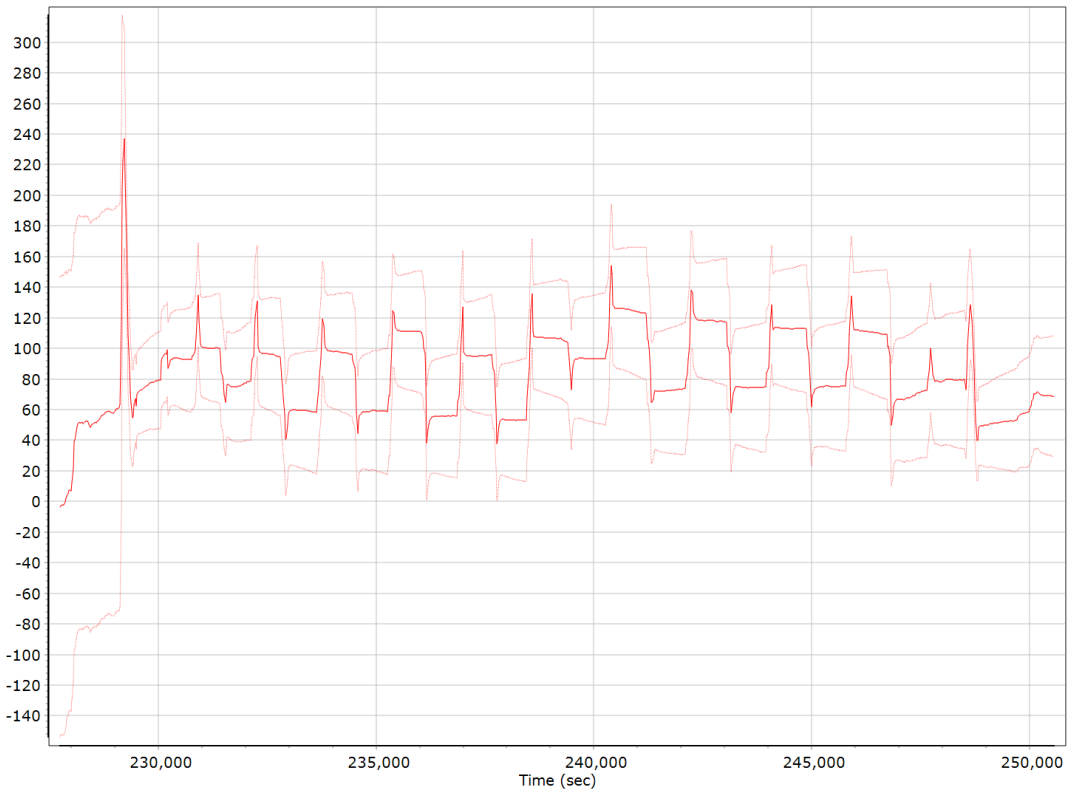
X Gyro Scale Error (ppm)



Y Gyro Scale Error (ppm)



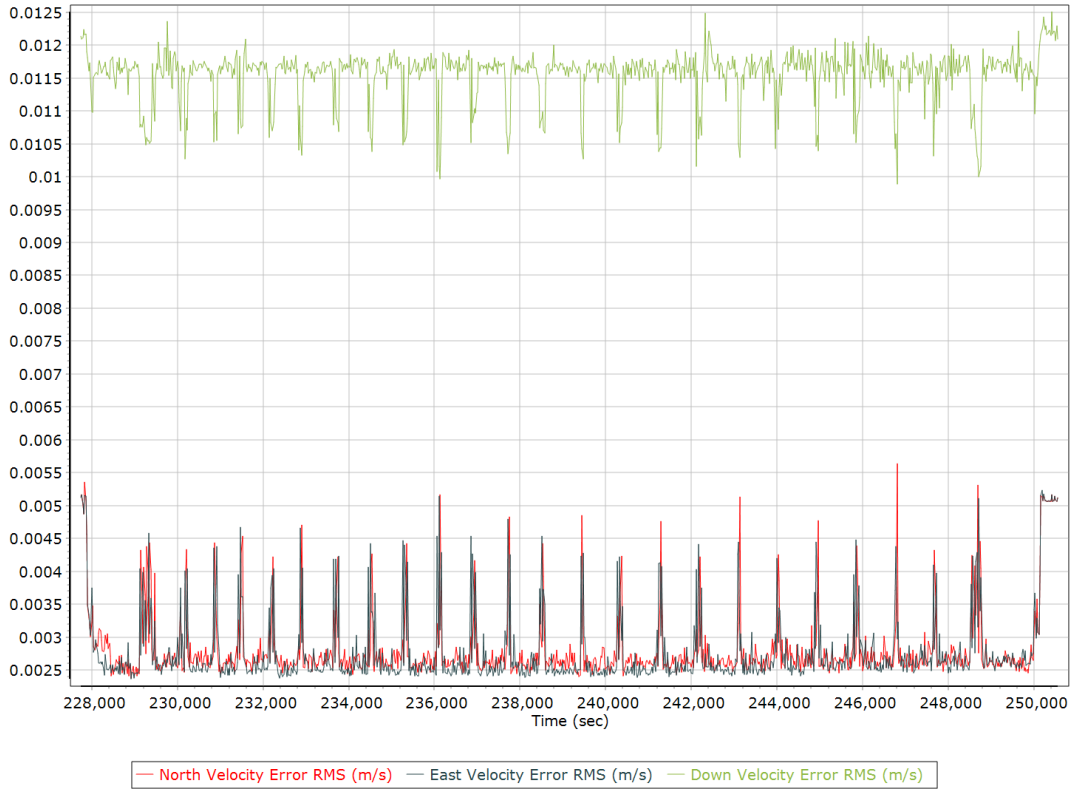
Z Gyro Scale Error (ppm)



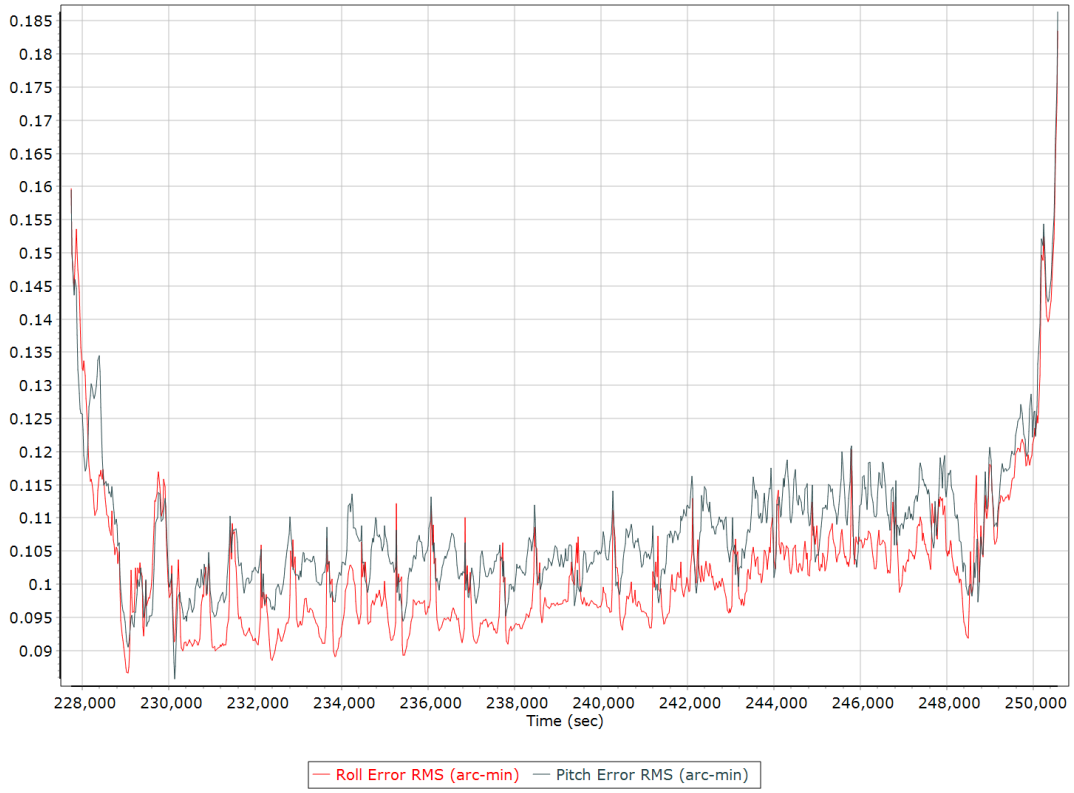
Smoothed Performance Metrics

Position Error RMS (m)

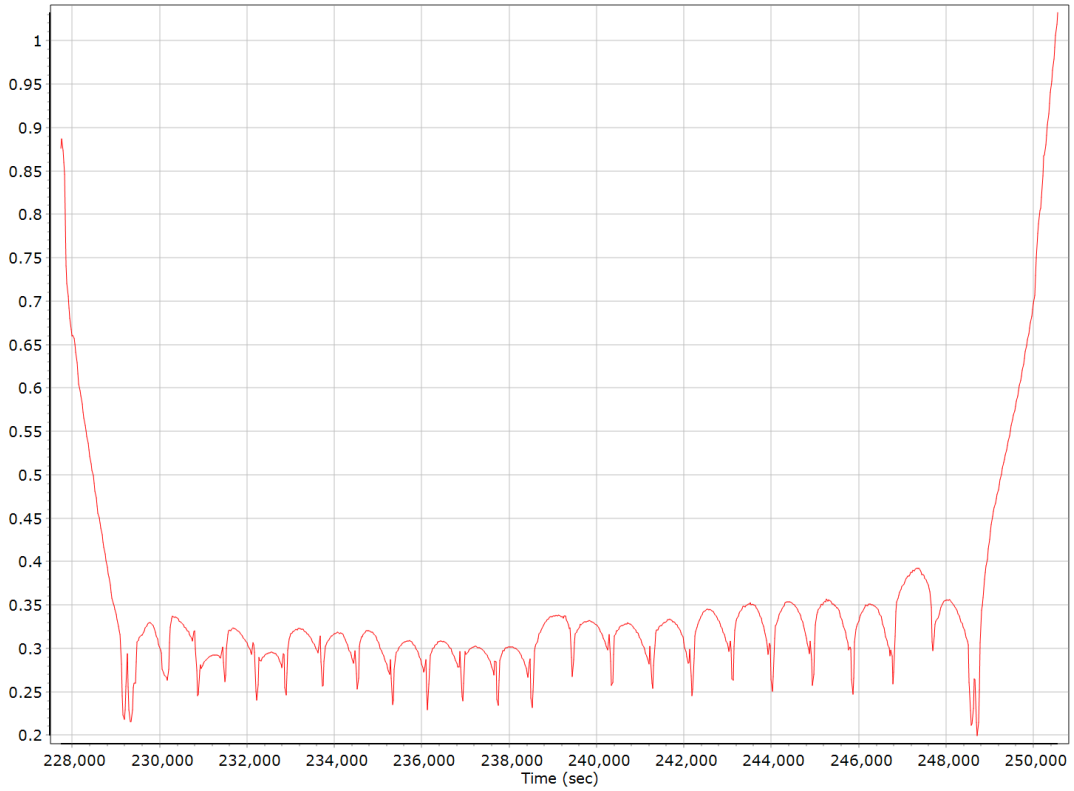
Velocity Error RMS (m/s)



Roll/Pitch Error RMS (arc-min)

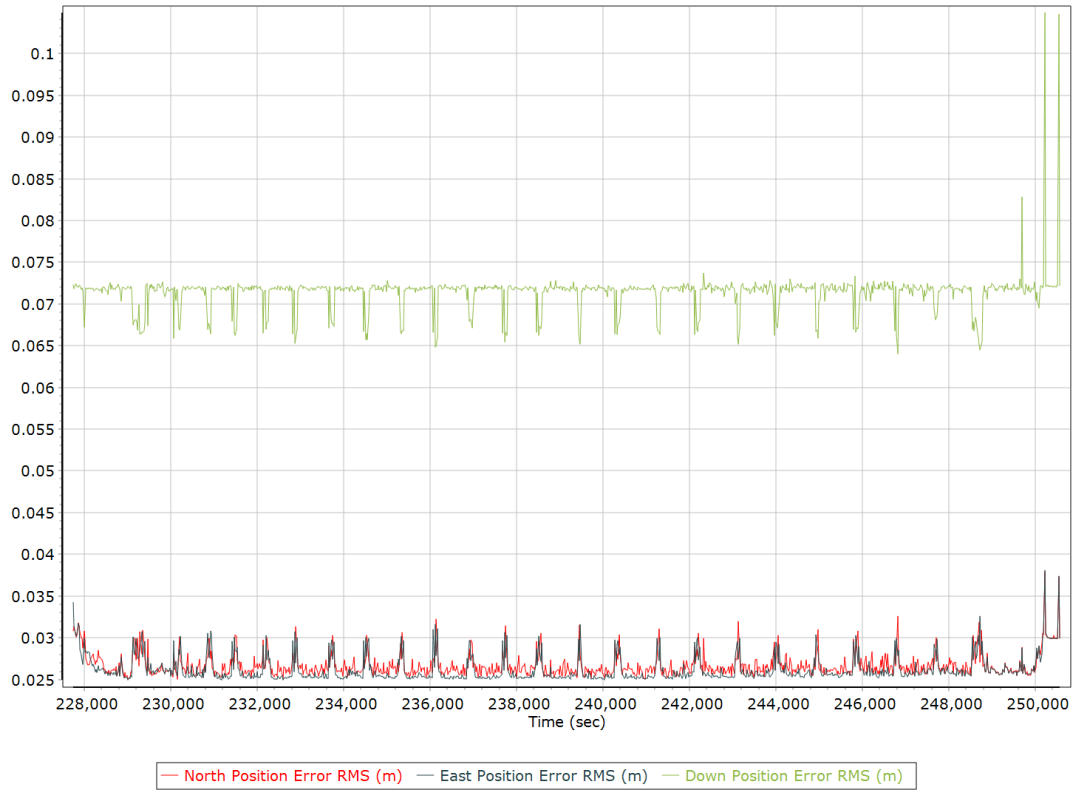


Heading Error RMS (arc-min)



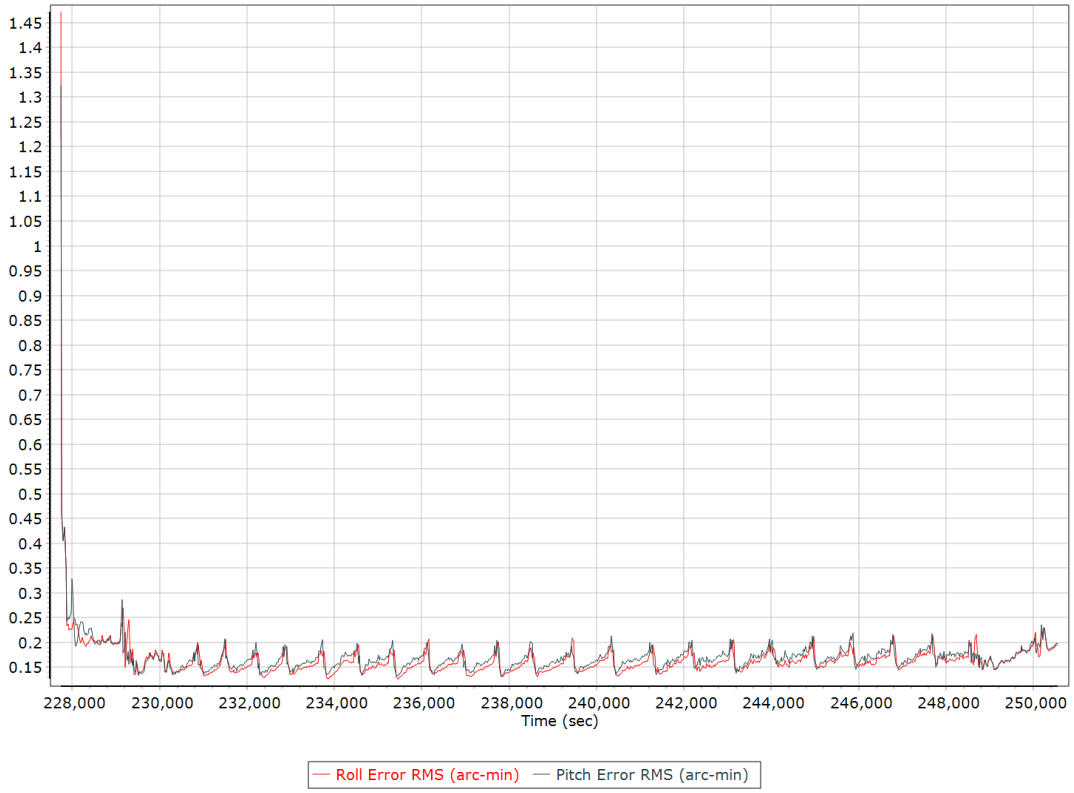
Forward Processed Performance Metrics

Position Error RMS (m)

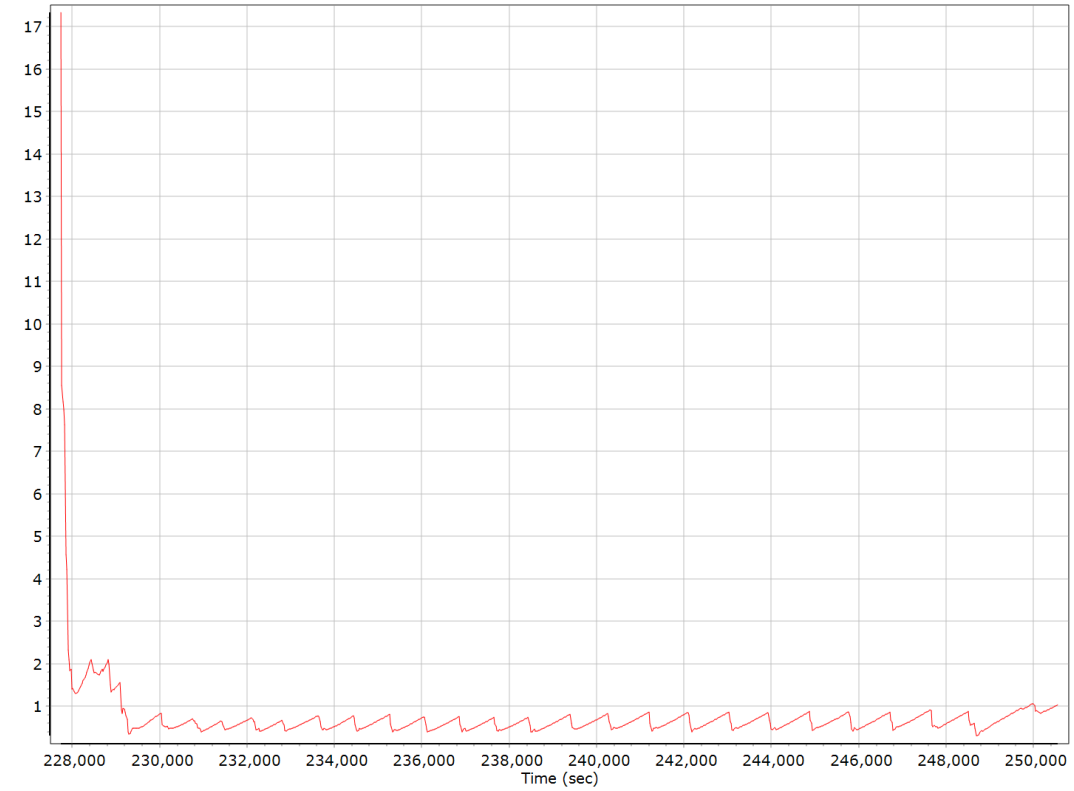


Velocity Error RMS (m/s)

Roll/Pitch Error RMS (arc-min)



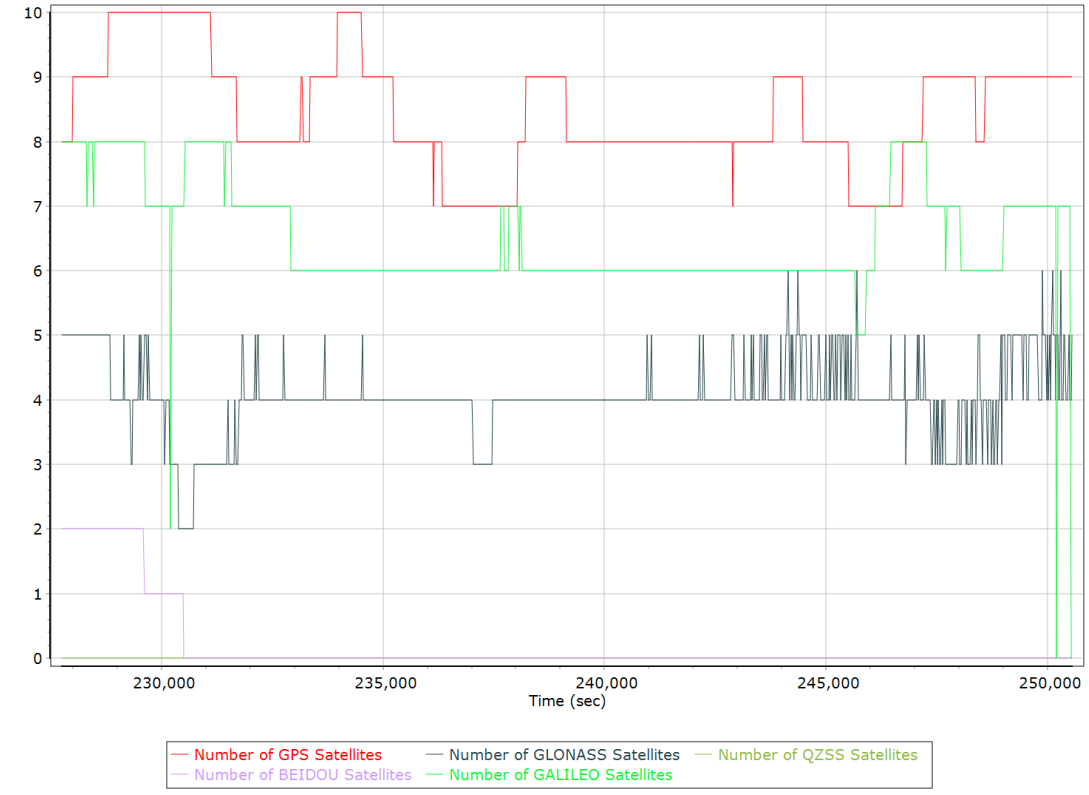
Heading Error RMS (arc-min)



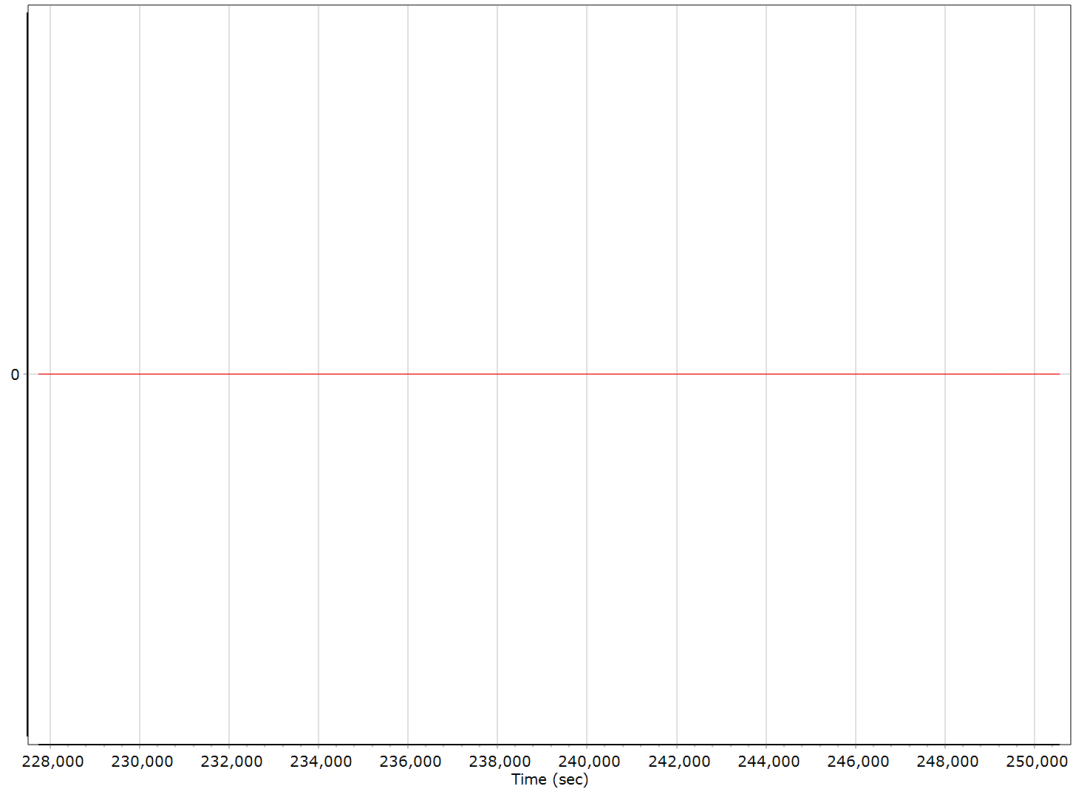
Forward Processed Solution Status

Processing Mode

Number of Satellites



Baseline Length



General Information

Mission Information

Project name	05102022A_3543
Processing date	2022-05-13 12:22:54
Mission date	2022-05-10 14:00:51
Mission duration	05:50:00.000
Processing mode	IN-Fusion PP-RTX

Rover Hardware Information

Product	POS AV 610 VER6 HW2.5-12
Serial number	S/N9683
IMU type	57
Receiver type	BD982
Antenna type	AV59

Project File List

Rover Data Files

File name	File type
N62756178.105	POS Data
N62756178.106	POS Data
N62756178.107	POS Data
N62756178.108	POS Data
N62756178.109	POS Data
N62756178.110	POS Data
N62756178.111	POS Data
N62756178.112	POS Data
N62756178.113	POS Data
N62756178.114	POS Data
N62756178.115	POS Data
N62756178.116	POS Data
N62756178.117	POS Data
N62756178.118	POS Data
N62756178.119	POS Data
N62756178.120	POS Data
N62756178.121	POS Data
N62756178.122	POS Data
N62756178.123	POS Data
N62756178.124	POS Data
N62756178.125	POS Data
N62756178.126	POS Data
N62756178.127	POS Data
N62756178.128	POS Data
N62756178.129	POS Data
N62756178.130	POS Data
N62756178.131	POS Data
N62756178.132	POS Data
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N62756178.158	POS Data
N62756178.159	POS Data
N62756178.160	POS Data
N62756178.161	POS Data
N62756178.162	POS Data
N62756178.163	POS Data

File name	File type
N62756178.164	POS Data
N62756178.165	POS Data
N62756178.166	POS Data
N62756178.167	POS Data
N62756178.168	POS Data
N62756178.169	POS Data
N62756178.170	POS Data
N62756178.171	POS Data
N62756178.172	POS Data
N62756178.173	POS Data
N62756178.174	POS Data
N62756178.175	POS Data

Input Files

File Name	File Type
Ephm1300.22g	GLONASS Broadcast Ephemeris
Ephm1300.22n	GPS Broadcast Ephemeris

Output Files

Filename	File type
sbet_05102022A_3543.out	SBET Trajectory File

Rover Data Summary

First raw data file	N62756178.105		
Last raw data file	N62756178.175		
Start GPS week	2209		
Start time	223244.659 (5/10/2022 2:00:44 PM)		
End time	245981.422 (5/10/2022 8:19:41 PM)		
Start of fine alignment	224000.722 (5/10/2022 2:13:20 PM)		
Available subsystems	Primary GNSS, Gimbal, IMU		
POS Event Input	Event 1 Input, Event 2 Input, Event 3 Input		
Correction data	None		
IMU Installation Lever Arms & Mounting Angles			
Gimbal to IMU lever arm (m)	-0.034	-0.010	-0.374
Gimbal to IMU mounting angles (deg)	0.000	0.000	0.000
Gimbal to Primary GNSS lever arm (m)	0.717	-0.178	-1.265
Gimbal to Primary GNSS lever arm std dev (m)	-1.000		
Aircraft to Reference mounting angles (deg)	0.000	0.000	0.000

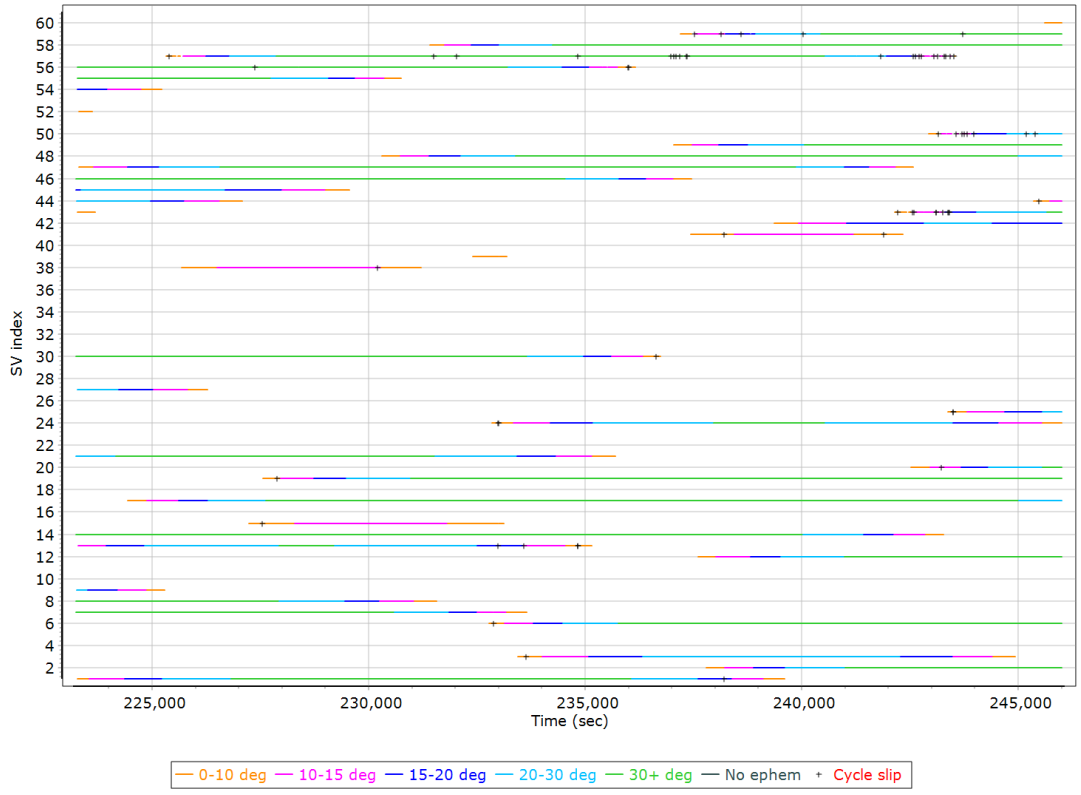
Rover Data QC

Raw IMU Import QC Summary

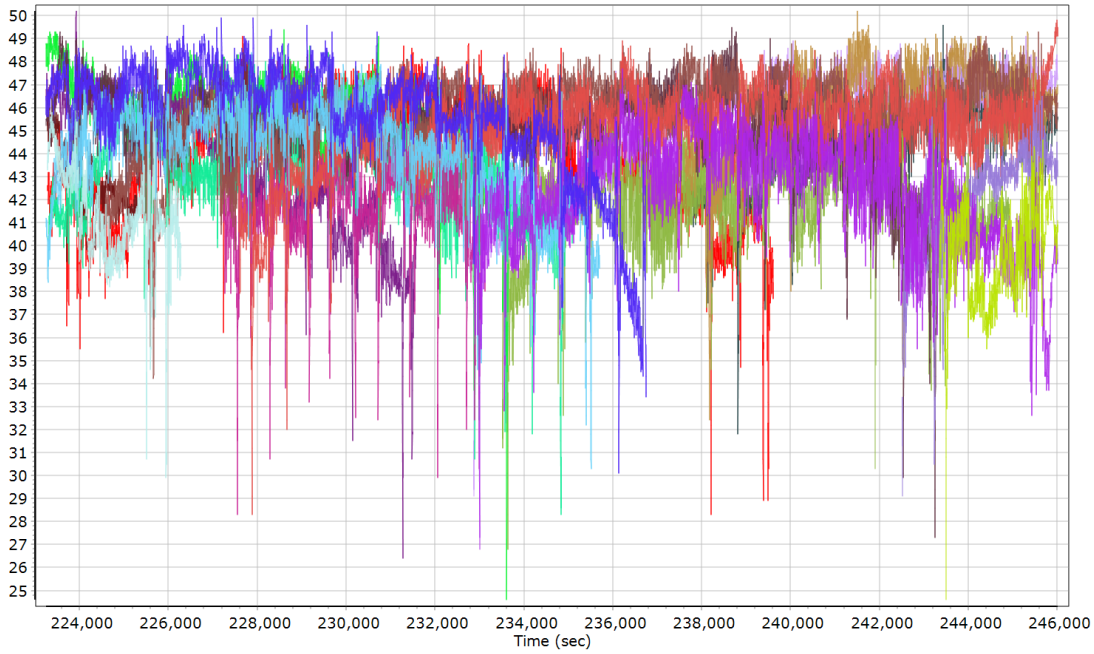
IMU data input file	imu_Mission 1.dat
IMU data check log file	imudt_05102022A_3543.log
IMU Records Processed	4543535
Termination Status	Warnings
IMU Anomalies	2
IMU Failure Messages	
245917.571 : WARNING : Gap of 36.7539 seconds in CHECKDT input data	
223244.504 : WARNING : Gap of 223232.5429 seconds in CHECKDT input data	

Primary Observables & Satellite Data

GPS/GLONASS L1 Satellite Lock/Elevation

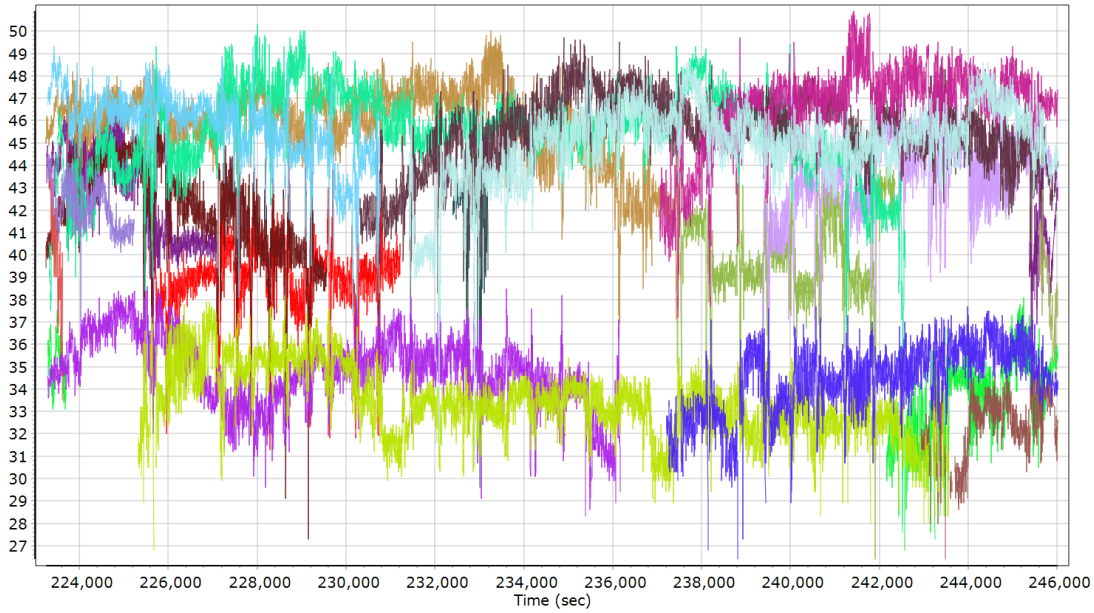


GPS L1 SNR



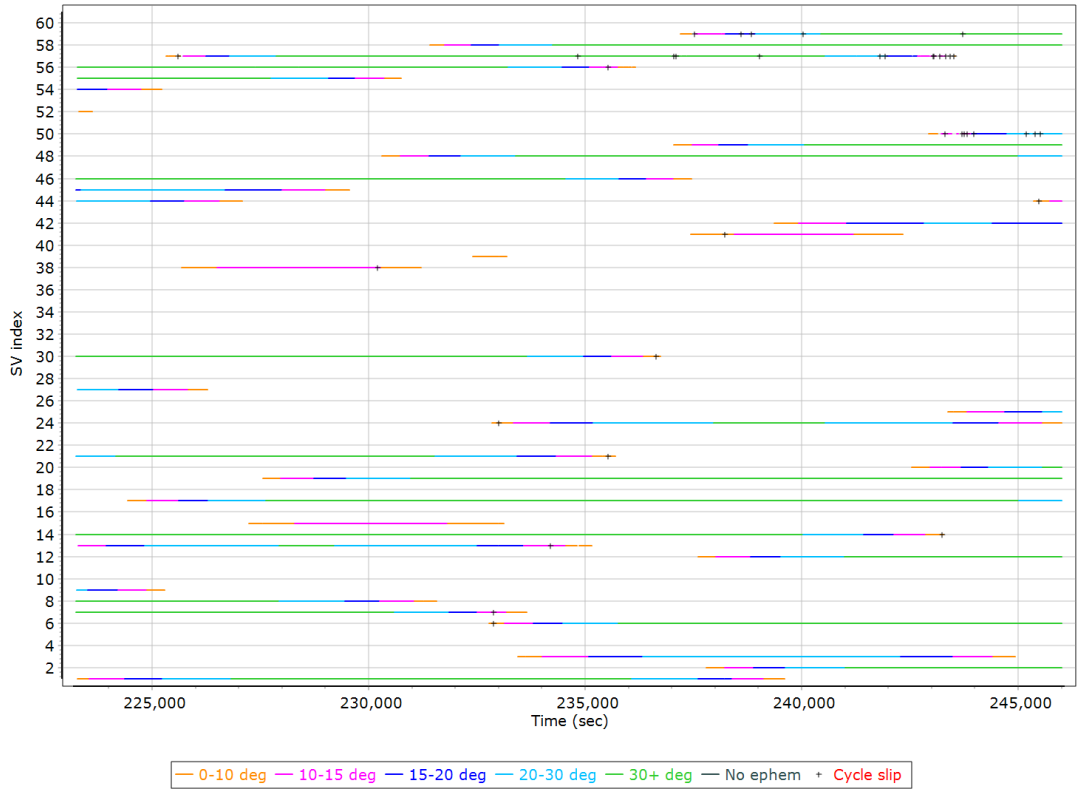
GPS PRN 01 L1 SNR (dB/Hz) GPS PRN 02 L1 SNR (dB/Hz) GPS PRN 03 L1 SNR (dB/Hz) GPS PRN 06 L1 SNR (dB/Hz)
GPS PRN 07 L1 SNR (dB/Hz) GPS PRN 08 L1 SNR (dB/Hz) GPS PRN 09 L1 SNR (dB/Hz) GPS PRN 12 L1 SNR (dB/Hz)
GPS PRN 13 L1 SNR (dB/Hz) GPS PRN 14 L1 SNR (dB/Hz) GPS PRN 15 L1 SNR (dB/Hz) GPS PRN 17 L1 SNR (dB/Hz)
GPS PRN 19 L1 SNR (dB/Hz) GPS PRN 20 L1 SNR (dB/Hz) GPS PRN 21 L1 SNR (dB/Hz) GPS PRN 24 L1 SNR (dB/Hz)
GPS PRN 25 L1 SNR (dB/Hz) GPS PRN 27 L1 SNR (dB/Hz) GPS PRN 30 L1 SNR (dB/Hz)

GLONASS L1 SNR

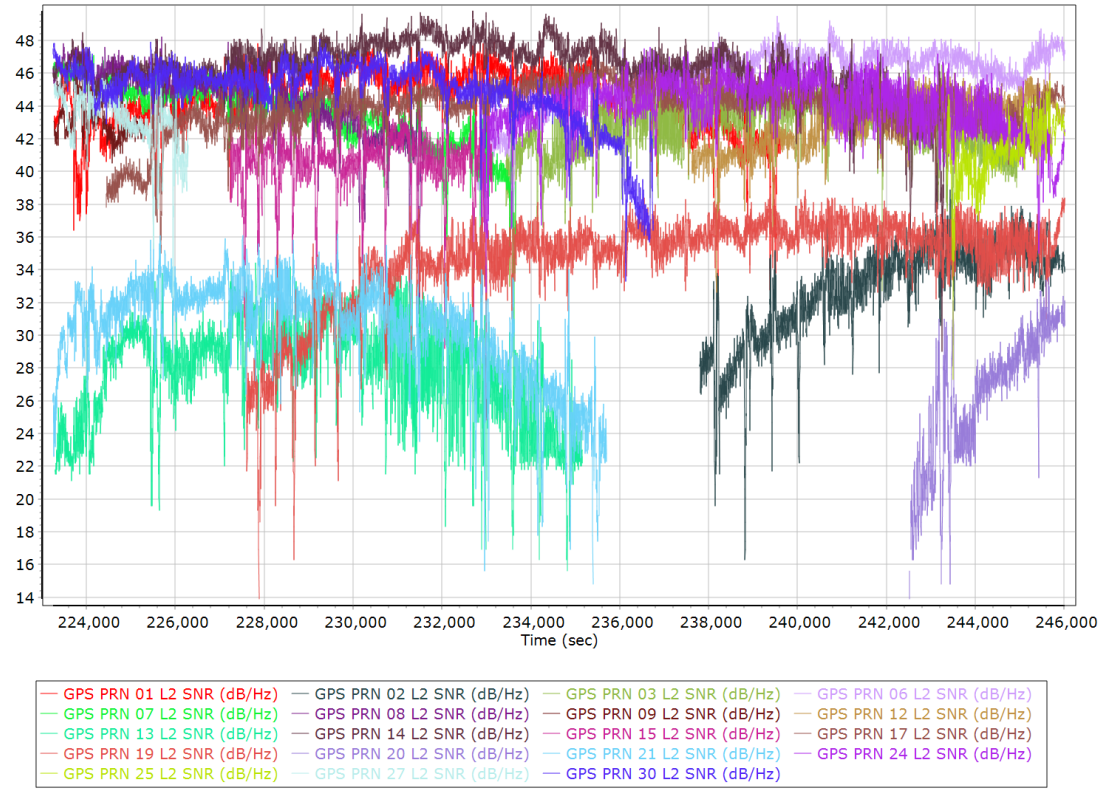


GLONASS 01 L1 SNR (dB/Hz) GLONASS 02 L1 SNR (dB/Hz) GLONASS 04 L1 SNR (dB/Hz)
GLONASS 05 L1 SNR (dB/Hz) GLONASS 06 L1 SNR (dB/Hz) GLONASS 07 L1 SNR (dB/Hz)
GLONASS 08 L1 SNR (dB/Hz) GLONASS 09 L1 SNR (dB/Hz) GLONASS 10 L1 SNR (dB/Hz)
GLONASS 11 L1 SNR (dB/Hz) GLONASS 12 L1 SNR (dB/Hz) GLONASS 13 L1 SNR (dB/Hz)
GLONASS 15 L1 SNR (dB/Hz) GLONASS 17 L1 SNR (dB/Hz) GLONASS 18 L1 SNR (dB/Hz)
GLONASS 19 L1 SNR (dB/Hz) GLONASS 20 L1 SNR (dB/Hz) GLONASS 21 L1 SNR (dB/Hz)
GLONASS 22 L1 SNR (dB/Hz) GLONASS 23 L1 SNR (dB/Hz)

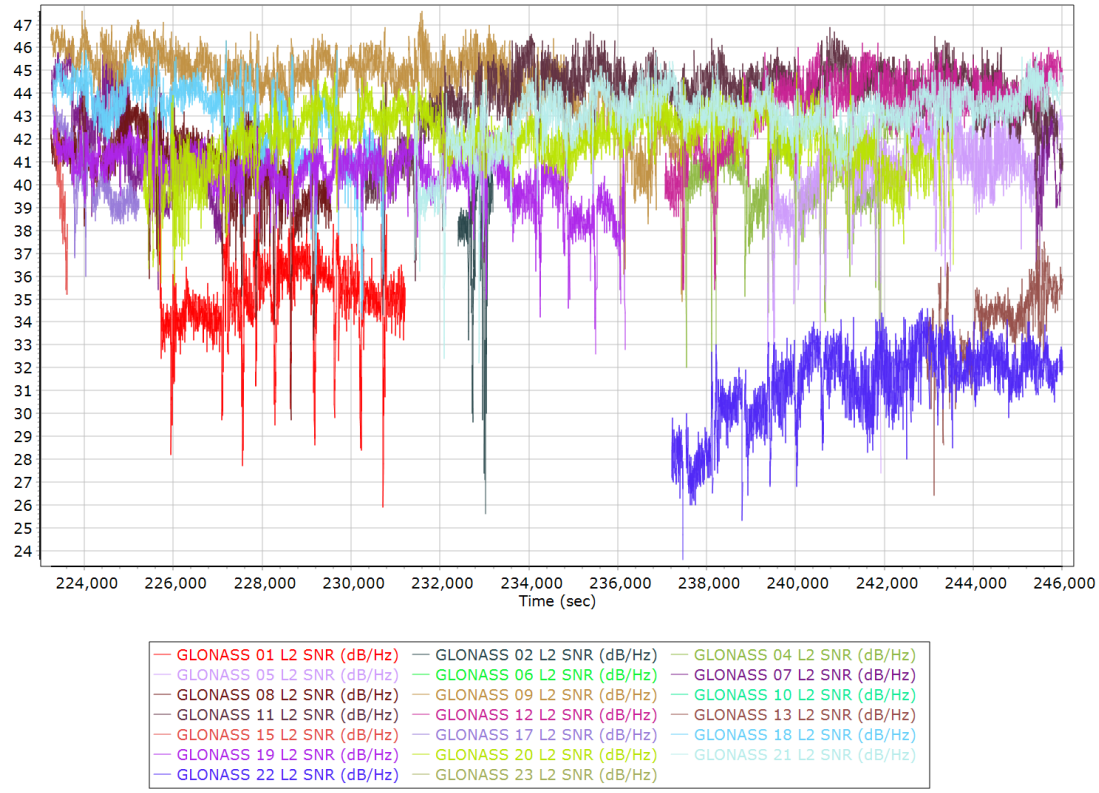
GPS/GLONASS L2 Satellite Lock/Elevation



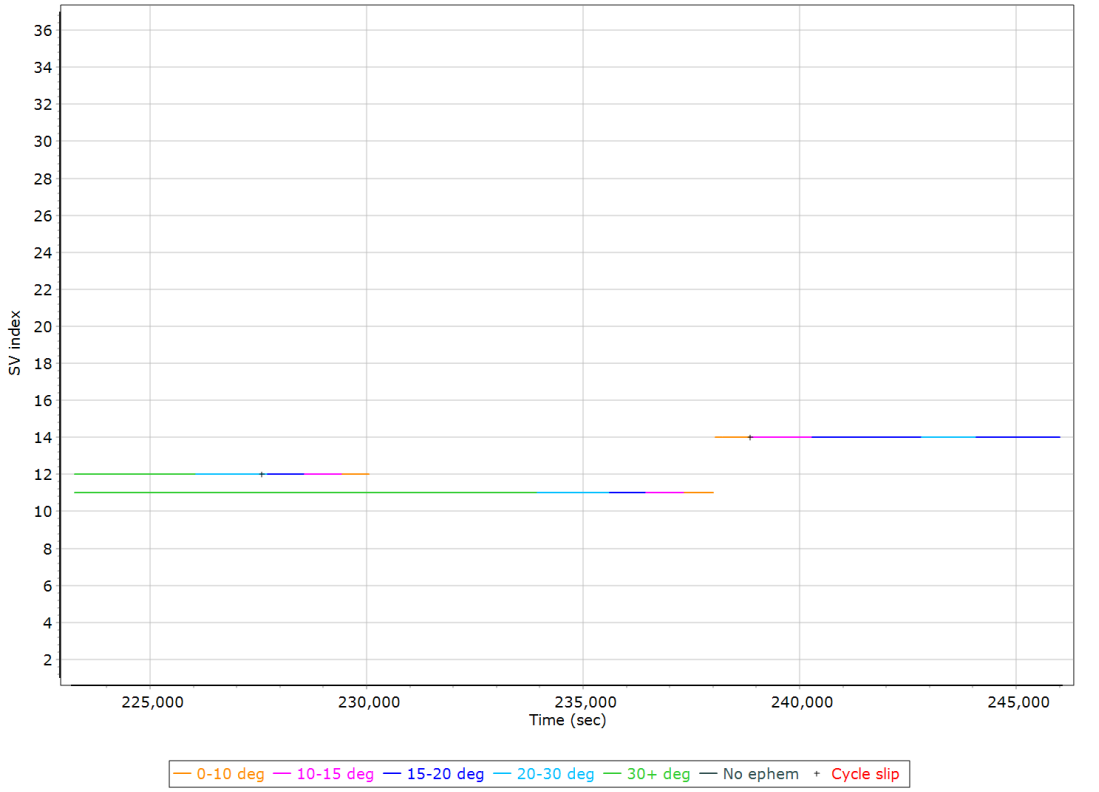
GPS L2 SNR



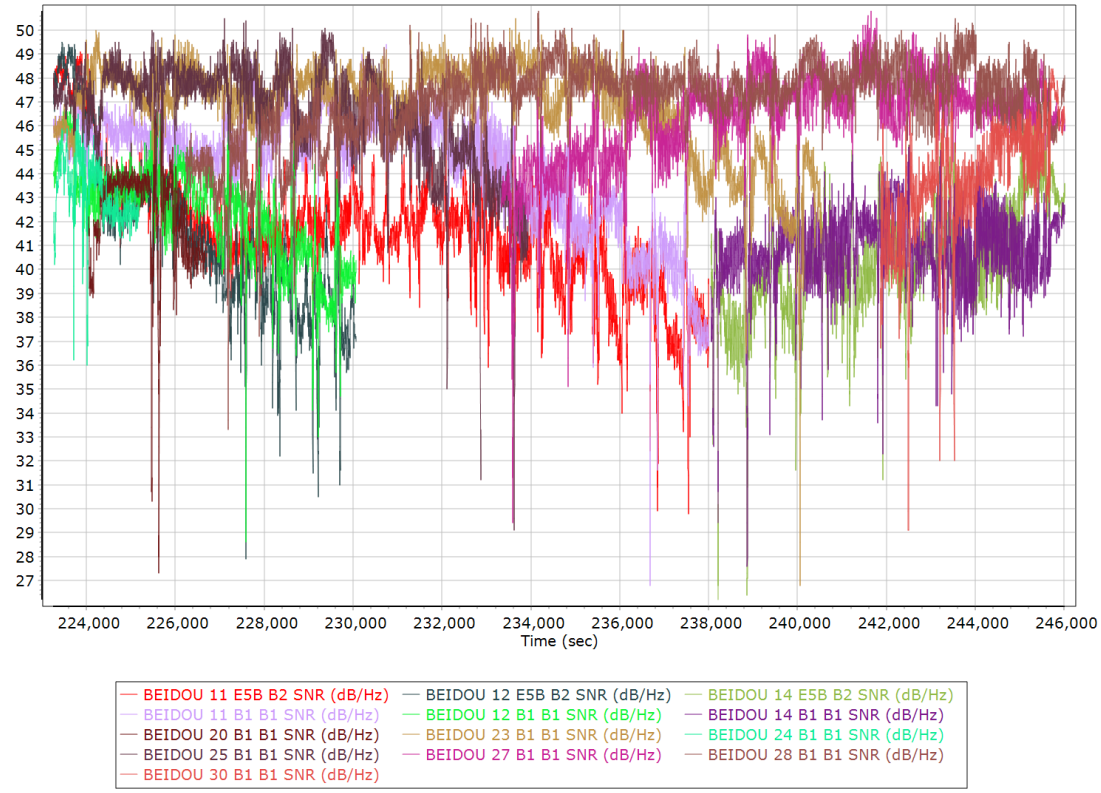
GLONASS L2 SNR



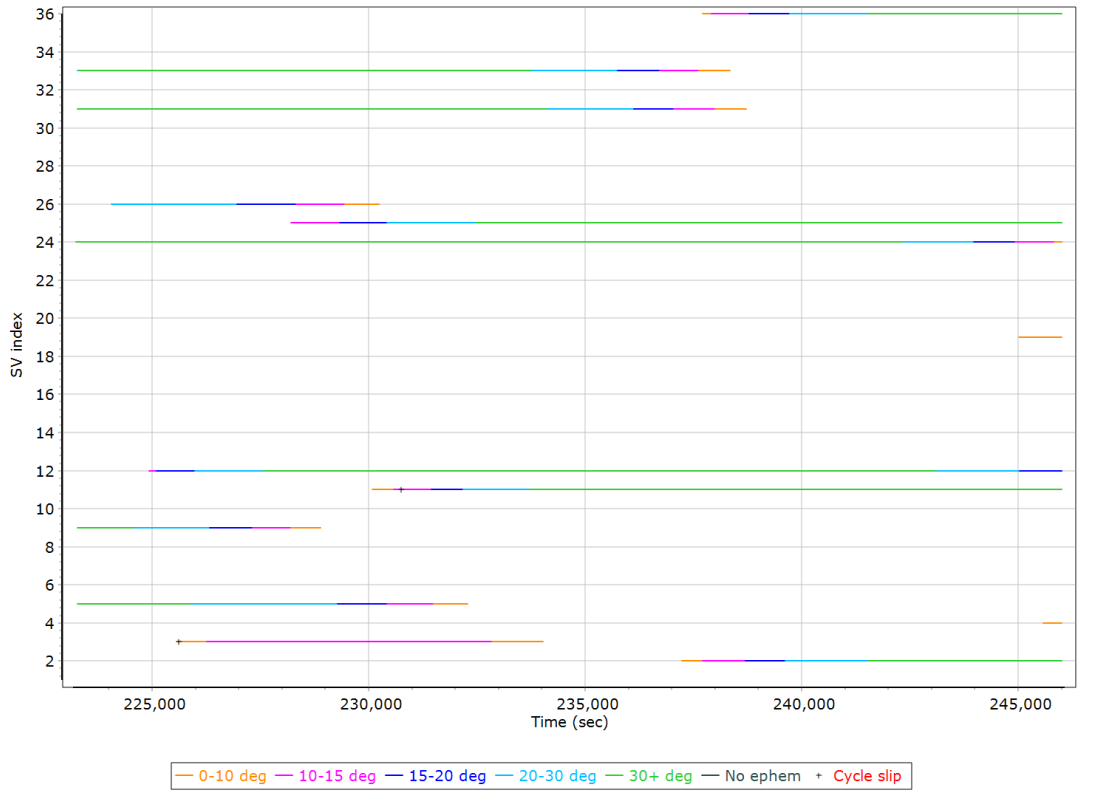
BEIDOU Satellite Lock/Elevation



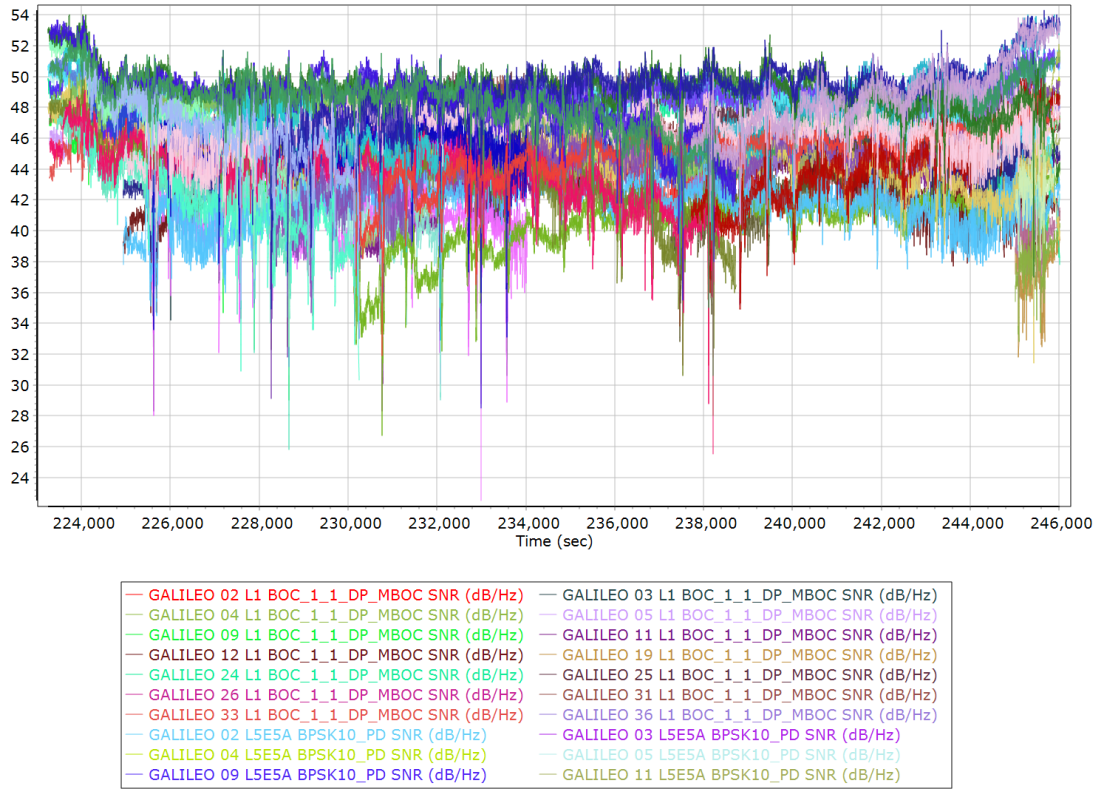
BEIDOU SNR



GALILEO Satellite Lock/Elevation

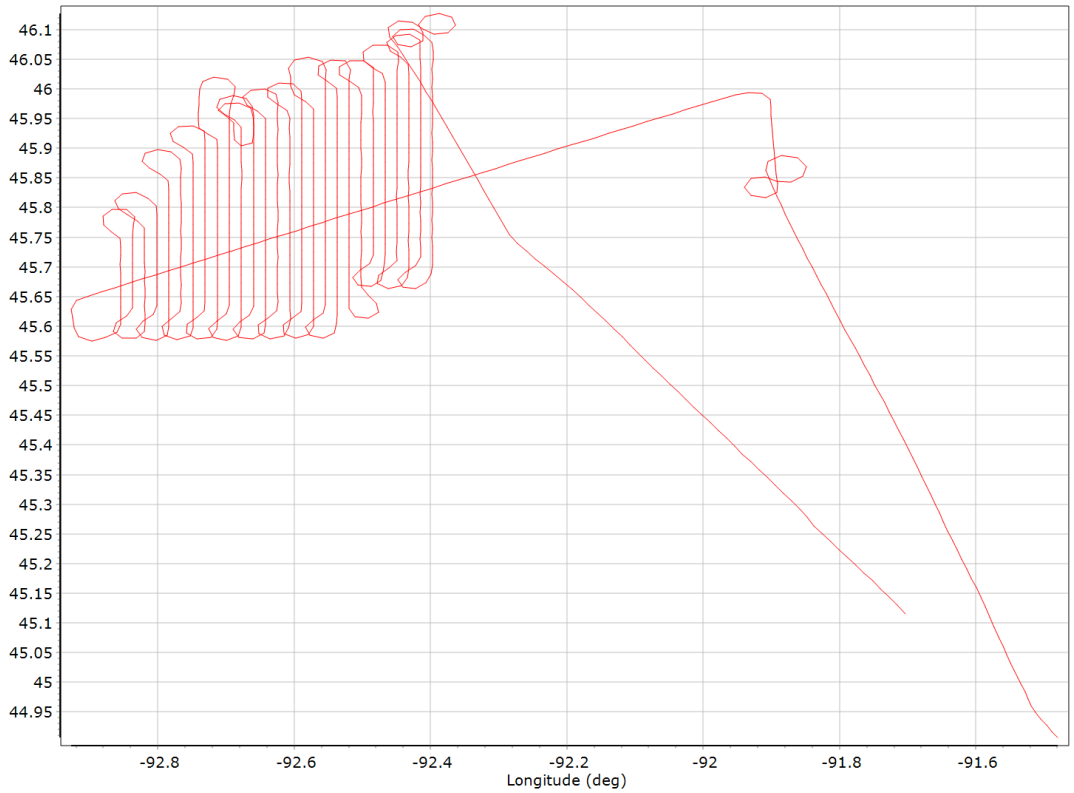


GALILEO SNR

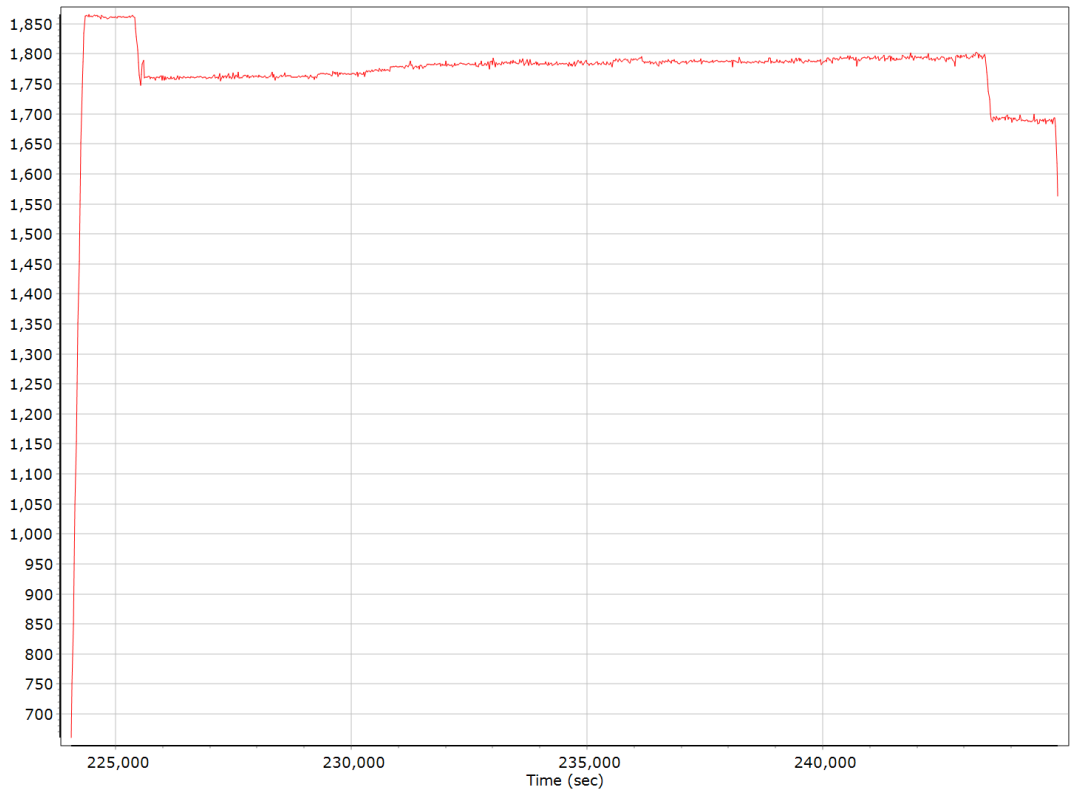

54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
24
224,000
226,000
228,000
230,000
232,000
234,000
236,000
238,000
240,000
242,000
244,000
246,000
Time (sec)
GALILEO 02 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 03 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 04 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 05 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 09 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 11 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 12 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 19 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 24 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 25 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 26 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 31 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 33 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 36 L1 BOC_1_1_DP_MBOC SNR (dB/Hz)
GALILEO 02 L5E5A BPSK10_PD SNR (dB/Hz)
GALILEO 03 L5E5A BPSK10_PD SNR (dB/Hz)
GALILEO 04 L5E5A BPSK10_PD SNR (dB/Hz)
GALILEO 05 L5E5A BPSK10_PD SNR (dB/Hz)
GALILEO 09 L5E5A BPSK10_PD SNR (dB/Hz)
GALILEO 11 L5E5A BPSK10_PD SNR (dB/Hz)

Smoothed Trajectory Information

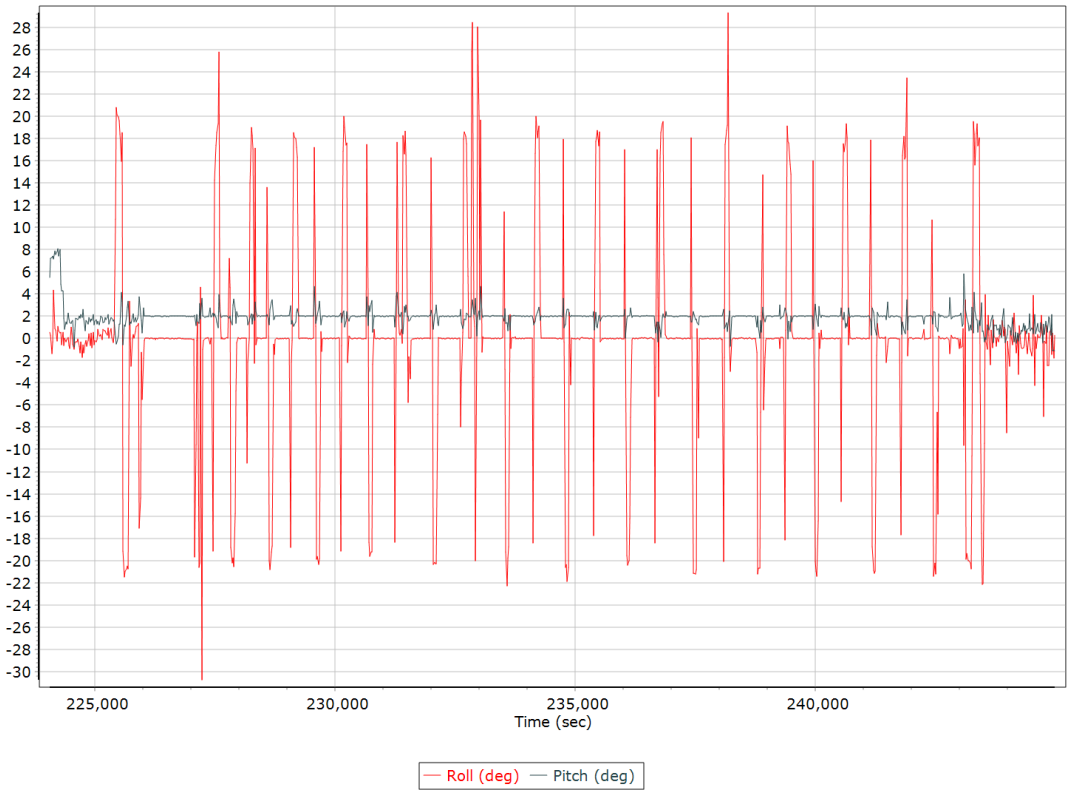
Top View



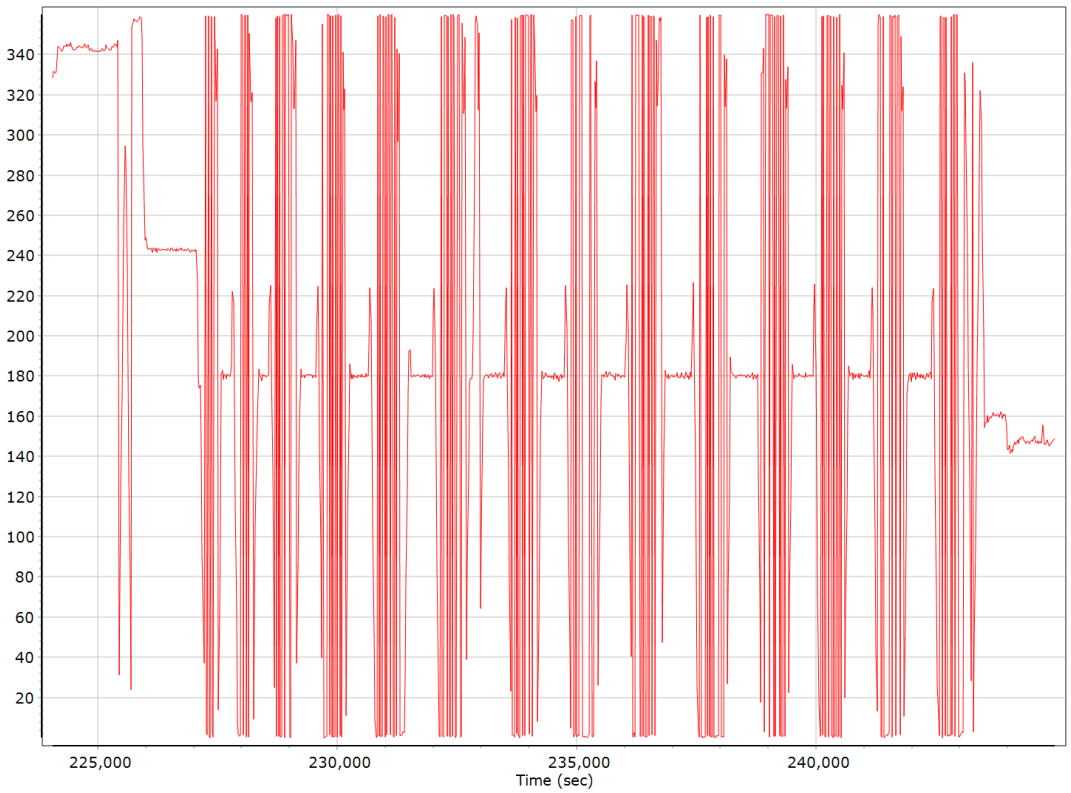
Altitude



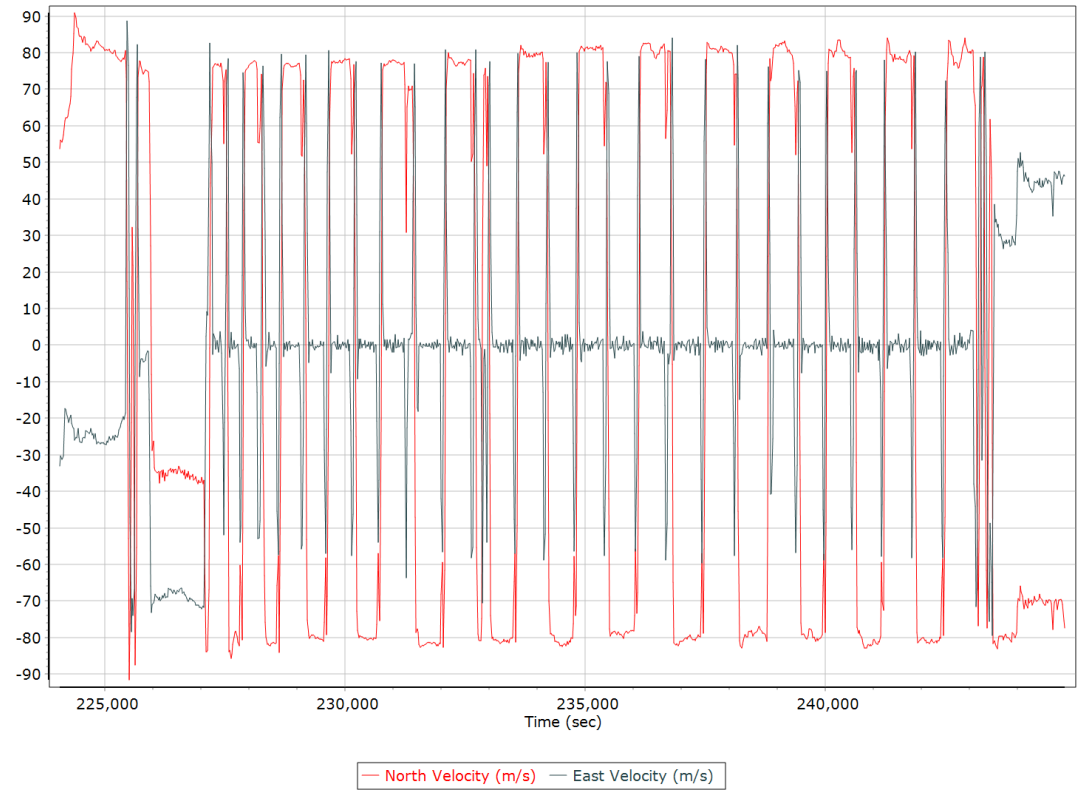
Roll/Pitch



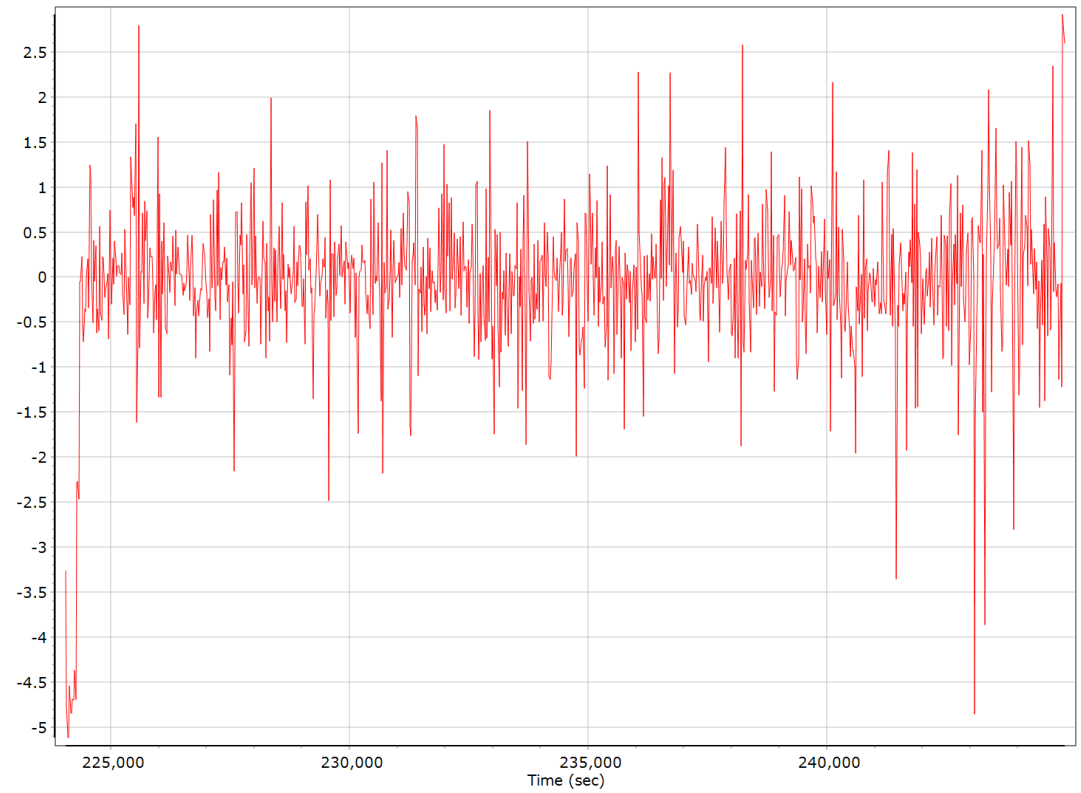
Heading



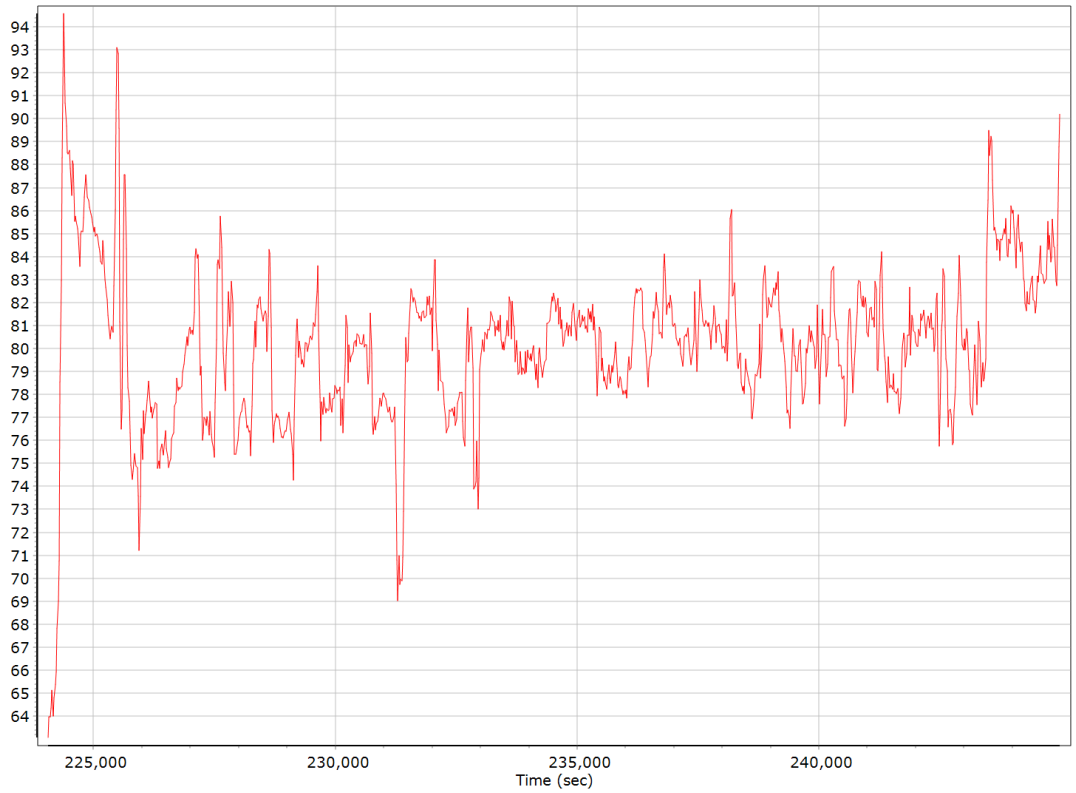
North/East Velocity



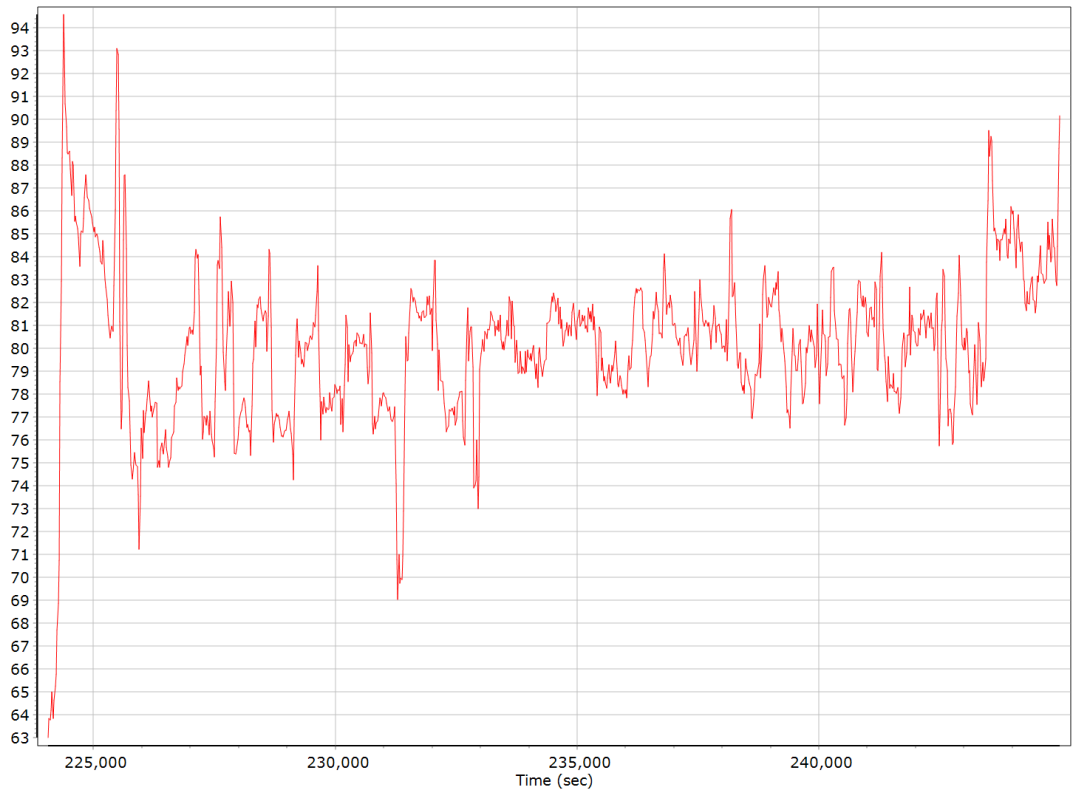
Down Velocity



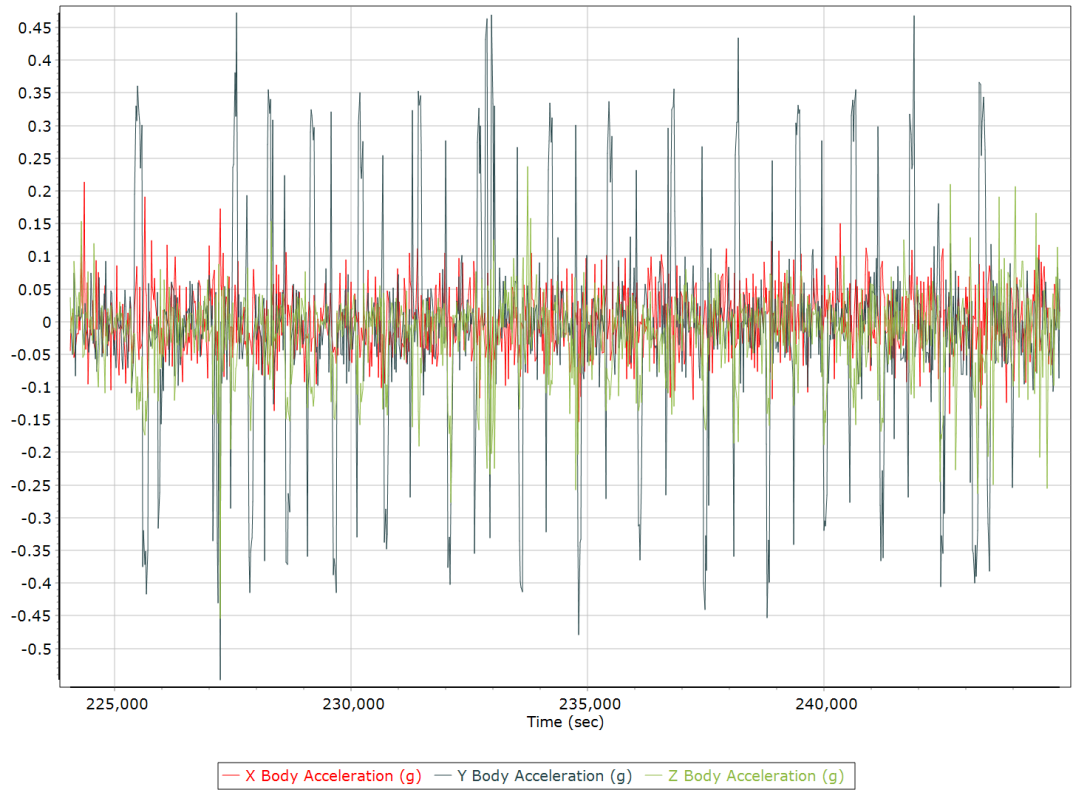
Total Speed



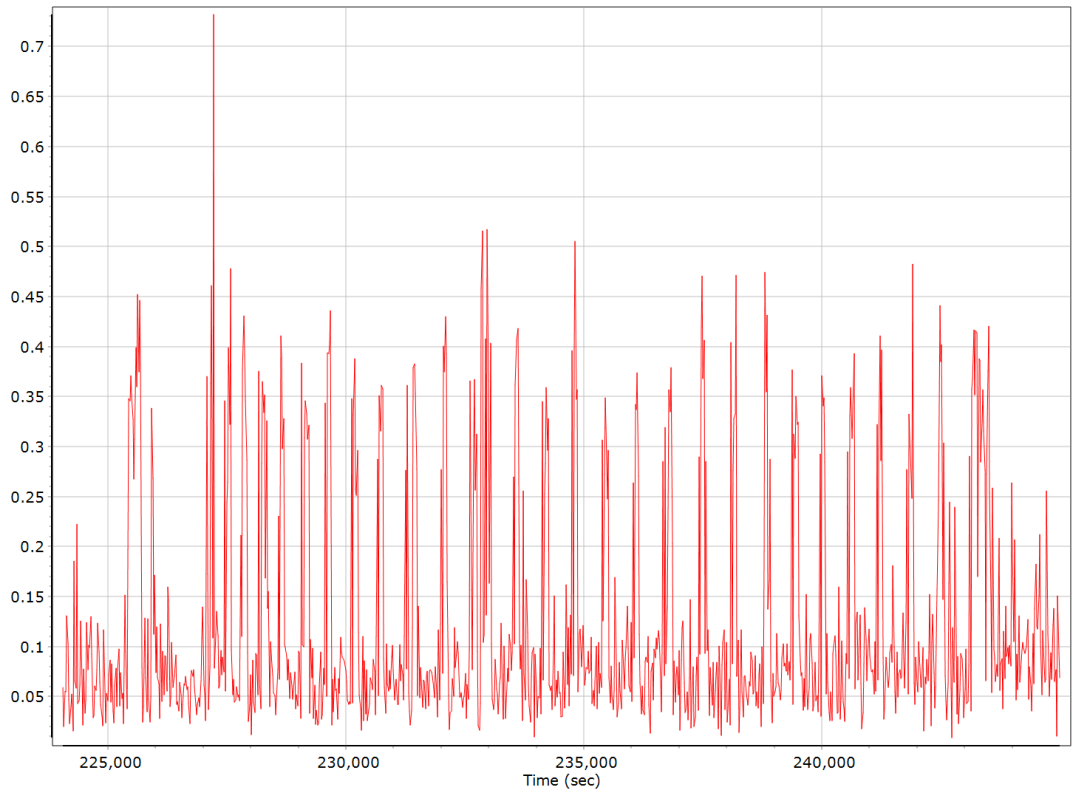
Ground Speed



Body Acceleration



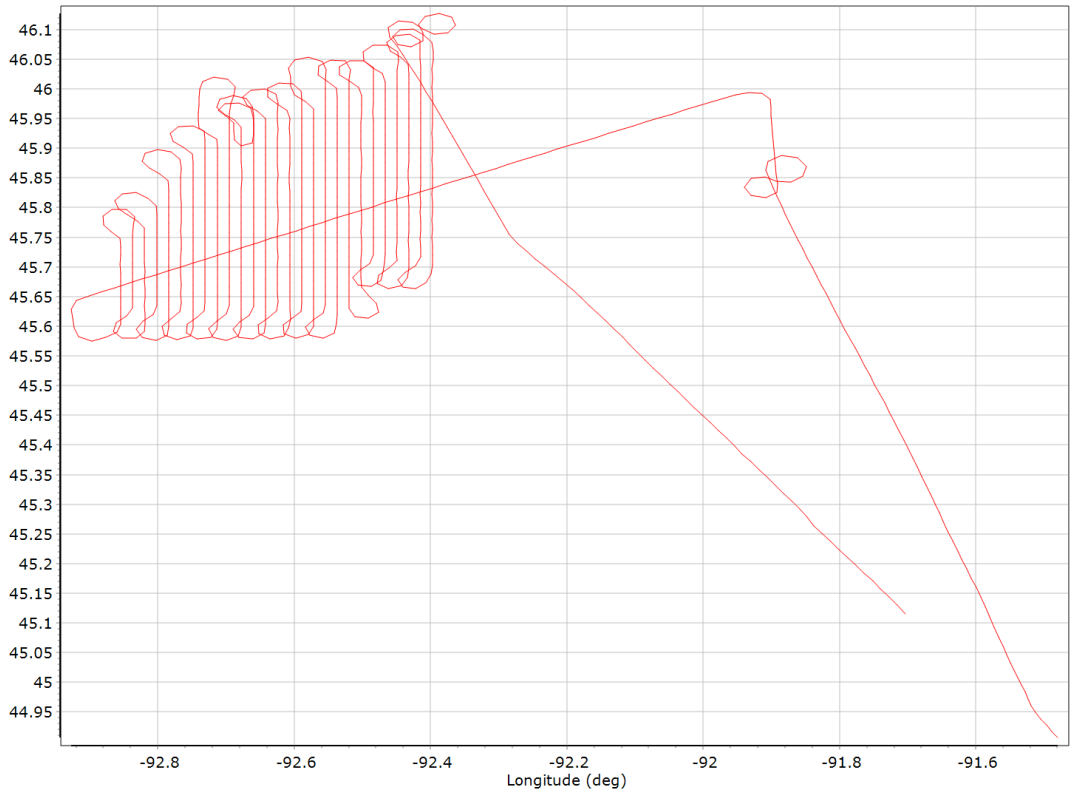
Total Body Acceleration



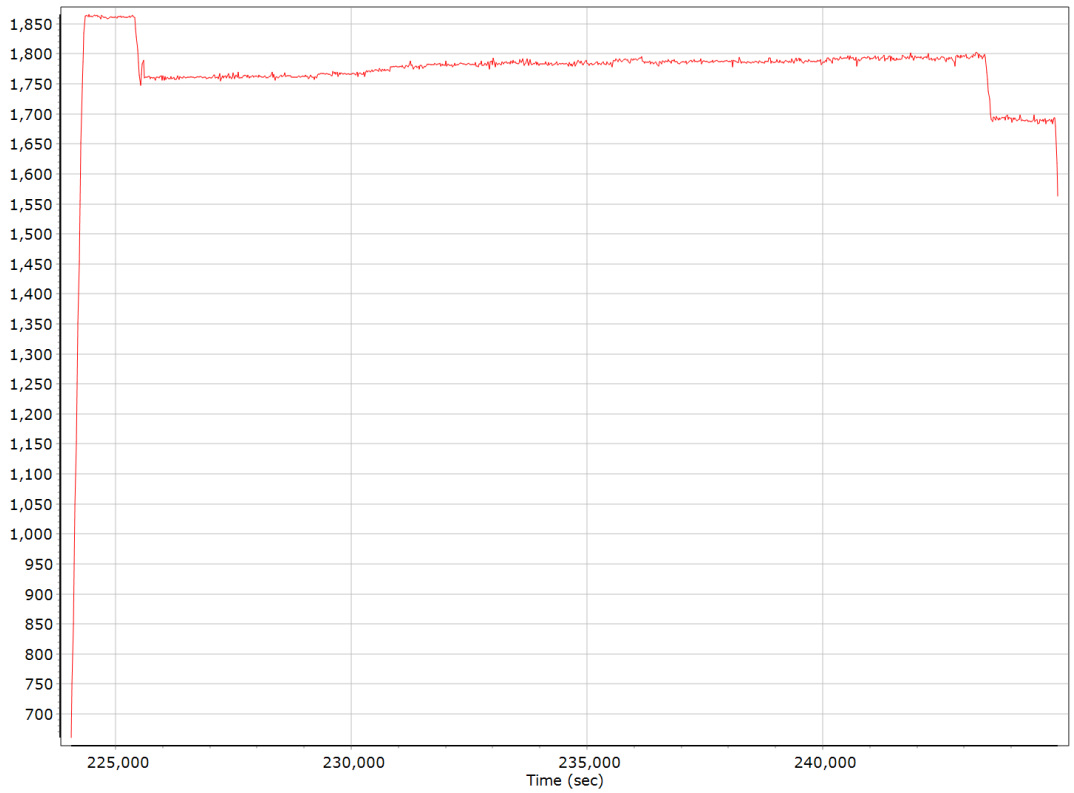
Body Angular Rate

Forward Processed Trajectory Information

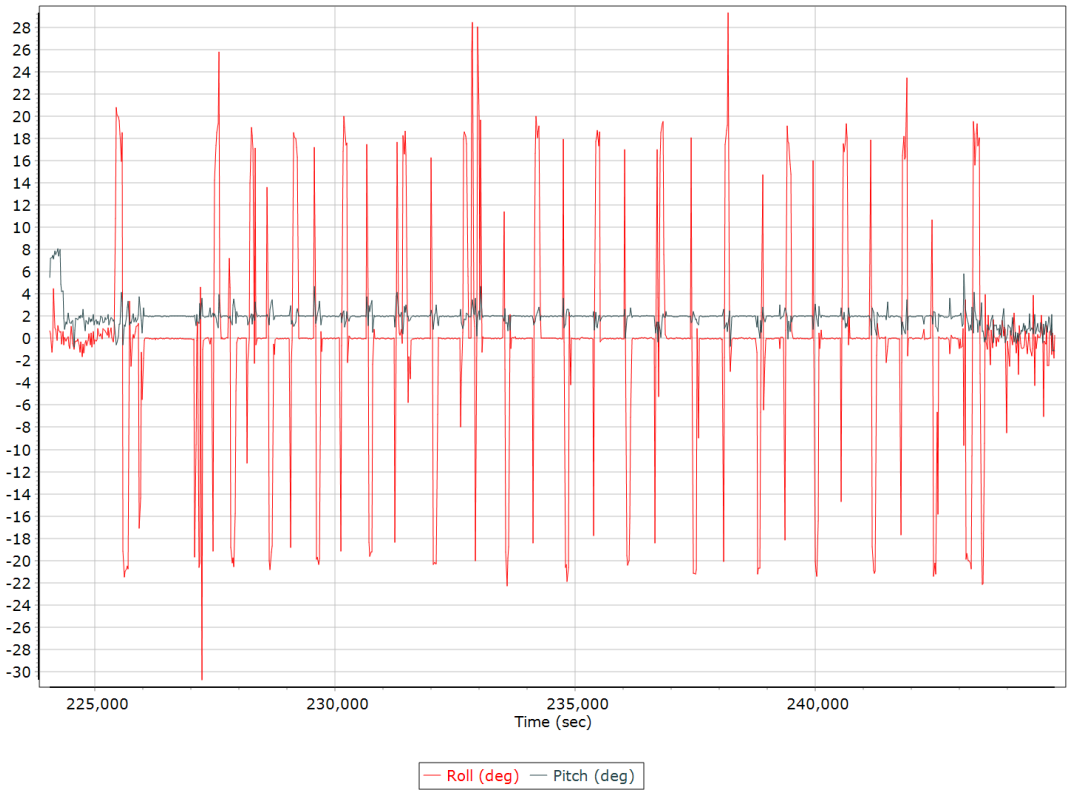
Top View



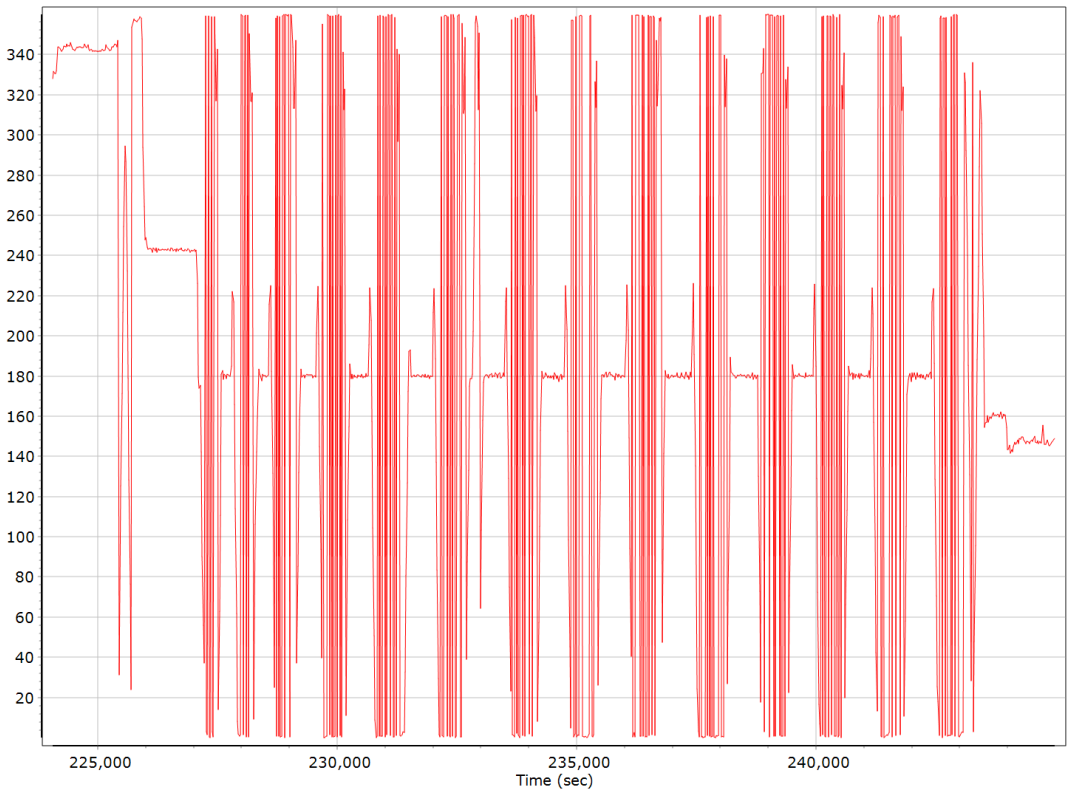
Altitude



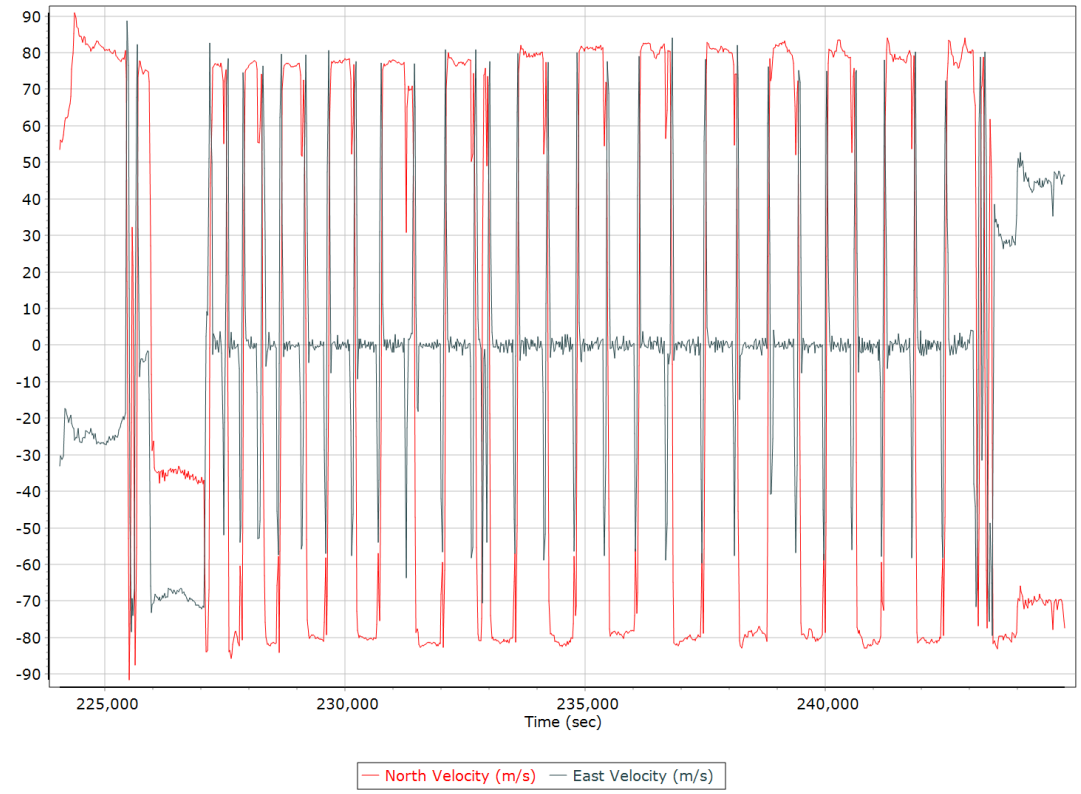
Roll/Pitch



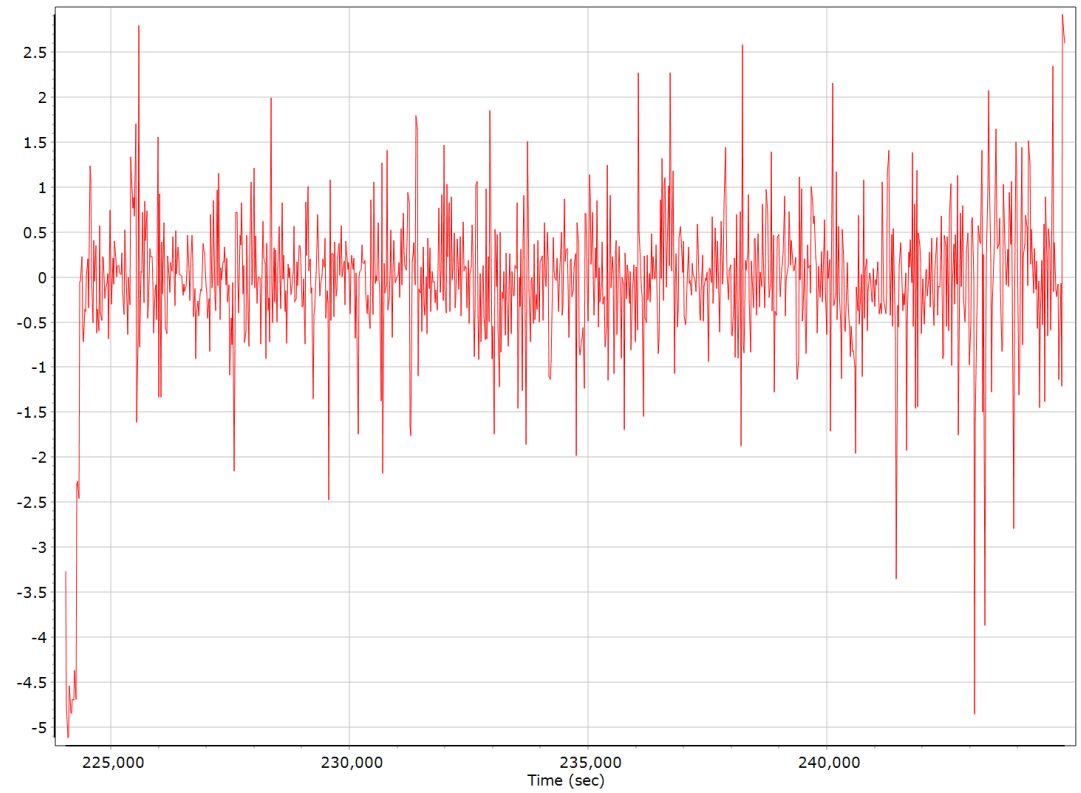
Heading



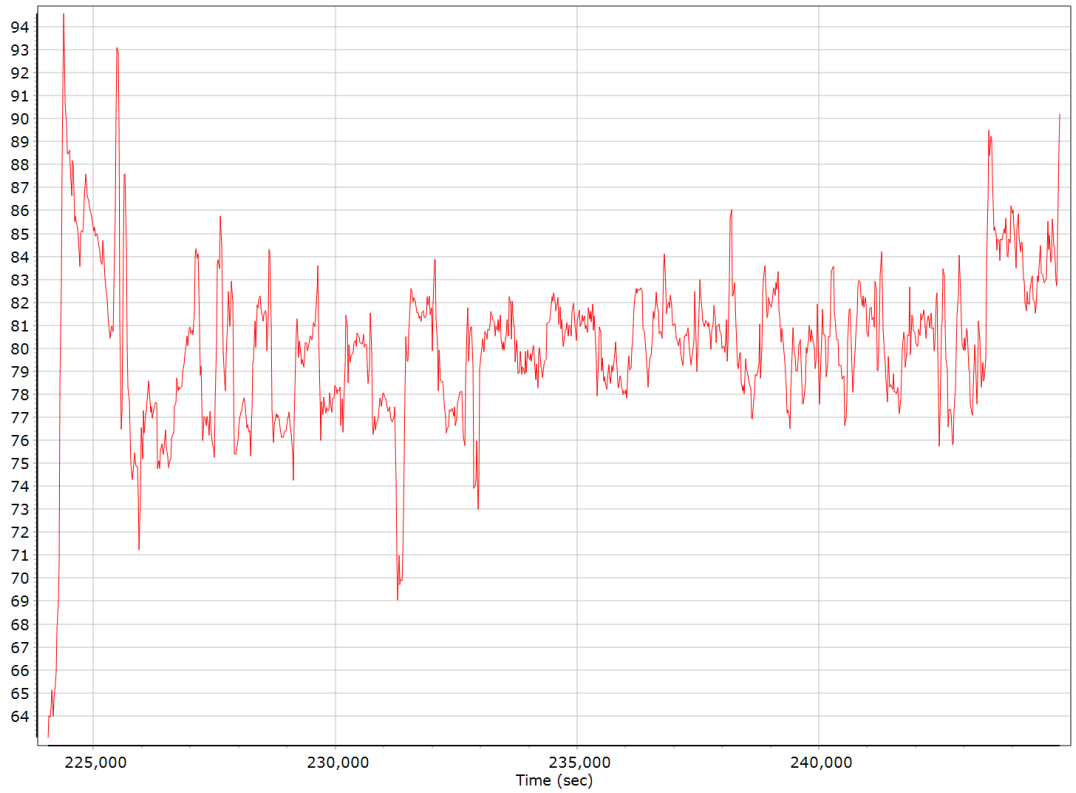
North/East Velocity



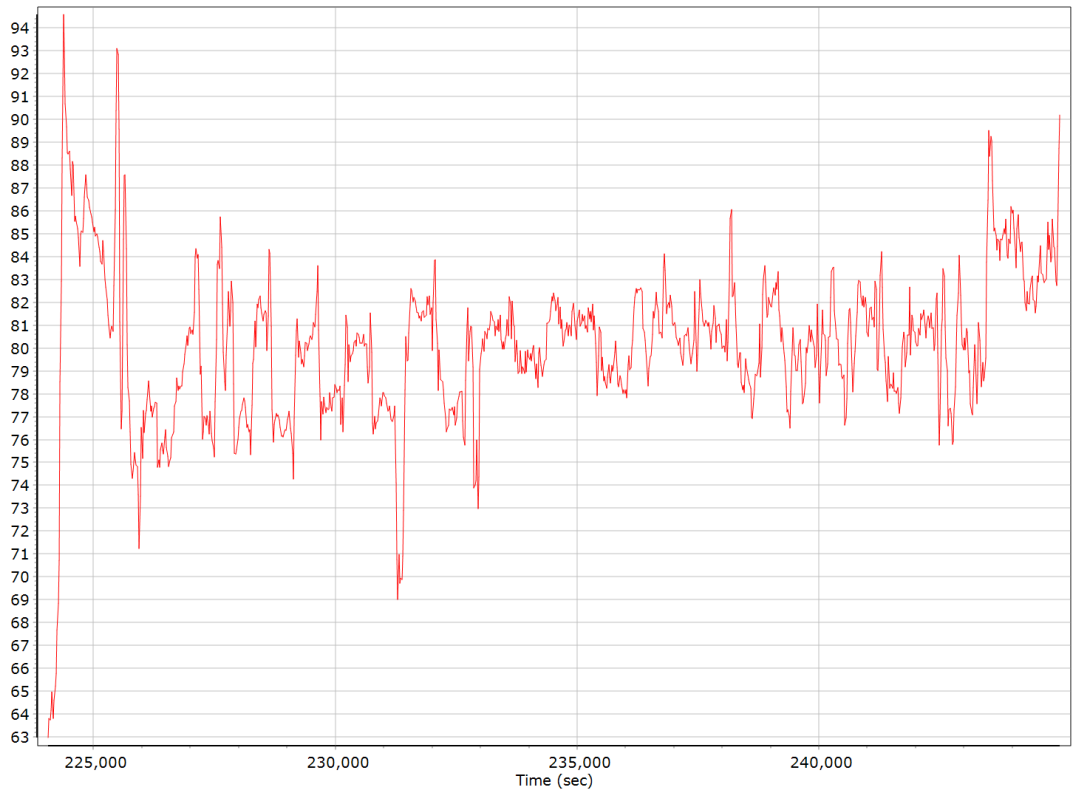
Down Velocity



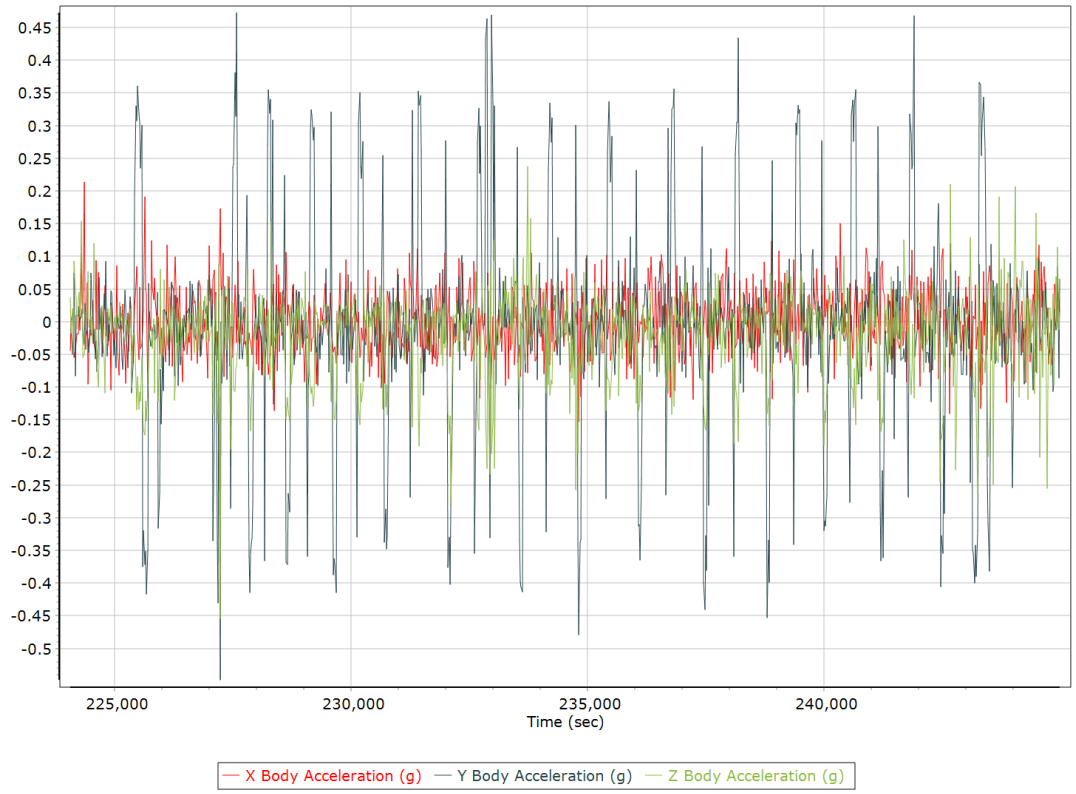
Total Speed



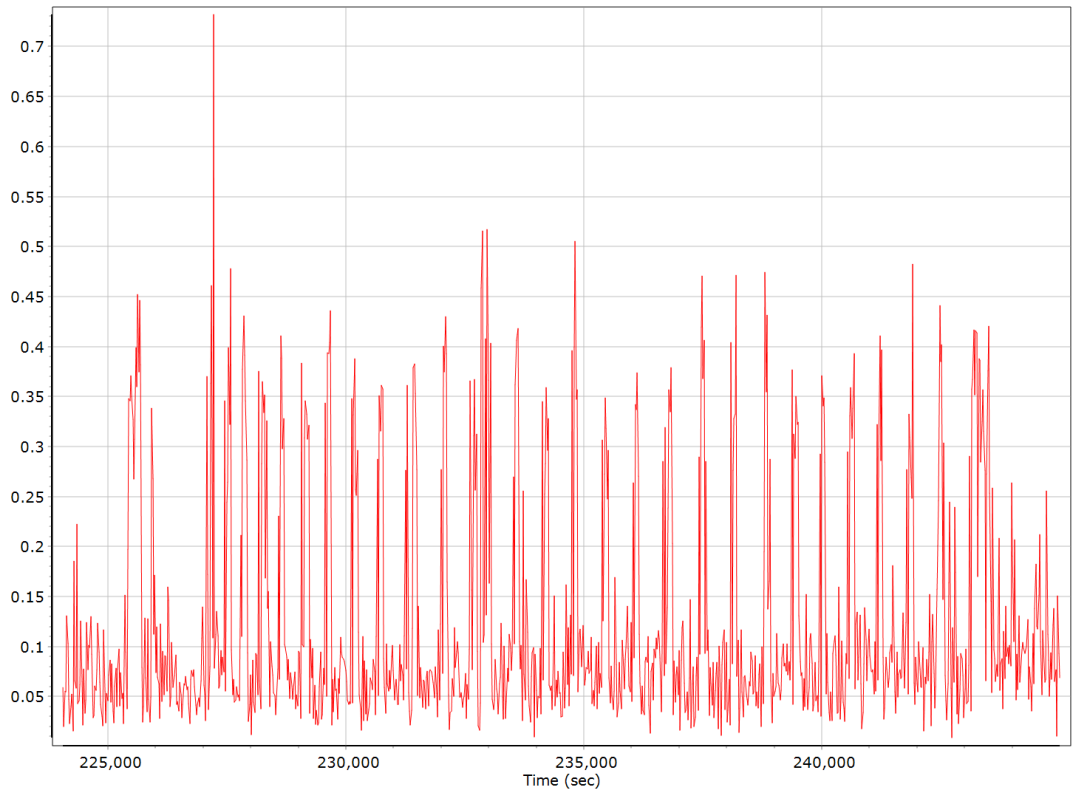
Ground Speed



Body Acceleration



Total Body Acceleration



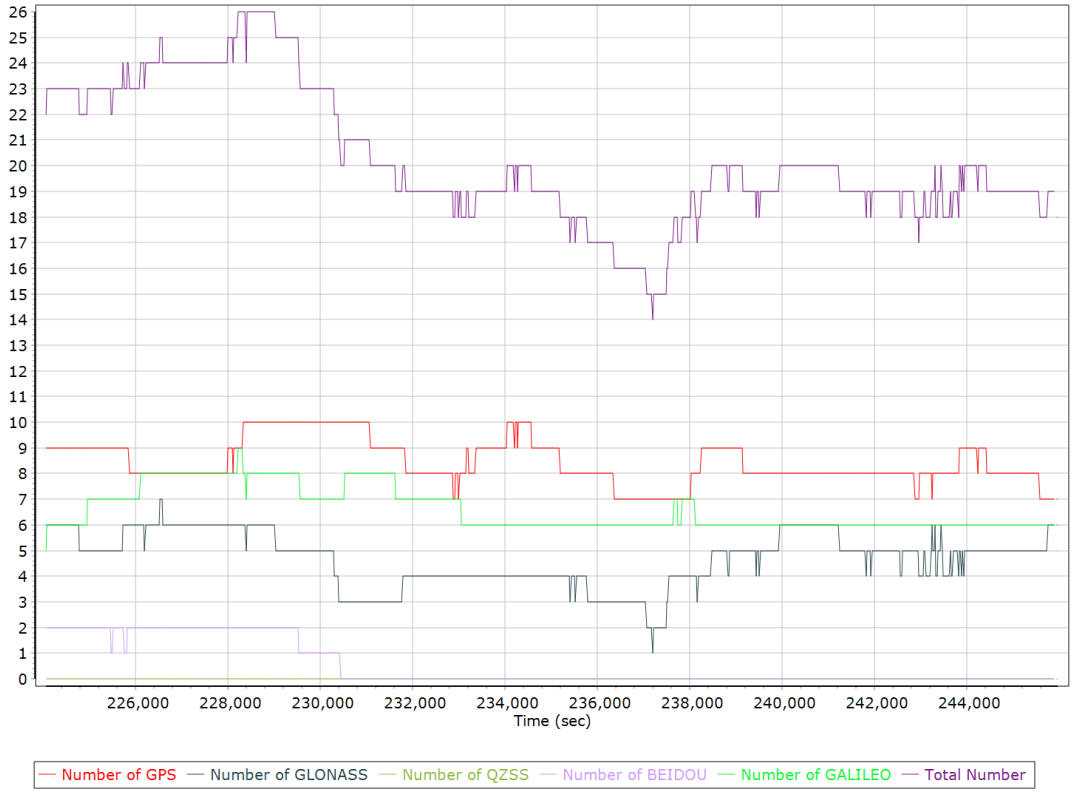
Body Angular Rate

GNSS QC

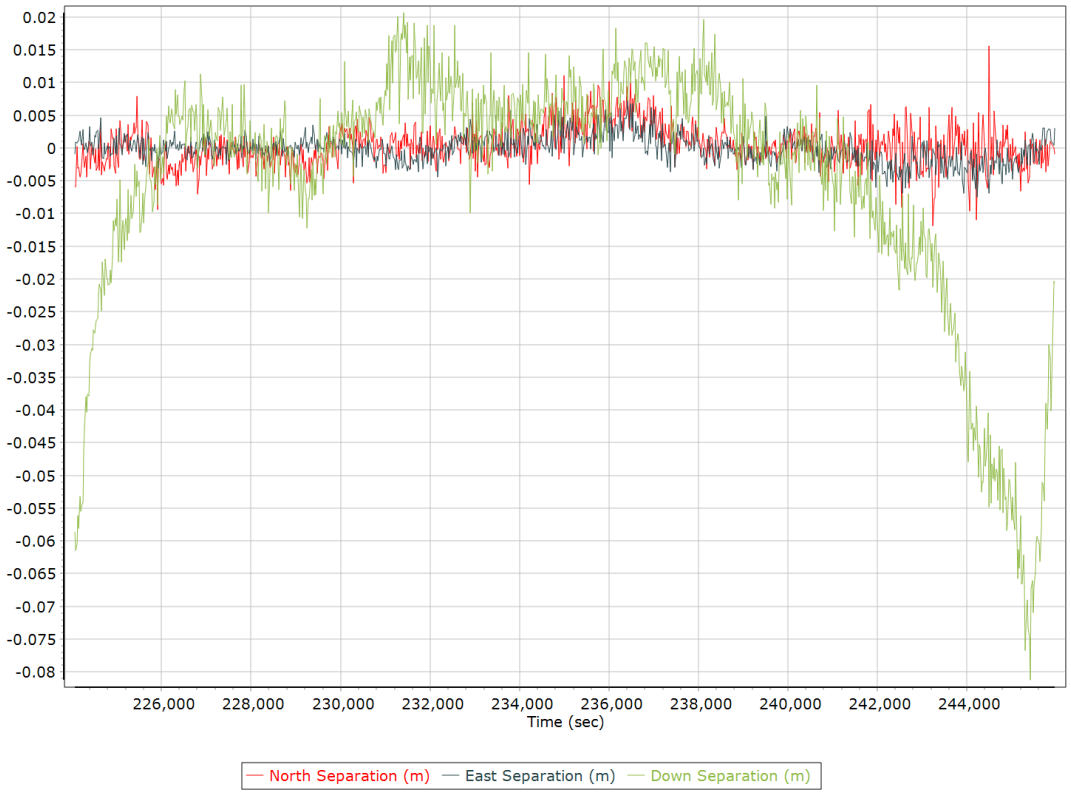
GNSS QC Statistics

Statistics	Min	Max	Mean
Baseline length (km)	0.00	0.00	
Number of GPS SV	5	10	8
Number of GLONASS SV	0	7	5
Number of QZSS SV	0	0	0
Number of BEIDOU SV	0	2	1
Number of GALILEO SV	0	9	7
Total number of SV	5	26	20
PDOP	1.01	2.99	1.17
QC Solution Gaps	37.00	37.00	
Solution Type	Fixed	Float	No solution
Epoch (sec)	22693.00	0.00	37.00
Percentage	99.84	0.00	0.16

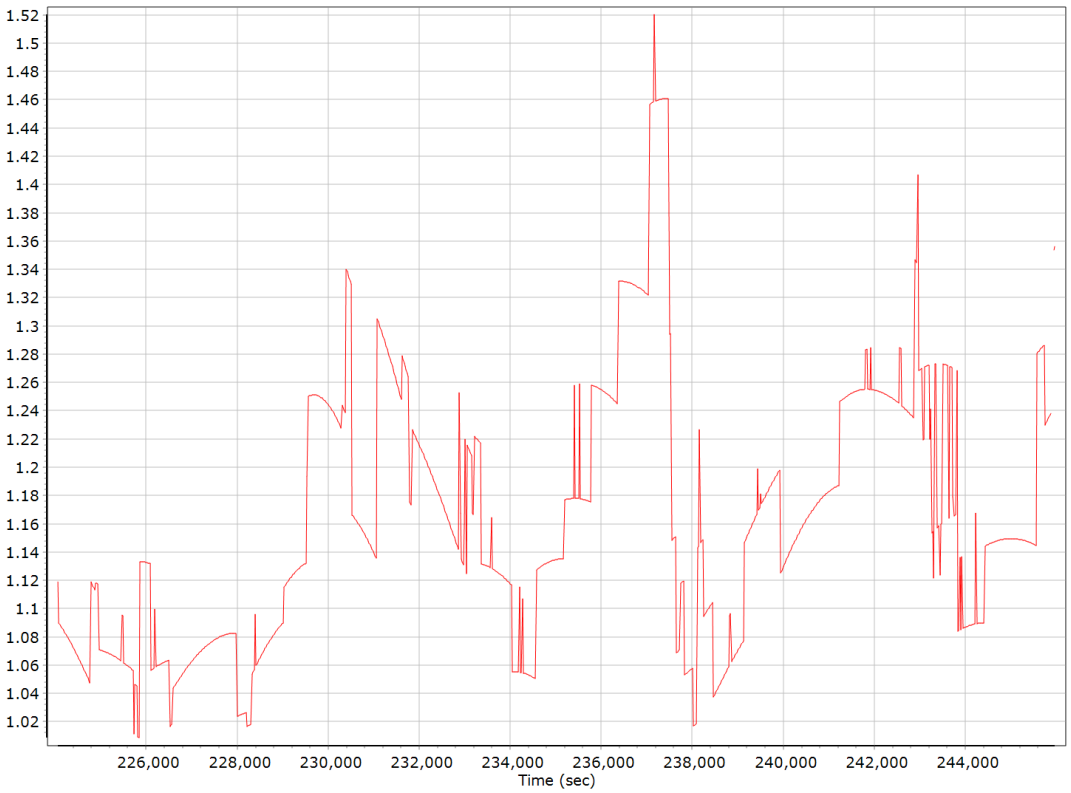
Num SVs in solution



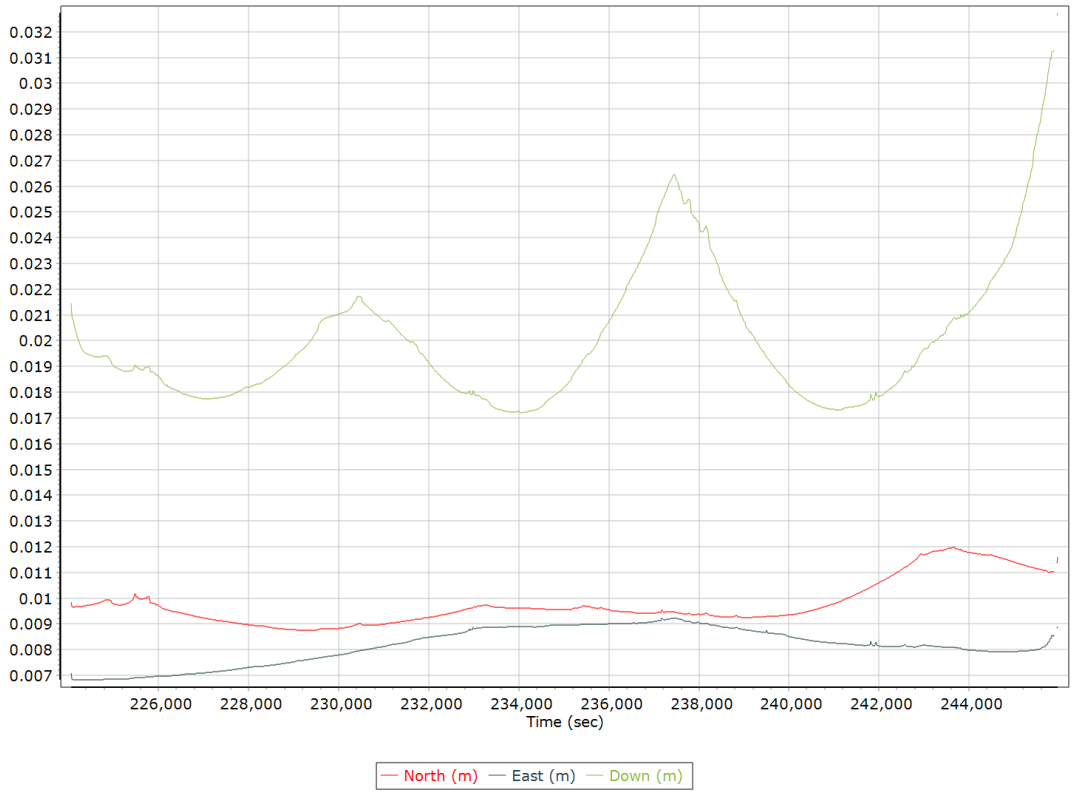
Forward/Reverse Separation



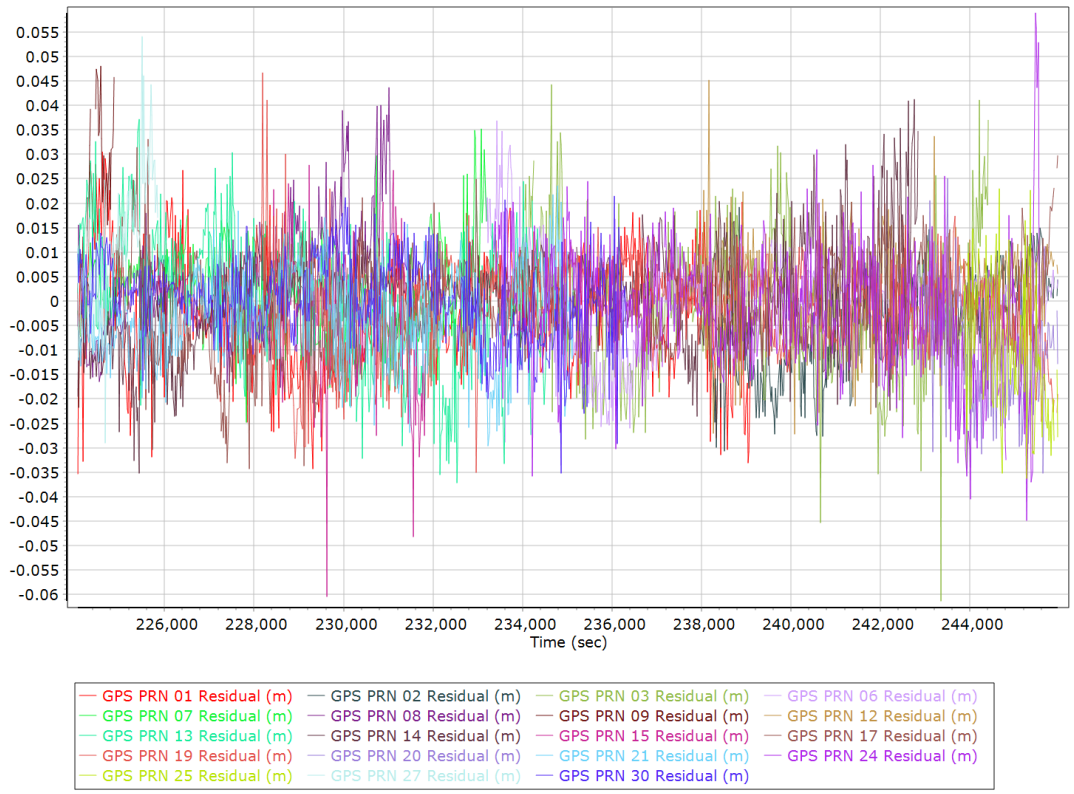
PDOP



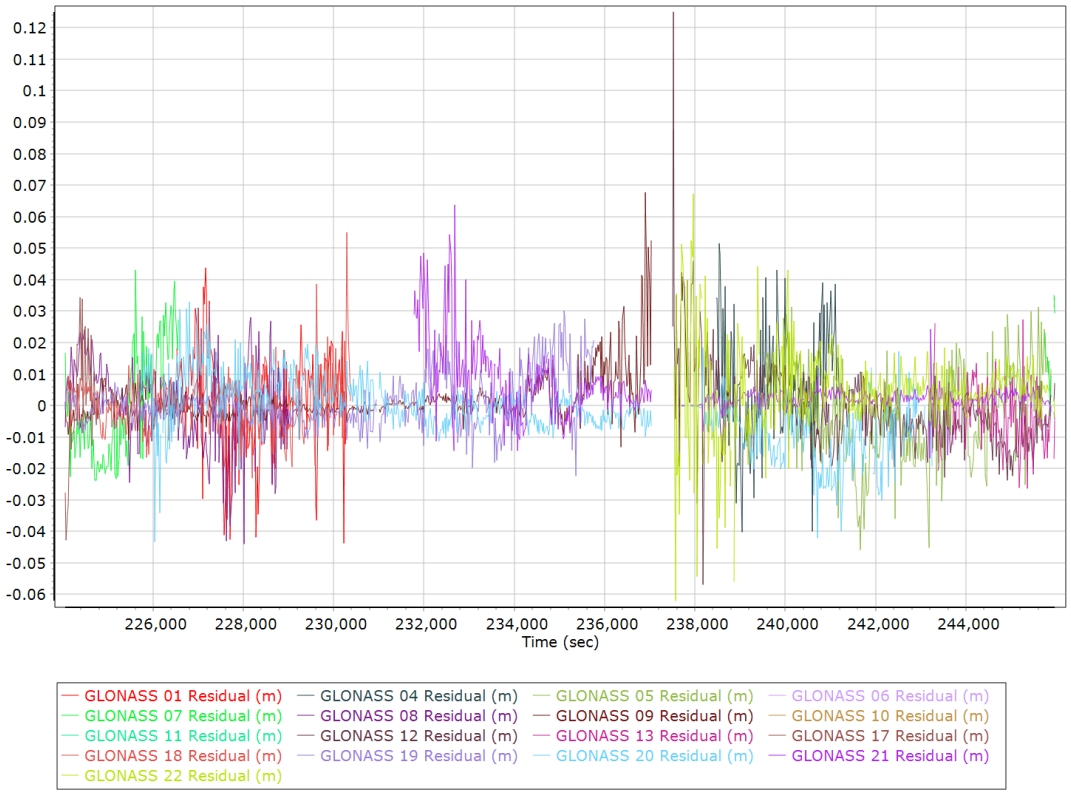
Estimated Position Accuracy



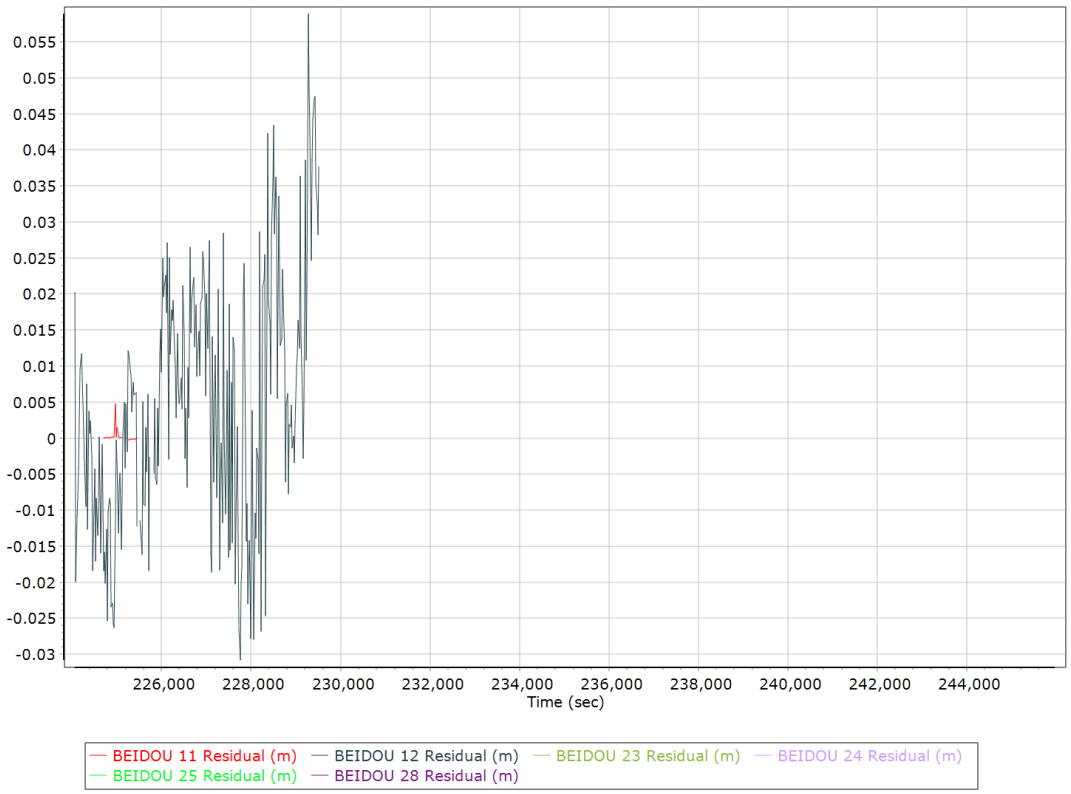
GPS Residuals



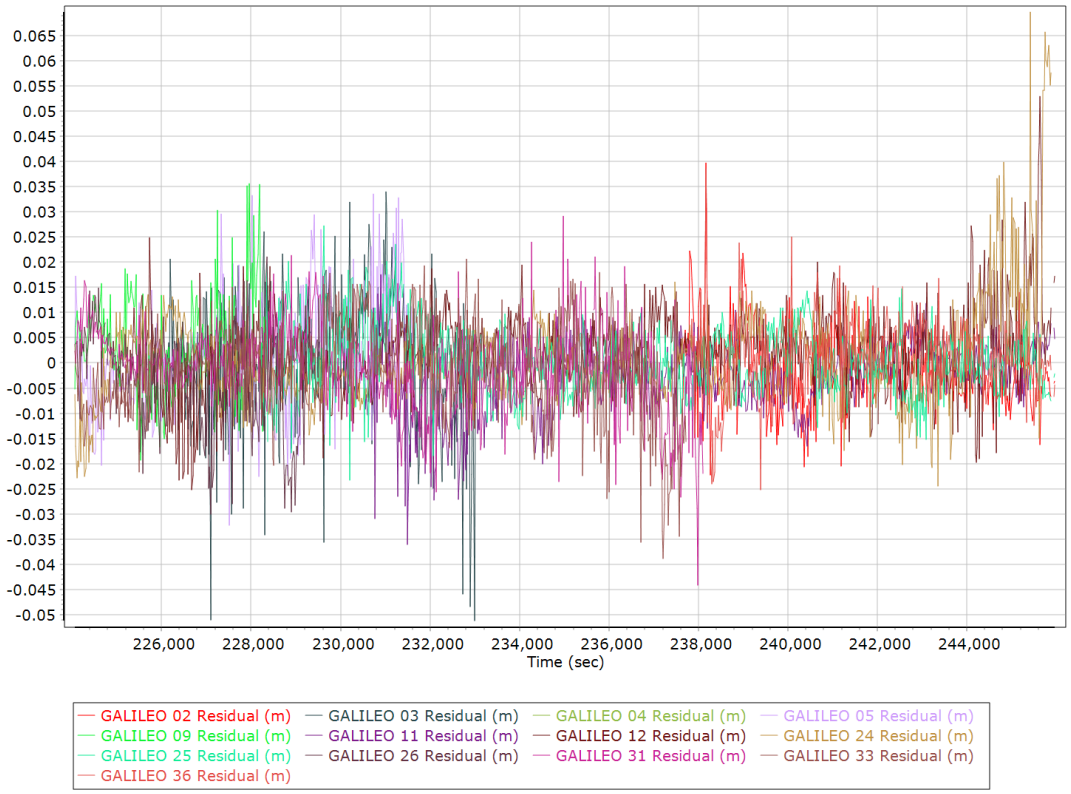
GLONASS Residuals



BEIDOU Residuals



GALILEO Residuals



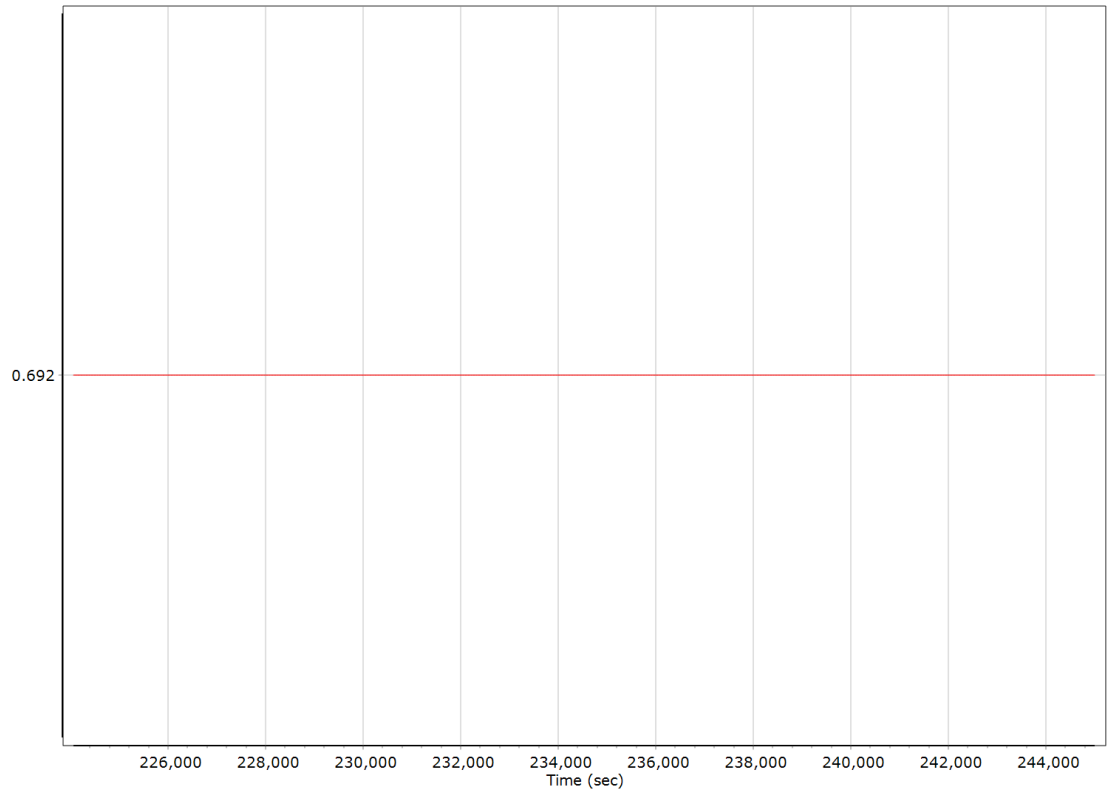
GNSS-Inertial Processor Configuration

Processing mode	IN-Fusion PP-RTX		
Stabilized mount	True		
Processing start time	224000.000 (5/10/2022 2:13:20 PM)		
Processing end time	245000.000 (5/10/2022 8:03:20 PM)		
Initial attitude source	Real-Time VNAV/RNAV Attitude		
IMU Sensor Context	Processing with Onboard IMU		
Gimbal to IMU lever arm (m)	-0.034	-0.010	-0.374
Gimbal to IMU mounting angles (deg)	0.000	0.000	0.000
Gimbal to Primary GNSS lever arm (m)	0.692	-0.181	-1.276
Gimbal to Primary GNSS lever arm std dev (m)	0.030	0.030	0.030
Aircraft to Reference mounting angles (deg)	0.000	0.000	0.000

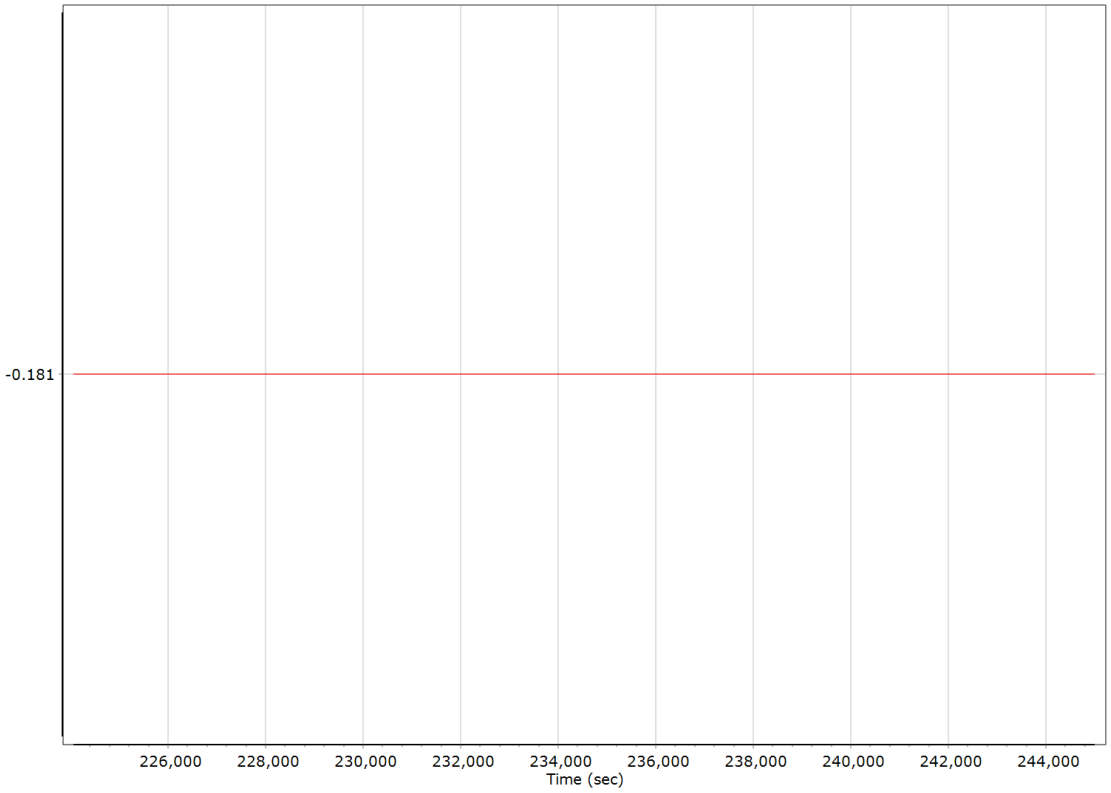
Calibrated Installation Parameters

Reference-Primary GNSS Lever Arm (m)

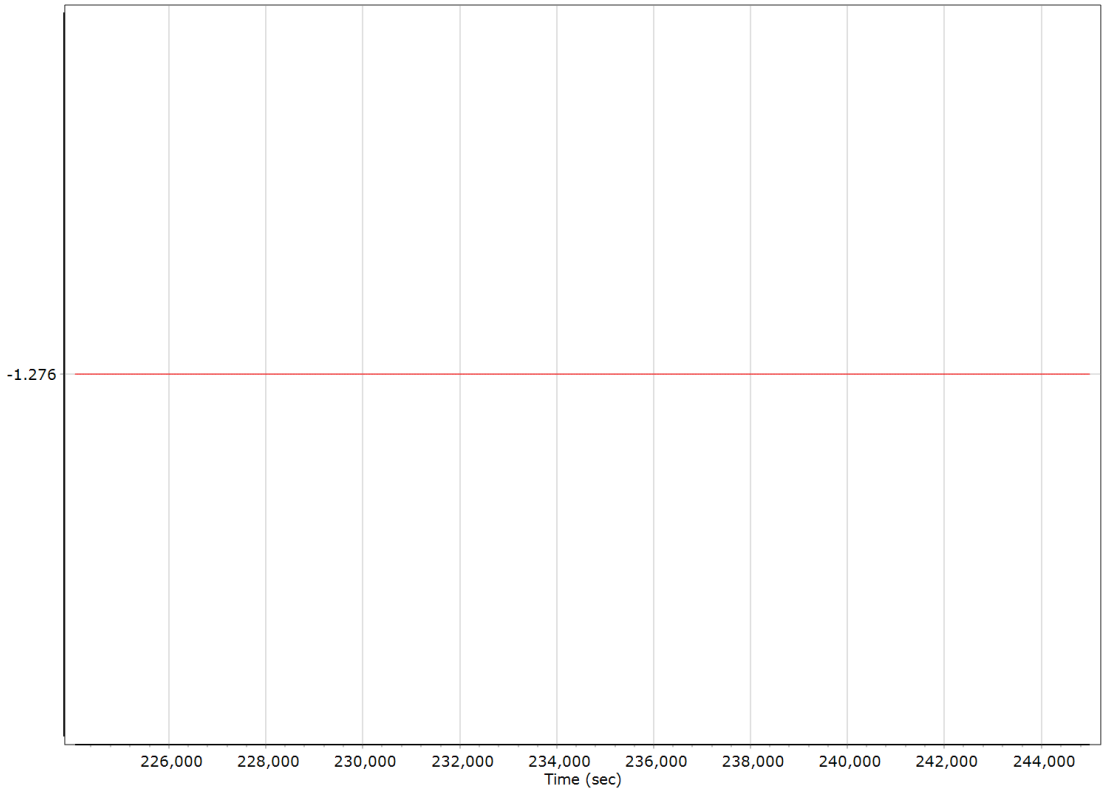
X Reference-Primary GNSS Lever Arm (m)



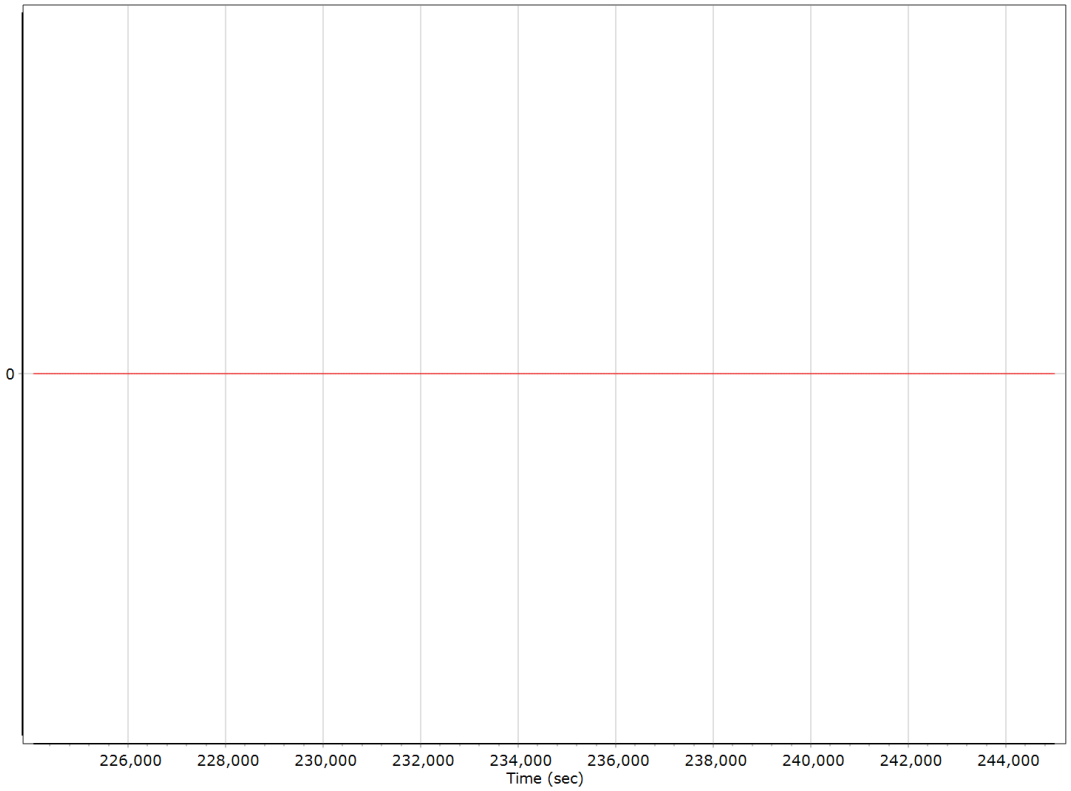
Y Reference-Primary GNSS Lever Arm (m)



Z Reference-Primary GNSS Lever Arm (m)



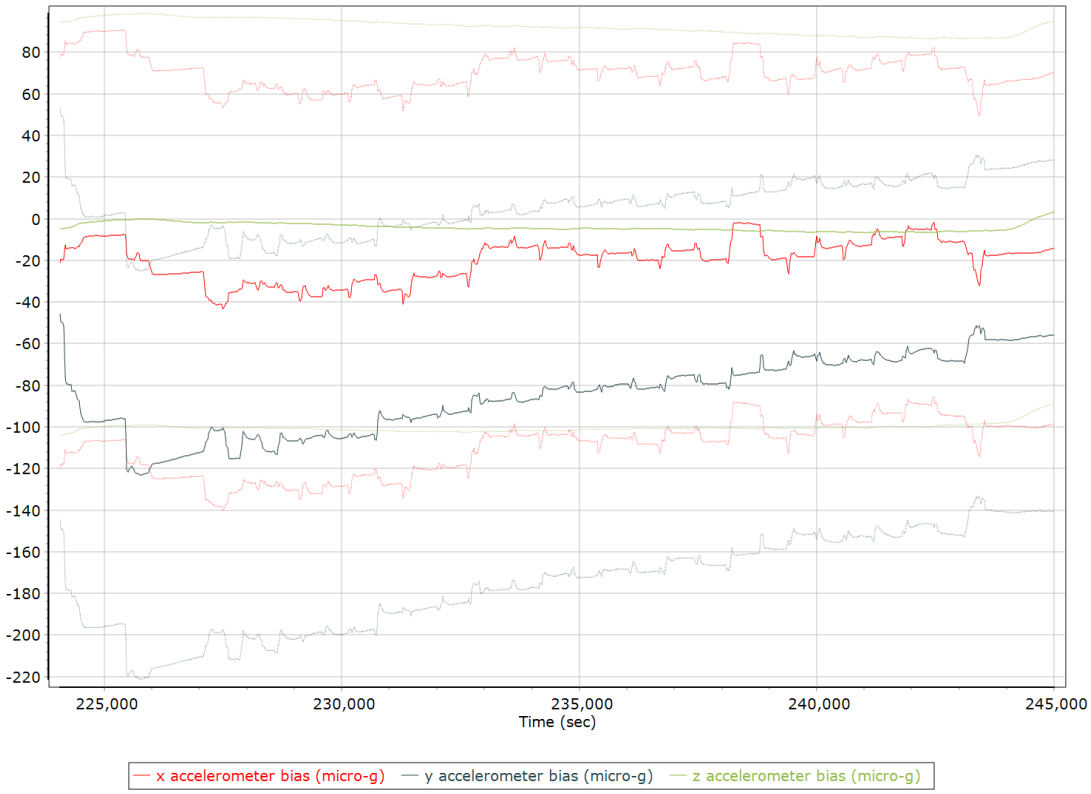
Reference-Primary GNSS Lever Arm Figure of Merit



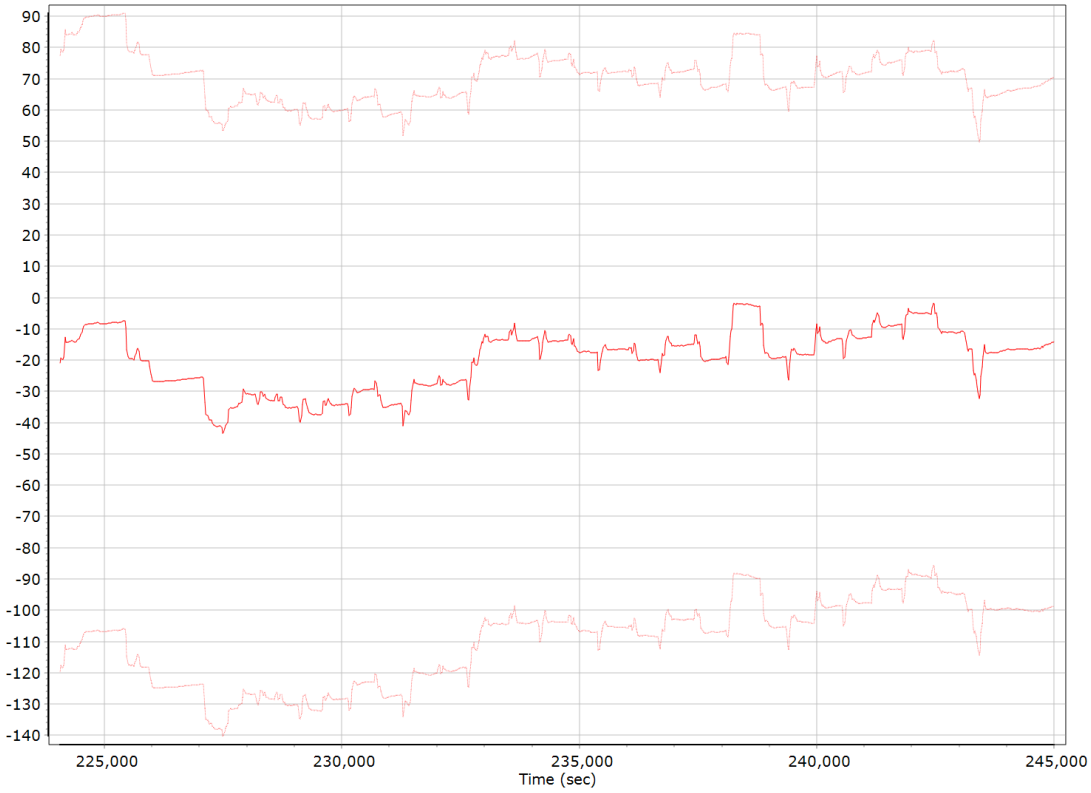
IN-Fusion QC

Forward Processed Estimated Errors, Reference Frame

Accelerometer Bias (micro-g)

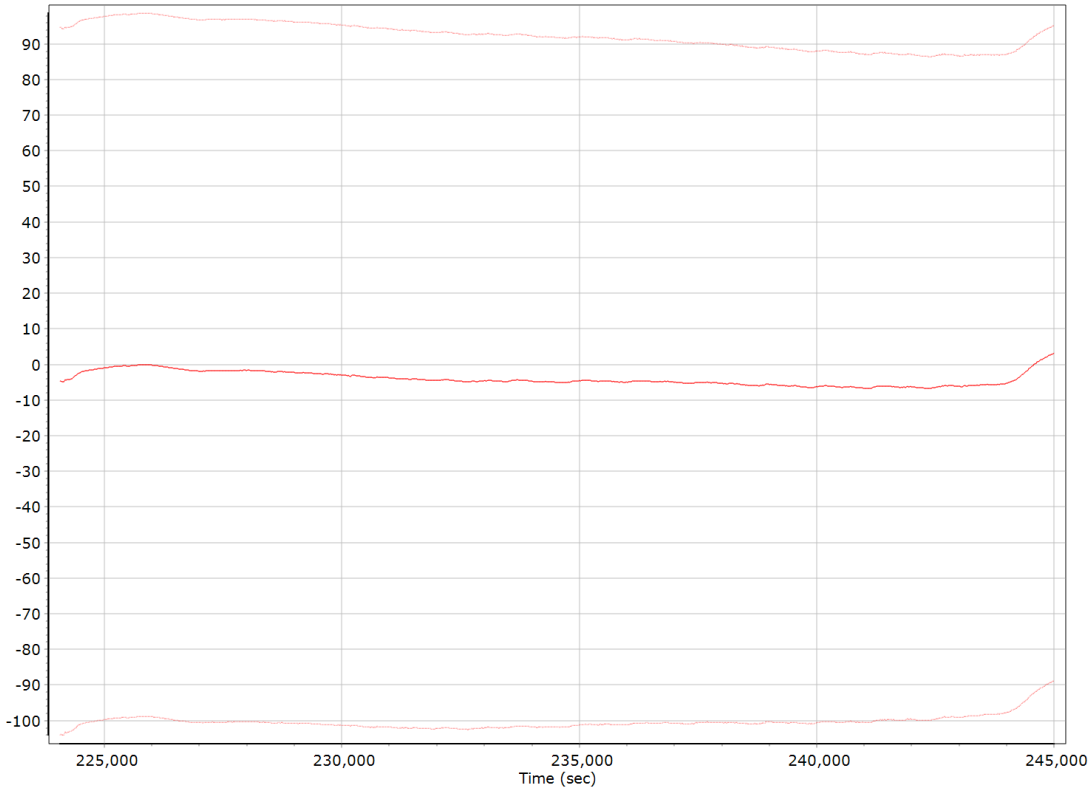


X Accelerometer Bias (micro-g)



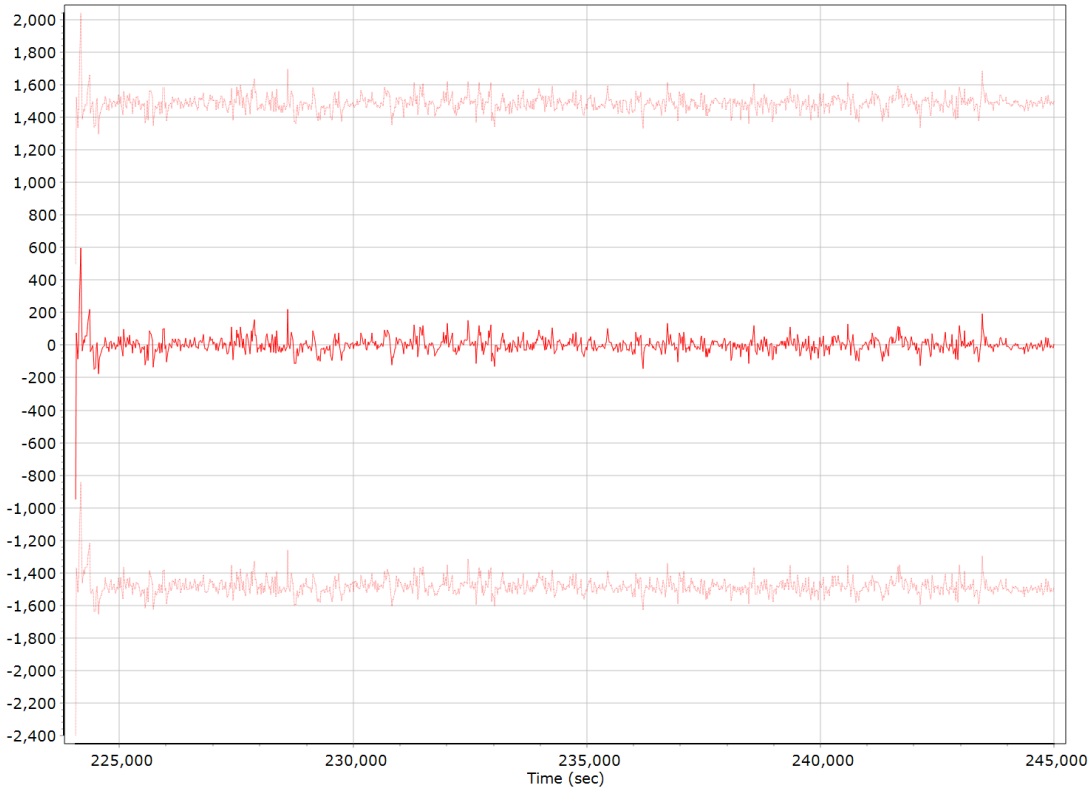
Y Accelerometer Bias (micro-g)

Z Accelerometer Bias (micro-g)

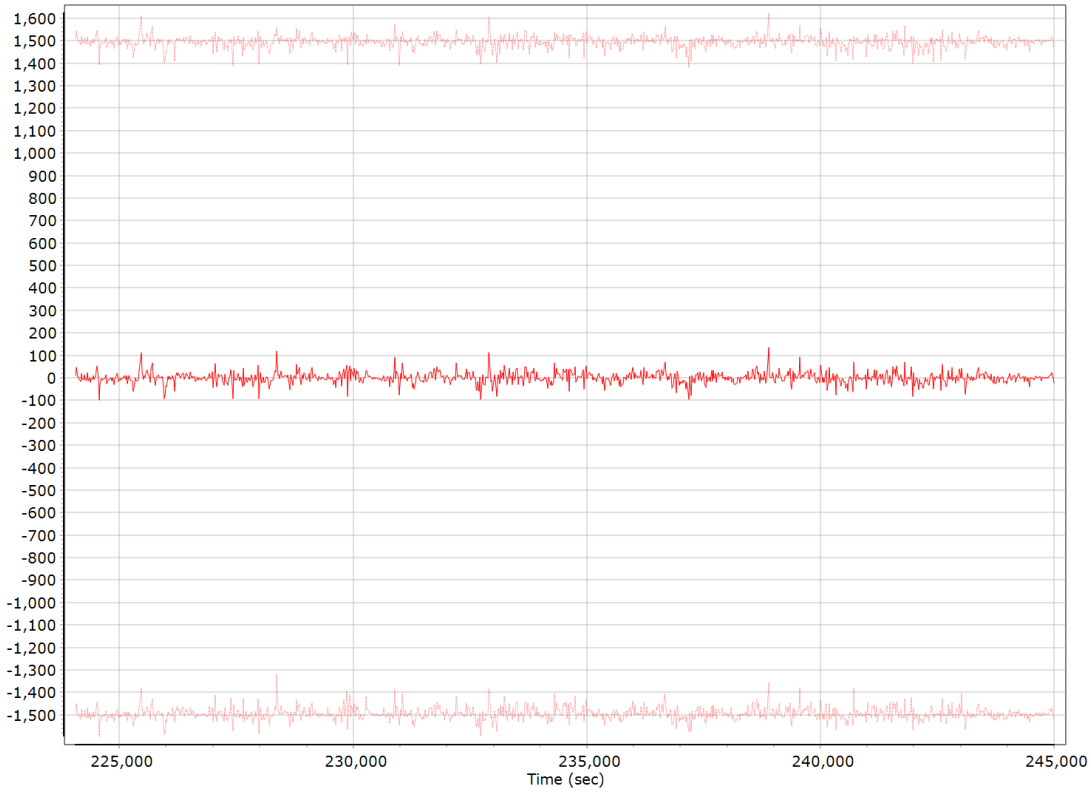


Accelerometer Scale Error (ppm)

X Accelerometer Scale Error (ppm)



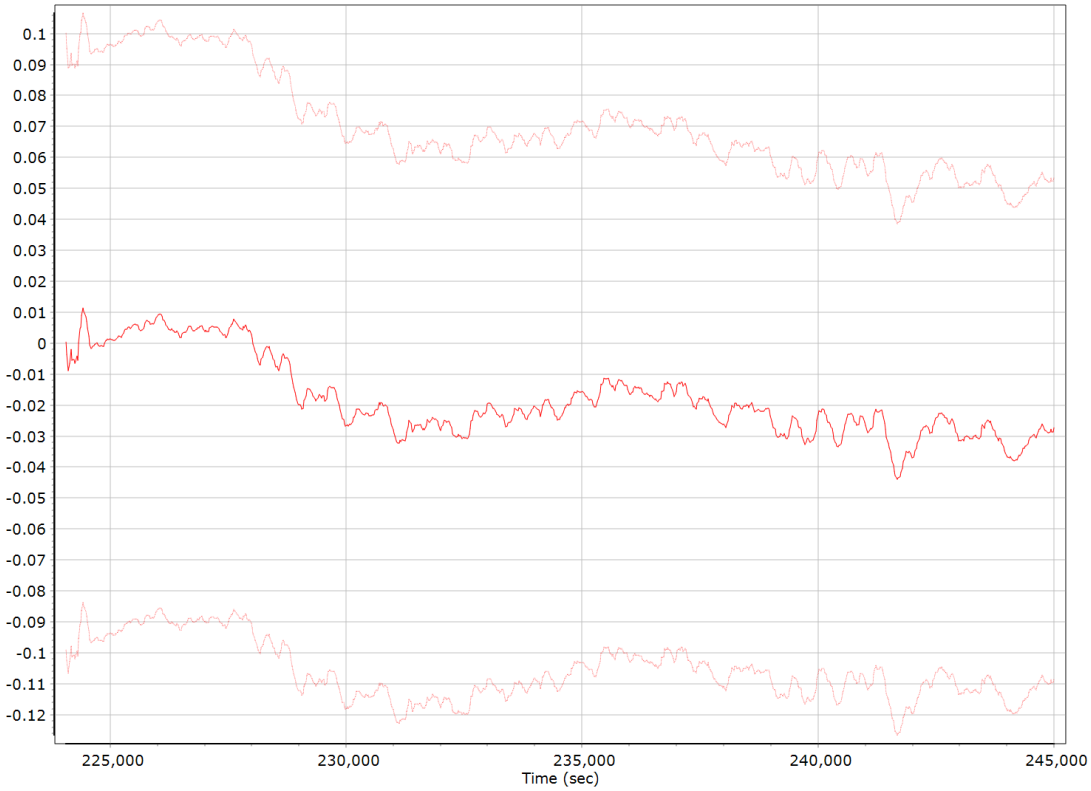
Y Accelerometer Scale Error (ppm)



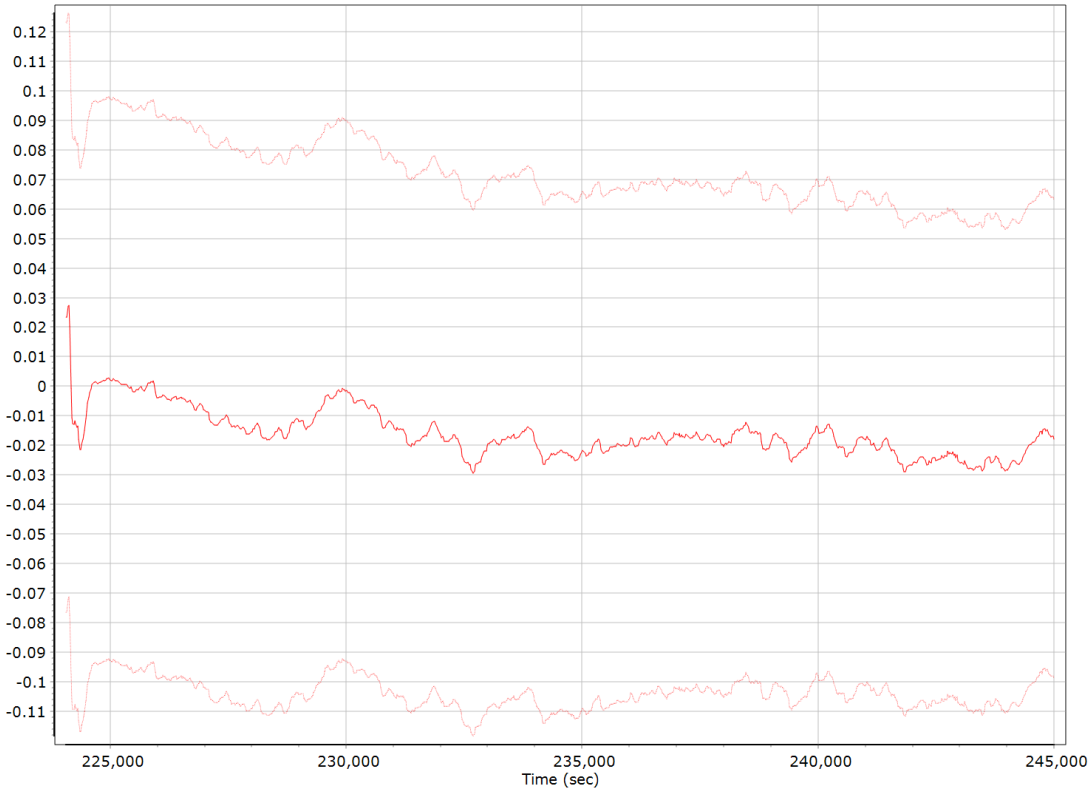
Z Accelerometer Scale Error (ppm)

Gyro Bias (deg/h)

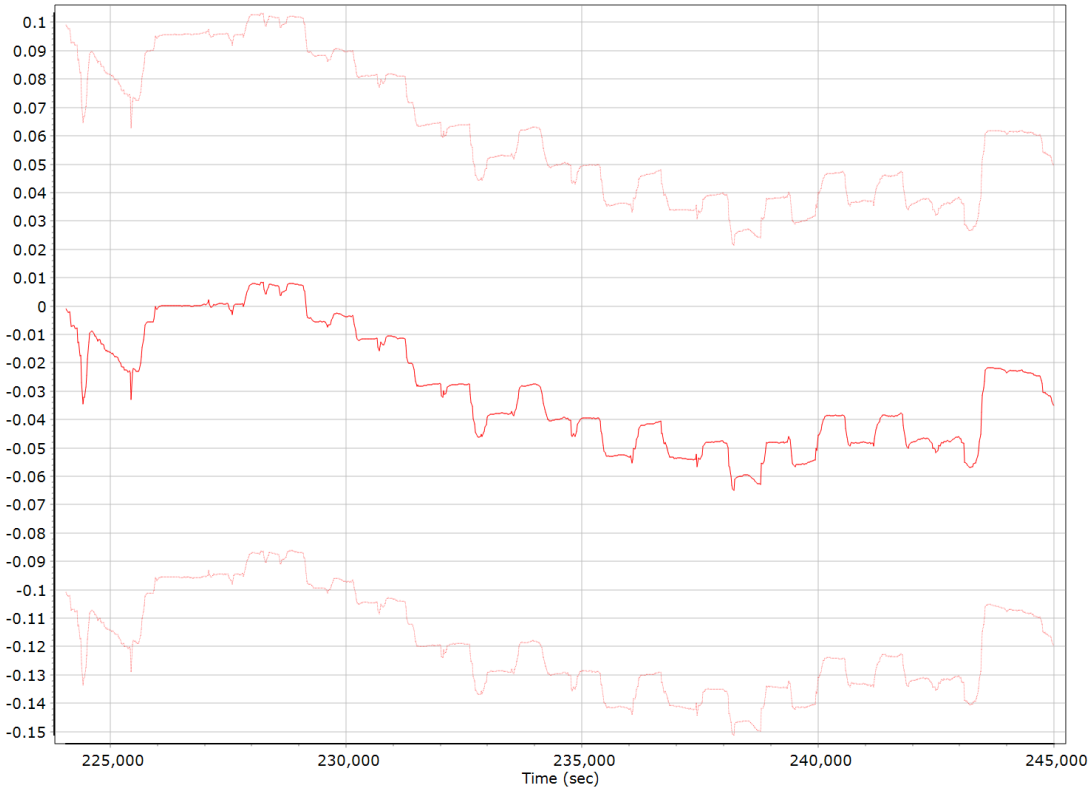
X Gyro Bias (deg/h)



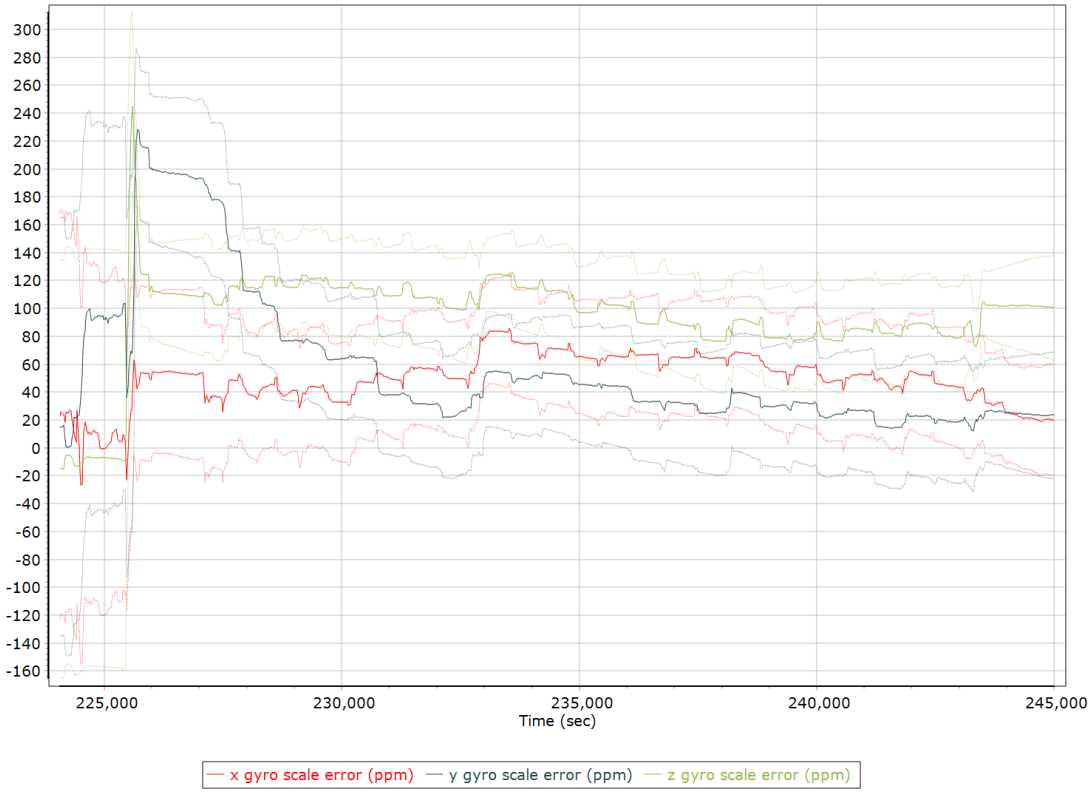
Y Gyro Bias (deg/h)



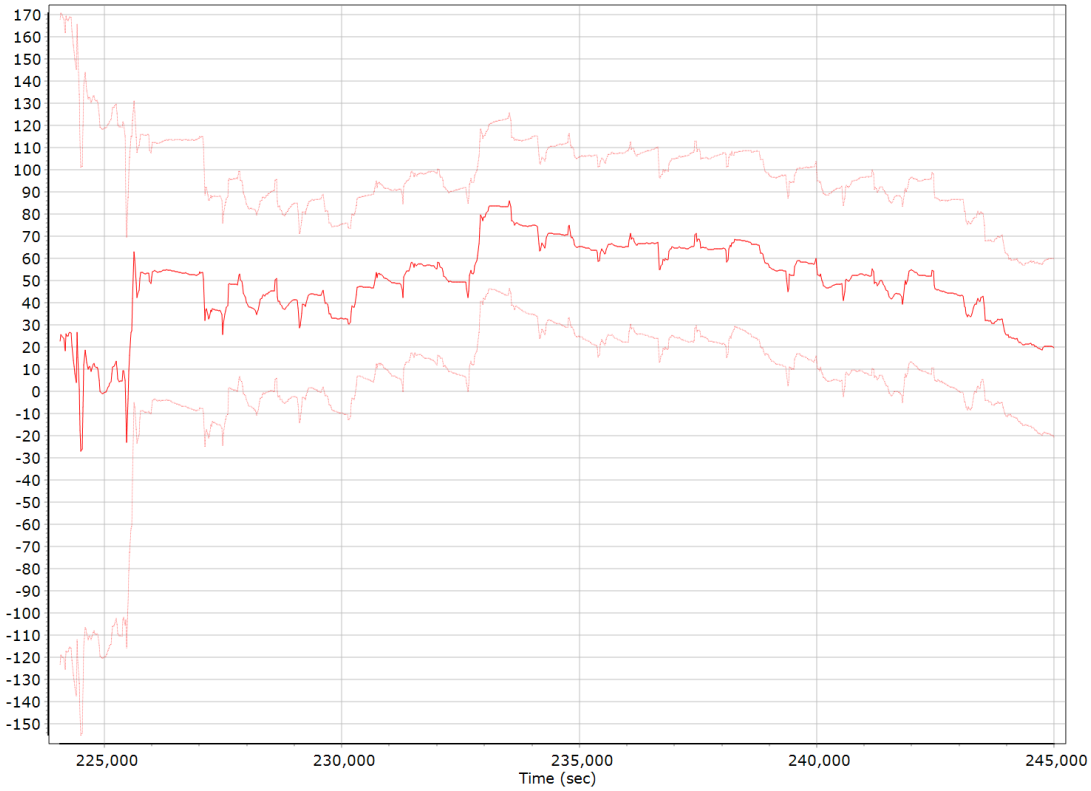
Z Gyro Bias (deg/h)



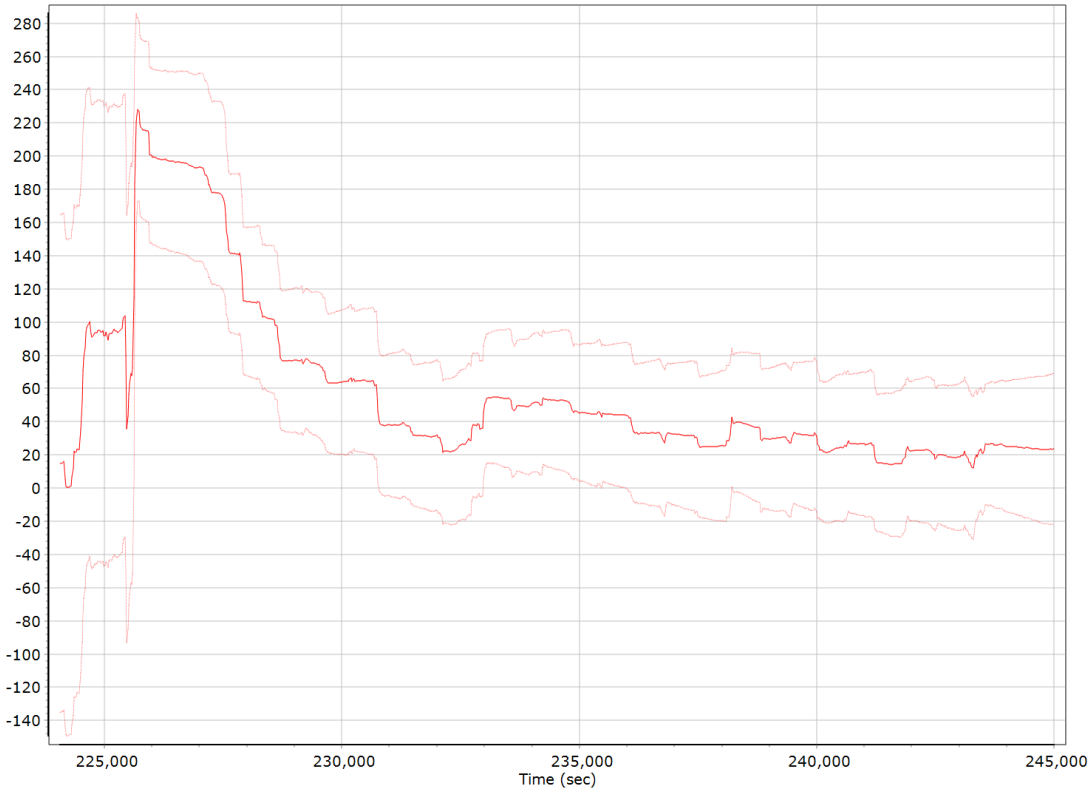
Gyro Scale Error (ppm)



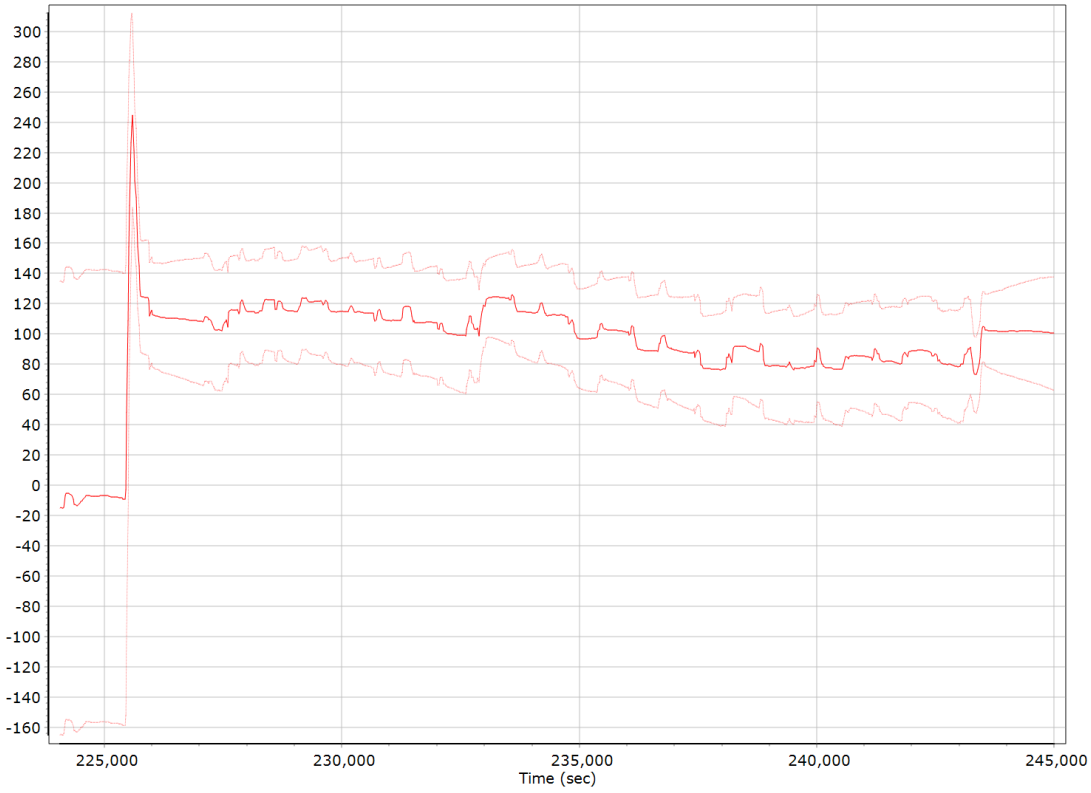
X Gyro Scale Error (ppm)



Y Gyro Scale Error (ppm)



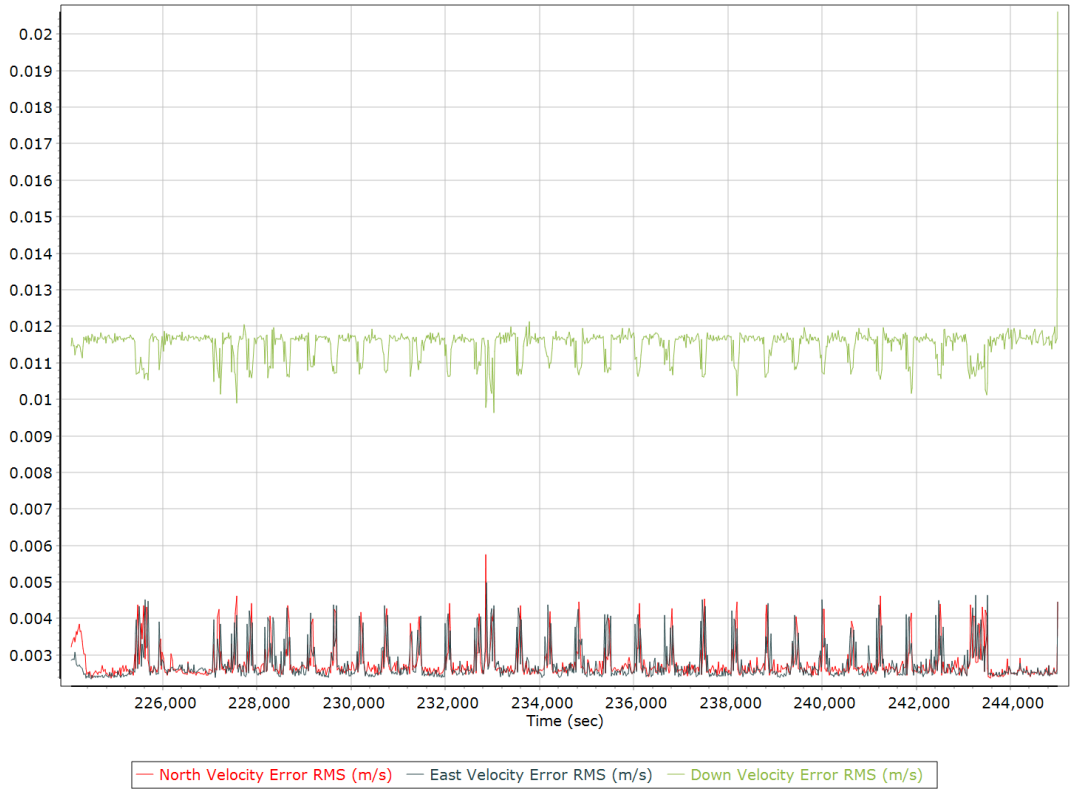
Z Gyro Scale Error (ppm)



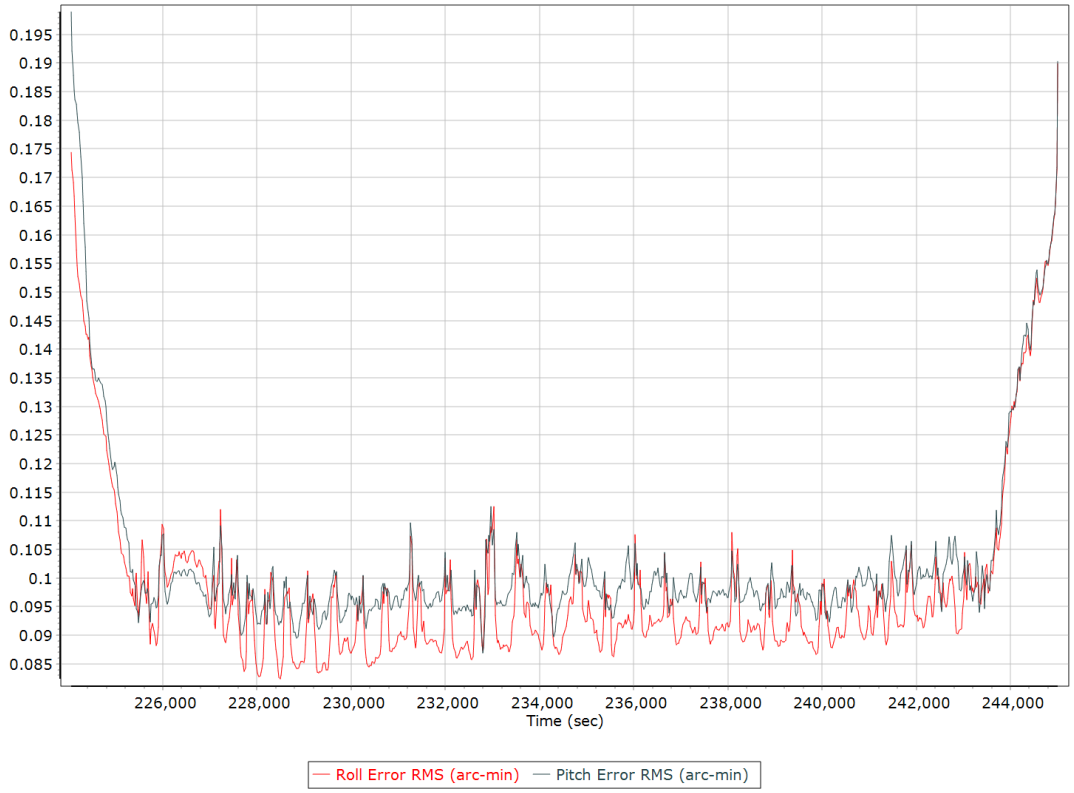
Smoothed Performance Metrics

Position Error RMS (m)

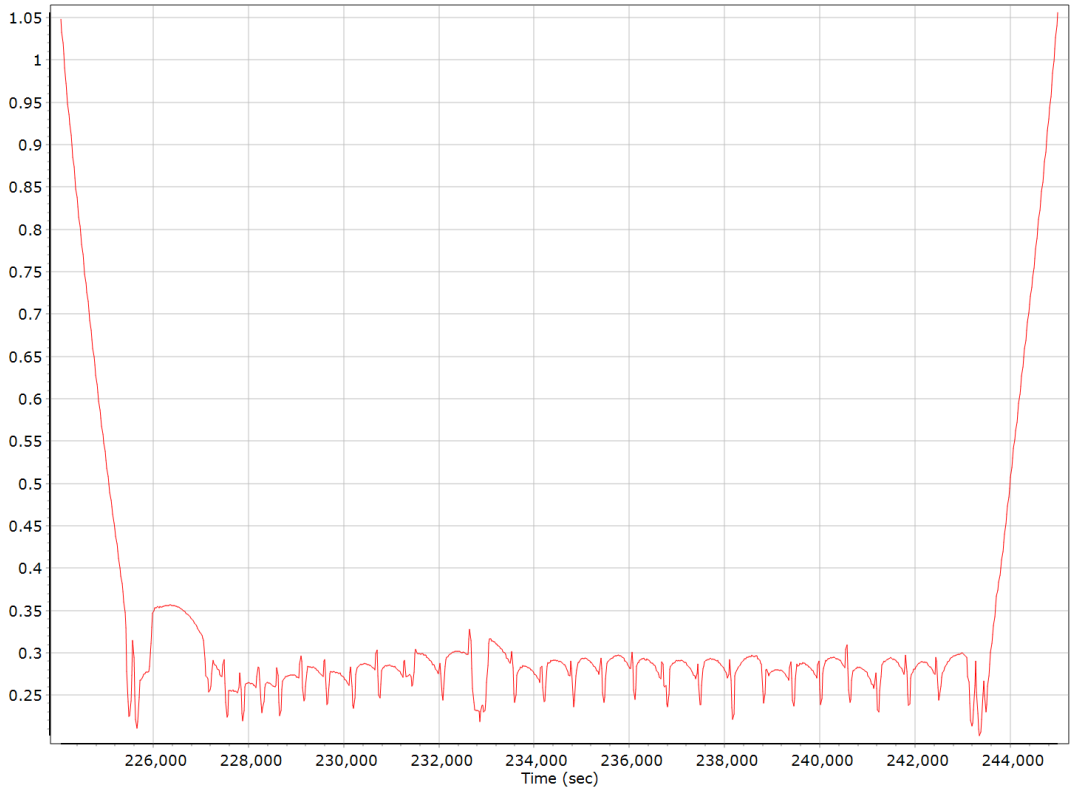
Velocity Error RMS (m/s)



Roll/Pitch Error RMS (arc-min)

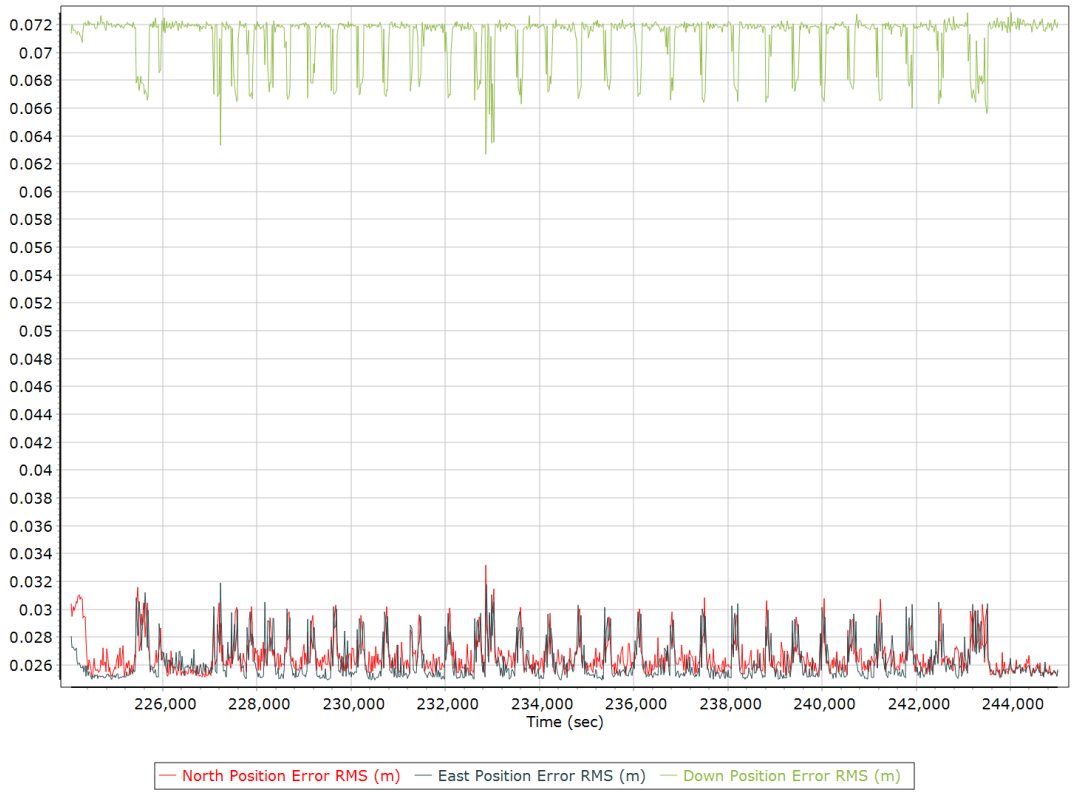


Heading Error RMS (arc-min)

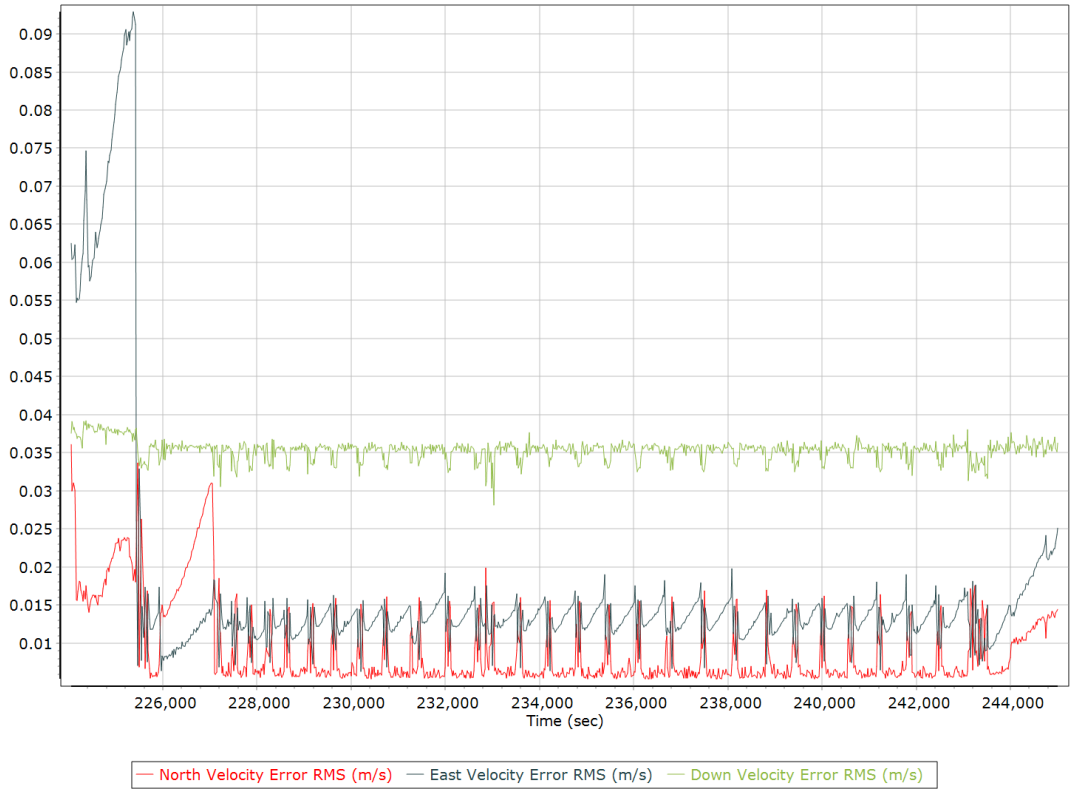


Forward Processed Performance Metrics

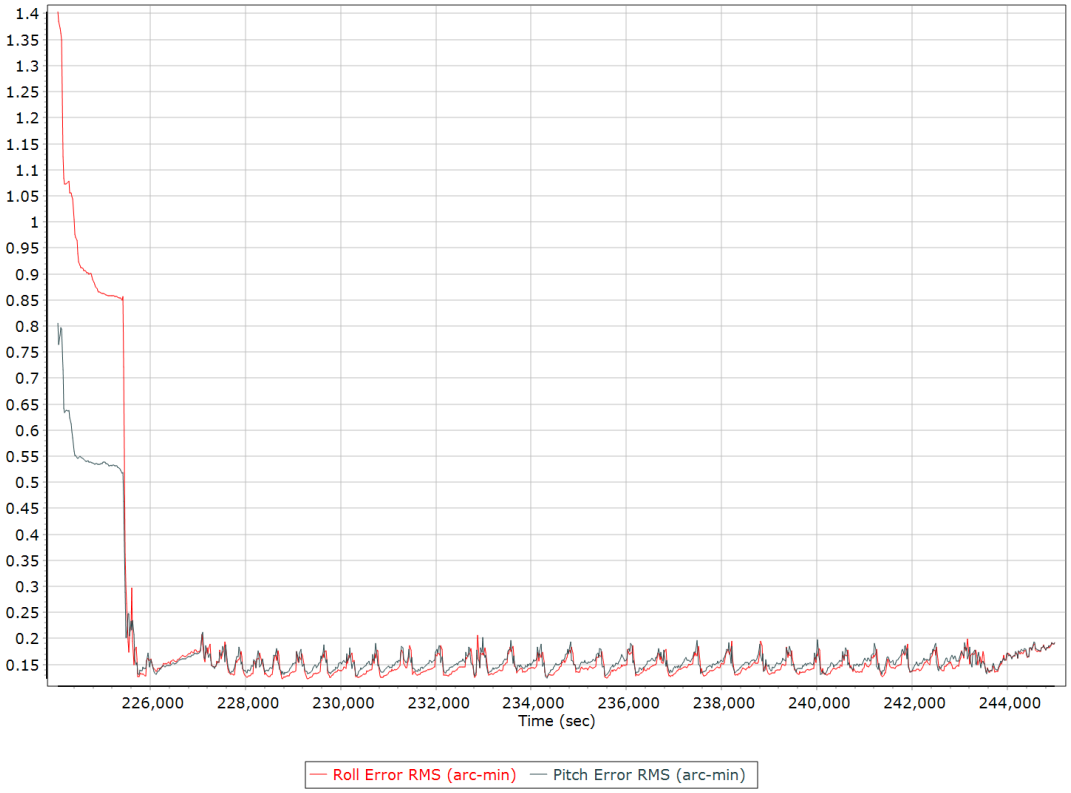
Position Error RMS (m)



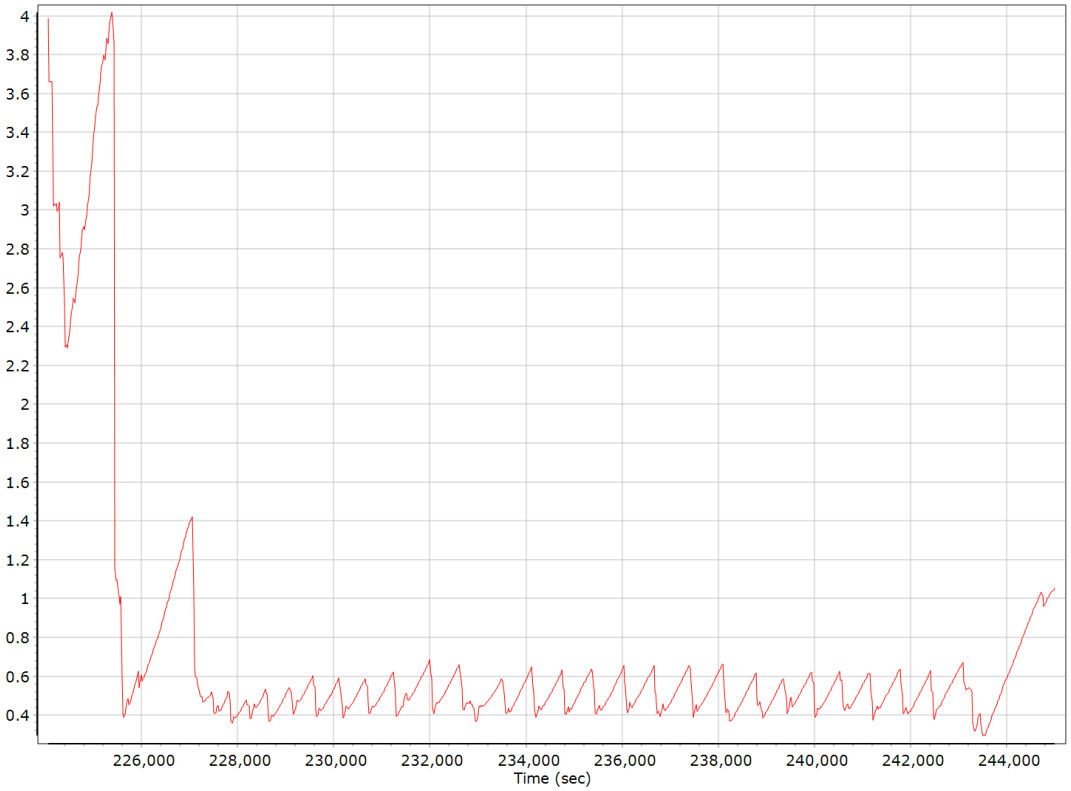
Velocity Error RMS (m/s)



Roll/Pitch Error RMS (arc-min)

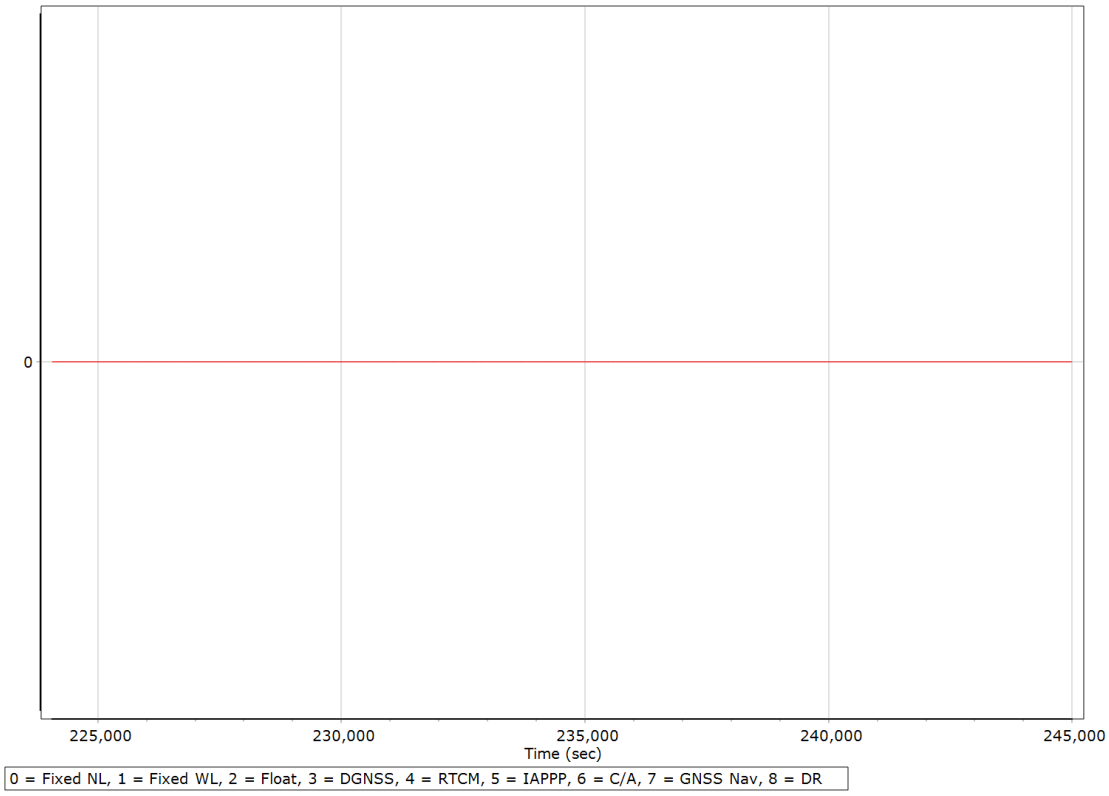


Heading Error RMS (arc-min)

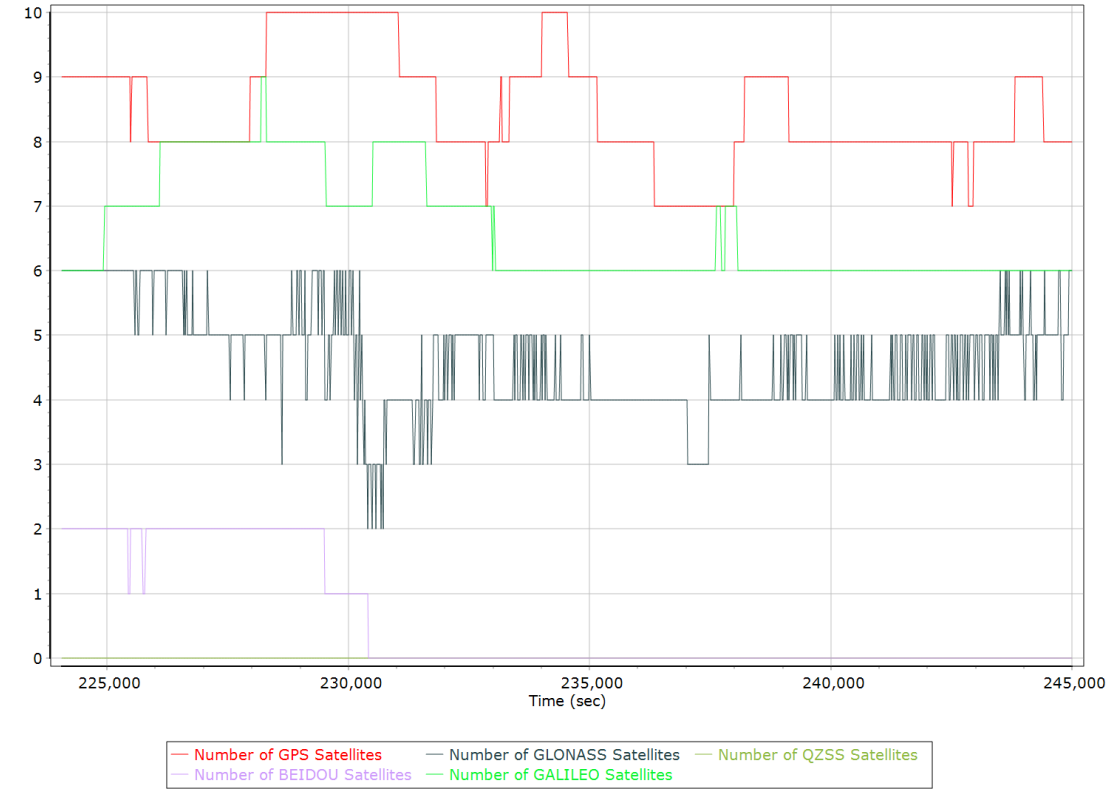


Forward Processed Solution Status

Processing Mode



Number of Satellites



Baseline Length