

Aerial Lidar Report

15164

Kansas Department of Agriculture, 2016 Kansas Lidar (North)

February 2017



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Section 1: Lidar Acquisition

1.1 Acquisition

The Atlantic Group, LLC (Atlantic) has successfully completed lidar acquisition for the 2016 Kansas Lidar (North) area of interest (AOI). Lidar for this AOI was acquired in thirty (30) flight missions completed on January 26th, 2016. The project area encompasses 7,660,267 acres, 31,000 square kilometers or 11,969 square miles.

1.2 Acquisition Status Report

Upon notification to proceed, the flight crew loaded the flight plans and validated the flight parameters. The Acquisition Manager contacted air traffic control and coordinated flight pattern requirements. Lidar acquisition began immediately upon notification that control base stations were in place. During flight operations, the flight crew monitored weather and atmospheric conditions. Lidar missions were flown only when no condition existed below the sensor that would affect the collection of data. The pilot constantly monitored the aircraft course, position, pitch, roll, and yaw of the aircraft. The sensor operator monitored the sensor, the status of PDOPs, and performed the first Q/C review during acquisition. The flight crew constantly reviewed weather and cloud locations. Any flight lines impacted by unfavorable conditions were marked as invalid and re-flown immediately or at an optimal time.

1.3 Acquisition Details

Atlantic acquired four hundred and thirty (430) passes of the AOI as a series of perpendicular and/or adjacent flight lines. The flight plan included zigzag flight line collection as a result of the inherent IMU drift associated with all IMU systems. Differential GPS unit in aircraft recorded sample positions at 2 Hz or more frequency. Lidar data was only acquired when GPS PDOP was ≤ 4 and at least 6 satellites were in view.

Atlantic lidar sensors are calibrated at a designated site located at the Fayetteville Municipal Airport (FYM) in Fayetteville, TN and are periodically checked and adjusted to minimize corrections at project sites.

1.4 Project Purpose

The primary purpose of the lidar survey was to establish measurements of the bare earth surface, as well as top surface feature data for providing geometric inputs for modeling, other numerical modeling and economic related assessments.

1.5 Lidar Flight-line Orientation

The following graphic represents the alignment of the project area of interest (AOI) and the flight-lines executed to provide AOI coverage.

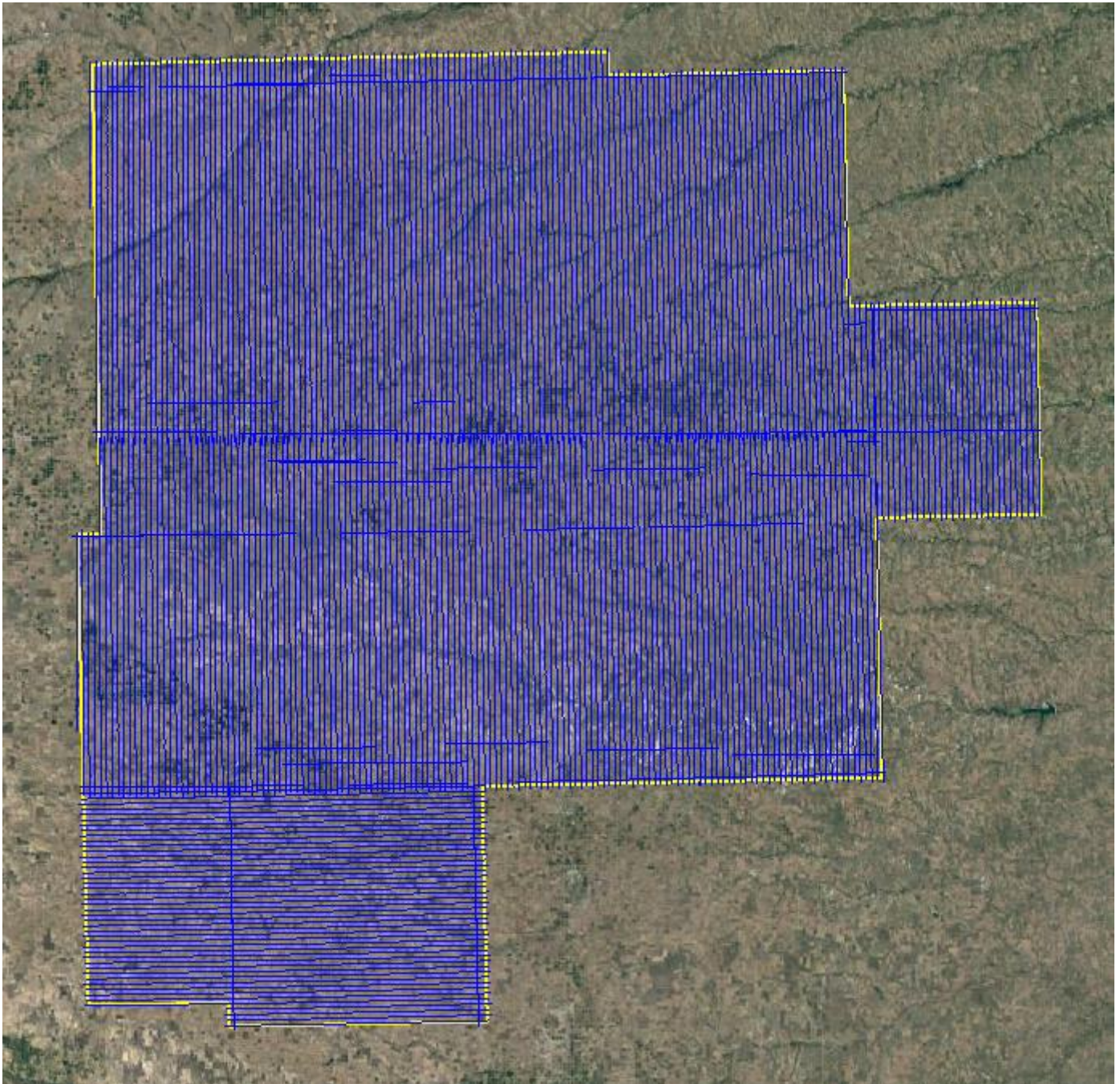


Figure 1: Trajectories as flown by Atlantic

1.6 Acquisition Equipment

Atlantic operated a Cessna T210L (N732JE) outfitted with a Leica ALS70-HP lidar system during the collection of the project area. Table 1 represents a list of the features and characteristics for the Leica ALS70-HP lidar system:

Atlantic's Sensor Characteristics		
Leica ALS70-HP		
Manufacturer	Leica	
Model	ALS70 - HP	
Platform	Fixed-Wing	
Scan Pattern	Sine, Triangle, Raster	
Maximum Scan Rate (Hz)	Sine	200
	Triangle	158
	Raster	120
Field of View (°)	0 - 75 (Full Angle, User Adjustable)	
Maximum Pulse rate (kHz)	500	
Maximum Flying height (m AGL)	3500	
Number of returns	Unlimited	
Number of Intensity Measurements	3 (First, Second, Third)	
Roll Stabilization (Automatic Adaptive, °)	75 - Active FOV	
Storage Media	Removable 500 GB SSD	
Storage Capacity (Hours @ Max Pulse Rate)	6	
Size (cm)	Scanner	37 W x 68 L x 26 H
	Control Electronics	45 W x 47 D x 36 H
Weight (kg)	Scanner	43
	Control Electronics	45
Operating Temperature	0 - 40 °C	
Flight Management	FCMS	
Power Consumption	927 @ 22.0 - 30.3 VDC	

Table 1: Atlantic Sensor Characteristics

1.7 Lidar System Acquisition Parameters

Table 2 illustrates Atlantic’s system parameters for lidar acquisition on this project.

Lidar System Acquisition Parameters	
Item	Parameter
System	Leica ALS-70 HP
Nominal Pulse Spacing (m)	0.6
Nominal Pulse Density (pls/m ²)	2.5
Nominal Flight Height (AGL meters)	2300
Nominal Flight Speed (kts)	120
Pass Heading (degree)	90
Sensor Scan Angle (degree)	45
Scan Frequency (Hz)	35.9
Pulse Rate of Scanner (kHz)	270.8
Line Spacing (m)	1265
Pulse Duration of Scanner (ns)	4
Pulse Width of Scanner (m)	0.51
Central Wavelength of Sensor Laser (nm)	1064
Sensor Operated with Multiple Pulses	Yes
Beam Divergence (mrad)	0.22
Nominal Swath Width (m)	1625
Nominal Swath Overlap (%)	20
Scan Pattern	Triangle

Table 2: Atlantic Lidar System Acquisition Parameters



1.8 Airborne GPS Kinematic

Differential GPS unit in aircraft collected positions at 2 Hz. Airborne GPS data was processed using the Inertial Explorer (version 8.60.5025) software. Flights were flown with a minimum of 6 satellites in view (10° above the horizon) and with a PDOP of ≤ 4 when the laser was online.

For all flights, the GPS data can be classified as good, with GPS residuals of 3cm average or better but none larger than 10cm being recorded.

Data collected by the lidar unit is reviewed for completeness, acceptable density and to make sure all data is captured without errors or corrupted values. In addition, all GPS, aircraft trajectory, mission information, and ground control files are reviewed and logged into a database.

GPS processing results for each lift are included in **Section 5: GPS Processing**.

Section 2: Lidar Processing

2.1 Generation of Laser Points

Atlantic used a combination of Waypoint and Leica software products to extract the lidar swath data from the raw flight records. Waypoint Inertial Explorer is used to extract the raw IPAS ABGPS/IMU data, which is further processed in combination with controlled base stations to provide the final Smoothed Best Estimate Trajectory (SBET) for each mission. The SBET's are combined with the raw laser scan files to export the (*.las) formatted swath point clouds.

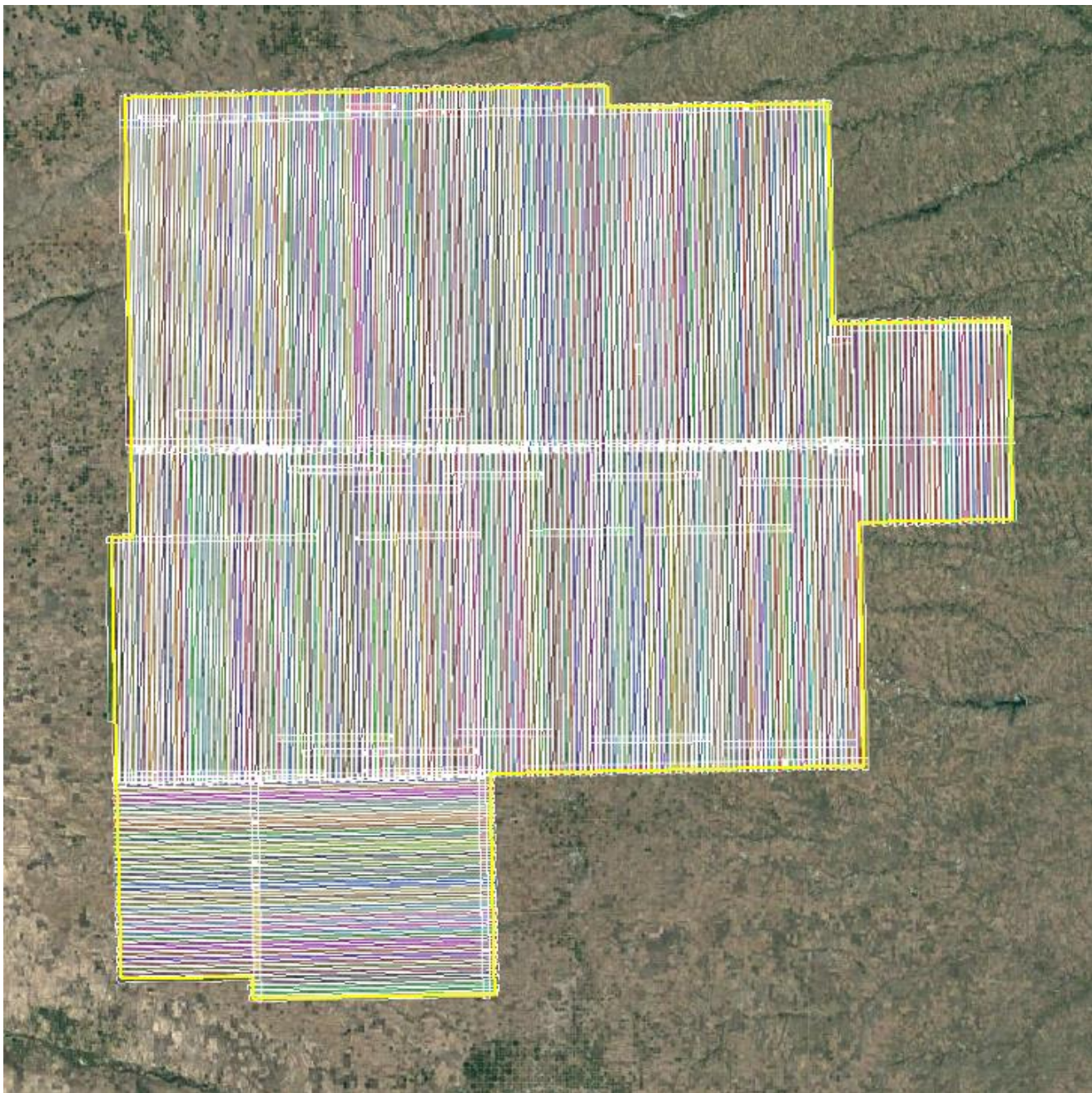


Figure 2: Lidar swath data showing complete coverage

2.2 Coordinate Reference System

Horizontal Datum:	North American Datum of 1983 (HARN)
Coordinate System:	Universal Transverse Mercator Northern Zone 14
Vertical Datum:	North American Vertical Datum of 1988
Geoid Model:	Geoid12B
Units of Reference:	Meters

2.3 Lidar Point Cloud Statistics

Table 3 illustrates the overall lidar point cloud statistics for this project.

Point Cloud Statistics	
Category	Value
Total Points	112,095,654,120
Nominal Pulse Spacing (m)	0.6247
Nominal Pulse Density (pls/m ²)	2.56
Nominal Pulse Spacing (ft)	2.0496
Nominal Pulse Density (pls/ft ²)	0.24
Total Aggregate Points	104,598,426,409
Aggregate Nominal Pulse Spacing (m)	0.5519
Aggregate Nominal Pulse Density (pls/m ²)	3.28
Aggregate Nominal Pulse Spacing (ft)	1.8106
Aggregate Nominal Pulse Density (pls/ft ²)	0.31

Table 3: Lidar Point Cloud Statistics

2.4 Lidar Classification

The calibrated point cloud data from the laser sensor was merged to produce processed (*.las) file(s) including but not limited to 3D position, intensity, and time-stamp. A filtering methodology was utilized to produce a multi-return surface elevation model dataset with bare-earth conditions. GeoCue, TerraScan, and TerraModel software was used for the initial batch processing and manual editing of the (*.las) point clouds. Atlantic utilized collected breakline data to preform classification for classes' 9-Water and 10-Ignored Ground in LP360. Outlined in Table 4 are the classification codes utilized for this project.

ASPRS Standard Lidar Point Classes	
Code	Description
1	Unclassified
2	Ground
7	Low Noise
9	Water
10	Ignored Ground
17	Bridges
18	High Noise

Table 4: Point Cloud Classification Scheme

Section 3: Relative Accuracy Assessment

3.1 Expected Horizontal Positional Error

As described in Section 7.5 of the ASPRS Positional Accuracy Standards for Digital Geospatial Data the horizontal errors in lidar data are largely a function of GNSS positional error, INS angular error, and flying altitude. Therefore lidar data collected with GNSS error of 8cm and the IMU error of 0.00427 degrees at an altitude of 2,300m; the expected radial horizontal positional error will be $RMSE_r = 32.7\text{cm}$.

3.2 Calibration of Lidar Point Cloud

LiDAR ranging data were initially calibrated using previous best parameters for this instrument and aircraft. Using a combination of GeoCue, and TerraSolid's TerraScan and TerraMatch the overlapping swath point clouds are corrected for any orientation or linear deviations to obtain the best fit swath-to-swath calibration. Relative calibration was evaluated using advanced plane-matching analysis and parameter corrections derived. This process was repeated interactively until residual errors between overlapping swaths, across all project missions, was reduced to 2 cm or less. A final analysis of the calibrated LiDAR is preformed using a TerraMatch Tie Line report for an overall statistical model of the project area.

3.3 Relative Vertical Accuracy

Upon completion of the data calibration, Atlantic runs a complete set of Delta-Z (dZ) ortho images. A user-defined color ramp is applied depicting the offsets between overlapping swaths based on project specifications. The dZ orthos provide an opportunity to review the data calibration in a qualitative manner. Atlantic assigns green to all offset values that fall below the required interswath accuracy RMSDz requirement of the project. A yellow color is assigned for offsets that fall between the RMSDz value and 1.5x of that value. Finally, red values are assigned to all values that fall beyond 1.5x of the RMSDz requirements of the project.

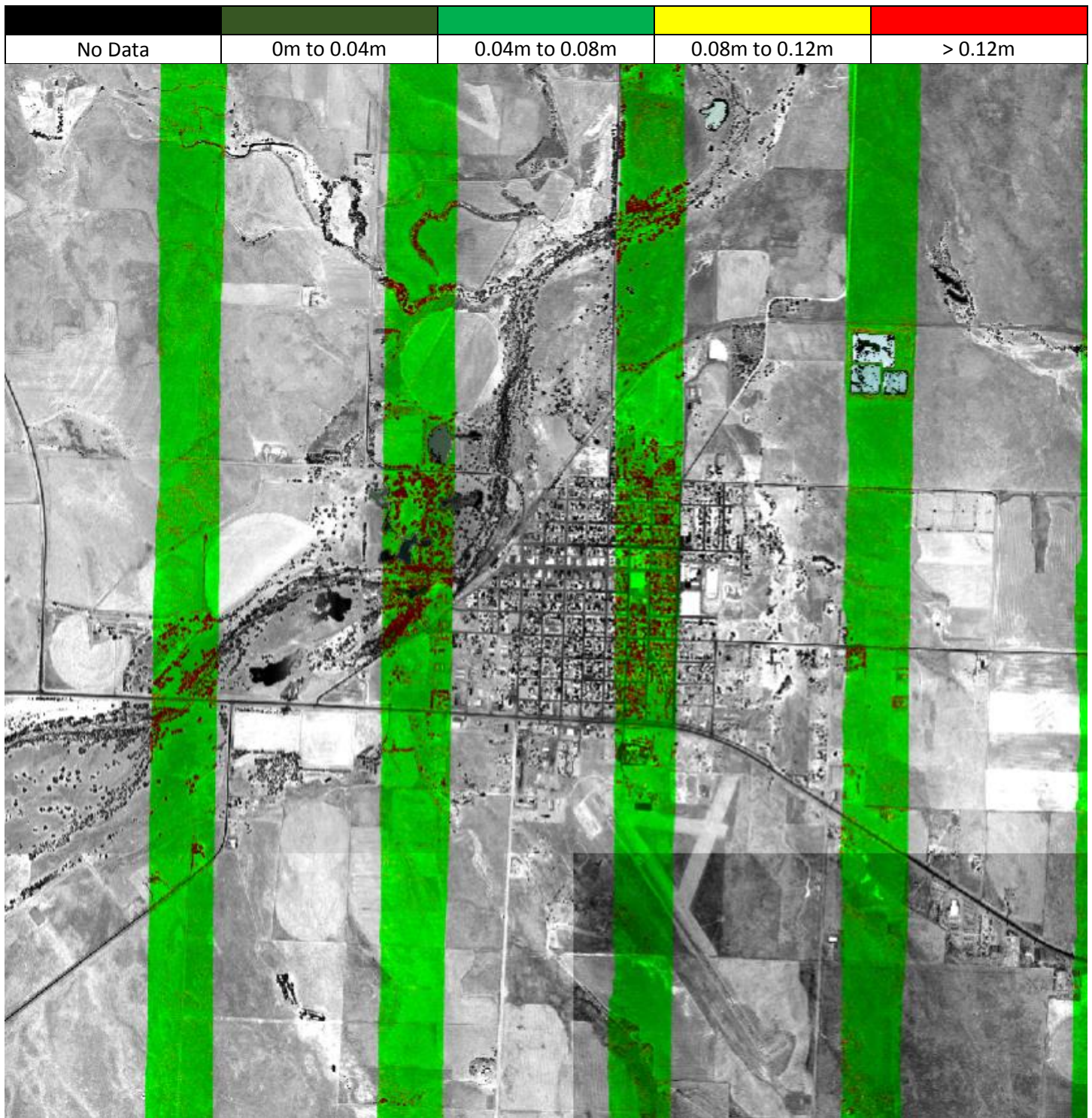


Figure 3: dZ ortho sample



3.4 Interswath Accuracy Results

An overall statistical assessment of the relative accuracy using TerraMatch Tie Line Report between lidar swaths can be found in Tables 5, 6, 7, and 8 below. The values provided are in meters.

Average Magnitudes Per Line											
Line	X	Y	Z	Line	X	Y	Z	Line	X	Y	Z
94	0.046	0.015	0.017	238	0.037	0.034	0.016	386	0.028	0.079	0.020
95	0.046	0.015	0.017	239	0.019	0.043	0.016	387	0.035	0.055	0.016
96	-	-	0.017	242	0.038	0.025	0.016	388	0.048	0.053	0.019
97	0.001	0.020	0.018	243	0.075	0.014	0.019	390	0.011	0.012	0.013
98	0.008	0.016	0.018	244	0.068	0.026	0.016	392	0.021	0.017	0.013
99	0.002	0.029	0.017	247	-	-	0.019	393	0.033	0.021	0.015
100	0.004	0.034	0.016	249	0.036	0.007	0.019	394	0.025	0.022	0.014
101	0.002	0.027	0.020	250	0.036	0.007	0.023	395	0.018	0.017	0.015
102	0.010	0.023	0.019	251	0.005	0.073	0.022	396	0.019	0.023	0.014
103	0.025	0.020	0.018	252	0.051	0.048	0.019	397	0.015	0.012	0.015
104	0.003	0.038	0.020	253	0.058	0.052	0.019	398	0.016	0.012	0.013
105	0.000	0.023	0.017	254	0.073	0.057	0.023	399	0.016	0.021	0.015
107	0.000	0.029	0.017	255	0.019	0.034	0.019	400	0.016	0.018	0.011
108	0.026	0.040	0.019	256	0.027	0.026	0.020	401	0.015	0.024	0.012
109	0.006	0.022	0.016	257	0.026	0.042	0.022	402	0.011	0.011	0.012
110	0.001	0.019	0.019	258	0.033	0.051	0.014	403	0.007	0.008	0.011
111	0.002	0.019	0.014	260	0.018	0.021	0.018	404	0.031	0.034	0.017
112	0.023	0.042	0.017	262	0.018	0.024	0.016	405	0.010	0.016	0.017
113	0.133	0.002	0.021	263	0.013	0.026	0.014	406	0.060	0.036	0.016
114	0.096	0.003	0.023	264	0.025	0.017	0.017	407	0.039	0.027	0.018
115	0.011	0.030	0.023	265	0.003	0.089	0.021	408	0.027	0.013	0.015
116	0.002	0.045	0.022	266	0.016	0.024	0.022	410	0.013	0.018	0.018
117	0.002	0.120	0.019	267	0.026	0.026	0.020	414	0.012	0.019	0.017
118	0.004	0.075	0.024	268	0.039	0.022	0.017	415	0.013	0.019	0.020
119	0.010	0.041	0.020	269	0.036	0.054	0.018	416	0.005	0.027	0.020
120	0.018	0.023	0.020	270	0.006	0.056	0.020	417	0.018	0.050	0.022
130	0.030	0.011	0.019	271	0.003	0.063	0.017	418	0.026	0.022	0.022
131	0.023	0.021	0.020	272	0.015	0.027	0.015	419	0.024	0.014	0.018
132	0.018	0.022	0.017	274	0.016	0.027	0.018	420	0.046	0.006	0.019
133	0.011	0.020	0.013	276	0.053	0.028	0.022	421	0.048	0.003	0.015
134	0.048	0.018	0.017	277	0.043	0.046	0.019	422	0.042	0.017	0.019
135	0.042	0.018	0.018	278	-	-	0.014	423	0.027	0.019	0.019
136	0.028	0.032	0.015	279	0.003	0.045	0.013	425	0.014	0.030	0.017
137	0.053	0.001	0.017	280	0.018	0.043	0.016	427	0.023	0.014	0.020
138	0.027	0.013	0.017	281	0.048	0.035	0.015	428	0.042	0.030	0.020
139	0.012	0.022	0.015	282	0.092	0.017	0.018	430	0.024	0.018	0.020
140	0.021	0.022	0.016	283	0.025	0.026	0.019	431	0.026	0.013	0.019



*Kansas Department of Agriculture, 2016 Kansas Lidar (North)
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142	0.024	0.026	0.022	285	0.015	0.029	0.014	432	0.034	0.009	0.021
143	0.021	0.028	0.038	288	0.004	0.080	0.021	433	0.006	0.034	0.021
144	0.020	0.038	0.044	290	0.028	0.018	0.020	434	0.010	0.015	0.022
145	0.033	0.049	0.024	291	0.024	0.042	0.018	435	0.017	0.013	0.023
146	0.031	0.038	0.017	292	0.021	0.051	0.022	436	0.020	0.034	0.022
147	0.028	0.019	0.018	293	0.030	0.023	0.018	437	0.021	0.025	0.022
148	0.020	0.032	0.021	294	0.030	0.011	0.019	438	0.021	0.014	0.024
149	0.004	0.028	0.027	295	0.007	0.037	0.021	439	0.016	0.017	0.021
152	0.018	0.029	0.020	296	0.020	0.022	0.020	440	0.016	0.014	0.018
154	0.030	0.033	0.025	297	0.047	0.021	0.017	443	0.026	0.010	0.017
155	0.033	0.029	0.048	298	0.051	0.028	0.018	445	0.017	0.012	0.014
156	0.016	0.035	0.050	299	0.039	0.034	0.014	446	0.019	0.012	0.014
157	0.008	0.033	0.024	300	0.027	0.085	0.017	447	0.015	0.018	0.017
159	0.015	0.029	0.015	301	0.004	0.111	0.016	448	0.014	0.016	0.017
161	0.016	0.027	0.016	302	-	-	0.021	449	0.014	0.016	0.017
162	0.029	0.019	0.016	303	0.038	0.022	0.014	450	0.032	0.014	0.015
163	0.036	0.023	0.014	305	0.049	0.014	0.017	451	0.030	0.016	0.018
164	0.040	0.007	0.014	307	0.051	0.020	0.019	452	0.026	0.013	0.015
165	0.011	0.016	0.015	308	0.031	0.045	0.016	453	0.037	0.016	0.017
166	0.019	0.033	0.014	309	0.026	0.055	0.014	454	0.020	0.032	0.017
167	0.029	0.026	0.015	310	0.047	0.002	0.014	455	0.012	0.019	0.016
168	0.044	0.015	0.015	311	0.029	0.040	0.014	456	0.051	0.024	0.017
169	0.031	0.015	0.017	312	0.045	0.012	0.018	457	0.033	0.030	0.020
170	0.031	0.013	0.016	313	0.051	0.025	0.015	459	0.008	0.018	0.017
172	0.035	0.023	0.019	314	0.088	0.022	0.015	461	0.018	0.021	0.014
174	0.029	0.024	0.021	315	0.119	0.004	0.014	462	0.033	0.010	0.016
175	0.011	0.035	0.018	316	0.020	0.016	0.017	463	0.020	0.013	0.015
176	0.024	0.032	0.021	318	0.029	0.021	0.018	464	0.023	0.014	0.015
177	0.040	0.026	0.017	320	0.018	0.012	0.021	465	0.022	0.032	0.015
178	0.044	0.028	0.020	321	0.016	0.014	0.015	466	0.013	0.023	0.017
179	0.034	0.039	0.017	322	0.014	0.018	0.016	467	0.021	0.024	0.015
180	0.025	0.035	0.017	323	0.027	0.036	0.016	468	0.026	0.024	0.016
181	0.014	0.035	0.016	324	0.063	0.040	0.021	469	0.035	0.020	0.017
182	0.069	0.023	0.019	325	0.028	0.027	0.023	470	0.015	0.015	0.016
183	0.065	0.011	0.017	326	0.017	0.019	0.024	471	0.012	0.021	0.016
184	0.035	0.016	0.018	327	0.002	0.024	0.023	472	0.011	0.025	0.016
185	0.020	0.020	0.018	328	0.004	0.022	0.025	473	0.011	0.020	0.018
186	0.030	0.016	0.019	329	0.018	0.025	0.024	475	0.020	0.019	0.015
187	0.050	0.009	0.018	330	0.020	0.018	0.025	476	0.024	0.021	0.015
188	0.040	0.020	0.020	331	0.021	0.022	0.025	477	0.026	0.019	0.015
189	0.000	0.036	0.017	332	0.021	0.018	0.026	478	0.019	0.015	0.014
190	0.016	0.031	0.019	333	0.034	0.020	0.016	479	0.017	0.012	0.015
192	0.029	0.035	0.016	336	0.050	0.028	0.020	480	0.015	0.013	0.015
194	0.016	0.033	0.017	338	0.038	0.022	0.017	481	0.031	0.037	0.019



195	0.012	0.048	0.018	339	0.019	0.017	0.016	482	0.023	0.034	0.017
196	0.029	0.035	0.017	340	0.015	0.010	0.014	483	0.022	0.029	0.016
197	0.040	0.042	0.015	341	0.038	0.009	0.016	484	0.035	0.008	0.016
198	0.049	0.029	0.017	342	0.013	0.017	0.015	485	0.030	0.013	0.022
199	0.036	0.014	0.016	343	0.013	0.017	0.018	486	0.025	0.019	0.019
200	0.021	0.012	0.017	344	0.020	0.019	0.018	487	0.026	0.017	0.020
201	0.034	0.015	0.015	345	0.051	0.015	0.018	489	0.024	0.014	0.022
202	0.047	0.030	0.016	348	0.014	0.023	0.018	490	0.026	0.014	0.020
203	0.038	0.038	0.016	349	0.013	0.016	0.014	492	0.050	0.027	0.014
204	0.039	0.034	0.018	350	-	-	0.015	494	0.058	0.034	0.016
205	0.031	0.021	0.015	351	0.013	0.018	0.015	495	0.040	0.017	0.018
207	0.027	0.009	0.015	352	0.059	0.006	0.014	496	0.031	0.046	0.017
209	0.026	0.016	0.014	353	0.059	0.019	0.014	497	0.039	0.031	0.014
210	0.021	0.036	0.016	354	0.052	0.023	0.017	498	0.044	0.009	0.015
211	0.052	0.032	0.018	355	0.041	0.009	0.019	499	0.022	0.031	0.013
212	0.030	0.015	0.017	356	0.036	0.014	0.017	500	0.012	0.023	0.013
213	0.031	0.015	0.021	357	0.046	0.018	0.014	501	0.017	0.014	0.014
214	0.041	0.021	0.031	358	0.035	0.027	0.016	502	0.023	0.025	0.014
215	0.043	0.031	0.025	359	0.017	0.033	0.014	503	0.027	0.032	0.014
216	0.054	0.034	0.019	360	0.047	0.030	0.015	504	0.022	0.017	0.014
217	0.048	0.025	0.021	361	0.023	0.031	0.015	505	0.011	0.019	0.013
218	0.034	0.027	0.019	362	0.024	0.028	0.016	506	0.043	0.012	0.013
219	0.025	0.027	0.017	363	0.034	0.026	0.014	507	0.036	0.008	0.018
220	0.020	0.063	0.015	365	0.025	0.025	0.017	509	0.004	0.000	0.015
221	0.018	0.059	0.013	368	0.029	0.032	0.024	511	0.000	0.001	0.014
222	0.043	0.021	0.016	370	0.012	0.025	0.022	513	0.005	0.079	0.015
223	0.039	0.026	0.018	371	0.025	0.041	0.019	514	0.004	0.048	0.016
224	0.037	0.035	0.018	372	0.027	0.042	0.025	515	0.015	0.036	0.019
226	0.051	0.006	0.015	373	0.028	0.064	0.018	516	0.024	0.051	0.017
228	0.030	0.024	0.015	374	0.009	0.022	0.026	517	0.025	0.052	0.017
229	0.032	0.025	0.014	375	0.013	0.026	0.019	518	0.015	0.048	0.018
230	0.006	0.014	0.016	376	0.020	0.034	0.028	519	0.004	0.035	0.018
231	0.017	0.017	0.015	377	0.023	0.053	0.019	520	0.000	0.016	0.018
232	0.032	0.019	0.016	378	0.011	0.031	0.018	521	0.000	0.014	0.017
233	0.033	0.019	0.014	379	0.015	0.028	0.016	522	0.015	0.025	0.017
234	0.022	0.033	0.017	380	0.038	0.015	0.017	523	0.041	0.036	0.017
235	0.023	0.029	0.016	382	0.036	0.021	0.017	524	0.059	0.043	0.017
236	0.026	0.022	0.016	384	0.039	0.025	0.016	525	0.000	0.002	0.013
237	0.044	0.024	0.016	385	0.040	0.051	0.016	527	0.005	0.102	0.015

Table 5: Average Tie Line Magnitudes per Line



Internal Observation Statistics			
Category	X	Y	Z
Average Magnitude	0.020	0.021	0.018
RMS Values	0.037	0.036	0.025
Maximum Values	0.159	0.163	0.160
Observation Weight	17542.0	17542.0	691728.0

Table 6: Tie Line Observation Statistics

Overall Relative Accuracy	
Category	Mismatch
Average 3D Mismatch	0.01905
Average XY Mismatch	0.03934
Average Z Mismatch	0.01828

Table 7: Relative Accuracy Results

TerraMatch Tie Lines	
Category	Observations
Section Lines	226,190
Roof Lines	8,497

Table 8: Total Tie Lines

Section 4: Vertical Accuracy Assessment

4.1 Ground Surveyed Check Points

Atlantic established a total of four hundred and fifteen (415) check points for this project (238 NVA + 177 VVA). Point cloud data accuracy was tested against a Triangulated Irregular Network (TIN) constructed from lidar points in clear and open areas. A clear and open area can be characterized with respect to topographic and ground cover variation such that a minimum of 5 times the NPS exists with less than 1/3 of the $RMSE_z$ deviation from a low-slope plane. Slopes that exceed 10 percent were avoided. Each land cover type representing 10 percent or more of the total project area were tested and reported with a VVA. In land cover categories other than dense urban areas, the tested points did not have obstructions 45 degrees above the horizon to ensure a sufficient TIN surface. The VVA value is provided as a target. It is understood that in areas of dense vegetation, swamps, or extremely difficult terrain, this value may be exceeded. The NVA value is a requirement that must be met, regardless of any allowed “busts” in the VVA(s) for individual land cover types within the project. Checkpoints for each assessment (NVA & VVA) are required to be well-distributed throughout the land cover type, for the entire project area.

4.2 Vertical Accuracy

Below are the vertical accuracy reporting requirements for this project:

Vertical Accuracy Reporting Requirements in Meters:

- $RMSE_z \leq 10.0\text{cm}$ (Non-Vegetated Swath, DEM)
- $NVA \leq 19.6\text{cm}$ 95% Confidence Level (Swath, DEM)
- $VVA \leq 29.4\text{cm}$ 95th Percentile (DEM)

Vertical Accuracy Reporting Requirements in Feet:

- $RMSE_z \leq 0.328\text{ft}$ (Non-Vegetated Swath, DEM)
- $NVA \leq 0.643\text{ft}$ 95% Confidence Level (Swath, DEM)
- $VVA \leq 0.965\text{ft}$ 95th Percentile (DEM)

*The terms FVA (Fundamental Vertical Accuracy), SVA (Supplemental Vertical Accuracy) and CVA (Consolidated Vertical Accuracy) are from the National Digital Elevation Program (NDEP) Guidelines for Digital Elevation Data (2004). The term FVA refers to open terrain, urban and levee classes; the term SVA refers to classes tested that are in addition or supplemental to the open terrain; the term CVA refers to the consolidated accuracy of the data from all classes (FVA + SVA).

*The terms NVA (Non-vegetated Vertical Accuracy) and VVA (Vegetated Vertical Accuracy) are from the ASPRS Positional Accuracy Standards for Digital Geospatial Data v1.0 (2014). The term NVA refers to assessments in clear, open areas (which typically produce only single lidar returns); the term VVA refers to assessments in vegetated areas (typically characterized by multiple return lidar).

4.3 Check Point Distribution

The following graphics depict the location and distribution of NVA and VVA Check Points established for this project.

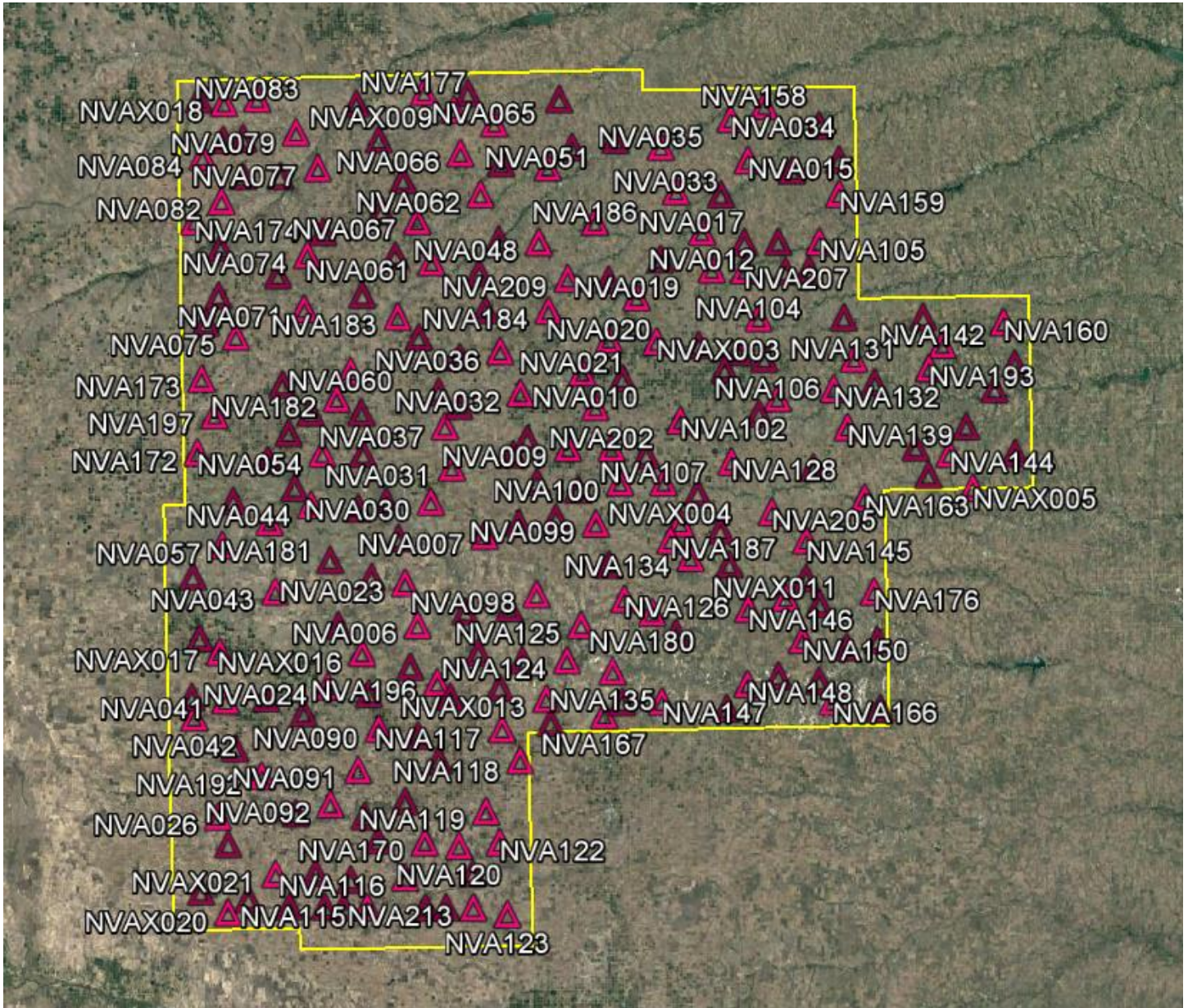


Figure 4: Non-vegetated Vertical Accuracy (NVA) Check Point Distribution

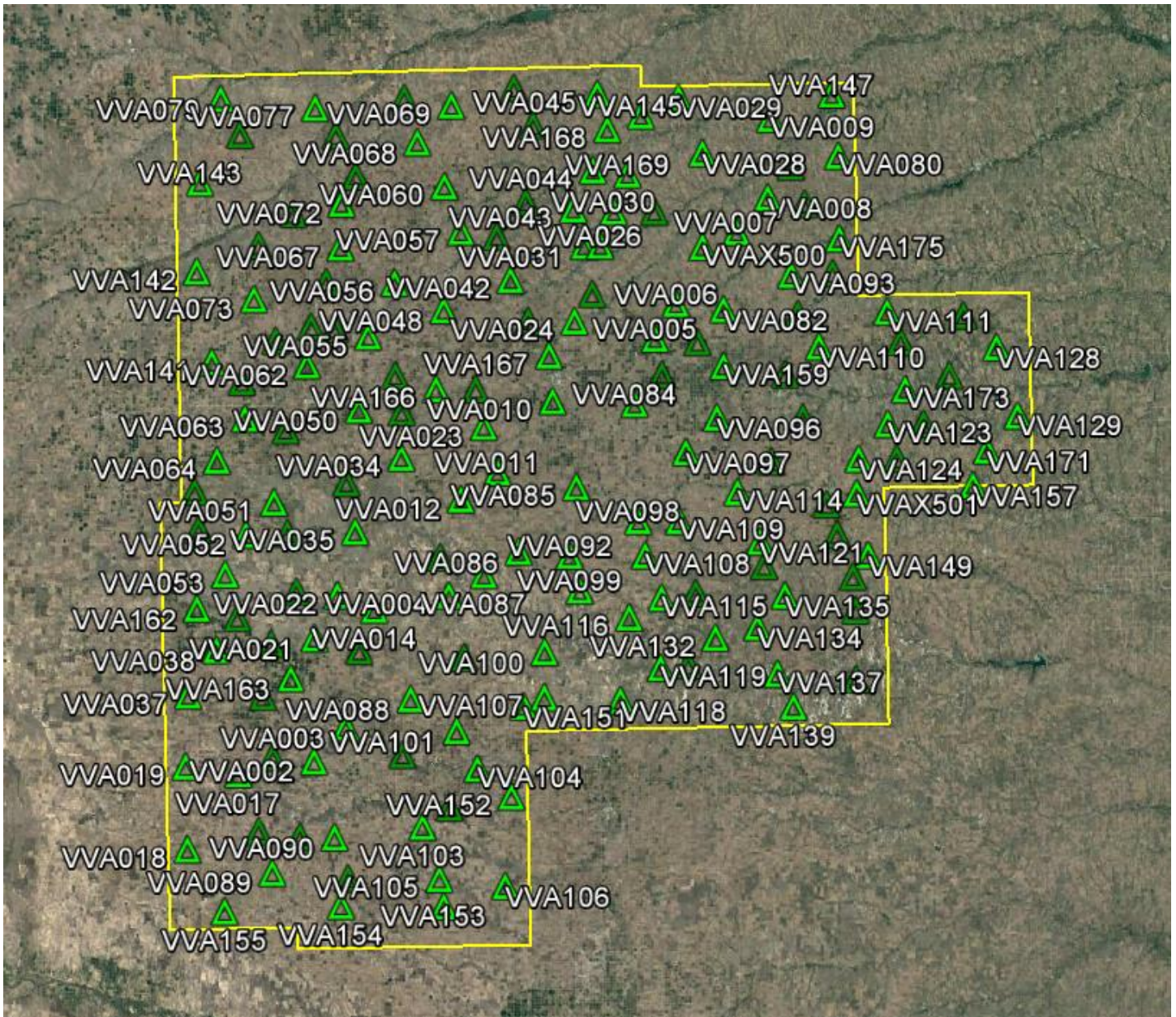


Figure 5: Vegetated Vertical Accuracy (VVA) Check Point Distribution



4.4 Check Point Assessment

A vertical accuracy assessment of the NVA & VVA check points against the lidar point cloud and bare-earth lidar can be found in Tables 9, 10, 11, and 12 below. The coordinates provided are in NAD83 (HARN), UTM North Zone 14, NAVD88 (Geoid12B), Meters.

Non-vegetated Vertical Accuracy (NVA) Check Point Assessment (Point Cloud)						
PointID	Easting	Northing	KnownZ	LaserZ	Description	DeltaZ
NVA001	236839.782	4244043.505	1169.011	1169.071	Bare Earth/Open Terrain	0.060
NVA002	243565.535	4255114.787	1150.229	1150.242	Urban Terrain	0.013
NVA003	259758.788	4262084.411	1100.692	1100.628	Urban Terrain	-0.064
NVA004	277666.602	4289808.469	1070.300	1070.415	Urban Terrain	0.115
NVA005	287577.979	4295991.353	1029.302	1029.367	Urban Terrain	0.065
NVA006	289532.060	4305674.640	991.257	991.285	Urban Terrain	0.028
NVA007	305745.598	4326259.371	1014.224	1014.201	Urban Terrain	-0.023
NVA008	318330.708	4338537.472	981.598	981.693	Urban Terrain	0.095
NVA009	325824.080	4346365.438	967.646	967.731	Bare Earth/Open Terrain	0.085
NVA010	332496.769	4355893.378	952.838	952.934	Bare Earth/Open Terrain	0.096
NVA011	338988.675	4362428.693	927.476	927.383	Bare Earth/Open Terrain	-0.093
NVA012	360576.896	4387517.398	859.944	860.065	Urban Terrain	0.121
NVA013	379914.747	4410386.533	808.163	808.195	Bare Earth/Open Terrain	0.032
NVA014	386562.906	4420870.026	775.193	775.242	Urban Terrain	0.049
NVA015	369605.434	4412997.186	814.694	814.830	Bare Earth/Open Terrain	0.136
NVA016	363101.509	4405105.987	794.038	794.150	Bare Earth/Open Terrain	0.112
NVA017	358445.076	4396390.371	866.182	866.296	Bare Earth/Open Terrain	0.114
NVA018	348503.137	4390144.660	875.087	875.167	Urban Terrain	0.080
NVA019	342731.539	4381379.308	913.690	913.724	Bare Earth/Open Terrain	0.034
NVA020	335991.953	4371620.280	928.051	927.904	Bare Earth/Open Terrain	-0.147
NVA021	329587.416	4364054.980	953.999	954.015	Urban Terrain	0.016
NVA022	316268.152	4348694.768	983.697	983.821	Bare Earth/Open Terrain	0.124
NVA023	286777.234	4315577.850	974.986	974.981	Bare Earth/Open Terrain	-0.005
NVA024	268039.195	4291738.933	1098.771	1098.844	Urban Terrain	0.073
NVA025	262220.010	4285639.284	1101.655	1101.613	Bare Earth/Open Terrain	-0.042
NVA026	241291.187	4261644.562	1165.455	1165.493	Bare Earth/Open Terrain	0.038
NVA027	245743.179	4277644.437	1161.627	1161.649	Urban Terrain	0.022
NVA028	278953.770	4317139.567	1017.067	1017.002	Bare Earth/Open Terrain	-0.065
NVA029	285456.813	4326161.980	1044.449	1044.414	Urban Terrain	-0.035
NVA030	293269.349	4334498.377	1010.538	1010.598	Bare Earth/Open Terrain	0.060
NVA031	298391.334	4342442.078	1034.733	1034.831	Bare Earth/Open Terrain	0.098
NVA032	314893.937	4359467.290	985.930	986.094	Urban Terrain	0.164
NVA033	352543.390	4406102.850	860.468	860.642	Bare Earth/Open Terrain	0.174
NVA034	365747.233	4422815.090	839.120	839.199	Bare Earth/Open Terrain	0.079
NVA035	349165.426	4416634.637	863.797	863.901	Urban Terrain	0.104



NVA036	310343.003	4369427.107	1002.065	1002.138	Bare Earth/Open Terrain	0.073
NVA037	296977.514	4352111.315	1048.668	1048.754	Urban Terrain	0.086
NVA038	282754.336	4334786.548	1030.789	1030.879	Bare Earth/Open Terrain	0.090
NVA039	269243.540	4321366.507	1088.914	1088.876	Bare Earth/Open Terrain	-0.038
NVA041	243740.111	4288922.701	1167.816	1167.815	Urban Terrain	-0.001
NVA042	236237.726	4285071.698	1191.601	1191.622	Bare Earth/Open Terrain	0.021
NVA043	256072.792	4314243.576	1079.524	1079.430	Bare Earth/Open Terrain	-0.094
NVA044	264990.978	4334363.893	1123.056	1123.053	Urban Terrain	-0.003
NVA045	277512.490	4346084.763	1099.092	1099.142	Bare Earth/Open Terrain	0.050
NVA046	300749.745	4368231.142	1031.704	1031.751	Urban Terrain	0.047
NVA047	307017.702	4379171.649	1008.168	1008.247	Bare Earth/Open Terrain	0.079
NVA048	319946.440	4394774.680	950.023	950.152	Urban Terrain	0.129
NVA049	338468.339	4418482.854	867.600	867.678	Bare Earth/Open Terrain	0.078
NVA051	322444.534	4412331.658	901.722	901.821	Bare Earth/Open Terrain	0.099
NVA052	305746.711	4387942.184	1007.521	1007.588	Urban Terrain	0.067
NVA053	291206.275	4373130.891	1050.189	1050.177	Bare Earth/Open Terrain	-0.012
NVA054	267894.118	4346329.429	1124.760	1124.803	Urban Terrain	0.043
NVA055	261195.316	4338445.781	1146.809	1146.872	Bare Earth/Open Terrain	0.063
NVA056	236625.421	4318208.362	1188.301	1188.282	Urban Terrain	-0.019
NVA057	243739.435	4325357.950	1181.761	1181.629	Urban Terrain	-0.132
NVA058	246562.526	4335656.261	1192.569	1192.659	Bare Earth/Open Terrain	0.090
NVA059	254966.439	4345054.675	1157.358	1157.357	Urban Terrain	-0.001
NVA060	274961.434	4365487.418	1097.892	1097.943	Bare Earth/Open Terrain	0.051
NVA061	294543.035	4390668.830	1027.147	1027.104	Bare Earth/Open Terrain	-0.043
NVA062	306424.666	4406398.762	984.131	984.248	Bare Earth/Open Terrain	0.117
NVA063	311483.202	4413547.711	941.949	942.061	Bare Earth/Open Terrain	0.112
NVA064	325439.038	4428337.243	920.320	920.403	Urban Terrain	0.083
NVA065	309995.576	4423026.874	962.686	962.799	Bare Earth/Open Terrain	0.113
NVA066	301877.030	4416141.225	1008.357	1008.530	Urban Terrain	0.173
NVA067	291359.783	4400401.731	1037.356	1037.425	Bare Earth/Open Terrain	0.069
NVA068	286045.036	4392465.274	1050.748	1050.660	Urban Terrain	-0.088
NVA069	278052.562	4383403.881	1082.836	1082.758	Bare Earth/Open Terrain	-0.078
NVA070	258797.992	4362768.784	1131.978	1131.943	Bare Earth/Open Terrain	-0.035
NVA071	264225.893	4380454.703	1104.580	1104.679	Bare Earth/Open Terrain	0.099
NVA072	288177.109	4410130.013	1041.957	1041.937	Bare Earth/Open Terrain	-0.020
NVA073	282650.455	4419918.721	998.202	998.261	Urban Terrain	0.059
NVA074	265221.913	4393072.016	1086.004	1086.012	Bare Earth/Open Terrain	0.008
NVA075	247962.053	4374272.911	1159.798	1159.751	Urban Terrain	-0.047
NVA076	244018.186	4384065.364	1152.666	1152.709	Bare Earth/Open Terrain	0.043
NVA077	268084.476	4413485.799	1013.617	1013.645	Urban Terrain	0.028
NVA078	277503.756	4428487.691	933.192	933.235	Bare Earth/Open Terrain	0.043
NVA079	263063.542	4422060.584	991.864	992.040	Bare Earth/Open Terrain	0.176
NVA080	259137.382	4411822.683	1046.639	1046.693	Urban Terrain	0.054



NVA081	244683.254	4395313.054	1073.650	1073.682	Bare Earth/Open Terrain	0.032
NVA082	245101.947	4406240.581	1121.835	1121.941	Urban Terrain	0.106
NVA083	254005.753	4430243.230	1055.752	1055.834	Bare Earth/Open Terrain	0.082
NVA084	240764.969	4416863.493	1122.587	1122.546	Bare Earth/Open Terrain	-0.041
NVA085	240061.361	4430504.111	1018.000	1018.095	Urban Terrain	0.095
NVA086	376356.919	4393656.439	823.944	823.944	Bare Earth/Open Terrain	0.000
NVA087	357102.392	4369853.165	886.710	886.688	Bare Earth/Open Terrain	-0.022
NVA088	322623.673	4330134.665	967.209	967.202	Bare Earth/Open Terrain	-0.007
NVA089	300878.044	4308673.912	913.121	913.023	Bare Earth/Open Terrain	-0.098
NVA090	279834.566	4281598.638	1050.180	1050.197	Urban Terrain	0.017
NVA091	274760.389	4272003.660	1067.104	1067.050	Bare Earth/Open Terrain	-0.054
NVA092	268026.294	4264065.146	1079.476	1079.435	Bare Earth/Open Terrain	-0.041
NVA093	248068.645	4242095.592	1126.138	1126.240	Urban Terrain	0.102
NVA094	264138.741	4248060.903	1088.360	1088.360	Bare Earth/Open Terrain	0.000
NVA095	289098.497	4279770.591	1029.691	1029.650	Bare Earth/Open Terrain	-0.041
NVA096	296922.393	4288686.865	1014.055	1014.158	Bare Earth/Open Terrain	0.103
NVA097	303673.570	4298947.495	968.386	968.441	Bare Earth/Open Terrain	0.055
NVA098	317716.169	4312315.354	919.745	919.706	Urban Terrain	-0.039
NVA099	332018.151	4328566.273	946.876	946.884	Bare Earth/Open Terrain	0.008
NVA100	337914.135	4338069.424	935.223	935.259	Bare Earth/Open Terrain	0.036
NVA101	344149.662	4344369.274	926.733	926.773	Bare Earth/Open Terrain	0.040
NVA102	352389.194	4352258.214	900.609	900.669	Urban Terrain	0.060
NVA103	366370.092	4368074.047	869.269	869.228	Bare Earth/Open Terrain	-0.041
NVA104	371321.082	4375863.431	842.521	842.580	Bare Earth/Open Terrain	0.059
NVA105	386018.441	4393428.693	784.045	784.060	Urban Terrain	0.015
NVA106	375382.612	4357015.353	816.059	816.088	Bare Earth/Open Terrain	0.029
NVA107	348133.629	4337869.208	905.493	905.608	Urban Terrain	0.115
NVA108	334916.408	4318890.286	937.682	937.692	Bare Earth/Open Terrain	0.010
NVA109	314061.834	4296995.081	936.579	936.626	Bare Earth/Open Terrain	0.047
NVA110	308602.914	4290761.828	979.483	979.554	Urban Terrain	0.071
NVA111	293808.606	4273926.107	1012.868	1012.882	Bare Earth/Open Terrain	0.014
NVA112	285667.924	4264491.933	1030.744	1030.705	Bare Earth/Open Terrain	-0.039
NVA113	279036.807	4255373.876	1048.785	1048.813	Urban Terrain	0.028
NVA114	266125.567	4239960.548	1079.296	1079.381	Bare Earth/Open Terrain	0.085
NVA115	276111.629	4239722.285	1051.839	1051.869	Bare Earth/Open Terrain	0.030
NVA116	285278.751	4246528.746	1028.019	1028.008	Urban Terrain	-0.011
NVA117	308927.520	4280921.586	979.311	979.260	Bare Earth/Open Terrain	-0.051
NVA118	313023.329	4273510.926	967.702	967.725	Bare Earth/Open Terrain	0.023
NVA119	304720.609	4261708.036	974.402	974.359	Bare Earth/Open Terrain	-0.043
NVA120	298181.537	4253712.461	984.013	983.972	Bare Earth/Open Terrain	-0.041
NVA121	289923.416	4239395.961	1015.984	1016.026	Urban Terrain	0.042
NVA122	307788.028	4254335.385	978.002	977.970	Bare Earth/Open Terrain	-0.032
NVA123	309228.163	4237419.061	969.579	969.607	Bare Earth/Open Terrain	0.028



NVA124	324529.911	4296708.372	884.434	884.479	Bare Earth/Open Terrain	0.045
NVA125	328046.928	4304891.401	878.256	878.310	Urban Terrain	0.054
NVA126	338352.023	4310786.396	911.801	911.766	Bare Earth/Open Terrain	-0.035
NVA127	356093.408	4335294.668	892.449	892.480	Bare Earth/Open Terrain	0.031
NVA128	364217.077	4342359.738	874.920	874.957	Bare Earth/Open Terrain	0.037
NVA129	370906.582	4353513.469	849.601	849.658	Urban Terrain	0.057
NVA130	391419.076	4375640.777	813.403	813.258	Bare Earth/Open Terrain	-0.145
NVA131	393564.034	4365931.874	790.066	789.986	Bare Earth/Open Terrain	-0.080
NVA132	388631.495	4358907.039	762.917	762.825	Urban Terrain	-0.092
NVA133	361260.419	4326399.976	875.092	875.164	Bare Earth/Open Terrain	0.072
NVA134	354118.610	4320108.183	883.886	883.897	Urban Terrain	0.011
NVA135	335230.014	4293915.160	836.657	836.675	Bare Earth/Open Terrain	0.018
NVA136	350372.342	4302590.349	862.283	862.267	Bare Earth/Open Terrain	-0.016
NVA137	363161.916	4318376.119	846.513	846.518	Urban Terrain	0.005
NVA138	383416.667	4340591.251	819.492	819.410	Bare Earth/Open Terrain	-0.082
NVA139	391686.747	4349892.403	814.752	814.607	Bare Earth/Open Terrain	-0.145
NVA140	398294.103	4360227.233	771.040	771.022	Bare Earth/Open Terrain	-0.018
NVA141	410093.417	4375395.802	771.874	771.849	Urban Terrain	-0.025
NVA142	414498.878	4368781.083	762.996	762.817	Bare Earth/Open Terrain	-0.179
NVA143	419691.183	4349523.415	729.827	729.815	Bare Earth/Open Terrain	-0.012
NVA144	415611.028	4343139.274	765.046	765.013	Urban Terrain	-0.033
NVA145	381394.834	4323616.164	826.563	826.594	Bare Earth/Open Terrain	0.031
NVA146	367398.310	4307865.158	860.451	860.423	Urban Terrain	-0.028
NVA147	346670.053	4286563.580	848.477	848.405	Bare Earth/Open Terrain	-0.072
NVA148	366885.941	4290238.233	761.347	761.335	Urban Terrain	-0.012
NVA149	381200.121	4314835.815	798.034	798.031	Bare Earth/Open Terrain	-0.003
NVA150	380027.909	4300360.879	772.765	772.740	Bare Earth/Open Terrain	-0.025
NVA151	383783.173	4290659.411	747.047	747.048	Urban Terrain	0.001
NVA152	390419.531	4298400.081	758.768	758.772	Bare Earth/Open Terrain	0.004
NVA153	361879.156	4284690.581	812.333	812.304	Urban Terrain	-0.029
NVA154	384247.244	4308727.115	762.160	762.157	Bare Earth/Open Terrain	-0.003
NVA155	245749.681	4420702.342	1101.632	1101.683	Bare Earth/Open Terrain	0.051
NVA156	303935.545	4430329.610	977.675	977.804	Bare Earth/Open Terrain	0.129
NVA157	240954.774	4377713.588	1170.223	1170.155	Urban Terrain	-0.068
NVA158	373762.373	4425792.267	799.545	799.659	Bare Earth/Open Terrain	0.114
NVA159	390956.290	4404634.928	804.879	804.852	Bare Earth/Open Terrain	-0.027
NVA160	429076.313	4373738.119	733.014	732.948	Bare Earth/Open Terrain	-0.066
NVA161	431498.889	4363982.520	695.467	695.433	Urban Terrain	-0.034
NVA162	431092.721	4343025.678	726.508	726.492	Bare Earth/Open Terrain	-0.016
NVA163	395346.868	4333260.767	757.264	757.146	Bare Earth/Open Terrain	-0.118
NVA164	397707.613	4299938.232	756.877	756.924	Bare Earth/Open Terrain	0.047
NVA165	398006.156	4283870.569	781.372	781.325	Urban Terrain	-0.047
NVA166	386843.475	4285723.401	769.350	769.324	Bare Earth/Open Terrain	-0.026



NVA167	333052.841	4283700.093	862.261	862.320	Bare Earth/Open Terrain	0.059
NVA168	320420.726	4282225.926	953.597	953.668	Bare Earth/Open Terrain	0.071
NVA169	301282.656	4247194.390	985.872	985.895	Urban Terrain	0.023
NVA170	290136.932	4254707.964	1014.247	1014.160	Bare Earth/Open Terrain	-0.087
NVA171	237939.515	4303709.093	1187.790	1187.843	Bare Earth/Open Terrain	0.053
NVA172	238290.057	4347201.426	1209.678	1209.768	Urban Terrain	0.090
NVA173	239637.486	4364572.143	1192.318	1192.287	Bare Earth/Open Terrain	-0.031
NVA174	238592.017	4401657.719	1116.127	1116.216	Bare Earth/Open Terrain	0.089
NVA175	410522.175	4338339.424	756.716	756.533	Bare Earth/Open Terrain	-0.183
NVA176	397093.920	4311232.033	771.267	771.317	Urban Terrain	0.050
NVA177	293573.040	4430849.442	983.942	984.077	Bare Earth/Open Terrain	0.135
NVA178	336190.915	4385587.277	930.204	930.070	Bare Earth/Open Terrain	-0.134
NVA179	407672.183	4344818.124	779.171	779.060	Bare Earth/Open Terrain	-0.111
NVA180	344826.442	4307490.714	874.931	874.870	Urban Terrain	-0.061
NVA181	255080.142	4330549.551	1143.843	1143.968	Bare Earth/Open Terrain	0.125
NVA182	271547.127	4359167.035	1106.272	1106.274	Bare Earth/Open Terrain	0.002
NVA183	286318.397	4378054.128	1055.158	1055.121	Bare Earth/Open Terrain	-0.037
NVA184	321908.547	4378674.874	977.407	977.311	Urban Terrain	-0.096
NVA185	269121.165	4398369.938	1065.247	1065.267	Bare Earth/Open Terrain	0.020
NVA186	333282.994	4399264.177	920.041	920.134	Bare Earth/Open Terrain	0.093
NVA187	349465.114	4324288.398	902.398	902.386	Bare Earth/Open Terrain	-0.012
NVA188	312909.146	4345167.690	996.607	996.697	Urban Terrain	0.090
NVA189	270790.138	4306040.783	1029.336	1029.371	Bare Earth/Open Terrain	0.035
NVA190	276082.083	4333313.027	1075.682	1075.655	Bare Earth/Open Terrain	-0.027
NVA191	300362.895	4356820.004	1028.685	1028.728	Urban Terrain	0.043
NVA192	251938.773	4270996.406	1135.388	1135.365	Bare Earth/Open Terrain	-0.023
NVA193	411226.893	4363329.319	755.094	754.957	Bare Earth/Open Terrain	-0.137
NVA194	276028.270	4261048.043	1056.850	1056.840	Bare Earth/Open Terrain	-0.010
NVA195	257708.653	4240174.846	1097.225	1097.297	Urban Terrain	0.072
NVA196	293870.799	4292138.630	1034.143	1034.177	Bare Earth/Open Terrain	0.034
NVA197	242549.851	4355947.827	1189.480	1189.481	Bare Earth/Open Terrain	0.001
NVA198	250241.996	4412060.353	1105.532	1105.635	Bare Earth/Open Terrain	0.103
NVA199	282999.547	4403034.231	1057.113	1057.121	Urban Terrain	0.008
NVA200	313922.233	4329053.020	987.856	987.881	Bare Earth/Open Terrain	0.025
NVA201	311276.258	4309222.672	890.799	890.725	Bare Earth/Open Terrain	-0.074
NVA202	336068.868	4346160.278	940.175	940.237	Bare Earth/Open Terrain	0.062
NVA203	328263.683	4417030.919	924.053	924.106	Urban Terrain	0.053
NVA204	372469.206	4366343.384	851.770	851.739	Bare Earth/Open Terrain	-0.031
NVA205	373460.014	4330391.511	856.030	856.027	Bare Earth/Open Terrain	-0.003
NVA206	426549.023	4358171.368	674.799	674.700	Urban Terrain	-0.099
NVA207	368209.599	4387157.923	820.139	820.219	Bare Earth/Open Terrain	0.080
NVA208	265315.498	4356009.311	1129.338	1129.372	Bare Earth/Open Terrain	0.034
NVA209	326587.271	4386097.774	936.160	936.158	Urban Terrain	-0.002



NVA211	258213.075	4388458.420	1118.458	1118.389	Bare Earth/Open Terrain	-0.069
NVA212	383414.115	4387092.121	808.129	808.168	Bare Earth/Open Terrain	0.039
NVA213	301213.863	4239141.295	989.536	989.596	Urban Terrain	0.060
NVAX001	391080.814	4412734.428	804.758	804.788	Bare Earth/Open Terrain	0.030
NVAX002	363089.222	4364118.597	874.239	874.237	Bare Earth/Open Terrain	-0.002
NVAX003	347178.845	4370829.527	901.697	901.733	Urban Terrain	0.036
NVAX004	351863.245	4328230.589	901.404	901.413	Bare Earth/Open Terrain	0.009
NVAX005	420938.907	4335056.522	724.134	724.234	Bare Earth/Open Terrain	0.100
NVAX006	327970.614	4336637.093	947.517	947.565	Urban Terrain	0.048
NVAX007	295625.010	4360194.406	1041.755	1041.806	Bare Earth/Open Terrain	0.051
NVAX008	310526.067	4395545.578	926.817	926.964	Bare Earth/Open Terrain	0.147
NVAX009	300493.169	4426535.046	1000.093	1000.174	Urban Terrain	0.081
NVAX010	374212.067	4292064.435	774.444	774.445	Bare Earth/Open Terrain	0.001
NVAX011	376276.164	4310290.492	781.843	781.876	Bare Earth/Open Terrain	0.033
NVAX012	337299.410	4286677.674	915.018	914.986	Bare Earth/Open Terrain	-0.032
NVAX013	319484.567	4287810.935	896.179	896.280	Bare Earth/Open Terrain	0.101
NVAX014	277312.797	4355745.803	1098.518	1098.630	Urban Terrain	0.112
NVAX015	260022.695	4351381.966	1140.007	1140.073	Bare Earth/Open Terrain	0.066
NVAX016	276311.679	4299444.038	1084.097	1084.180	Bare Earth/Open Terrain	0.083
NVAX017	242622.752	4300312.230	1156.714	1156.623	Bare Earth/Open Terrain	-0.091
NVAX018	246074.903	4429468.392	1081.513	1081.653	Urban Terrain	0.140
NVAX019	250488.979	4420911.345	1068.944	1068.945	Bare Earth/Open Terrain	0.001
NVAX020	243136.829	4239008.880	1141.958	1141.995	Bare Earth/Open Terrain	0.037
NVAX021	254632.000	4247867.826	1111.045	1111.111	Urban Terrain	0.066
NVAX022	270590.373	4239852.974	1067.386	1067.434	Bare Earth/Open Terrain	0.048
NVAX023	272394.911	4246247.204	1066.504	1066.543	Bare Earth/Open Terrain	0.039
NVAX024	294799.848	4239300.787	1003.927	1003.997	Urban Terrain	0.070
NVAX025	253411.859	4289227.366	1133.055	1133.118	Bare Earth/Open Terrain	0.063
NVAX026	235715.177	4289855.021	1195.494	1195.449	Bare Earth/Open Terrain	-0.045
NVAX500	368351.815	4393733.096	841.565	841.691	Bare Earth/Open Terrain	0.126
NVAX501	377845.436	4386712.077	831.901	831.906	Bare Earth/Open Terrain	0.005

Table 9: Lidar Point Cloud NVA Assessment

Non-vegetated Vertical Accuracy (NVA) Check Point Assessment (Bare-Earth)						
PointID	Easting	Northing	KnownZ	LaserZ	Description	DeltaZ
NVA001	236839.782	4244043.505	1169.011	1169.069	Bare Earth/Open Terrain	0.058
NVA002	243565.535	4255114.787	1150.229	1150.190	Urban Terrain	-0.039
NVA003	259758.788	4262084.411	1100.692	1100.628	Urban Terrain	-0.064
NVA004	277666.602	4289808.469	1070.300	1070.359	Urban Terrain	0.059
NVA005	287577.979	4295991.353	1029.302	1029.367	Urban Terrain	0.065
NVA006	289532.060	4305674.640	991.257	991.269	Urban Terrain	0.012
NVA007	305745.598	4326259.371	1014.224	1014.145	Urban Terrain	-0.079
NVA008	318330.708	4338537.472	981.598	981.652	Urban Terrain	0.054



NVA009	325824.080	4346365.438	967.646	967.731	Bare Earth/Open Terrain	0.085
NVA010	332496.769	4355893.378	952.838	952.934	Bare Earth/Open Terrain	0.096
NVA011	338988.675	4362428.693	927.476	927.383	Bare Earth/Open Terrain	-0.093
NVA012	360576.896	4387517.398	859.944	860.014	Urban Terrain	0.070
NVA013	379914.747	4410386.533	808.163	808.195	Bare Earth/Open Terrain	0.032
NVA014	386562.906	4420870.026	775.193	775.236	Urban Terrain	0.043
NVA015	369605.434	4412997.186	814.694	814.803	Bare Earth/Open Terrain	0.109
NVA016	363101.509	4405105.987	794.038	794.139	Bare Earth/Open Terrain	0.101
NVA017	358445.076	4396390.371	866.182	866.235	Bare Earth/Open Terrain	0.053
NVA018	348503.137	4390144.660	875.087	875.146	Urban Terrain	0.059
NVA019	342731.539	4381379.308	913.690	913.724	Bare Earth/Open Terrain	0.034
NVA020	335991.953	4371620.280	928.051	927.862	Bare Earth/Open Terrain	-0.189
NVA021	329587.416	4364054.980	953.999	953.964	Urban Terrain	-0.035
NVA022	316268.152	4348694.768	983.697	983.720	Bare Earth/Open Terrain	0.023
NVA023	286777.234	4315577.850	974.986	974.967	Bare Earth/Open Terrain	-0.019
NVA024	268039.195	4291738.933	1098.771	1098.840	Urban Terrain	0.069
NVA025	262220.010	4285639.284	1101.655	1101.592	Bare Earth/Open Terrain	-0.063
NVA026	241291.187	4261644.562	1165.455	1165.493	Bare Earth/Open Terrain	0.038
NVA027	245743.179	4277644.437	1161.627	1161.630	Urban Terrain	0.003
NVA028	278953.770	4317139.567	1017.067	1016.912	Bare Earth/Open Terrain	-0.155
NVA029	285456.813	4326161.980	1044.449	1044.387	Urban Terrain	-0.062
NVA030	293269.349	4334498.377	1010.538	1010.583	Bare Earth/Open Terrain	0.045
NVA031	298391.334	4342442.078	1034.733	1034.829	Bare Earth/Open Terrain	0.096
NVA032	314893.937	4359467.290	985.930	985.960	Urban Terrain	0.030
NVA033	352543.390	4406102.850	860.468	860.563	Bare Earth/Open Terrain	0.095
NVA034	365747.233	4422815.090	839.120	839.199	Bare Earth/Open Terrain	0.079
NVA035	349165.426	4416634.637	863.797	863.834	Urban Terrain	0.037
NVA036	310343.003	4369427.107	1002.065	1002.123	Bare Earth/Open Terrain	0.058
NVA037	296977.514	4352111.315	1048.668	1048.737	Urban Terrain	0.069
NVA038	282754.336	4334786.548	1030.789	1030.870	Bare Earth/Open Terrain	0.081
NVA039	269243.540	4321366.507	1088.914	1088.863	Bare Earth/Open Terrain	-0.051
NVA041	243740.111	4288922.701	1167.816	1167.783	Urban Terrain	-0.033
NVA042	236237.726	4285071.698	1191.601	1191.607	Bare Earth/Open Terrain	0.006
NVA043	256072.792	4314243.576	1079.524	1079.418	Bare Earth/Open Terrain	-0.106
NVA044	264990.978	4334363.893	1123.056	1123.008	Urban Terrain	-0.048
NVA045	277512.490	4346084.763	1099.092	1099.138	Bare Earth/Open Terrain	0.046
NVA046	300749.745	4368231.142	1031.704	1031.715	Urban Terrain	0.011
NVA047	307017.702	4379171.649	1008.168	1008.169	Bare Earth/Open Terrain	0.001
NVA048	319946.440	4394774.680	950.023	950.096	Urban Terrain	0.073
NVA049	338468.339	4418482.854	867.600	867.622	Bare Earth/Open Terrain	0.022
NVA051	322444.534	4412331.658	901.722	901.801	Bare Earth/Open Terrain	0.079
NVA052	305746.711	4387942.184	1007.521	1007.567	Urban Terrain	0.046
NVA053	291206.275	4373130.891	1050.189	1050.177	Bare Earth/Open Terrain	-0.012



NVA054	267894.118	4346329.429	1124.760	1124.801	Urban Terrain	0.041
NVA055	261195.316	4338445.781	1146.809	1146.866	Bare Earth/Open Terrain	0.057
NVA056	236625.421	4318208.362	1188.301	1188.266	Urban Terrain	-0.035
NVA057	243739.435	4325357.950	1181.761	1181.593	Urban Terrain	-0.168
NVA058	246562.526	4335656.261	1192.569	1192.630	Bare Earth/Open Terrain	0.061
NVA059	254966.439	4345054.675	1157.358	1157.350	Urban Terrain	-0.008
NVA060	274961.434	4365487.418	1097.892	1097.909	Bare Earth/Open Terrain	0.017
NVA061	294543.035	4390668.830	1027.147	1027.104	Bare Earth/Open Terrain	-0.043
NVA062	306424.666	4406398.762	984.131	984.265	Bare Earth/Open Terrain	0.134
NVA063	311483.202	4413547.711	941.949	941.999	Bare Earth/Open Terrain	0.050
NVA064	325439.038	4428337.243	920.320	920.393	Urban Terrain	0.073
NVA065	309995.576	4423026.874	962.686	962.786	Bare Earth/Open Terrain	0.100
NVA066	301877.030	4416141.225	1008.357	1008.515	Urban Terrain	0.158
NVA067	291359.783	4400401.731	1037.356	1037.422	Bare Earth/Open Terrain	0.066
NVA068	286045.036	4392465.274	1050.748	1050.597	Urban Terrain	-0.151
NVA069	278052.562	4383403.881	1082.836	1082.757	Bare Earth/Open Terrain	-0.079
NVA070	258797.992	4362768.784	1131.978	1131.943	Bare Earth/Open Terrain	-0.035
NVA071	264225.893	4380454.703	1104.580	1104.656	Bare Earth/Open Terrain	0.076
NVA072	288177.109	4410130.013	1041.957	1041.918	Bare Earth/Open Terrain	-0.039
NVA073	282650.455	4419918.721	998.202	998.225	Urban Terrain	0.023
NVA074	265221.913	4393072.016	1086.004	1086.012	Bare Earth/Open Terrain	0.008
NVA075	247962.053	4374272.911	1159.798	1159.714	Urban Terrain	-0.084
NVA076	244018.186	4384065.364	1152.666	1152.649	Bare Earth/Open Terrain	-0.017
NVA077	268084.476	4413485.799	1013.617	1013.642	Urban Terrain	0.025
NVA078	277503.756	4428487.691	933.192	933.186	Bare Earth/Open Terrain	-0.006
NVA079	263063.542	4422060.584	991.864	991.943	Bare Earth/Open Terrain	0.079
NVA080	259137.382	4411822.683	1046.639	1046.656	Urban Terrain	0.017
NVA081	244683.254	4395313.054	1073.650	1073.677	Bare Earth/Open Terrain	0.027
NVA082	245101.947	4406240.581	1121.835	1121.919	Urban Terrain	0.084
NVA083	254005.753	4430243.230	1055.752	1055.834	Bare Earth/Open Terrain	0.082
NVA084	240764.969	4416863.493	1122.587	1122.536	Bare Earth/Open Terrain	-0.051
NVA085	240061.361	4430504.111	1018.000	1018.095	Urban Terrain	0.095
NVA086	376356.919	4393656.439	823.944	823.944	Bare Earth/Open Terrain	0.000
NVA087	357102.392	4369853.165	886.710	886.688	Bare Earth/Open Terrain	-0.022
NVA088	322623.673	4330134.665	967.209	967.187	Bare Earth/Open Terrain	-0.022
NVA089	300878.044	4308673.912	913.121	913.015	Bare Earth/Open Terrain	-0.106
NVA090	279834.566	4281598.638	1050.180	1050.209	Urban Terrain	0.029
NVA091	274760.389	4272003.660	1067.104	1067.050	Bare Earth/Open Terrain	-0.054
NVA092	268026.294	4264065.146	1079.476	1079.428	Bare Earth/Open Terrain	-0.048
NVA093	248068.645	4242095.592	1126.138	1126.221	Urban Terrain	0.083
NVA094	264138.741	4248060.903	1088.360	1088.360	Bare Earth/Open Terrain	0.000
NVA095	289098.497	4279770.591	1029.691	1029.642	Bare Earth/Open Terrain	-0.049
NVA096	296922.393	4288686.865	1014.055	1014.136	Bare Earth/Open Terrain	0.081



NVA097	303673.570	4298947.495	968.386	968.413	Bare Earth/Open Terrain	0.027
NVA098	317716.169	4312315.354	919.745	919.666	Urban Terrain	-0.079
NVA099	332018.151	4328566.273	946.876	946.876	Bare Earth/Open Terrain	0.000
NVA100	337914.135	4338069.424	935.223	935.231	Bare Earth/Open Terrain	0.008
NVA101	344149.662	4344369.274	926.733	926.764	Bare Earth/Open Terrain	0.031
NVA102	352389.194	4352258.214	900.609	900.608	Urban Terrain	-0.001
NVA103	366370.092	4368074.047	869.269	869.175	Bare Earth/Open Terrain	-0.094
NVA104	371321.082	4375863.431	842.521	842.580	Bare Earth/Open Terrain	0.059
NVA105	386018.441	4393428.693	784.045	784.060	Urban Terrain	0.015
NVA106	375382.612	4357015.353	816.059	816.087	Bare Earth/Open Terrain	0.028
NVA107	348133.629	4337869.208	905.493	905.604	Urban Terrain	0.111
NVA108	334916.408	4318890.286	937.682	937.692	Bare Earth/Open Terrain	0.010
NVA109	314061.834	4296995.081	936.579	936.622	Bare Earth/Open Terrain	0.043
NVA110	308602.914	4290761.828	979.483	979.528	Urban Terrain	0.045
NVA111	293808.606	4273926.107	1012.868	1012.826	Bare Earth/Open Terrain	-0.042
NVA112	285667.924	4264491.933	1030.744	1030.705	Bare Earth/Open Terrain	-0.039
NVA113	279036.807	4255373.876	1048.785	1048.798	Urban Terrain	0.013
NVA114	266125.567	4239960.548	1079.296	1079.336	Bare Earth/Open Terrain	0.040
NVA115	276111.629	4239722.285	1051.839	1051.911	Bare Earth/Open Terrain	0.072
NVA116	285278.751	4246528.746	1028.019	1027.998	Urban Terrain	-0.021
NVA117	308927.520	4280921.586	979.311	979.245	Bare Earth/Open Terrain	-0.066
NVA118	313023.329	4273510.926	967.702	967.648	Bare Earth/Open Terrain	-0.054
NVA119	304720.609	4261708.036	974.402	974.359	Bare Earth/Open Terrain	-0.043
NVA120	298181.537	4253712.461	984.013	983.954	Bare Earth/Open Terrain	-0.059
NVA121	289923.416	4239395.961	1015.984	1015.993	Urban Terrain	0.009
NVA122	307788.028	4254335.385	978.002	977.970	Bare Earth/Open Terrain	-0.032
NVA123	309228.163	4237419.061	969.579	969.602	Bare Earth/Open Terrain	0.023
NVA124	324529.911	4296708.372	884.434	884.464	Bare Earth/Open Terrain	0.030
NVA125	328046.928	4304891.401	878.256	878.271	Urban Terrain	0.015
NVA126	338352.023	4310786.396	911.801	911.766	Bare Earth/Open Terrain	-0.035
NVA127	356093.408	4335294.668	892.449	892.480	Bare Earth/Open Terrain	0.031
NVA128	364217.077	4342359.738	874.920	874.912	Bare Earth/Open Terrain	-0.008
NVA129	370906.582	4353513.469	849.601	849.646	Urban Terrain	0.045
NVA130	391419.076	4375640.777	813.403	813.257	Bare Earth/Open Terrain	-0.146
NVA131	393564.034	4365931.874	790.066	789.986	Bare Earth/Open Terrain	-0.080
NVA132	388631.495	4358907.039	762.917	762.808	Urban Terrain	-0.109
NVA133	361260.419	4326399.976	875.092	875.164	Bare Earth/Open Terrain	0.072
NVA134	354118.610	4320108.183	883.886	883.859	Urban Terrain	-0.027
NVA135	335230.014	4293915.160	836.657	836.675	Bare Earth/Open Terrain	0.018
NVA136	350372.342	4302590.349	862.283	862.267	Bare Earth/Open Terrain	-0.016
NVA137	363161.916	4318376.119	846.513	846.473	Urban Terrain	-0.040
NVA138	383416.667	4340591.251	819.492	819.407	Bare Earth/Open Terrain	-0.085
NVA139	391686.747	4349892.403	814.752	814.607	Bare Earth/Open Terrain	-0.145



NVA140	398294.103	4360227.233	771.040	771.022	Bare Earth/Open Terrain	-0.018
NVA141	410093.417	4375395.802	771.874	771.803	Urban Terrain	-0.071
NVA142	414498.878	4368781.083	762.996	762.803	Bare Earth/Open Terrain	-0.193
NVA143	419691.183	4349523.415	729.827	729.773	Bare Earth/Open Terrain	-0.054
NVA144	415611.028	4343139.274	765.046	765.004	Urban Terrain	-0.042
NVA145	381394.834	4323616.164	826.563	826.507	Bare Earth/Open Terrain	-0.056
NVA146	367398.310	4307865.158	860.451	860.423	Urban Terrain	-0.028
NVA147	346670.053	4286563.580	848.477	848.405	Bare Earth/Open Terrain	-0.072
NVA148	366885.941	4290238.233	761.347	761.330	Urban Terrain	-0.017
NVA149	381200.121	4314835.815	798.034	797.935	Bare Earth/Open Terrain	-0.099
NVA150	380027.909	4300360.879	772.765	772.730	Bare Earth/Open Terrain	-0.035
NVA151	383783.173	4290659.411	747.047	747.024	Urban Terrain	-0.023
NVA152	390419.531	4298400.081	758.768	758.772	Bare Earth/Open Terrain	0.004
NVA153	361879.156	4284690.581	812.333	812.279	Urban Terrain	-0.054
NVA154	384247.244	4308727.115	762.160	762.154	Bare Earth/Open Terrain	-0.006
NVA155	245749.681	4420702.342	1101.632	1101.683	Bare Earth/Open Terrain	0.051
NVA156	303935.545	4430329.610	977.675	977.796	Bare Earth/Open Terrain	0.121
NVA157	240954.774	4377713.588	1170.223	1170.155	Urban Terrain	-0.068
NVA158	373762.373	4425792.267	799.545	799.659	Bare Earth/Open Terrain	0.114
NVA159	390956.290	4404634.928	804.879	804.852	Bare Earth/Open Terrain	-0.027
NVA160	429076.313	4373738.119	733.014	732.927	Bare Earth/Open Terrain	-0.087
NVA161	431498.889	4363982.520	695.467	695.409	Urban Terrain	-0.058
NVA162	431092.721	4343025.678	726.508	726.492	Bare Earth/Open Terrain	-0.016
NVA163	395346.868	4333260.767	757.264	757.146	Bare Earth/Open Terrain	-0.118
NVA164	397707.613	4299938.232	756.877	756.924	Bare Earth/Open Terrain	0.047
NVA165	398006.156	4283870.569	781.372	781.325	Urban Terrain	-0.047
NVA166	386843.475	4285723.401	769.350	769.304	Bare Earth/Open Terrain	-0.046
NVA167	333052.841	4283700.093	862.261	862.269	Bare Earth/Open Terrain	0.008
NVA168	320420.726	4282225.926	953.597	953.635	Bare Earth/Open Terrain	0.038
NVA169	301282.656	4247194.390	985.872	985.895	Urban Terrain	0.023
NVA170	290136.932	4254707.964	1014.247	1014.084	Bare Earth/Open Terrain	-0.163
NVA171	237939.515	4303709.093	1187.790	1187.800	Bare Earth/Open Terrain	0.010
NVA172	238290.057	4347201.426	1209.678	1209.693	Urban Terrain	0.015
NVA173	239637.486	4364572.143	1192.318	1192.212	Bare Earth/Open Terrain	-0.106
NVA174	238592.017	4401657.719	1116.127	1116.212	Bare Earth/Open Terrain	0.085
NVA175	410522.175	4338339.424	756.716	756.533	Bare Earth/Open Terrain	-0.183
NVA176	397093.920	4311232.033	771.267	771.215	Urban Terrain	-0.052
NVA177	293573.040	4430849.442	983.942	984.024	Bare Earth/Open Terrain	0.082
NVA178	336190.915	4385587.277	930.204	930.069	Bare Earth/Open Terrain	-0.135
NVA179	407672.183	4344818.124	779.171	779.031	Bare Earth/Open Terrain	-0.140
NVA180	344826.442	4307490.714	874.931	874.834	Urban Terrain	-0.097
NVA181	255080.142	4330549.551	1143.843	1143.873	Bare Earth/Open Terrain	0.030
NVA182	271547.127	4359167.035	1106.272	1106.220	Bare Earth/Open Terrain	-0.052



NVA183	286318.397	4378054.128	1055.158	1055.113	Bare Earth/Open Terrain	-0.045
NVA184	321908.547	4378674.874	977.407	977.238	Urban Terrain	-0.169
NVA185	269121.165	4398369.938	1065.247	1065.215	Bare Earth/Open Terrain	-0.032
NVA186	333282.994	4399264.177	920.041	920.084	Bare Earth/Open Terrain	0.043
NVA187	349465.114	4324288.398	902.398	902.383	Bare Earth/Open Terrain	-0.015
NVA188	312909.146	4345167.690	996.607	996.691	Urban Terrain	0.084
NVA189	270790.138	4306040.783	1029.336	1029.356	Bare Earth/Open Terrain	0.020
NVA190	276082.083	4333313.027	1075.682	1075.630	Bare Earth/Open Terrain	-0.052
NVA191	300362.895	4356820.004	1028.685	1028.728	Urban Terrain	0.043
NVA192	251938.773	4270996.406	1135.388	1135.365	Bare Earth/Open Terrain	-0.023
NVA193	411226.893	4363329.319	755.094	754.957	Bare Earth/Open Terrain	-0.137
NVA194	276028.270	4261048.043	1056.850	1056.840	Bare Earth/Open Terrain	-0.010
NVA195	257708.653	4240174.846	1097.225	1097.297	Urban Terrain	0.072
NVA196	293870.799	4292138.630	1034.143	1034.173	Bare Earth/Open Terrain	0.030
NVA197	242549.851	4355947.827	1189.480	1189.481	Bare Earth/Open Terrain	0.001
NVA198	250241.996	4412060.353	1105.532	1105.622	Bare Earth/Open Terrain	0.090
NVA199	282999.547	4403034.231	1057.113	1057.121	Urban Terrain	0.008
NVA200	313922.233	4329053.020	987.856	987.864	Bare Earth/Open Terrain	0.008
NVA201	311276.258	4309222.672	890.799	890.725	Bare Earth/Open Terrain	-0.074
NVA202	336068.868	4346160.278	940.175	940.231	Bare Earth/Open Terrain	0.056
NVA203	328263.683	4417030.919	924.053	924.106	Urban Terrain	0.053
NVA204	372469.206	4366343.384	851.770	851.739	Bare Earth/Open Terrain	-0.031
NVA205	373460.014	4330391.511	856.030	855.999	Bare Earth/Open Terrain	-0.031
NVA206	426549.023	4358171.368	674.799	674.700	Urban Terrain	-0.099
NVA207	368209.599	4387157.923	820.139	820.219	Bare Earth/Open Terrain	0.080
NVA208	265315.498	4356009.311	1129.338	1129.362	Bare Earth/Open Terrain	0.024
NVA209	326587.271	4386097.774	936.160	936.140	Urban Terrain	-0.020
NVA211	258213.075	4388458.420	1118.458	1118.373	Bare Earth/Open Terrain	-0.085
NVA212	383414.115	4387092.121	808.129	808.137	Bare Earth/Open Terrain	0.008
NVA213	301213.863	4239141.295	989.536	989.596	Urban Terrain	0.060
NVAX001	391080.814	4412734.428	804.758	804.788	Bare Earth/Open Terrain	0.030
NVAX002	363089.222	4364118.597	874.239	874.237	Bare Earth/Open Terrain	-0.002
NVAX003	347178.845	4370829.527	901.697	901.692	Urban Terrain	-0.005
NVAX004	351863.245	4328230.589	901.404	901.396	Bare Earth/Open Terrain	-0.008
NVAX005	420938.907	4335056.522	724.134	724.234	Bare Earth/Open Terrain	0.100
NVAX006	327970.614	4336637.093	947.517	947.565	Urban Terrain	0.048
NVAX007	295625.010	4360194.406	1041.755	1041.806	Bare Earth/Open Terrain	0.051
NVAX008	310526.067	4395545.578	926.817	926.952	Bare Earth/Open Terrain	0.135
NVAX009	300493.169	4426535.046	1000.093	1000.101	Urban Terrain	0.008
NVAX010	374212.067	4292064.435	774.444	774.435	Bare Earth/Open Terrain	-0.009
NVAX011	376276.164	4310290.492	781.843	781.876	Bare Earth/Open Terrain	0.033
NVAX012	337299.410	4286677.674	915.018	914.946	Bare Earth/Open Terrain	-0.072
NVAX013	319484.567	4287810.935	896.179	896.241	Bare Earth/Open Terrain	0.062



NVAX014	277312.797	4355745.803	1098.518	1098.576	Urban Terrain	0.058
NVAX015	260022.695	4351381.966	1140.007	1140.044	Bare Earth/Open Terrain	0.037
NVAX016	276311.679	4299444.038	1084.097	1084.161	Bare Earth/Open Terrain	0.064
NVAX017	242622.752	4300312.230	1156.714	1156.623	Bare Earth/Open Terrain	-0.091
NVAX018	246074.903	4429468.392	1081.513	1081.594	Urban Terrain	0.081
NVAX019	250488.979	4420911.345	1068.944	1068.945	Bare Earth/Open Terrain	0.001
NVAX020	243136.829	4239008.880	1141.958	1141.976	Bare Earth/Open Terrain	0.018
NVAX021	254632.000	4247867.826	1111.045	1111.089	Urban Terrain	0.044
NVAX022	270590.373	4239852.974	1067.386	1067.434	Bare Earth/Open Terrain	0.048
NVAX023	272394.911	4246247.204	1066.504	1066.532	Bare Earth/Open Terrain	0.028
NVAX024	294799.848	4239300.787	1003.927	1003.944	Urban Terrain	0.017
NVAX025	253411.859	4289227.366	1133.055	1133.118	Bare Earth/Open Terrain	0.063
NVAX026	235715.177	4289855.021	1195.494	1195.410	Bare Earth/Open Terrain	-0.084
NVAX500	368351.815	4393733.096	841.565	841.589	Bare Earth/Open Terrain	0.024
NVAX501	377845.436	4386712.077	831.901	831.906	Bare Earth/Open Terrain	0.005

Table 10: Bare-Earth Lidar NVA Assessment

Non-vegetated Vertical Accuracy (NVA) Check Point Assessment (DEM)						
PointID	Easting	Northing	KnownZ	DEMZ	Description	DeltaZ
NVA001	236839.782	4244043.505	1169.011	1169.068	Bare Earth/Open Terrain	0.057
NVA002	243565.535	4255114.787	1150.229	1150.198	Urban Terrain	-0.031
NVA003	259758.788	4262084.411	1100.692	1100.629	Urban Terrain	-0.063
NVA004	277666.602	4289808.469	1070.300	1070.359	Urban Terrain	0.059
NVA005	287577.979	4295991.353	1029.302	1029.361	Urban Terrain	0.059
NVA006	289532.060	4305674.640	991.257	991.256	Urban Terrain	-0.001
NVA007	305745.598	4326259.371	1014.224	1014.148	Urban Terrain	-0.076
NVA008	318330.708	4338537.472	981.598	981.653	Urban Terrain	0.055
NVA009	325824.080	4346365.438	967.646	967.734	Bare Earth/Open Terrain	0.088
NVA010	332496.769	4355893.378	952.838	952.929	Bare Earth/Open Terrain	0.091
NVA011	338988.675	4362428.693	927.476	927.393	Bare Earth/Open Terrain	-0.083
NVA012	360576.896	4387517.398	859.944	860.009	Urban Terrain	0.065
NVA013	379914.747	4410386.533	808.163	808.190	Bare Earth/Open Terrain	0.027
NVA014	386562.906	4420870.026	775.193	775.229	Urban Terrain	0.036
NVA015	369605.434	4412997.186	814.694	814.785	Bare Earth/Open Terrain	0.091
NVA016	363101.509	4405105.987	794.038	794.125	Bare Earth/Open Terrain	0.087
NVA017	358445.076	4396390.371	866.182	866.221	Bare Earth/Open Terrain	0.039
NVA018	348503.137	4390144.660	875.087	875.141	Urban Terrain	0.054
NVA019	342731.539	4381379.308	913.690	913.724	Bare Earth/Open Terrain	0.034
NVA020	335991.953	4371620.280	928.051	927.884	Bare Earth/Open Terrain	-0.167
NVA021	329587.416	4364054.980	953.999	953.963	Urban Terrain	-0.036
NVA022	316268.152	4348694.768	983.697	983.717	Bare Earth/Open Terrain	0.020
NVA023	286777.234	4315577.850	974.986	974.995	Bare Earth/Open Terrain	0.009
NVA024	268039.195	4291738.933	1098.771	1098.813	Urban Terrain	0.042



NVA025	262220.010	4285639.284	1101.655	1101.579	Bare Earth/Open Terrain	-0.076
NVA026	241291.187	4261644.562	1165.455	1165.492	Bare Earth/Open Terrain	0.037
NVA027	245743.179	4277644.437	1161.627	1161.623	Urban Terrain	-0.004
NVA028	278953.770	4317139.567	1017.067	1016.913	Bare Earth/Open Terrain	-0.154
NVA029	285456.813	4326161.980	1044.449	1044.390	Urban Terrain	-0.059
NVA030	293269.349	4334498.377	1010.538	1010.579	Bare Earth/Open Terrain	0.041
NVA031	298391.334	4342442.078	1034.733	1034.832	Bare Earth/Open Terrain	0.099
NVA032	314893.937	4359467.290	985.930	985.954	Urban Terrain	0.024
NVA033	352543.390	4406102.850	860.468	860.553	Bare Earth/Open Terrain	0.085
NVA034	365747.233	4422815.090	839.120	839.178	Bare Earth/Open Terrain	0.058
NVA035	349165.426	4416634.637	863.797	863.839	Urban Terrain	0.042
NVA036	310343.003	4369427.107	1002.065	1002.122	Bare Earth/Open Terrain	0.057
NVA037	296977.514	4352111.315	1048.668	1048.725	Urban Terrain	0.057
NVA038	282754.336	4334786.548	1030.789	1030.870	Bare Earth/Open Terrain	0.081
NVA039	269243.540	4321366.507	1088.914	1088.863	Bare Earth/Open Terrain	-0.051
NVA041	243740.111	4288922.701	1167.816	1167.792	Urban Terrain	-0.024
NVA042	236237.726	4285071.698	1191.601	1191.595	Bare Earth/Open Terrain	-0.006
NVA043	256072.792	4314243.576	1079.524	1079.420	Bare Earth/Open Terrain	-0.104
NVA044	264990.978	4334363.893	1123.056	1123.009	Urban Terrain	-0.047
NVA045	277512.490	4346084.763	1099.092	1099.149	Bare Earth/Open Terrain	0.057
NVA046	300749.745	4368231.142	1031.704	1031.734	Urban Terrain	0.030
NVA047	307017.702	4379171.649	1008.168	1008.169	Bare Earth/Open Terrain	0.001
NVA048	319946.440	4394774.680	950.023	950.102	Urban Terrain	0.079
NVA049	338468.339	4418482.854	867.600	867.629	Bare Earth/Open Terrain	0.029
NVA051	322444.534	4412331.658	901.722	901.795	Bare Earth/Open Terrain	0.073
NVA052	305746.711	4387942.184	1007.521	1007.574	Urban Terrain	0.053
NVA053	291206.275	4373130.891	1050.189	1050.167	Bare Earth/Open Terrain	-0.022
NVA054	267894.118	4346329.429	1124.760	1124.791	Urban Terrain	0.031
NVA055	261195.316	4338445.781	1146.809	1146.858	Bare Earth/Open Terrain	0.049
NVA056	236625.421	4318208.362	1188.301	1188.264	Urban Terrain	-0.037
NVA057	243739.435	4325357.950	1181.761	1181.589	Urban Terrain	-0.172
NVA058	246562.526	4335656.261	1192.569	1192.630	Bare Earth/Open Terrain	0.061
NVA059	254966.439	4345054.675	1157.358	1157.347	Urban Terrain	-0.011
NVA060	274961.434	4365487.418	1097.892	1097.904	Bare Earth/Open Terrain	0.012
NVA061	294543.035	4390668.830	1027.147	1027.112	Bare Earth/Open Terrain	-0.035
NVA062	306424.666	4406398.762	984.131	984.256	Bare Earth/Open Terrain	0.125
NVA063	311483.202	4413547.711	941.949	942.011	Bare Earth/Open Terrain	0.062
NVA064	325439.038	4428337.243	920.320	920.390	Urban Terrain	0.070
NVA065	309995.576	4423026.874	962.686	962.785	Bare Earth/Open Terrain	0.099
NVA066	301877.030	4416141.225	1008.357	1008.520	Urban Terrain	0.163
NVA067	291359.783	4400401.731	1037.356	1037.415	Bare Earth/Open Terrain	0.059
NVA068	286045.036	4392465.274	1050.748	1050.599	Urban Terrain	-0.149
NVA069	278052.562	4383403.881	1082.836	1082.806	Bare Earth/Open Terrain	-0.030



NVA070	258797.992	4362768.784	1131.978	1131.942	Bare Earth/Open Terrain	-0.036
NVA071	264225.893	4380454.703	1104.580	1104.658	Bare Earth/Open Terrain	0.078
NVA072	288177.109	4410130.013	1041.957	1041.908	Bare Earth/Open Terrain	-0.049
NVA073	282650.455	4419918.721	998.202	998.223	Urban Terrain	0.021
NVA074	265221.913	4393072.016	1086.004	1086.037	Bare Earth/Open Terrain	0.033
NVA075	247962.053	4374272.911	1159.798	1159.719	Urban Terrain	-0.079
NVA076	244018.186	4384065.364	1152.666	1152.645	Bare Earth/Open Terrain	-0.021
NVA077	268084.476	4413485.799	1013.617	1013.637	Urban Terrain	0.020
NVA078	277503.756	4428487.691	933.192	933.182	Bare Earth/Open Terrain	-0.010
NVA079	263063.542	4422060.584	991.864	991.942	Bare Earth/Open Terrain	0.078
NVA080	259137.382	4411822.683	1046.639	1046.659	Urban Terrain	0.020
NVA081	244683.254	4395313.054	1073.650	1073.696	Bare Earth/Open Terrain	0.046
NVA082	245101.947	4406240.581	1121.835	1121.905	Urban Terrain	0.070
NVA083	254005.753	4430243.230	1055.752	1055.842	Bare Earth/Open Terrain	0.090
NVA084	240764.969	4416863.493	1122.587	1122.548	Bare Earth/Open Terrain	-0.039
NVA085	240061.361	4430504.111	1018.000	1018.071	Urban Terrain	0.071
NVA086	376356.919	4393656.439	823.944	823.937	Bare Earth/Open Terrain	-0.007
NVA087	357102.392	4369853.165	886.710	886.690	Bare Earth/Open Terrain	-0.020
NVA088	322623.673	4330134.665	967.209	967.179	Bare Earth/Open Terrain	-0.030
NVA089	300878.044	4308673.912	913.121	912.998	Bare Earth/Open Terrain	-0.123
NVA090	279834.566	4281598.638	1050.180	1050.205	Urban Terrain	0.025
NVA091	274760.389	4272003.660	1067.104	1067.054	Bare Earth/Open Terrain	-0.050
NVA092	268026.294	4264065.146	1079.476	1079.432	Bare Earth/Open Terrain	-0.044
NVA093	248068.645	4242095.592	1126.138	1126.221	Urban Terrain	0.083
NVA094	264138.741	4248060.903	1088.360	1088.354	Bare Earth/Open Terrain	-0.006
NVA095	289098.497	4279770.591	1029.691	1029.640	Bare Earth/Open Terrain	-0.051
NVA096	296922.393	4288686.865	1014.055	1014.133	Bare Earth/Open Terrain	0.078
NVA097	303673.570	4298947.495	968.386	968.413	Bare Earth/Open Terrain	0.027
NVA098	317716.169	4312315.354	919.745	919.675	Urban Terrain	-0.070
NVA099	332018.151	4328566.273	946.876	946.874	Bare Earth/Open Terrain	-0.002
NVA100	337914.135	4338069.424	935.223	935.230	Bare Earth/Open Terrain	0.007
NVA101	344149.662	4344369.274	926.733	926.760	Bare Earth/Open Terrain	0.027
NVA102	352389.194	4352258.214	900.609	900.620	Urban Terrain	0.011
NVA103	366370.092	4368074.047	869.269	869.172	Bare Earth/Open Terrain	-0.097
NVA104	371321.082	4375863.431	842.521	842.582	Bare Earth/Open Terrain	0.061
NVA105	386018.441	4393428.693	784.045	784.055	Urban Terrain	0.010
NVA106	375382.612	4357015.353	816.059	816.085	Bare Earth/Open Terrain	0.026
NVA107	348133.629	4337869.208	905.493	905.612	Urban Terrain	0.119
NVA108	334916.408	4318890.286	937.682	937.689	Bare Earth/Open Terrain	0.007
NVA109	314061.834	4296995.081	936.579	936.631	Bare Earth/Open Terrain	0.052
NVA110	308602.914	4290761.828	979.483	979.530	Urban Terrain	0.047
NVA111	293808.606	4273926.107	1012.868	1012.839	Bare Earth/Open Terrain	-0.029
NVA112	285667.924	4264491.933	1030.744	1030.709	Bare Earth/Open Terrain	-0.035



NVA113	279036.807	4255373.876	1048.785	1048.793	Urban Terrain	0.008
NVA114	266125.567	4239960.548	1079.296	1079.332	Bare Earth/Open Terrain	0.036
NVA115	276111.629	4239722.285	1051.839	1051.903	Bare Earth/Open Terrain	0.064
NVA116	285278.751	4246528.746	1028.019	1028.010	Urban Terrain	-0.009
NVA117	308927.520	4280921.586	979.311	979.242	Bare Earth/Open Terrain	-0.069
NVA118	313023.329	4273510.926	967.702	967.639	Bare Earth/Open Terrain	-0.063
NVA119	304720.609	4261708.036	974.402	974.341	Bare Earth/Open Terrain	-0.061
NVA120	298181.537	4253712.461	984.013	983.953	Bare Earth/Open Terrain	-0.060
NVA121	289923.416	4239395.961	1015.984	1015.994	Urban Terrain	0.010
NVA122	307788.028	4254335.385	978.002	977.964	Bare Earth/Open Terrain	-0.038
NVA123	309228.163	4237419.061	969.579	969.607	Bare Earth/Open Terrain	0.028
NVA124	324529.911	4296708.372	884.434	884.456	Bare Earth/Open Terrain	0.022
NVA125	328046.928	4304891.401	878.256	878.274	Urban Terrain	0.018
NVA126	338352.023	4310786.396	911.801	911.790	Bare Earth/Open Terrain	-0.011
NVA127	356093.408	4335294.668	892.449	892.467	Bare Earth/Open Terrain	0.018
NVA128	364217.077	4342359.738	874.920	874.917	Bare Earth/Open Terrain	-0.003
NVA129	370906.582	4353513.469	849.601	849.637	Urban Terrain	0.036
NVA130	391419.076	4375640.777	813.403	813.272	Bare Earth/Open Terrain	-0.131
NVA131	393564.034	4365931.874	790.066	789.960	Bare Earth/Open Terrain	-0.106
NVA132	388631.495	4358907.039	762.917	762.810	Urban Terrain	-0.107
NVA133	361260.419	4326399.976	875.092	875.158	Bare Earth/Open Terrain	0.066
NVA134	354118.610	4320108.183	883.886	883.848	Urban Terrain	-0.038
NVA135	335230.014	4293915.160	836.657	836.690	Bare Earth/Open Terrain	0.033
NVA136	350372.342	4302590.349	862.283	862.275	Bare Earth/Open Terrain	-0.008
NVA137	363161.916	4318376.119	846.513	846.484	Urban Terrain	-0.029
NVA138	383416.667	4340591.251	819.492	819.418	Bare Earth/Open Terrain	-0.074
NVA139	391686.747	4349892.403	814.752	814.610	Bare Earth/Open Terrain	-0.142
NVA140	398294.103	4360227.233	771.040	771.018	Bare Earth/Open Terrain	-0.022
NVA141	410093.417	4375395.802	771.874	771.823	Urban Terrain	-0.051
NVA142	414498.878	4368781.083	762.996	762.811	Bare Earth/Open Terrain	-0.185
NVA143	419691.183	4349523.415	729.827	729.783	Bare Earth/Open Terrain	-0.044
NVA144	415611.028	4343139.274	765.046	764.995	Urban Terrain	-0.051
NVA145	381394.834	4323616.164	826.563	826.507	Bare Earth/Open Terrain	-0.056
NVA146	367398.310	4307865.158	860.451	860.419	Urban Terrain	-0.032
NVA147	346670.053	4286563.580	848.477	848.413	Bare Earth/Open Terrain	-0.064
NVA148	366885.941	4290238.233	761.347	761.377	Urban Terrain	0.030
NVA149	381200.121	4314835.815	798.034	797.948	Bare Earth/Open Terrain	-0.086
NVA150	380027.909	4300360.879	772.765	772.721	Bare Earth/Open Terrain	-0.044
NVA151	383783.173	4290659.411	747.047	747.025	Urban Terrain	-0.022
NVA152	390419.531	4298400.081	758.768	758.776	Bare Earth/Open Terrain	0.008
NVA153	361879.156	4284690.581	812.333	812.265	Urban Terrain	-0.068
NVA154	384247.244	4308727.115	762.160	762.161	Bare Earth/Open Terrain	0.001
NVA155	245749.681	4420702.342	1101.632	1101.674	Bare Earth/Open Terrain	0.042



NVA156	303935.545	4430329.610	977.675	977.789	Bare Earth/Open Terrain	0.114
NVA157	240954.774	4377713.588	1170.223	1170.153	Urban Terrain	-0.070
NVA158	373762.373	4425792.267	799.545	799.647	Bare Earth/Open Terrain	0.102
NVA159	390956.290	4404634.928	804.879	804.838	Bare Earth/Open Terrain	-0.041
NVA160	429076.313	4373738.119	733.014	732.937	Bare Earth/Open Terrain	-0.077
NVA161	431498.889	4363982.520	695.467	695.398	Urban Terrain	-0.069
NVA162	431092.721	4343025.678	726.508	726.500	Bare Earth/Open Terrain	-0.008
NVA163	395346.868	4333260.767	757.264	757.141	Bare Earth/Open Terrain	-0.123
NVA164	397707.613	4299938.232	756.877	756.913	Bare Earth/Open Terrain	0.036
NVA165	398006.156	4283870.569	781.372	781.331	Urban Terrain	-0.041
NVA166	386843.475	4285723.401	769.350	769.306	Bare Earth/Open Terrain	-0.044
NVA167	333052.841	4283700.093	862.261	862.284	Bare Earth/Open Terrain	0.023
NVA168	320420.726	4282225.926	953.597	953.630	Bare Earth/Open Terrain	0.033
NVA169	301282.656	4247194.390	985.872	985.900	Urban Terrain	0.028
NVA170	290136.932	4254707.964	1014.247	1014.090	Bare Earth/Open Terrain	-0.157
NVA171	237939.515	4303709.093	1187.790	1187.808	Bare Earth/Open Terrain	0.018
NVA172	238290.057	4347201.426	1209.678	1209.707	Urban Terrain	0.029
NVA173	239637.486	4364572.143	1192.318	1192.243	Bare Earth/Open Terrain	-0.075
NVA174	238592.017	4401657.719	1116.127	1116.209	Bare Earth/Open Terrain	0.082
NVA175	410522.175	4338339.424	756.716	756.516	Bare Earth/Open Terrain	-0.200
NVA176	397093.920	4311232.033	771.267	771.213	Urban Terrain	-0.054
NVA177	293573.040	4430849.442	983.942	984.021	Bare Earth/Open Terrain	0.079
NVA178	336190.915	4385587.277	930.204	930.083	Bare Earth/Open Terrain	-0.121
NVA179	407672.183	4344818.124	779.171	779.030	Bare Earth/Open Terrain	-0.141
NVA180	344826.442	4307490.714	874.931	874.842	Urban Terrain	-0.089
NVA181	255080.142	4330549.551	1143.843	1143.869	Bare Earth/Open Terrain	0.026
NVA182	271547.127	4359167.035	1106.272	1106.231	Bare Earth/Open Terrain	-0.041
NVA183	286318.397	4378054.128	1055.158	1055.104	Bare Earth/Open Terrain	-0.054
NVA184	321908.547	4378674.874	977.407	977.248	Urban Terrain	-0.159
NVA185	269121.165	4398369.938	1065.247	1065.222	Bare Earth/Open Terrain	-0.025
NVA186	333282.994	4399264.177	920.041	920.114	Bare Earth/Open Terrain	0.073
NVA187	349465.114	4324288.398	902.398	902.390	Bare Earth/Open Terrain	-0.008
NVA188	312909.146	4345167.690	996.607	996.688	Urban Terrain	0.081
NVA189	270790.138	4306040.783	1029.336	1029.320	Bare Earth/Open Terrain	-0.016
NVA190	276082.083	4333313.027	1075.682	1075.602	Bare Earth/Open Terrain	-0.080
NVA191	300362.895	4356820.004	1028.685	1028.744	Urban Terrain	0.059
NVA192	251938.773	4270996.406	1135.388	1135.366	Bare Earth/Open Terrain	-0.022
NVA193	411226.893	4363329.319	755.094	754.972	Bare Earth/Open Terrain	-0.122
NVA194	276028.270	4261048.043	1056.850	1056.835	Bare Earth/Open Terrain	-0.015
NVA195	257708.653	4240174.846	1097.225	1097.287	Urban Terrain	0.062
NVA196	293870.799	4292138.630	1034.143	1034.158	Bare Earth/Open Terrain	0.015
NVA197	242549.851	4355947.827	1189.480	1189.478	Bare Earth/Open Terrain	-0.002
NVA198	250241.996	4412060.353	1105.532	1105.594	Bare Earth/Open Terrain	0.062



NVA199	282999.547	4403034.231	1057.113	1057.115	Urban Terrain	0.002
NVA200	313922.233	4329053.020	987.856	987.853	Bare Earth/Open Terrain	-0.003
NVA201	311276.258	4309222.672	890.799	890.738	Bare Earth/Open Terrain	-0.061
NVA202	336068.868	4346160.278	940.175	940.211	Bare Earth/Open Terrain	0.036
NVA203	328263.683	4417030.919	924.053	924.108	Urban Terrain	0.055
NVA204	372469.206	4366343.384	851.770	851.738	Bare Earth/Open Terrain	-0.032
NVA205	373460.014	4330391.511	856.030	855.989	Bare Earth/Open Terrain	-0.041
NVA206	426549.023	4358171.368	674.799	674.674	Urban Terrain	-0.125
NVA207	368209.599	4387157.923	820.139	820.244	Bare Earth/Open Terrain	0.105
NVA208	265315.498	4356009.311	1129.338	1129.361	Bare Earth/Open Terrain	0.023
NVA209	326587.271	4386097.774	936.160	936.130	Urban Terrain	-0.030
NVA211	258213.075	4388458.420	1118.458	1118.375	Bare Earth/Open Terrain	-0.083
NVA212	383414.115	4387092.121	808.129	808.141	Bare Earth/Open Terrain	0.012
NVA213	301213.863	4239141.295	989.536	989.601	Urban Terrain	0.065
NVAX001	391080.814	4412734.428	804.758	804.790	Bare Earth/Open Terrain	0.032
NVAX002	363089.222	4364118.597	874.239	874.241	Bare Earth/Open Terrain	0.002
NVAX003	347178.845	4370829.527	901.697	901.691	Urban Terrain	-0.006
NVAX004	351863.245	4328230.589	901.404	901.397	Bare Earth/Open Terrain	-0.007
NVAX005	420938.907	4335056.522	724.134	724.215	Bare Earth/Open Terrain	0.081
NVAX006	327970.614	4336637.093	947.517	947.570	Urban Terrain	0.053
NVAX007	295625.010	4360194.406	1041.755	1041.822	Bare Earth/Open Terrain	0.067
NVAX008	310526.067	4395545.578	926.817	926.946	Bare Earth/Open Terrain	0.129
NVAX009	300493.169	4426535.046	1000.093	1000.102	Urban Terrain	0.009
NVAX010	374212.067	4292064.435	774.444	774.424	Bare Earth/Open Terrain	-0.020
NVAX011	376276.164	4310290.492	781.843	781.870	Bare Earth/Open Terrain	0.027
NVAX012	337299.410	4286677.674	915.018	914.965	Bare Earth/Open Terrain	-0.053
NVAX013	319484.567	4287810.935	896.179	896.242	Bare Earth/Open Terrain	0.063
NVAX014	277312.797	4355745.803	1098.518	1098.567	Urban Terrain	0.049
NVAX015	260022.695	4351381.966	1140.007	1140.040	Bare Earth/Open Terrain	0.033
NVAX016	276311.679	4299444.038	1084.097	1084.146	Bare Earth/Open Terrain	0.049
NVAX017	242622.752	4300312.230	1156.714	1156.614	Bare Earth/Open Terrain	-0.100
NVAX018	246074.903	4429468.392	1081.513	1081.610	Urban Terrain	0.097
NVAX019	250488.979	4420911.345	1068.944	1068.943	Bare Earth/Open Terrain	-0.001
NVAX020	243136.829	4239008.880	1141.958	1141.988	Bare Earth/Open Terrain	0.030
NVAX021	254632.000	4247867.826	1111.045	1111.084	Urban Terrain	0.039
NVAX022	270590.373	4239852.974	1067.386	1067.457	Bare Earth/Open Terrain	0.071
NVAX023	272394.911	4246247.204	1066.504	1066.531	Bare Earth/Open Terrain	0.027
NVAX024	294799.848	4239300.787	1003.927	1003.943	Urban Terrain	0.016
NVAX025	253411.859	4289227.366	1133.055	1133.114	Bare Earth/Open Terrain	0.059
NVAX026	235715.177	4289855.021	1195.494	1195.430	Bare Earth/Open Terrain	-0.064
NVAX500	368351.815	4393733.096	841.565	841.603	Bare Earth/Open Terrain	0.038
NVAX501	377845.436	4386712.077	831.901	831.904	Bare Earth/Open Terrain	0.003

Table 11: Bare=Earth DEM NVA Assessment



Vegetated Vertical Accuracy (VVA) Check Point Assessment (Bare Earth)						
PointID	Easting	Northing	KnownZ	LaserZ	Description	DeltaZ
VVA001	251604.973	4257699.741	1124.423	1124.401	Brush	-0.022
VVA002	265061.618	4273830.138	1097.098	1097.109	Trees	0.011
VVA003	272719.894	4281689.165	1077.883	1077.823	High Grass	-0.060
VVA004	297588.029	4311950.294	939.451	939.460	Brush	0.009
VVA005	347154.434	4370834.914	901.439	901.442	High Grass	0.003
VVA006	352231.350	4378869.555	890.868	890.846	Trees	-0.022
VVA007	366793.306	4395371.310	848.813	848.860	Brush	0.047
VVA008	374295.190	4403291.912	833.888	833.934	Trees	0.046
VVA009	375286.160	4421762.489	816.526	816.711	High Grass	0.185
VVA010	322869.471	4356777.890	971.590	971.757	Brush	0.167
VVA011	309610.196	4340478.566	990.892	990.968	Trees	0.076
VVA012	300874.029	4334325.429	1023.741	1023.636	High Grass	-0.105
VVA013	295751.439	4320916.716	957.914	957.896	Brush	-0.018
VVA014	280019.554	4309023.748	974.575	974.605	High Grass	0.030
VVA015	276318.450	4299455.868	1083.982	1084.047	Trees	0.065
VVA016	255345.585	4274920.533	1133.562	1133.661	High Grass	0.099
VVA017	247132.425	4271185.667	1151.700	1151.792	Brush	0.092
VVA018	234675.051	4253761.677	1175.735	1175.808	High Grass	0.073
VVA019	234730.739	4273169.884	1177.123	1177.086	Trees	-0.037
VVA020	253409.319	4289210.452	1132.905	1132.987	Trees	0.082
VVA021	265828.327	4302617.322	1093.262	1093.296	Brush	0.034
VVA022	271408.831	4312513.542	1017.041	1017.007	High Grass	-0.034
VVA023	306647.644	4351157.990	1018.222	1018.306	Trees	0.084
VVA024	328377.439	4375300.542	938.984	938.955	Brush	-0.029
VVA025	332673.296	4381630.055	937.380	937.426	Brush	0.046
VVA026	334757.759	4392851.800	920.348	920.396	High Grass	0.048
VVA027	347630.228	4400566.874	879.864	879.895	Trees	0.031
VVA028	359184.657	4414016.188	864.497	864.642	High Grass	0.145
VVA029	353847.014	4427125.811	870.964	871.026	Brush	0.062
VVA030	338094.936	4400758.760	921.278	921.265	High Grass	-0.013
VVA031	330995.883	4392889.453	932.682	932.752	Trees	0.070
VVA032	317513.512	4375592.285	981.031	981.041	High Grass	0.010
VVA033	304881.444	4359987.514	1020.290	1020.418	Brush	0.128
VVA034	287127.639	4344329.908	1060.623	1060.646	Trees	0.023
VVA035	275926.027	4327301.850	1019.857	1019.712	High Grass	-0.145
VVA036	255570.921	4301513.670	1139.717	1139.698	Brush	-0.019
VVA037	235698.574	4289846.906	1194.838	1194.848	Trees	0.010
VVA038	242589.894	4300325.766	1157.517	1157.475	High Grass	-0.042
VVA039	247736.985	4307764.808	1150.267	1150.340	Brush	0.073
VVA040	259928.598	4327236.189	1102.154	1101.884	Trees	-0.270
VVA041	287390.341	4354985.697	1049.713	1049.844	High Grass	0.131



VVA042	313571.946	4385349.235	994.662	994.707	Brush	0.045
VVA043	328594.754	4401520.656	948.541	948.792	Trees	0.251
VVA044	333433.682	4410537.155	902.442	902.550	High Grass	0.108
VVA045	334806.622	4428449.156	899.308	899.439	Brush	0.131
VVA046	317542.502	4403473.118	893.108	893.202	Trees	0.094
VVA047	310531.541	4395538.258	926.738	926.889	High Grass	0.151
VVA048	297750.967	4378594.923	1031.640	1031.753	Brush	0.113
VVA049	286092.341	4363575.105	1063.818	1063.834	Trees	0.016
VVA050	277320.031	4355766.672	1098.545	1098.607	High Grass	0.062
VVA051	256935.529	4334548.521	1149.070	1149.194	Brush	0.124
VVA052	250164.243	4327144.883	1149.390	1149.324	Trees	-0.066
VVA053	245085.654	4317968.807	1179.187	1179.041	Brush	-0.146
VVA054	260040.419	4351394.445	1140.138	1140.153	High Grass	0.015
VVA055	279909.873	4372865.677	1083.179	1083.128	Trees	-0.051
VVA056	286331.552	4385241.643	1043.217	1043.180	High Grass	-0.037
VVA057	302124.081	4396846.379	1005.416	1005.487	Brush	0.071
VVA058	319566.019	4421419.137	930.567	930.676	Trees	0.109
VVA059	315227.522	4430292.596	932.708	932.830	Brush	0.122
VVA060	298476.884	4407619.860	1012.543	1012.661	High Grass	0.118
VVA061	272023.952	4374846.897	1072.499	1072.389	Trees	-0.110
VVA062	265349.814	4366430.942	1110.078	1110.078	High Grass	0.000
VVA063	250481.453	4354324.709	1164.185	1164.147	Brush	-0.038
VVA064	243675.858	4344625.732	1196.206	1196.293	High Grass	0.087
VVA065	249955.881	4362924.967	1158.205	1158.163	Trees	-0.042
VVA066	258078.973	4372338.352	1132.545	1132.474	Brush	-0.071
VVA067	273780.170	4393840.910	1067.792	1067.812	High Grass	0.020
VVA068	292301.557	4418048.142	1033.731	1033.678	Trees	-0.053
VVA069	300475.440	4426530.872	999.884	1000.120	Brush	0.236
VVA070	289425.044	4428542.435	987.397	987.383	High Grass	-0.014
VVA071	277679.626	4410479.279	1059.791	1059.831	Trees	0.040
VVA072	274176.795	4404102.029	1066.499	1066.549	Brush	0.050
VVA073	253139.585	4382217.419	1136.038	1136.042	High Grass	0.004
VVA074	254461.250	4394790.036	1105.563	1105.781	Trees	0.218
VVA075	262801.664	4401986.726	1046.026	1046.175	High Grass	0.149
VVA076	273137.490	4420197.955	991.613	991.707	Brush	0.094
VVA077	268387.612	4426776.278	1023.212	1023.262	Trees	0.050
VVA078	250502.316	4420918.656	1068.144	1068.309	High Grass	0.165
VVA079	246087.902	4429479.366	1081.196	1081.332	Brush	0.136
VVA080	391057.806	4412744.563	803.760	803.813	Trees	0.053
VVA081	382887.206	4401570.010	807.647	807.754	High Grass	0.107
VVA082	363315.077	4377353.467	869.502	869.595	Brush	0.093
VVA083	348599.552	4362364.429	915.567	915.564	Trees	-0.003
VVA084	342046.210	4355716.180	929.705	929.774	High Grass	0.069



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VVA085	327988.071	4336636.676	947.707	947.754	Brush	0.047
VVA086	314175.049	4321813.194	981.453	981.253	High Grass	-0.200
VVA087	305903.051	4316577.164	952.173	952.182	Trees	0.009
VVA088	288123.180	4287968.402	1035.359	1035.452	Brush	0.093
VVA089	254609.196	4247896.160	1110.924	1110.967	Trees	0.043
VVA090	269474.578	4255967.495	1074.888	1074.951	High Grass	0.063
VVA091	285905.003	4274981.730	1024.799	1024.873	Brush	0.074
VVA092	326097.730	4320647.439	956.385	956.401	High Grass	0.016
VVA093	379373.130	4385061.866	817.053	817.028	Trees	-0.025
VVA094	389093.553	4385306.243	808.403	808.457	High Grass	0.054
VVA095	380763.308	4375837.758	814.635	814.680	Brush	0.045
VVA096	361240.081	4352111.931	885.161	885.203	High Grass	0.042
VVA097	353814.965	4344188.197	909.014	909.005	Trees	-0.009
VVA098	342337.992	4328410.458	919.874	919.822	Brush	-0.052
VVA099	328277.760	4312507.392	926.249	926.146	High Grass	-0.103
VVA100	319766.441	4298334.261	912.109	912.153	Trees	0.044
VVA101	298742.892	4280283.108	1003.066	1003.063	High Grass	-0.003
VVA102	272387.757	4246265.422	1066.022	1066.175	Brush	0.153
VVA103	290237.915	4258082.943	1008.418	1008.441	High Grass	0.023
VVA104	303390.341	4271376.462	989.799	989.742	Trees	-0.057
VVA105	293909.265	4245772.319	1008.654	1008.767	High Grass	0.113
VVA106	309336.394	4243823.755	953.113	953.142	Brush	0.029
VVA107	319469.275	4287746.803	895.789	895.837	Trees	0.048
VVA108	343781.534	4320357.324	891.510	891.663	Brush	0.153
VVA109	351864.432	4328212.457	901.406	901.363	High Grass	-0.043
VVA110	385525.838	4368201.712	818.834	818.806	Trees	-0.028
VVA111	401687.066	4376022.988	782.057	782.063	Brush	0.006
VVA112	381395.300	4351663.949	783.488	783.504	High Grass	0.016
VVA113	373838.677	4341612.477	850.515	850.548	Trees	0.033
VVA114	365709.007	4334629.921	837.150	837.082	Brush	-0.068
VVA115	347415.305	4310362.803	894.727	894.750	Trees	0.023
VVA116	339737.662	4305977.559	885.439	885.434	High Grass	-0.005
VVA118	337279.297	4286667.509	915.173	915.251	Brush	0.078
VVA119	346841.866	4294031.448	789.174	789.124	High Grass	-0.050
VVA120	355449.124	4311303.406	861.870	861.778	Trees	-0.092
VVA121	370683.909	4322958.309	856.362	856.470	Brush	0.108
VVA122	404730.073	4369007.137	765.207	765.135	Trees	-0.072
VVA123	401259.455	4349766.717	791.906	791.882	High Grass	-0.024
VVA124	394235.007	4341810.292	799.580	799.580	Trees	0.000
VVA125	403162.661	4341667.200	781.349	781.255	Brush	-0.094
VVA126	409646.740	4349652.566	765.521	765.448	Trees	-0.073
VVA127	415951.841	4360897.671	736.589	736.537	High Grass	-0.052
VVA128	427204.271	4367240.316	719.404	719.312	Trees	-0.092



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VVA129	431814.473	4351132.321	695.687	695.631	Brush	-0.056
VVA130	386480.076	4331381.896	815.586	815.477	High Grass	-0.109
VVA131	371602.813	4317287.857	841.693	841.654	Trees	-0.039
VVA132	359832.322	4300782.435	809.952	809.878	High Grass	-0.074
VVA133	353365.530	4294555.527	814.479	814.500	Brush	0.021
VVA134	369685.987	4303094.070	835.643	835.674	Trees	0.031
VVA135	376291.968	4310299.540	781.249	781.282	High Grass	0.033
VVA136	392348.480	4314395.408	782.249	782.394	Brush	0.145
VVA137	374189.056	4292052.083	774.080	774.079	Trees	-0.001
VVA138	392571.129	4290418.989	732.995	733.099	High Grass	0.104
VVA139	377772.406	4284383.312	776.337	776.335	Brush	-0.002
VVA140	274079.956	4338735.080	1070.842	1070.853	Trees	0.011
VVA141	242908.346	4367685.313	1174.865	1174.741	High Grass	-0.124
VVA142	239734.094	4389006.346	1131.174	1131.180	Brush	0.006
VVA143	240869.857	4409903.187	1133.811	1133.869	High Grass	0.058
VVA144	238261.730	4337514.454	1207.292	1207.405	Trees	0.113
VVA145	344989.234	4423145.833	867.804	867.917	High Grass	0.113
VVA146	239031.045	4328517.005	1198.618	1198.497	Brush	-0.121
VVA147	389853.157	4427195.192	767.356	767.444	Trees	0.088
VVA148	419585.470	4374824.556	727.965	727.886	Brush	-0.079
VVA149	395996.703	4319280.871	787.185	787.196	Trees	0.011
VVA150	392770.173	4306494.981	737.660	737.735	High Grass	0.075
VVA151	314555.178	4285727.695	936.777	936.889	Brush	0.112
VVA152	311257.336	4264747.219	969.400	969.320	Trees	-0.080
VVA153	294805.233	4239334.330	1003.639	1003.651	High Grass	0.012
VVA154	270613.323	4239887.490	1066.969	1067.022	Brush	0.053
VVA155	243110.699	4239033.887	1141.806	1141.923	Trees	0.117
VVA156	270236.959	4385734.685	1085.875	1085.968	Brush	0.093
VVA157	420943.861	4335081.901	724.305	724.397	High Grass	0.092
VVA158	300848.971	4297388.286	969.139	969.221	Trees	0.082
VVA159	363070.464	4364101.435	874.374	874.430	Brush	0.056
VVA160	296708.954	4262455.637	1002.930	1002.941	Trees	0.011
VVA161	261325.491	4256242.265	1095.406	1095.491	High Grass	0.085
VVA162	238232.225	4310111.712	1190.563	1190.541	Brush	-0.022
VVA163	260020.823	4293366.950	1110.985	1111.065	Trees	0.080
VVA164	261788.158	4313658.506	1044.363	1044.195	Brush	-0.168
VVA166	295589.537	4360196.391	1040.564	1040.702	Trees	0.138
VVA167	322256.245	4367437.814	973.886	973.898	High Grass	0.012
VVA168	336982.991	4420124.372	894.280	894.334	Brush	0.054
VVA169	341519.144	4409392.780	906.372	906.620	Trees	0.248
VVA170	388832.998	4324285.735	819.709	819.622	Brush	-0.087
VVA171	424406.874	4343141.620	733.443	733.643	Trees	0.200
VVA172	377433.063	4361866.124	844.594	844.603	Brush	0.009



VVA173	405508.574	4357807.984	713.292	713.254	High Grass	-0.038
VVA174	266484.033	4375437.098	1108.732	1108.551	Trees	-0.181
VVA175	390850.082	4393355.845	785.550	785.564	Brush	0.014
VVAX001	379918.272	4410440.114	808.798	808.802	Brush	0.004
VVAX002	357096.573	4369863.027	887.267	887.269	Trees	0.002
VVAX500	358723.402	4392048.899	864.374	864.568	Brush	0.194
VVAX501	393608.429	4333770.234	770.029	769.896	High Grass	-0.133

Table 12: Bare-Earth Lidar VVA Assessment

4.5 Vertical Accuracy Results

An overall statistical assessment of the check points can be found in Tables 13, 14, 15, 16, and 17 below. The values provided are in meters.

Check Points Error Statistics								
Land Cover Category	# of points	Min	Max	Mean	Median	Skew	Std Dev	RMSE _z
Open Terrain/Bare Earth	159	-0.193	0.135	-0.002	0.005	-0.500	0.070	0.069
Urban Terrain	79	-0.169	0.158	0.003	0.013	-0.513	0.064	0.064
Brush	59	-0.168	0.236	0.039	0.047	-0.252	0.085	0.093
High Grass	59	-0.200	0.185	0.022	0.016	-0.334	0.084	0.086
Trees	59	-0.270	0.251	0.021	0.016	-0.019	0.092	0.094
Consolidated	415	-0.270	0.251	0.011	0.015	-0.173	0.078	0.078

Table 13: Check Points Error Statistics

Check Points Vertical Accuracy Assessment				
Land Cover Category	# of Points	FVA — Fundamental Vertical Accuracy (RMSE _z x 1.9600)	CVA — Consolidated Vertical Accuracy (95th Percentile)	SVA — Supplemental Vertical Accuracy (95th Percentile)
Open Terrain/Bare Earth	159	0.136		
Urban Terrain	79			0.115
Brush	59			0.167
High Grass	59			0.152
Trees	59			0.221
Consolidated	415		0.154	

Table 14: Check Points Vertical Accuracy Assessment

Non-vegetated Vertical Accuracy (NVA) and Vegetated Vertical Accuracy (VVA)				
Broad Land Cover Type	# of Points	RMSE _z	95% Confidence Level	95th Percentile
NVA of Lidar Point Cloud	238	0.072	0.142	
NVA of Bare-Earth Lidar	238	0.068	0.133	
NVA of Bare-Earth DEM	238	0.066	0.129	
VVA of Bare-Earth Lidar	177	0.091		0.182

Table 15: Non-vegetated Vertical Accuracy (NVA) and Vegetated Vertical Accuracy (VVA)



Comparison of NSSDA, NDEP, and ASPRS Statistics					
Land Cover Category	NSSDA Accuracy _z at 95% confidence level based on RMSE _z * 1.9600	NDEP FVA, plus SVAs and CVA based on 95th Percentile	NDEP Accuracy Term	ASPRS Vertical Accuracy	ASPRS Accuracy Term
Open Terrain/Bare Earth	0.136	0.137	FVA	0.133	NVA
Urban Terrain	0.125	0.115	SVA		
Brush	0.182	0.167	SVA	0.182	VVA
High Grass	0.169	0.152	SVA		
Trees	0.184	0.221	SVA		
Consolidated	0.154	0.154	CVA	N/A	N/A

Table 16: Comparison of NSSDA, NDEP, and ASPRS Statistics

5% Outliers > 95th Percentile (0.154m)						
PointID	Easting	Northing	KnownZ	LaserZ	Description	DeltaZ
NVA020	335991.953	4371620.280	928.051	927.862	Bare Earth/Open Terrain	-0.189
NVA028	278953.770	4317139.567	1017.067	1016.912	Bare Earth/Open Terrain	-0.155
NVA057	243739.435	4325357.950	1181.761	1181.593	Urban Terrain	-0.168
NVA066	301877.030	4416141.225	1008.357	1008.515	Urban Terrain	0.158
NVA142	414498.878	4368781.083	762.996	762.803	Bare Earth/Open Terrain	-0.193
NVA170	290136.932	4254707.964	1014.247	1014.084	Bare Earth/Open Terrain	-0.163
NVA175	410522.175	4338339.424	756.716	756.533	Bare Earth/Open Terrain	-0.183
NVA184	321908.547	4378674.874	977.407	977.238	Urban Terrain	-0.169
VVA009	375286.160	4421762.489	816.526	816.711	High Grass	0.185
VVA010	322869.471	4356777.890	971.590	971.757	Brush	0.167
VVA040	259928.598	4327236.189	1102.154	1101.884	Trees	-0.270
VVA043	328594.754	4401520.656	948.541	948.792	Trees	0.251
VVA069	300475.440	4426530.872	999.884	1000.120	Brush	0.236
VVA074	254461.250	4394790.036	1105.563	1105.781	Trees	0.218
VVA078	250502.316	4420918.656	1068.144	1068.309	High Grass	0.165
VVA086	314175.049	4321813.194	981.453	981.253	High Grass	-0.200
VVA164	261788.158	4313658.506	1044.363	1044.195	Brush	-0.168
VVA169	341519.144	4409392.780	906.372	906.620	Trees	0.248
VVA171	424406.874	4343141.620	733.443	733.643	Trees	0.200
VVA174	266484.033	4375437.098	1108.732	1108.551	Trees	-0.181
VVAX500	358723.402	4392048.899	864.374	864.568	Brush	0.194

Table 17: 5% Outlier Check Points

Section 5: Certification

5.1 Limitations of Use

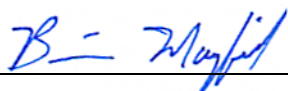
The accuracy assessment confirms that the data may be used for the intended applications stated in the **Project Purpose** section of this document. The dataset may also be used as a topographic input for other applications but the user should be aware that this lidar dataset was designed with a specific purpose and was not intended to meet specifications and/or requirements of users outside of the Kansas Department of Agriculture.

It should also be noted that lidar points do not represent a continuous surface model. Lidar points are discrete measurements of the surface and any values derived within a triangle of three lidar points are interpolated. As such, the user should not use the resultant lidar dataset for vertical placement of a planimetric feature such as a headwall, building footprint or any other planimetric feature unless there is an associated lidar point that can be reasonably located on this structure.

Consideration should be given by the end user of this dataset to the fact that this lidar dataset was developed differently and that previous lidar datasets that may be available for this geographic location. It is likely that the data in this project was created using different geodetic control, a different Geoid, newer lidar technology and more up-to-date processing techniques. As such, any direct comparative analysis performed between this dataset and previous datasets could result in misleading or inaccurate results. Users are encouraged to proceed with caution while performing this type of comparative analysis and to completely understand the variables that make each of these datasets unique and not corollary.

It is encouraged that the user refers to the full FGDC Metadata and project reports for a complete understanding on the content of this dataset.

I, hereby, certify to the extent of my knowledge that the statements and statistics represented in this document are true and factual.



Brian J. Mayfield, ASPRS Certified Photogrammetrist #R1276





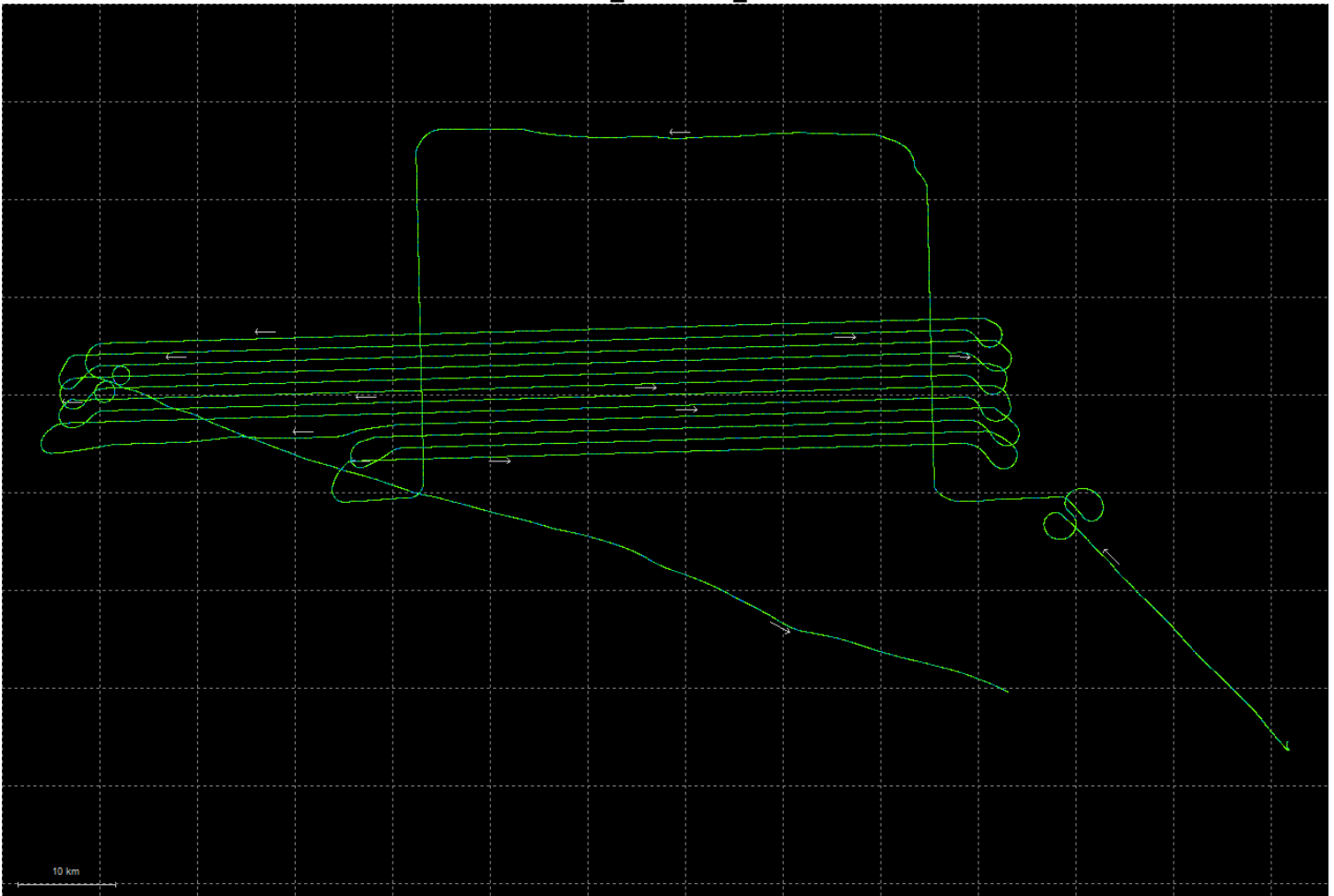
Section 6: GPS Processing

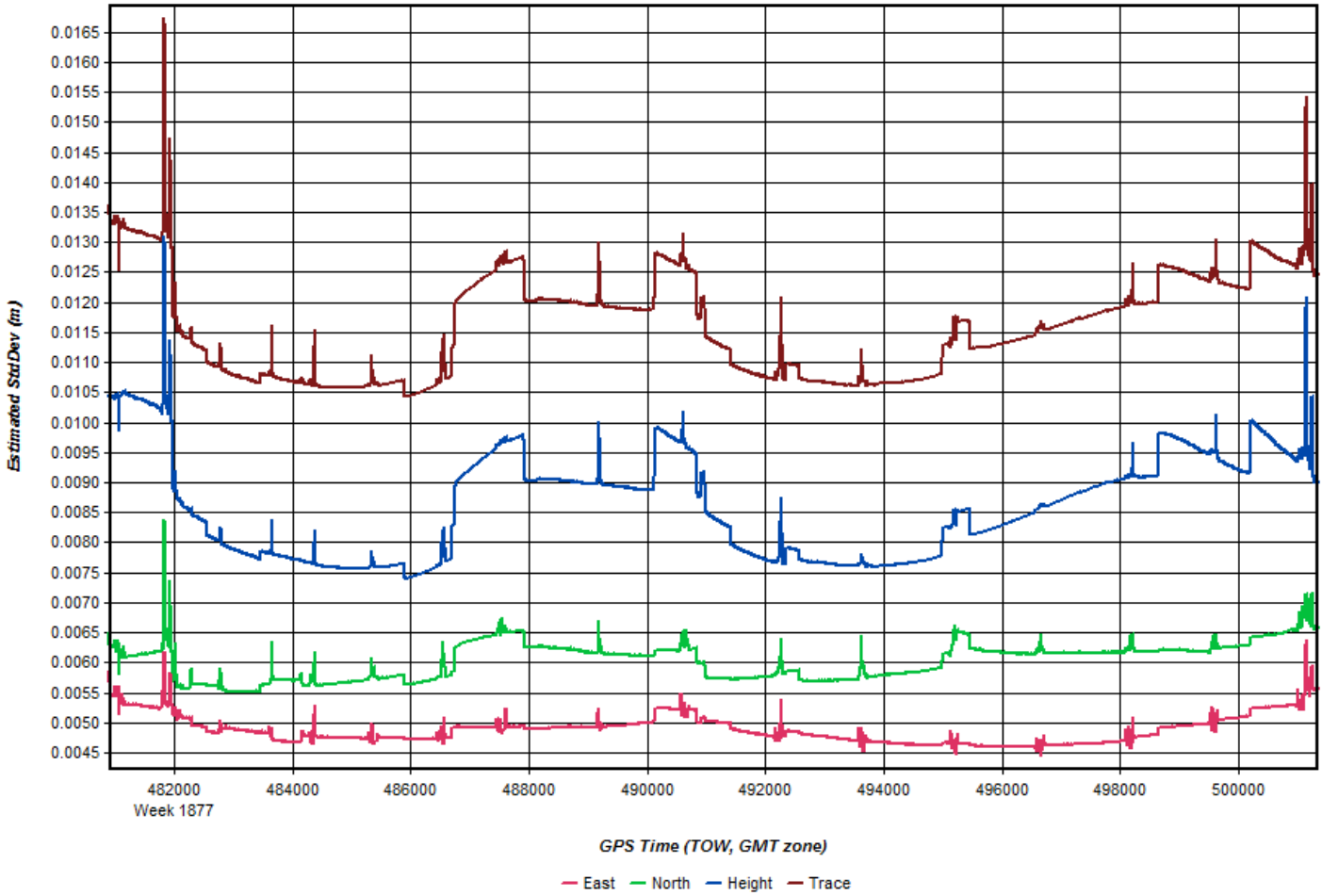
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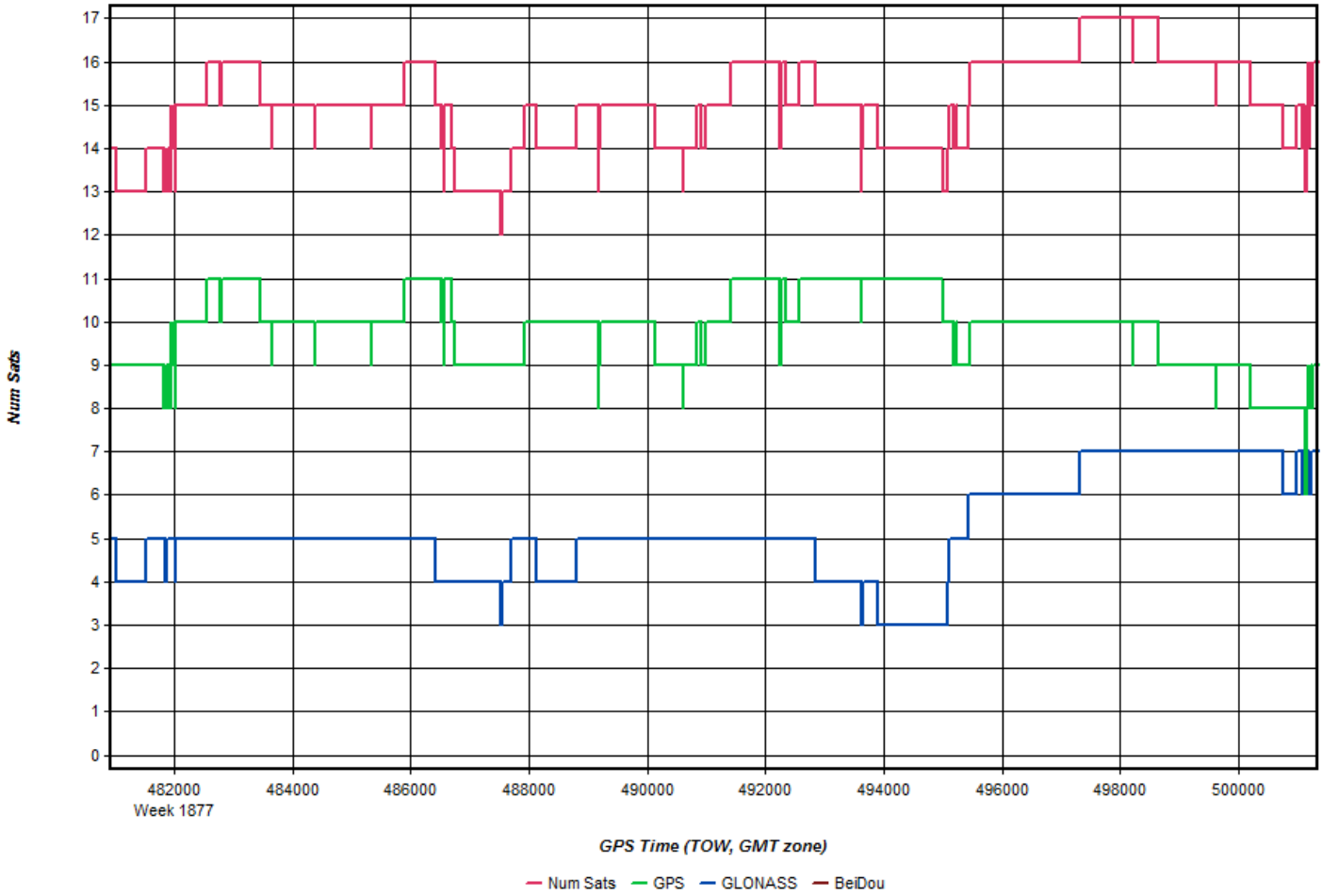
Plots by Mission: Coverage Map, Estimated Position Accuracy, Number of Satellites, Combined Separation, and PDOP.

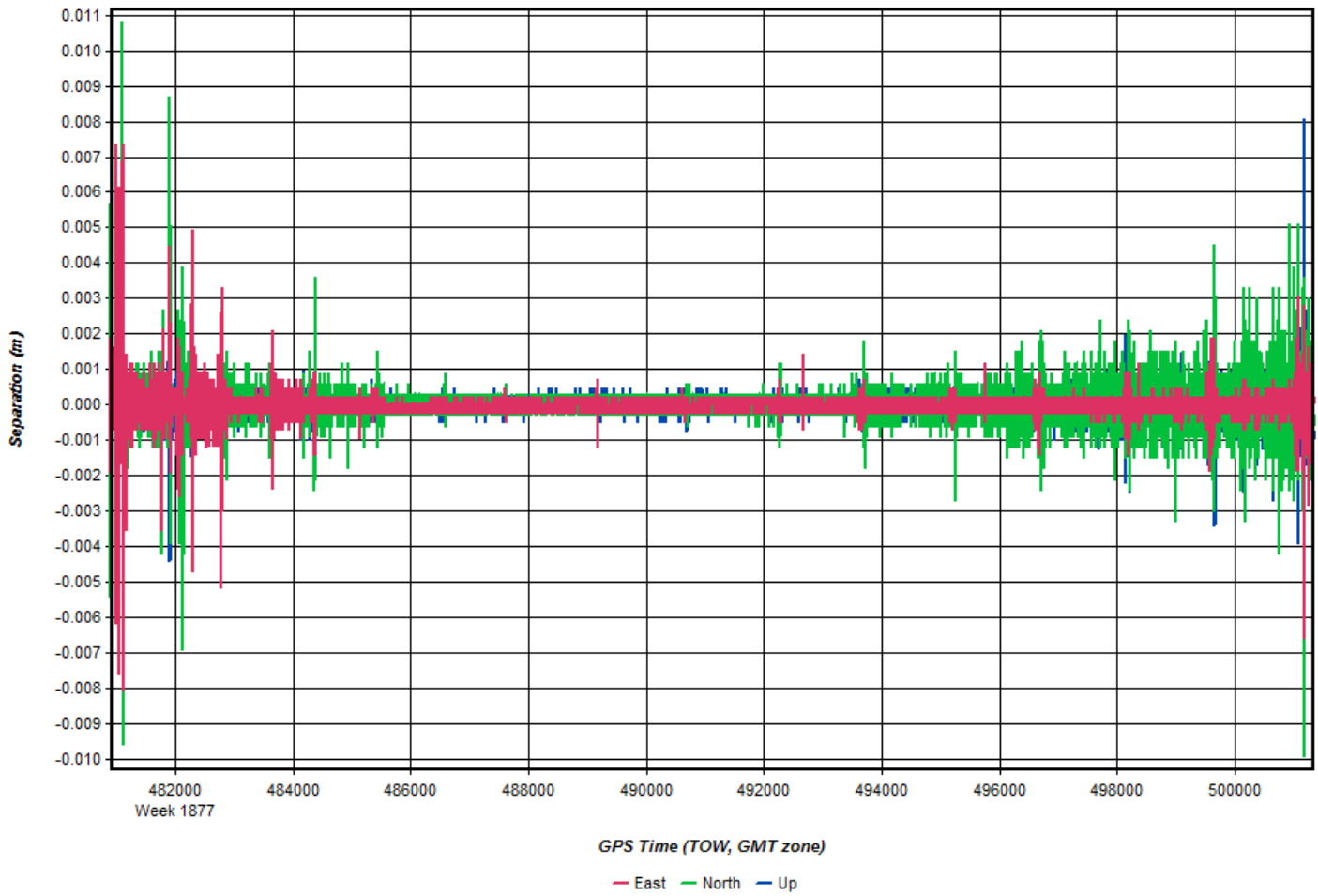
Coverage Map	The Coverage Map plot shows the Aircraft GPS-IMU Trajectory in reference to localized GPS Reference Stations.
Estimated Position Accuracy	The Estimated Position Accuracy plot shows the standard deviations of the east, north, and up directions versus time for the solution. The total standard deviation with a distance dependent component is also plotted.
Number of Satellites	Plots the number of satellites used in the solution as a function of time. The number of GPS satellites, GLONASS satellites, and the total number of satellites are distinguished with separate lines.
Combined Separation	Plots the north, east, and height position difference between any two solutions loaded into the project. This is most often the forward and reverse processing results, unless other solutions have been loaded from the Combine Solutions dialog. Plotting the difference between forward and reverse solutions can be very helpful in quality checking. When processing both directions, no information is shared between forward and reverse processing. Thus both directions are processed independently of each other. When forward and reverse solutions agree closely, it helps provide confidence in the solution. To a lesser extent, this plot can also help gauge solution accuracy.
PDOP	PDOP is a unit less number which indicates how favorable the satellite geometry is to 3D positioning accuracy. A strong satellite geometry, where the PDOP is low, occurs when satellites are well distributed in each direction (north, south, east and west) as well as directly overhead. Values in the range of 1-2 indicate very good satellite geometry, 2-3 are adequate in the sense that they do not generally, by themselves, limit positioning accuracy. Values between 3 and 4 are considered marginal, and values approaching or exceeding 5 can be considered poor. PDOP spikes can occur on aircraft turns where the antenna angle is unfavorable, these spikes while aesthetically unfavorable do not generally reduce the accuracy of the acquired data.

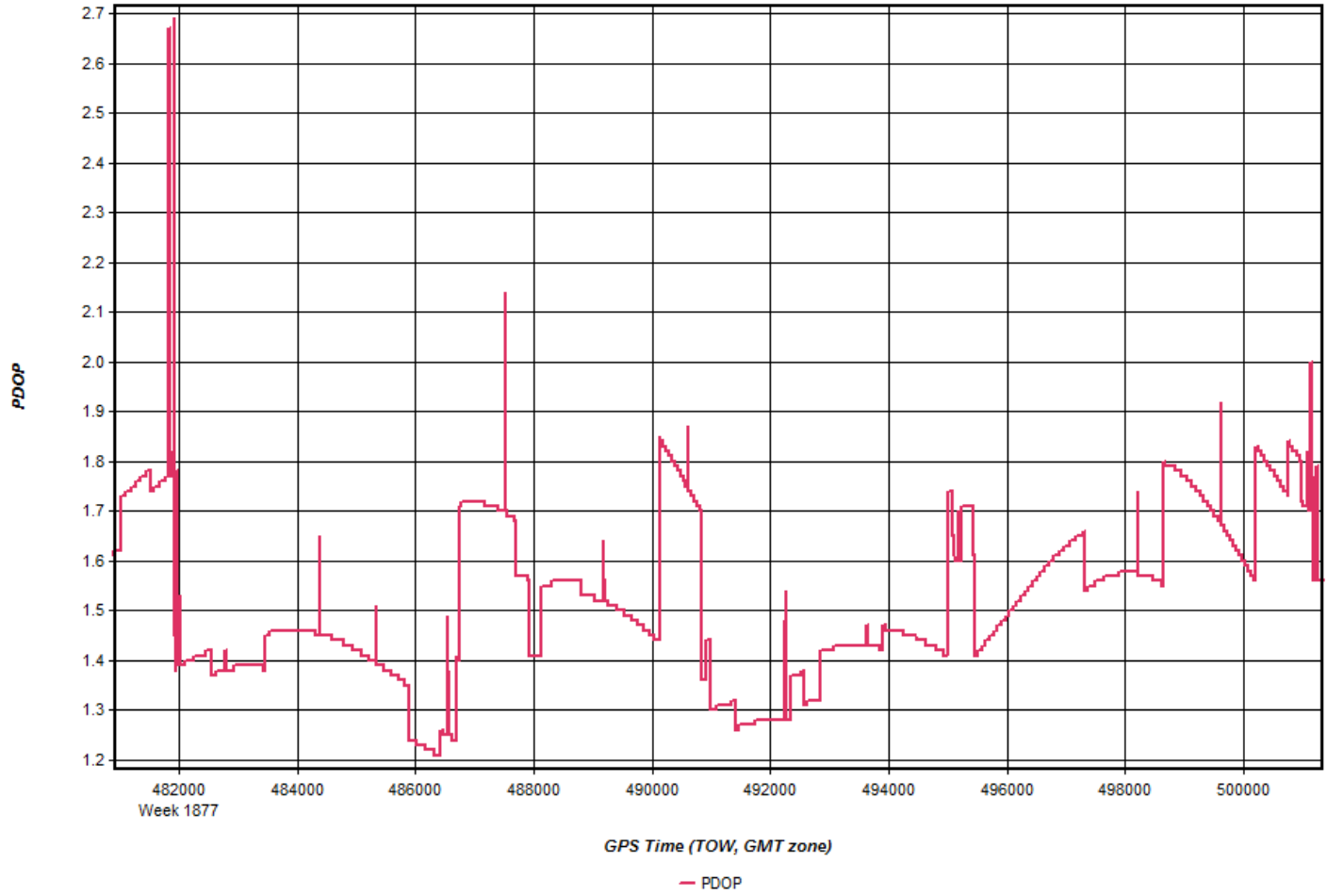
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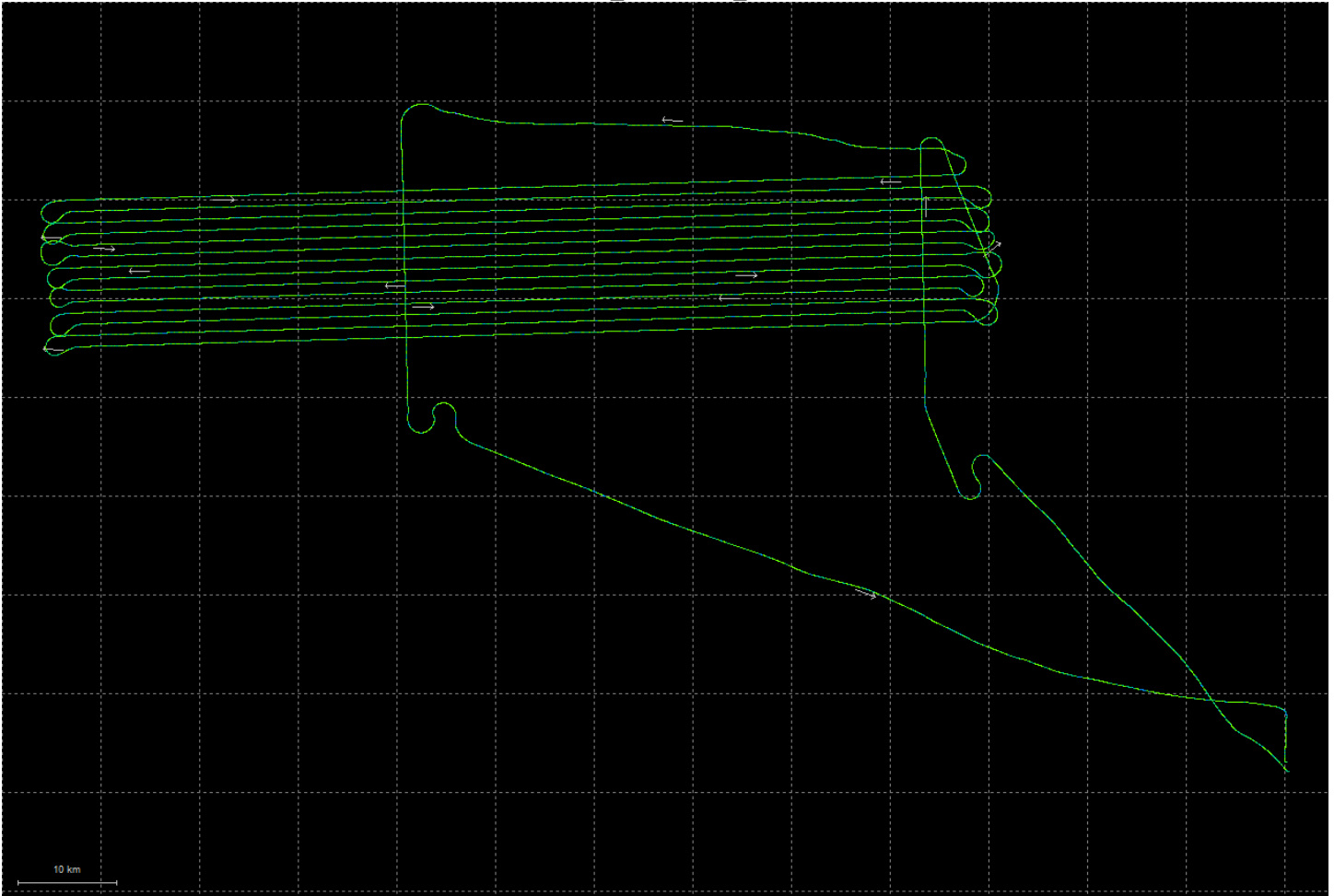


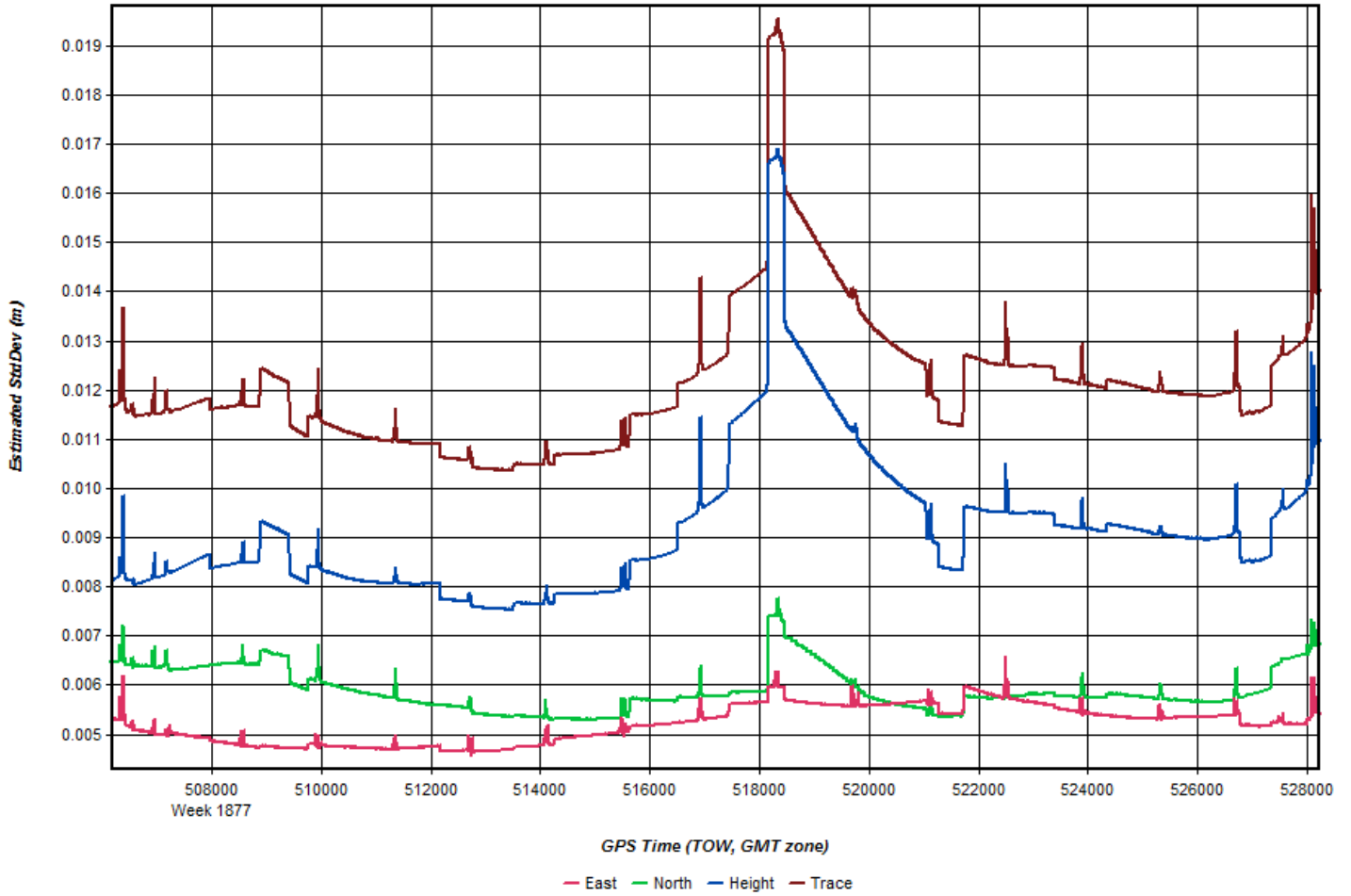


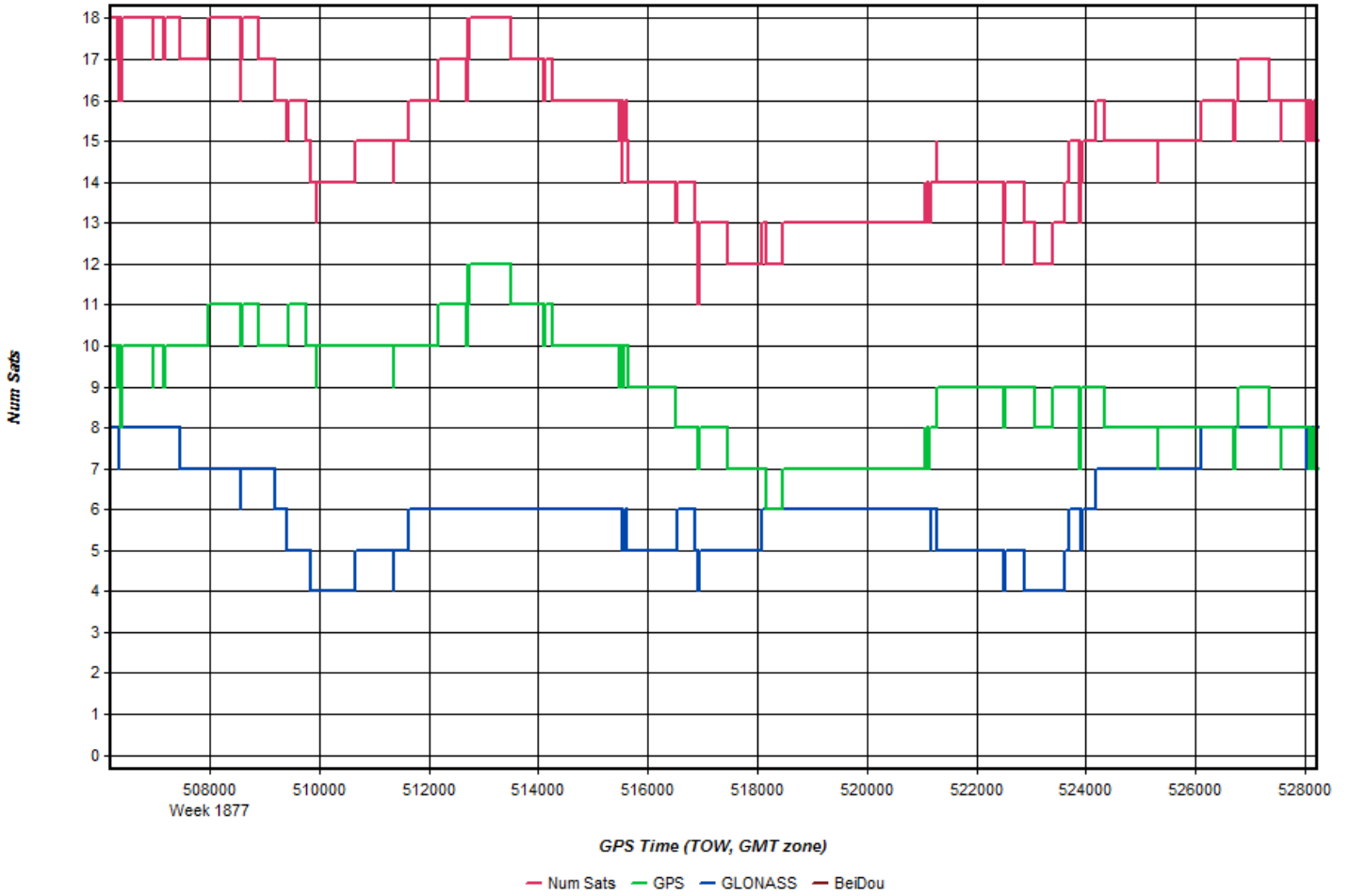


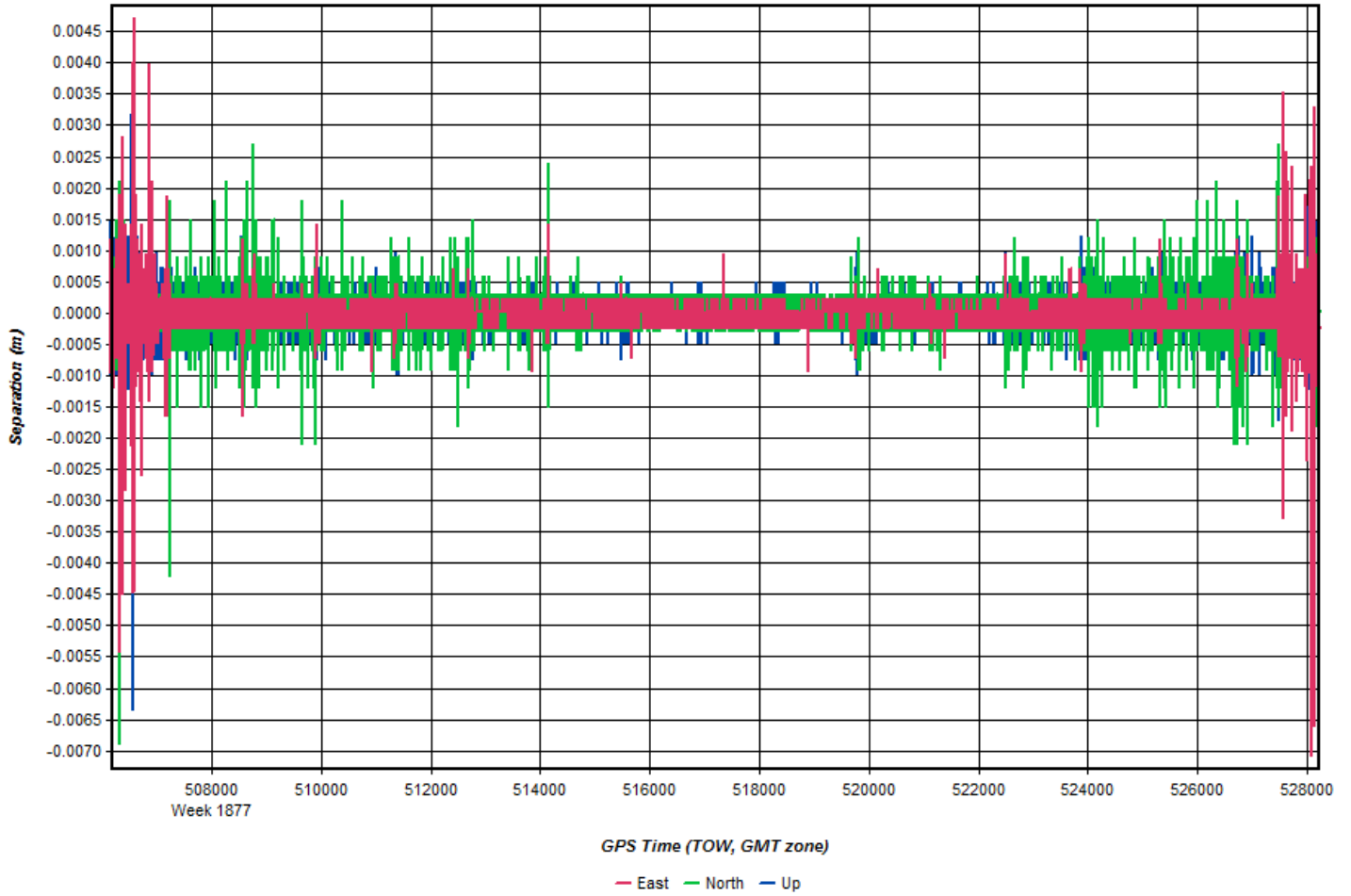


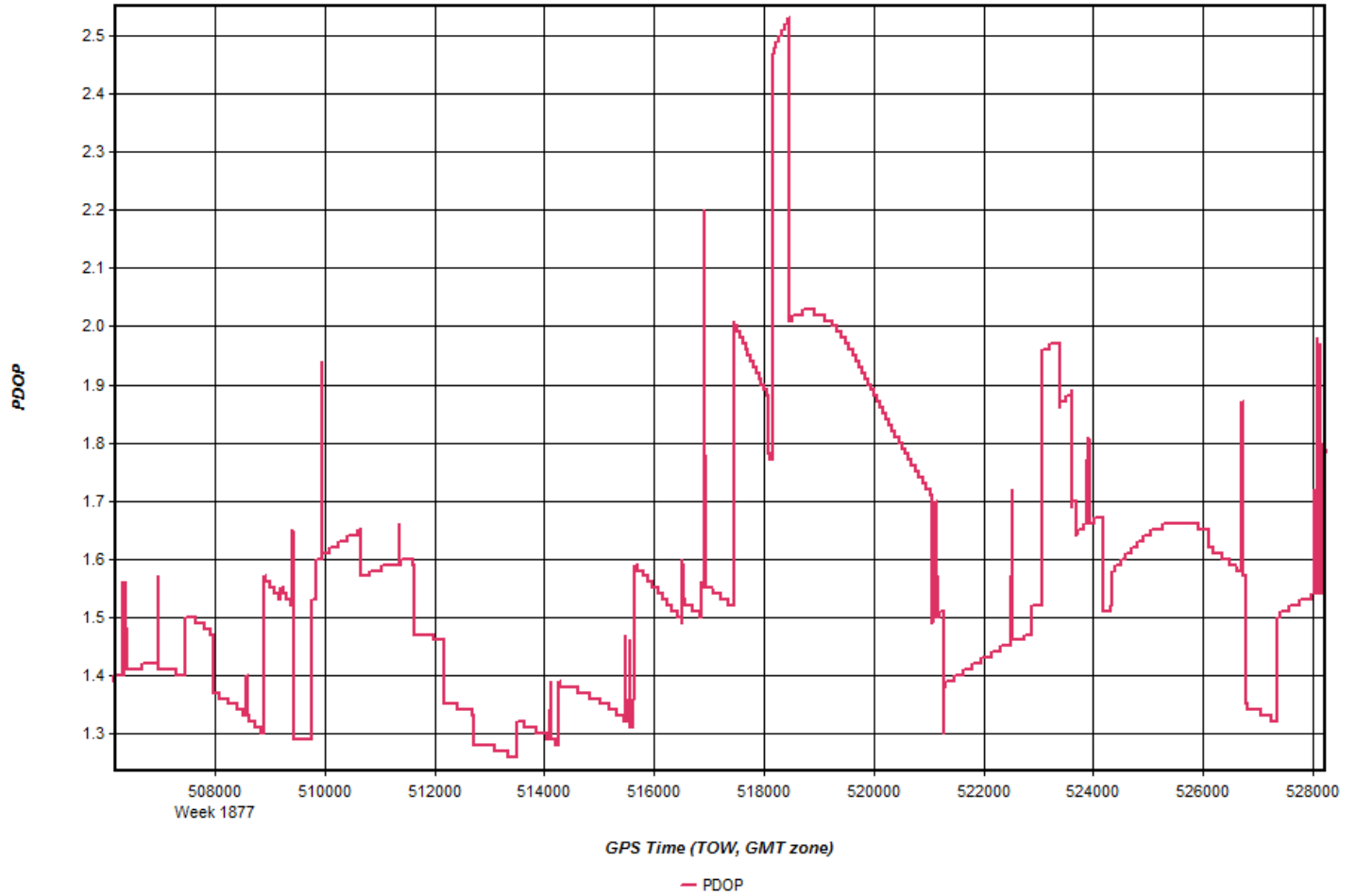
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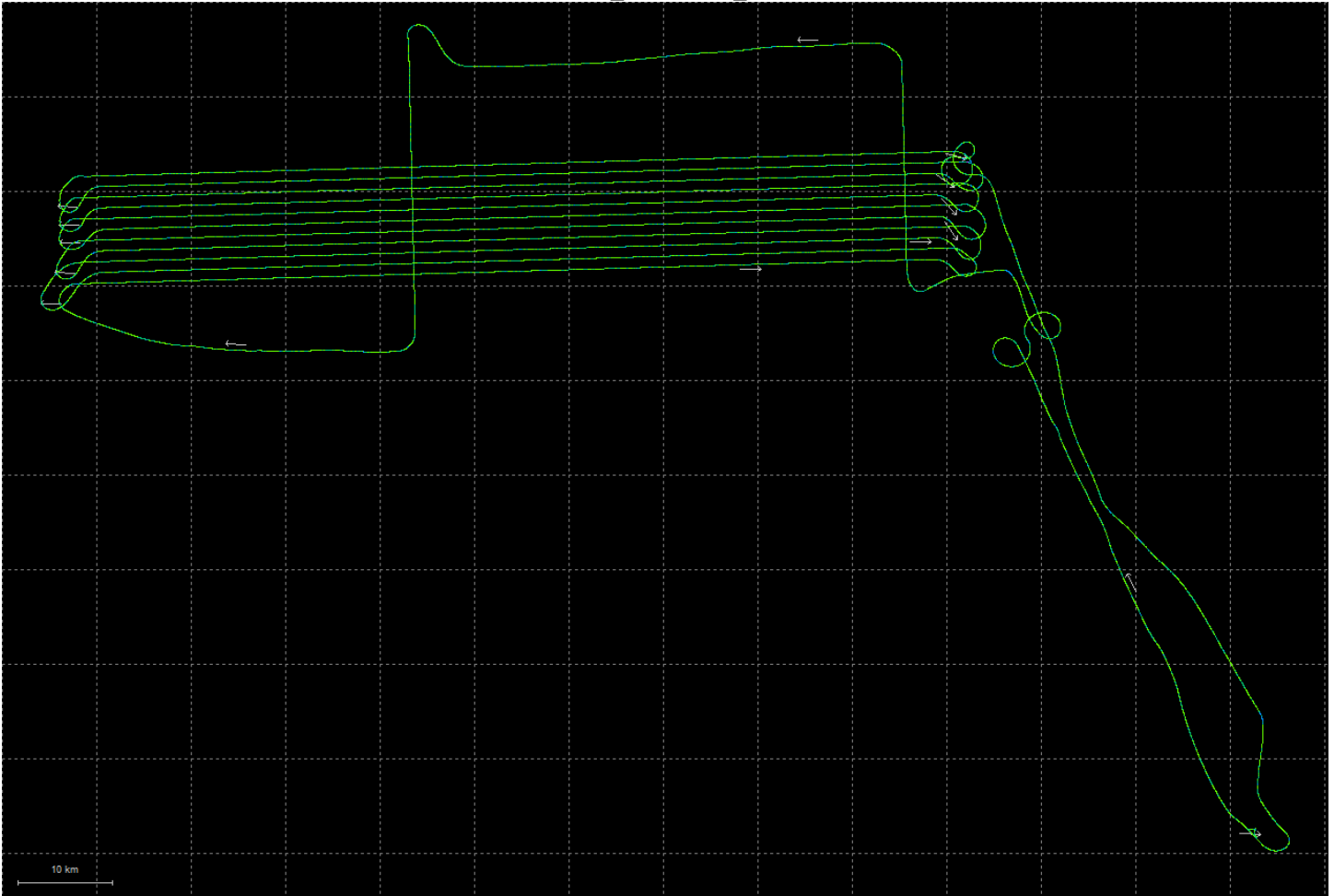


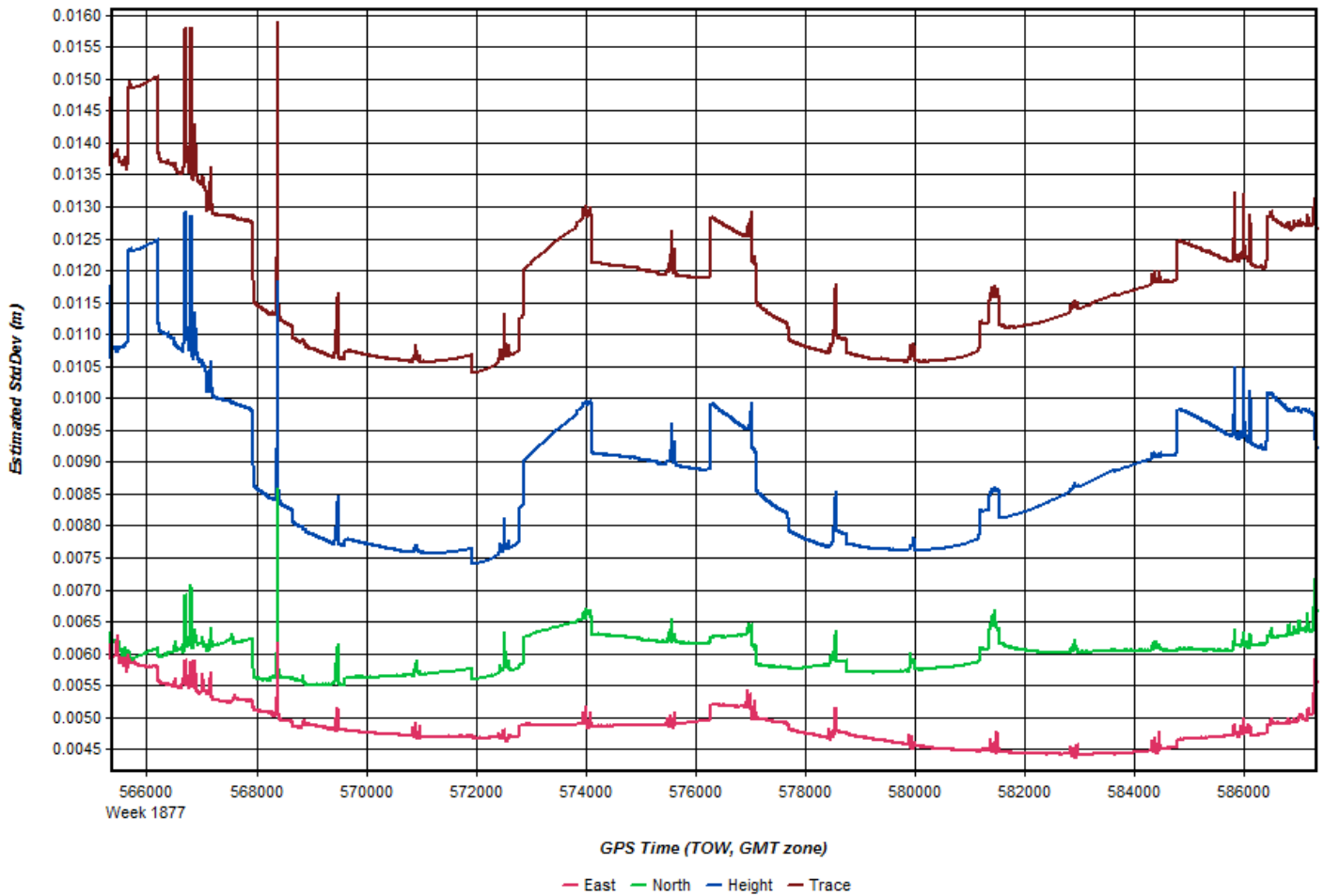


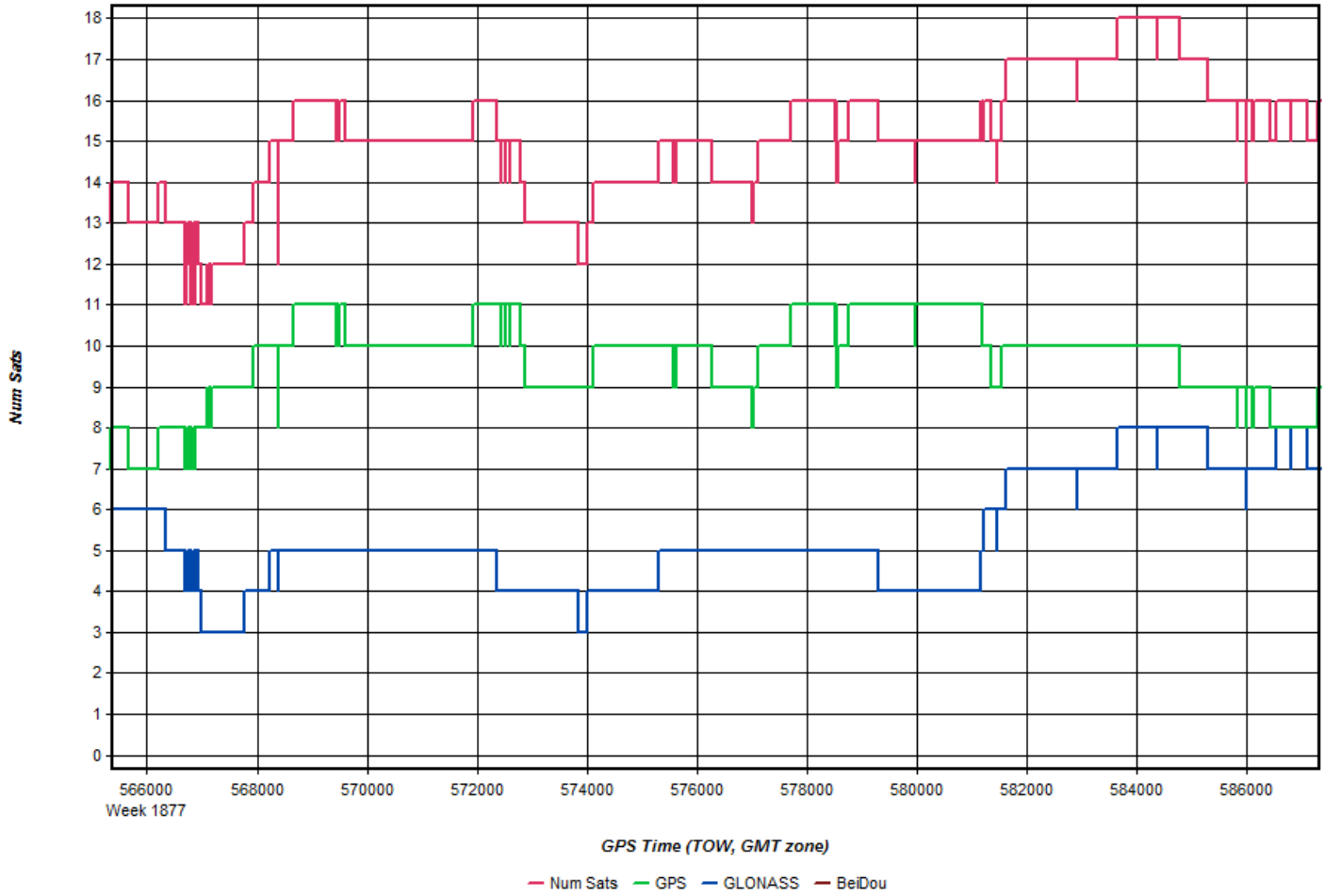


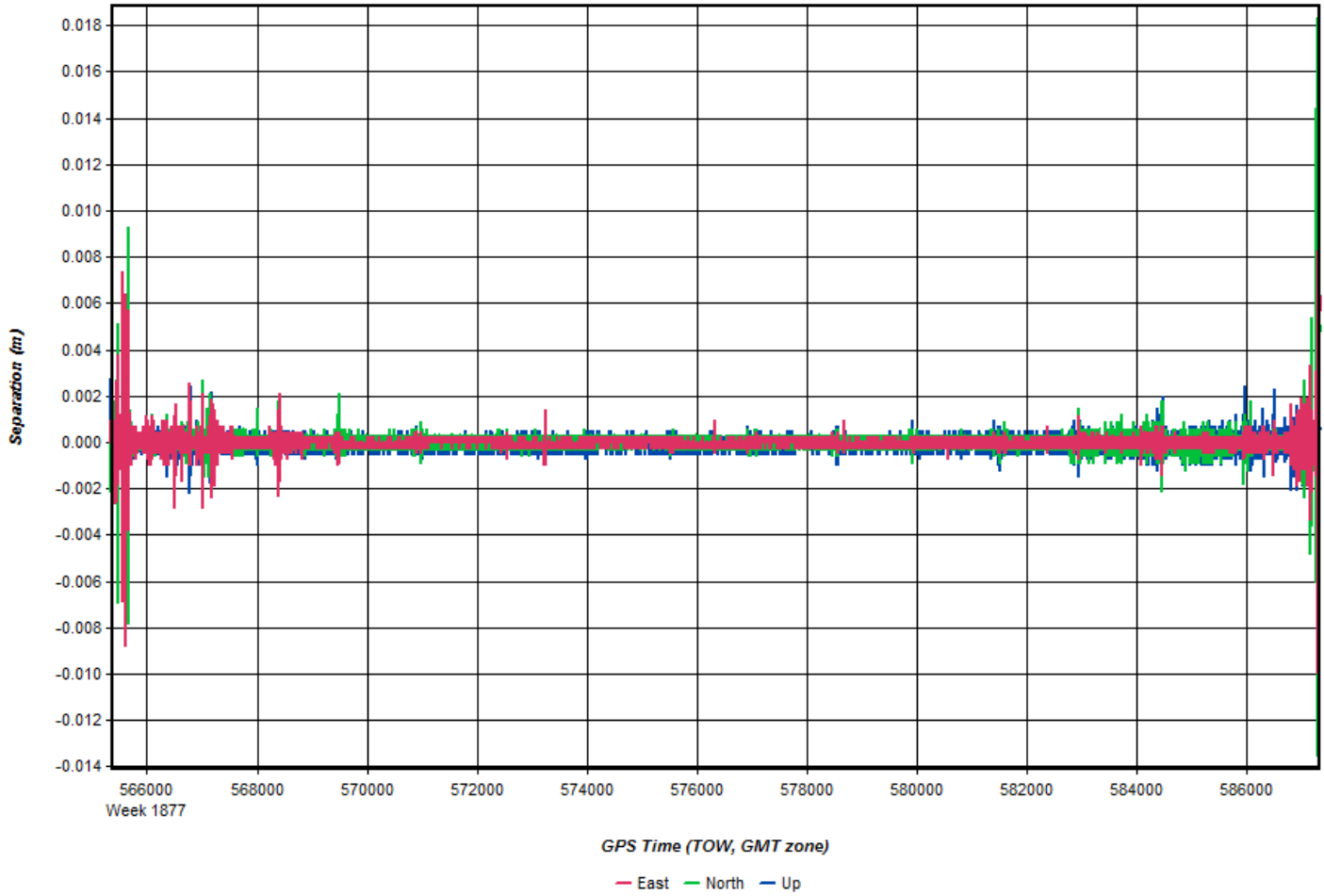


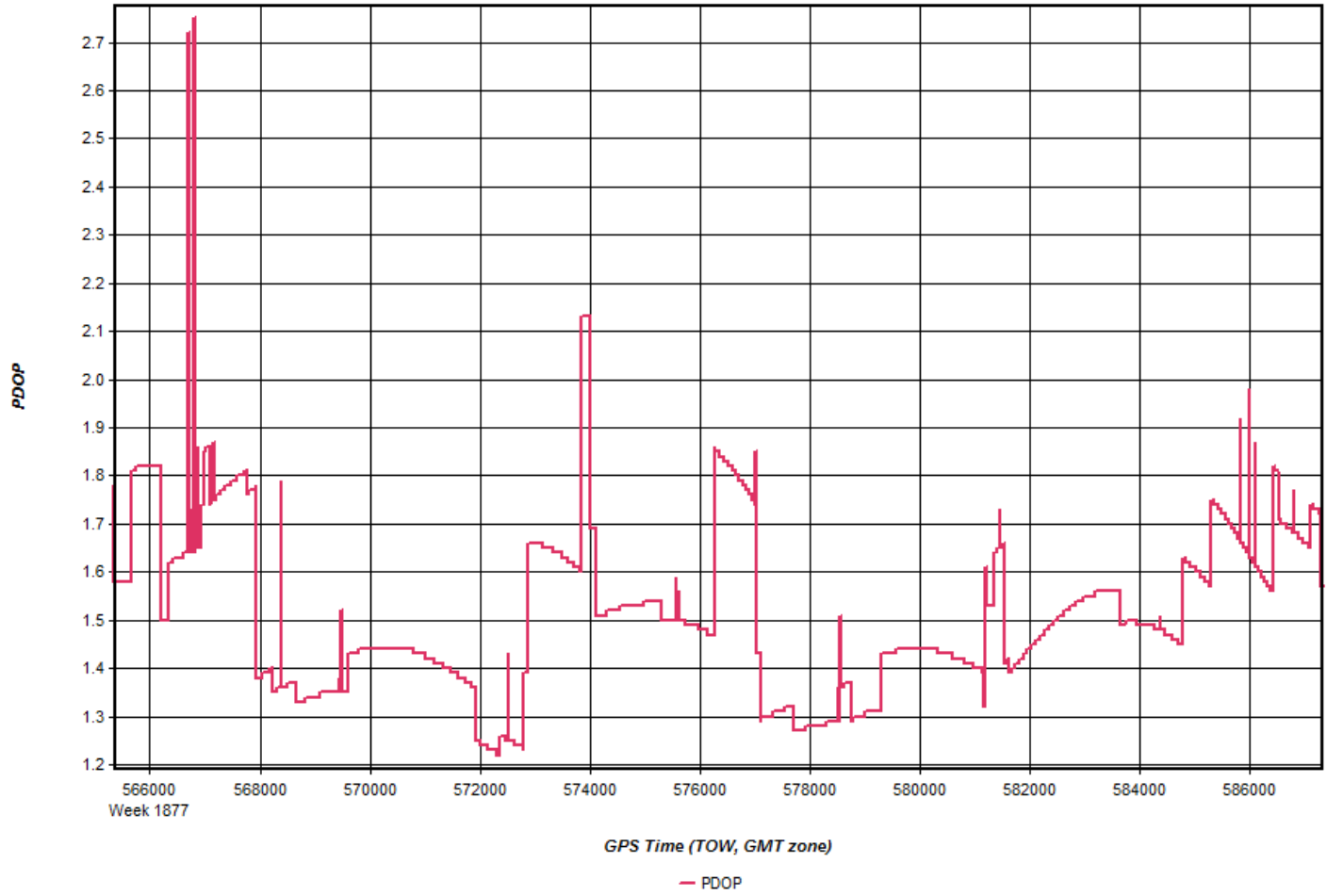
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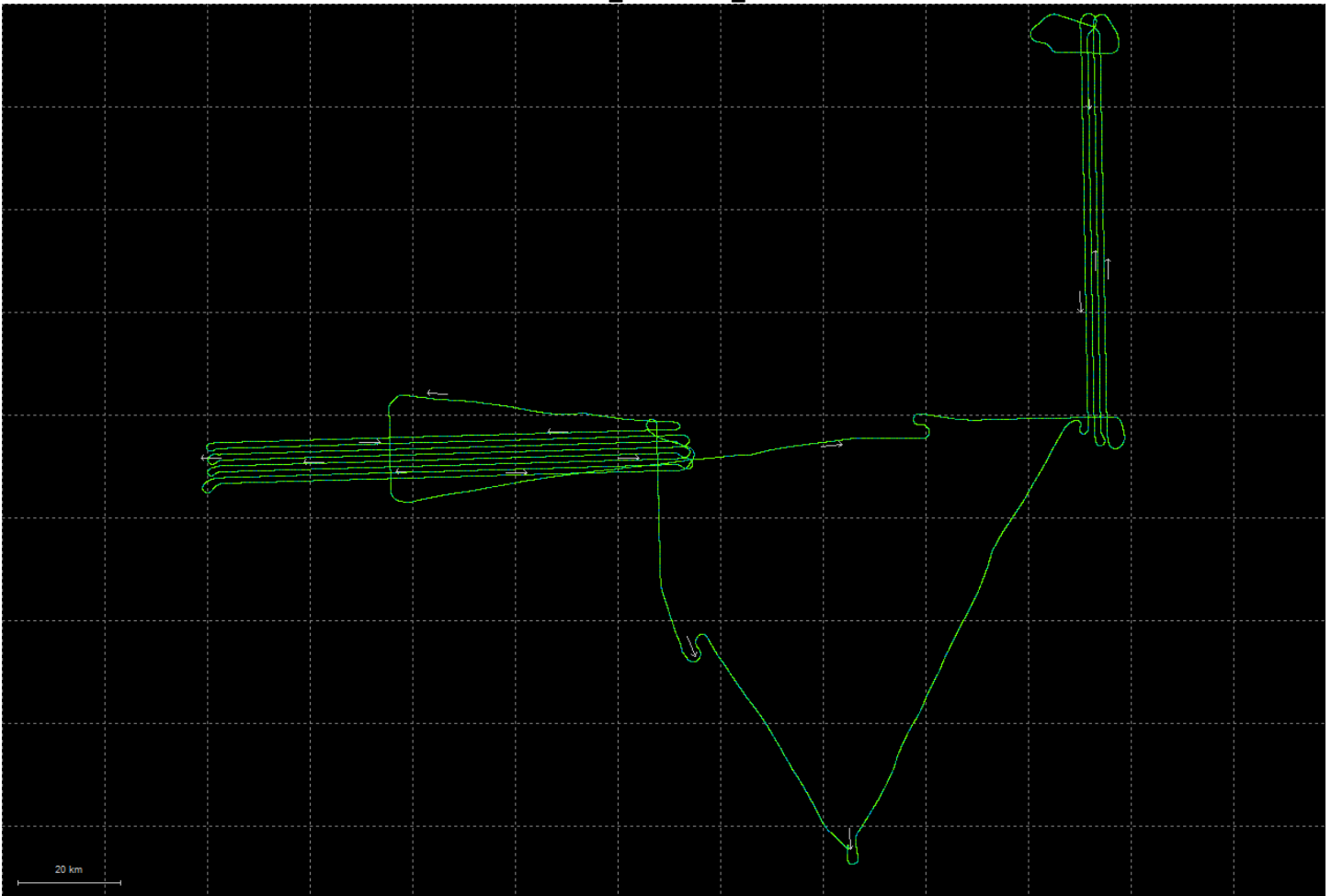


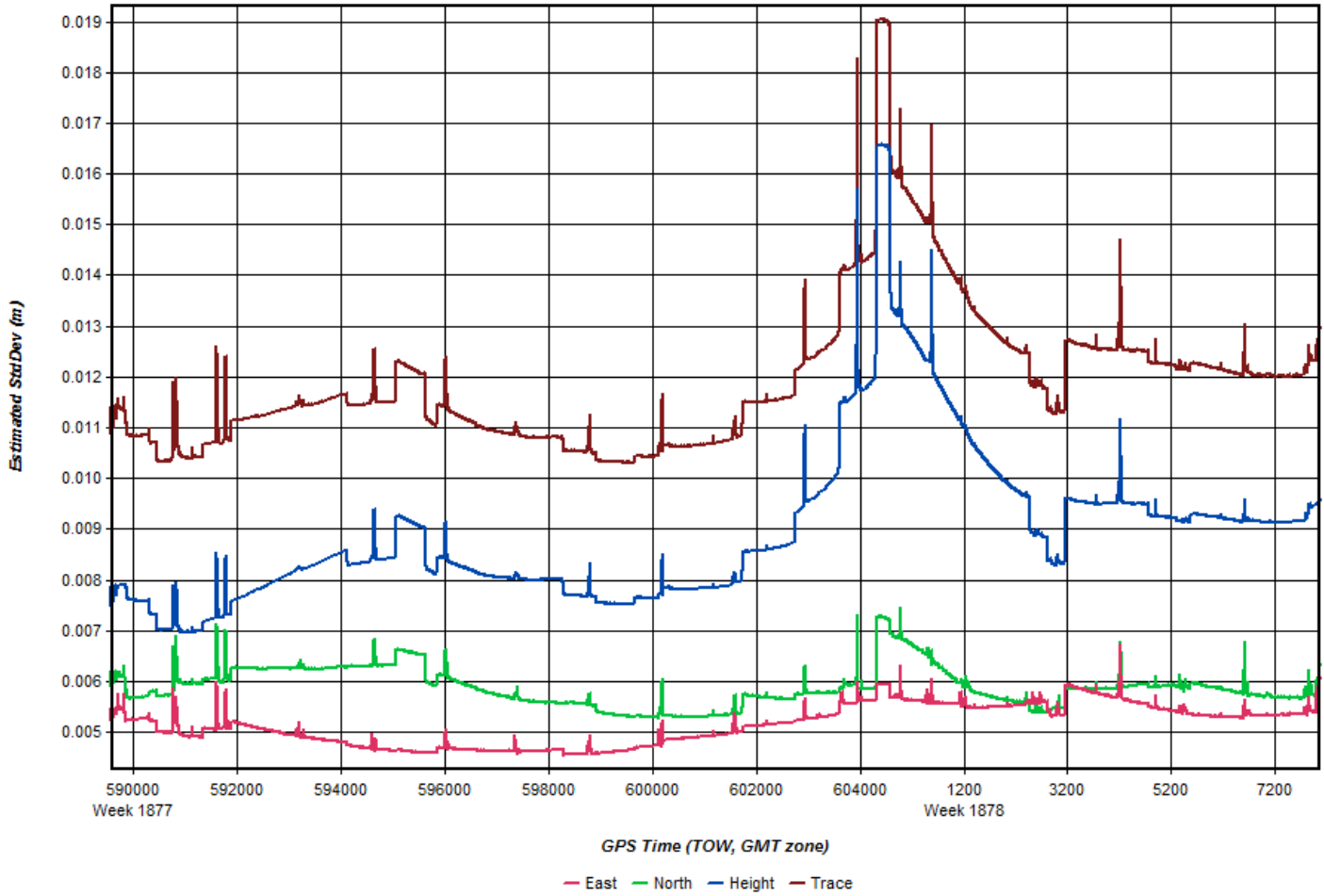


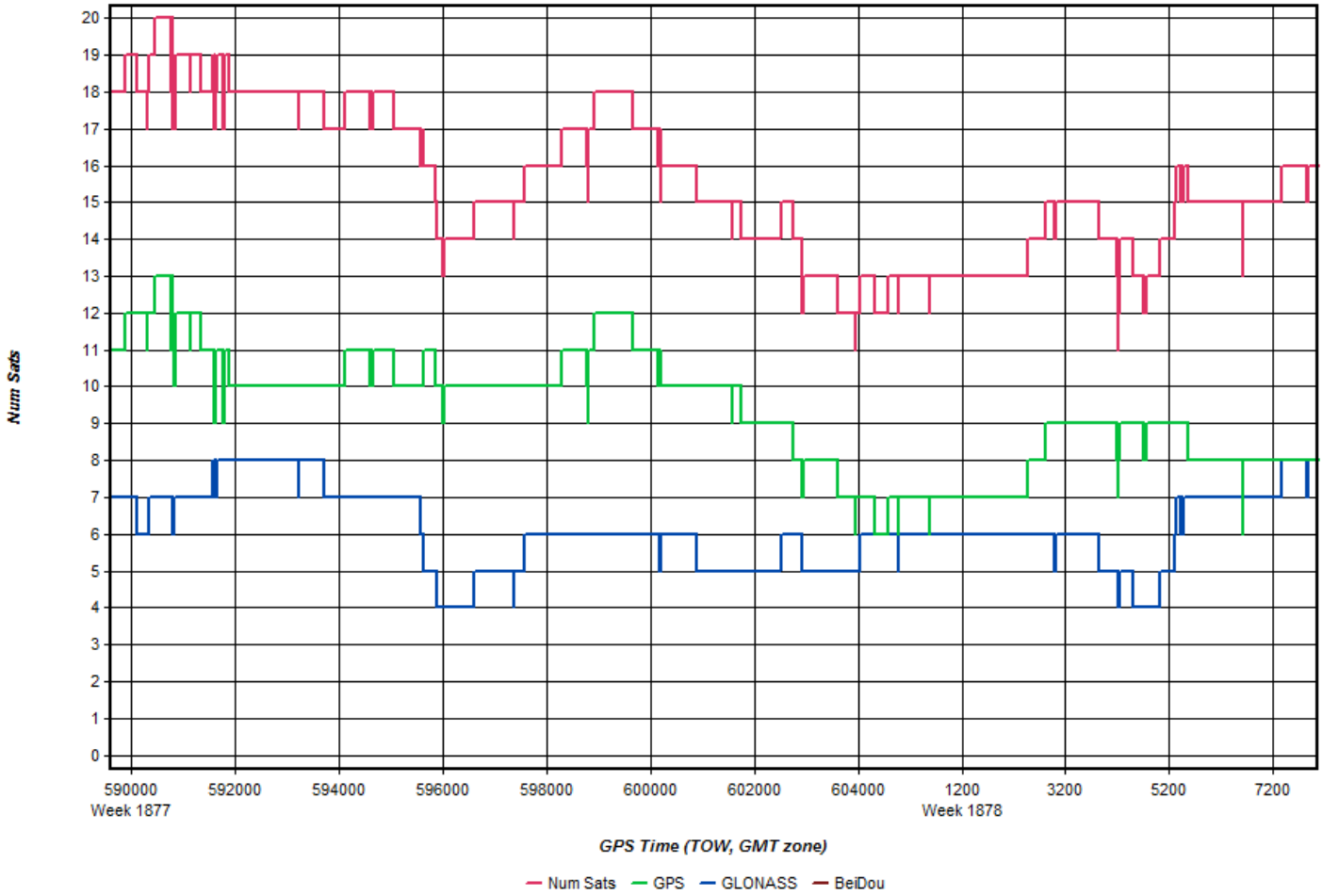


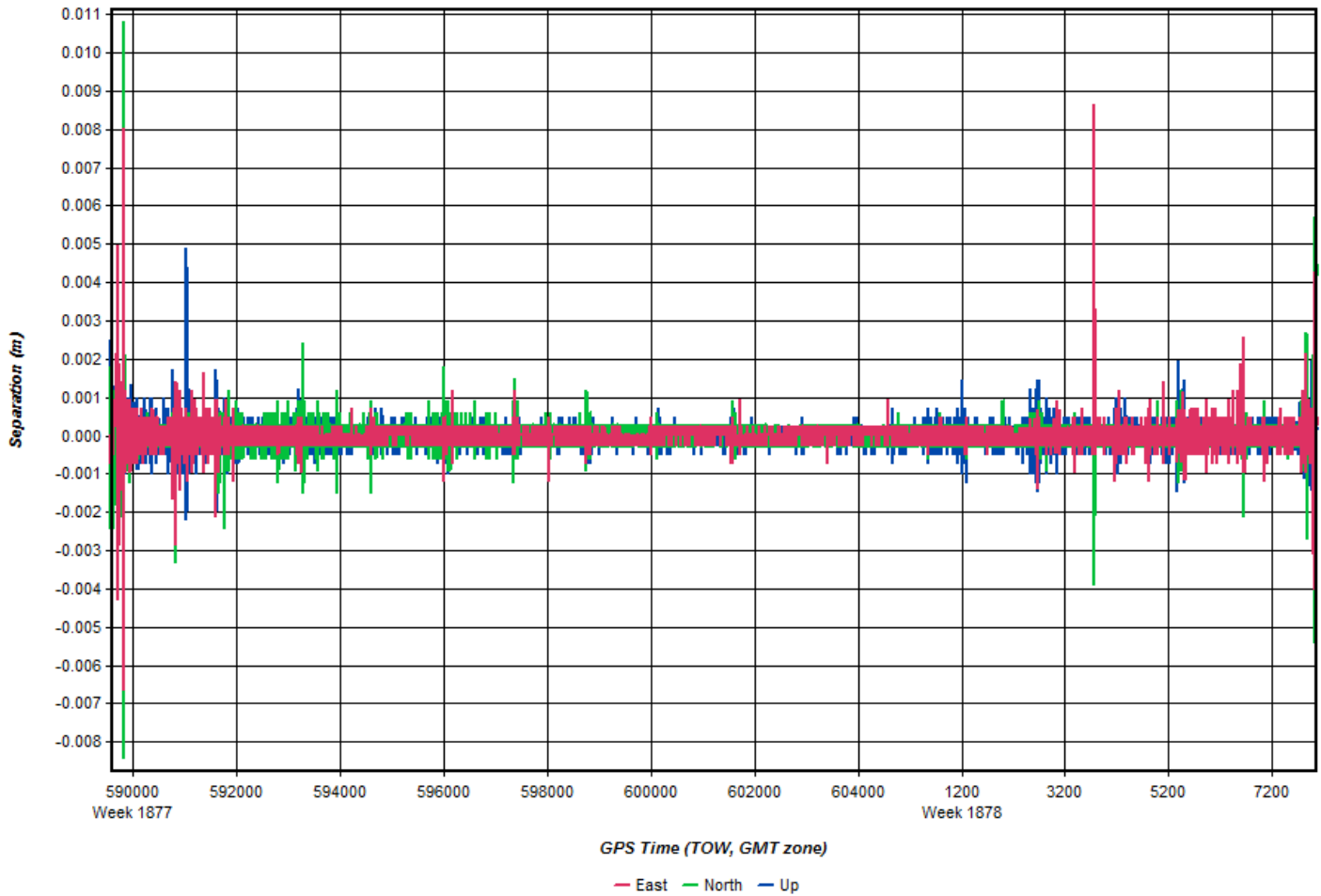


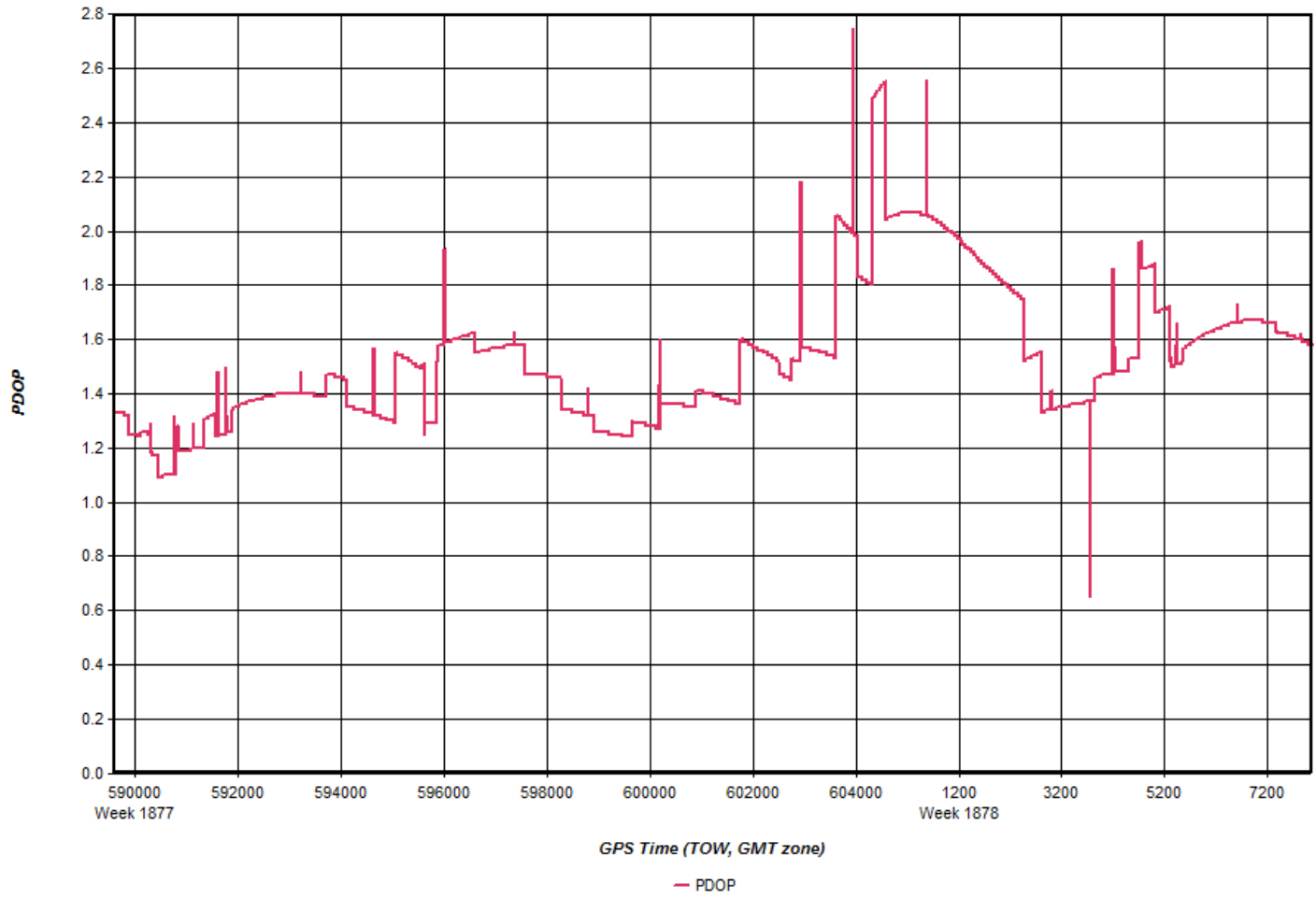
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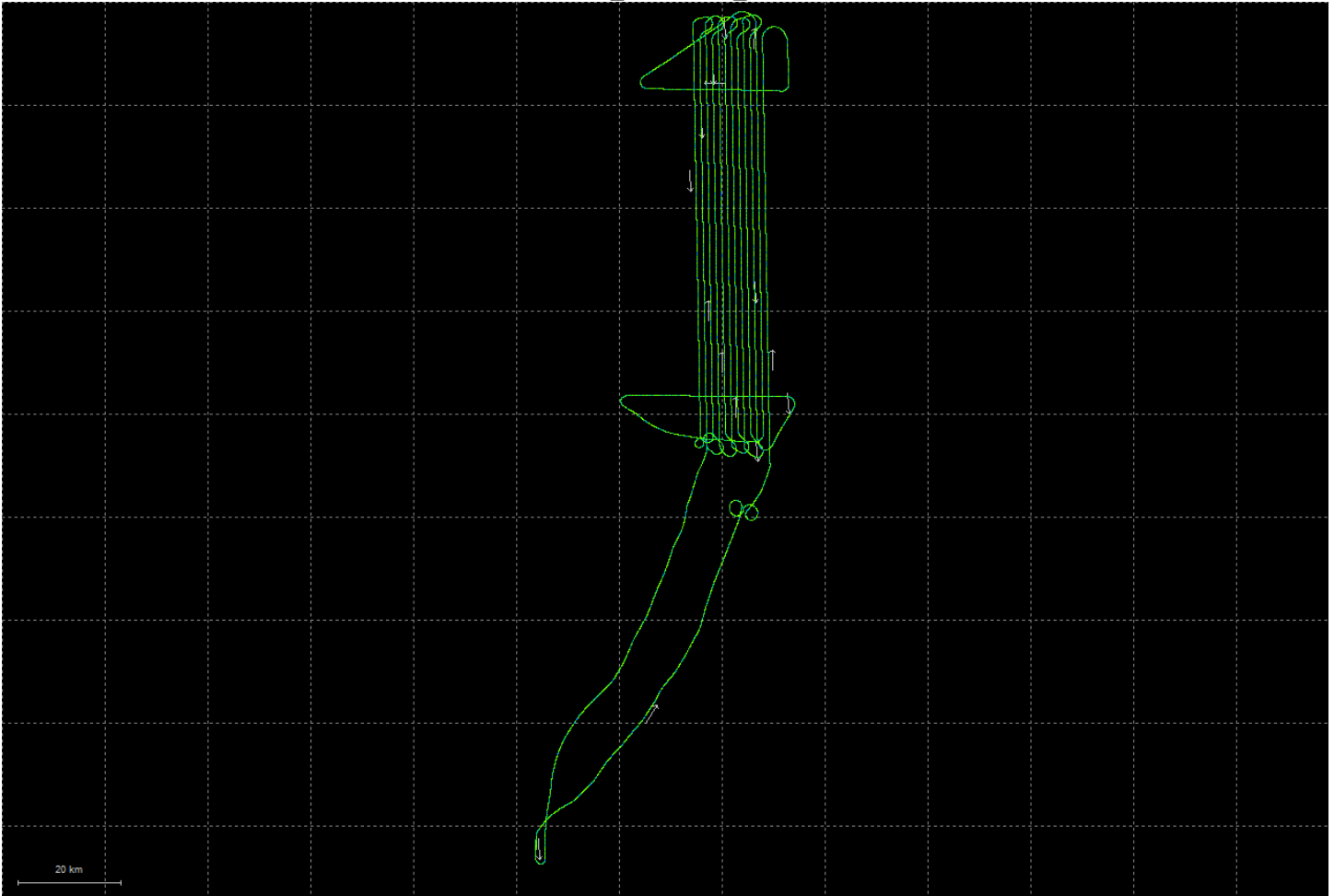


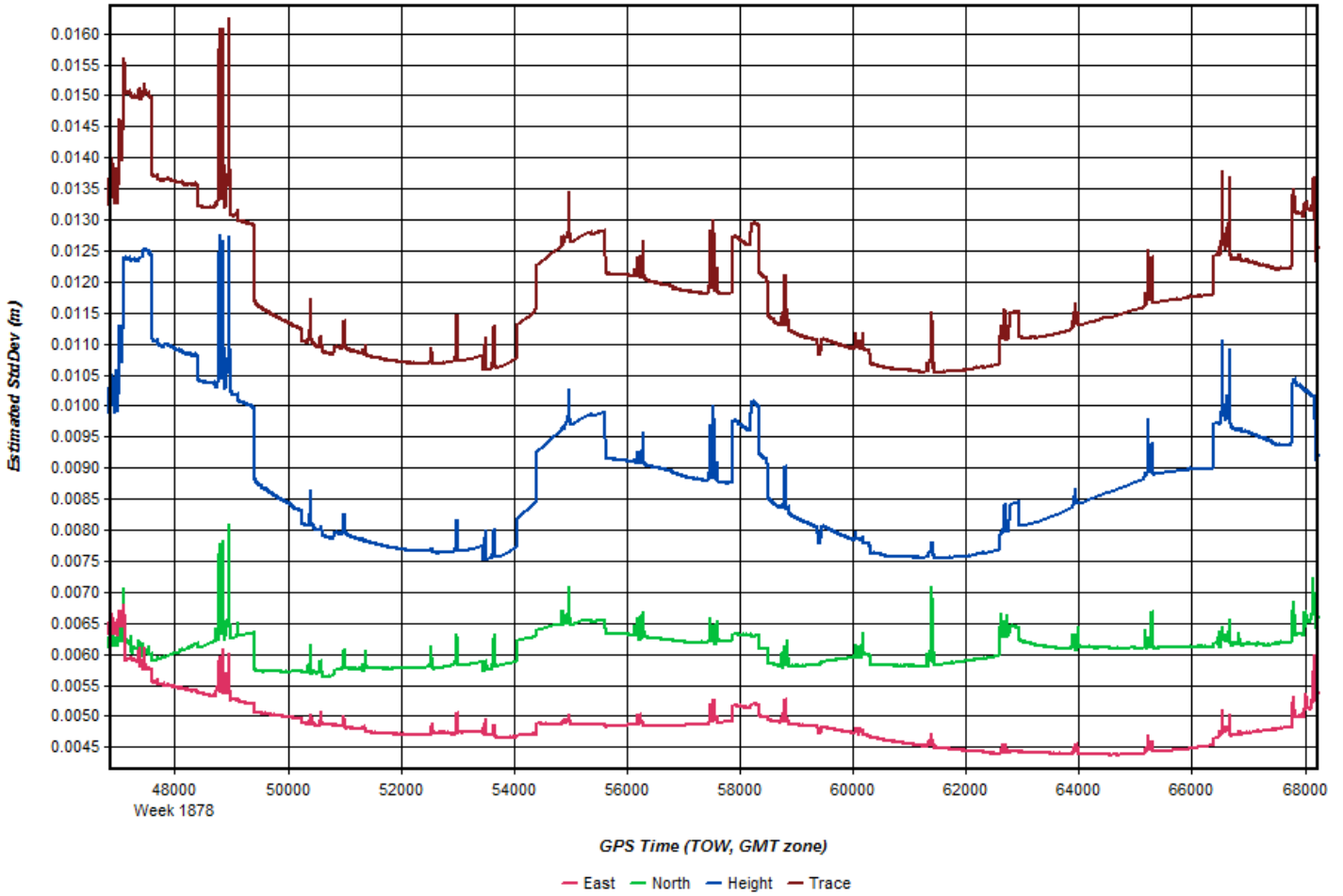


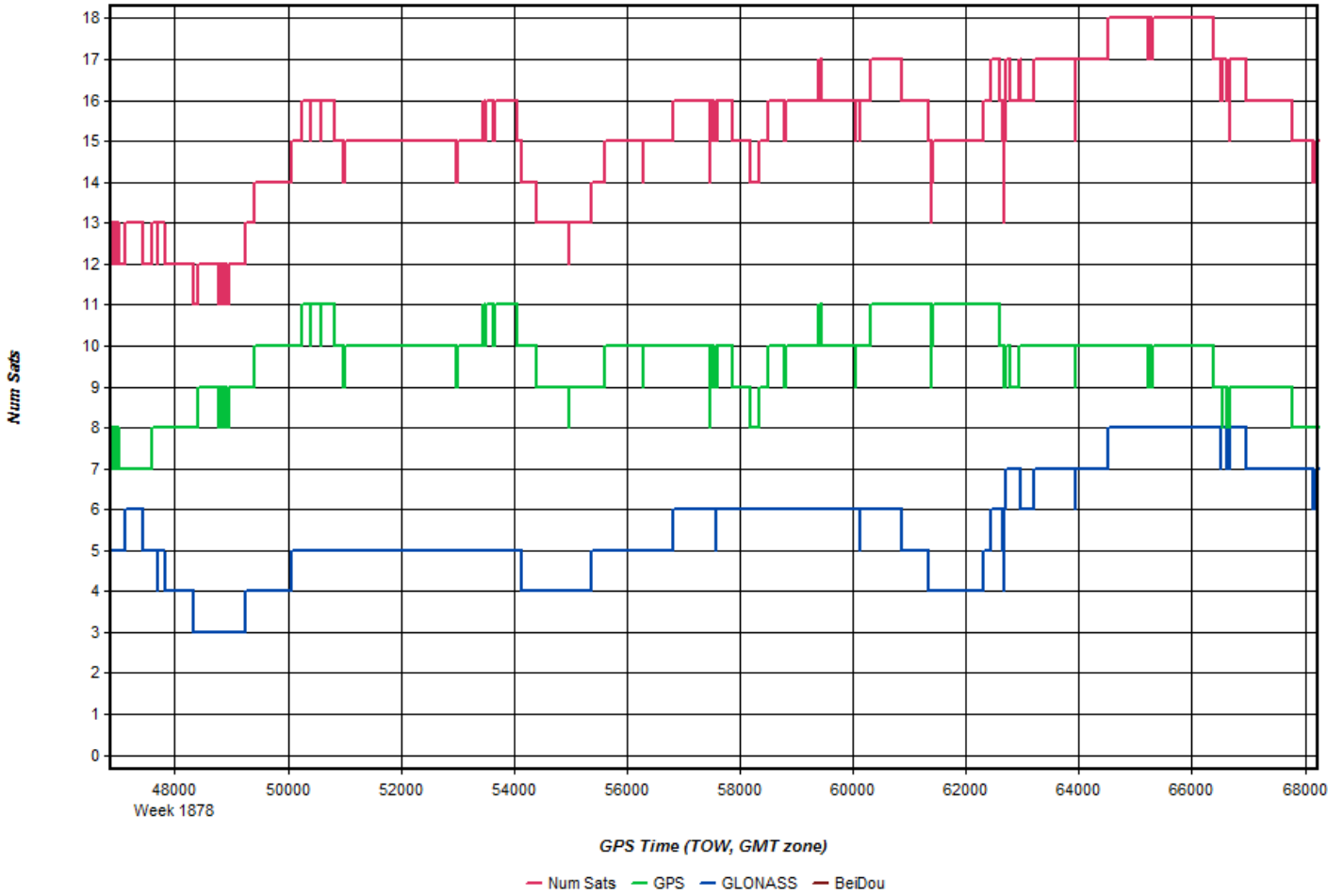


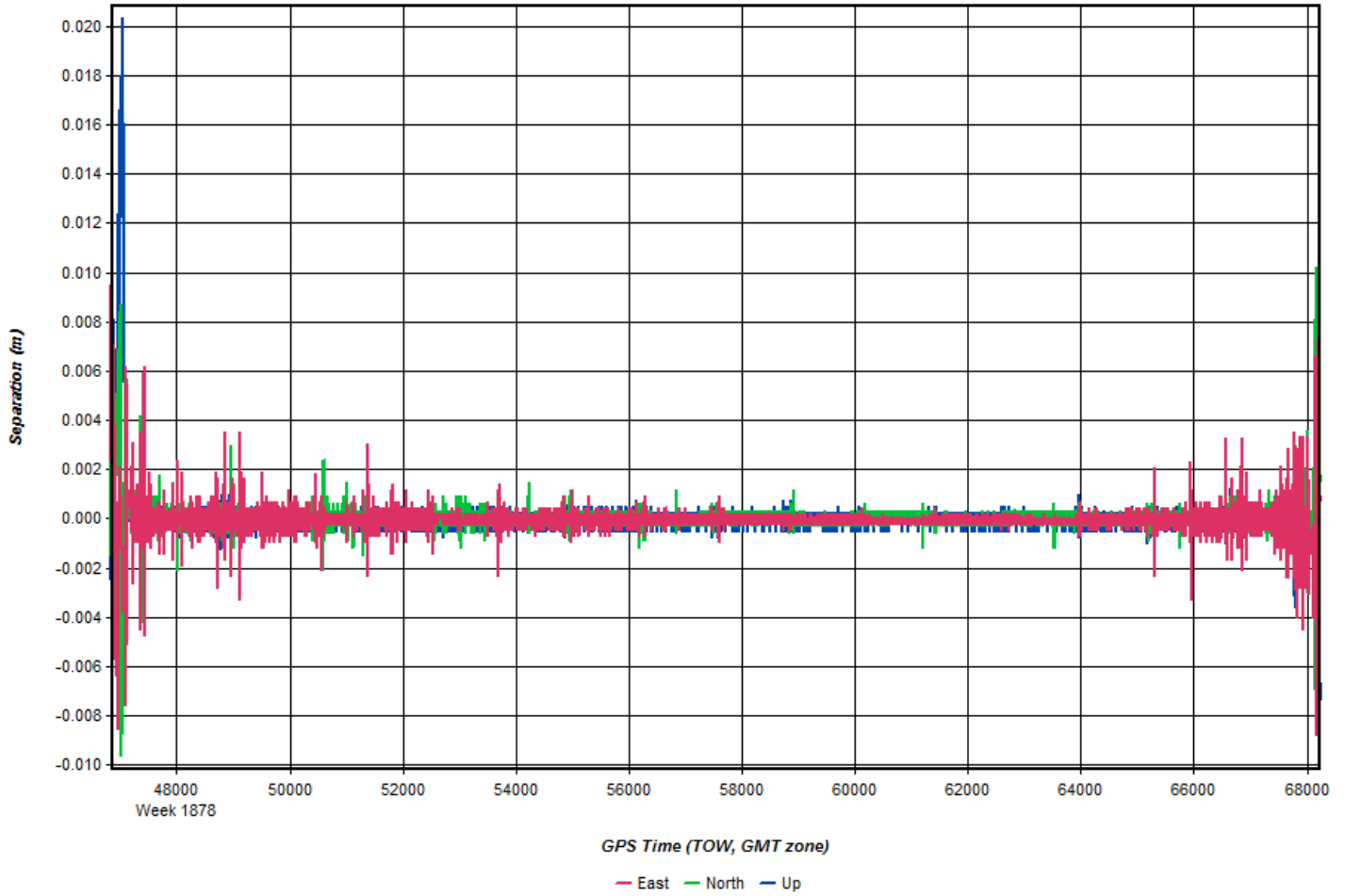


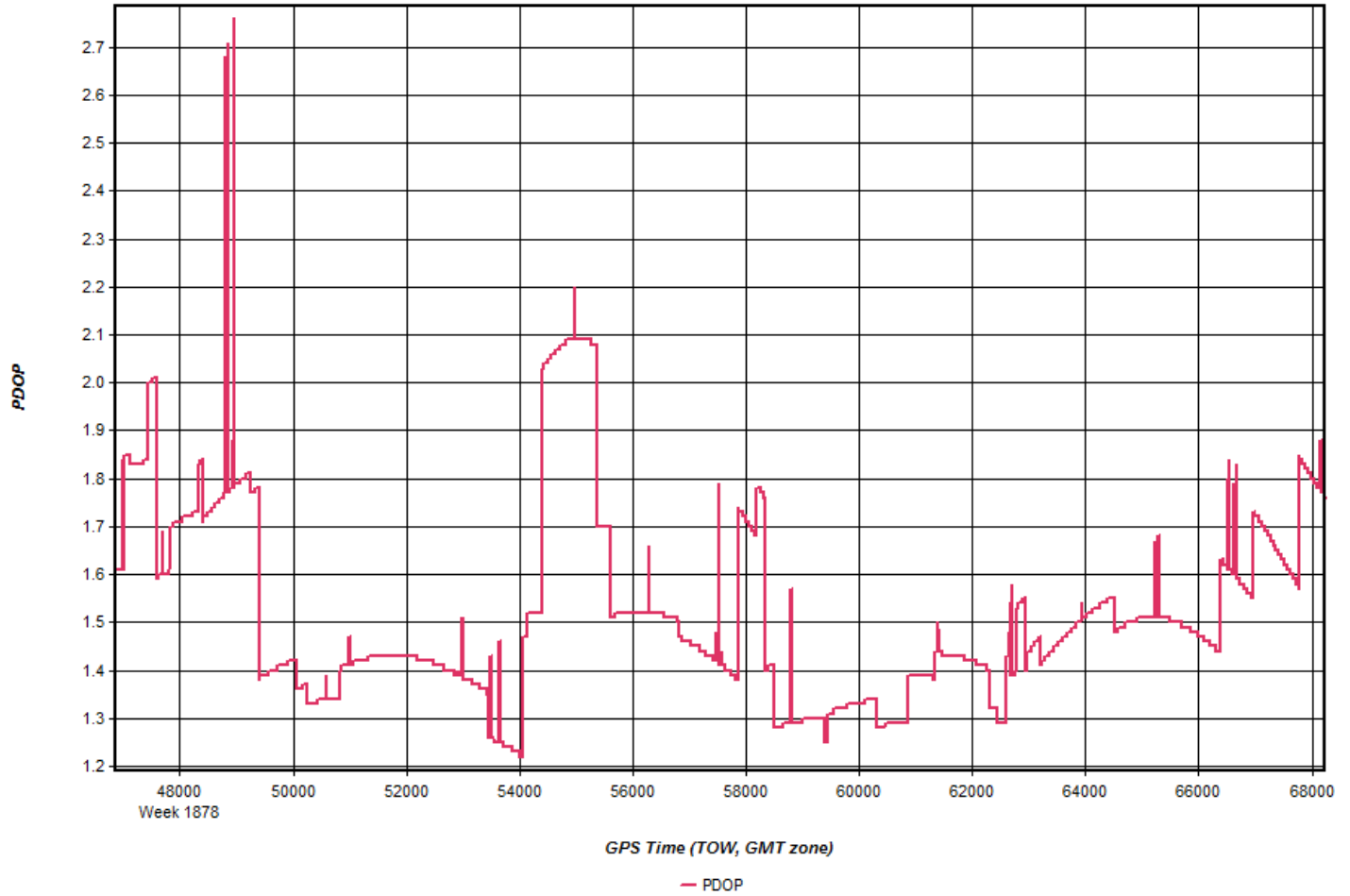
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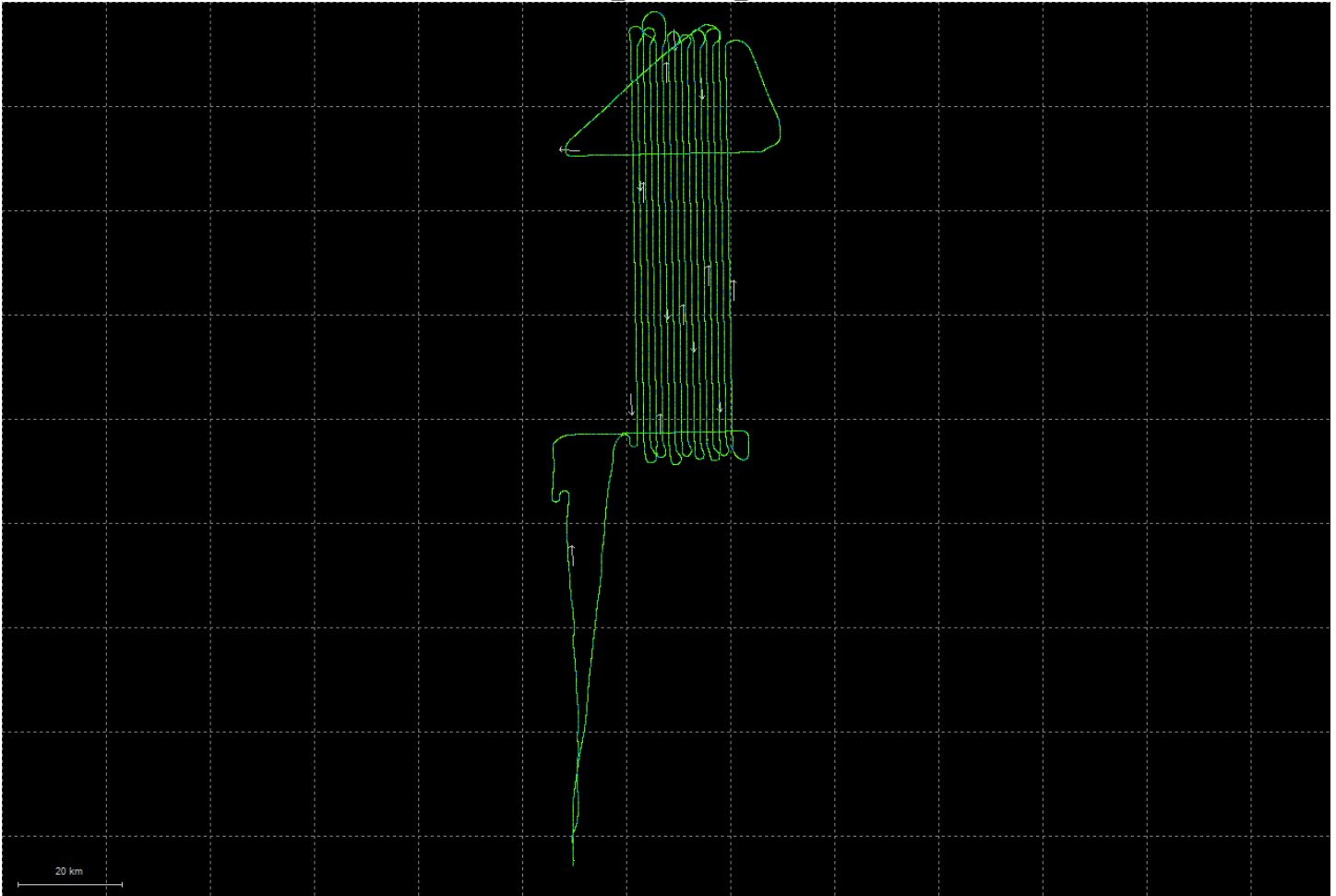


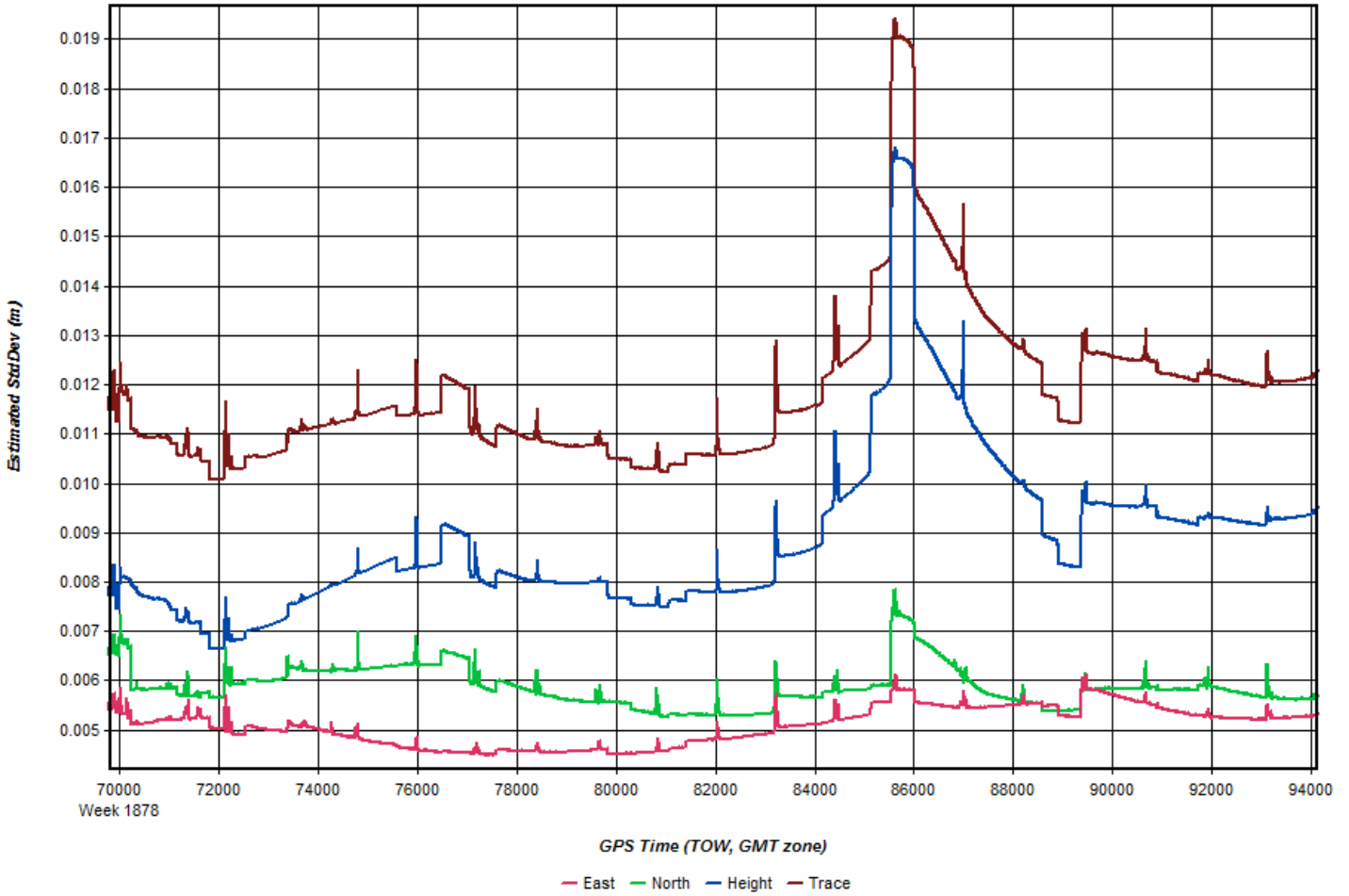




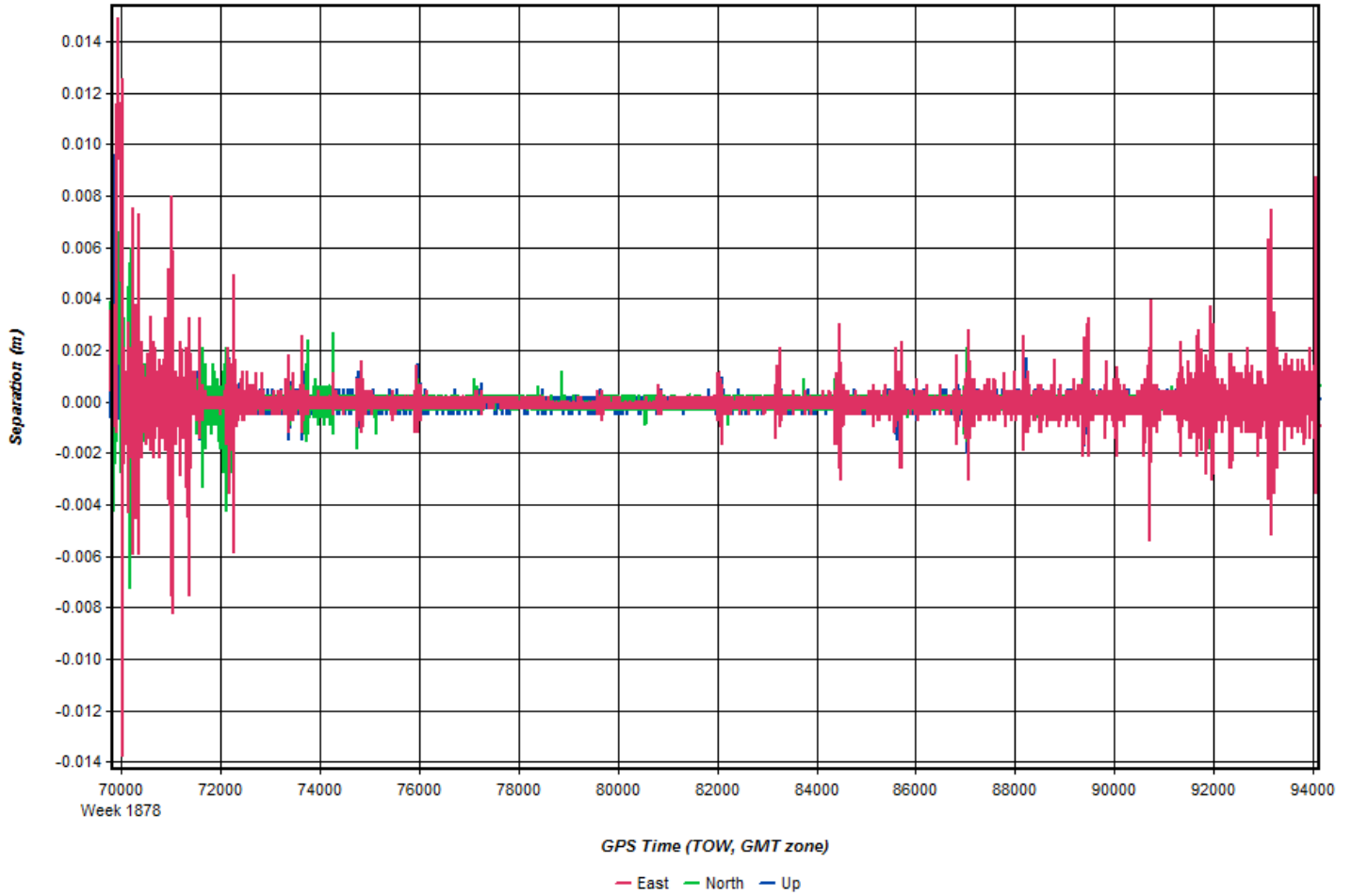


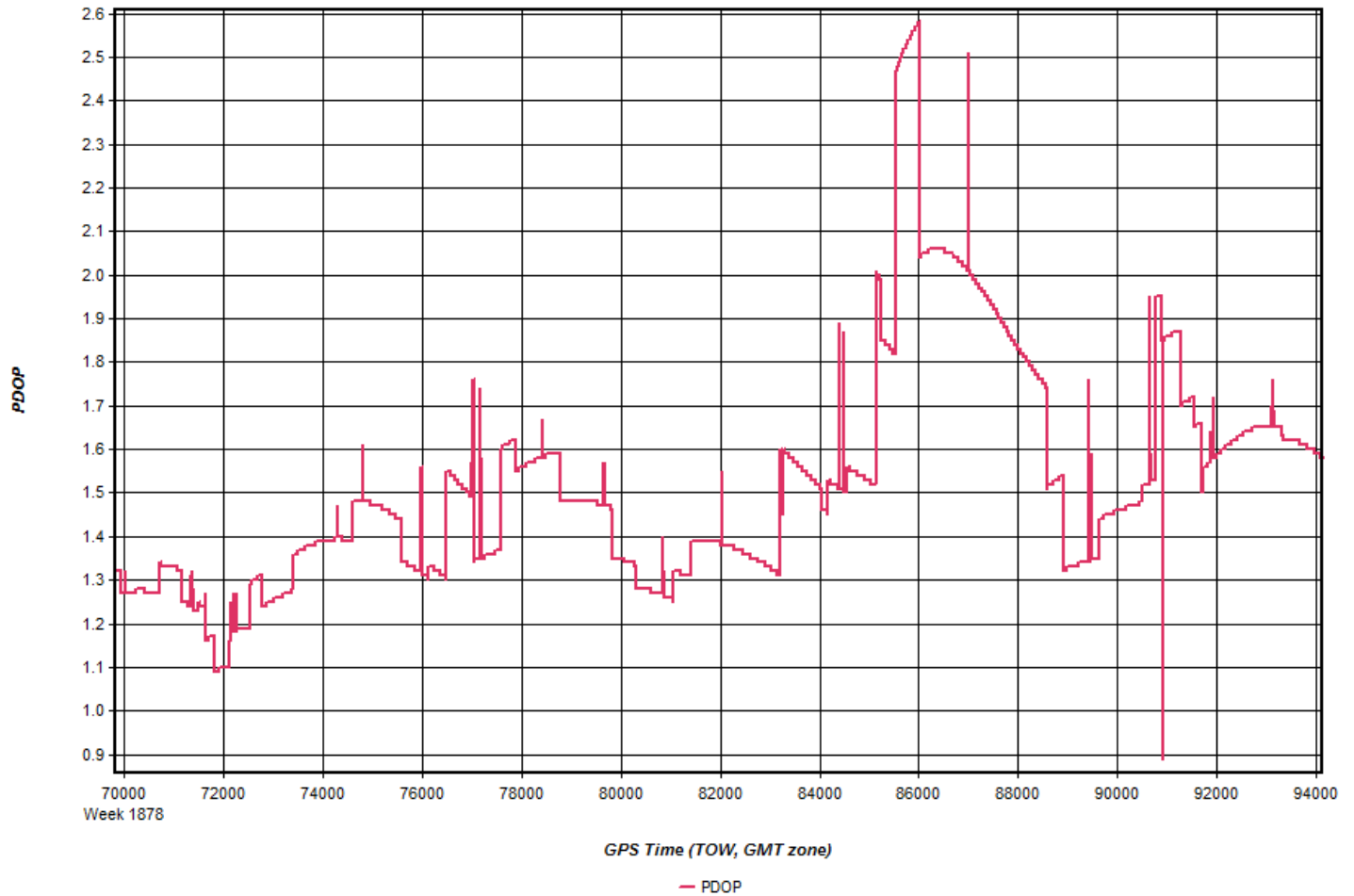
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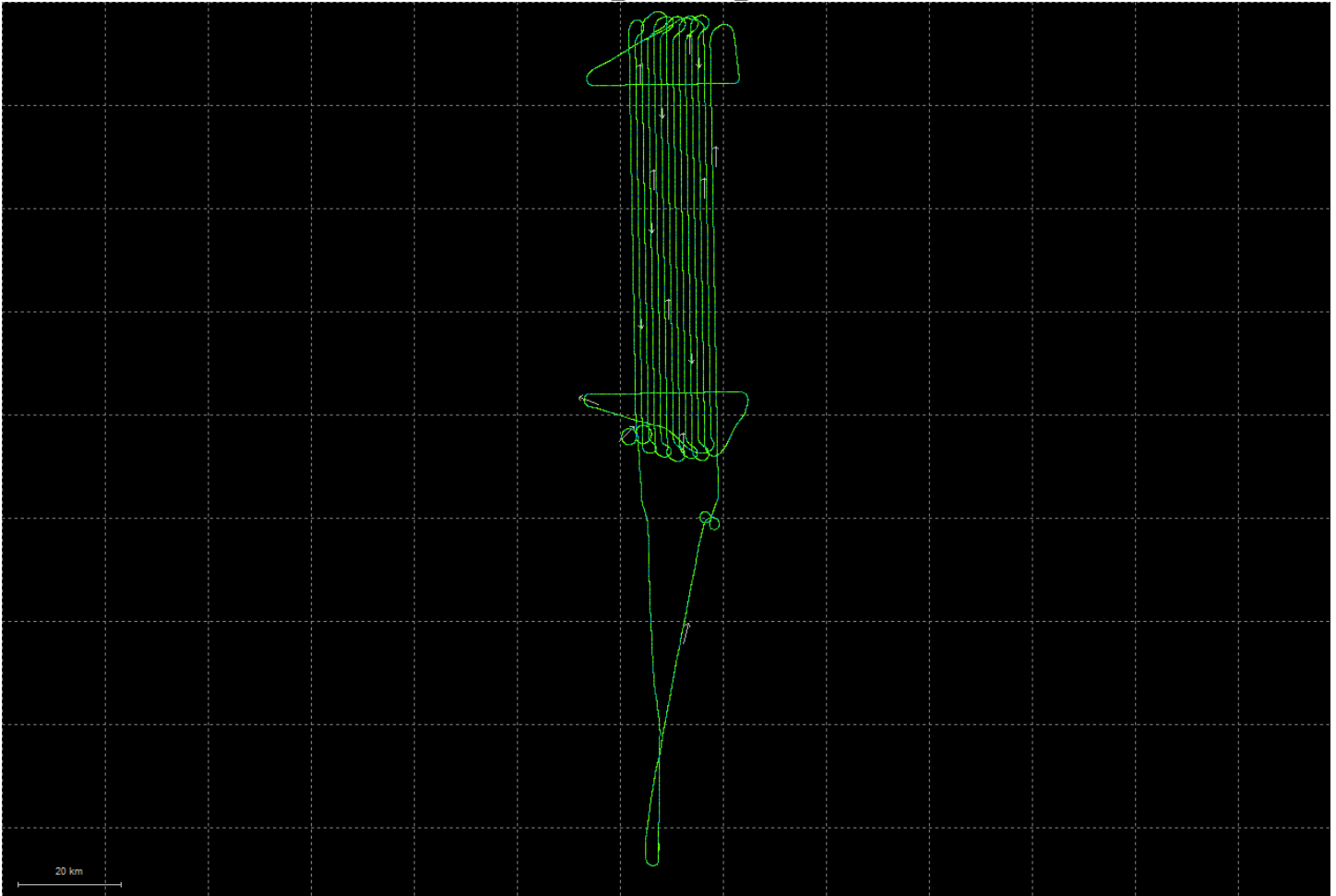


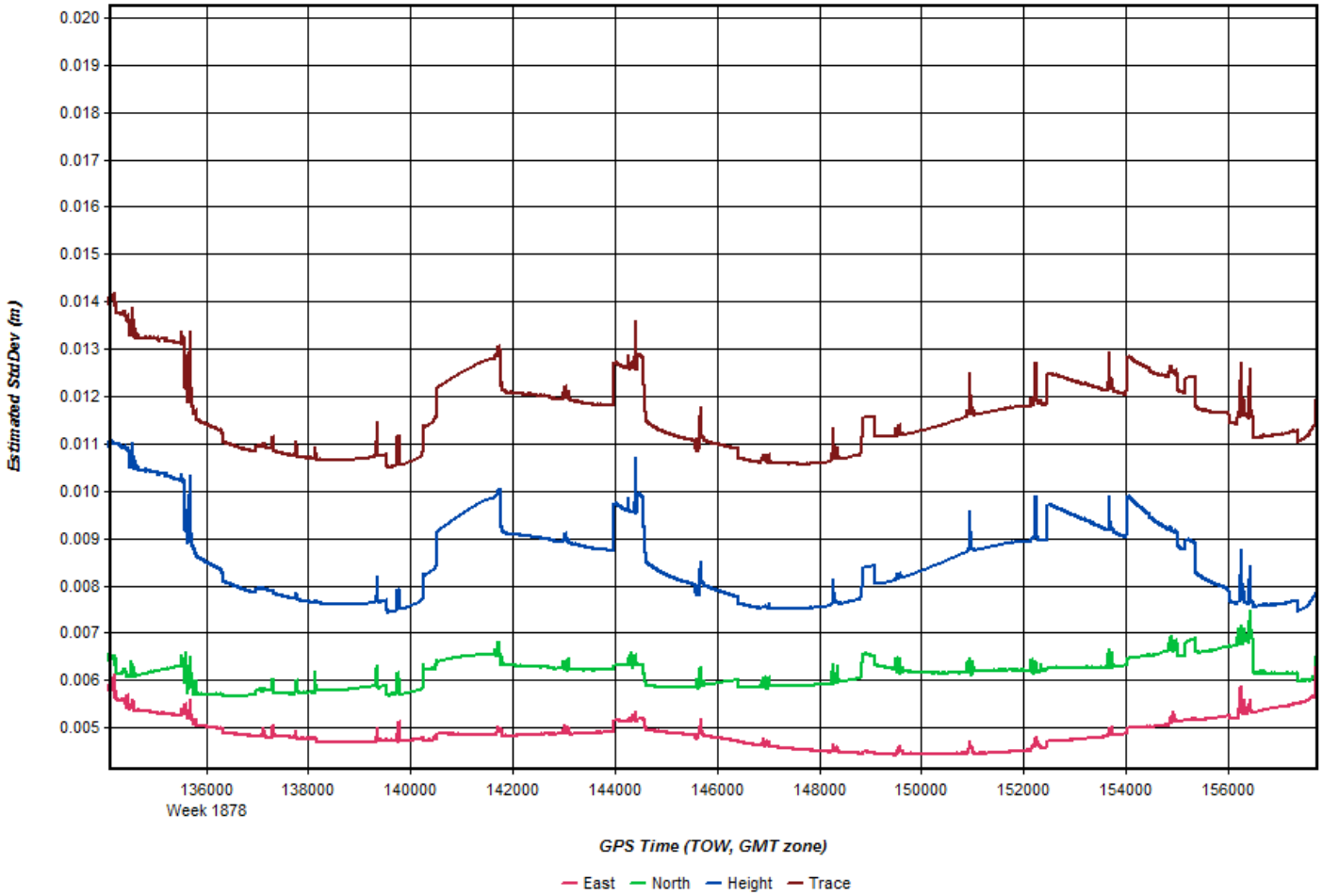


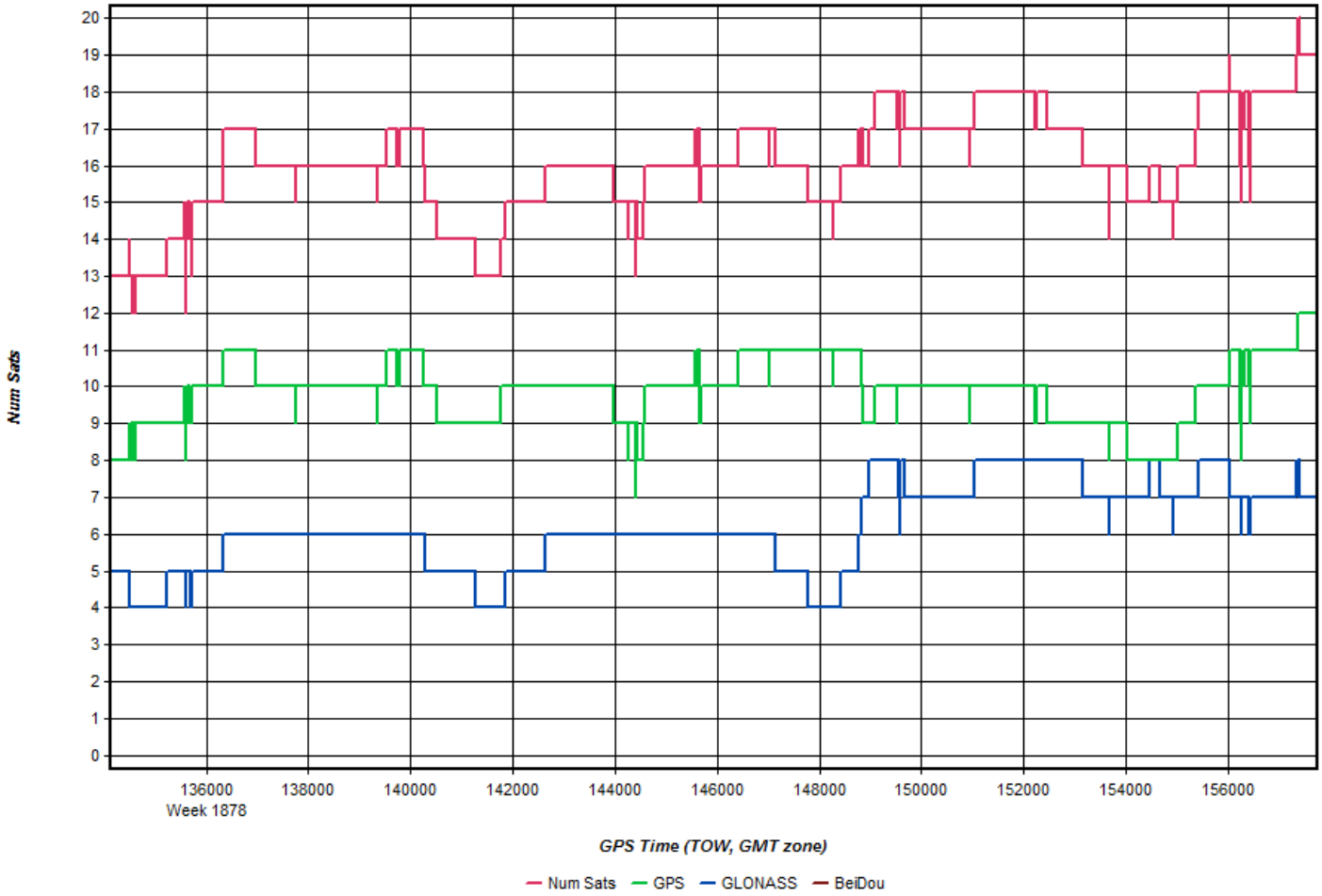


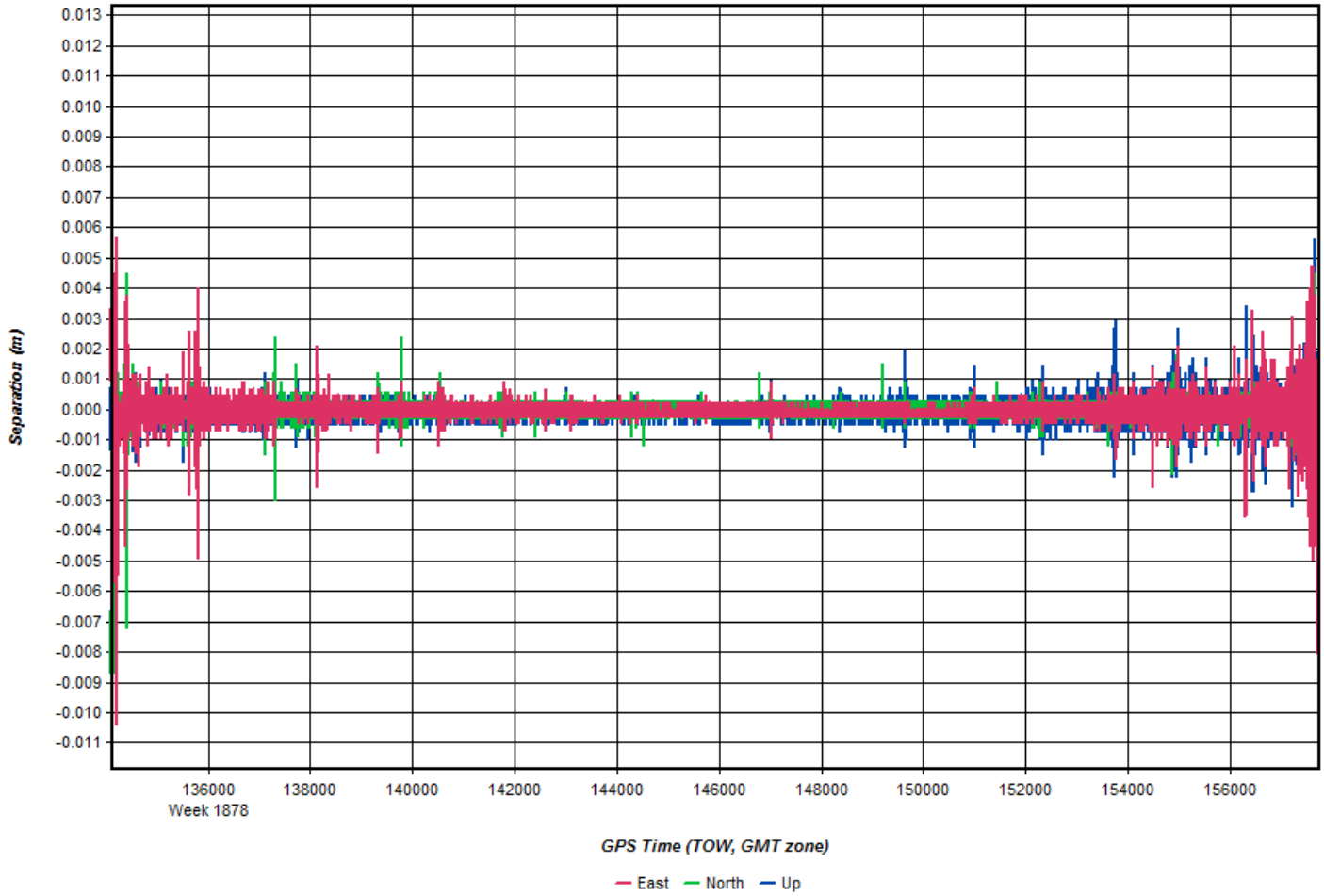


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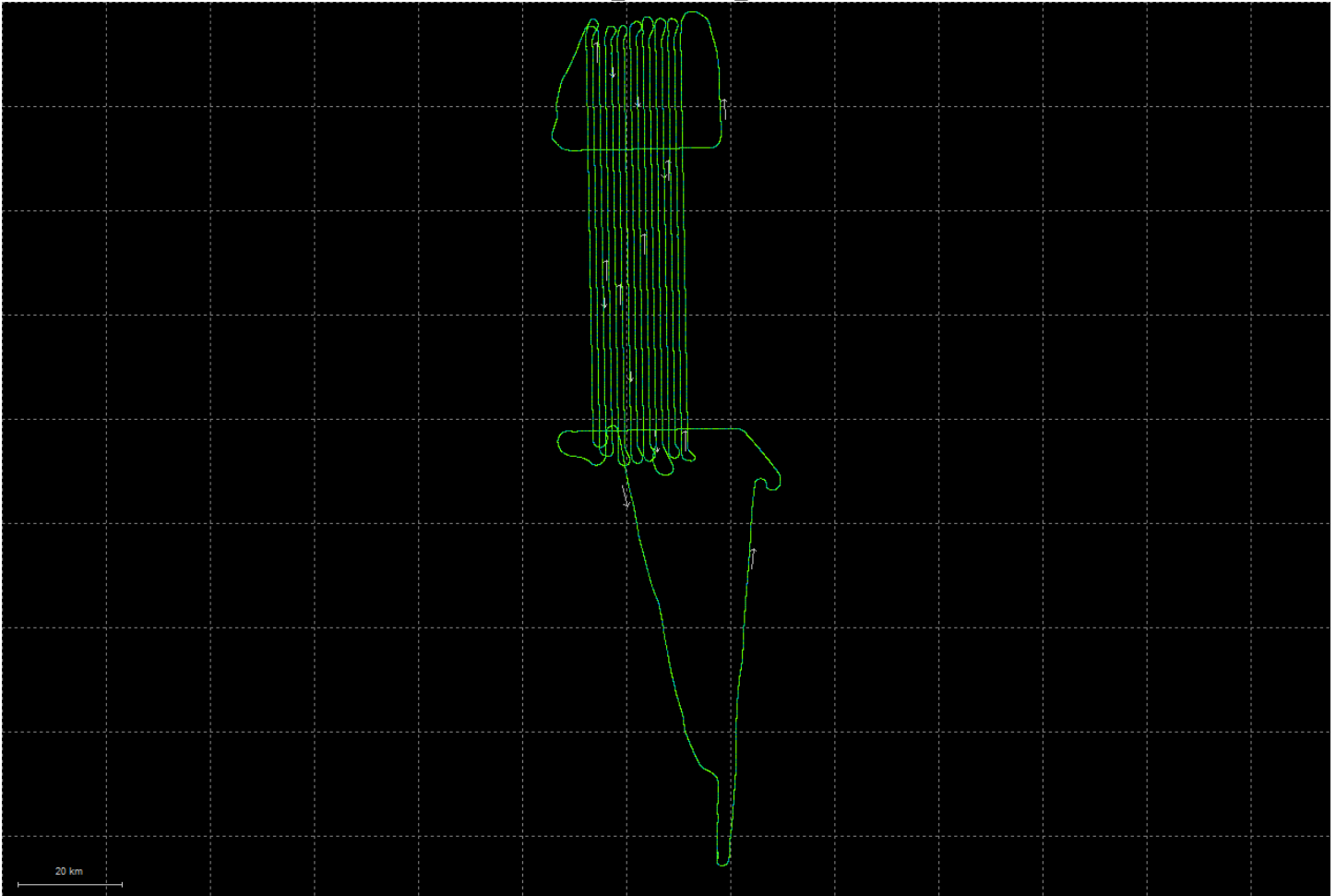


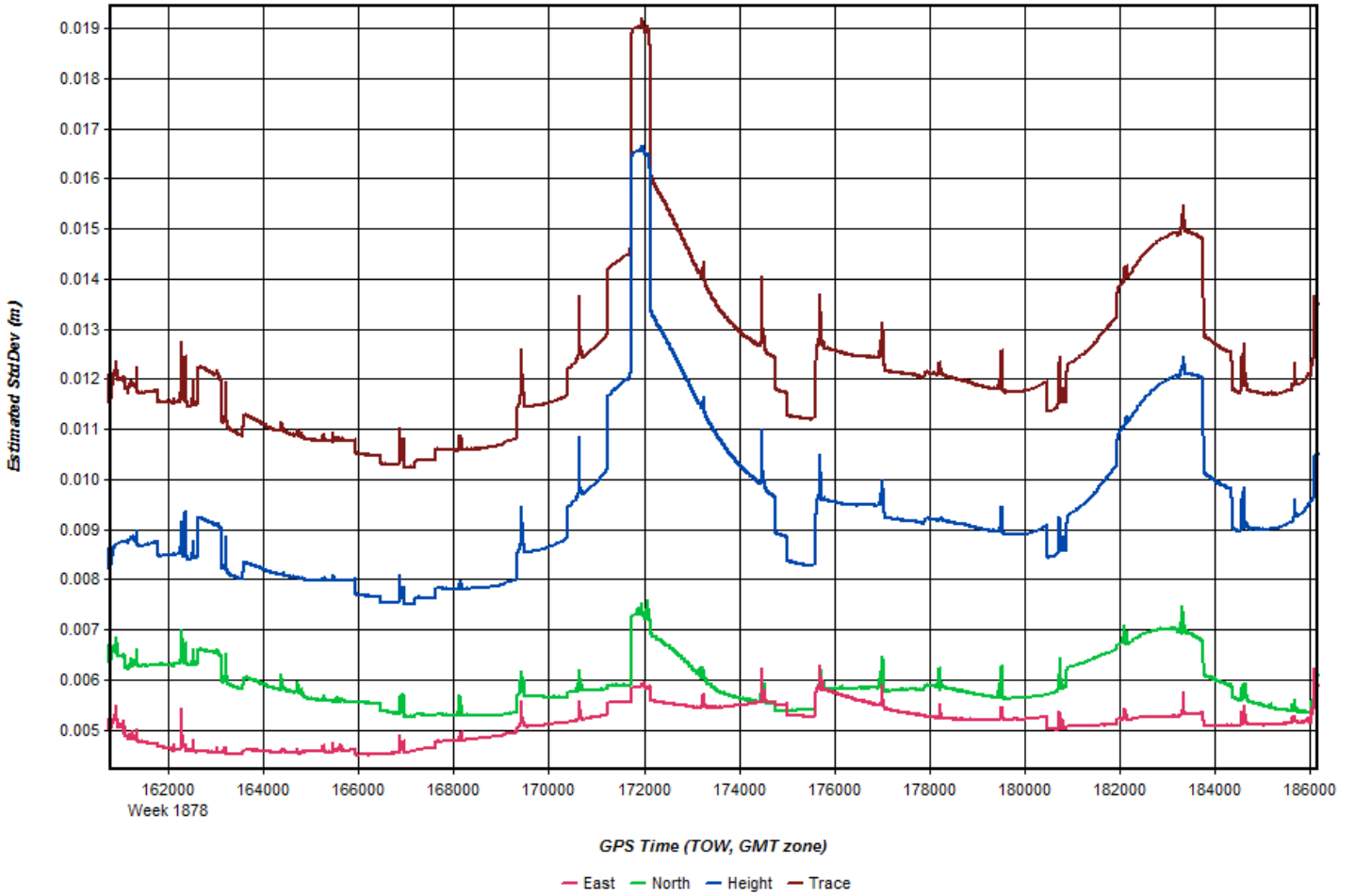


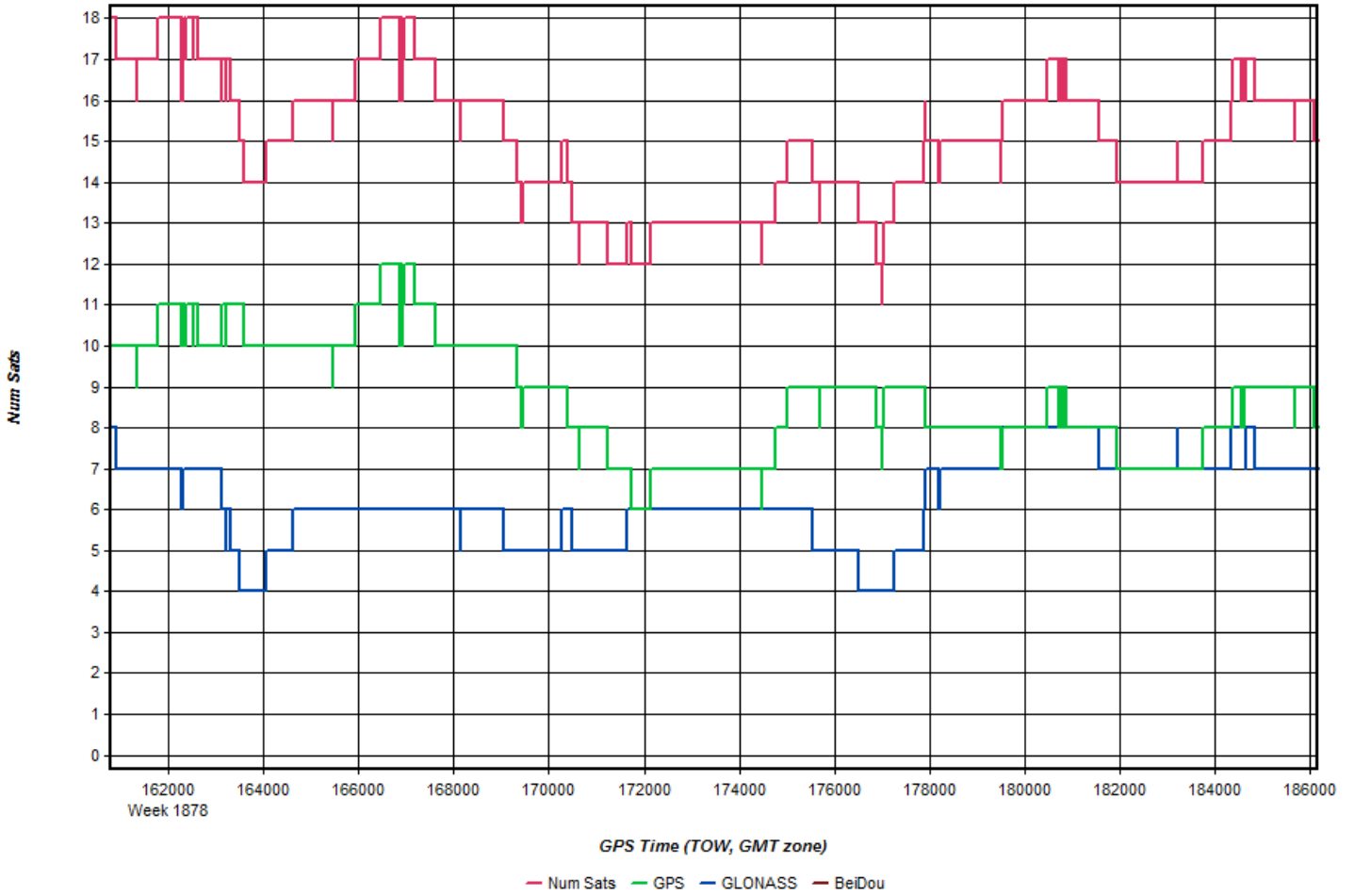


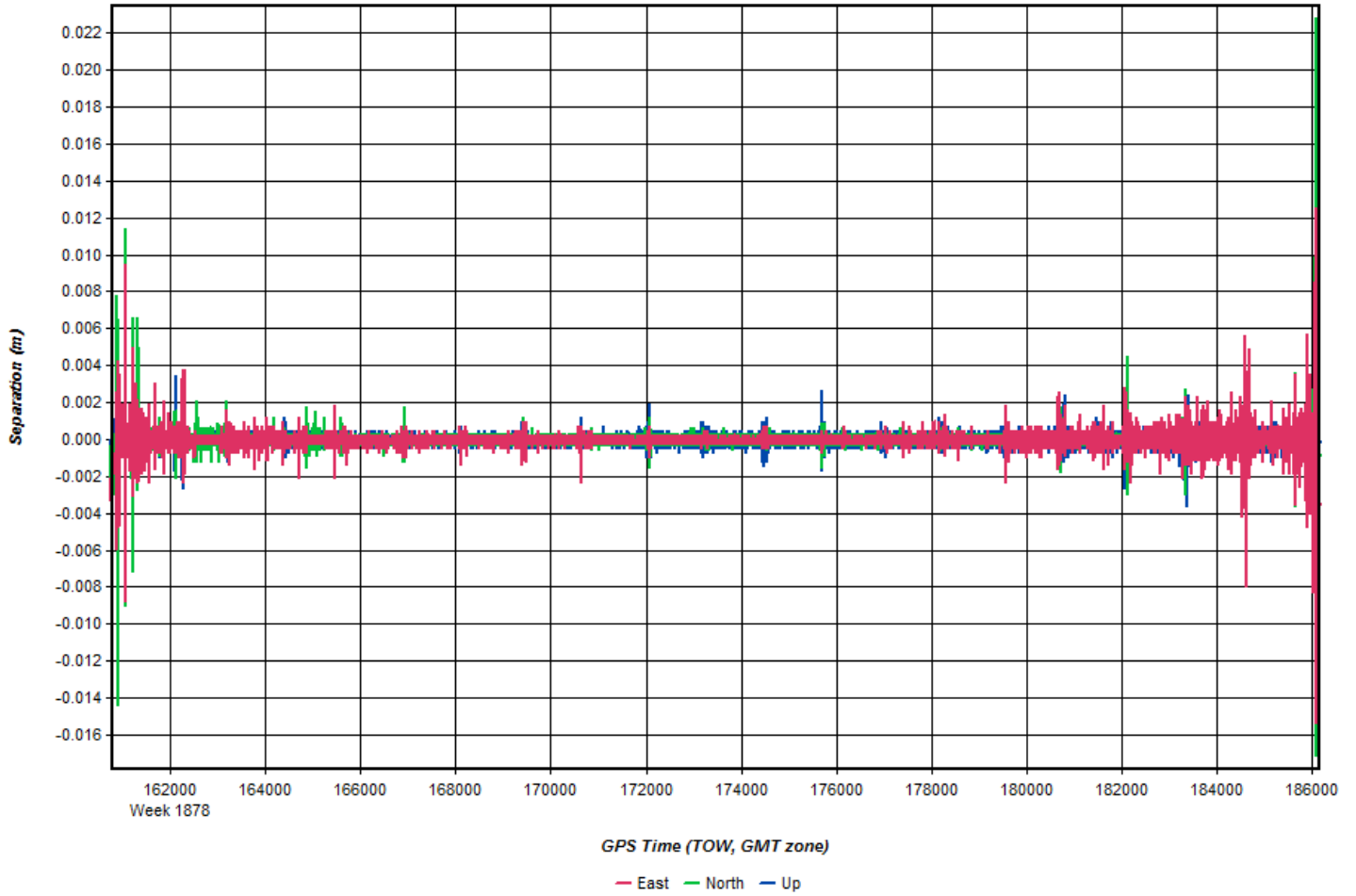


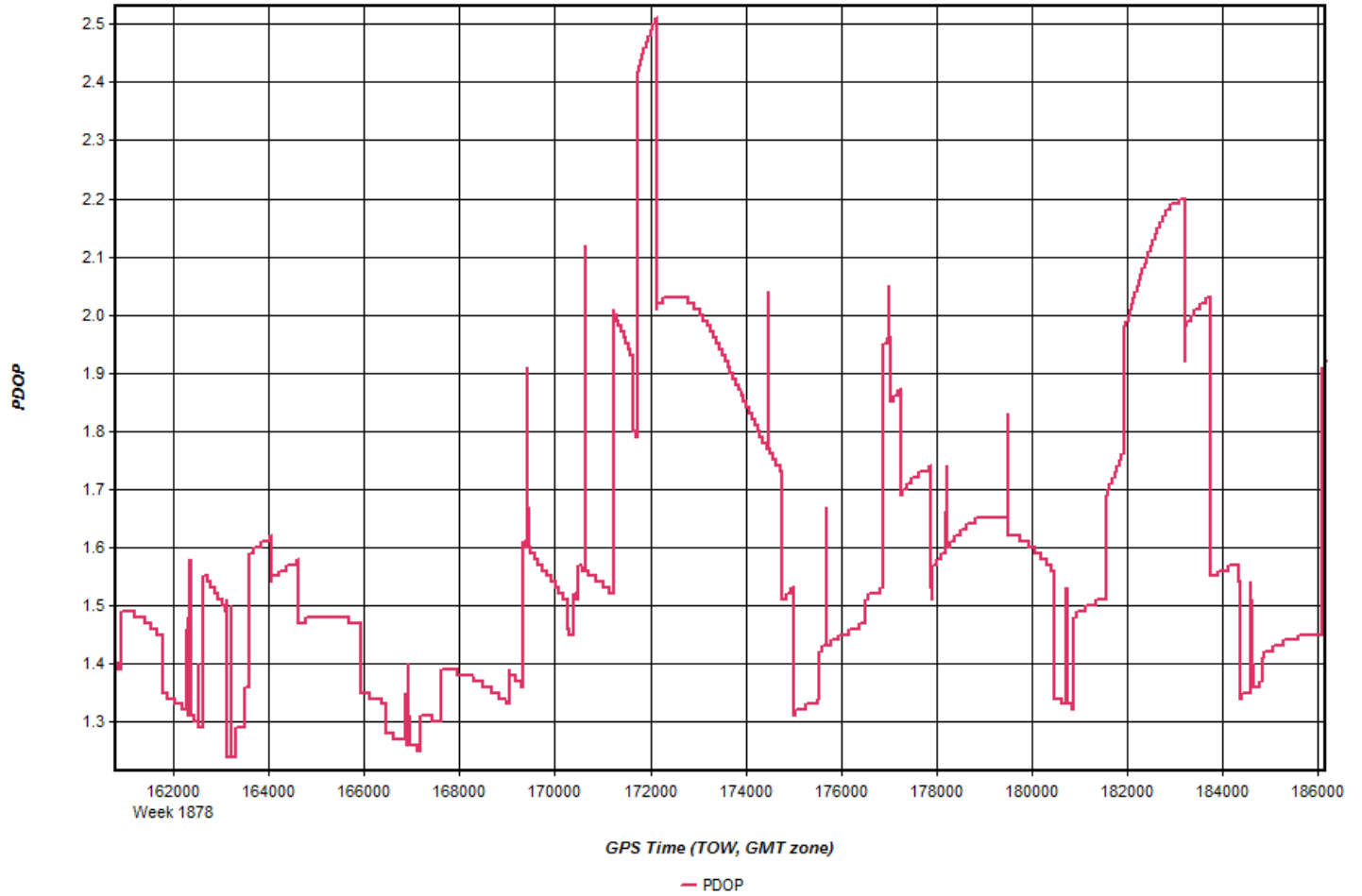
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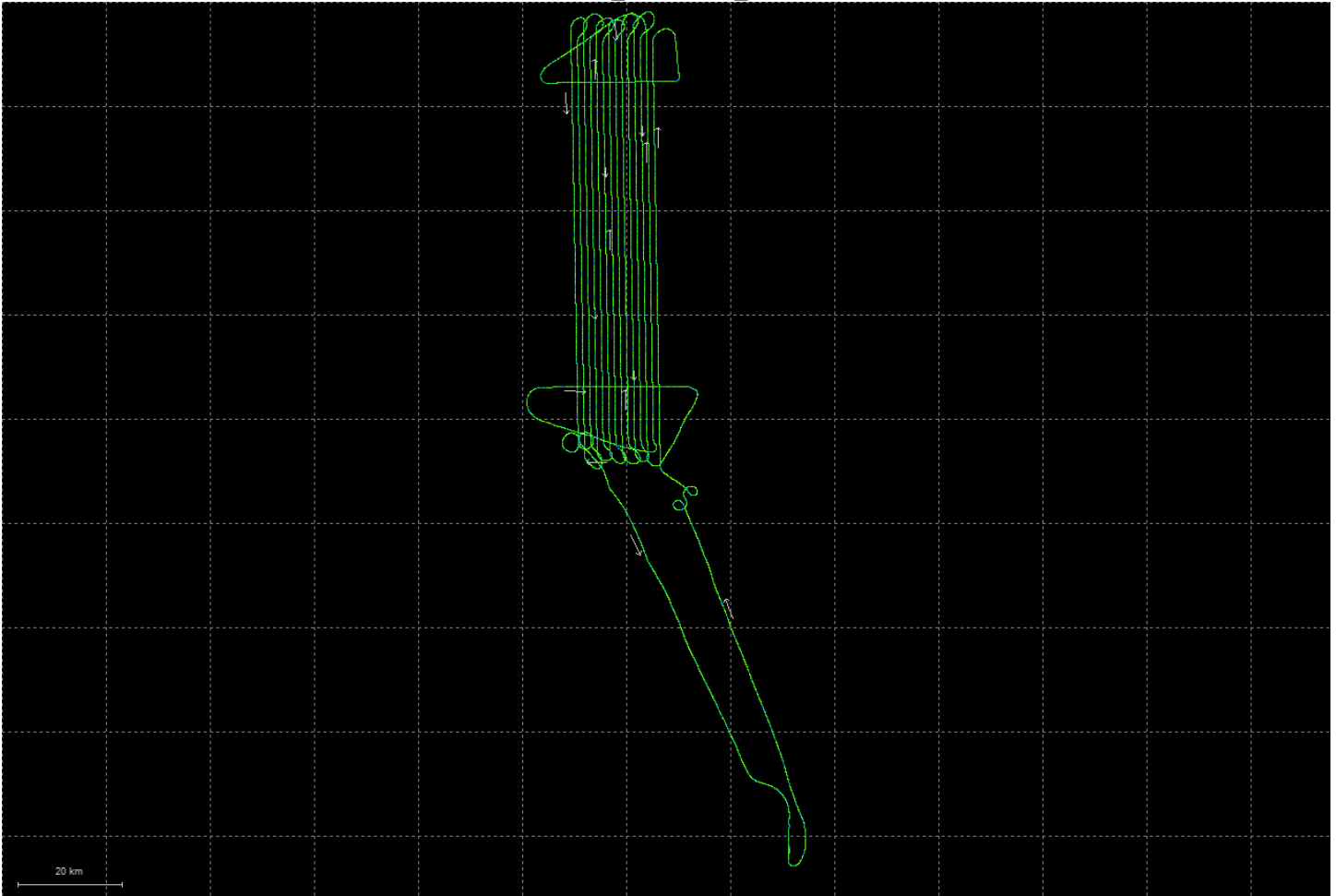


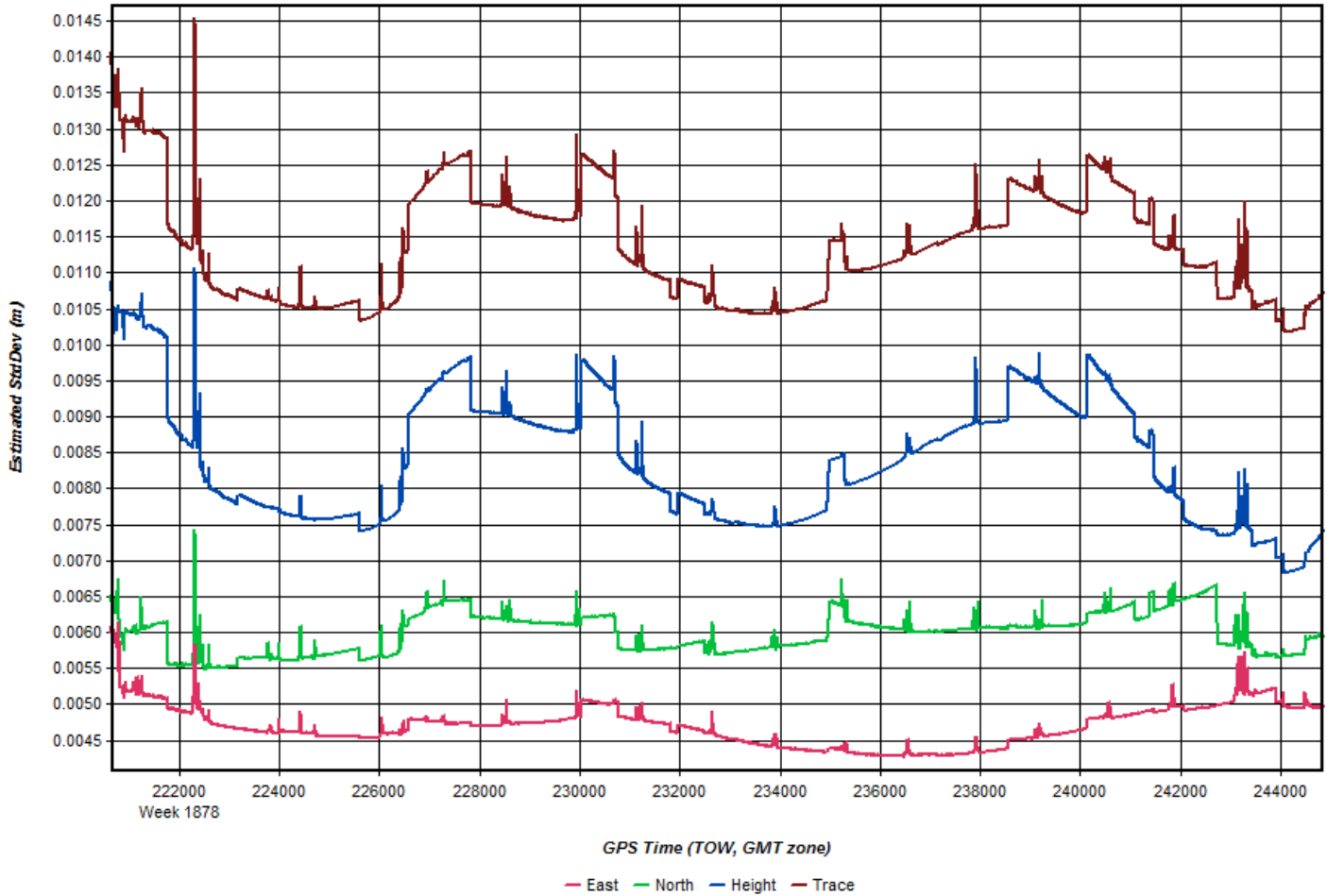


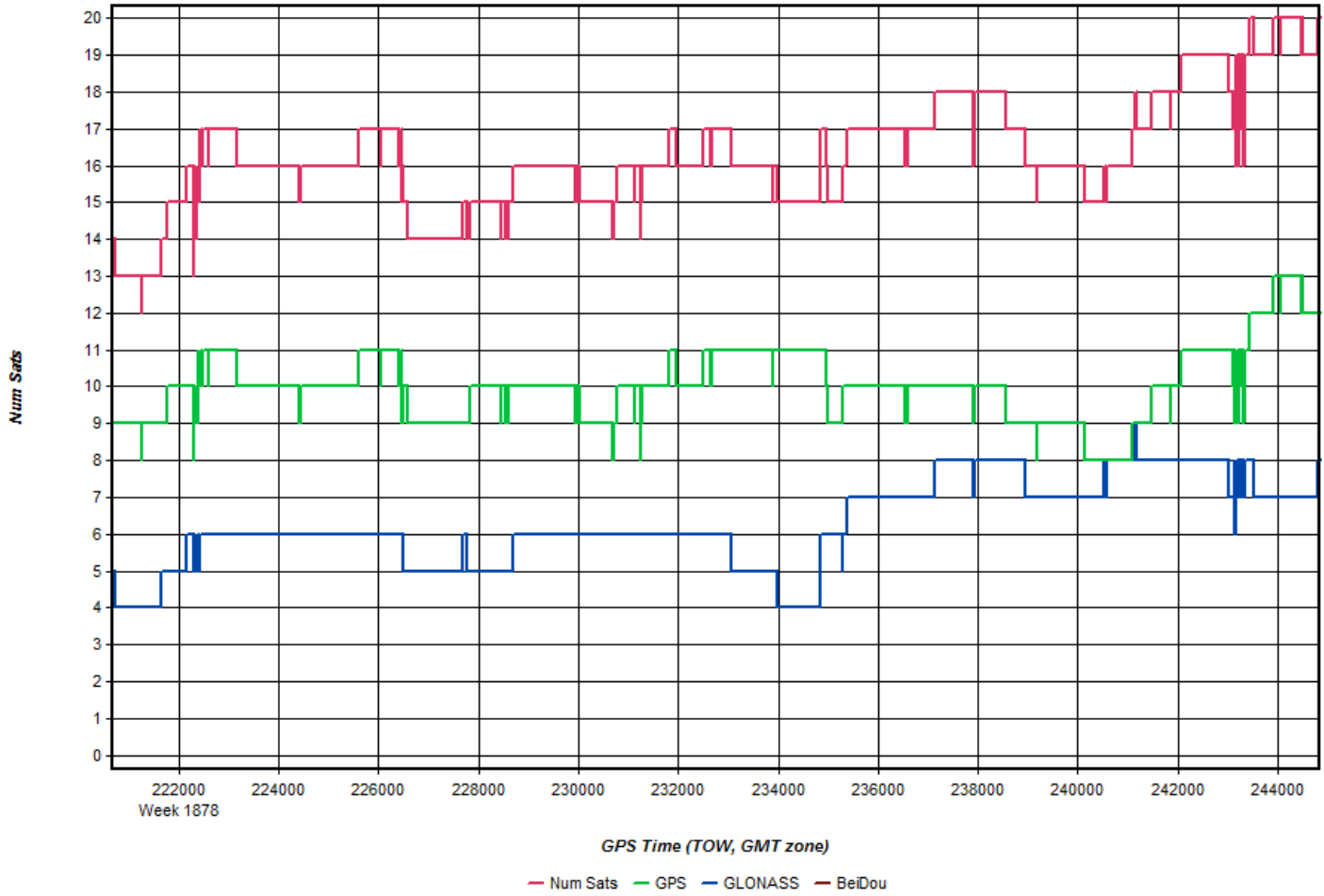


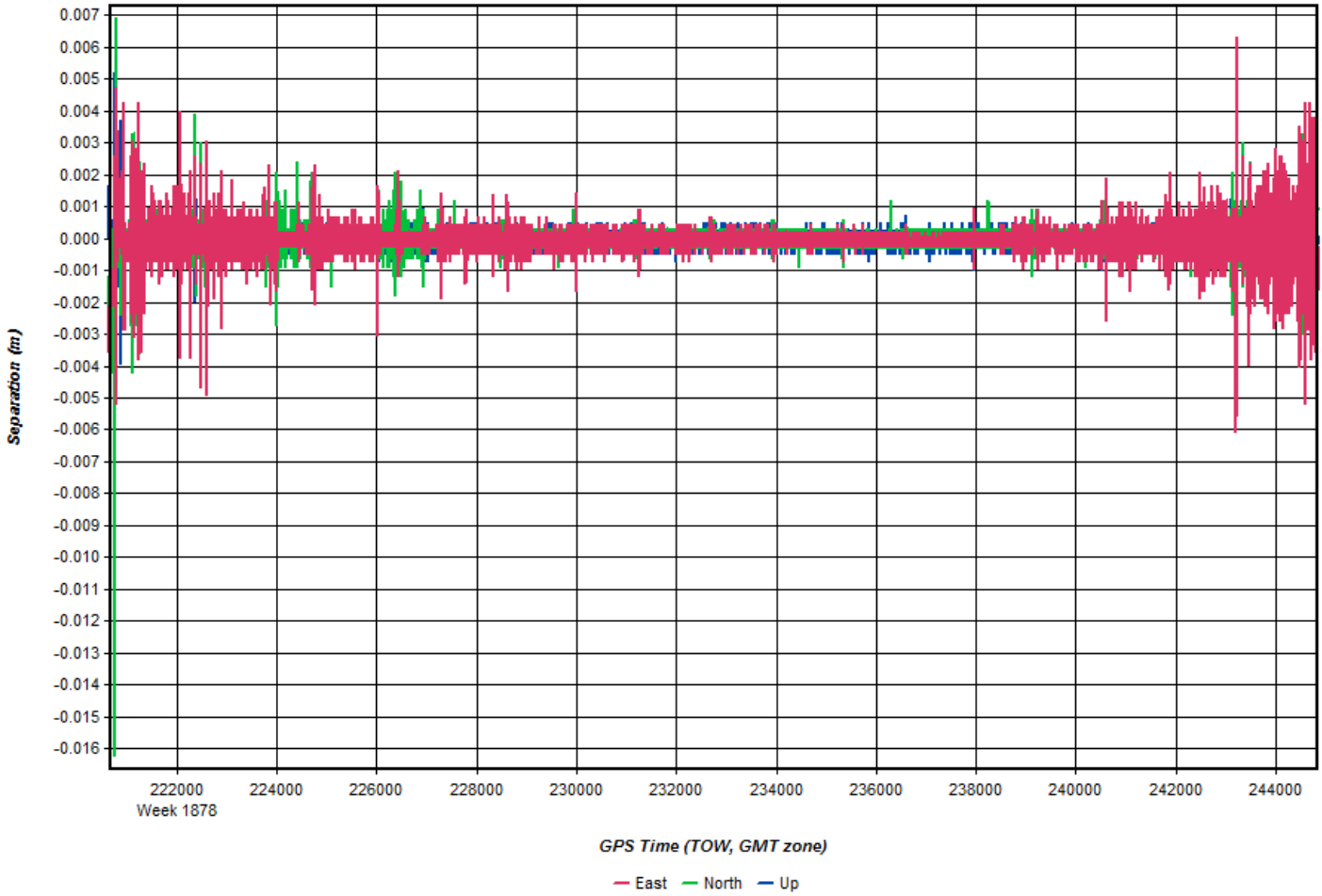


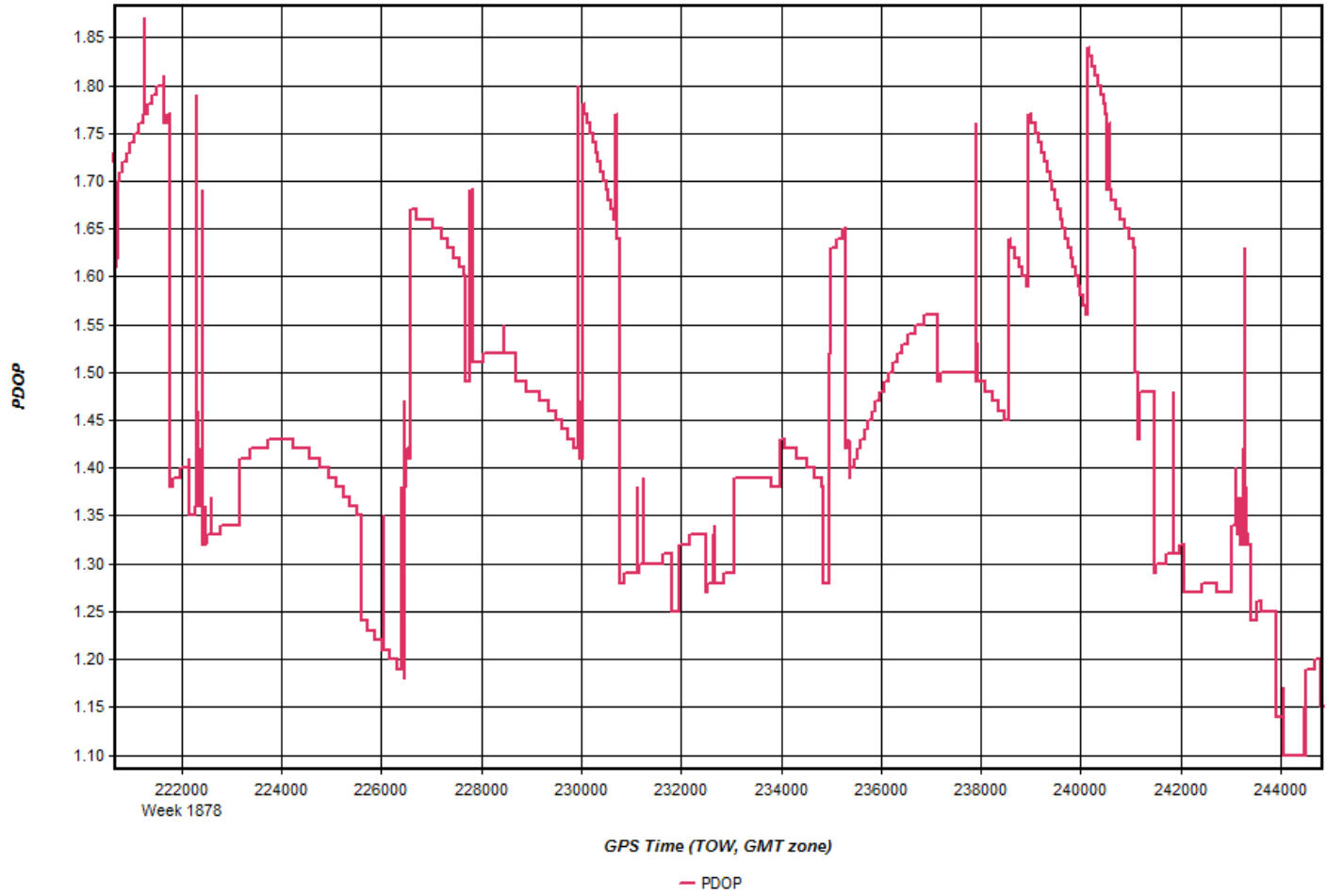
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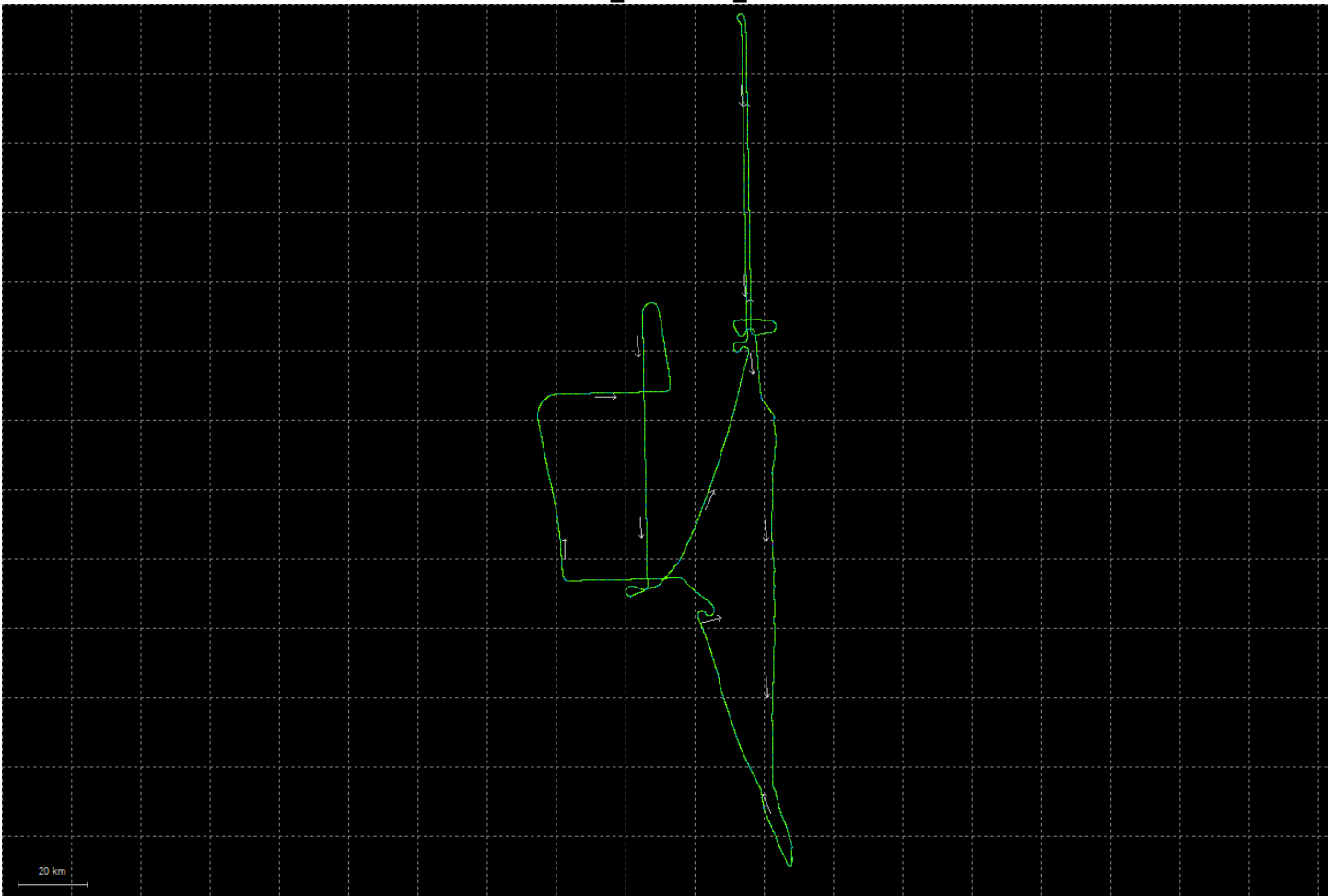


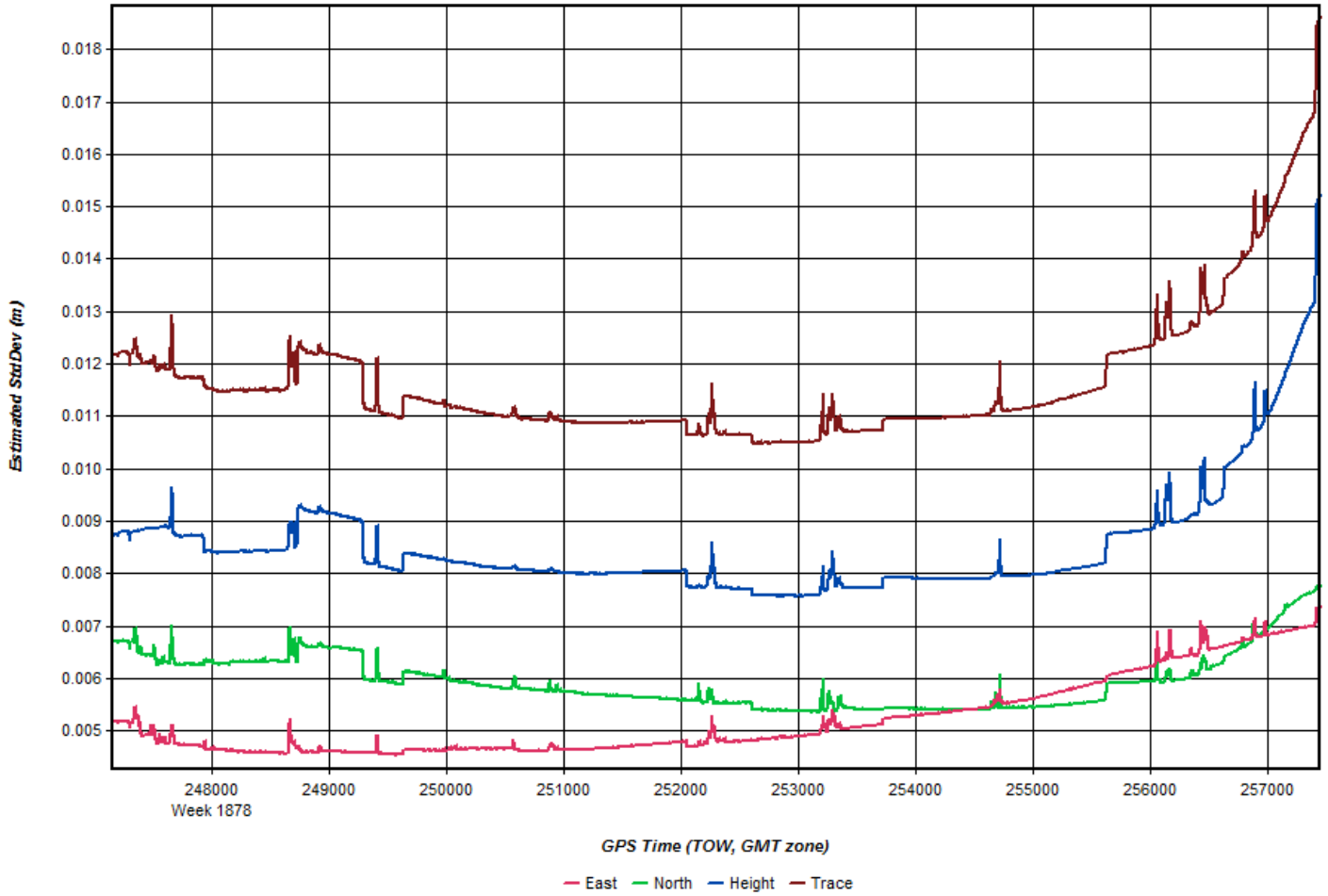


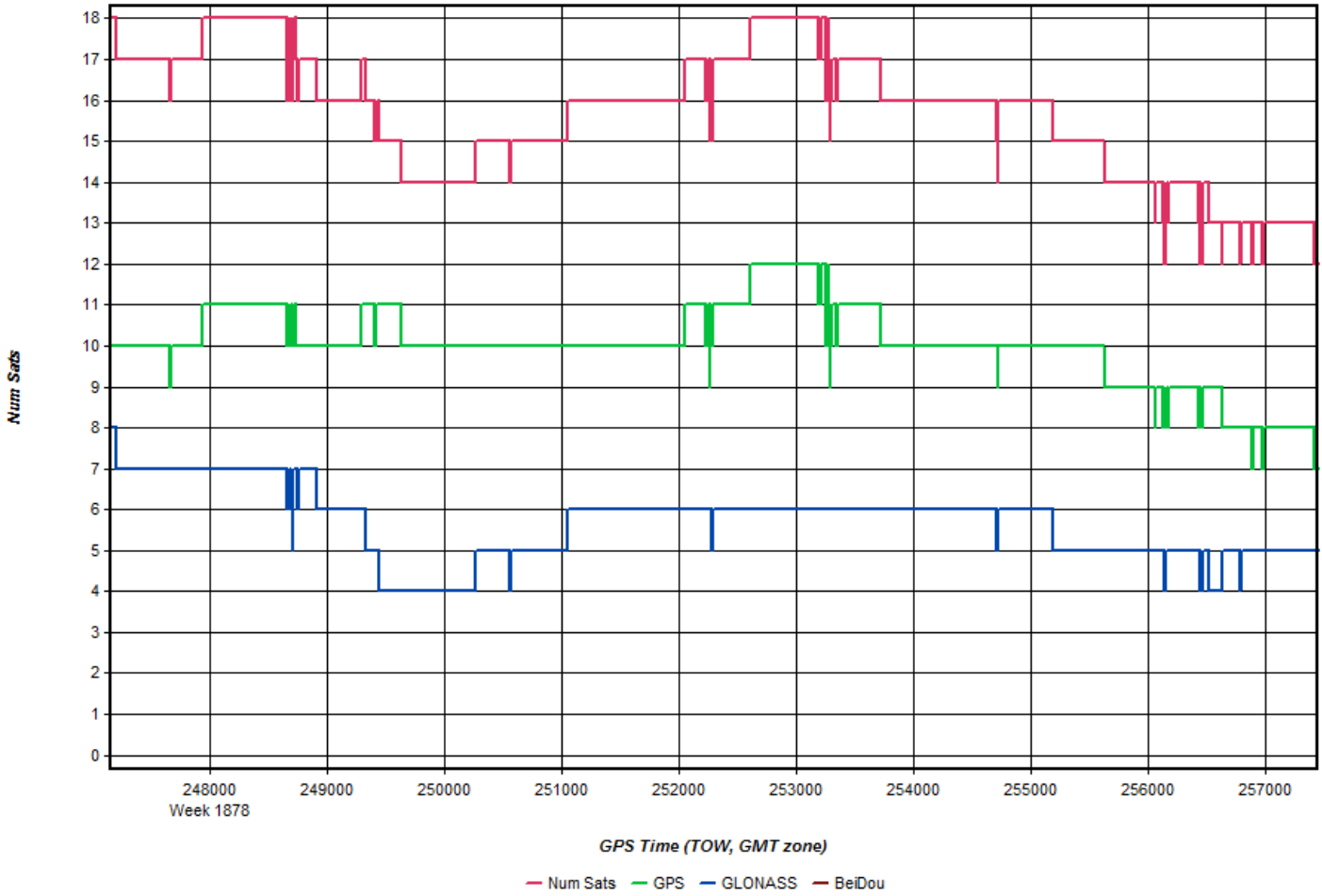


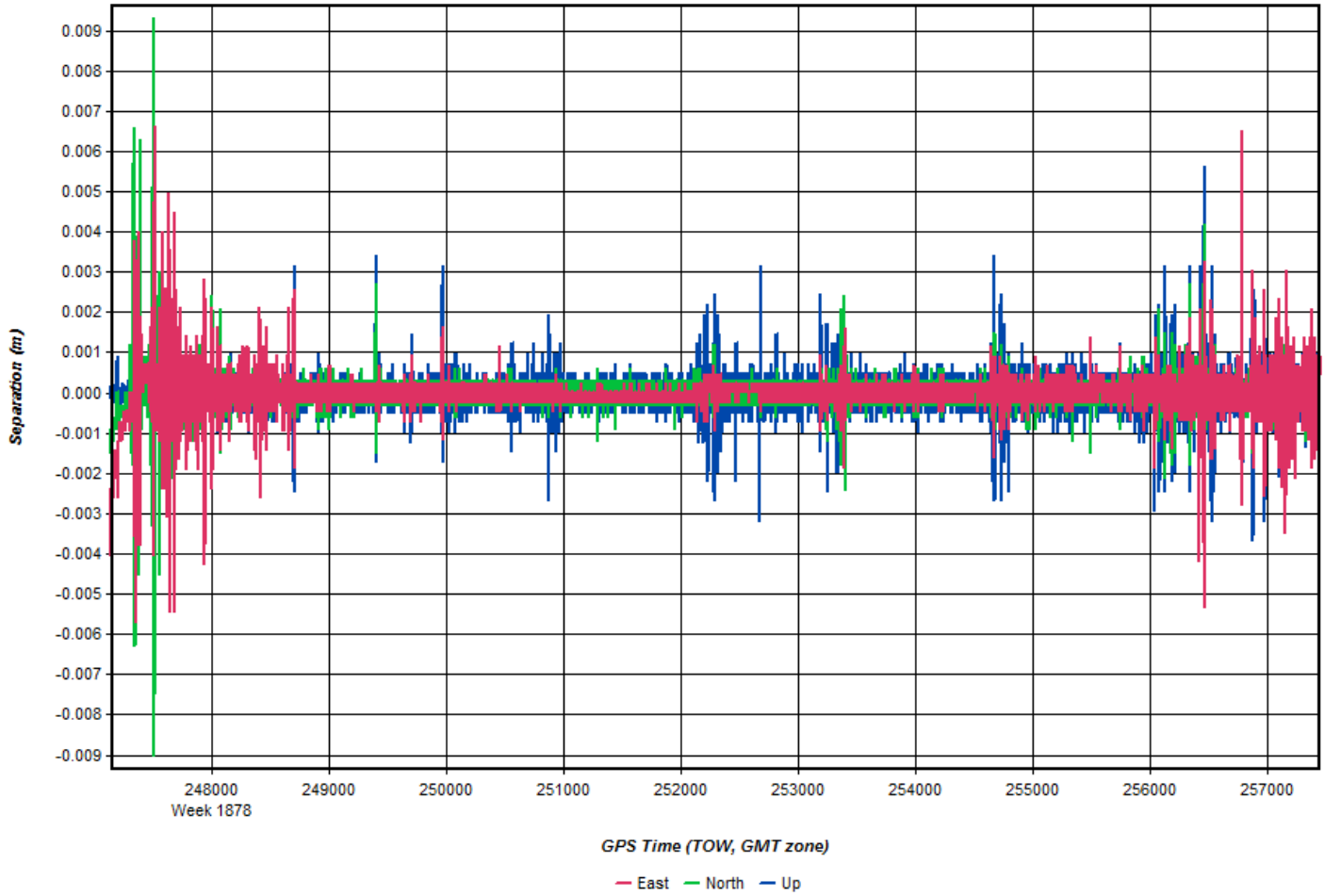


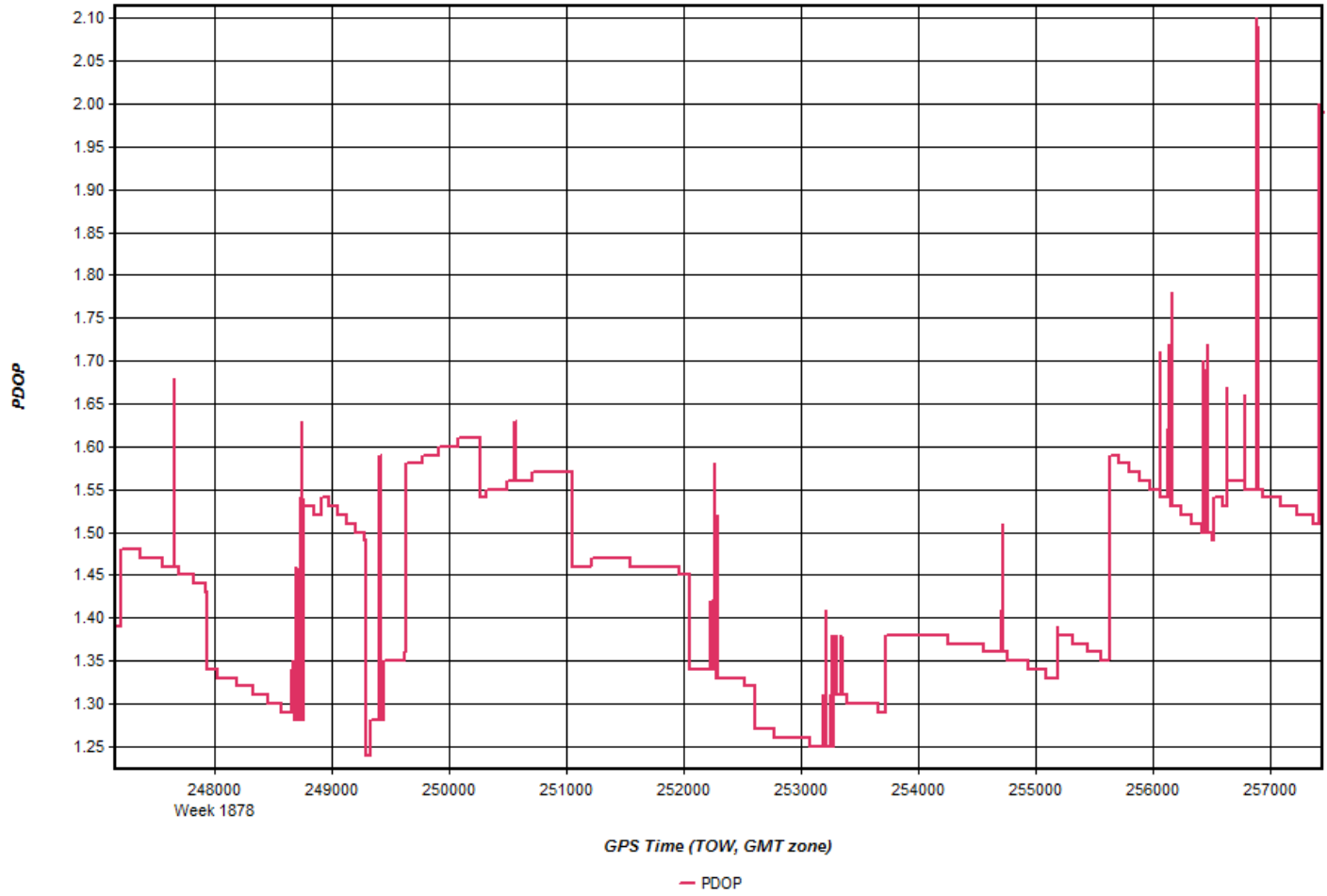
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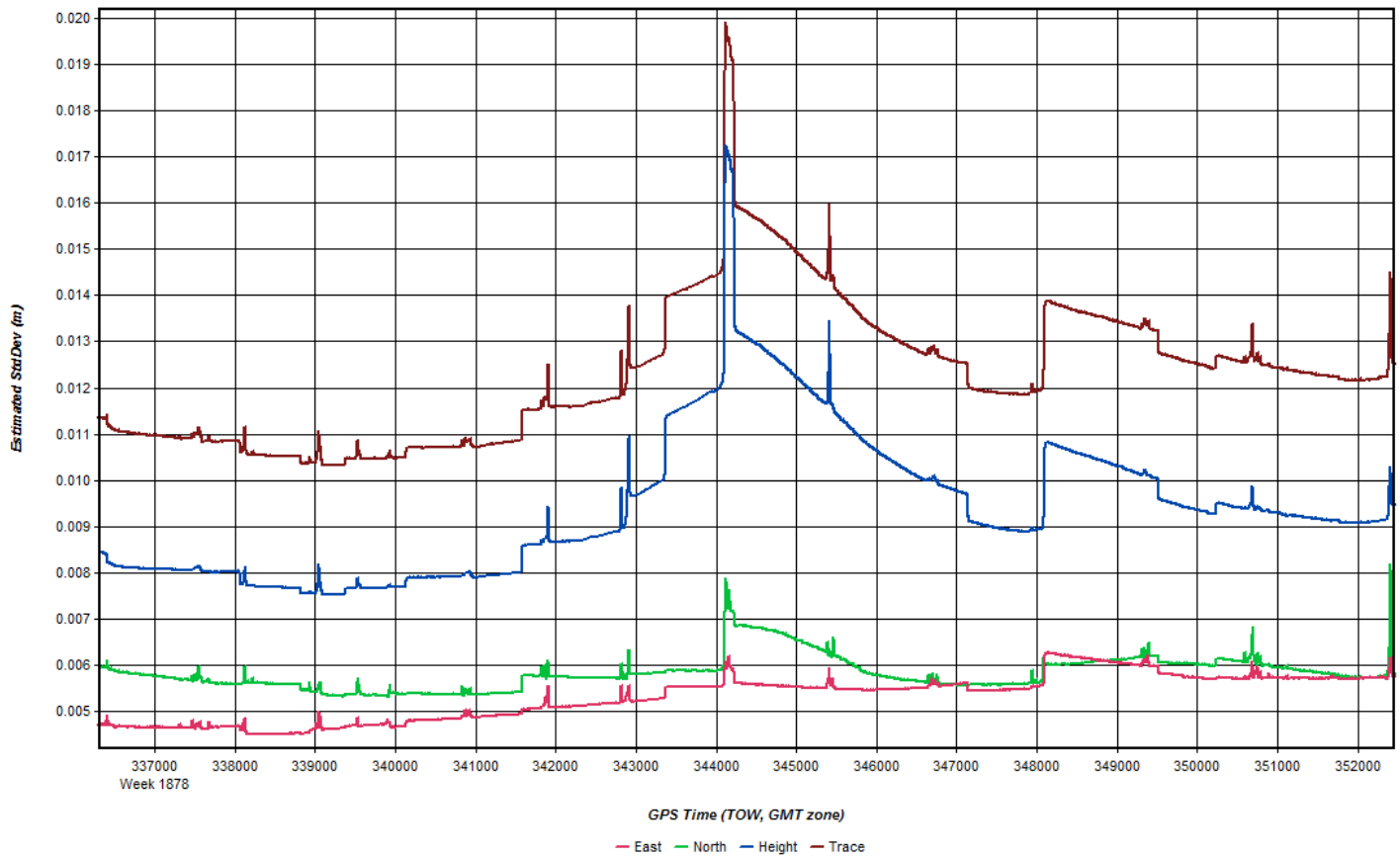


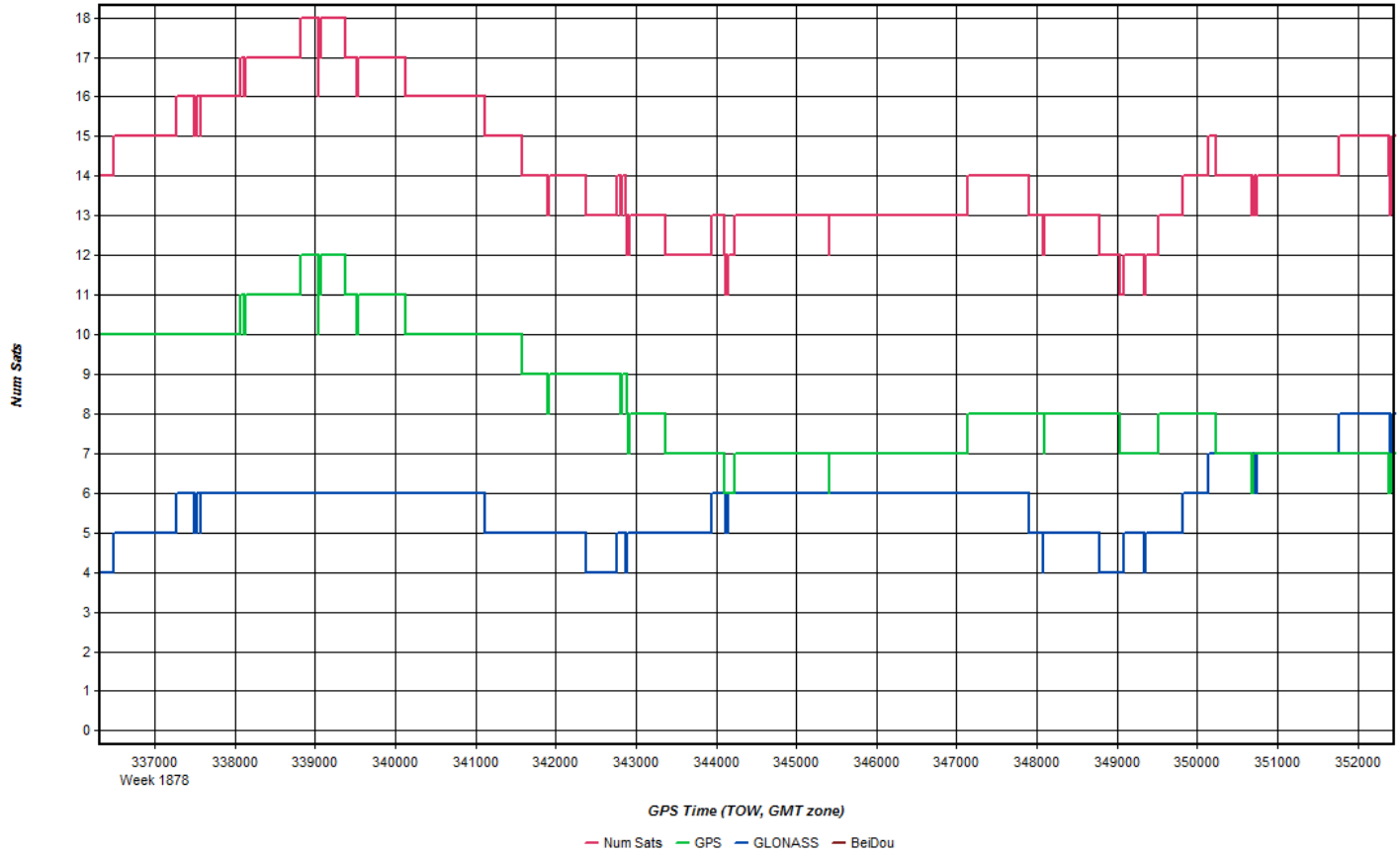


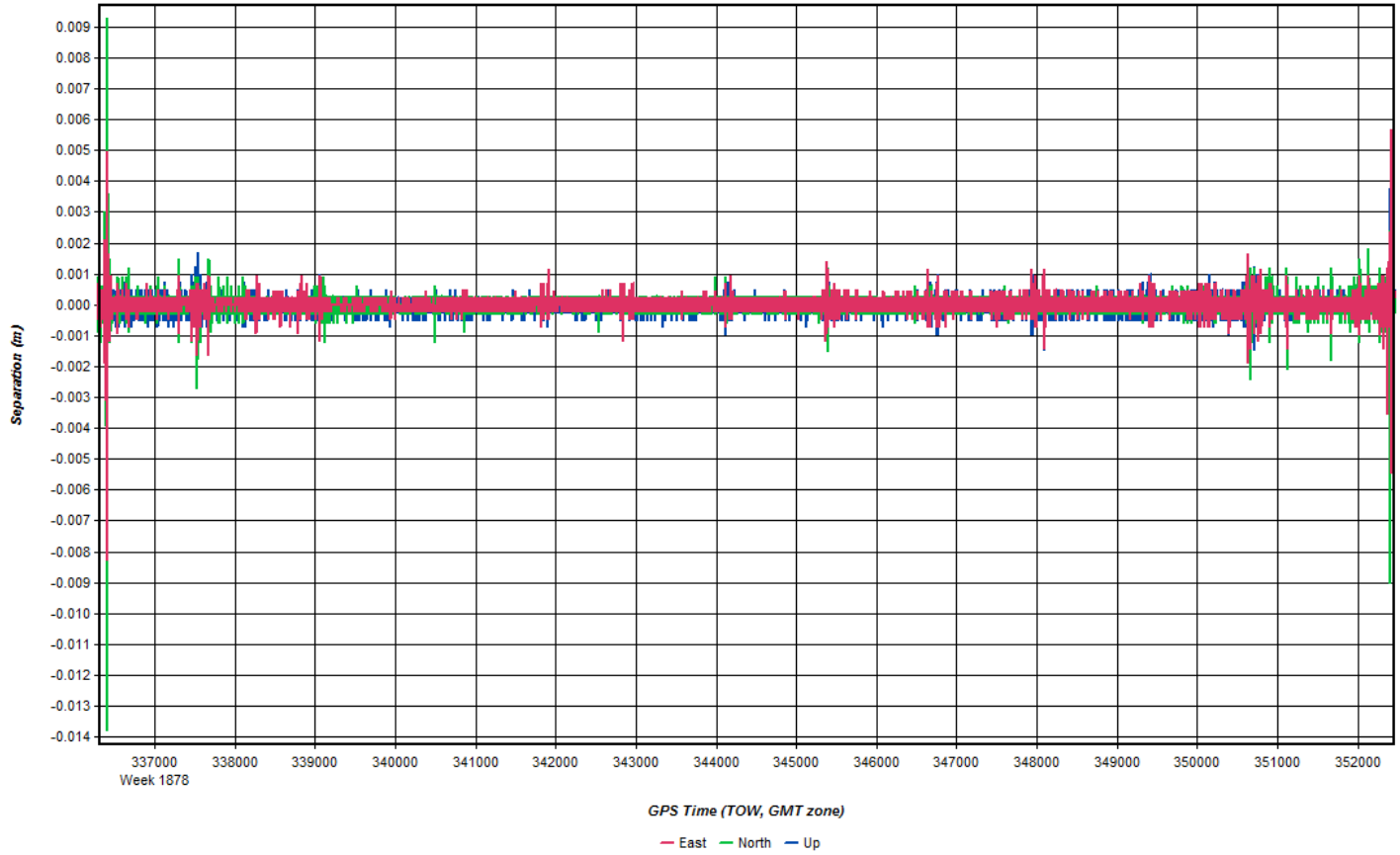


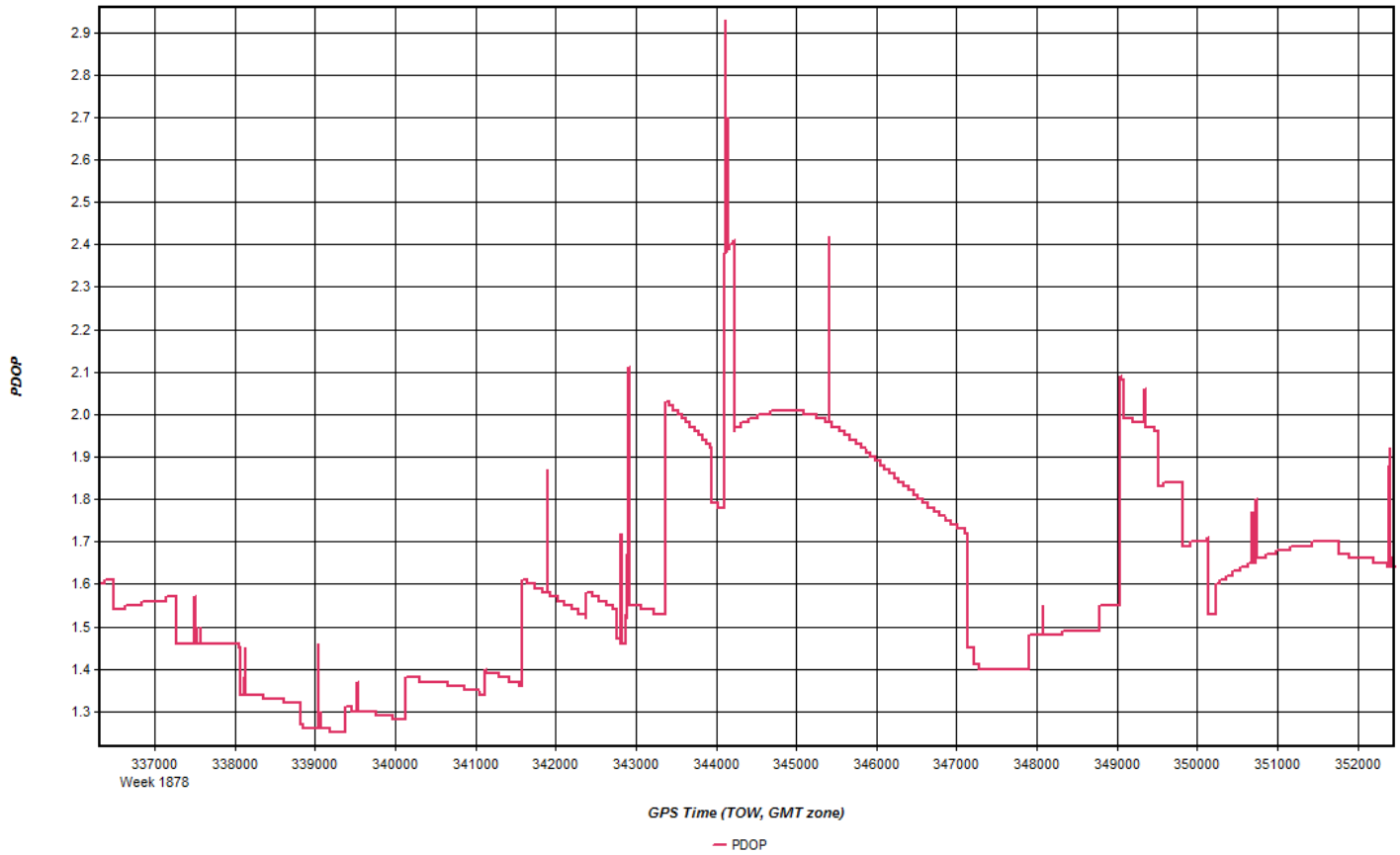
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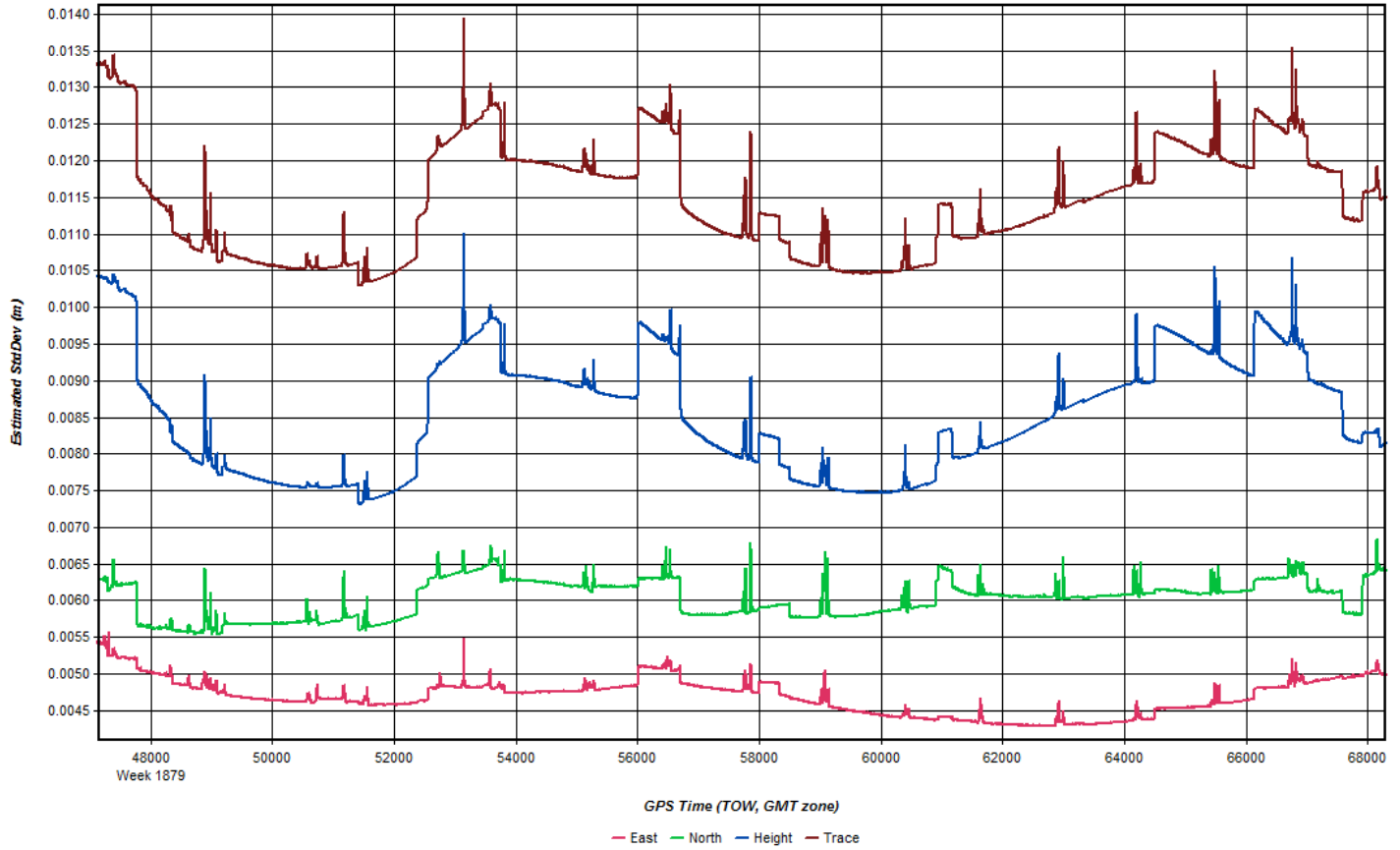




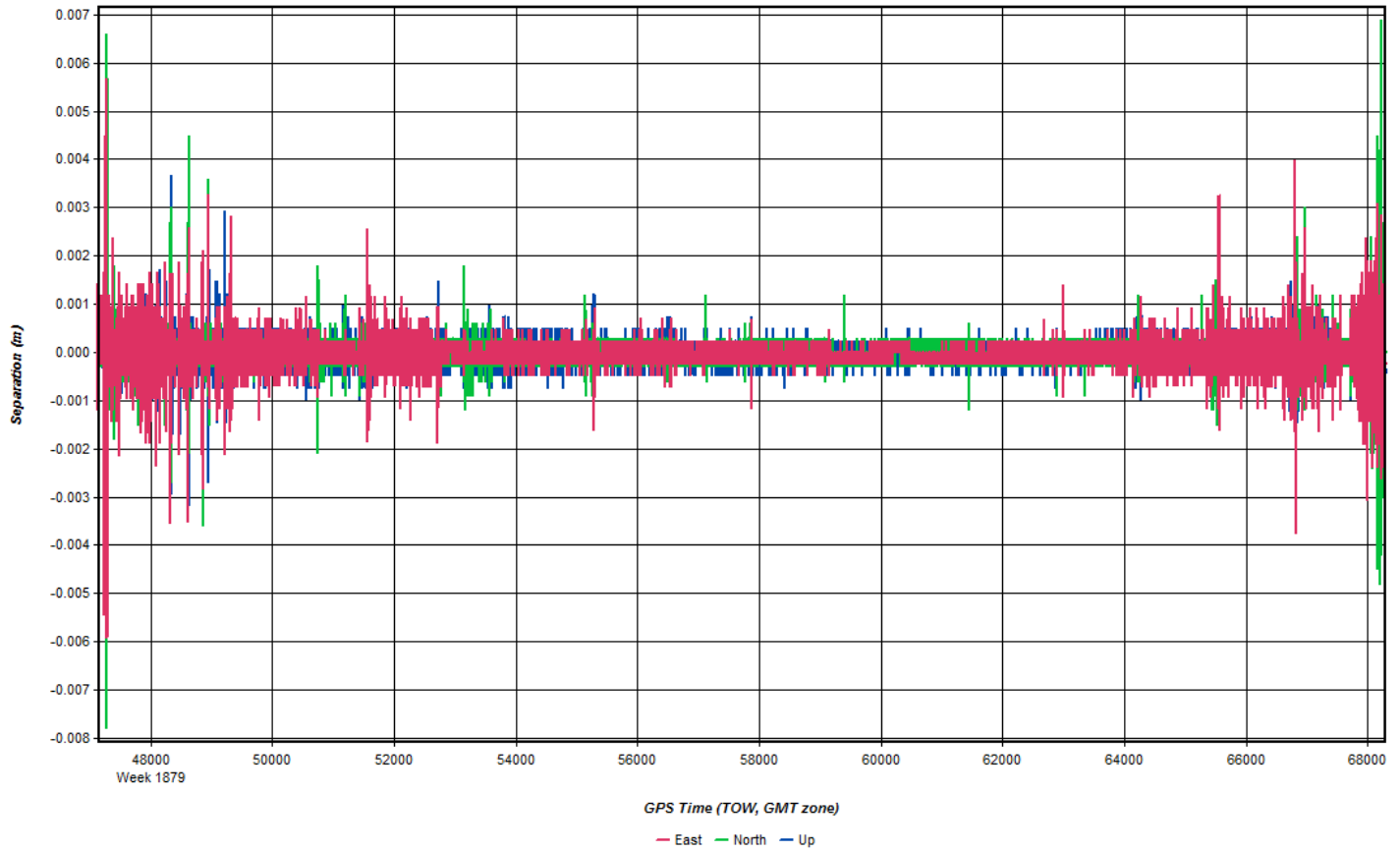


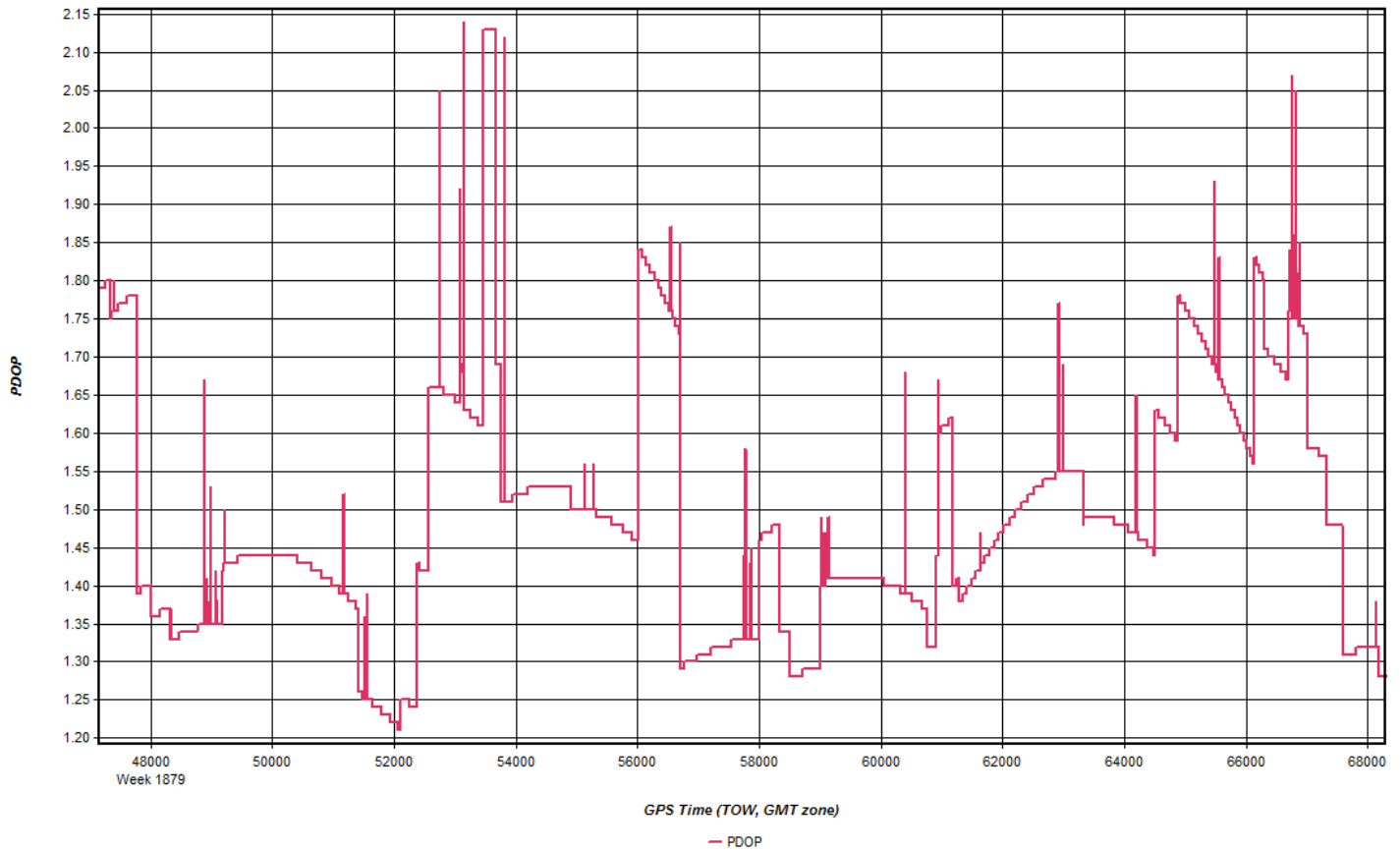
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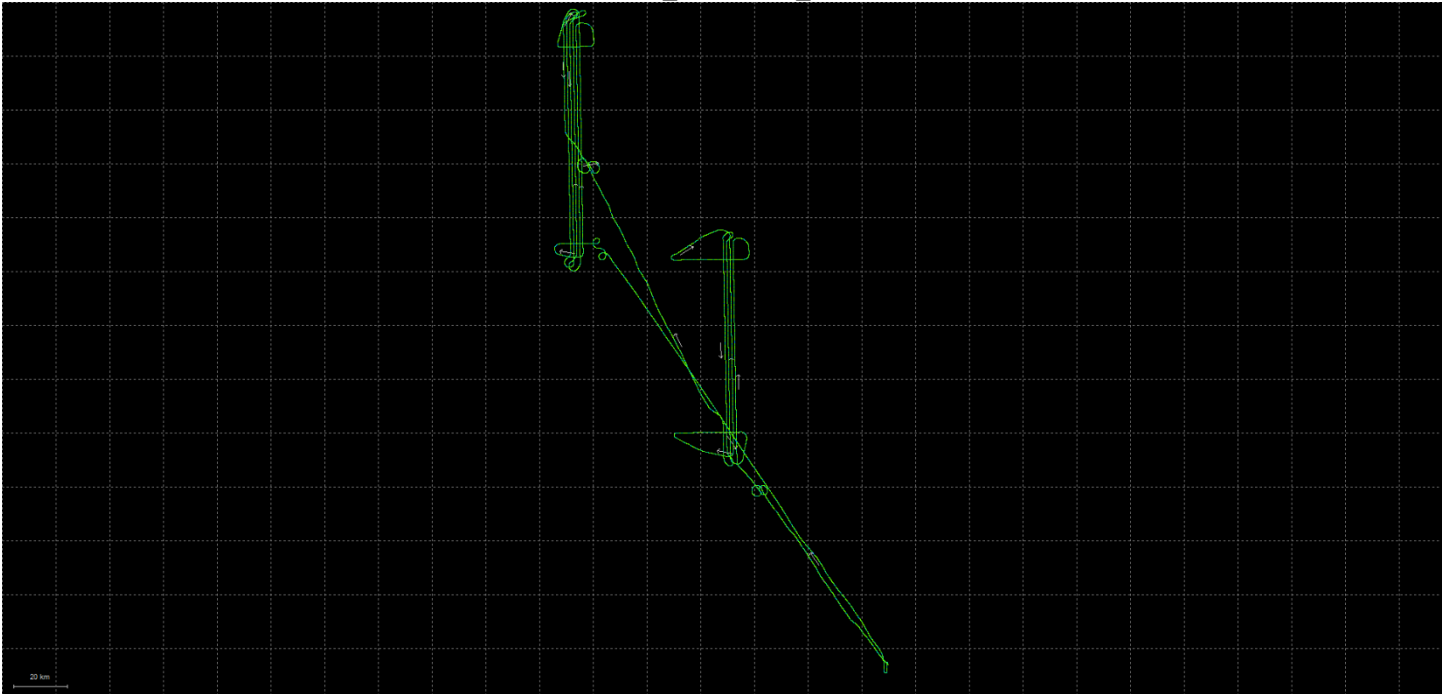


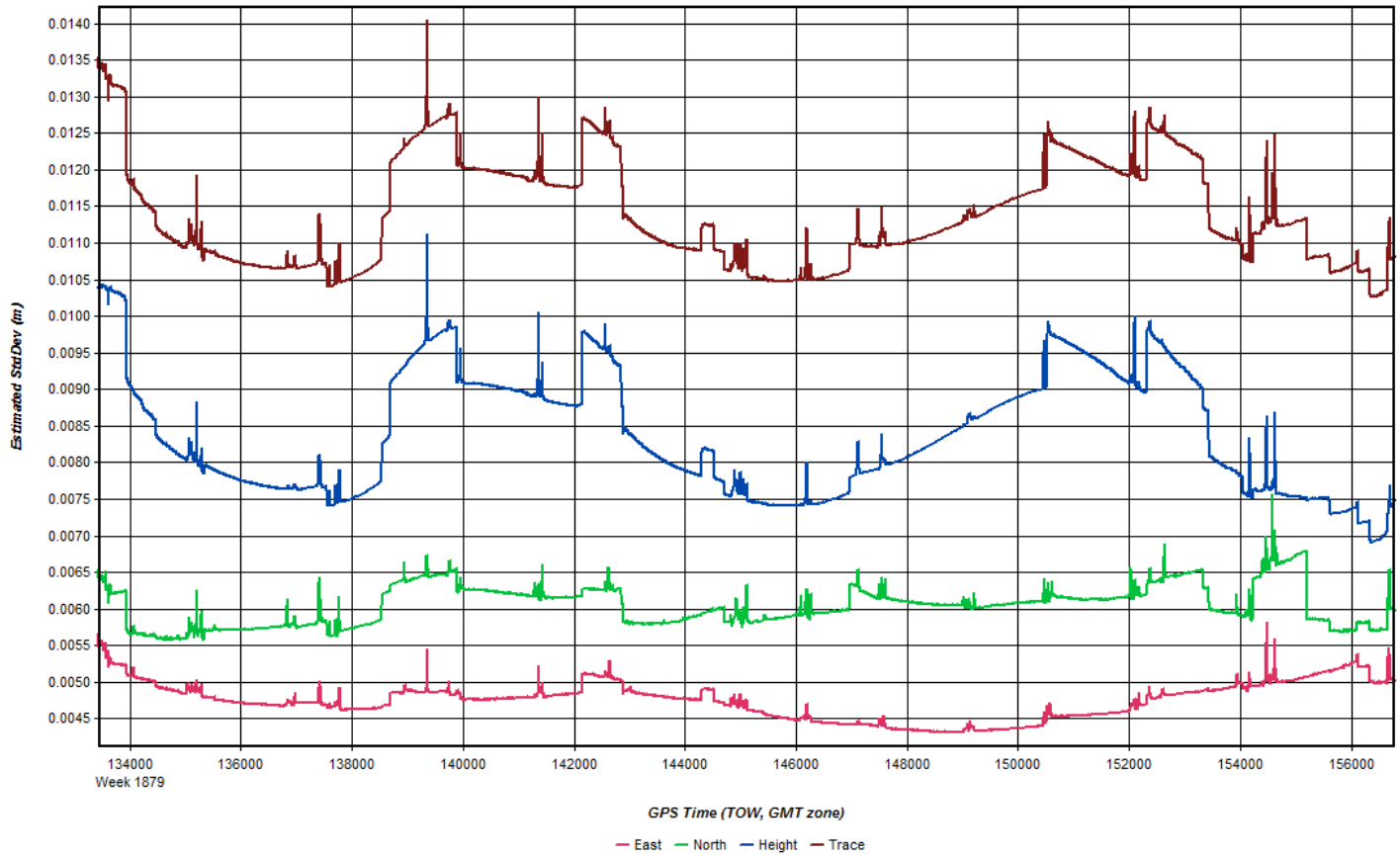


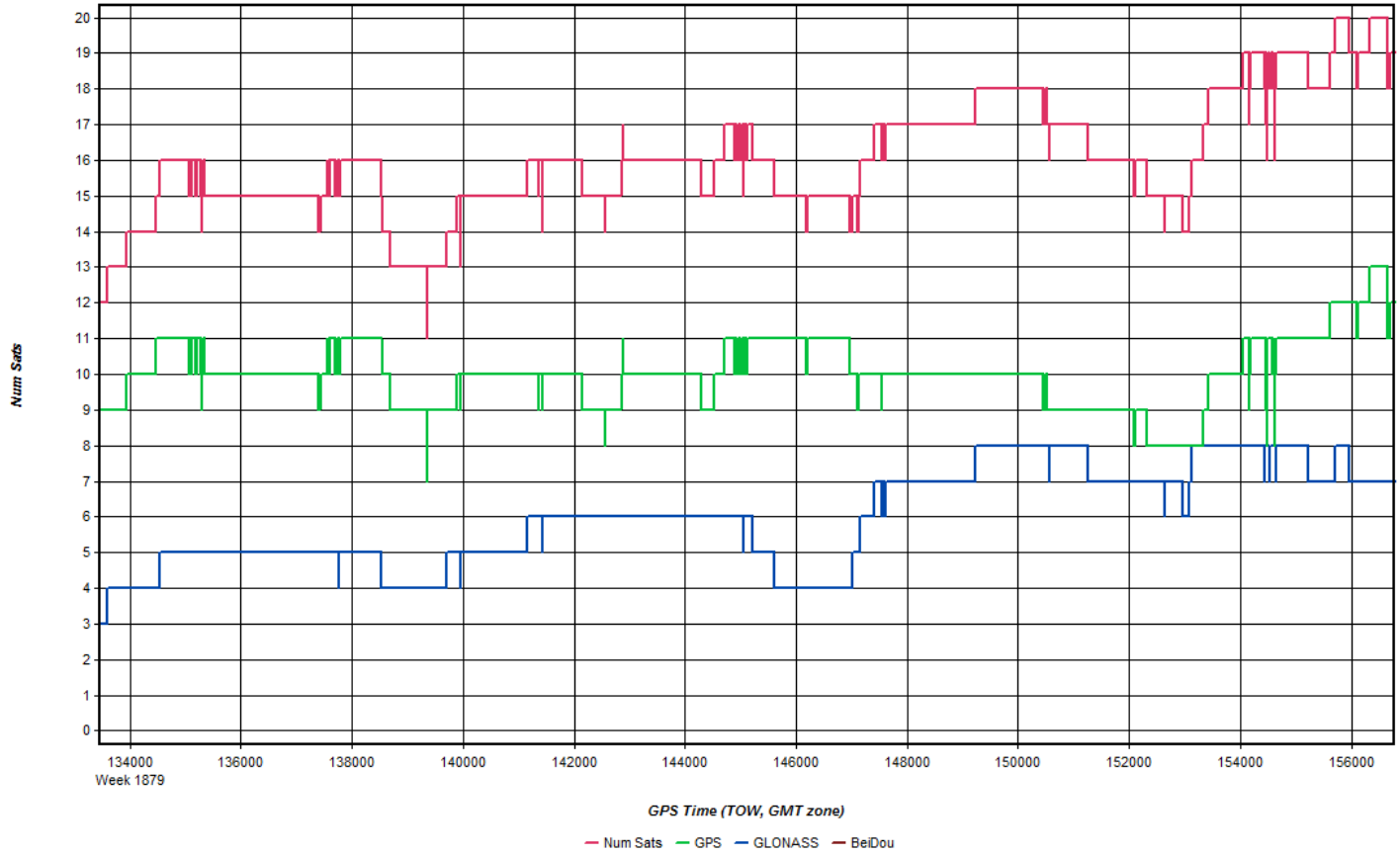


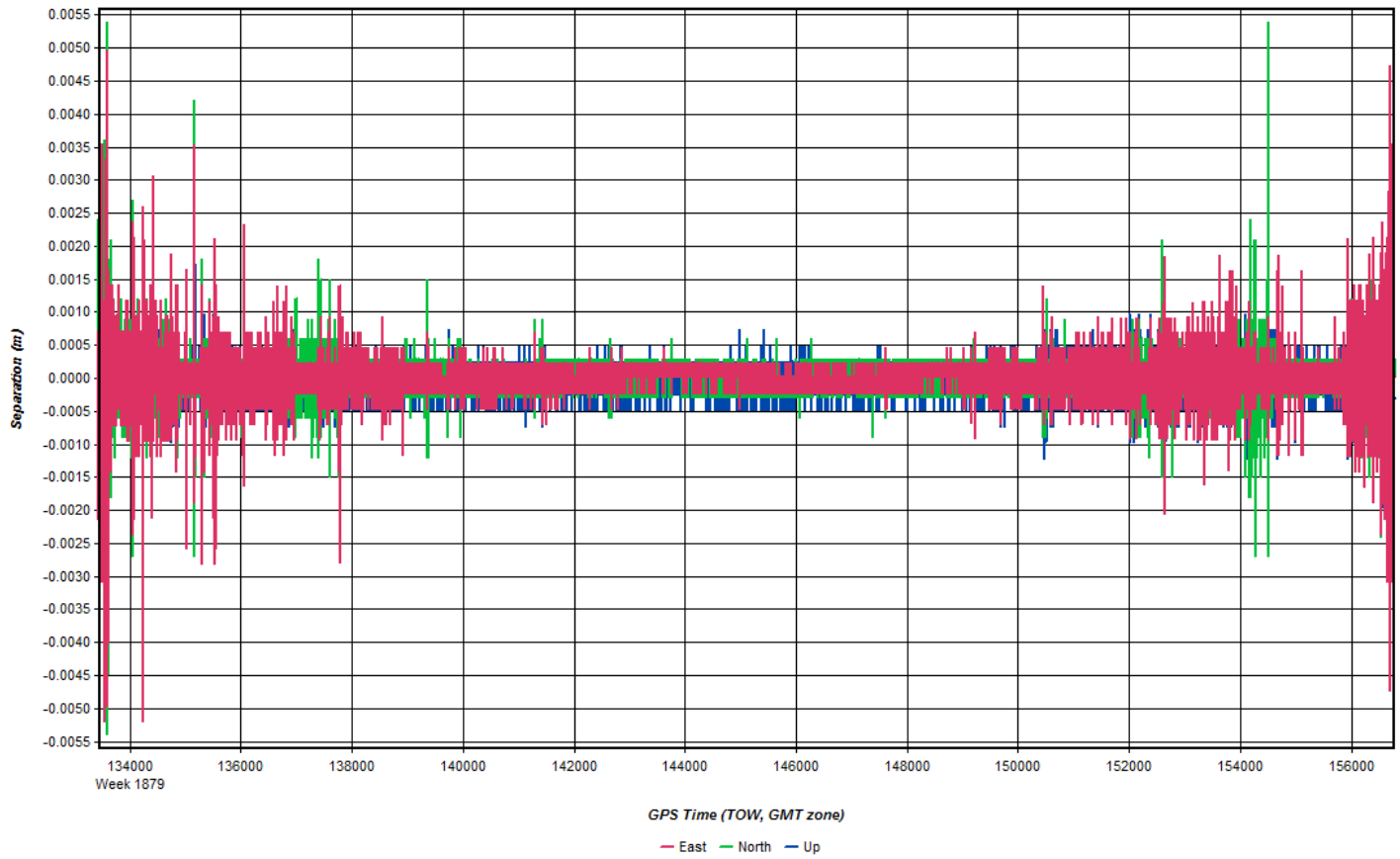


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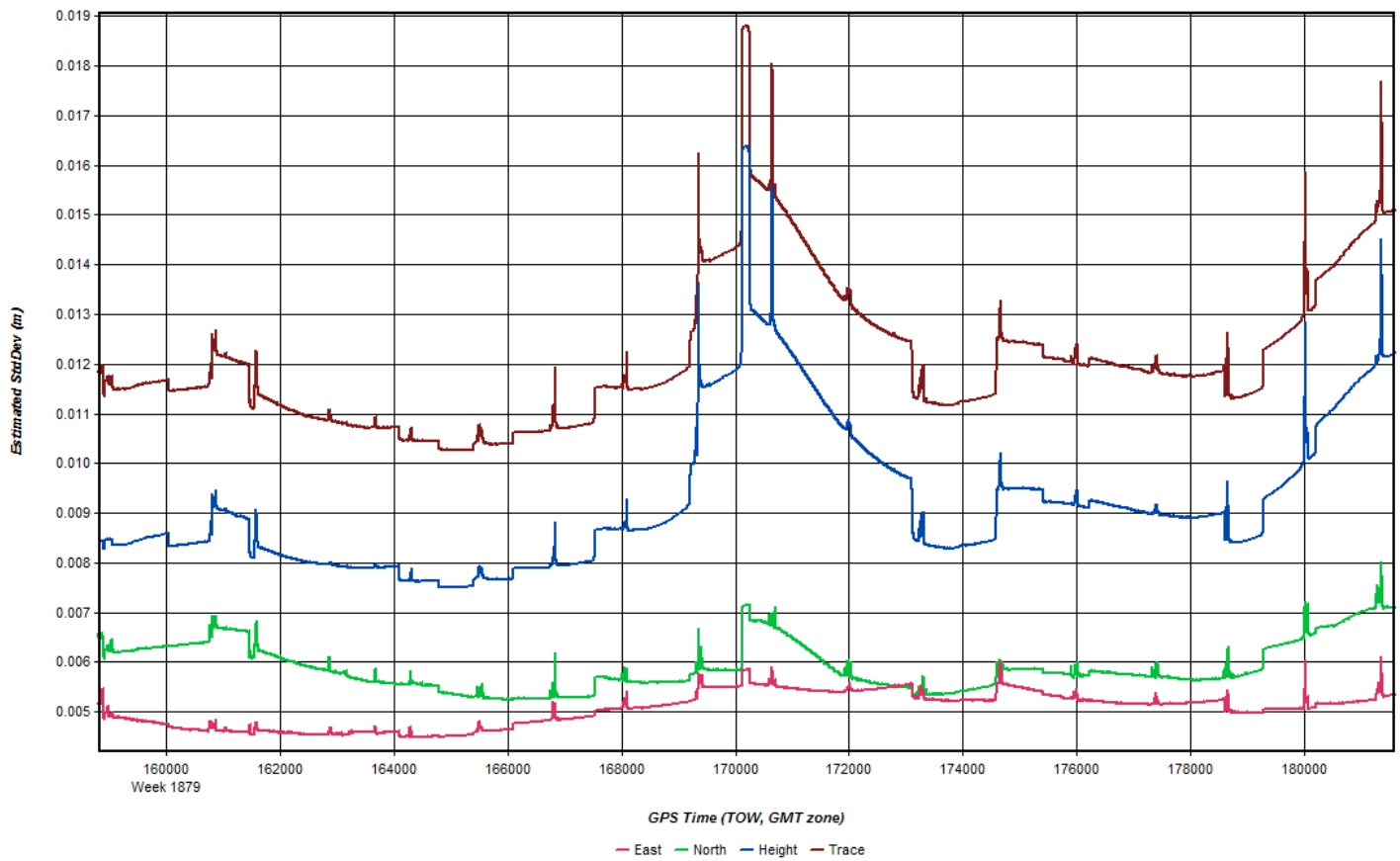


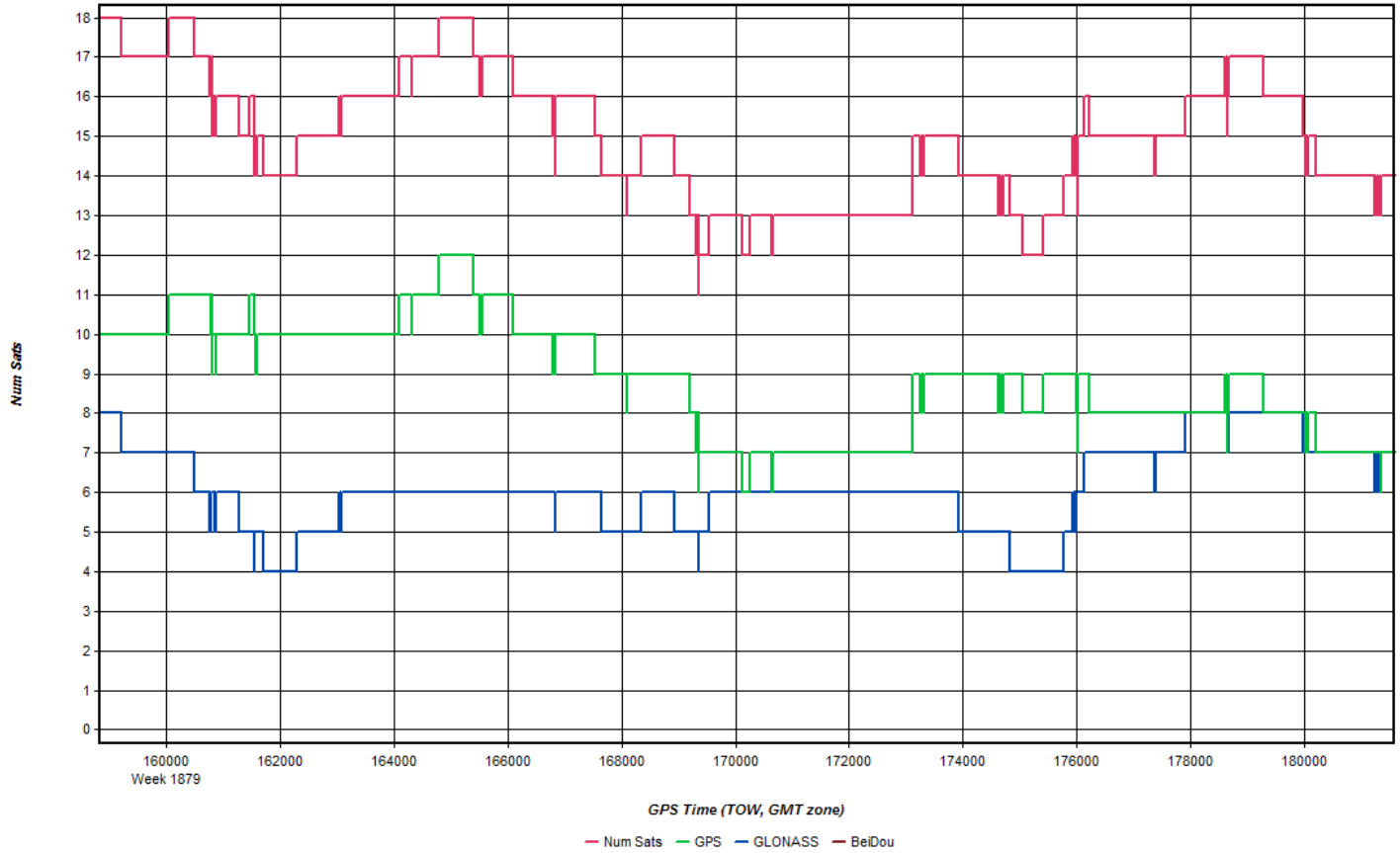


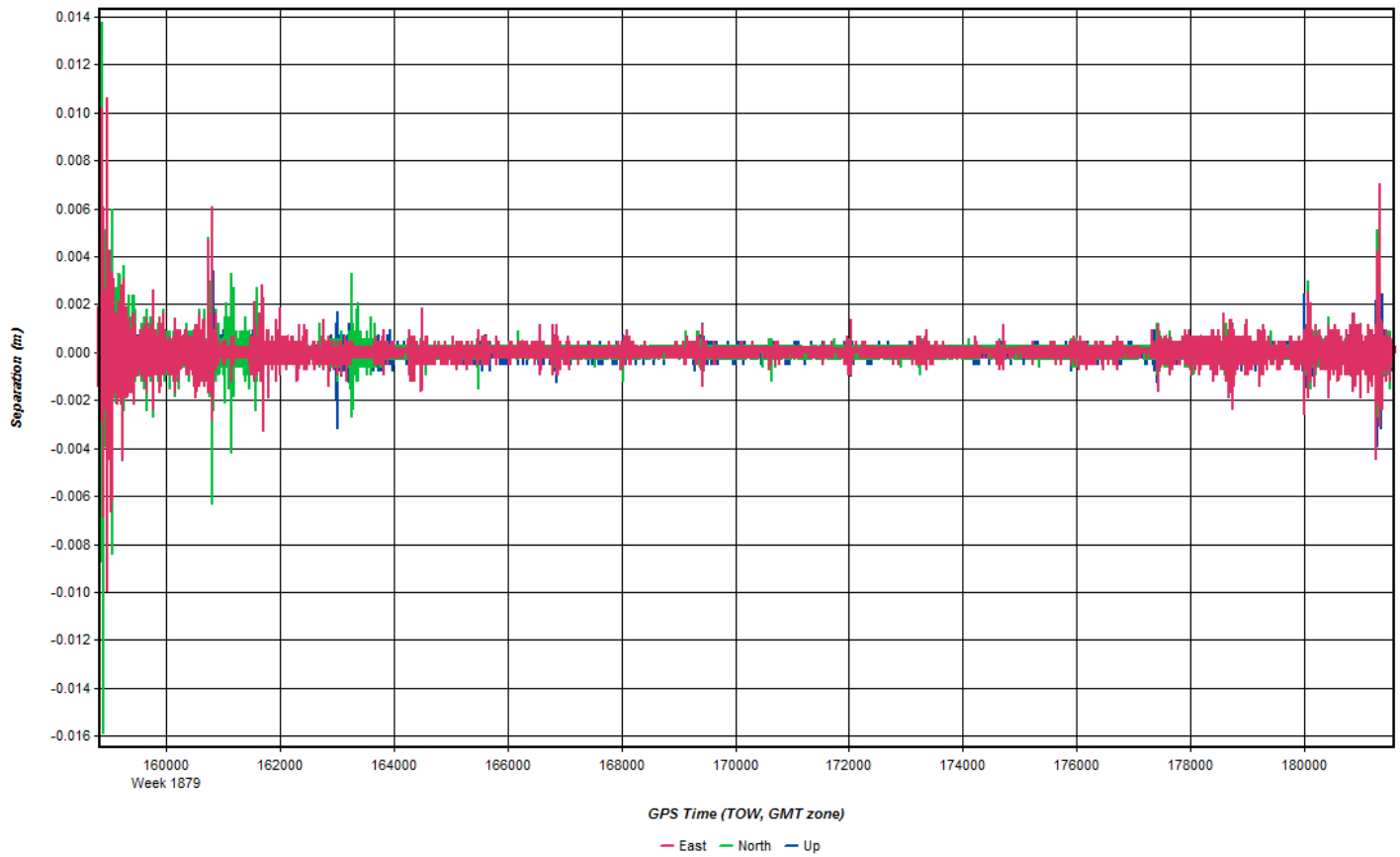


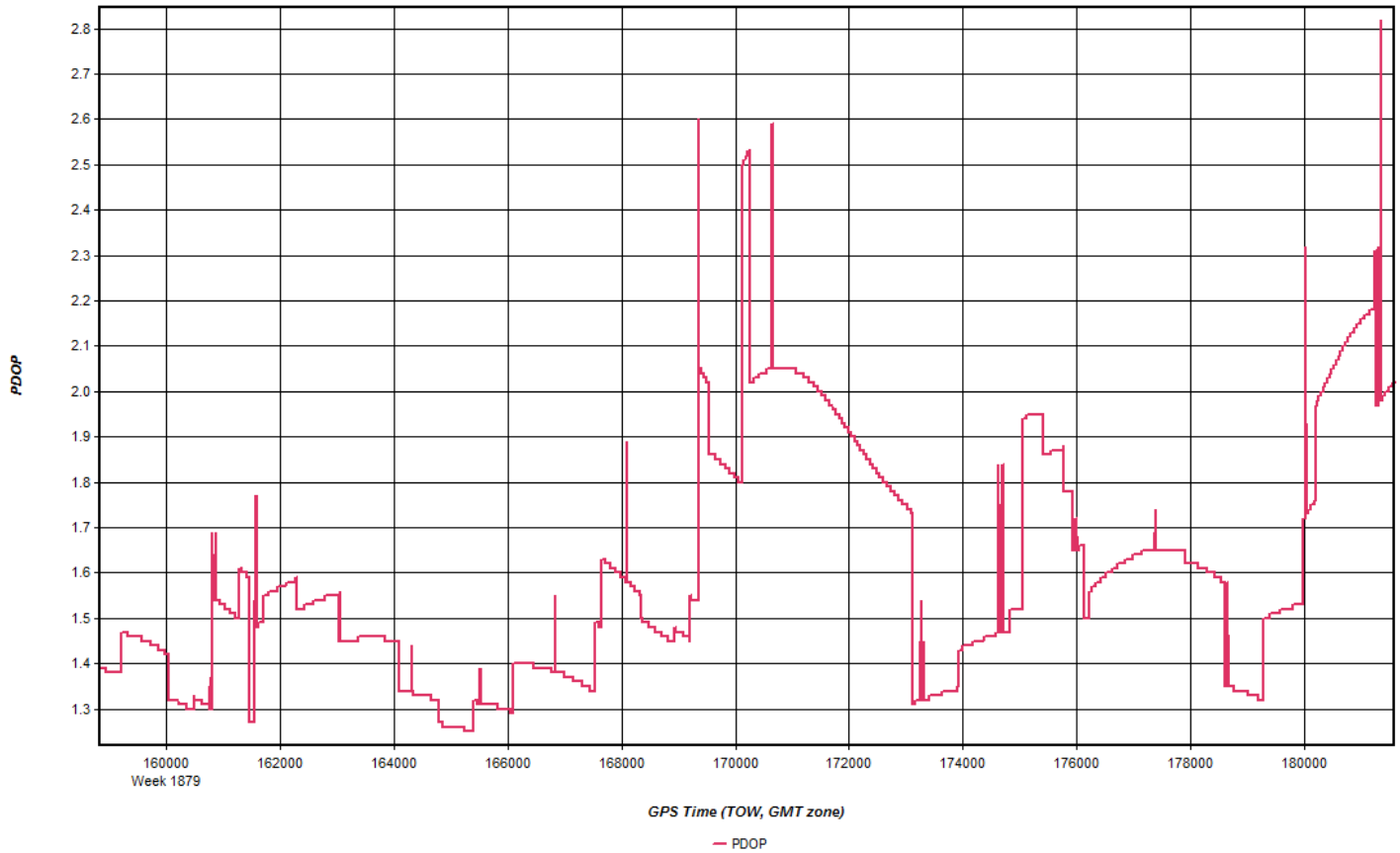
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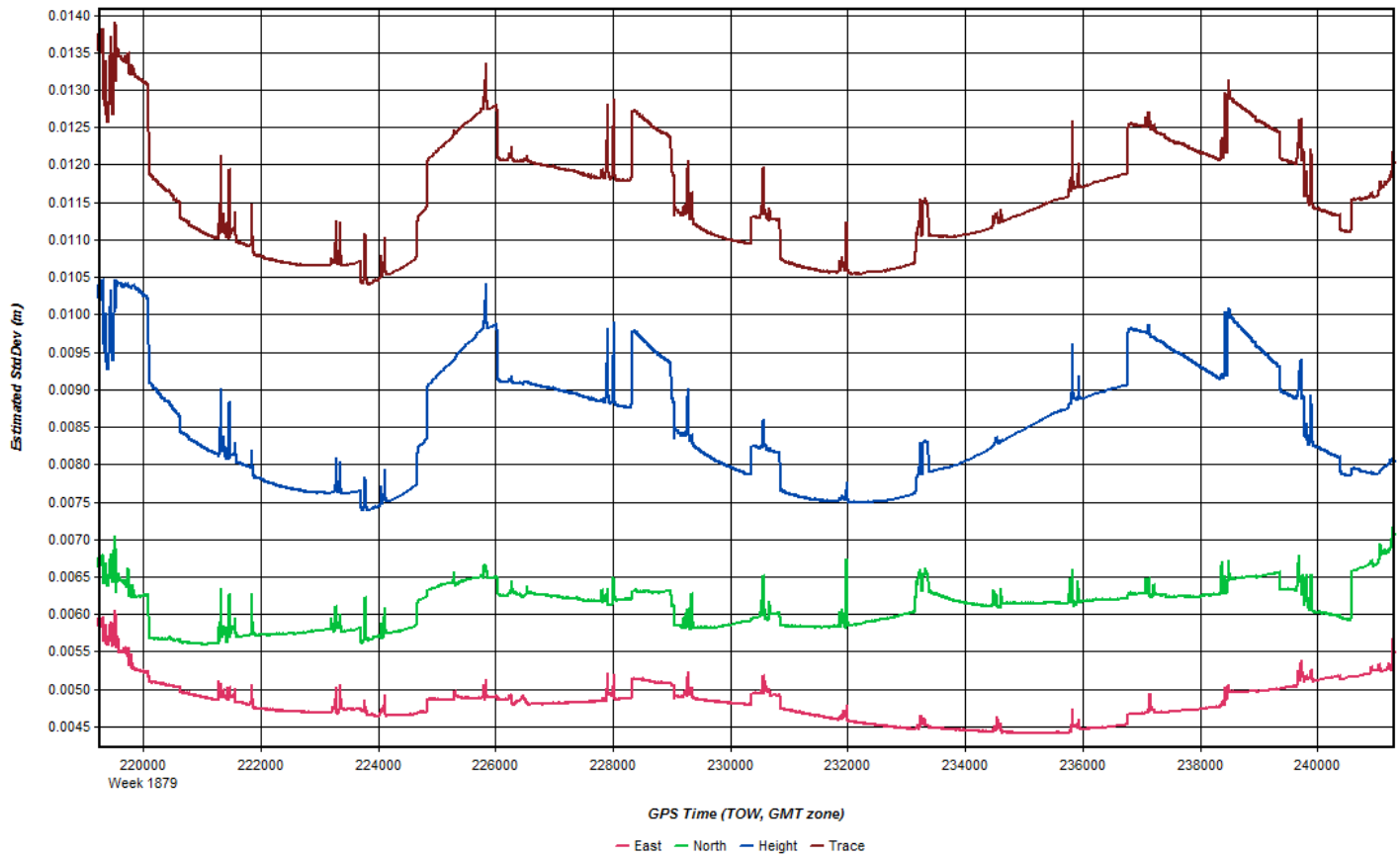


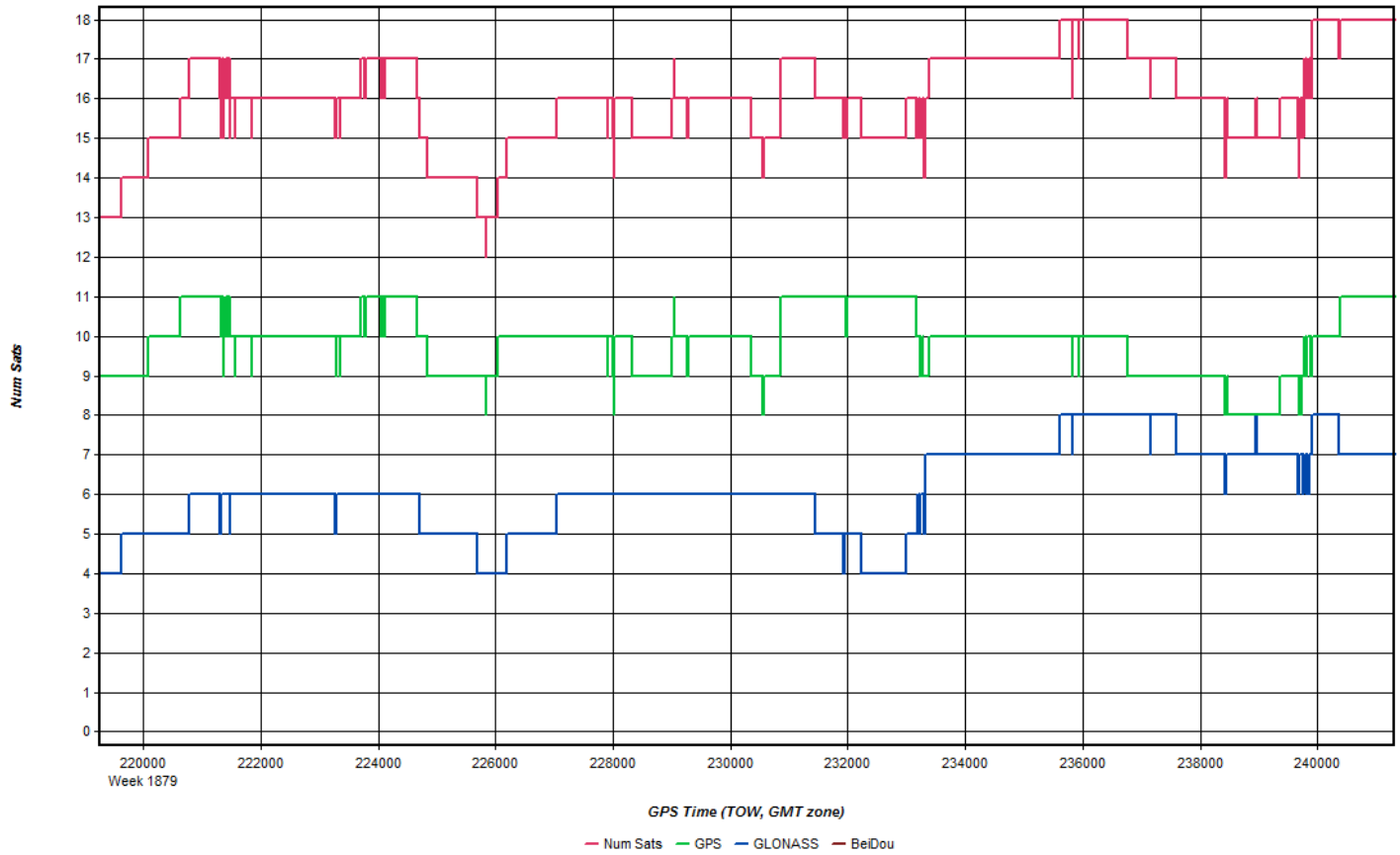


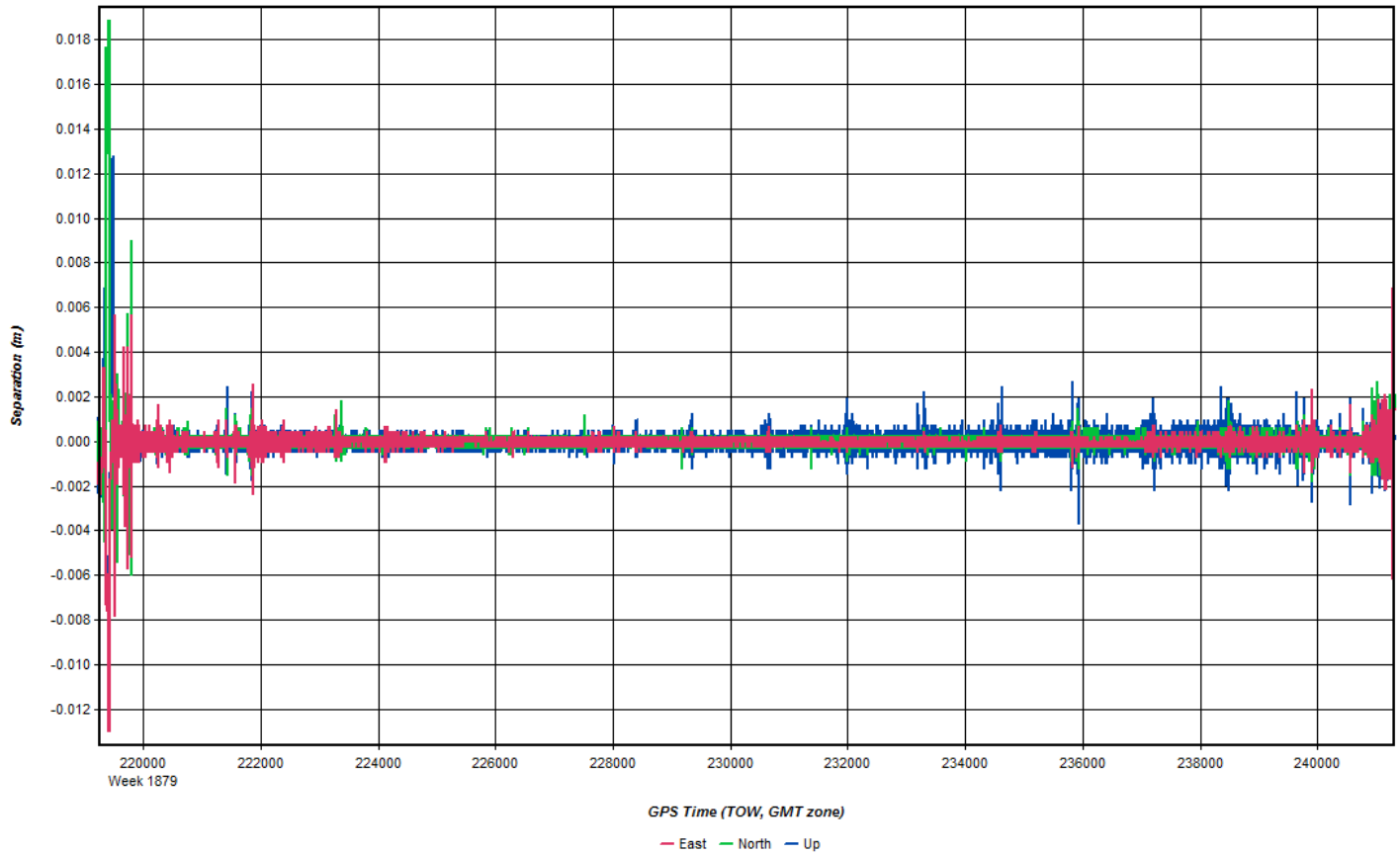


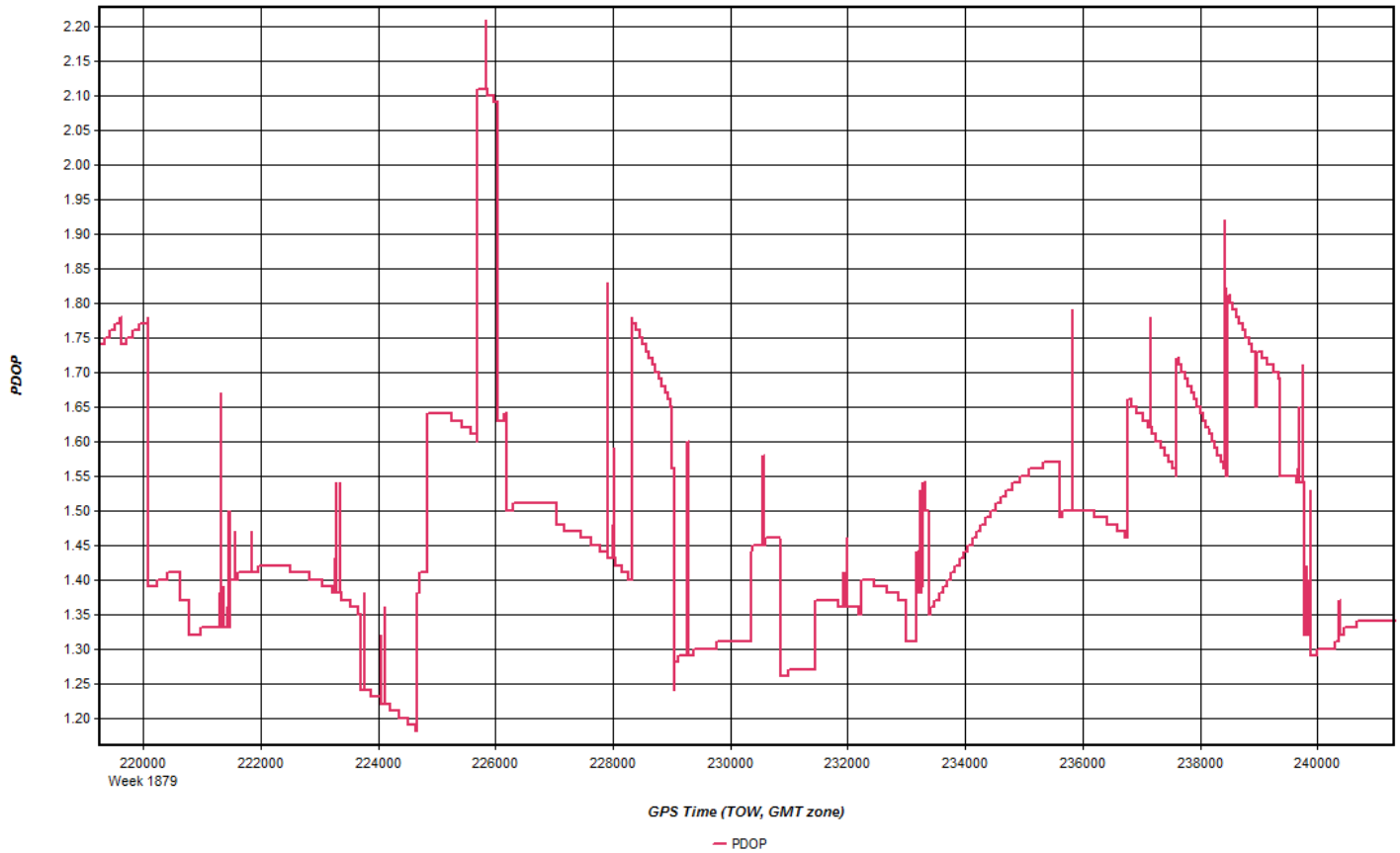
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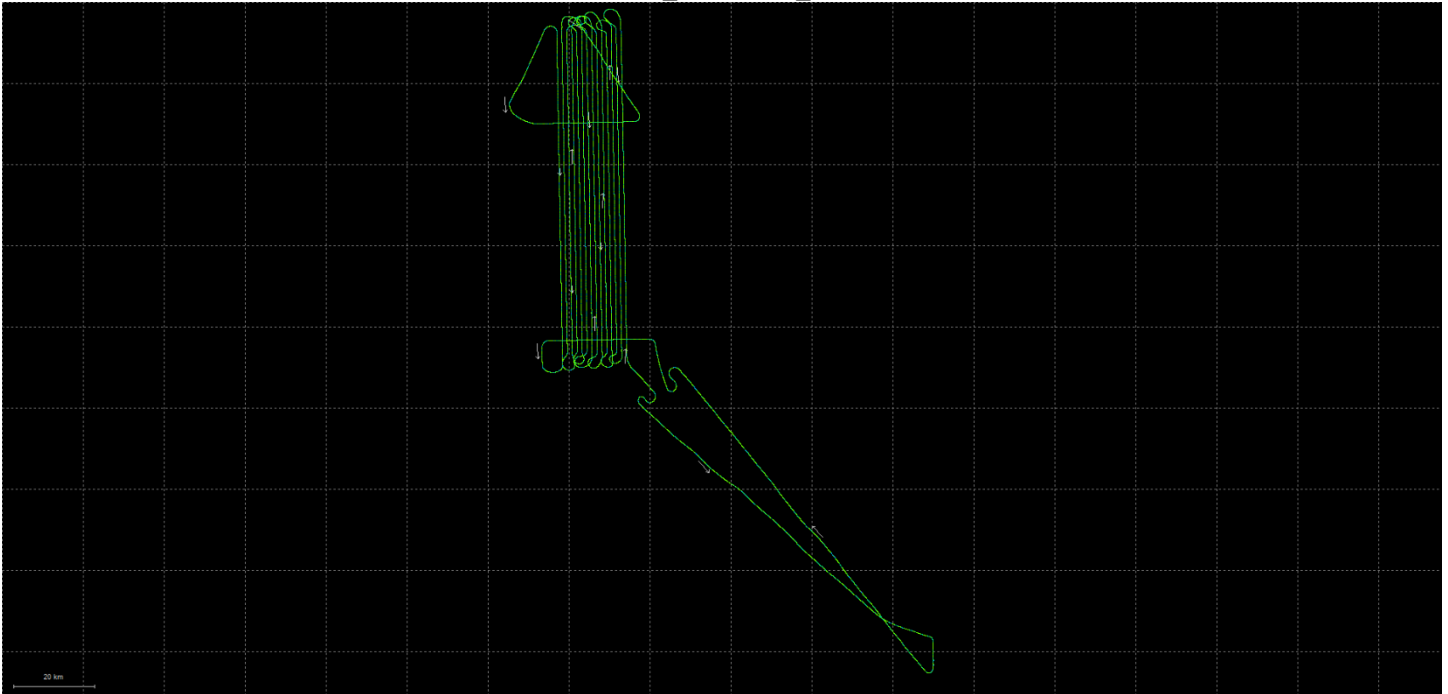


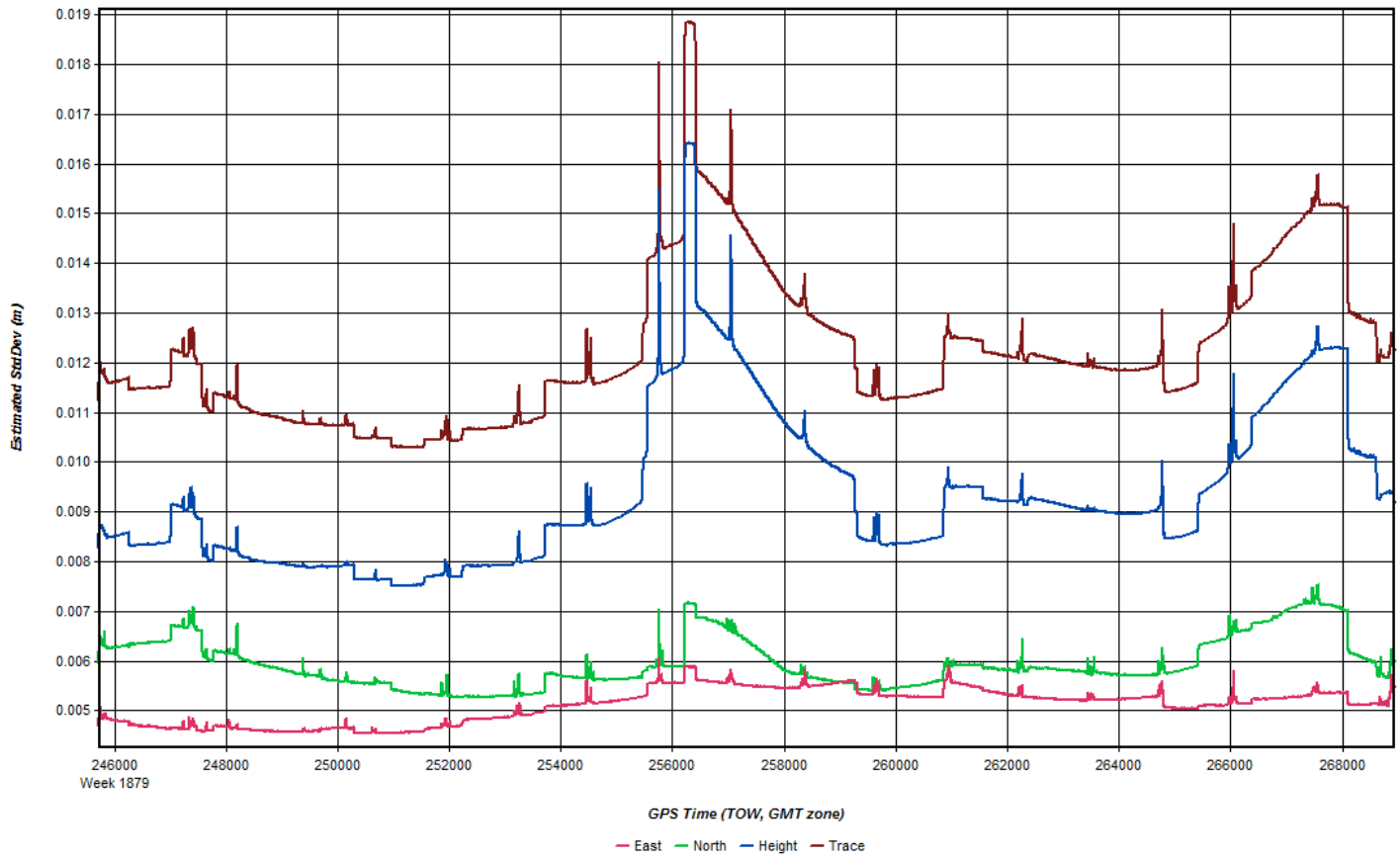




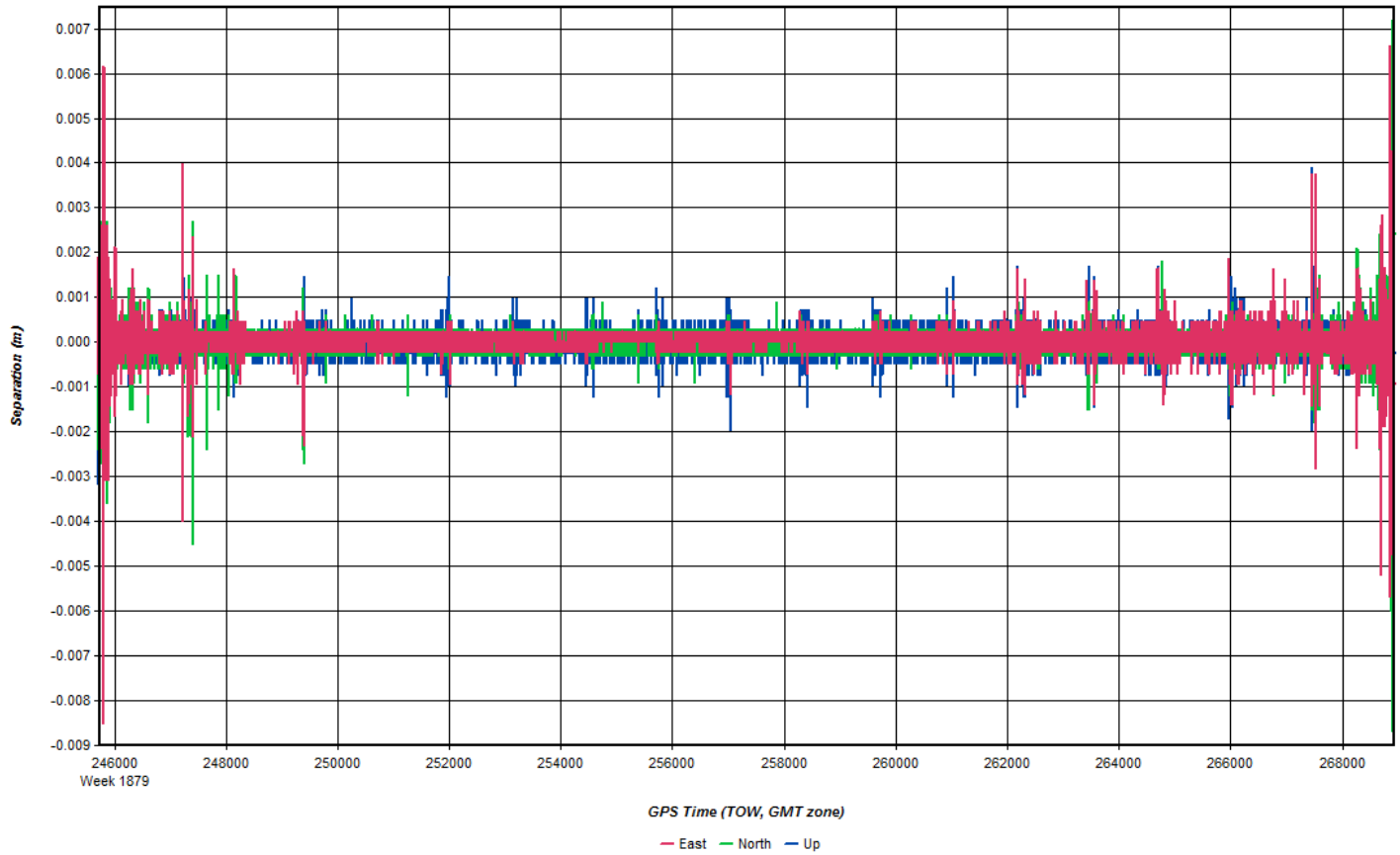


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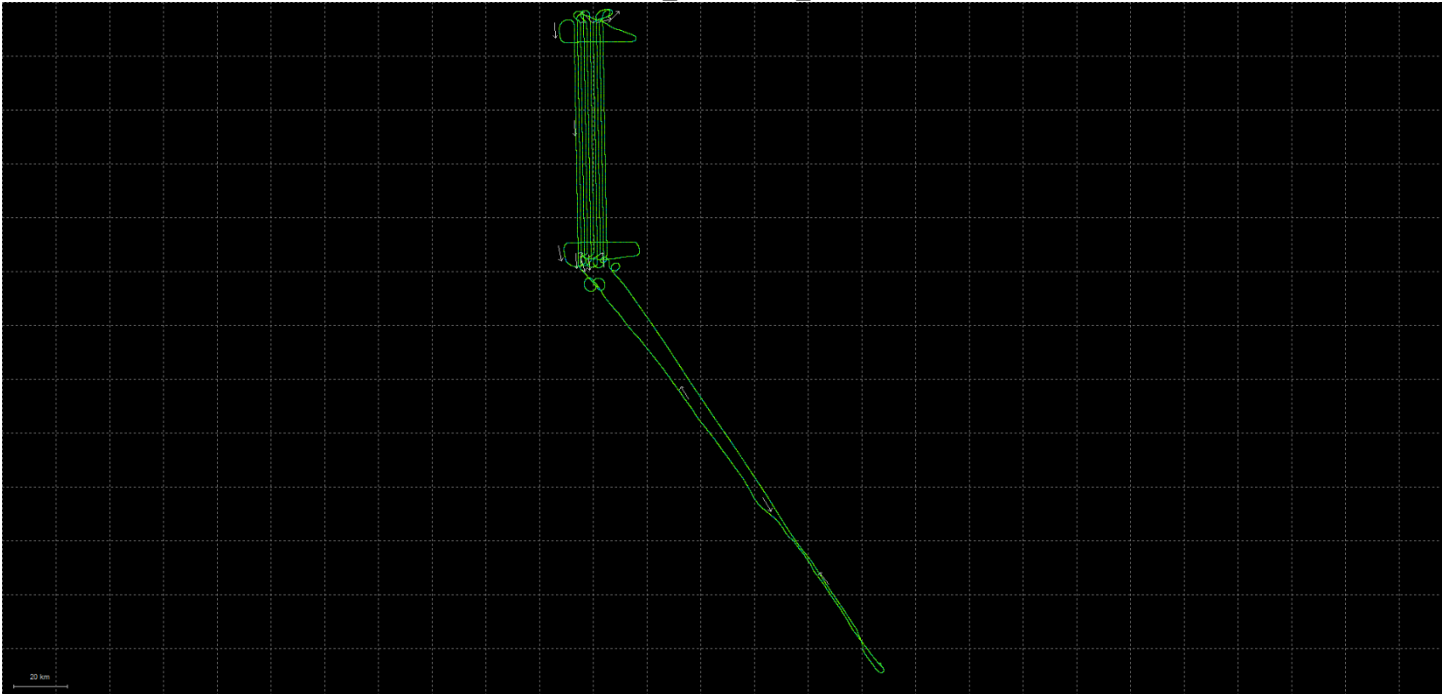


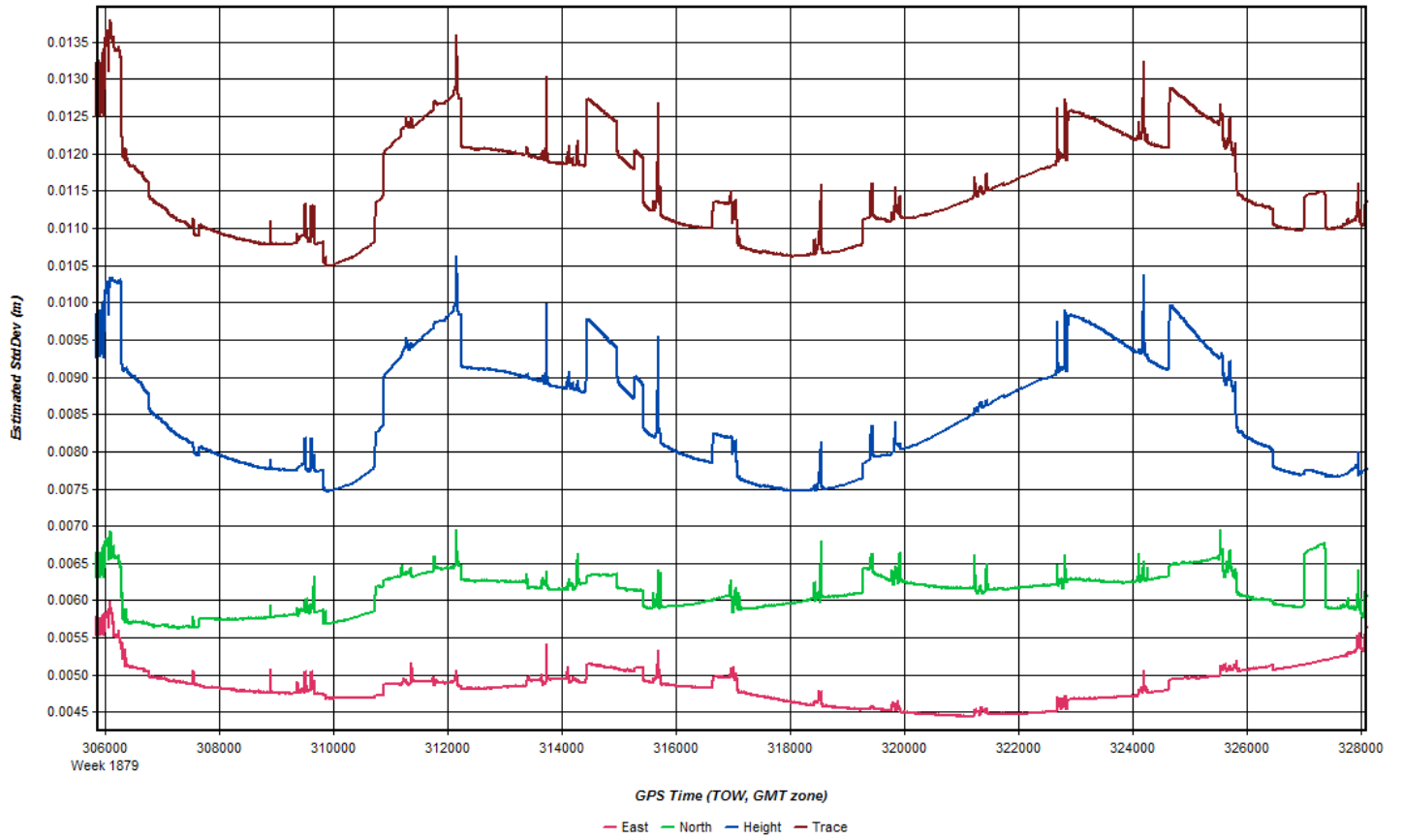


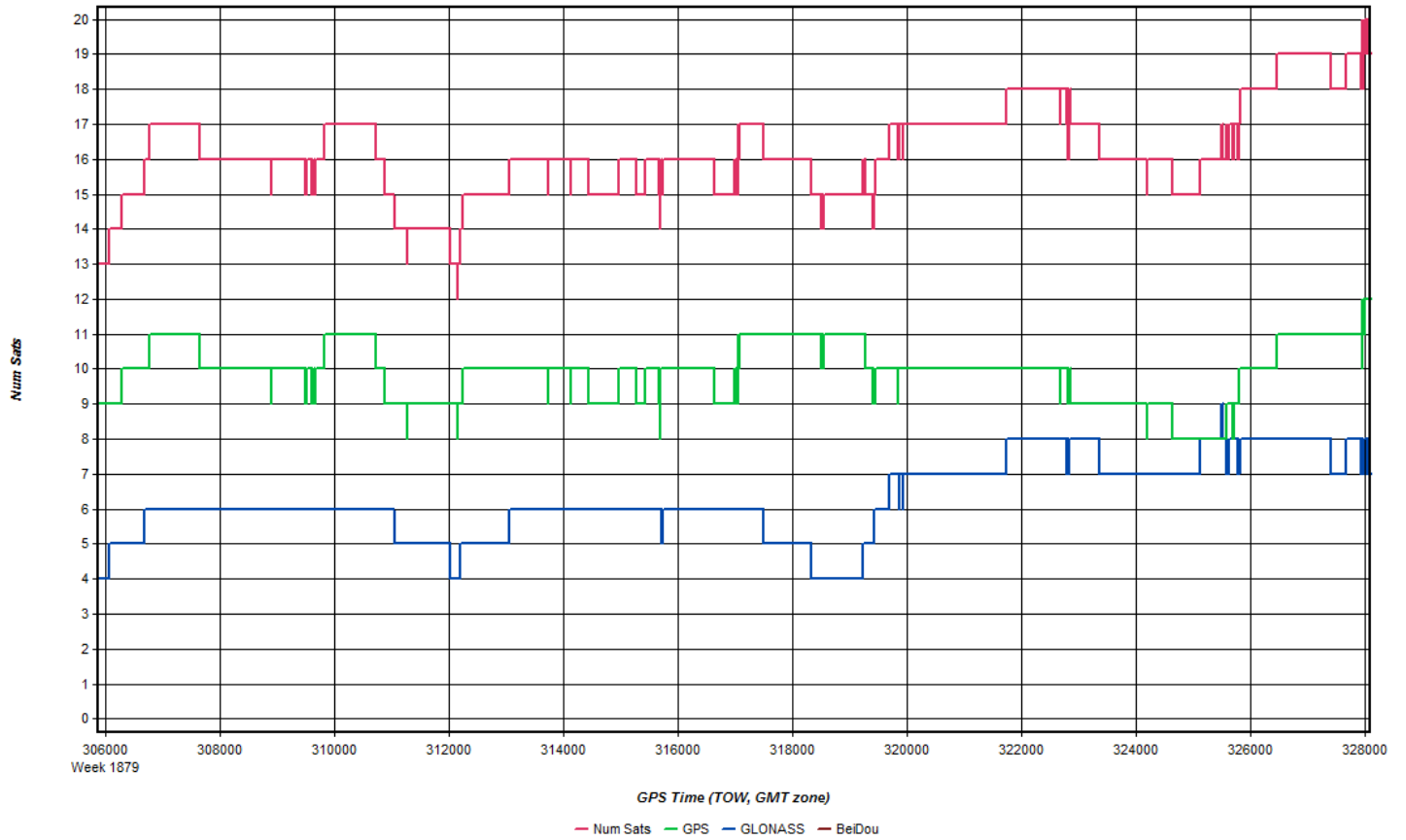




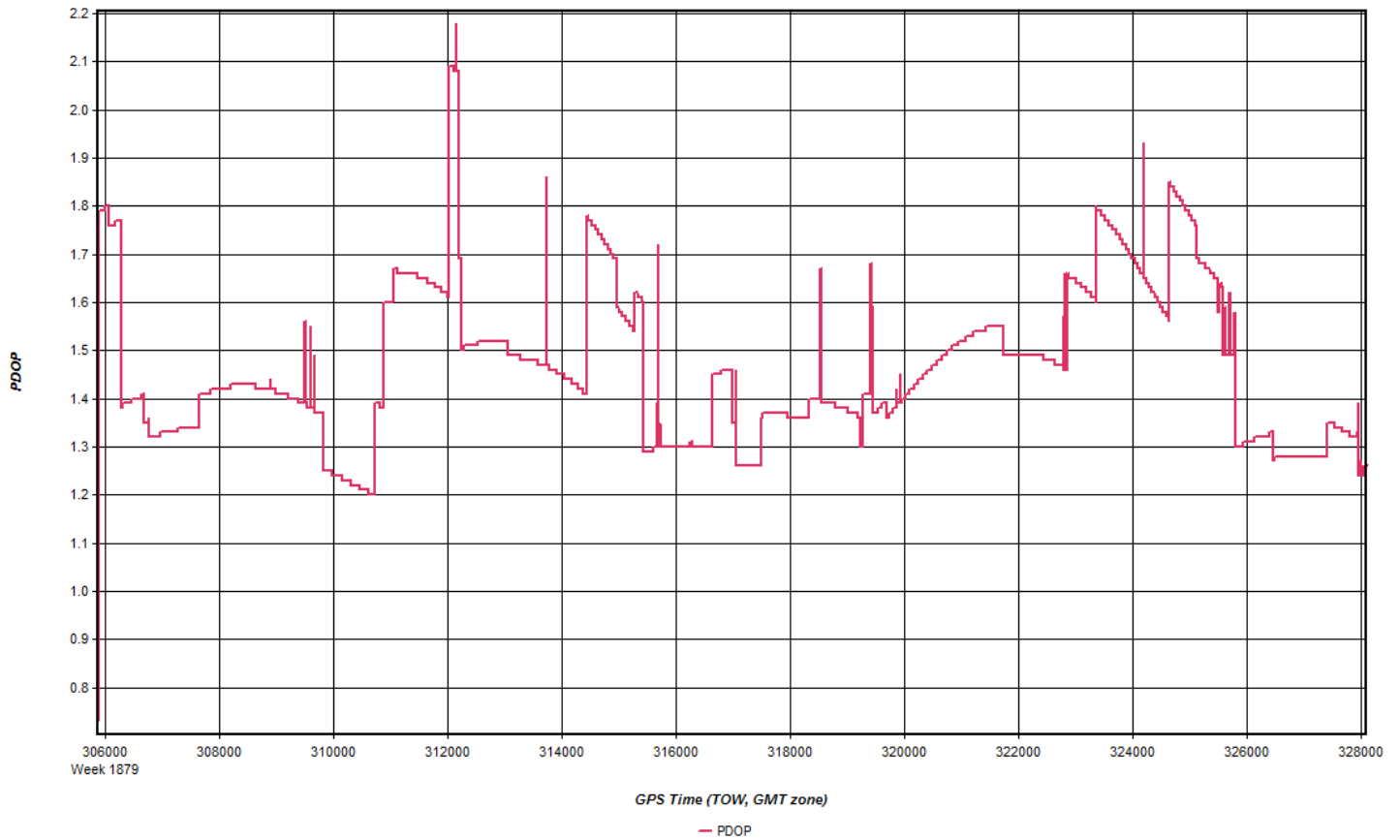
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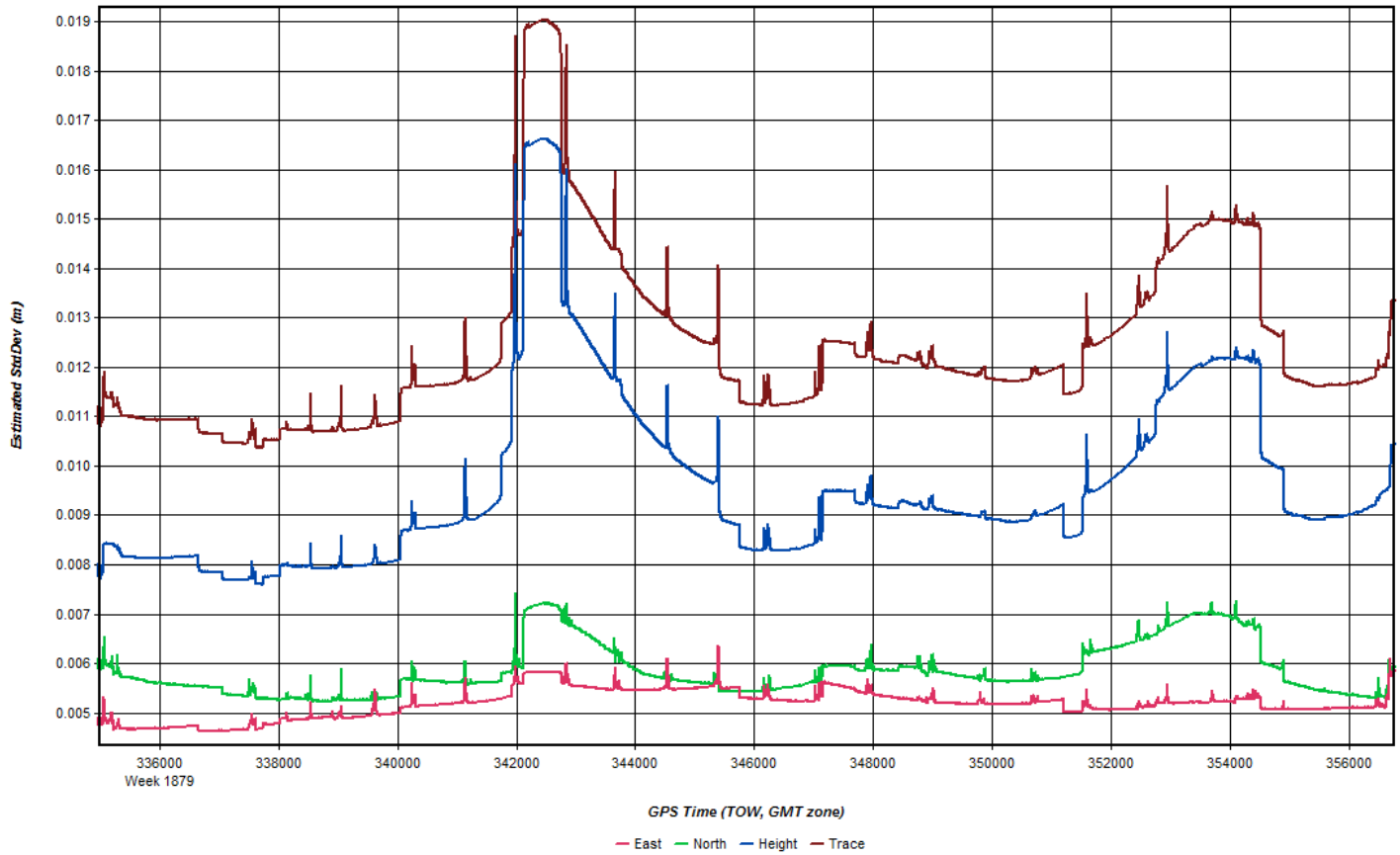


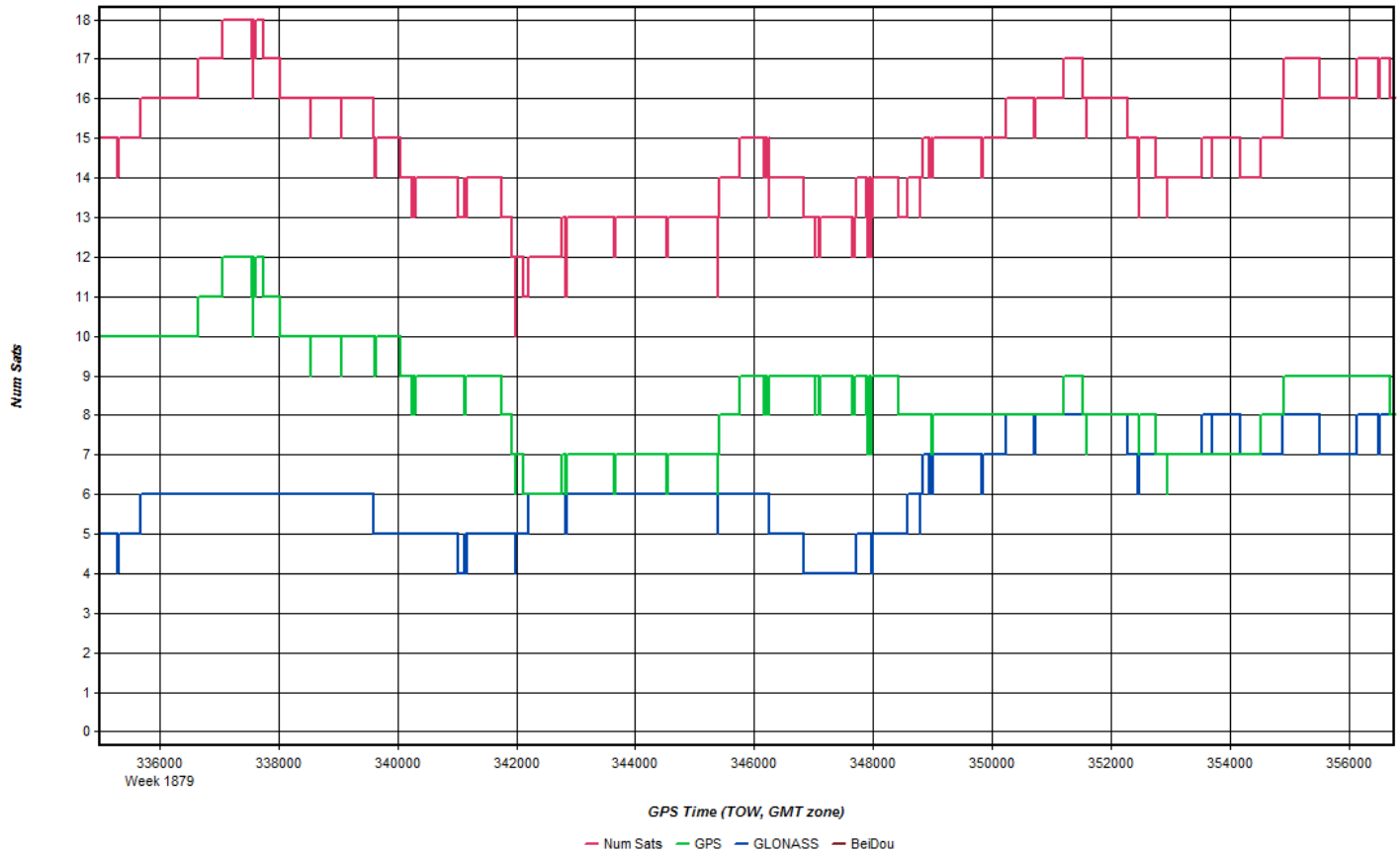


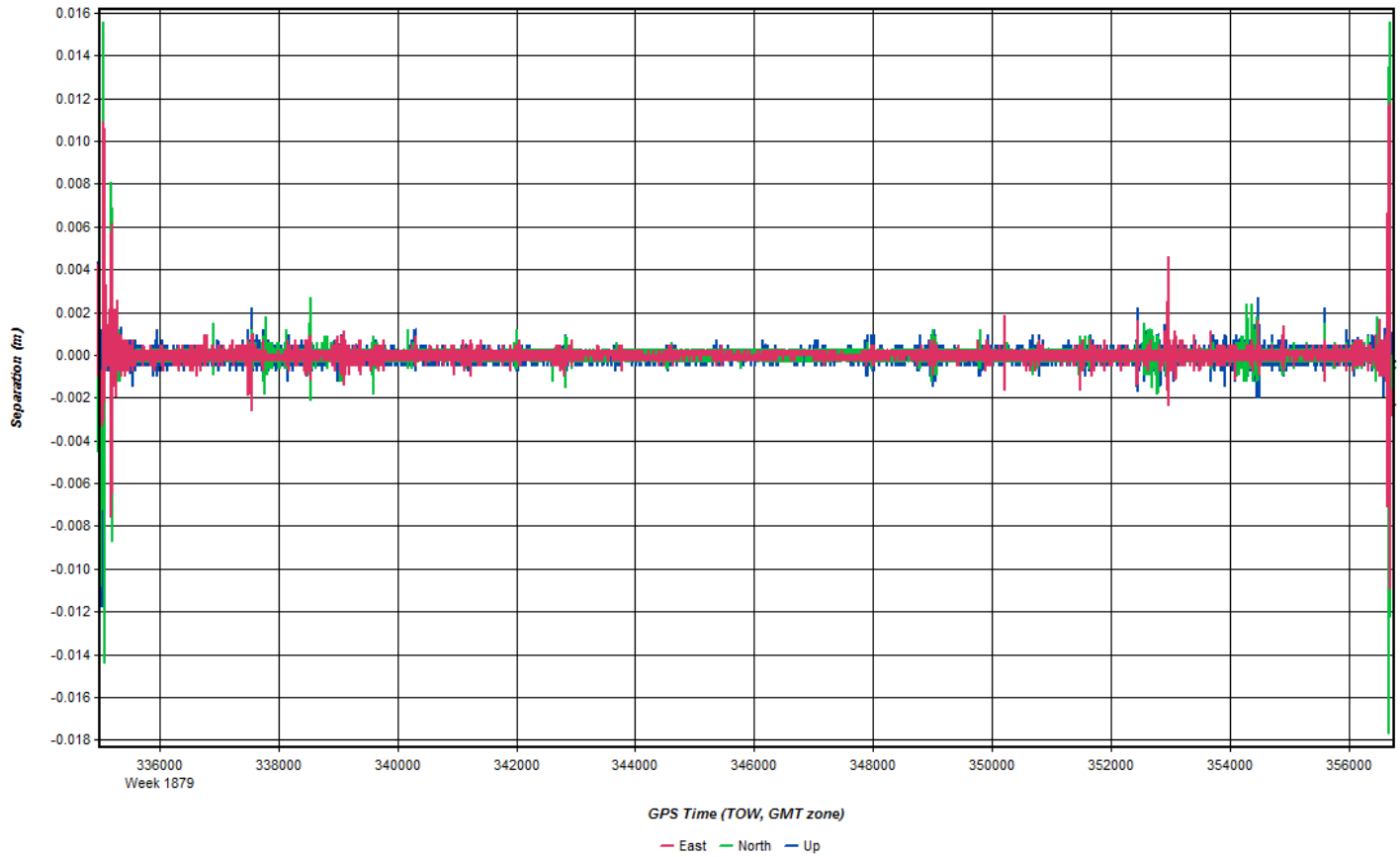


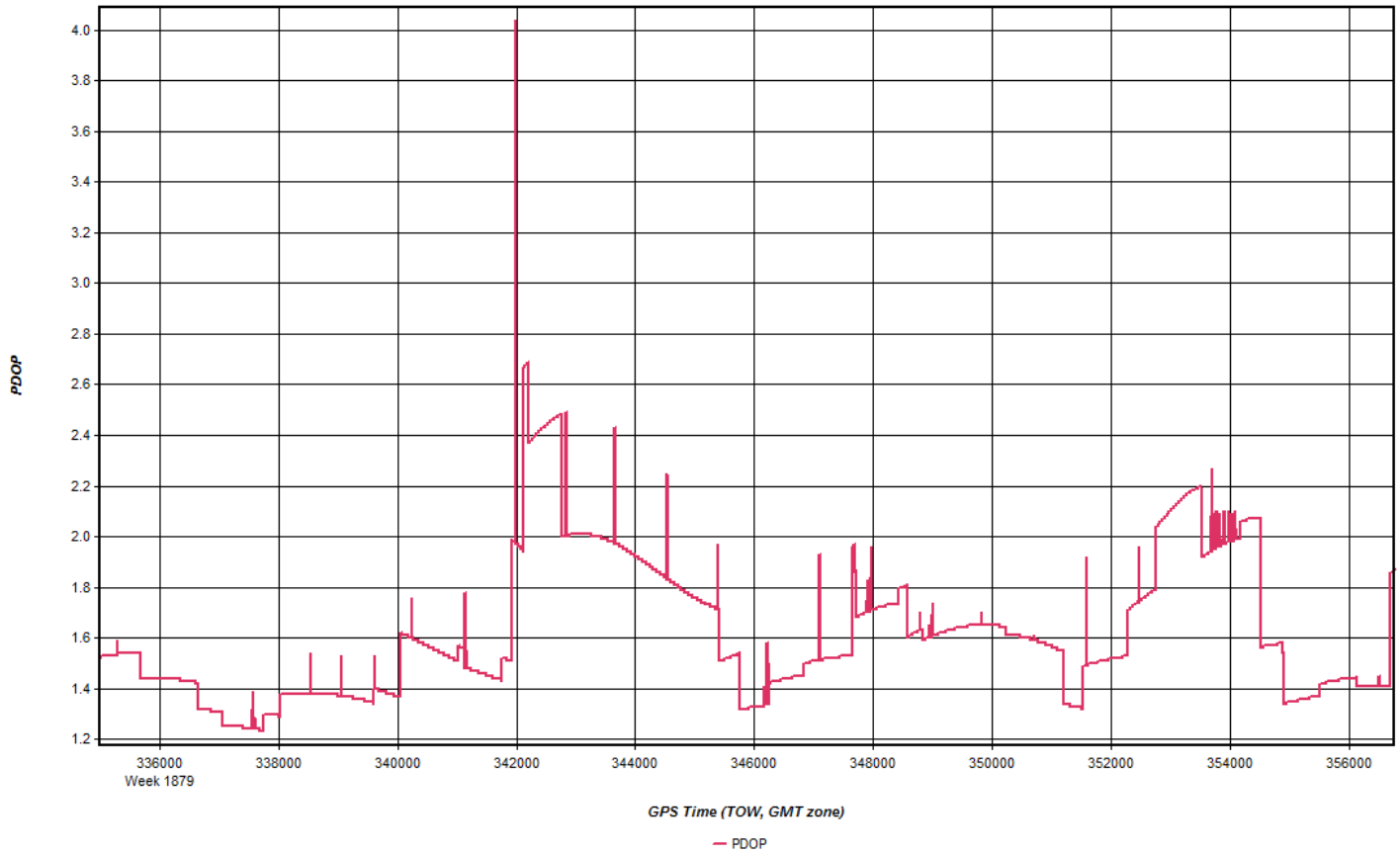
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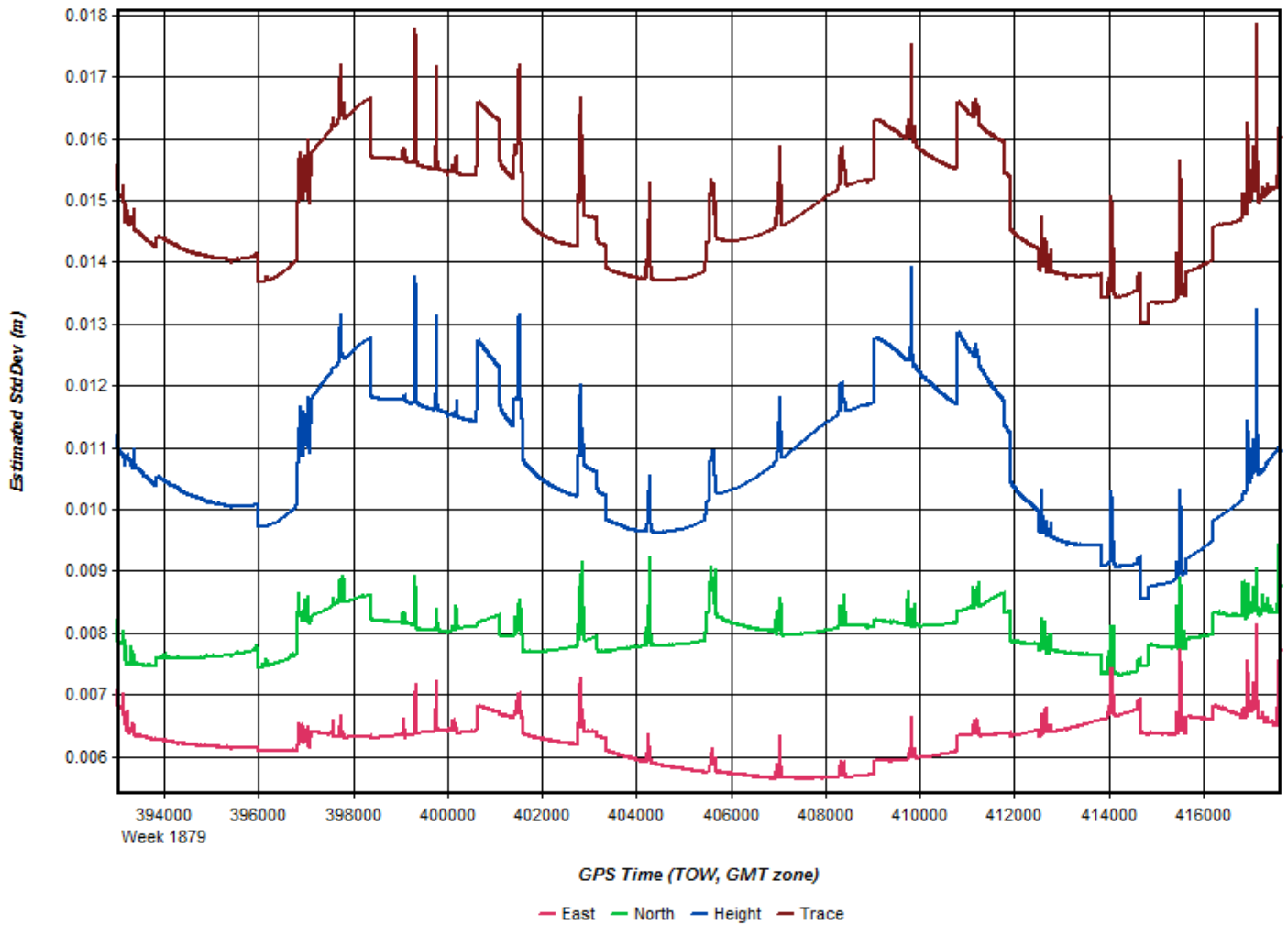


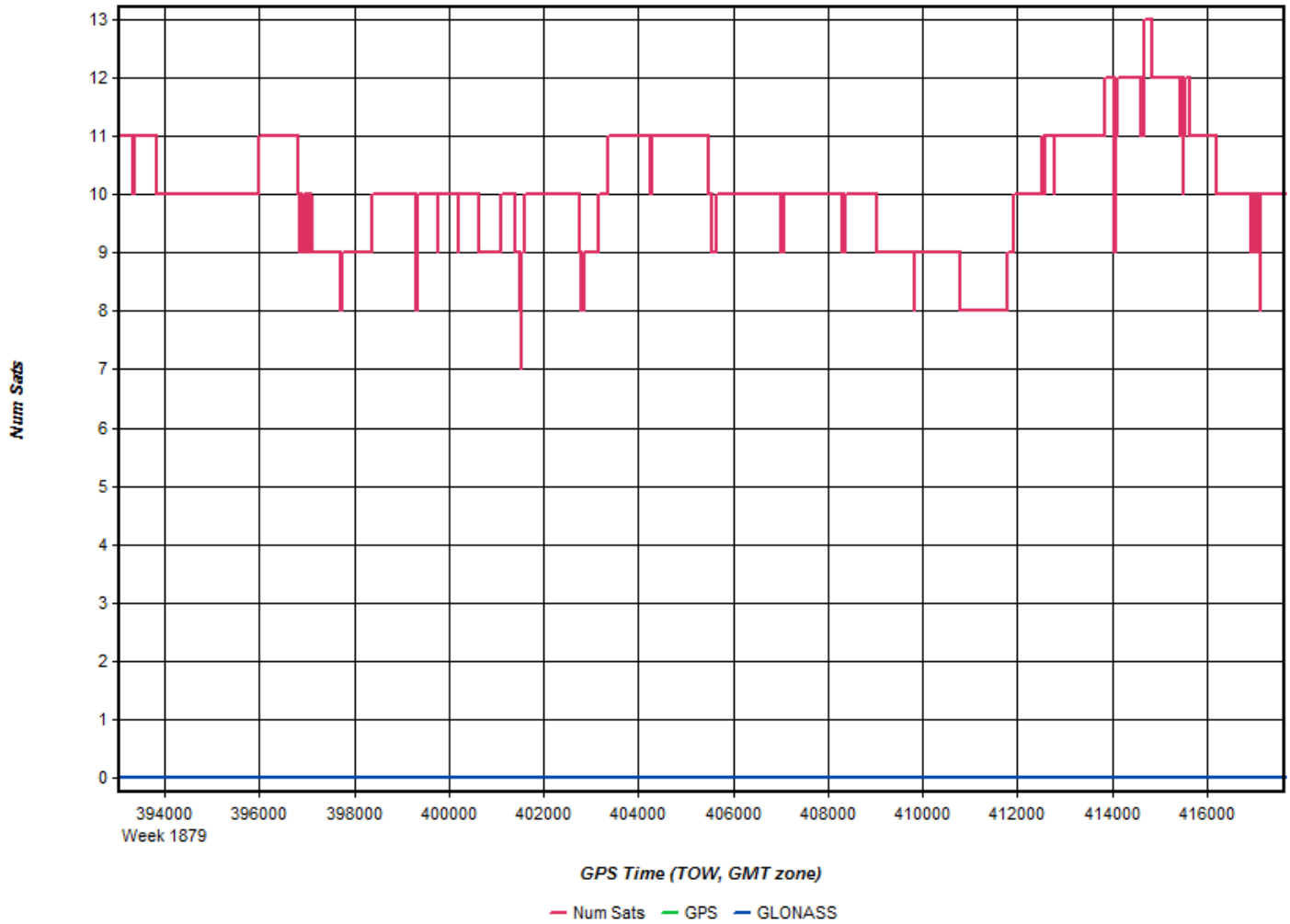


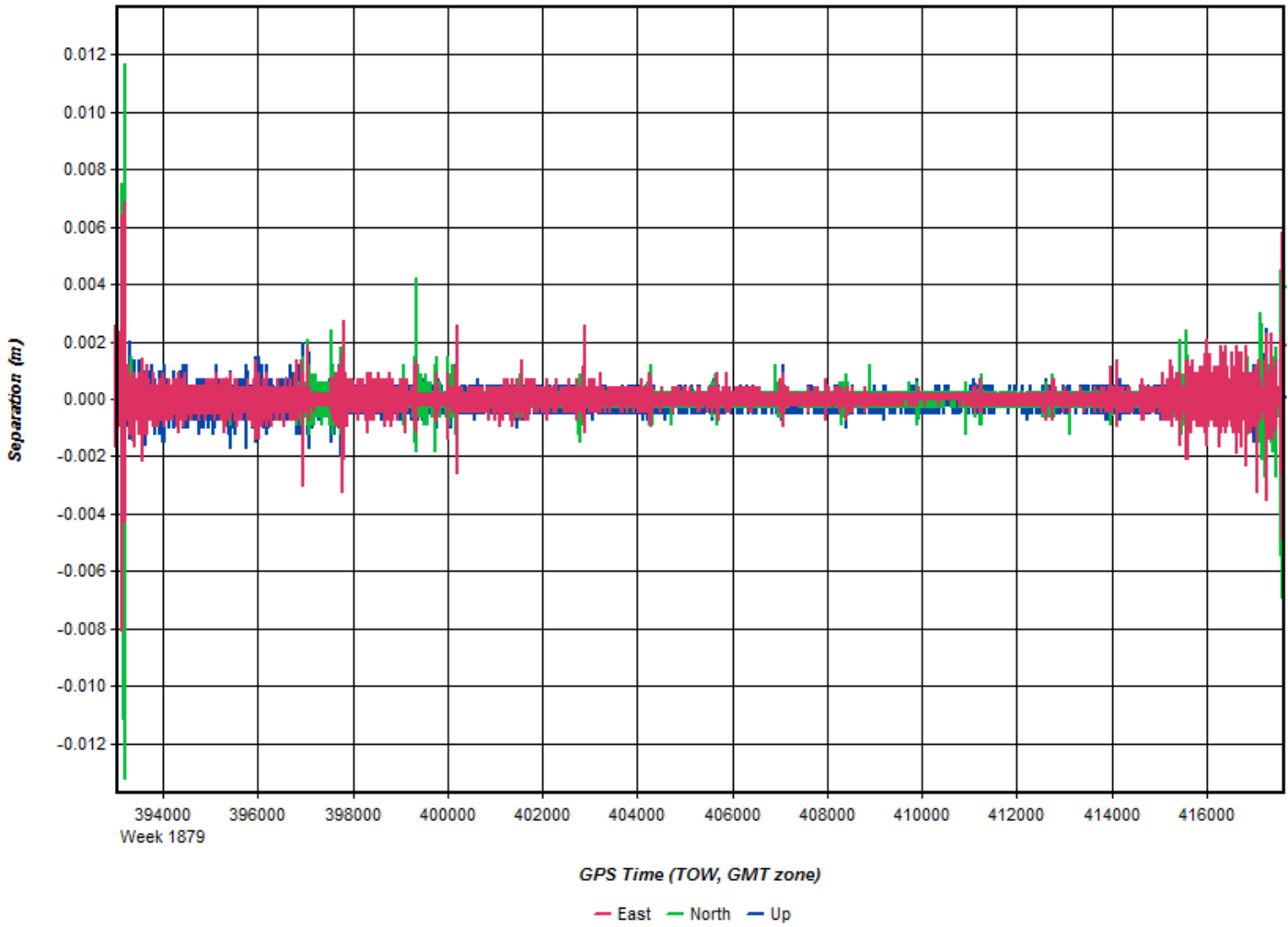


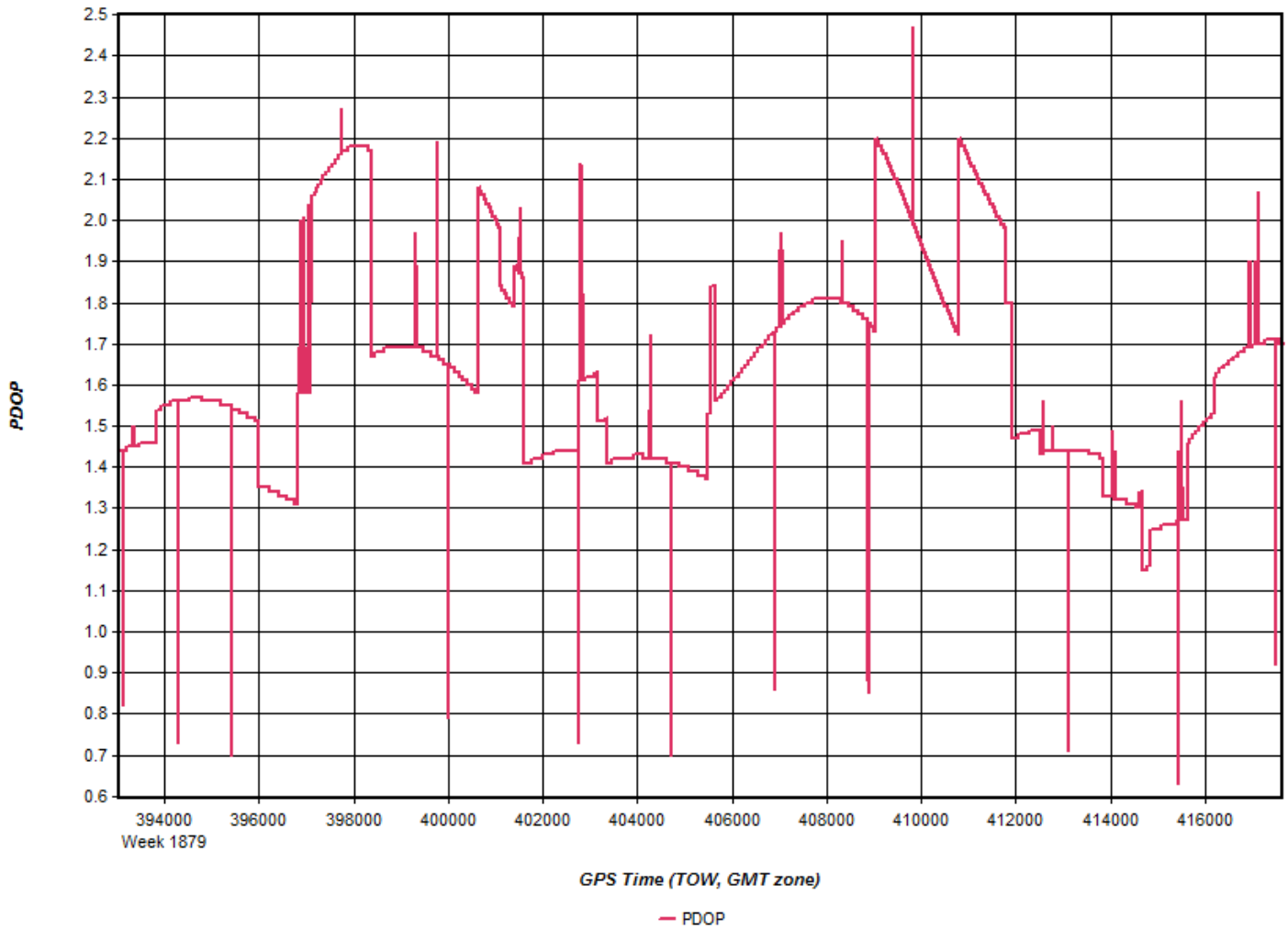
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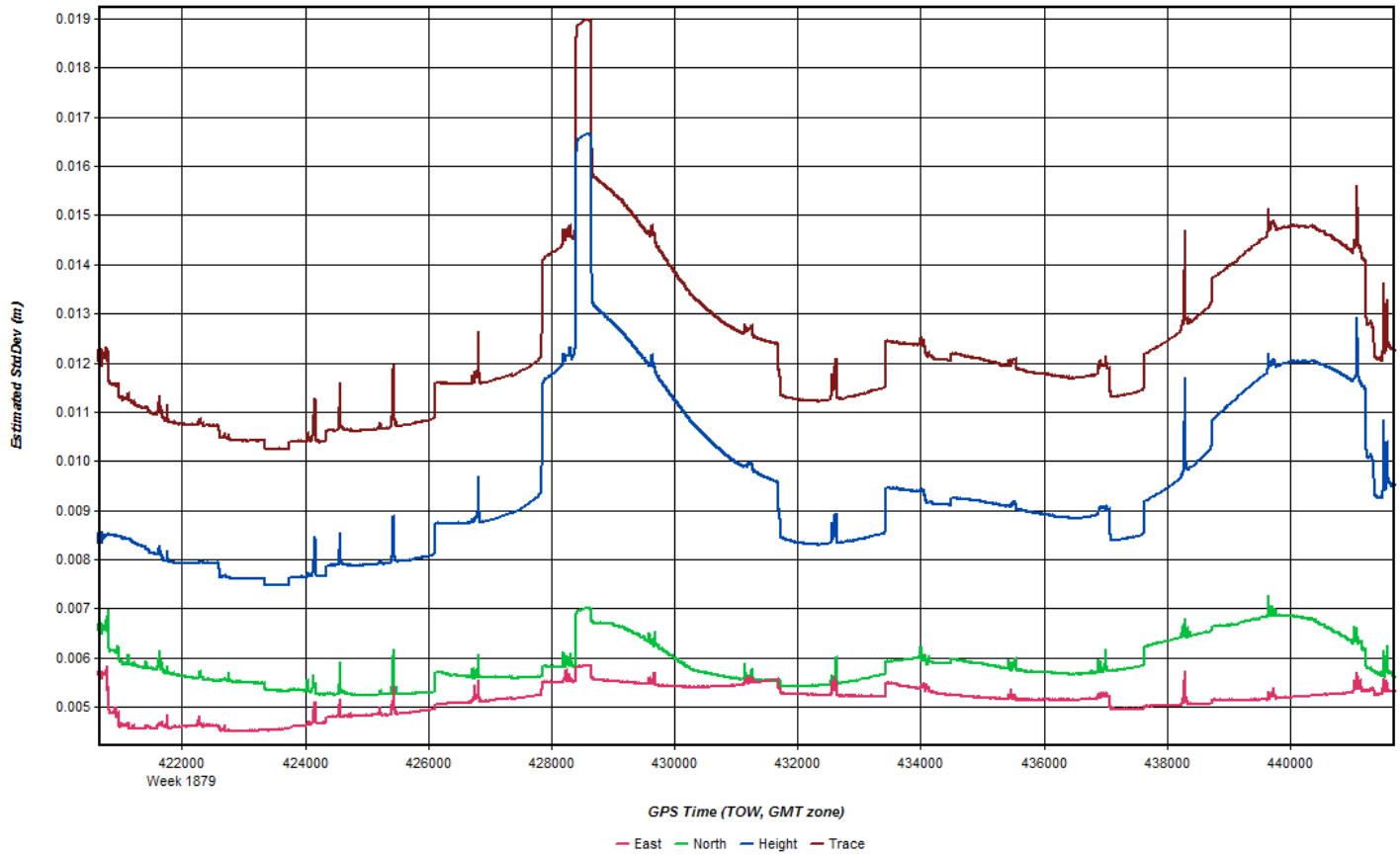


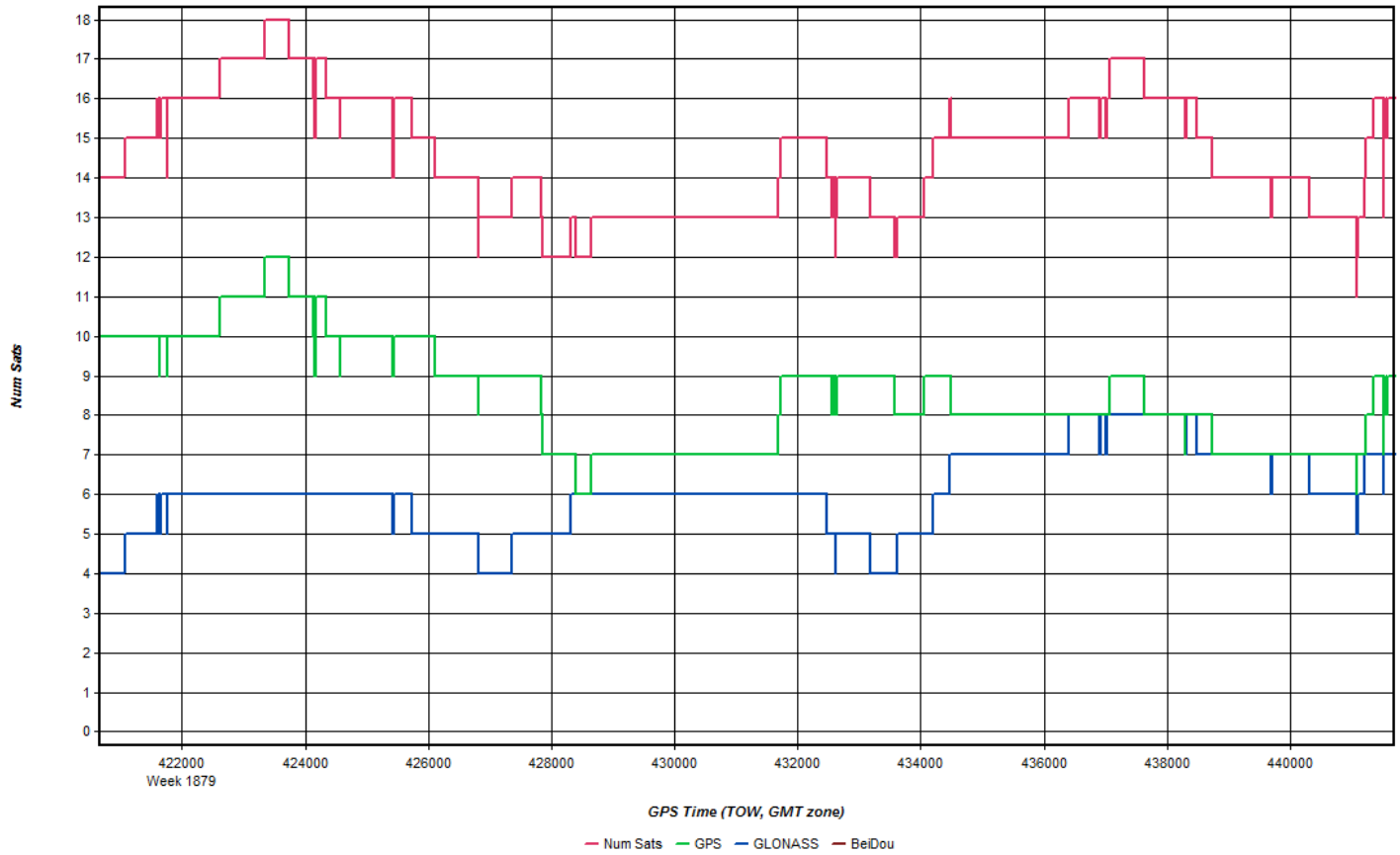


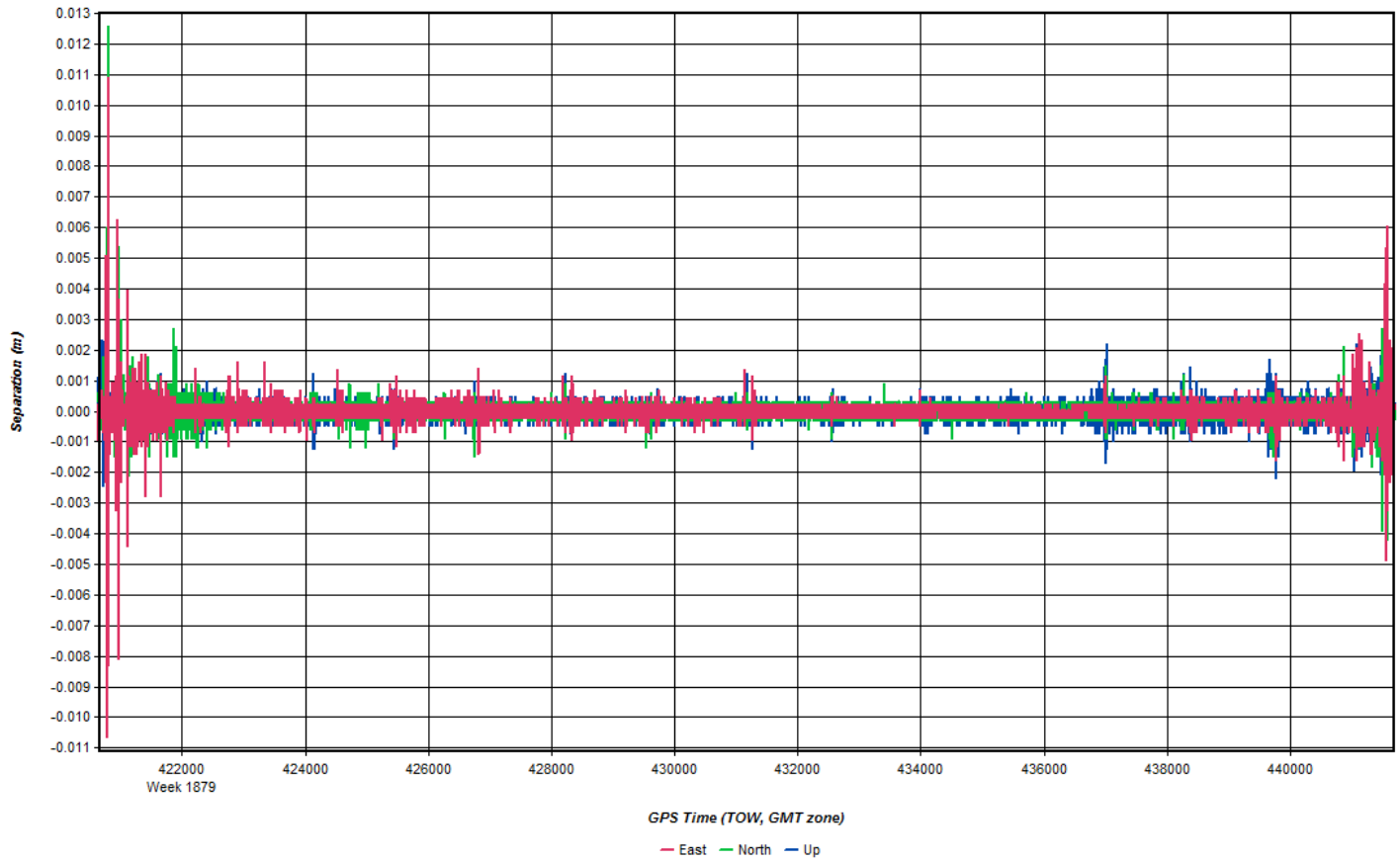


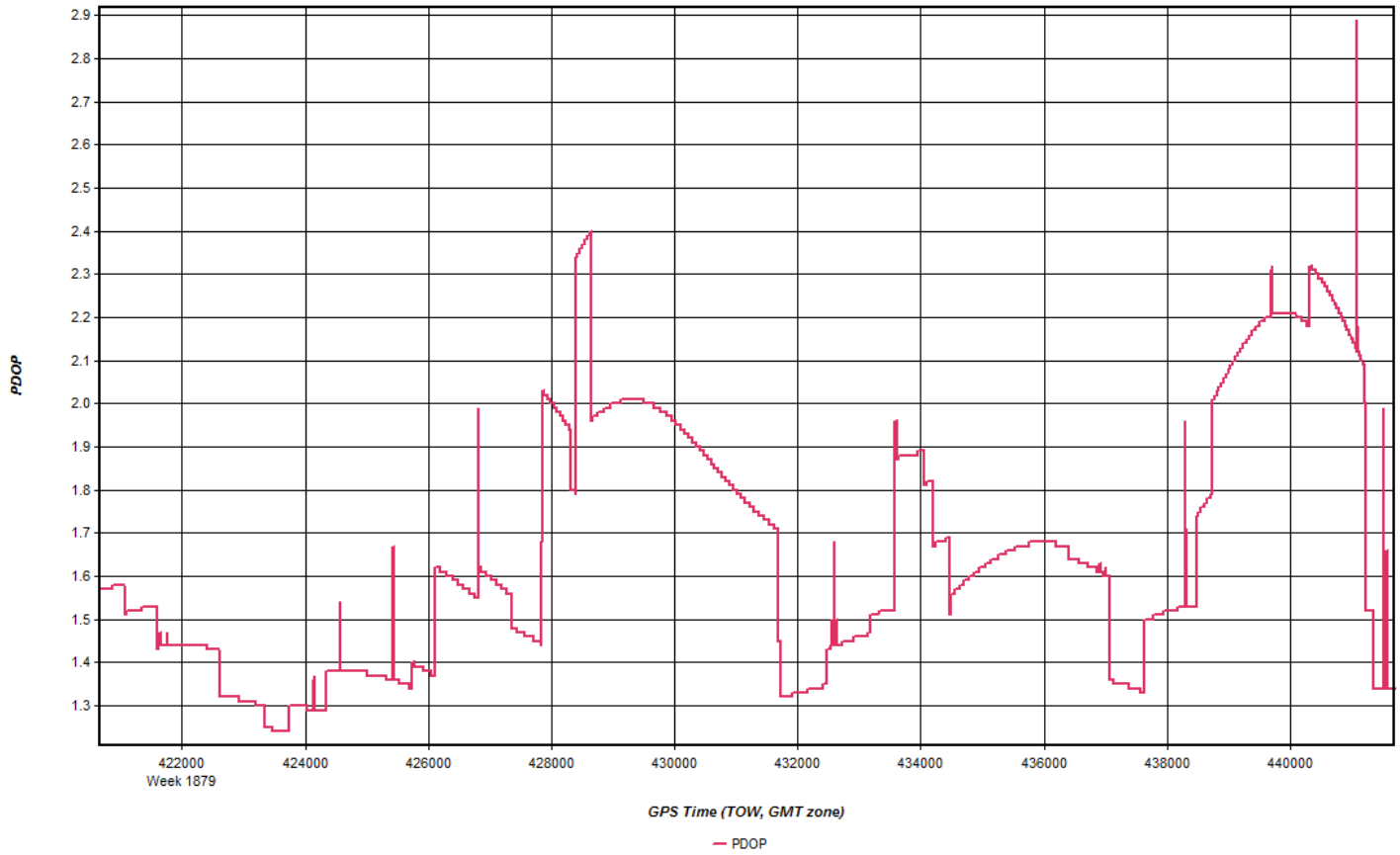
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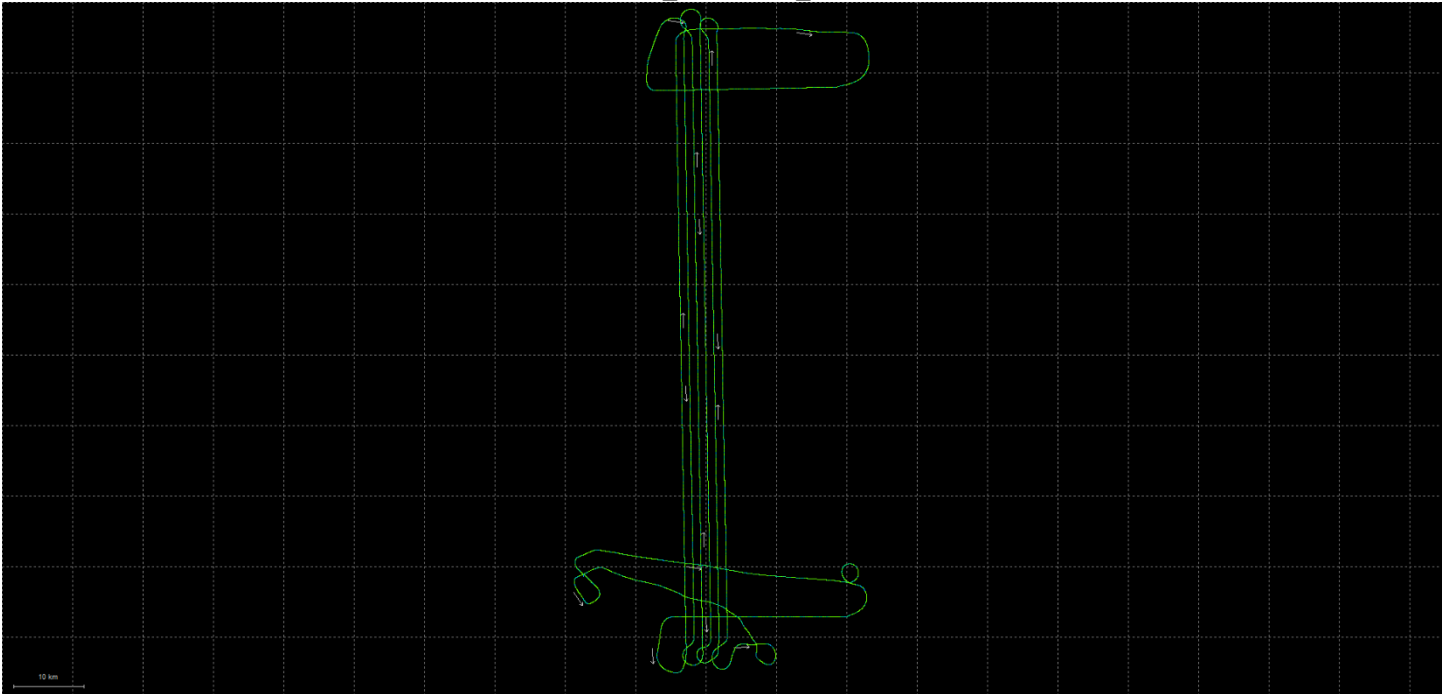


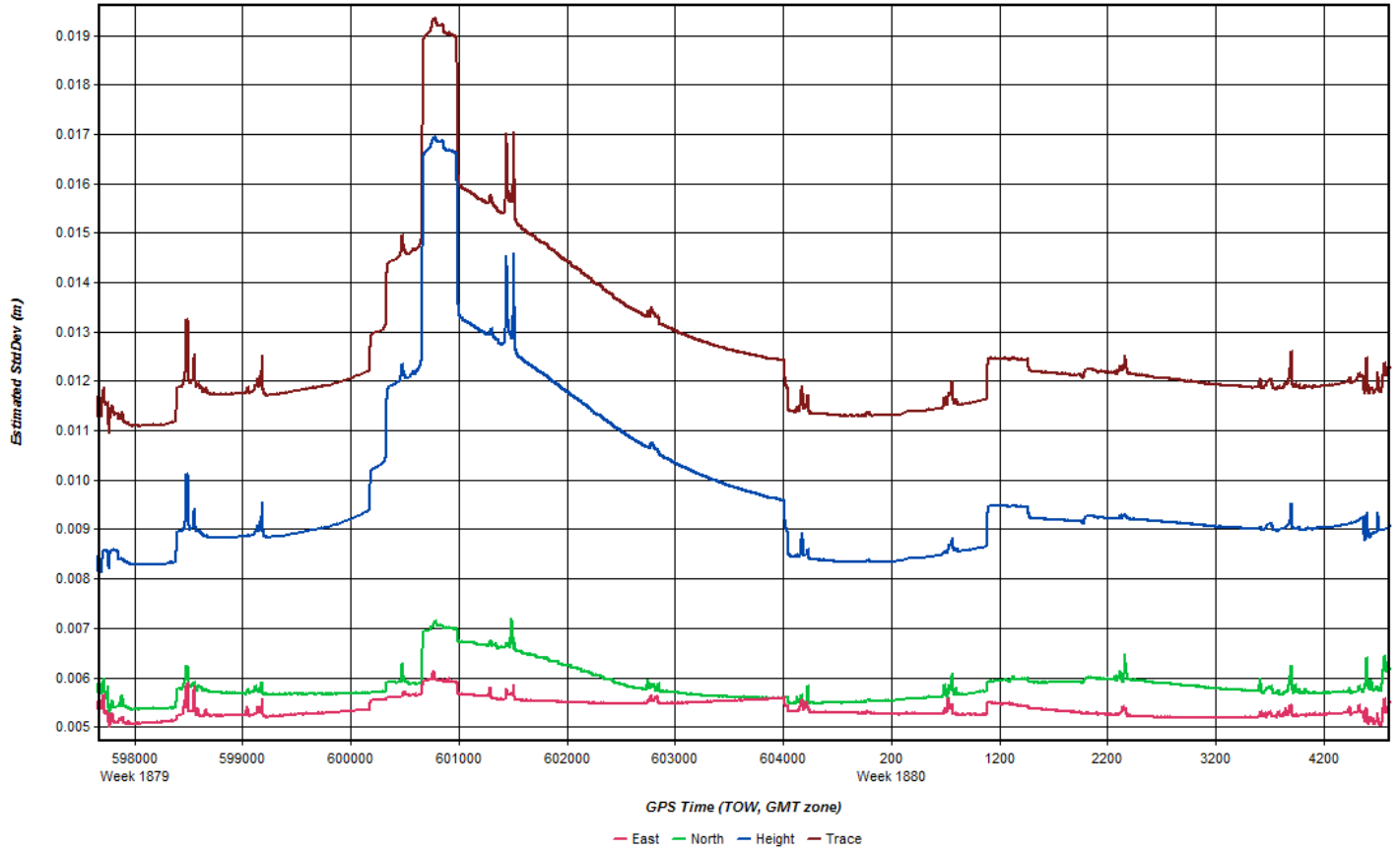


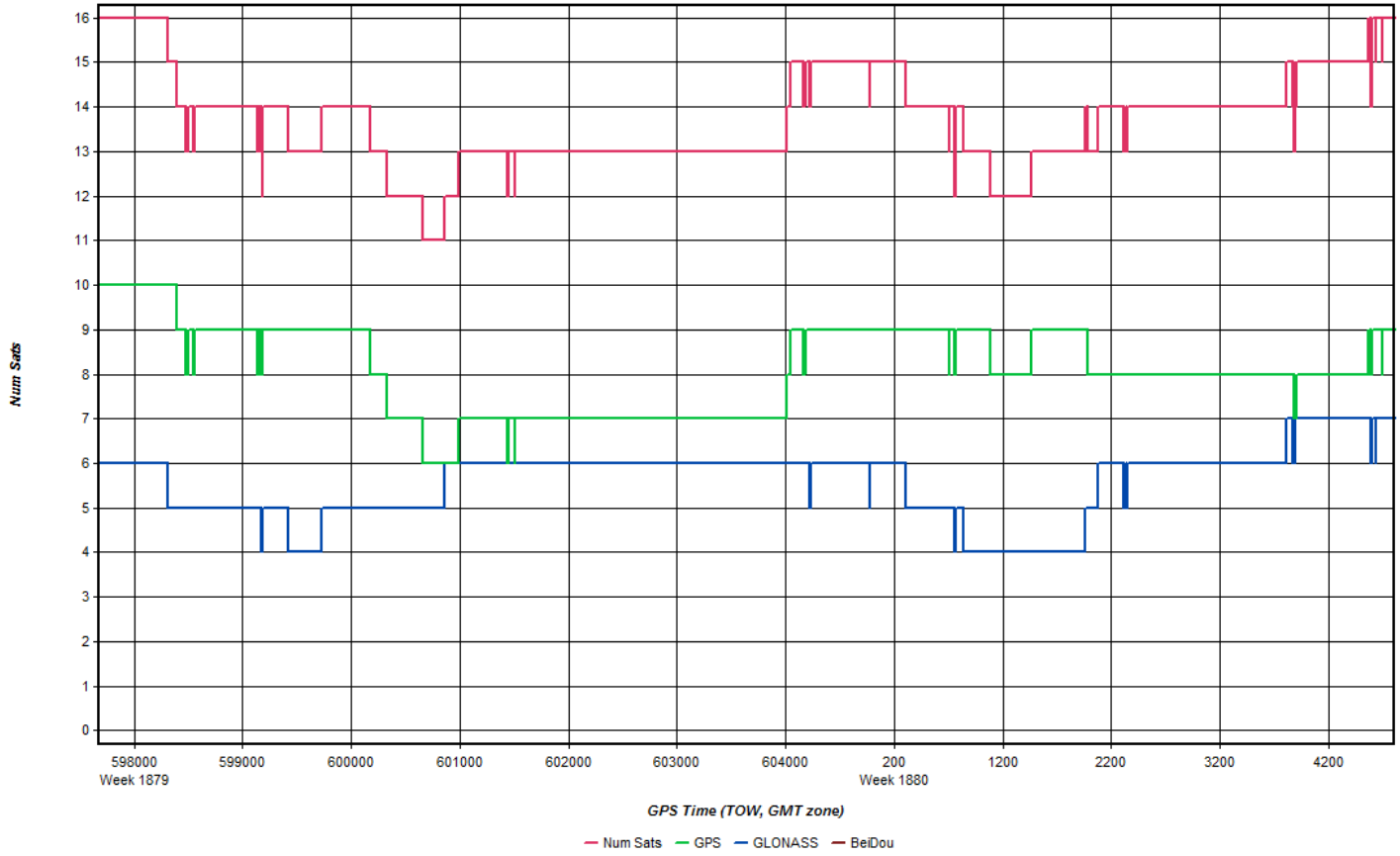


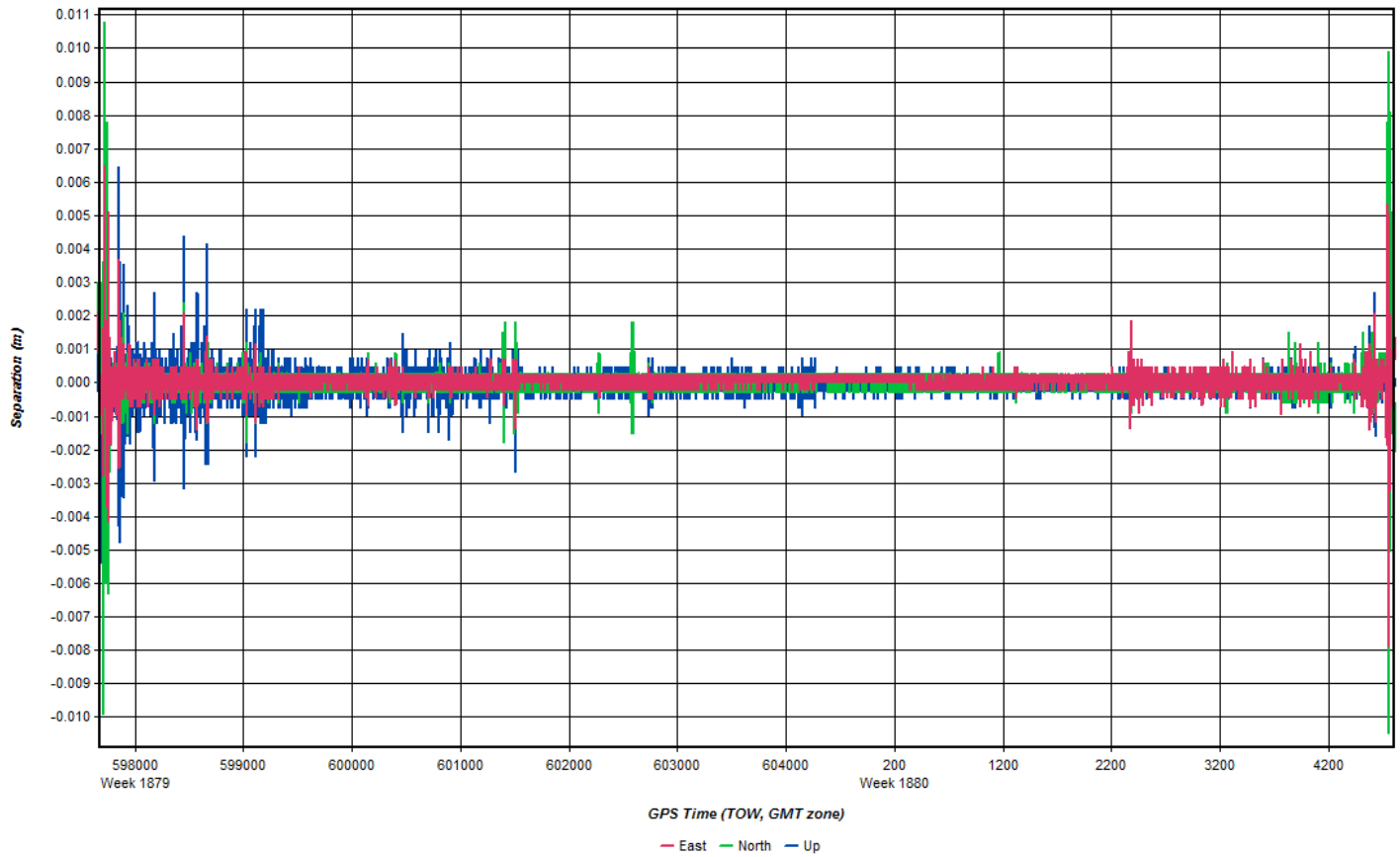


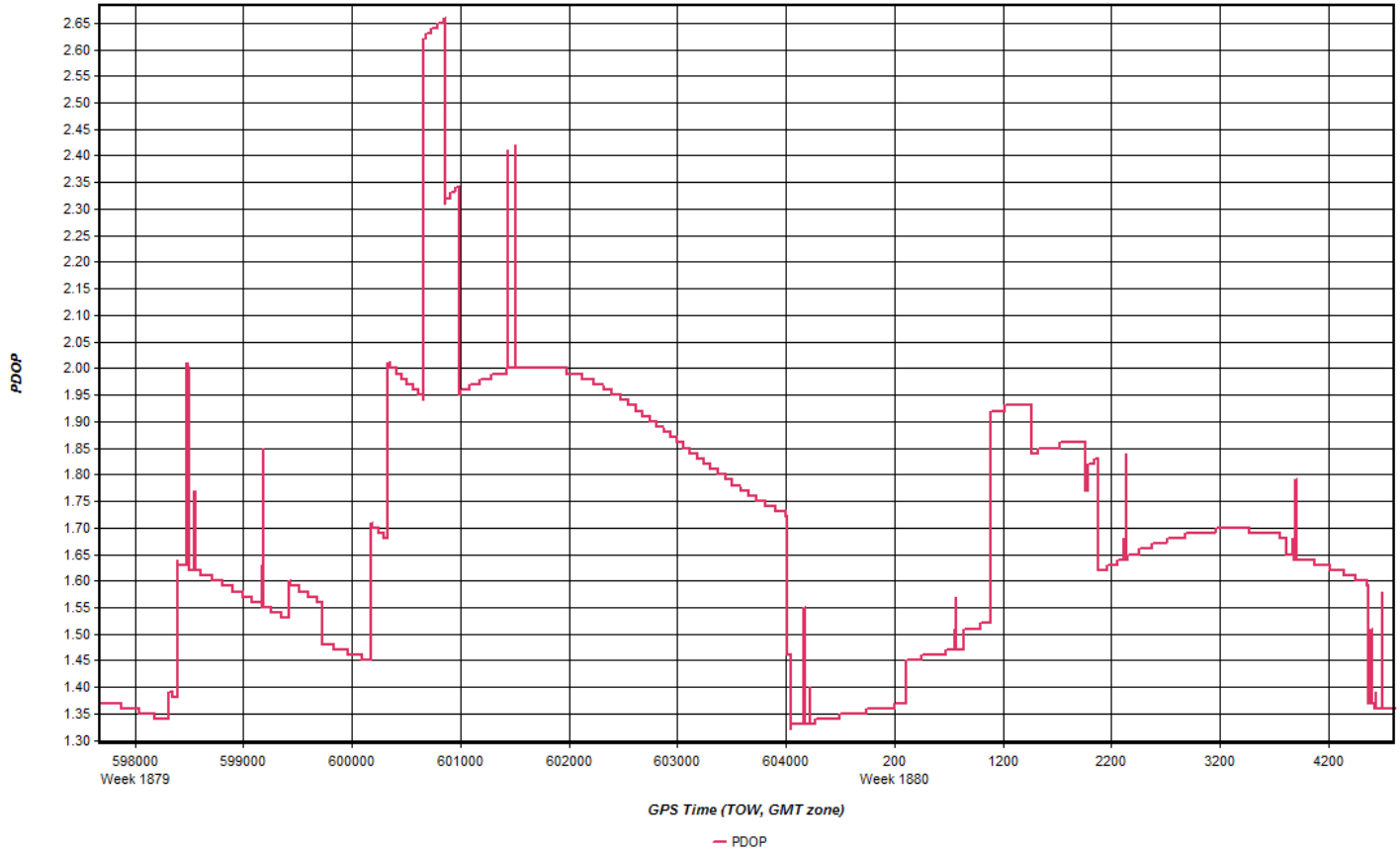
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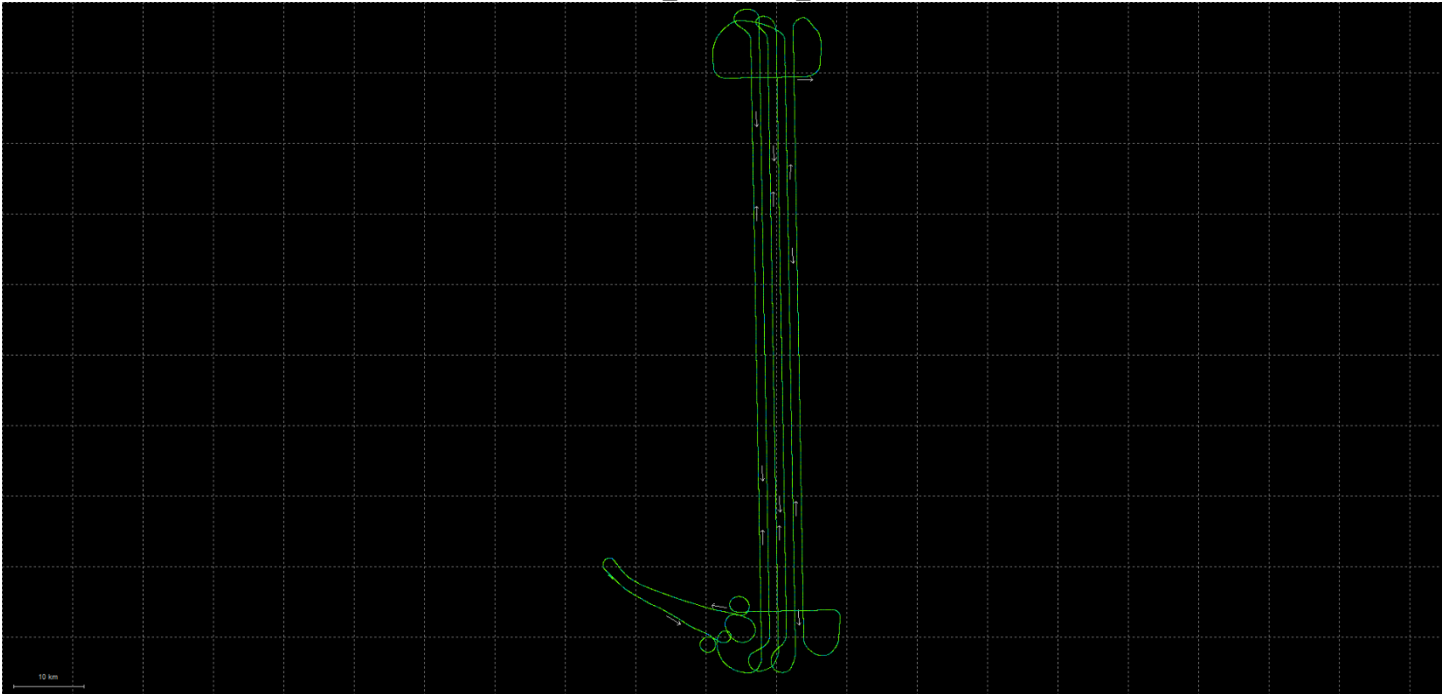


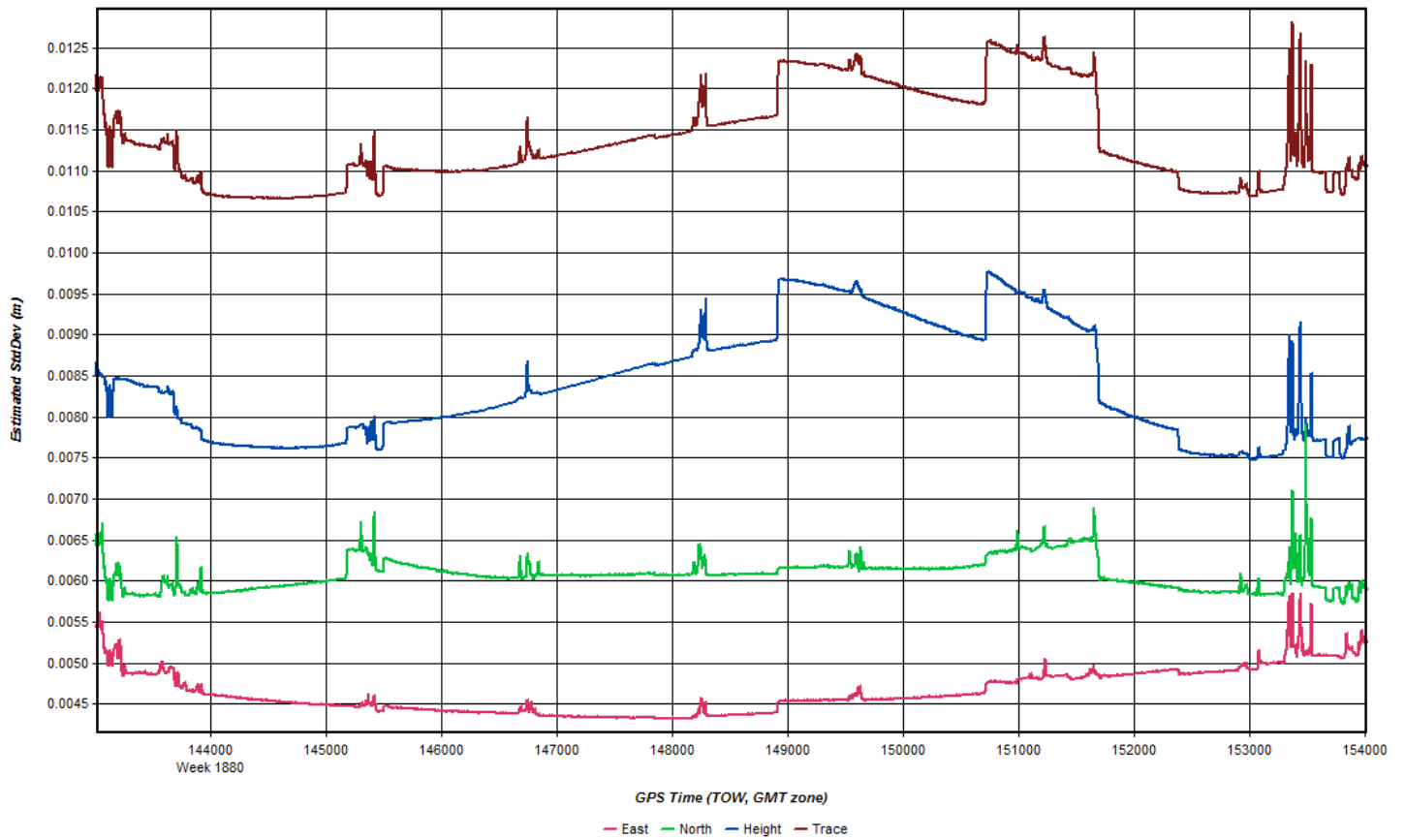


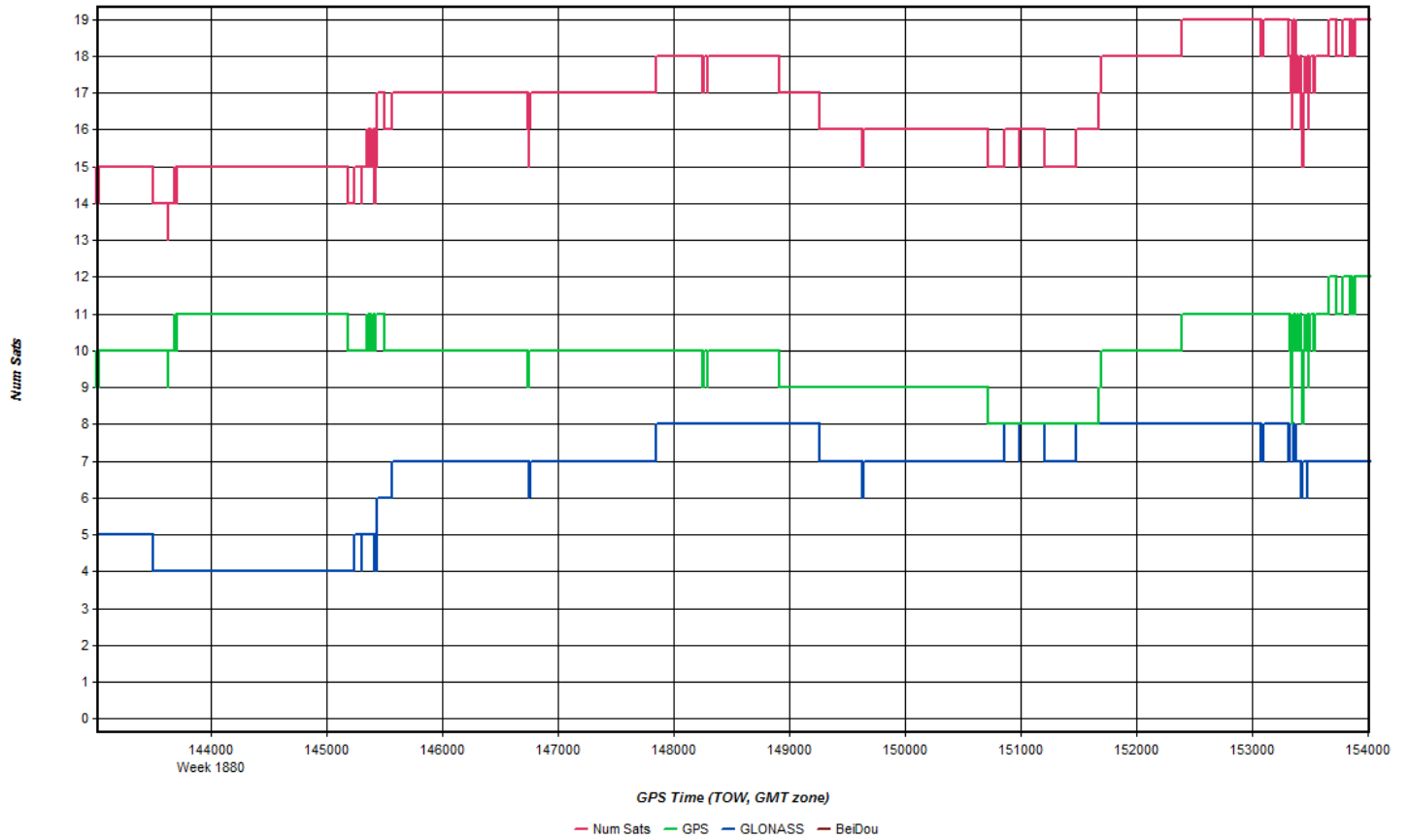


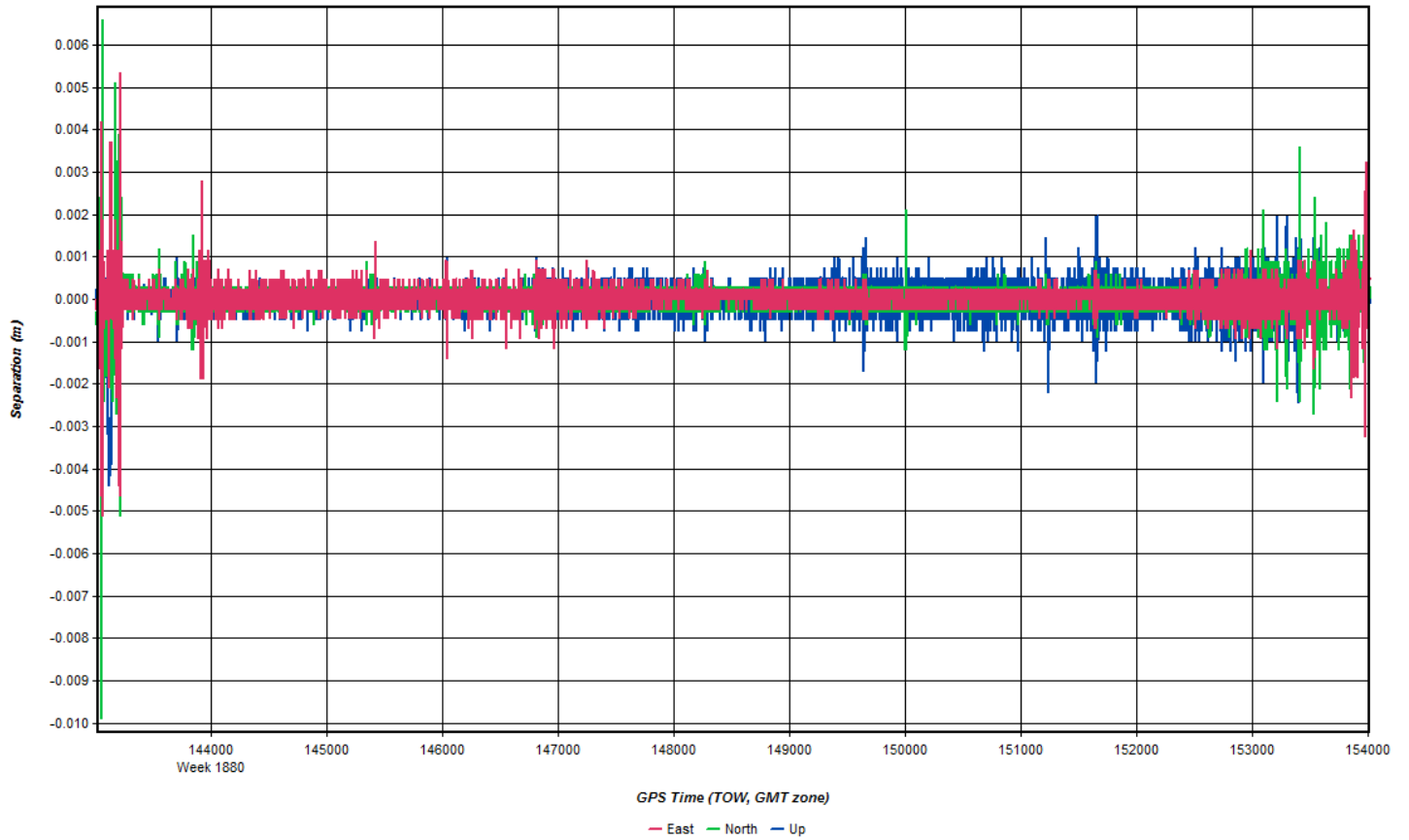


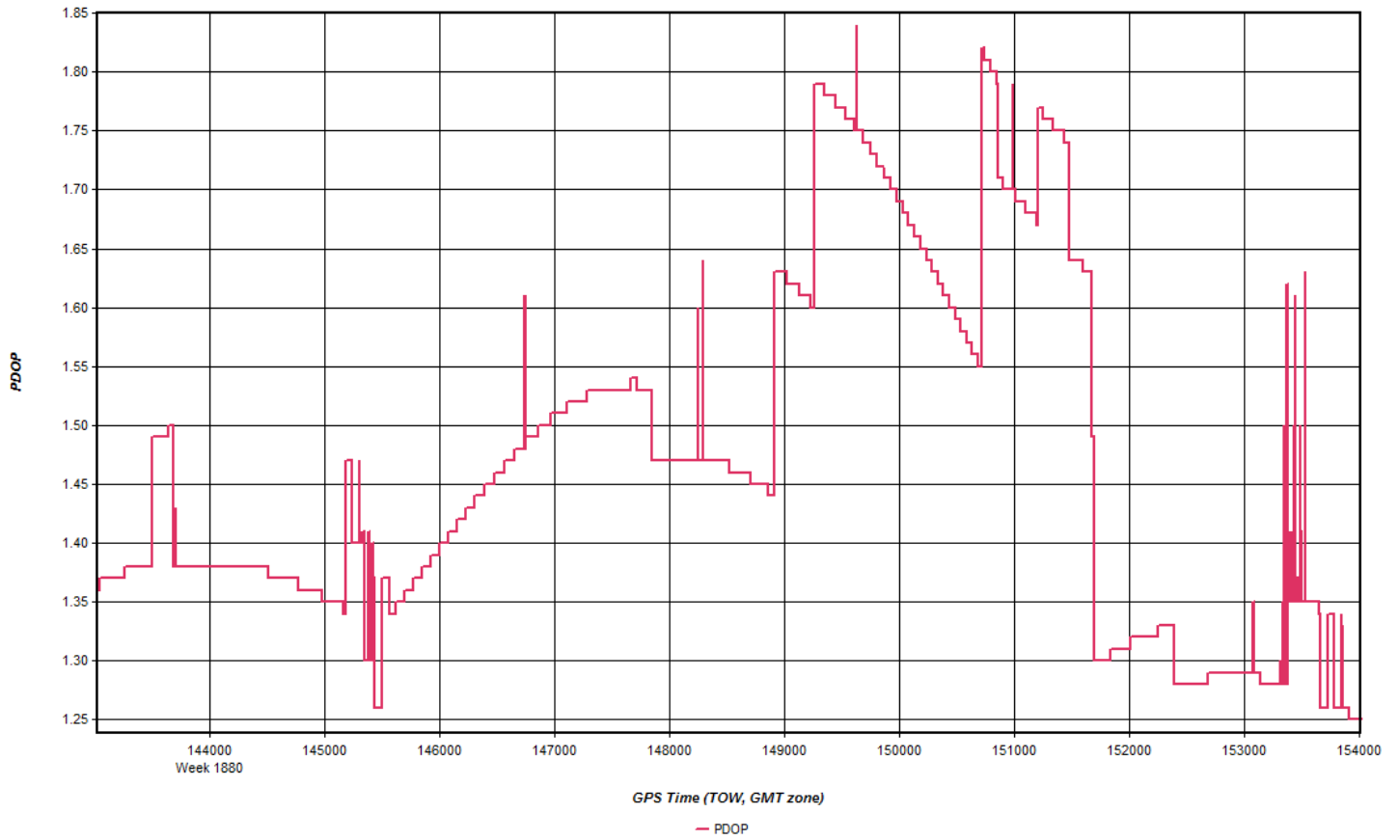
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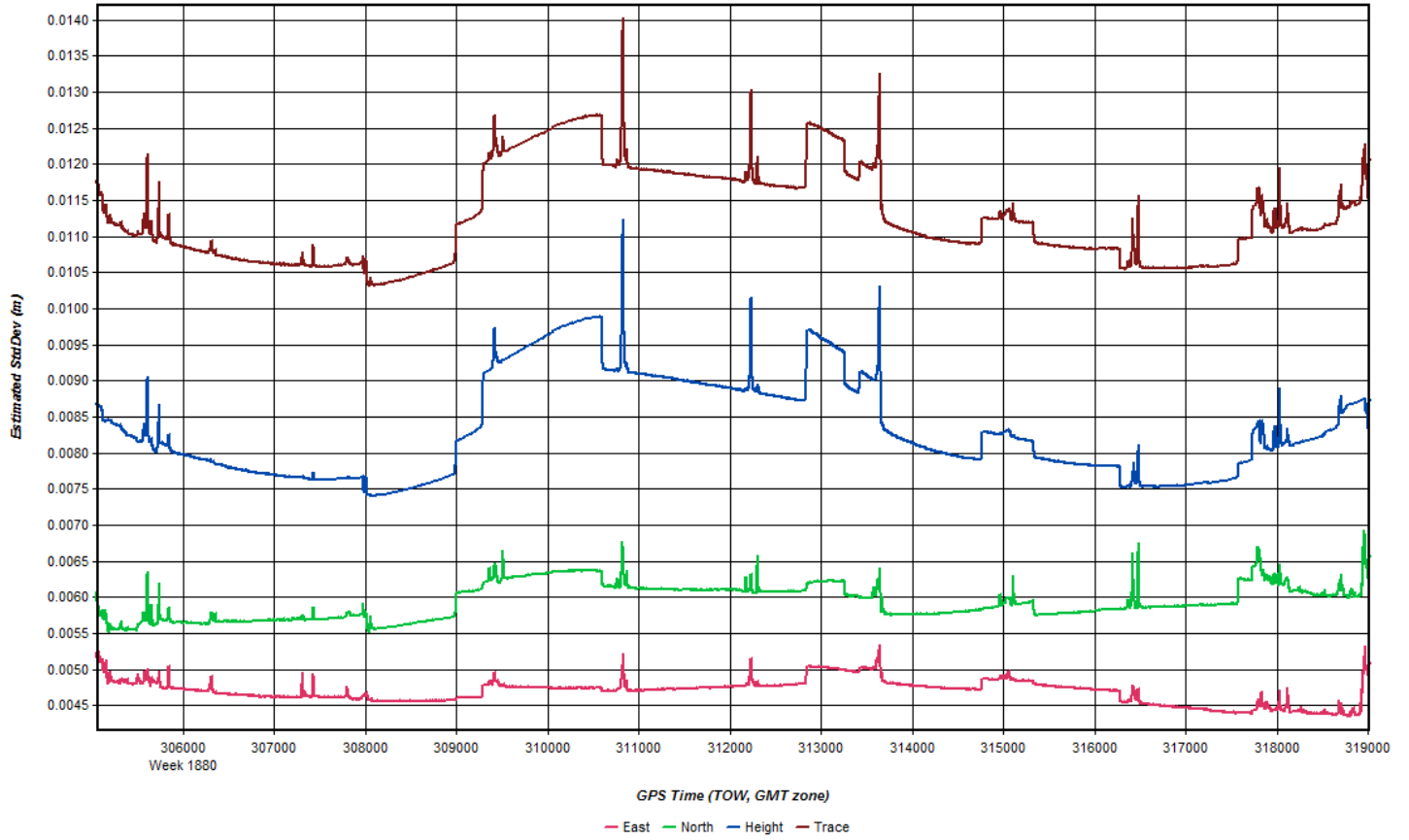


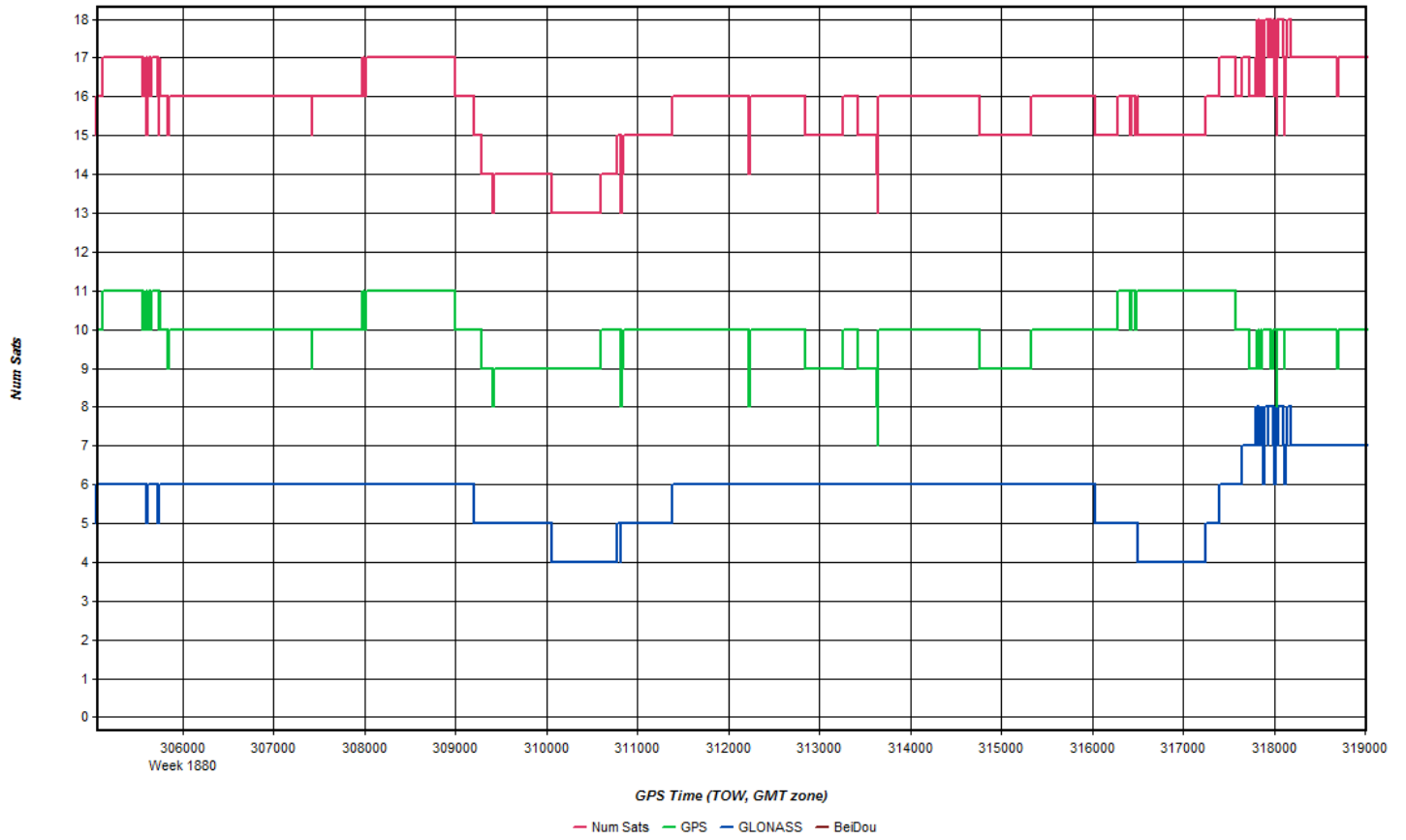


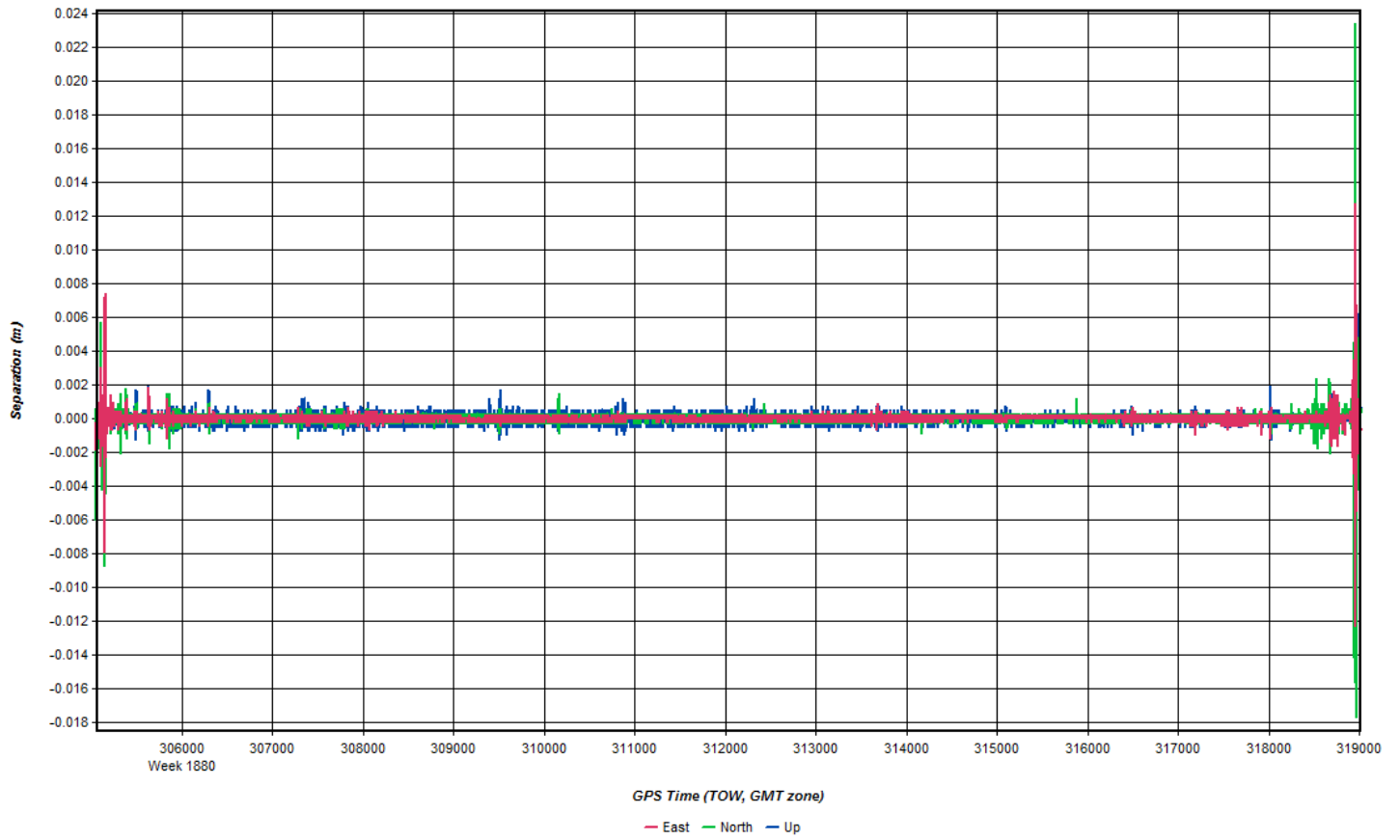


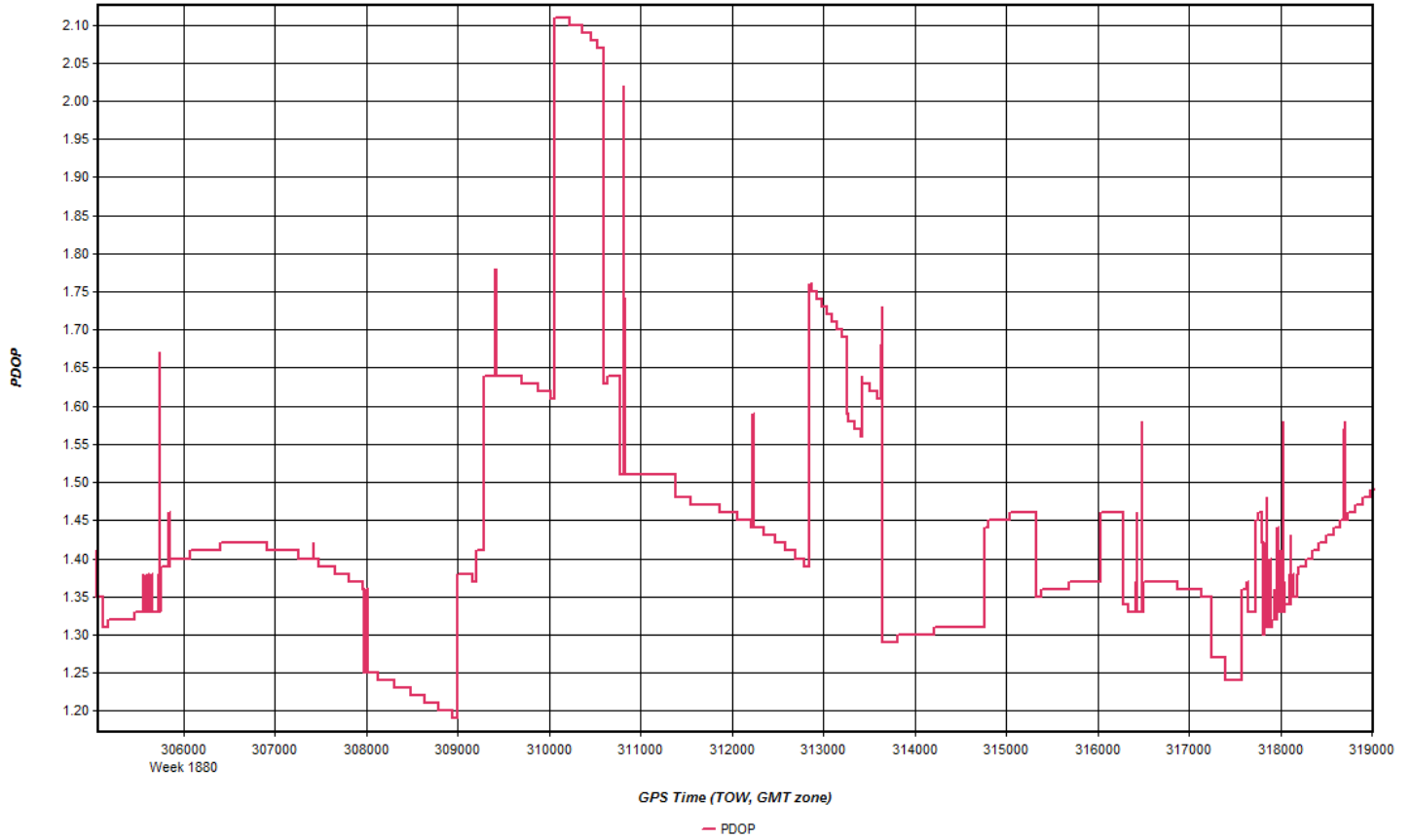
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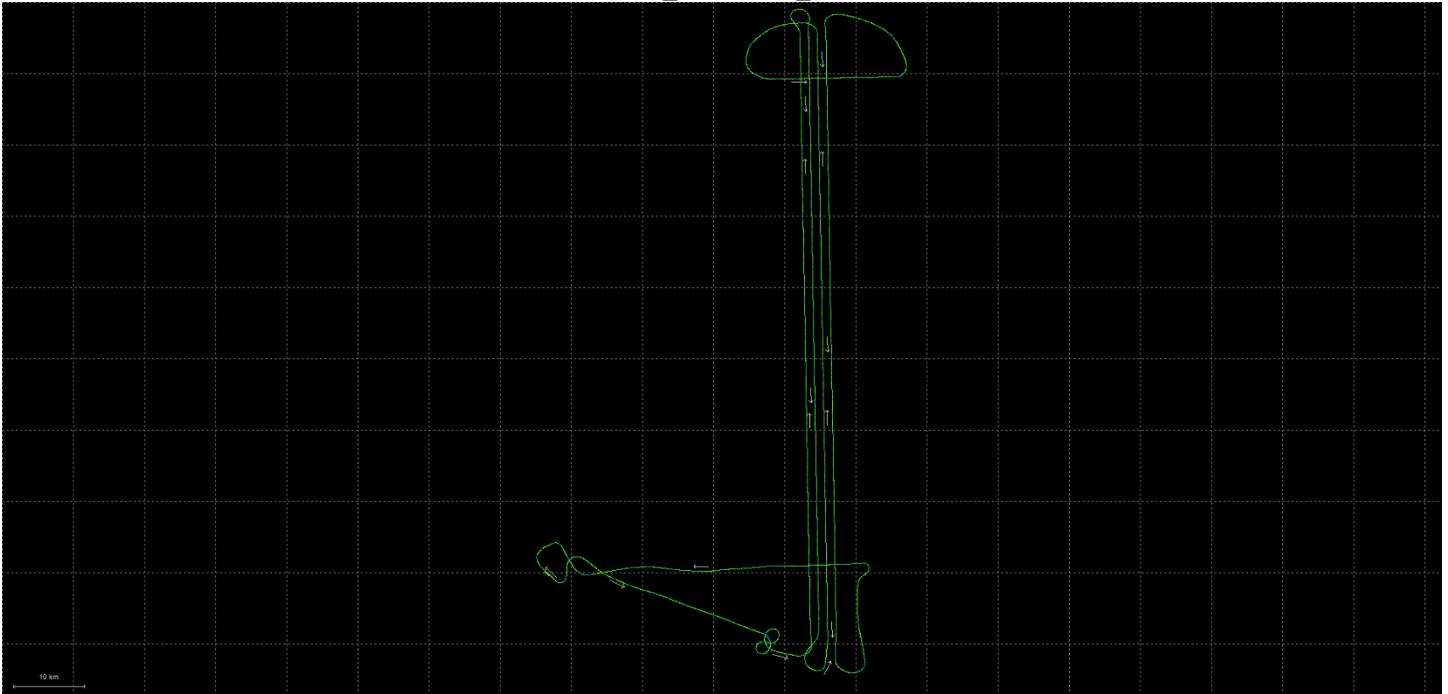


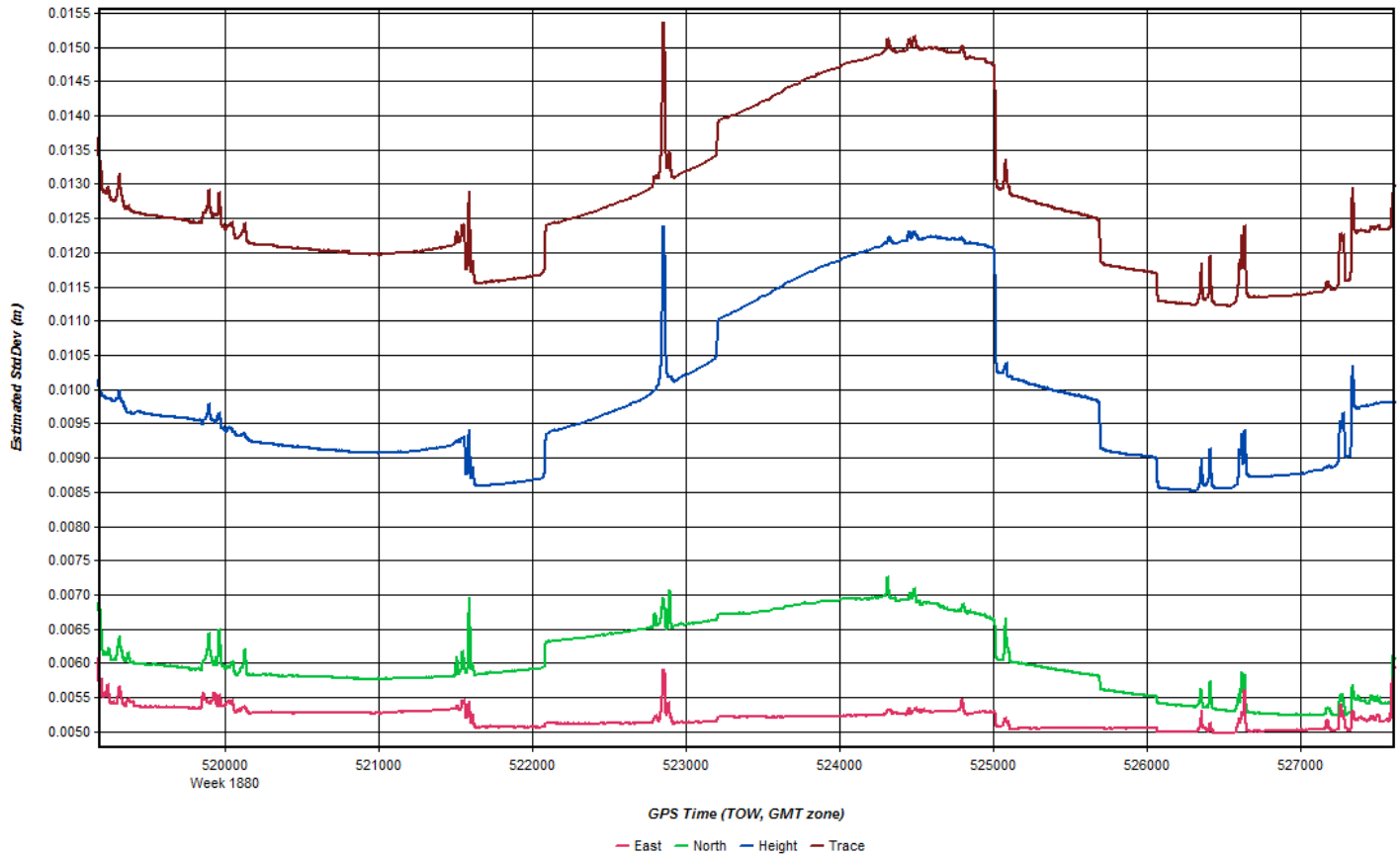


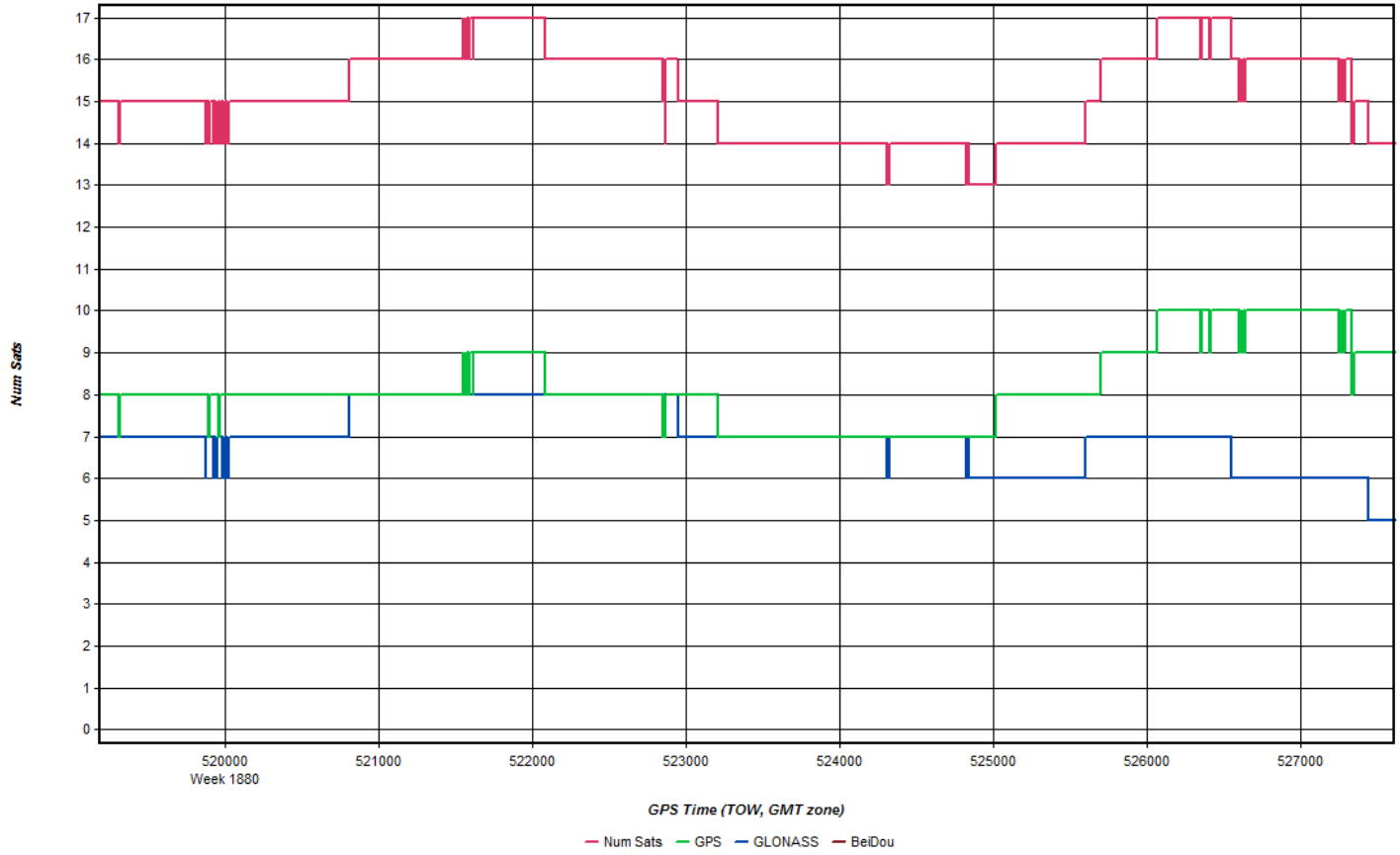


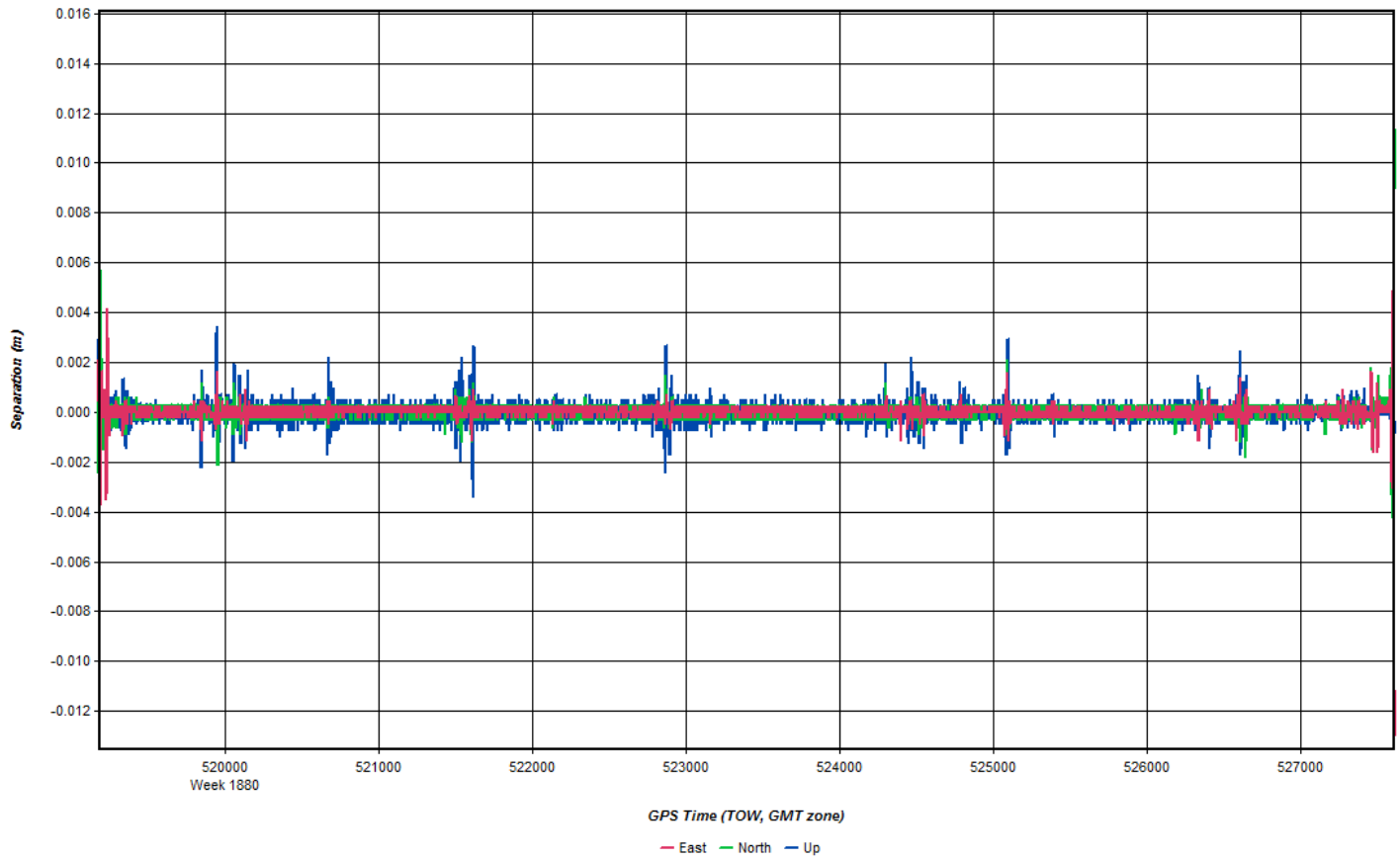


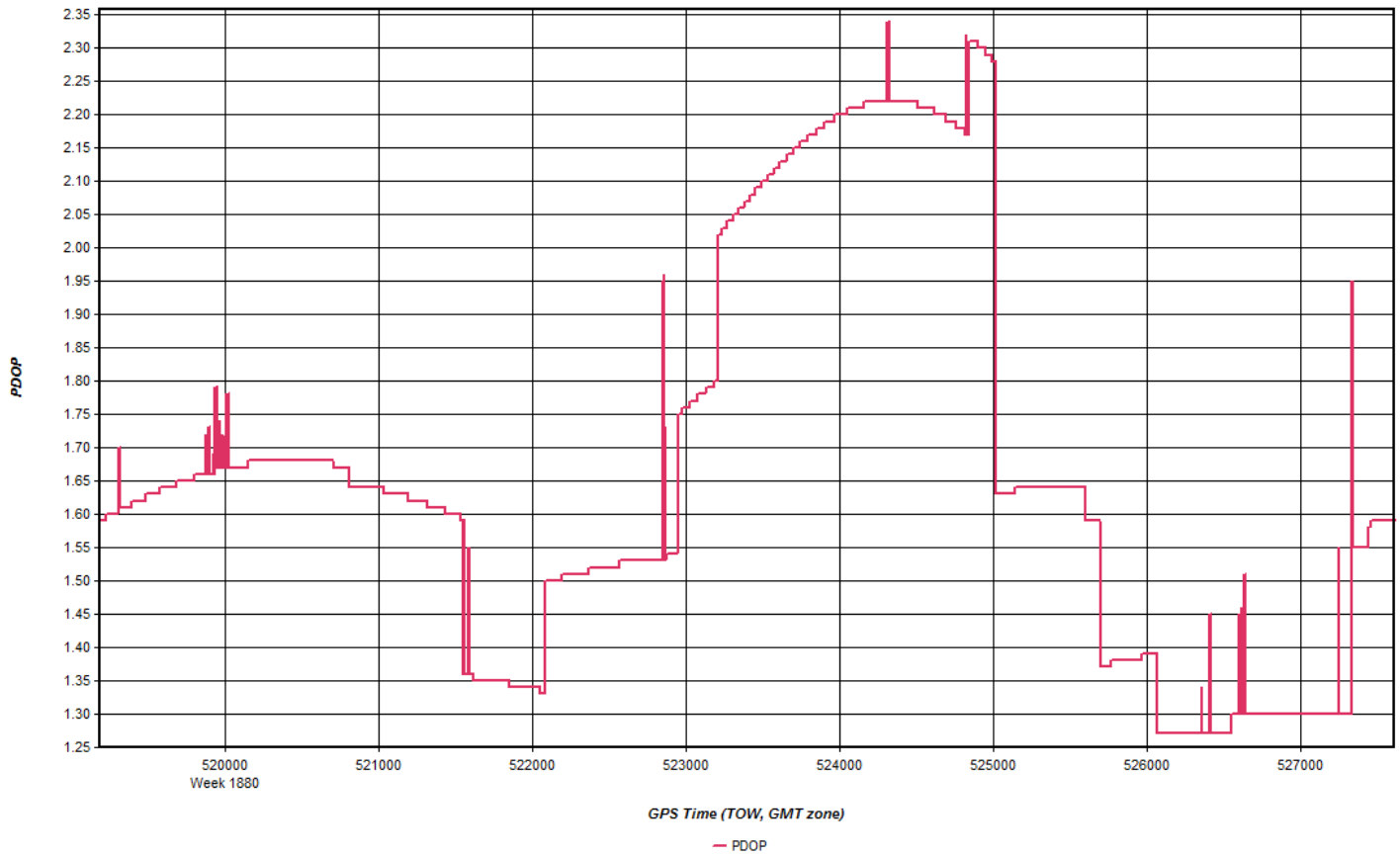
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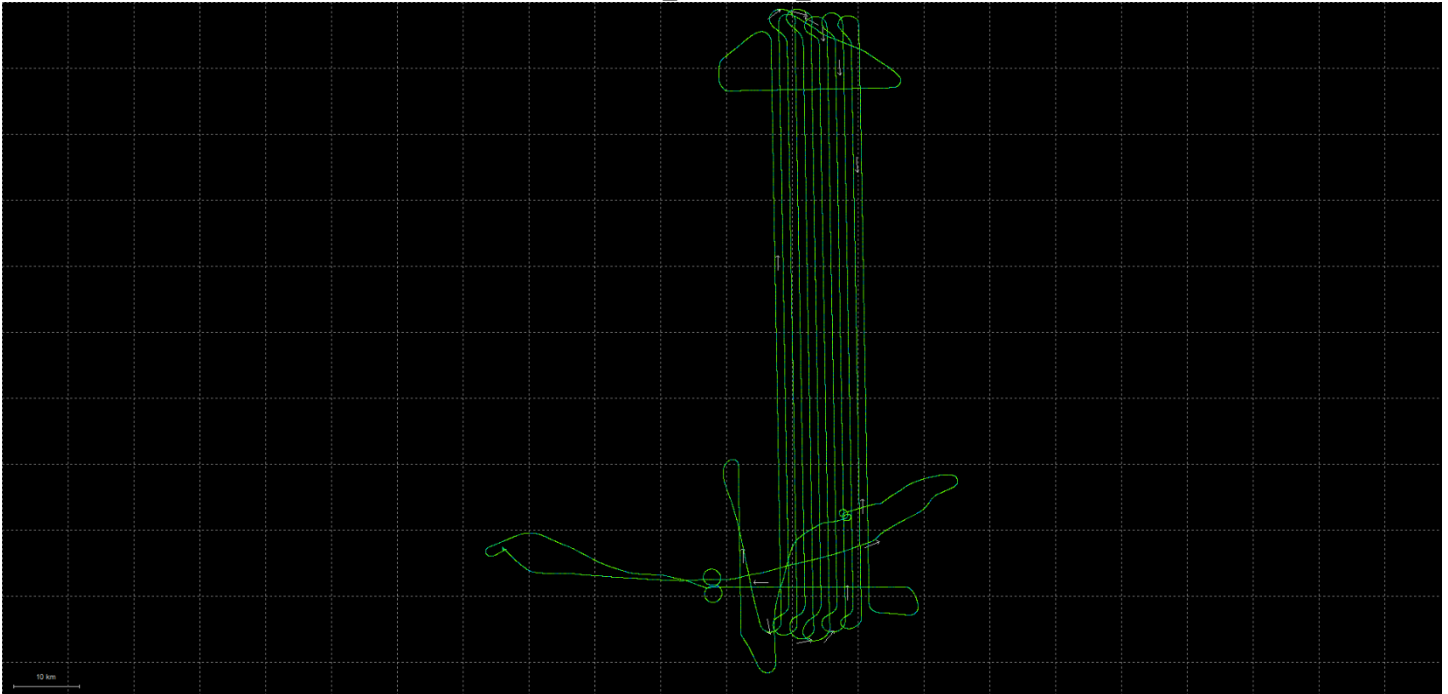


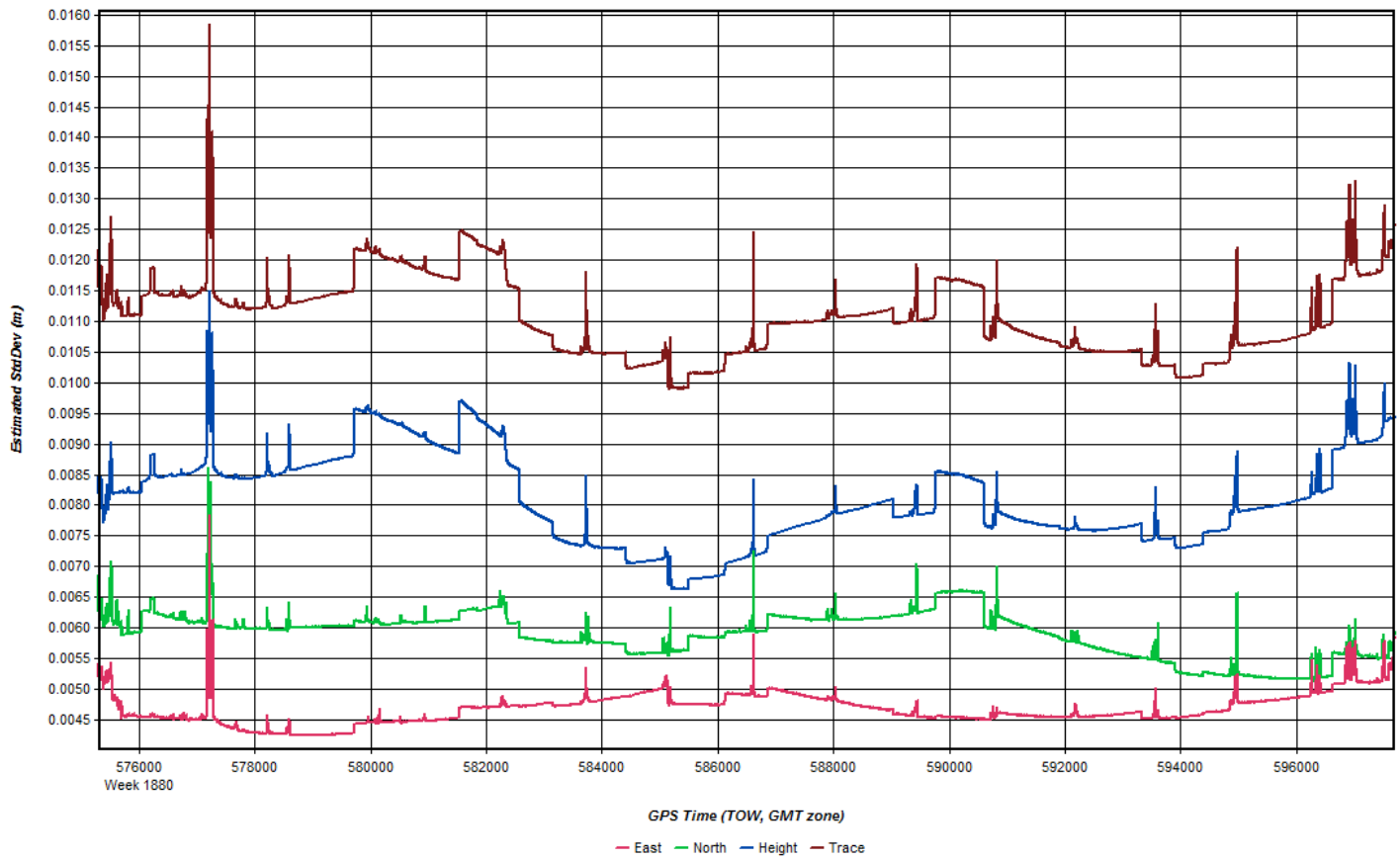


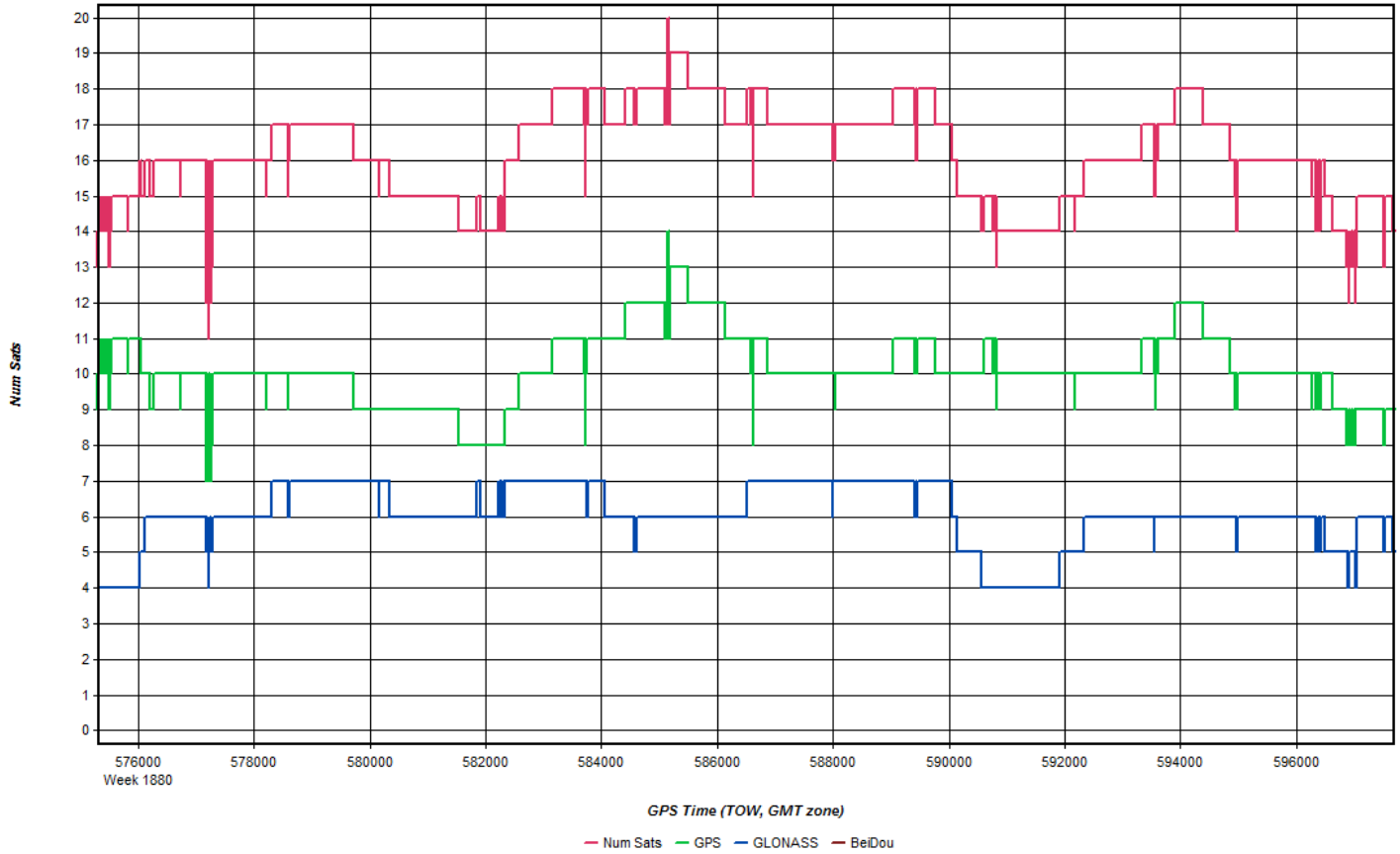


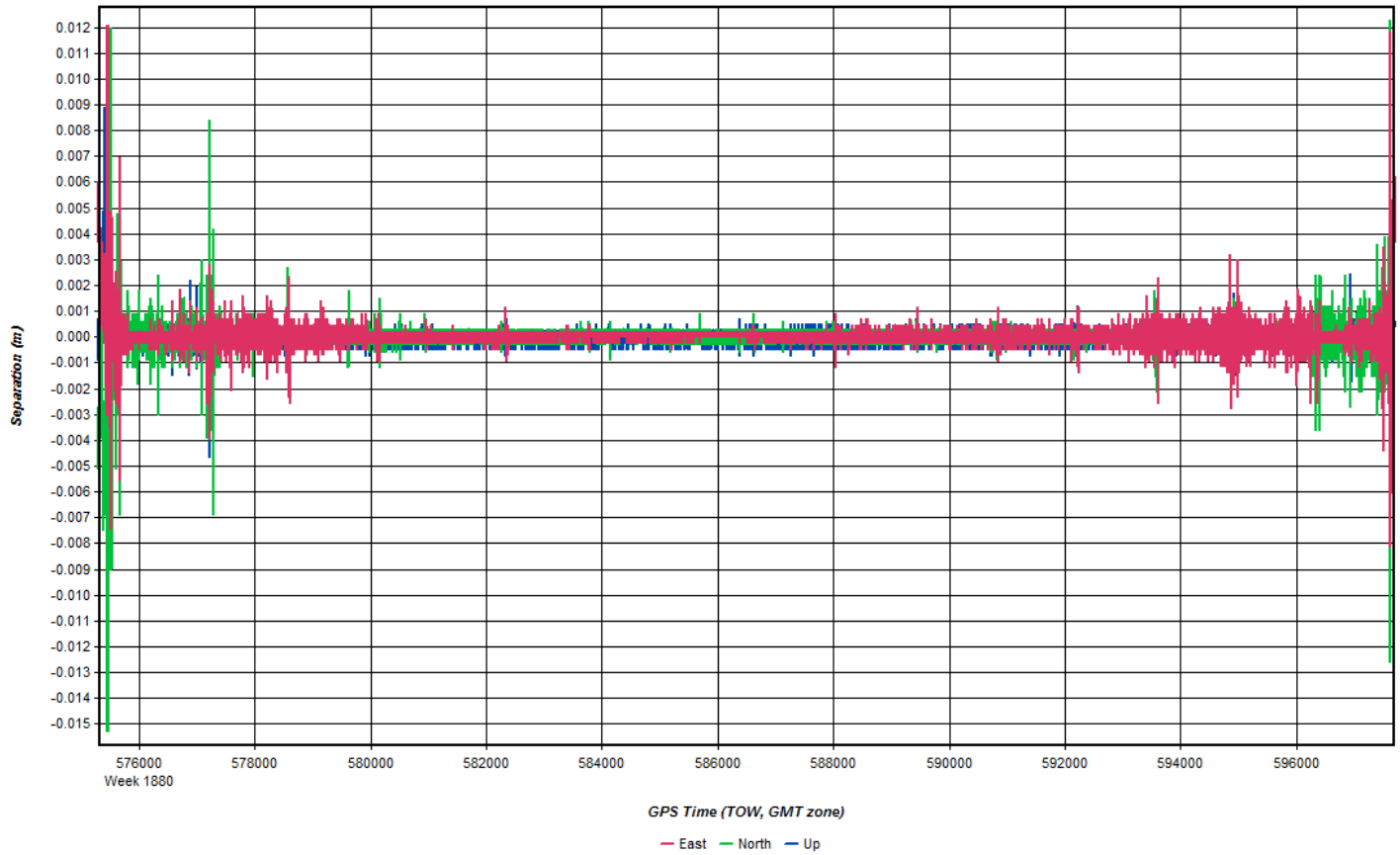


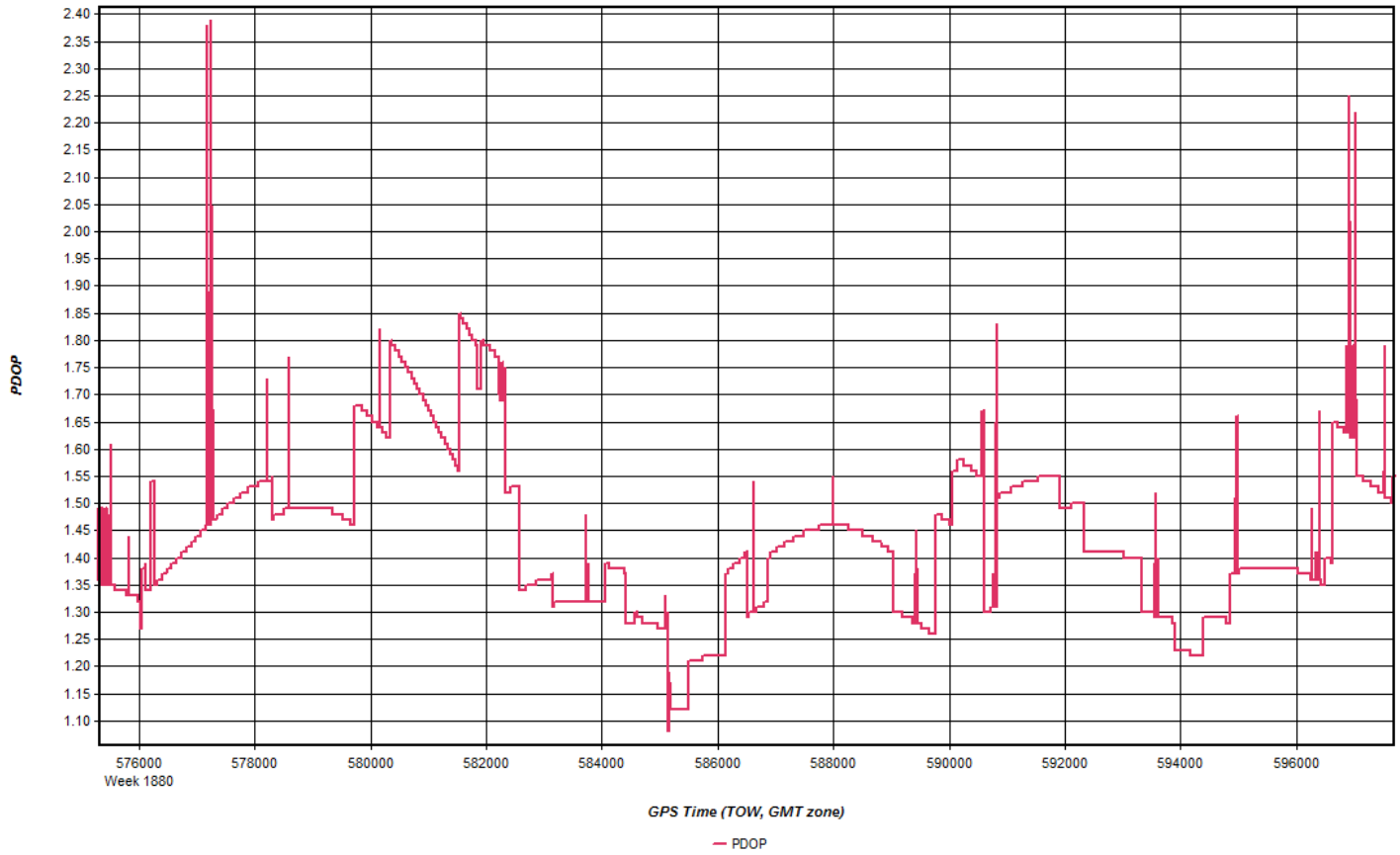
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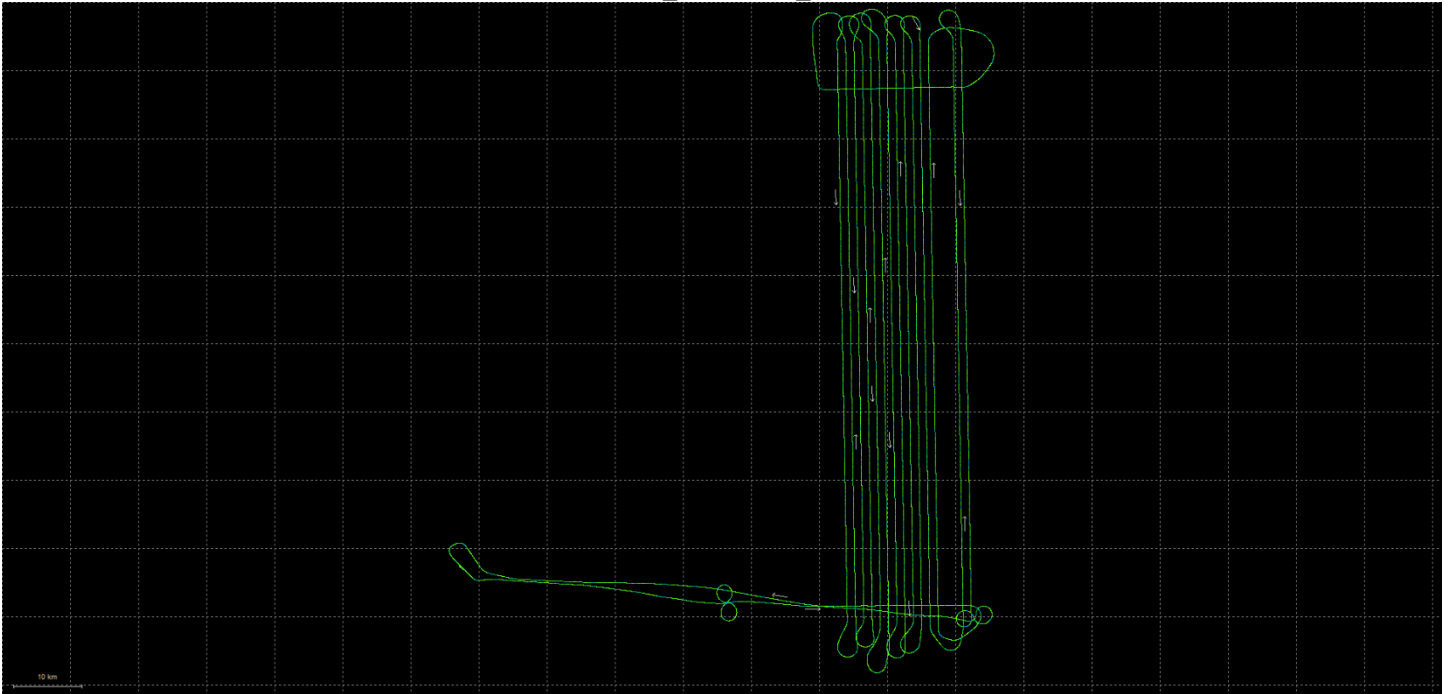


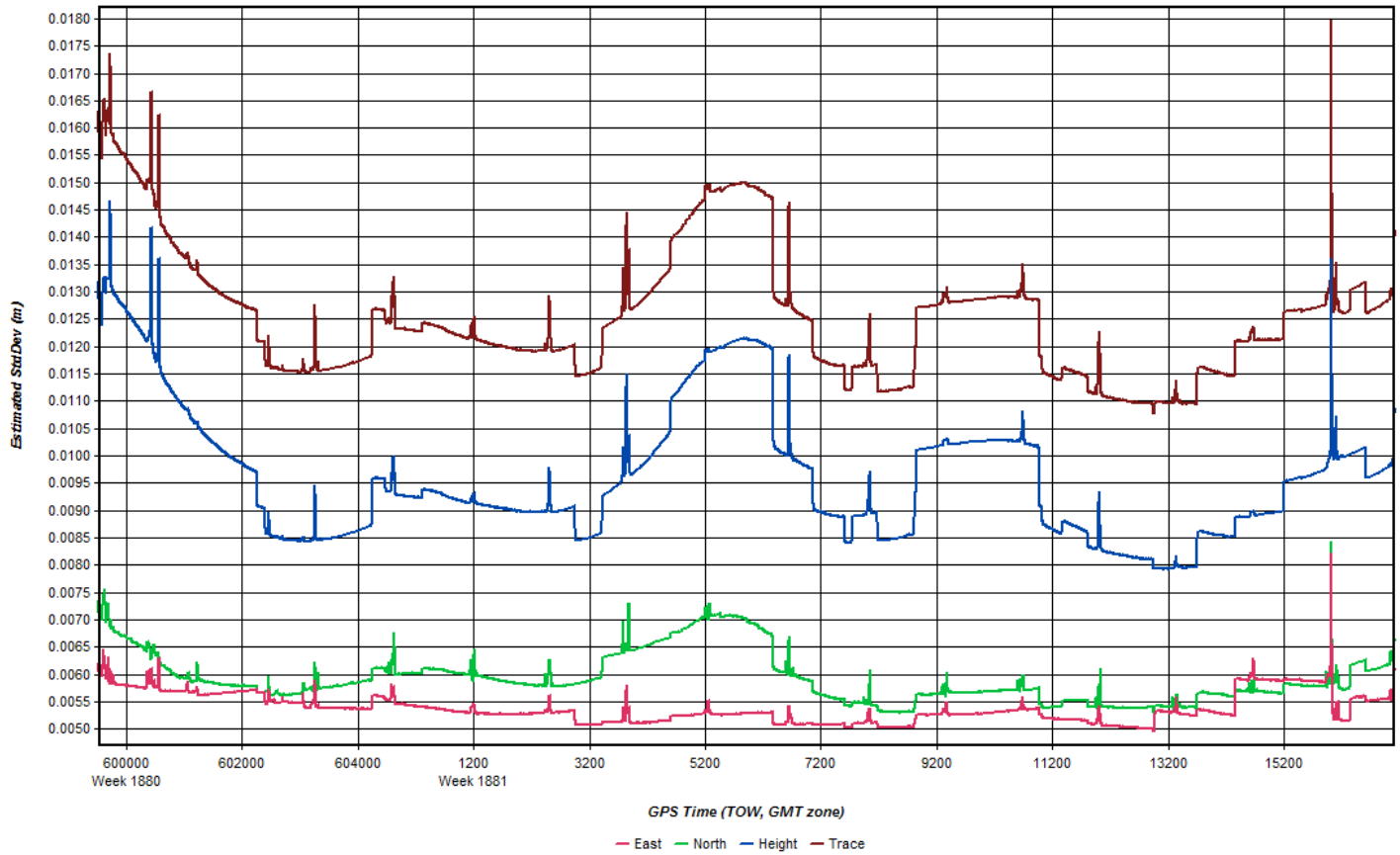


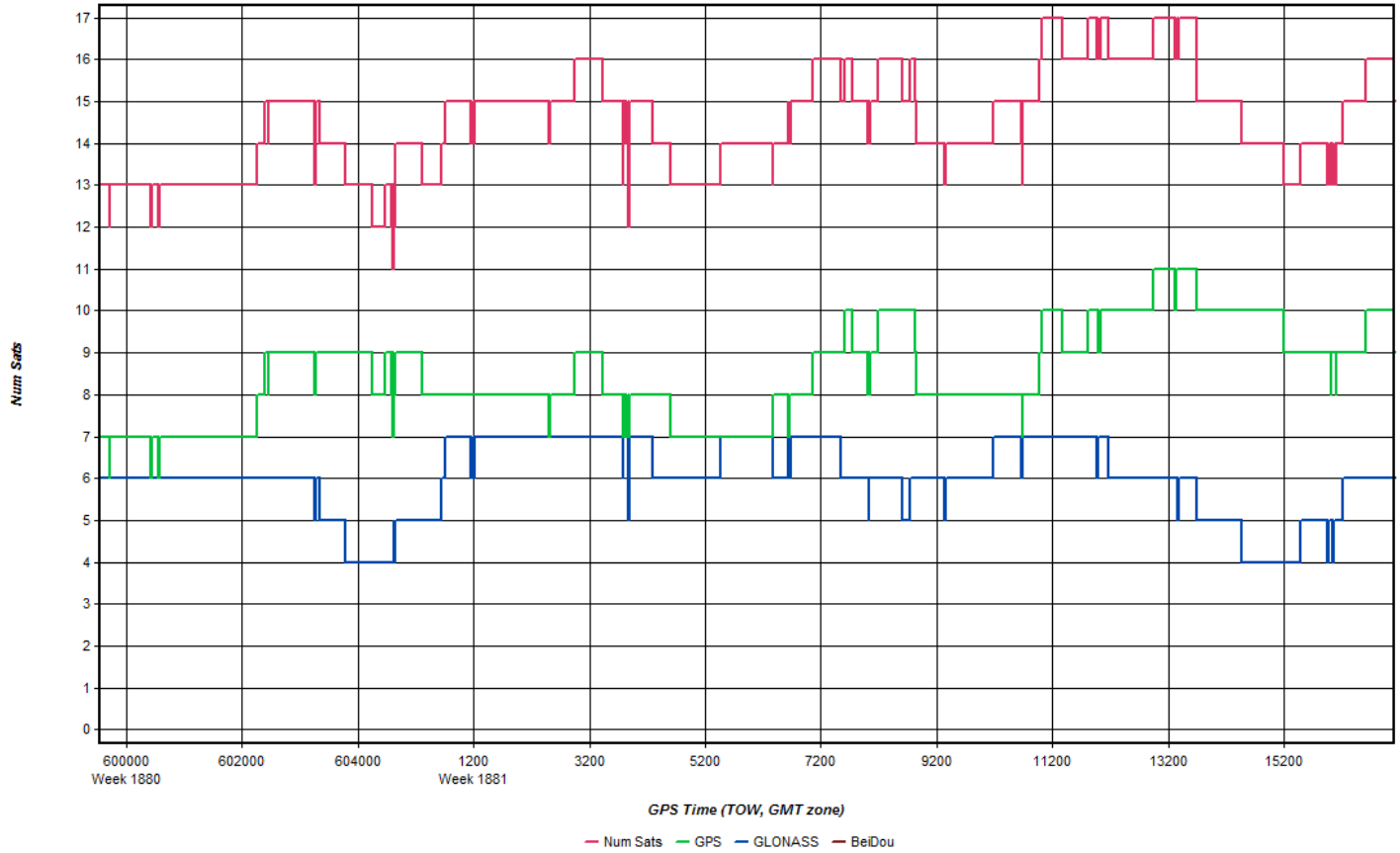


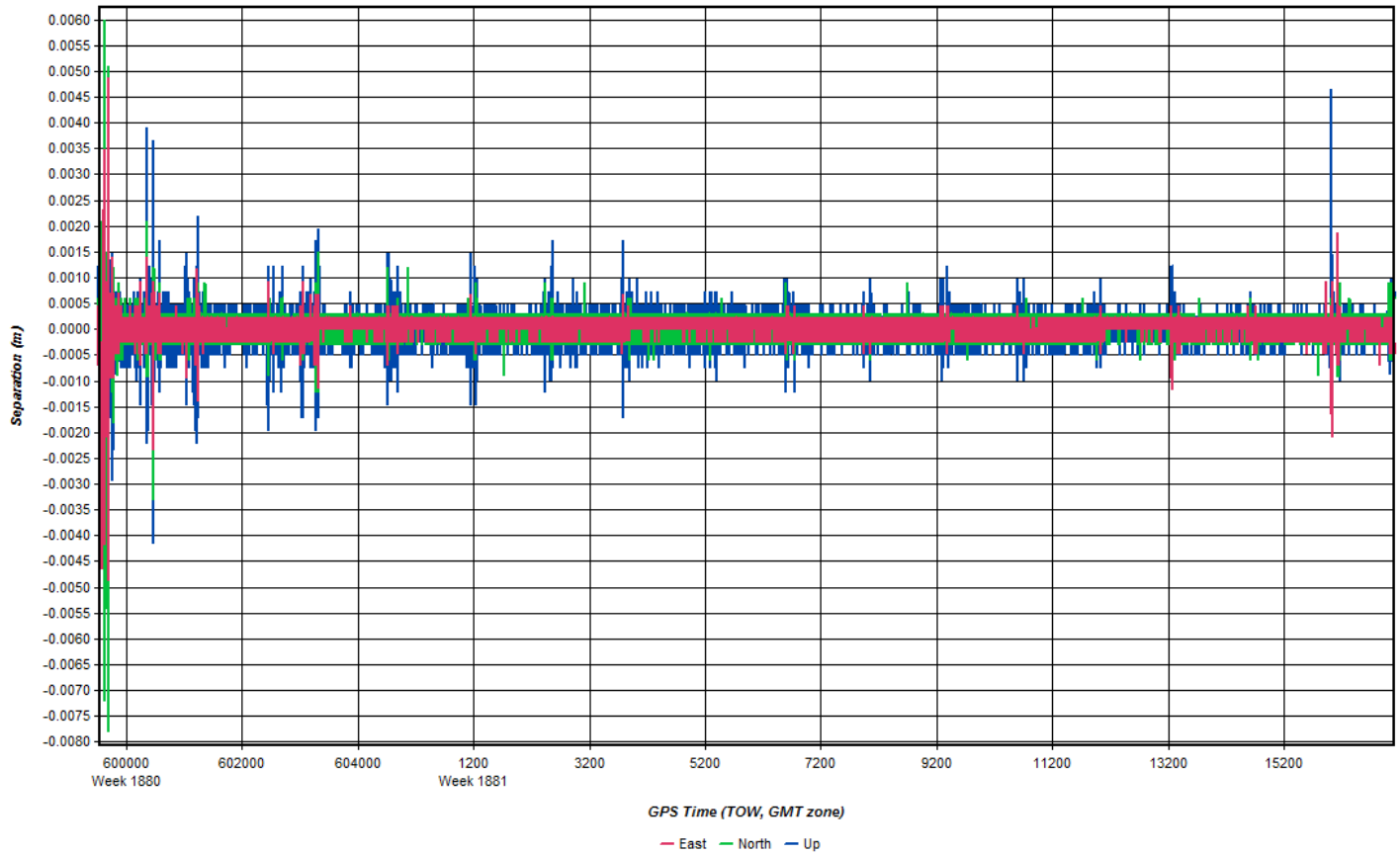


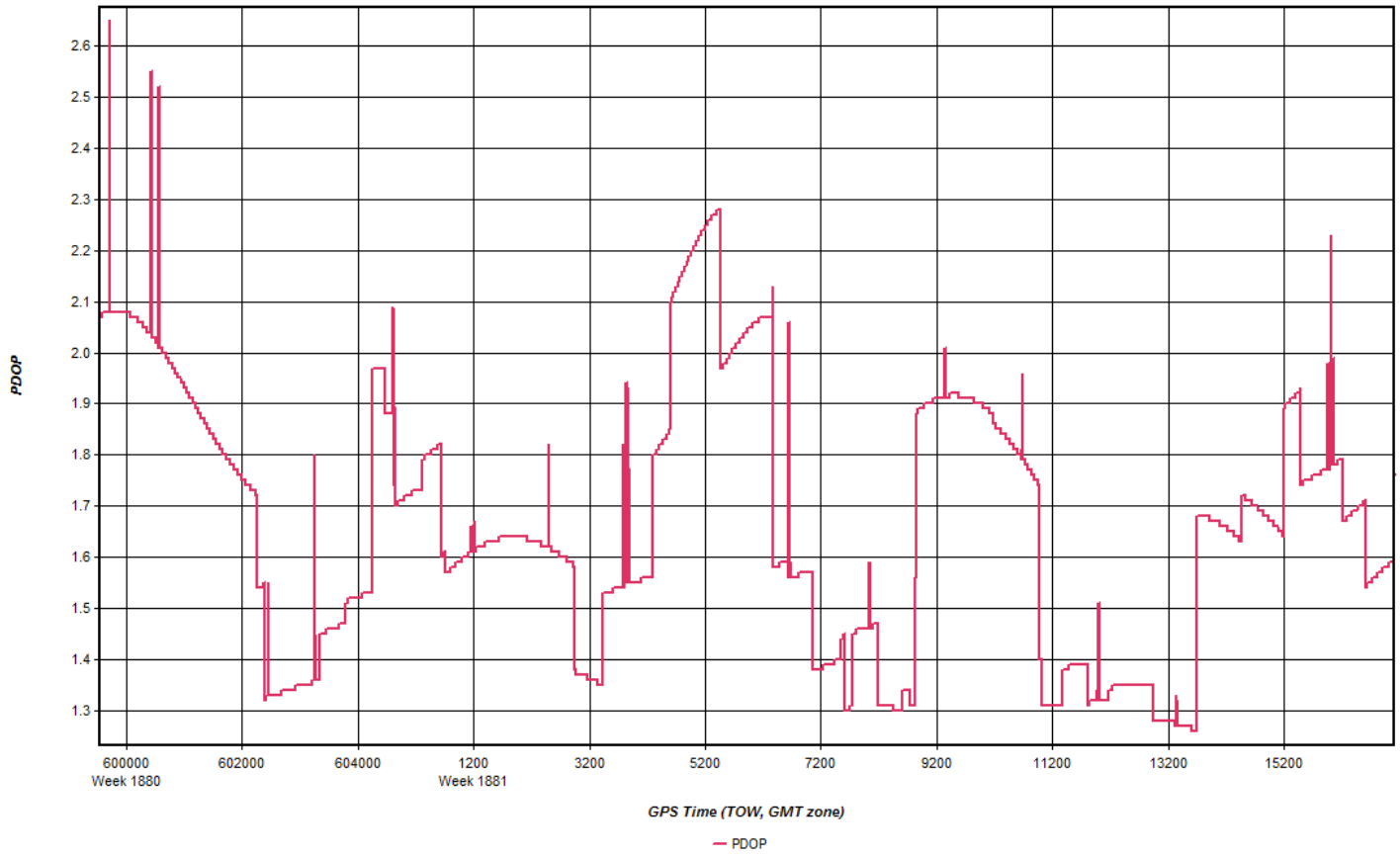
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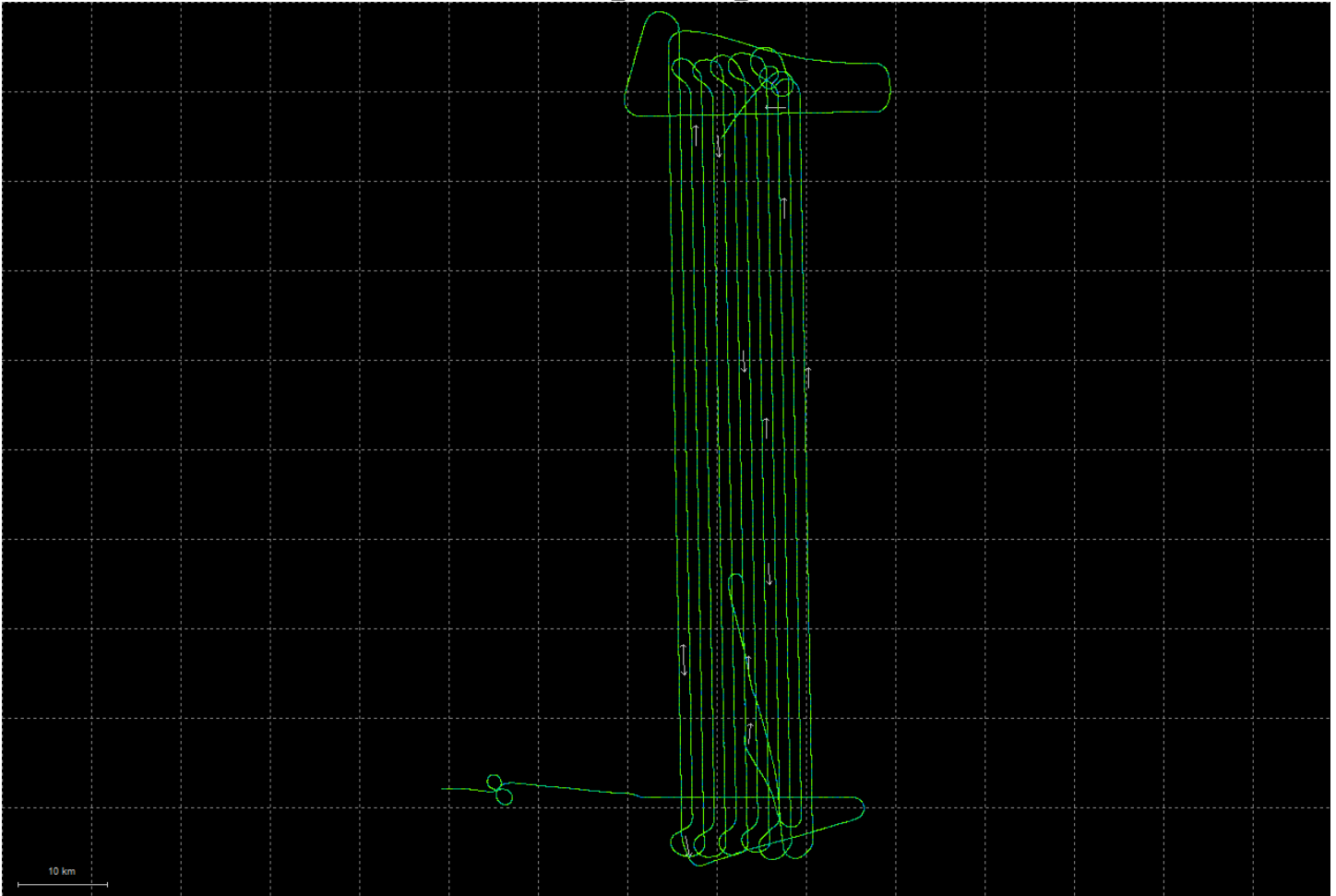


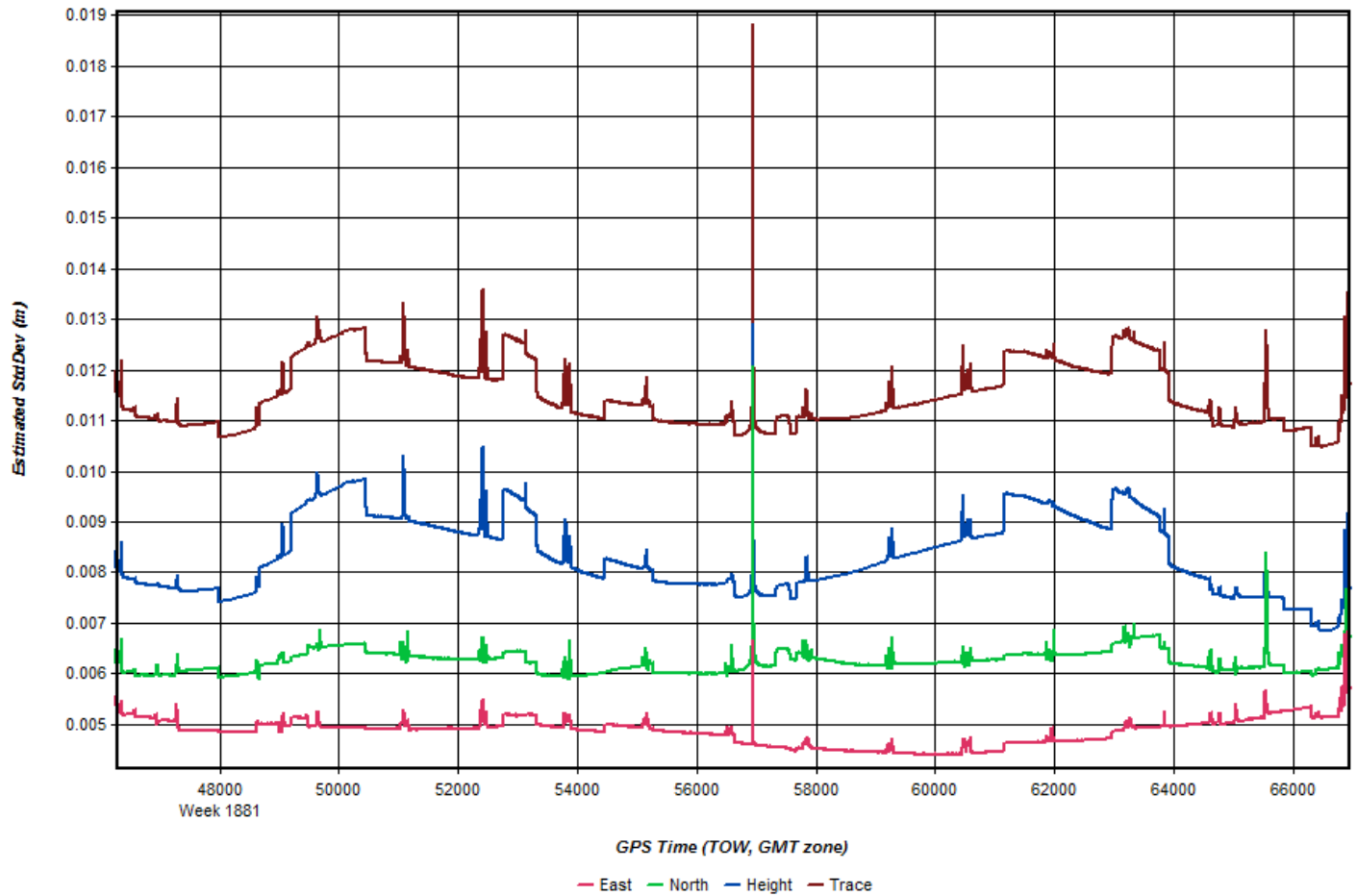




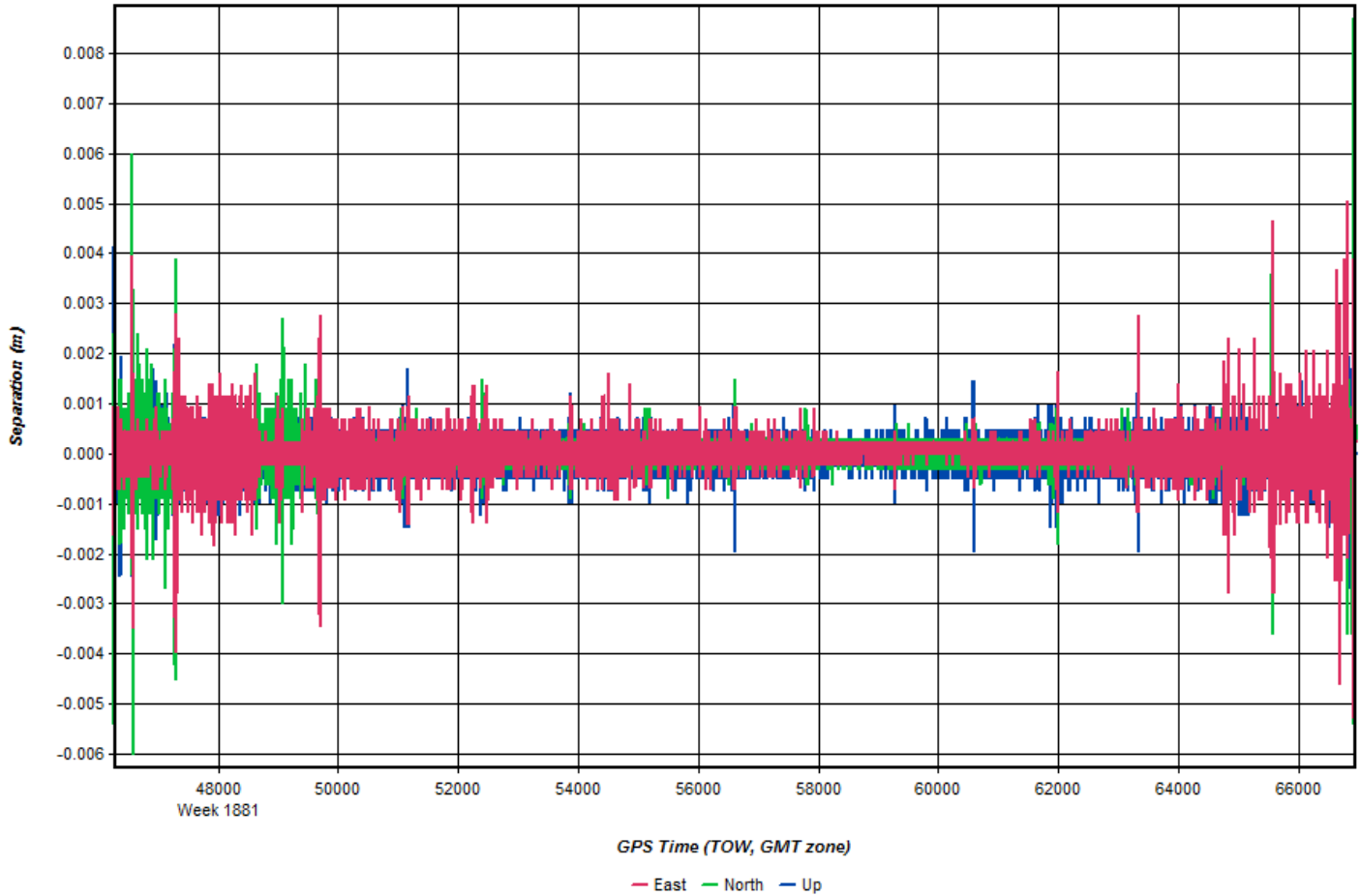


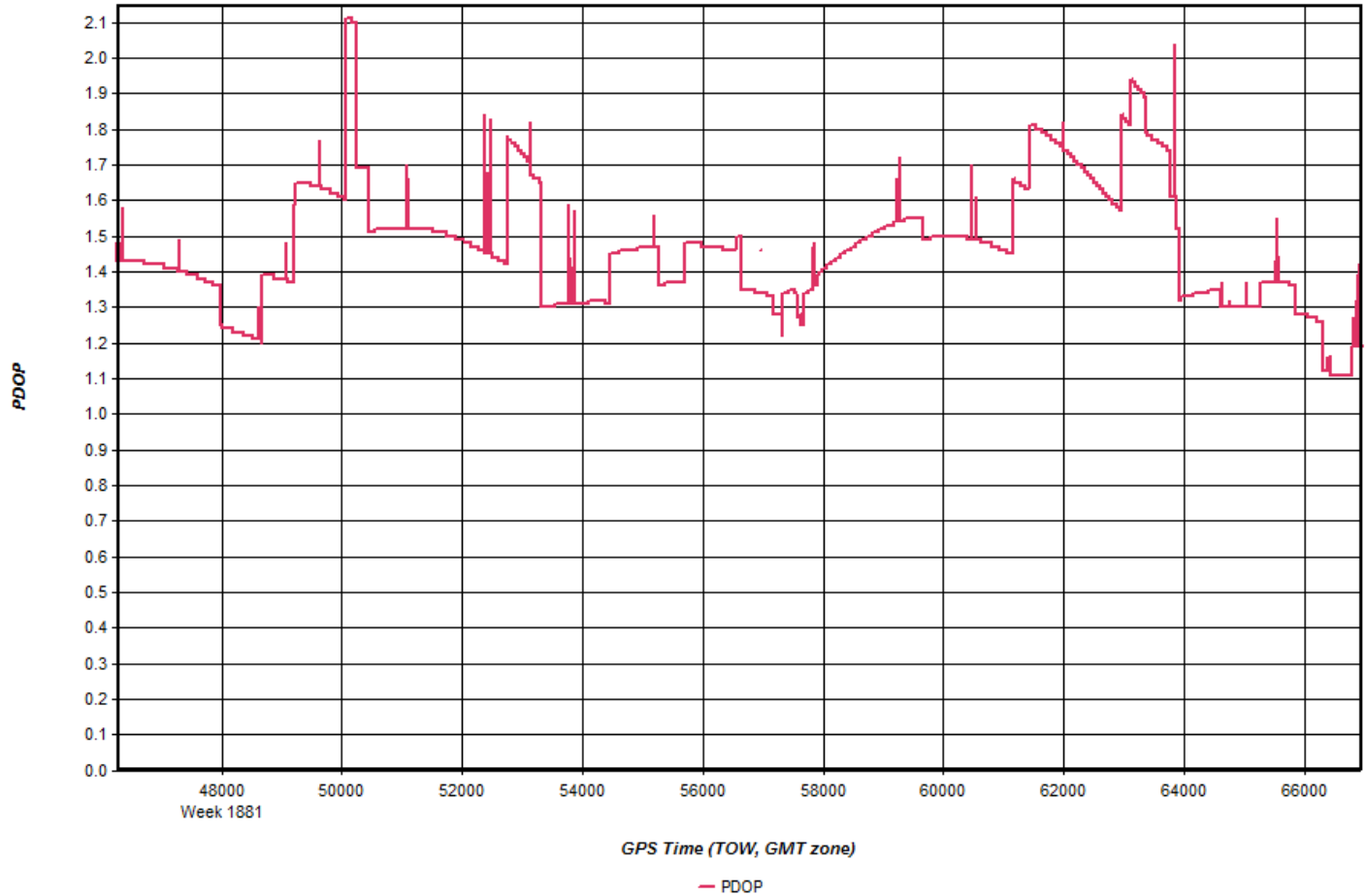
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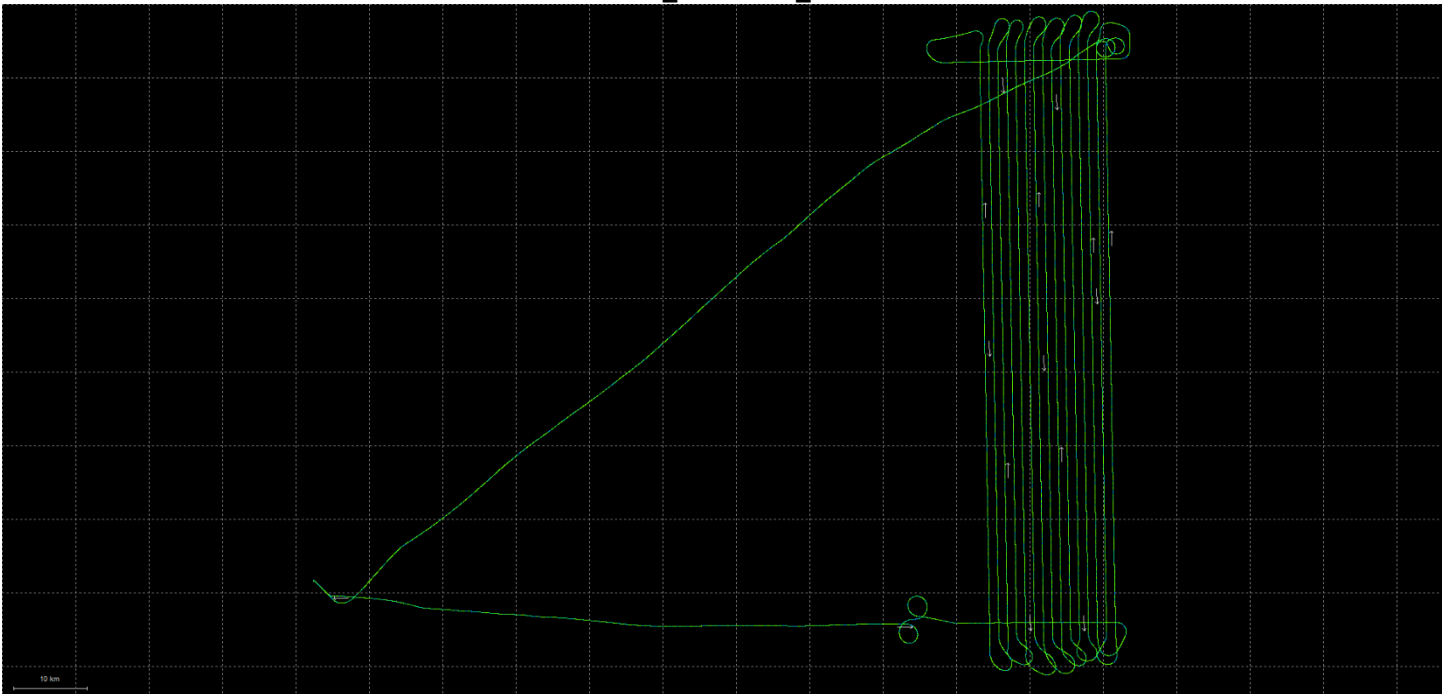


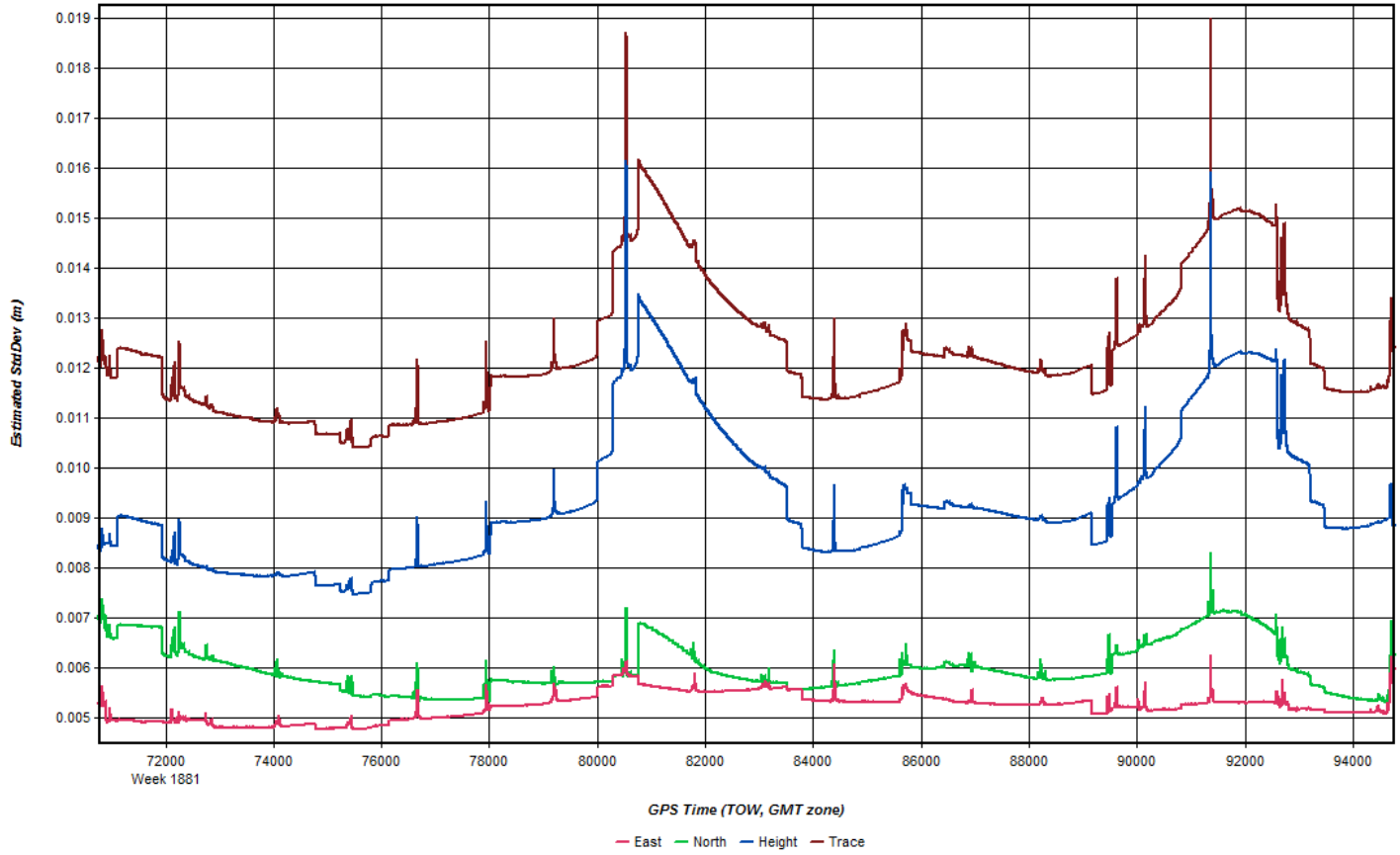


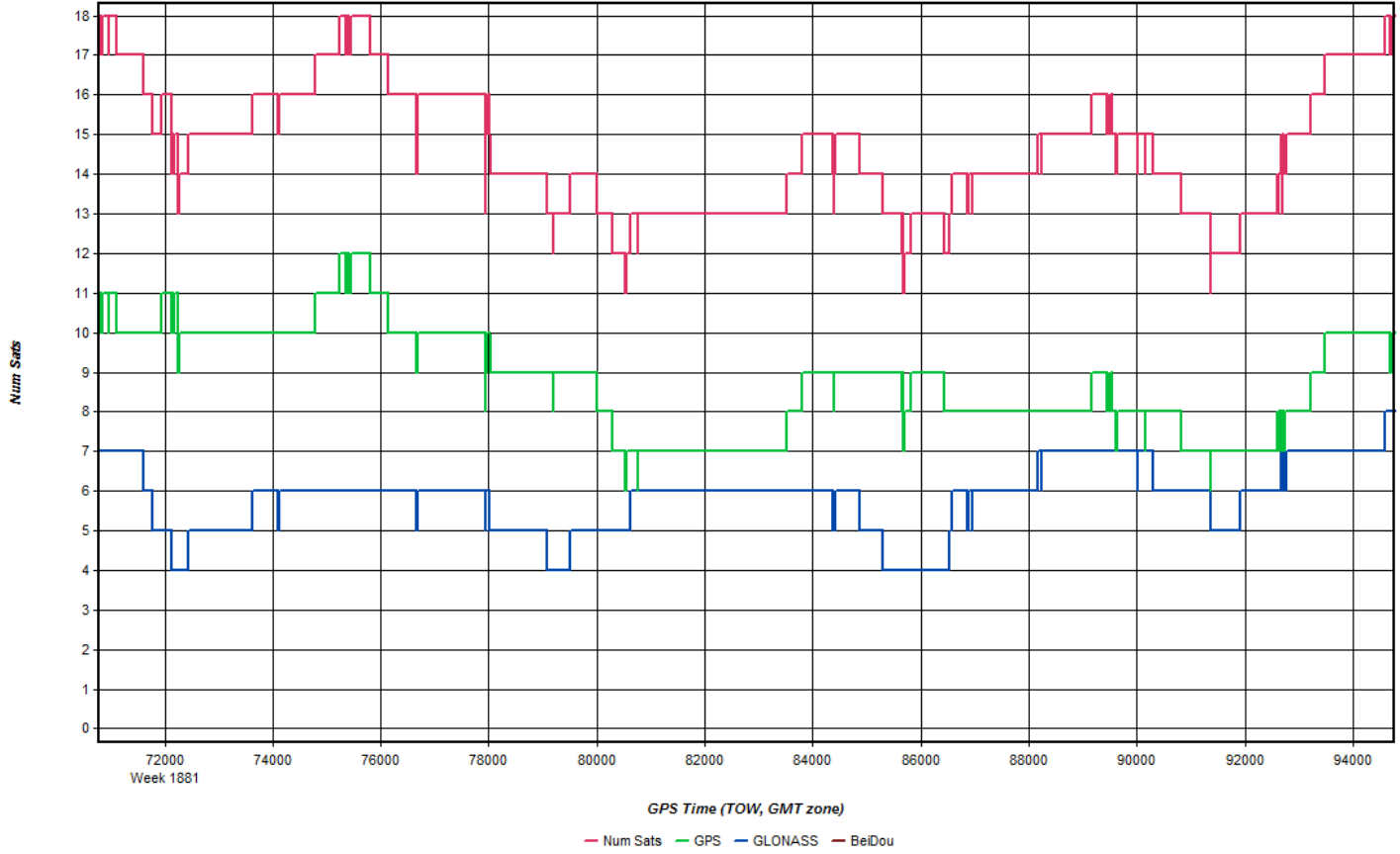


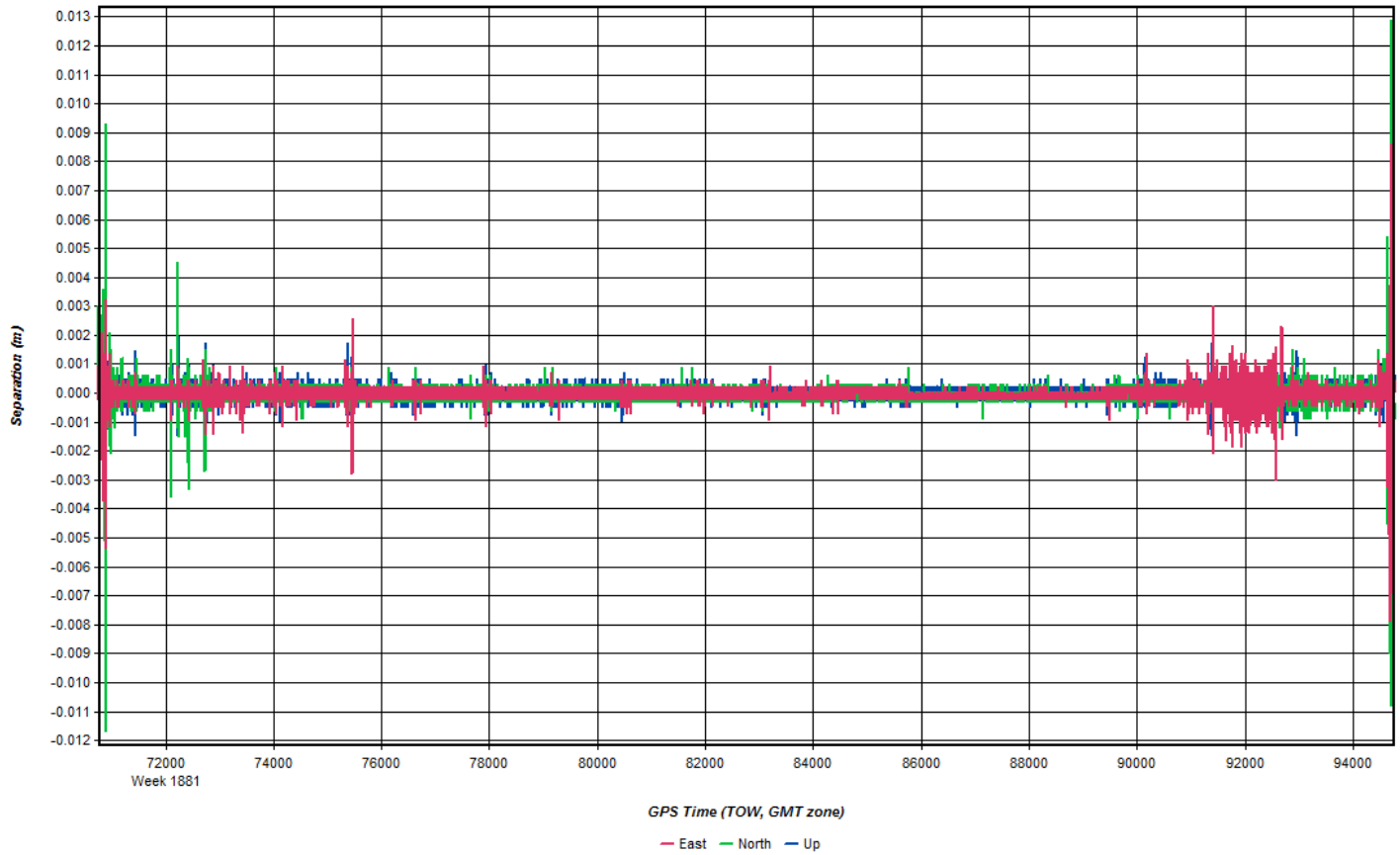


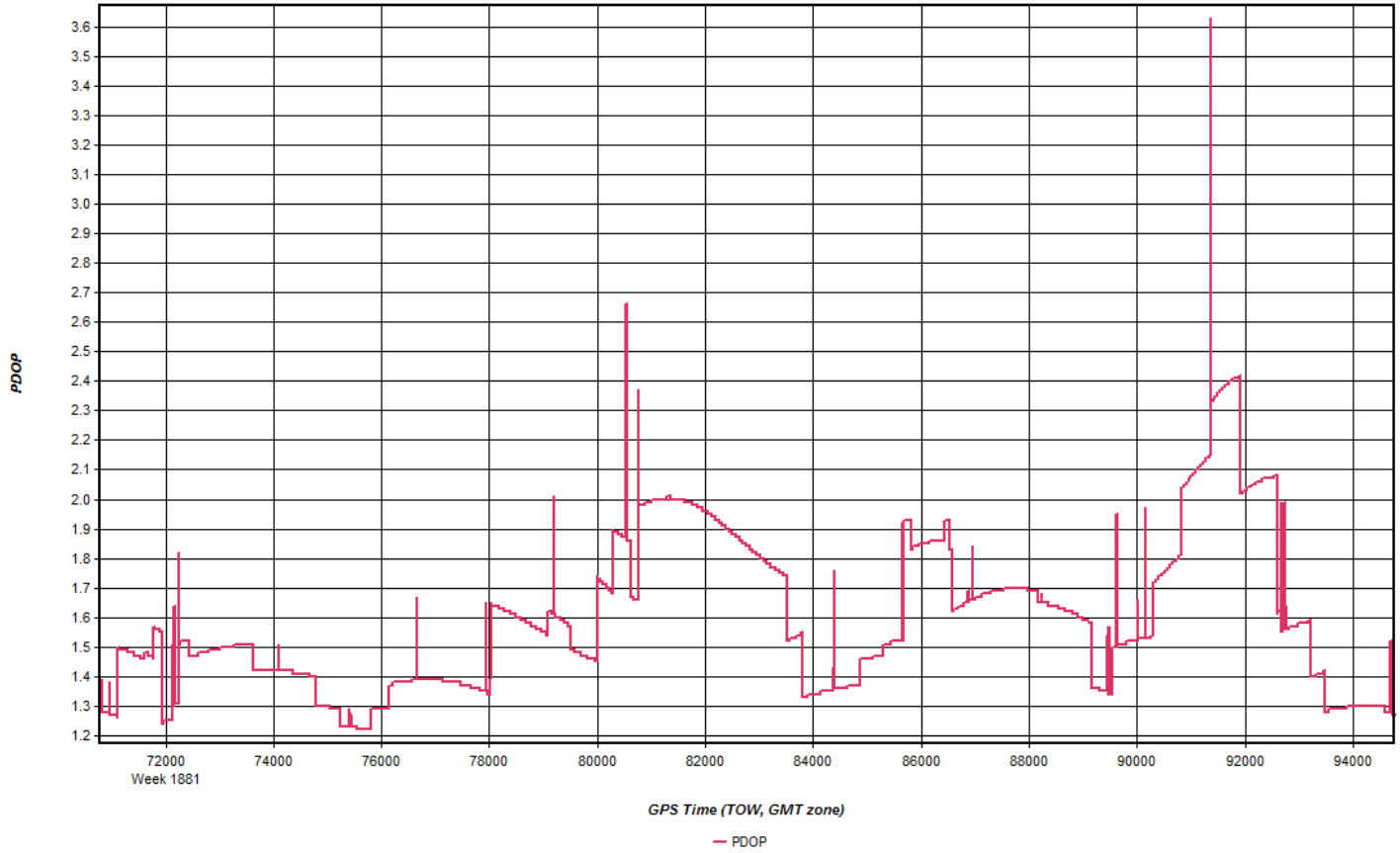
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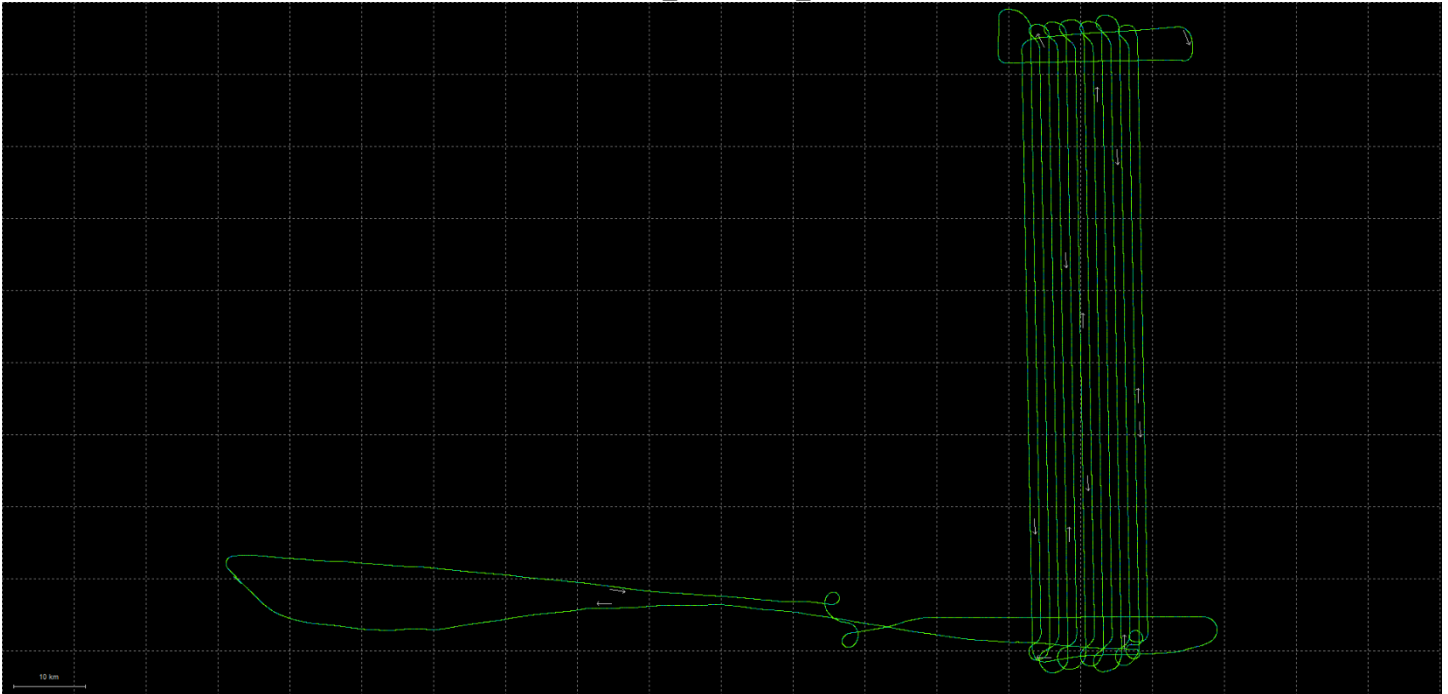


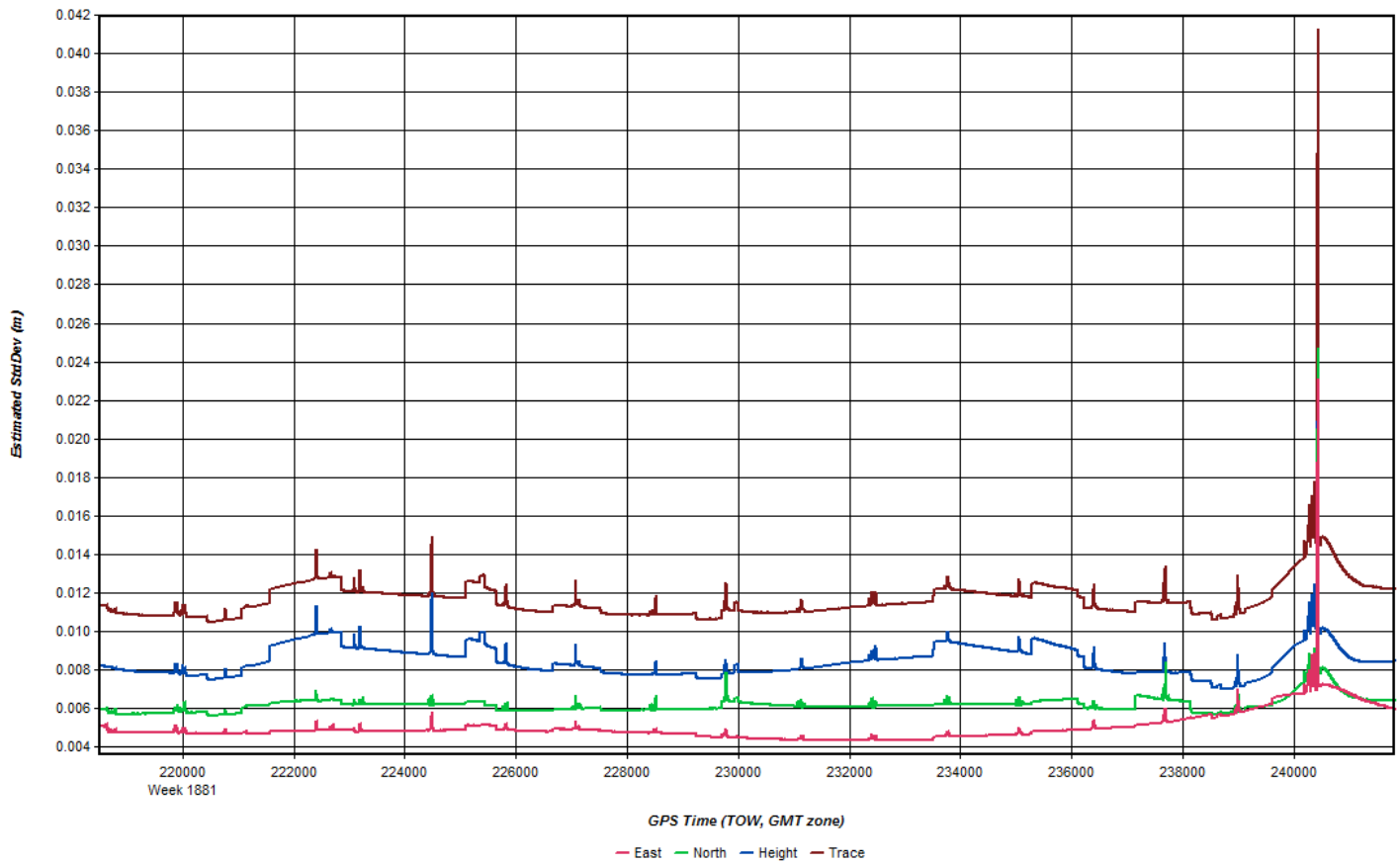


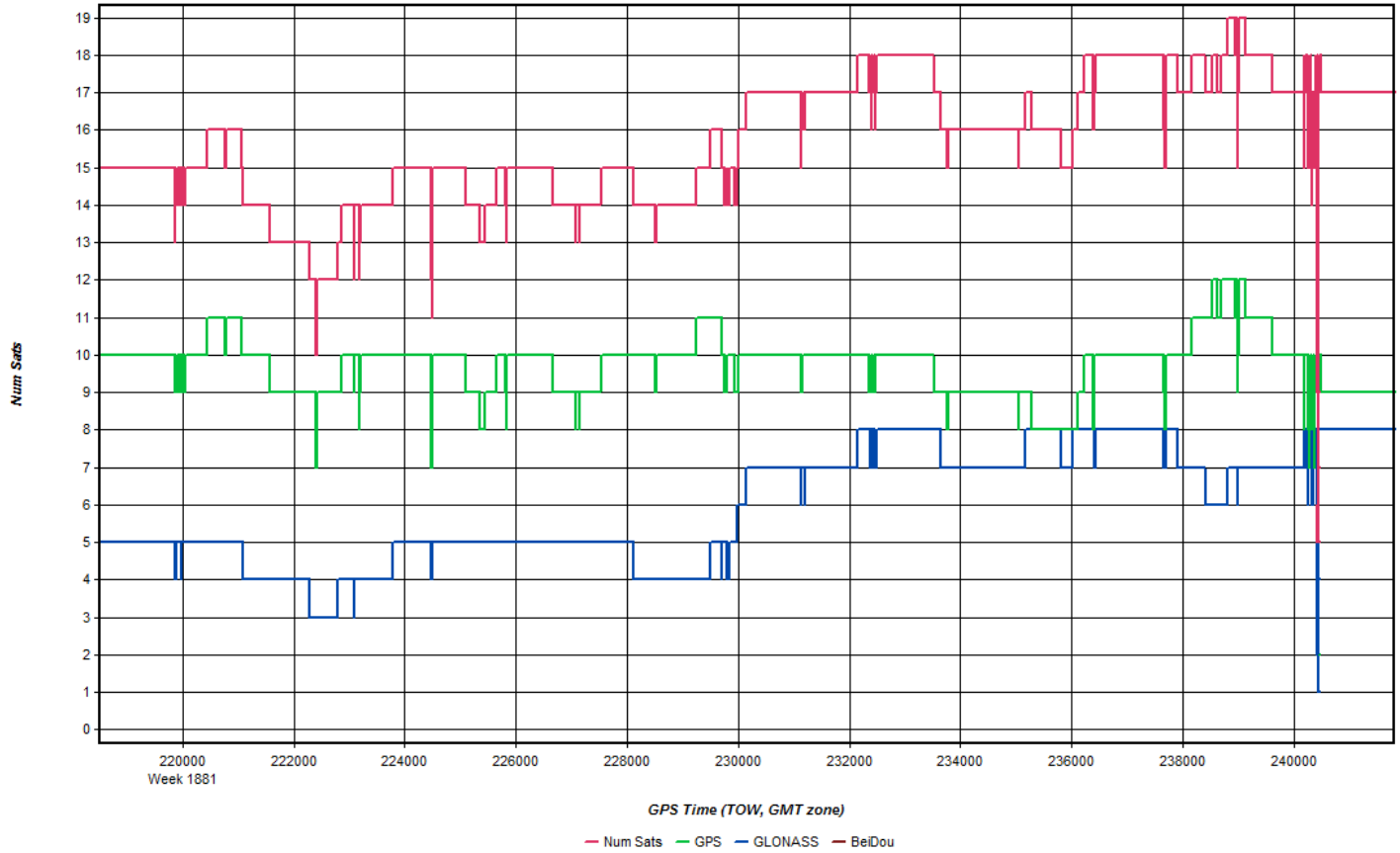


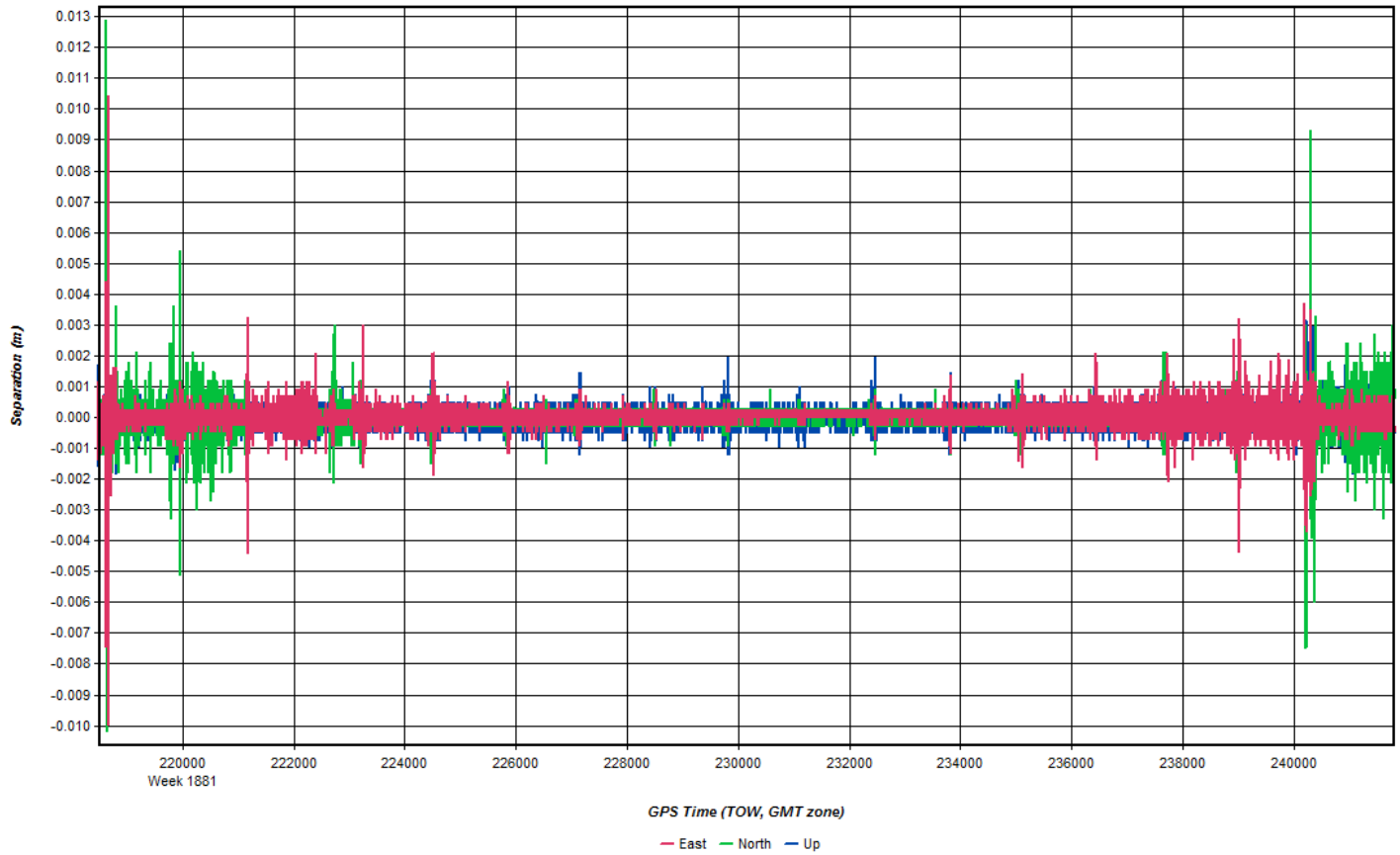


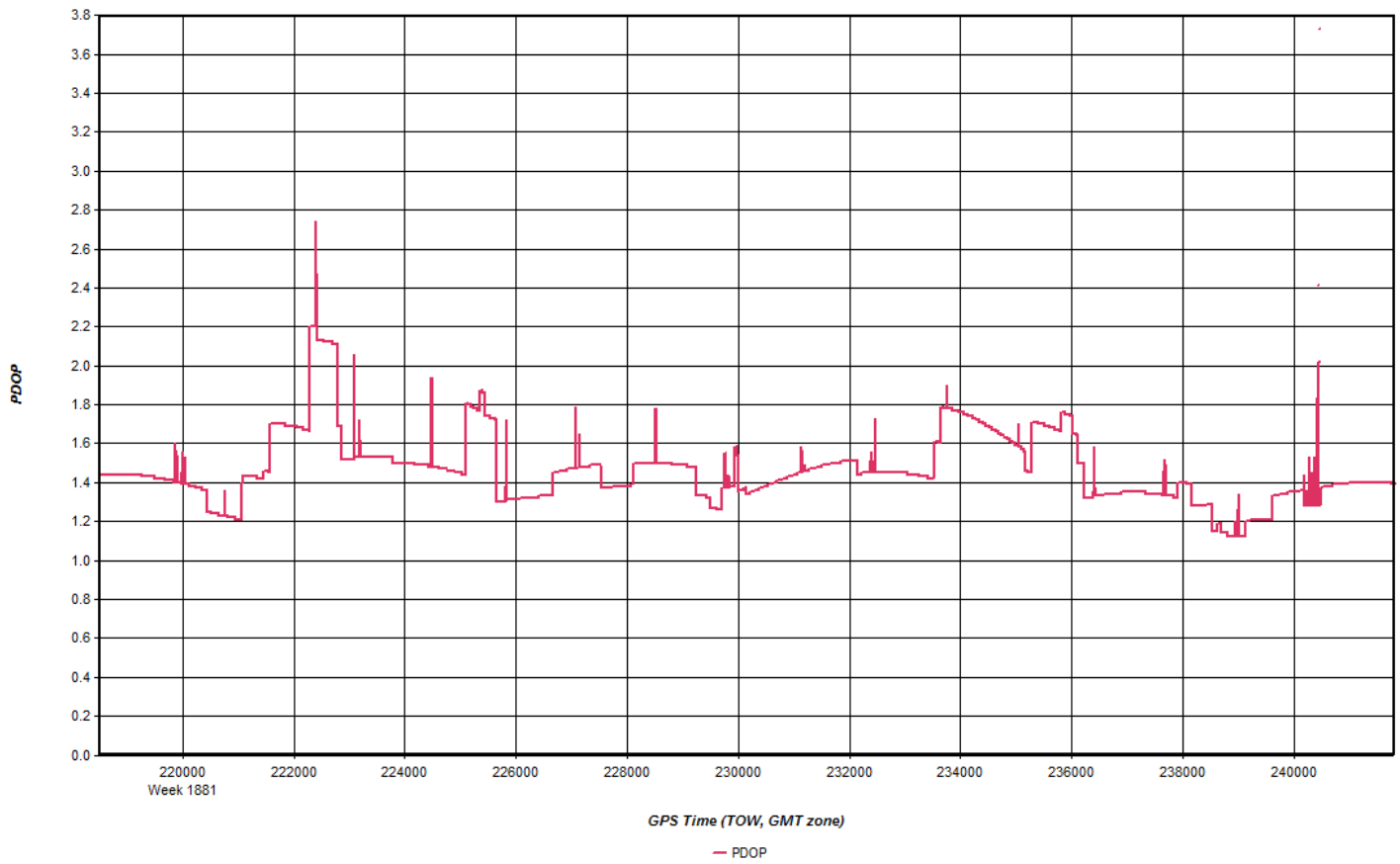
225_20160126_1











225_20160126_2

