Aerial Lidar Report

Kansas Lidar (AOI 3)

15115

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Table of Contents

Section 1: Lidar Acquisition

1.1 Acquisition

The Atlantic Group, LLC (Atlantic) has successfully completed lidar acquisition for the Kansas Lidar (AOI 3). Lidar for this AOI was acquired in eighteen (18) flight lifts completed on March 20th, 2015. The project area encompasses 3,733 square miles or 9,669 square kilometers.

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 one hundred and eighty eight (188) 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. At least two (2) GPS reference station(s) were in operation during all missions, sampling positions at 1 Hz or higher frequently. Differential GPS baseline lengths did not exceed 40 km, unless otherwise approved. Differential GPS unit in aircraft recorded sample positions at 2 Hz or more frequently. Lidar data was only acquired when GPS PDOP was ≤ 4 and at least 6 satellites were in view.

Atlantic monitored weather and atmospheric conditions and conducted lidar missions only when conditions existed that would not degrade sensor ability in the collection of data. These conditions included no snow, rain, fog, smoke, mist and/or low clouds. Lidar systems are active sensors, not requiring light, thus missions may be conducted during night hours when weather restrictions do not prevent collection. Atlantic accessed reliable weather sites and indicators (webcams) to establish the highest probability for successful collection in order to position our sensor to maximize successful data acquisition.

Within 72-hours prior to the planned day(s) of acquisition, Atlantic closely monitored the weather, checking all sources for forecasts at least twice daily. As soon as weather conditions were conducive to acquisition, our aircraft mobilized to the project site to begin data collection. Once on site, the acquisition team took responsibility for weather analysis. 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 Lidar Flightline Orientation

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

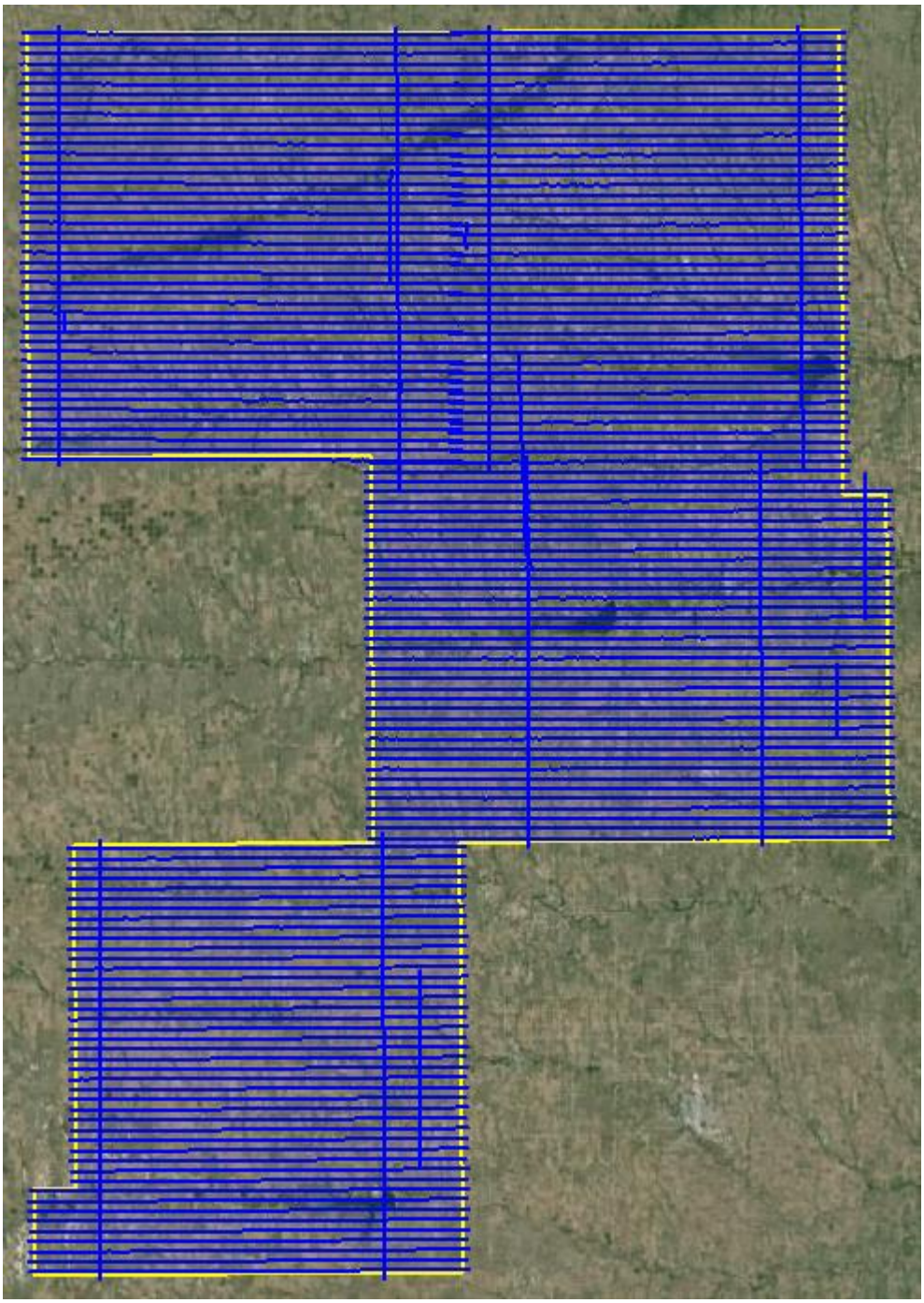

Figure 1: Trajectories as flown by Atlantic

1.5 Acquisition Equipment

Atlantic operated a Partenavia S.P.A. P 68 C/TC (N775MW) outfitted with 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

1.6 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/m²)	2.5
Nominal Flight Height (AGL meters)	2318
Nominal Flight Speed (kts)	130
Pass Heading (degree)	90
Sensor Scan Angle (degree)	40
Scan Frequency (Hz)	35.8
Pulse Rate of Scanner (kHz)	256.8
Line Spacing (m)	286
Pulse Duration of Scanner (ns)	4
Pulse Width of Scanner (m)	0.46
Central Wavelength of Sensor Laser (nm)	1064
Sensor Operated with Multiple Pulses	Yes
Beam Divergence (mrad)	0.15
Nominal Swath With (m)	1536
Nominal Swath Overlap (%)	20
Scan Pattern	Triangle

Table 2: Atlantic Lidar System Acquisition Parameters

1.7 GPS Reference Stations

Four (4) CORS stations, one (1) NGS monument, and seven (7) dedicated stations set by Atlantic were used to control the lidar acquisition for the project area. The coordinates provided in Table 3 below are in NAD83 (2011), Geographic Coordinate System, Ellipsoid, Meters.

GPS Reference Station Coordinates				
Designation	**PID**	**Latitude (N)**	**Longitude (W)**	**Height**
NEMC	DM5411	40°11'57.84817"	100°34'41.39506"	740.679
NEAP	DM4130	40°18'21.07849"	099°54'19.33320"	647.251
NEHO	DL7806	40°26'17.90679"	099°21'43.23456"	685.677
NERC	DN5842	40°04'32.25430"	098°31'05.27213"	495.036
NORTONPORT 2	KG0520	39°50'48.59768"	099°53'32.71819"	694.975
PHG SET	n/a	39°44'24.56830"	099°19'11.29774"	555.009
SP2	n/a	39°22'17.75531"	099°17'47.00291"	576.794
SP3	n/a	39°48'42.35315"	099°53'21.54479"	674.629
SP4	n/a	39°45'20.67569"	099°20'48.40101"	563.642
SP5	n/a	38°54'49.33808"	099°53'31.25748"	713.187
SP6	n/a	39°22'16.92968"	099°18'55.95975"	547.249
SP7	n/a	39°45'20.77692"	099°22'00.79143"	553.804

Table 3: GPS Reference Station Coordinates

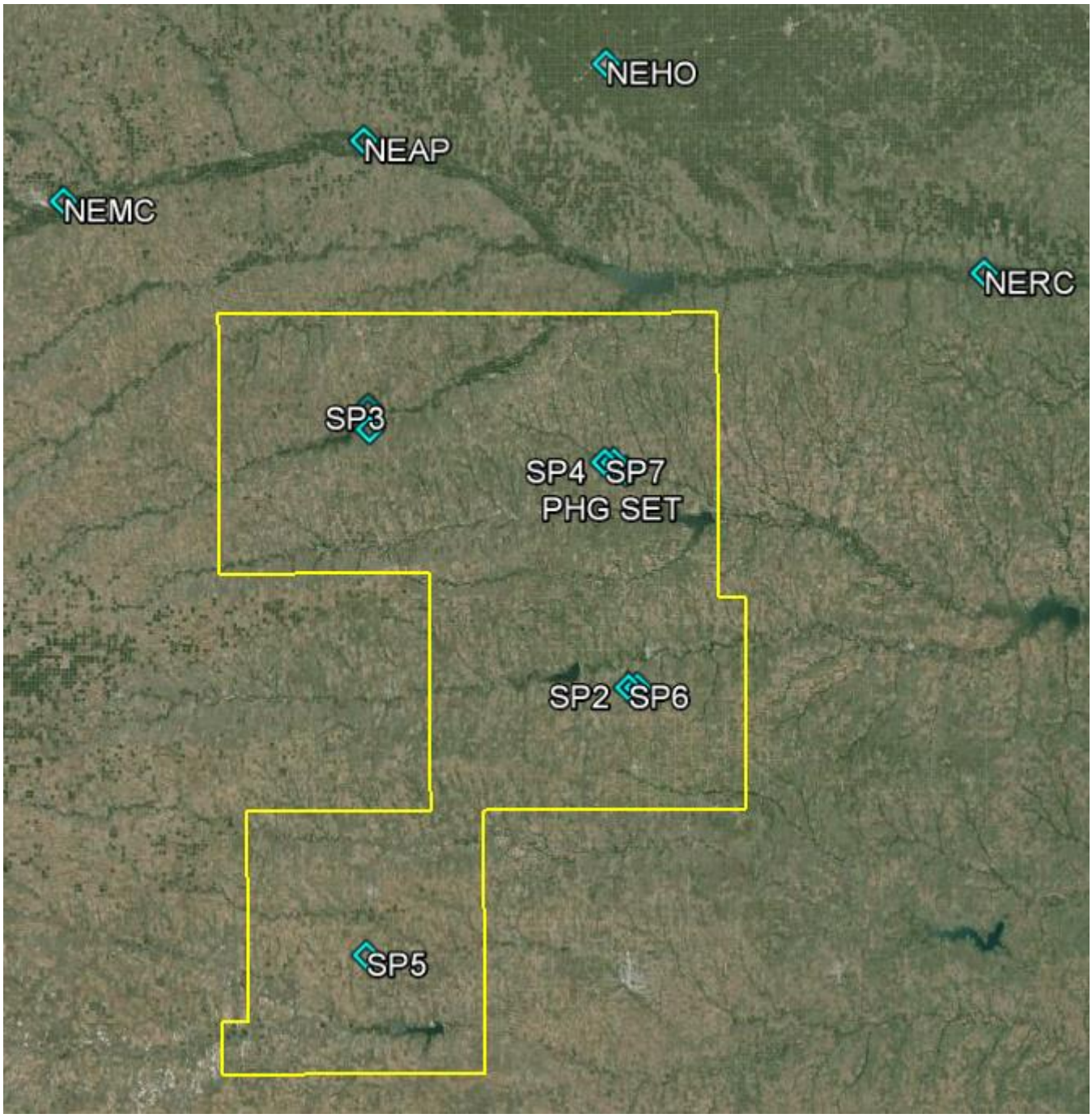

Figure 2: GPS Reference Station(s)

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 8.5.4320) software. Flights were flown with a minimum of 6 satellites in view (10° above the horizon) and with a PDOP of ≤4 when laser online. Distances from base station to aircraft were kept to a maximum of 40km.

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 and Calibration of Laser Points

The initial step of calibration is to verify availability and status of all needed GPS and Laser data against field notes and compile any data if not complete. Subsequently, the mission points are output using Leica's CloudPro post processor with the most recent boresight values. The initial point generation for each mission calibration is verified within TerraScan using distance colored points to identify errors. If a calibration error greater than specification is observed within the mission, the roll, pitch and scanner scale corrections that need to be applied are calculated. Once validated each output mission is imported into the GeoCue software package. Here a project level supplementary coverage check is carried out to ensure no data voids unreported by Field Operations are present.

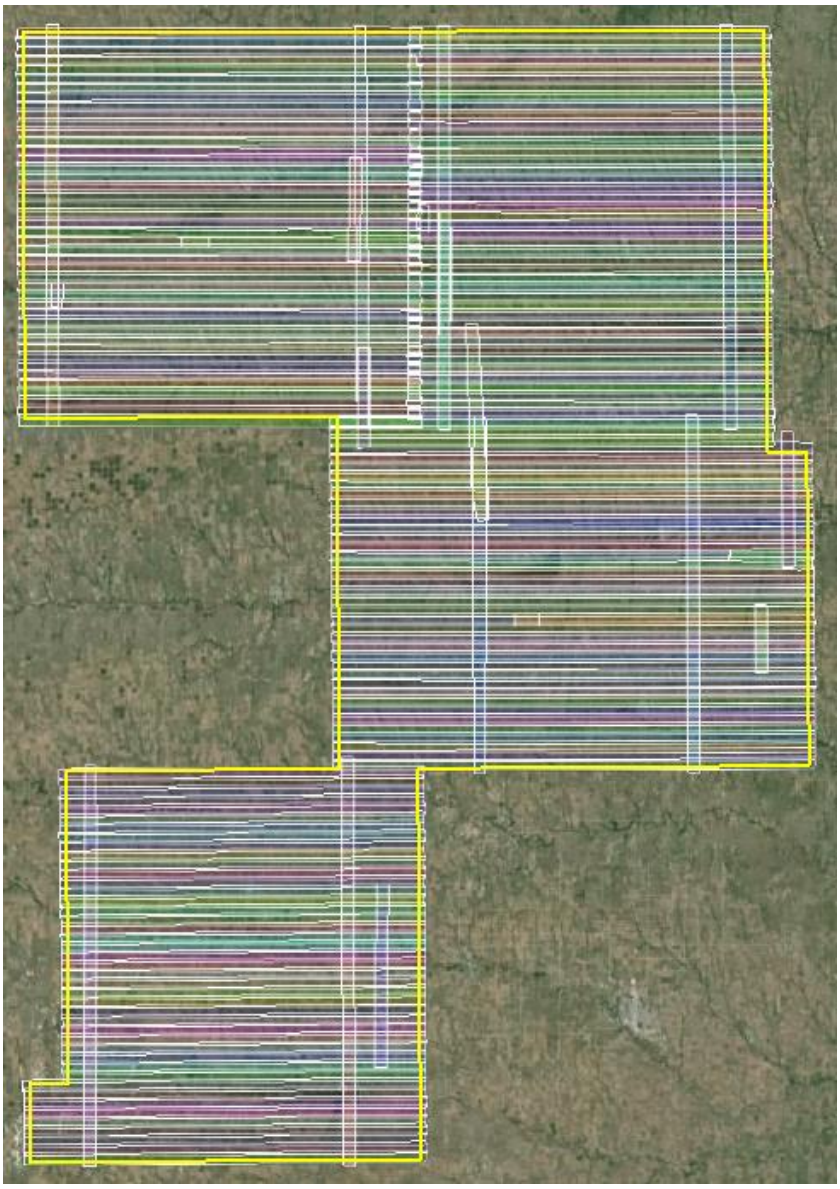

Figure 3: Lidar swath data showing complete coverage

2.2 Reference Systems

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:	Geoid12A
Units:	Meters

2.3 Lidar Point Cloud Statistics

Table 4 illustrates the overall lidar point cloud statistics for this project.

Point Cloud Statistics	
Category	**Value**
Total Points	32,924,358,282
Aggregate Nominal Pulse Spacing (m)	0.6883
Aggregate Nominal Pulse Density (pls/m²)	2.1

Table 4: Lidar Point Cloud Statistics

2.4 Relative Accuracy

For effective data management, each imported mission is tiled out in GeoCue to a project specific tile scheme or index. Relative accuracy and internal quality are then checked using a number of carefully selected tiles in which points from all lines are loaded and inspected. Vertical differences between ground surfaces of each line are displayed by the generation of Z-Difference colored intensity orthos in GeoCue. The color scale of these orthos are adjusted so that errors greater than the specifications are flagged. Cross sections are visually inspected across each block to validate point to point, flight line to flight line and mission to mission alignment. When available, surveyed control points are used to supplement and verify the calibration of the data.

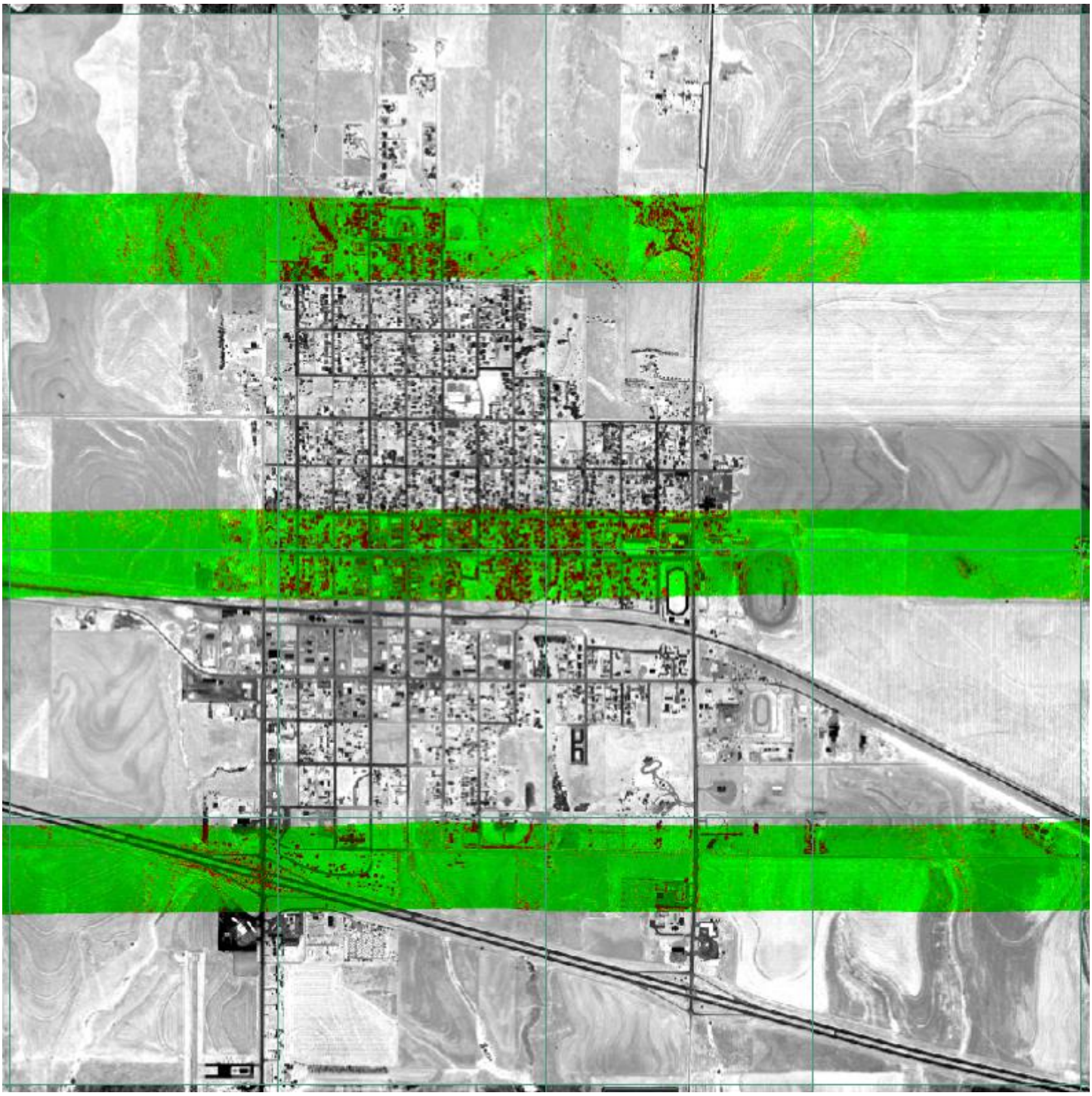

Figure 4: dZ ortho sub-sample

2.5 Relative 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
79	0.017	0.055	0.01	141	0.03	0.036	0.012	207	0.027	0.036	0.012
80	0.015	0.061	0.011	144	0.002	0.053	0.012	208	0.028	0.019	0.014
81	0.031	0.035	0.012	145	0.003	0.025	0.012	209	0.017	0.022	0.013
82	0.026	0.032	0.011	146	0.032	0.023	0.012	210	0.012	0.02	0.013
83	0.023	0.037	0.012	147	0.021	0.015	0.012	211	0.014	0.02	0.013
84	0.034	0.035	0.011	148	0.018	0.012	0.012	212	0.012	0.01	0.013
85	0.03	0.021	0.012	149	0.024	0.022	0.012	213	0.021	0.019	0.013
86	0.02	0.017	0.012	150	0.036	0.036	0.013	214	0.024	0.02	0.013
87	0.018	0.016	0.012	151	0.033	0.033	0.013	215	0.029	0.031	0.014
88	0.013	0.024	0.012	153	0.042	0.024	0.013	217	0.009	0.019	0.013
89	0.015	0.03	0.012	154	0.023	0.018	0.013	218	0.011	0.018	0.013
90	0.014	0.036	0.012	155	0.015	0.015	0.012	219	0.02	0.014	0.013
92	0.005	0.057	0.013	156	0.02	0.018	0.013	220	0.01	0.075	0.013
93	0.012	0.026	0.011	157	0.038	0.04	0.013	221	0.02	0.05	0.013
94	0.021	0.015	0.01	158	0.083	0.003	0.013	222	0.039	0.014	0.014
95	0.022	0.033	0.01	159	0.036	0.012	0.013	223	0.032	0.024	0.013
96	0.023	0.039	0.011	161	0.033	0.052	0.014	224	0.023	0.027	0.013
97	0.023	0.013	0.011	162	0.025	0.049	0.012	225	0.022	0.028	0.013
98	0.02	0.022	0.011	163	0.008	0.044	0.012	226	0.013	0.051	0.013
99	0.019	0.078	0.01	164	0.015	0.037	0.012	227	0.02	0.041	0.013
100	0.021	0.043	0.011	167	0.014	0.016	0.012	228	0.025	0.027	0.012
101	0.02	0.035	0.011	168	0.013	0.075	0.012	229	0.023	0.029	0.013
102	0.024	0.028	0.011	169	0.01	0.057	0.013	230	0.023	0.042	0.012
103	0.025	0.036	0.011	170	0.022	0.053	0.013	231	0.023	0.028	0.014
104	0.016	0.046	0.011	171	0.023	0.047	0.013	232	0.014	0.036	0.013
105	0.014	0.04	0.012	172	0.014	0.027	0.012	233	0.01	0.016	0.011
106	0.016	0.025	0.011	173	0.028	0.048	0.012	234	0.011	0.018	0.012
107	0.018	0.021	0.011	174	0.045	0.042	0.012	235	0.015	0.03	0.011
110	0.029	0.023	0.011	175	0.025	0.064	0.014	236	0.03	0.018	0.011
111	0.009	0.024	0.011	176	0.007	0.026	0.012	237	0.032	0.019	0.011
112	0.021	0.03	0.011	177	0.038	0.032	0.013	238	0.03	0.023	0.013
113	0.011	0.039	0.011	178	0.056	0.054	0.013	239	0.005	0.024	0.012
114	0.005	0.044	0.011	179	0.012	0.018	0.012	240	0.01	0.033	0.012
115	0.008	0.05	0.012	180	0.016	0.036	0.012	241	0.008	0.073	0.013
116	0.028	0.06	0.012	181	0.014	0.034	0.012	244	0.021	0.036	0.012
117	0.029	0.033	0.011	182	0.016	0.031	0.012	245	0.035	0.026	0.012
118	0.021	0.067	0.011	183	0.023	0.039	0.012	246	0.034	0.023	0.012

119	0.01	0.057	0.011	**184**	0.016	0.029	0.012	**247**	0.009	0.06	0.012
120	0.02	0.056	0.012	**185**	0.013	0.024	0.012	**248**	0.002	0.062	0.015
121	0.024	0.031	0.011	**186**	0.015	0.022	0.012	**250**	0.011	0.036	0.014
122	0.011	0.017	0.013	**187**	0.017	0.02	0.012	**251**	0.007	0.042	0.013
123	0.011	0.019	0.011	**188**	0.011	0.018	0.013	**252**	0.017	0.05	0.013
124	0.02	0.034	0.013	**189**	0.014	0.017	0.012	**253**	0.024	0.048	0.013
125	0.043	0.035	0.013	**190**	0.018	0.023	0.012	**254**	0.038	0.036	0.013
126	0.045	0.028	0.014	**191**	0.019	0.055	0.013	**255**	0.013	0.012	0.013
127	0.019	0.027	0.014	**192**	0.054	0.021	0.014	**256**	0.017	0.024	0.013
128	0.021	0.026	0.013	**195**	0.021	0.066	0.011	**257**	0.028	0.044	0.016
129	0.021	0.028	0.012	**196**	0.014	0.039	0.012	**259**	0.016	0.014	0.015
130	0.011	0.01	0.011	**197**	0.005	0.02	0.013	**260**	0.015	0.016	0.012
131	0.015	0.012	0.012	**198**	0.033	0.017	0.013	**261**	0.02	0.03	0.014
132	0.013	0.011	0.012	**199**	0.034	0.03	0.012	**262**	0.02	0.016	0.013
133	0.014	0.021	0.012	**200**	0.029	0.018	0.013	**263**	0.079	0.002	0.013
134	0.017	0.027	0.012	**201**	0.025	0.024	0.013	**264**	0.075	0.001	0.012
135	0.011	0.037	0.014	**202**	0.015	0.037	0.014	**266**	0.01	0.035	0.017
136	0.019	0.066	0.012	**203**	0.024	0.028	0.014	**268**	0.052	0.047	0.014
138	0.035	0.013	0.013	**205**	0.013	0.026	0.012	**270**	0.001	0.045	0.013
139	0.017	0.01	0.011	**206**	0.012	0.039	0.012	**271**	0.027	0.032	0.013
140	0.031	0.03	0.012								

Table 5: Average Tie Line Magnitudes per Line

Internal Observation Statistics			
Category	**X**	**Y**	**Z**
Average Magnitude	0.017	0.023	0.012
RMS Values	0.030	0.037	0.017
Maximum Values	0.147	0.148	0.150
Observation Weight	7180.0	7180.0	912183.0

Table 6: Tie Line Observation Statistics

Overall Relative Accuracy	
Category	**Mismatch**
Average 3D Mismatch	0.01262
Average XY Mismatch	0.03730
Average Z Mismatch	0.01237

Table 7: Relative Accuracy Results

TerraMatch Tie Lines	
Category	**Observations**
Section Lines	395,974
Roof Lines	3,586

Table 8: Total Tie Line

2.6 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.

2.7 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-Rail (breakline buffer) in LP360. Outlined in Table 9 are the classification codes utilized for this project.

ASPRS Standard Lidar Point Classes		
Code	**Description**	**Utilized**
0	Created, never classified	
1	Unclassified[3]	X
2	Ground	X
3	Low Vegetation	
4	Medium Vegetation	
5	High Vegetation	
6	Building	
7	Low Point (noise)	X
8	Reserved	
9	Water	X
10	Rail (breakline buffer)	X
11	Road Surface	
12	Reserved	
13	Wire – Guard (Shield)	
14	Wire – Conductor (Phase)	
15	Transmission Tower	
16	Wire-structure Connector (e.g. Insulator)	
17	Bridge Deck	X
18	High Noise	X
19-63	Reserved	
64-255	User Definable	

Table 9: Point Cloud Classification Scheme

Section 3: Vertical Accuracy Assessment

3.1 Ground Surveyed Check Points

Atlantic established a total of one hundred and eighty four (184) checkpoints for this project (116 NVA + 68 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.

3.2 Vertical Accuracy

Below are the vertical accuracy reporting requirements for this project:

Vertical Accuracy Reporting Requirements in Meters:

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

Vertical Accuracy Reporting Requirements in Feet:

$RMSE_Z \leq 0.328$ft (Non-Vegetated Swath, DEM)
NVA ≤ 0.643ft 95% Confidence Level (Swath, DEM)
VVA ≤ 0.965ft 95^{th} 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).

3.3 Check Point Distribution

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

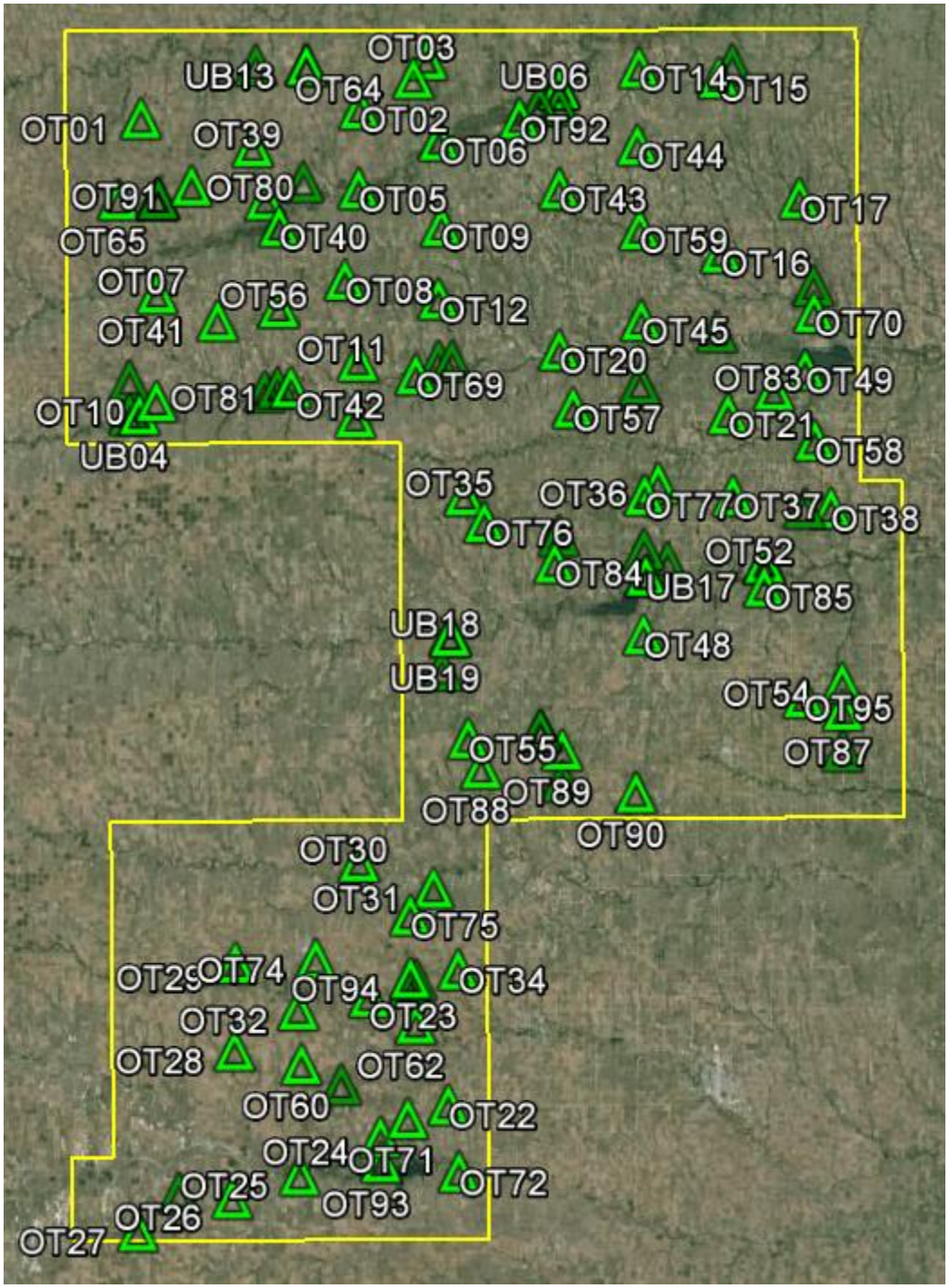

Figure 5: Non-vegetated Vertical Accuracy (NVA) Check Point Distribution

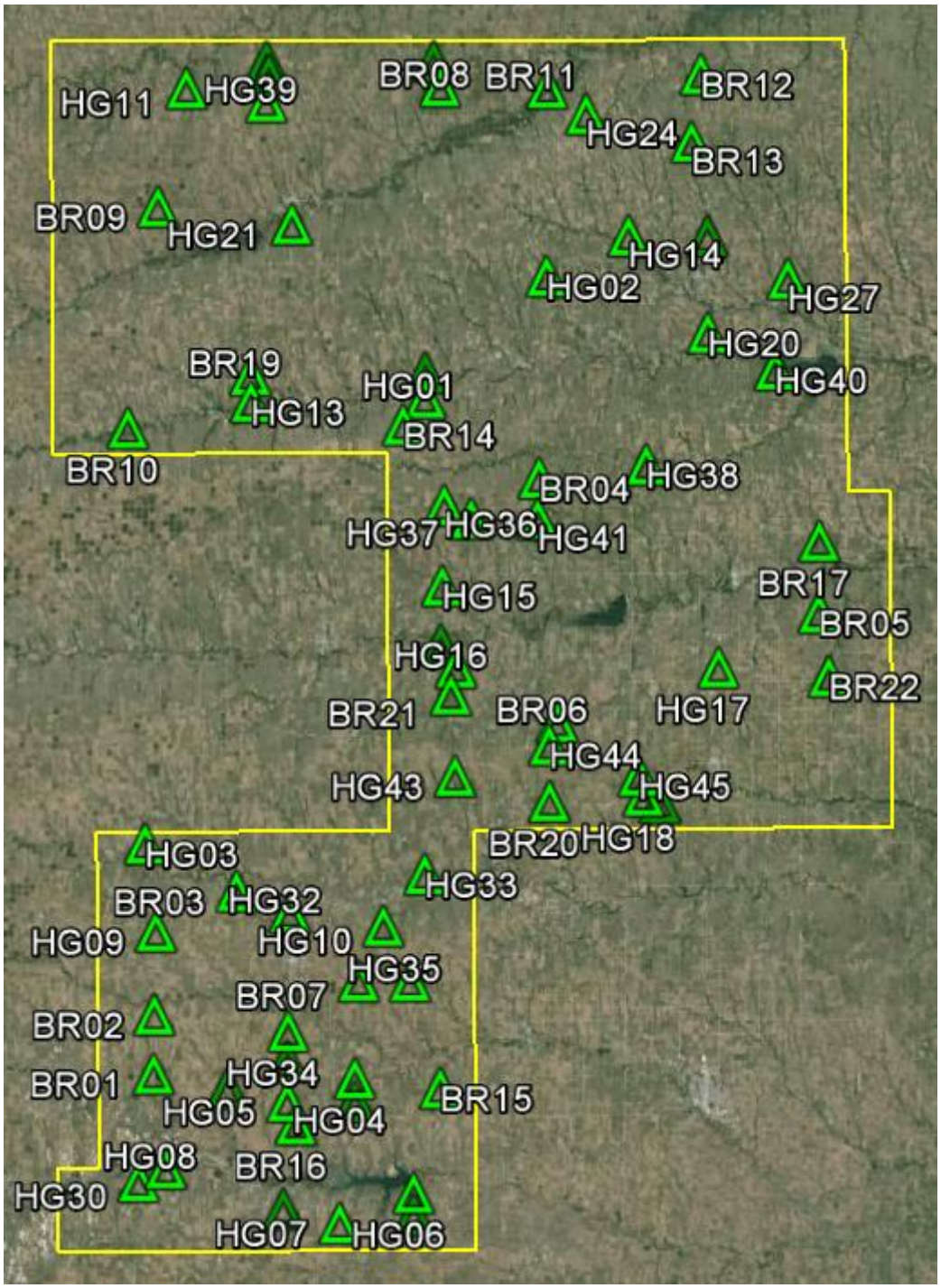

Figure 6: Vegetated Vertical Accuracy (VVA) Check Point Distribution

3.4 Check Point Assessment

A vertical accuracy assessment of the NVA & VVA checkpoints against the lidar point cloud swath data and bare-earth surface DEM's can be found in Tables 10, 11, and 12 below. The coordinates provided are in NAD83 (HARN), UTM Zone 14N, NAVD88 (Geoid12A), Meters.

Non-vegetated Vertical Accuracy (NVA) Check Point Assessment (Swath)						
PointID	**Easting**	**Northing**	**KnownZ**	**LaserZ**	**Description**	**DeltaZ**
OT01	404207.646	4418885.123	769.806	769.781	Open Terrain/Bare Earth	-0.025
OT02	430447.263	4419799.081	721.197	721.202	Open Terrain/Bare Earth	0.005
OT03	438560.300	4425652.254	712.329	712.332	Open Terrain/Bare Earth	0.003
OT04	406080.406	4409200.181	766.711	766.730	Open Terrain/Bare Earth	0.019
OT05	430264.879	4410253.761	677.003	677.011	Open Terrain/Bare Earth	0.008
OT06	439942.102	4415940.701	655.227	655.237	Open Terrain/Bare Earth	0.010
OT07	406032.423	4397954.589	769.378	769.442	Open Terrain/Bare Earth	0.064
OT08	428557.611	4399356.341	729.252	729.346	Open Terrain/Bare Earth	0.094
OT09	440155.827	4405681.680	721.390	721.455	Open Terrain/Bare Earth	0.065
OT10	405873.078	4385056.966	741.115	741.157	Open Terrain/Bare Earth	0.042
OT11	430066.099	4389668.088	672.504	672.506	Open Terrain/Bare Earth	0.002
OT12	439746.025	4396986.944	681.890	681.935	Open Terrain/Bare Earth	0.045
OT13	454365.611	4420087.191	642.709	642.646	Open Terrain/Bare Earth	-0.063
OT14	463978.662	4424483.461	635.156	635.129	Open Terrain/Bare Earth	-0.027
OT15	473541.828	4423202.596	657.006	656.953	Open Terrain/Bare Earth	-0.053
OT16	473622.769	4402298.896	593.922	593.858	Open Terrain/Bare Earth	-0.064
OT17	483072.707	4408738.439	585.932	585.940	Open Terrain/Bare Earth	0.008
OT18	473060.387	4392867.450	554.009	554.018	Open Terrain/Bare Earth	0.009
OT19	484676.407	4398294.826	552.387	552.363	Open Terrain/Bare Earth	-0.024
OT20	454170.976	4390811.954	590.365	590.333	Open Terrain/Bare Earth	-0.032
OT21	474309.560	4383038.616	600.541	600.528	Open Terrain/Bare Earth	-0.013
OT22	440256.088	4301025.760	674.491	674.486	Open Terrain/Bare Earth	-0.005
OT23	430866.323	4313951.843	722.967	722.983	Open Terrain/Bare Earth	0.016
OT24	432099.428	4297225.829	683.136	683.261	Open Terrain/Bare Earth	0.125
OT25	422390.316	4292738.547	659.196	659.240	Open Terrain/Bare Earth	0.044
OT26	414286.416	4290006.040	723.918	723.955	Open Terrain/Bare Earth	0.037
OT27	402923.247	4286160.932	752.876	752.974	Open Terrain/Bare Earth	0.098
OT28	414711.979	4307669.039	727.456	727.467	Open Terrain/Bare Earth	0.011
OT29	414867.165	4318083.343	742.210	742.187	Open Terrain/Bare Earth	-0.023
OT30	429781.645	4330069.222	680.610	680.556	Open Terrain/Bare Earth	-0.054
OT31	438660.933	4326874.811	704.092	704.151	Open Terrain/Bare Earth	0.059
OT32	422383.503	4312461.751	749.189	749.275	Open Terrain/Bare Earth	0.086
OT33	436518.078	4315966.463	723.099	723.151	Open Terrain/Bare Earth	0.052
OT34	441554.779	4317120.023	700.740	700.681	Open Terrain/Bare Earth	-0.059
OT35	442719.679	4373551.415	695.285	695.263	Open Terrain/Bare Earth	-0.022

OT36	465898.445	4374861.995	634.844	634.784	Open Terrain/Bare Earth	-0.060
OT37	474824.804	4373309.614	587.568	587.617	Open Terrain/Bare Earth	0.049
OT38	486567.195	4371748.218	576.730	576.802	Open Terrain/Bare Earth	0.072
OT39	417607.417	4415382.835	750.381	750.401	Open Terrain/Bare Earth	0.020
OT40	420728.634	4405815.420	715.528	715.568	Open Terrain/Bare Earth	0.040
OT41	413274.659	4394628.074	766.288	766.336	Open Terrain/Bare Earth	0.048
OT42	429683.520	4382922.044	700.972	701.070	Open Terrain/Bare Earth	0.098
OT43	454307.873	4410054.929	673.471	673.471	Open Terrain/Bare Earth	0.000
OT44	463702.044	4415212.492	682.831	682.902	Open Terrain/Bare Earth	0.071
OT45	464009.644	4394276.547	594.833	594.720	Open Terrain/Bare Earth	-0.113
OT46	463813.916	4386662.758	594.527	594.482	Open Terrain/Bare Earth	-0.045
OT47	464144.597	4367011.047	592.920	592.895	Open Terrain/Bare Earth	-0.025
OT48	463992.032	4356844.539	577.587	577.668	Open Terrain/Bare Earth	0.081
OT49	483608.595	4388262.640	544.005	543.975	Open Terrain/Bare Earth	-0.030
OT50	453972.358	4368688.956	664.882	664.844	Open Terrain/Bare Earth	-0.038
OT51	487760.166	4342835.198	629.124	628.960	Open Terrain/Bare Earth	-0.164
OT52	478530.570	4365239.414	532.389	533.067	Open Terrain/Bare Earth	slope
OT53	478530.515	4365239.381	532.264	533.189	Open Terrain/Bare Earth	slope
OT54	487740.837	4350916.789	580.354	580.427	Open Terrain/Bare Earth	0.073
OT55	442933.475	4344626.772	699.999	700.003	Open Terrain/Bare Earth	0.004
OT56	420613.697	4396143.777	739.752	739.813	Open Terrain/Bare Earth	0.061
OT57	455764.473	4383902.497	650.733	650.709	Open Terrain/Bare Earth	-0.024
OT58	484679.182	4379835.744	570.287	570.172	Open Terrain/Bare Earth	-0.115
OT59	463894.578	4405109.052	612.736	612.722	Open Terrain/Bare Earth	-0.014
OT60	422716.196	4305973.968	736.536	736.639	Open Terrain/Bare Earth	0.103
OT61	423652.668	4411138.358	719.636	719.745	Open Terrain/Bare Earth	0.109
OT62	436426.027	4310727.960	700.687	700.819	Open Terrain/Bare Earth	0.132
OT63	427460.574	4303548.877	709.325	709.406	Open Terrain/Bare Earth	0.081
OT64	436918.556	4423393.436	701.133	701.172	Open Terrain/Bare Earth	0.039
OT65	401442.299	4409210.000	770.547	770.545	Open Terrain/Bare Earth	-0.002
OT66	402644.743	4387545.916	776.097	776.159	Open Terrain/Bare Earth	0.062
OT67	452017.461	4420093.006	636.650	636.609	Open Terrain/Bare Earth	-0.041
OT68	475168.116	4424796.127	636.449	636.390	Open Terrain/Bare Earth	-0.059
OT69	436972.619	4388002.816	620.267	620.368	Open Terrain/Bare Earth	0.101
OT70	484725.395	4395098.302	534.385	534.356	Open Terrain/Bare Earth	-0.029
OT71	435386.587	4299434.373	682.097	682.224	Open Terrain/Bare Earth	0.127
OT72	441457.798	4293007.848	644.959	645.054	Open Terrain/Bare Earth	0.095
OT73	407868.704	4290645.240	727.042	727.124	Open Terrain/Bare Earth	0.082
OT74	424528.906	4318472.026	743.660	743.583	Open Terrain/Bare Earth	-0.077
OT75	435861.530	4323655.459	711.916	711.947	Open Terrain/Bare Earth	0.031
OT76	445054.416	4370344.856	679.125	679.198	Open Terrain/Bare Earth	0.073
OT77	464266.197	4373438.419	638.315	638.315	Open Terrain/Bare Earth	0.000

OT78	483372.057	4371759.740	585.143	585.012	Open Terrain/Bare Earth	-0.131
OT79	418025.545	4425160.228	745.293	745.215	Open Terrain/Bare Earth	-0.078
OT80	419112.206	4409037.649	723.773	723.776	Open Terrain/Bare Earth	0.003
OT81	422016.704	4386584.532	679.230	679.258	Open Terrain/Bare Earth	0.028
OT82	466930.841	4365397.712	575.867	575.926	Open Terrain/Bare Earth	0.059
OT83	479839.911	4385831.669	589.693	589.659	Open Terrain/Bare Earth	-0.034
OT84	453438.431	4365451.761	625.959	625.990	Open Terrain/Bare Earth	0.031
OT85	478493.710	4362447.524	550.668	550.668	Open Terrain/Bare Earth	0.000
OT86	439858.317	4352795.926	672.161	672.179	Open Terrain/Bare Earth	0.018
OT87	487846.342	4347682.042	596.443	596.429	Open Terrain/Bare Earth	-0.014
OT88	444494.822	4341056.480	698.863	698.899	Open Terrain/Bare Earth	0.036
OT89	454192.272	4343182.514	691.115	691.000	Open Terrain/Bare Earth	-0.115
OT90	462971.656	4338047.386	668.861	668.988	Open Terrain/Bare Earth	0.127
OT91	410239.780	4410764.203	753.042	753.082	Open Terrain/Bare Earth	0.040
OT92	449606.551	4418483.702	640.864	640.822	Open Terrain/Bare Earth	-0.042
OT93	432185.746	4294218.377	657.968	658.165	Open Terrain/Bare Earth	0.197
OT94	435836.188	4316154.375	724.101	724.136	Open Terrain/Bare Earth	0.035
OT95	483113.837	4349218.760	606.438	606.464	Open Terrain/Bare Earth	0.026
UB01	454162.612	4339476.988	685.417	685.541	Urban Terrain	0.124
UB02	406222.440	4409230.589	767.406	767.403	Urban Terrain	-0.003
UB03	406205.416	4409230.749	767.325	767.315	Urban Terrain	-0.010
UB04	403818.789	4383481.696	738.653	738.670	Urban Terrain	0.017
UB05	402639.951	4383506.629	740.656	740.695	Urban Terrain	0.039
UB06	454392.985	4422041.960	631.155	631.105	Urban Terrain	-0.050
UB07	454393.093	4422026.230	631.077	631.071	Urban Terrain	-0.006
UB08	441300.646	4389585.407	622.026	622.059	Urban Terrain	0.033
UB09	439694.669	4389586.976	623.430	623.456	Urban Terrain	0.026
UB10	435710.518	4315252.924	717.716	717.813	Urban Terrain	0.097
UB11	435708.215	4315190.064	719.383	719.471	Urban Terrain	0.088
UB12	424080.149	4425087.620	716.328	716.336	Urban Terrain	0.008
UB13	424087.122	4425060.355	716.930	716.964	Urban Terrain	0.034
UB14	420423.806	4386554.007	675.150	675.201	Urban Terrain	0.051
UB15	418842.728	4386111.318	680.334	680.392	Urban Terrain	0.058
UB16	464394.507	4363815.342	574.714	574.819	Urban Terrain	0.105
UB17	464329.217	4363807.954	576.314	576.370	Urban Terrain	0.056
UB18	440903.866	4356811.500	625.269	625.324	Urban Terrain	0.055
UB19	440904.157	4356819.527	625.166	625.193	Urban Terrain	0.027
UB20	451683.174	4345380.345	684.365	684.292	Urban Terrain	-0.073
UB21	451569.405	4345557.193	687.571	687.472	Urban Terrain	-0.099

Table 10: Lidar Point Cloud Swath Data Assessment

Non-vegetated Vertical Accuracy (NVA) Check Point Assessment (DEM)						
PointID	**Easting**	**Northing**	**KnownZ**	**LaserZ**	**Description**	**DeltaZ**
OT01	404207.646	4418885.123	769.806	769.775	Open Terrain/Bare Earth	-0.031
OT02	430447.263	4419799.081	721.197	721.222	Open Terrain/Bare Earth	0.025
OT03	438560.300	4425652.254	712.329	712.313	Open Terrain/Bare Earth	-0.016
OT04	406080.406	4409200.181	766.711	766.730	Open Terrain/Bare Earth	0.019
OT05	430264.879	4410253.761	677.003	677.011	Open Terrain/Bare Earth	0.008
OT06	439942.102	4415940.701	655.227	655.237	Open Terrain/Bare Earth	0.010
OT07	406032.423	4397954.589	769.378	769.433	Open Terrain/Bare Earth	0.055
OT08	428557.611	4399356.341	729.252	729.323	Open Terrain/Bare Earth	0.071
OT09	440155.827	4405681.680	721.390	721.400	Open Terrain/Bare Earth	0.010
OT10	405873.078	4385056.966	741.115	741.157	Open Terrain/Bare Earth	0.042
OT11	430066.099	4389668.088	672.504	672.506	Open Terrain/Bare Earth	0.002
OT12	439746.025	4396986.944	681.890	681.899	Open Terrain/Bare Earth	0.009
OT13	454365.611	4420087.191	642.709	642.622	Open Terrain/Bare Earth	-0.087
OT14	463978.662	4424483.461	635.156	635.129	Open Terrain/Bare Earth	-0.027
OT15	473541.828	4423202.596	657.006	656.934	Open Terrain/Bare Earth	-0.072
OT16	473622.769	4402298.896	593.922	593.858	Open Terrain/Bare Earth	-0.064
OT17	483072.707	4408738.439	585.932	585.940	Open Terrain/Bare Earth	0.008
OT18	473060.387	4392867.450	554.009	554.018	Open Terrain/Bare Earth	0.009
OT19	484676.407	4398294.826	552.387	552.347	Open Terrain/Bare Earth	-0.040
OT20	454170.976	4390811.954	590.365	590.311	Open Terrain/Bare Earth	-0.054
OT21	474309.560	4383038.616	600.541	600.475	Open Terrain/Bare Earth	-0.066
OT22	440256.088	4301025.760	674.491	674.469	Open Terrain/Bare Earth	-0.022
OT23	430866.323	4313951.843	722.967	722.972	Open Terrain/Bare Earth	0.005
OT24	432099.428	4297225.829	683.136	683.121	Open Terrain/Bare Earth	-0.015
OT25	422390.316	4292738.547	659.196	659.240	Open Terrain/Bare Earth	0.044
OT26	414286.416	4290006.040	723.918	723.954	Open Terrain/Bare Earth	0.036
OT27	402923.247	4286160.932	752.876	752.913	Open Terrain/Bare Earth	0.037
OT28	414711.979	4307669.039	727.456	727.467	Open Terrain/Bare Earth	0.011
OT29	414867.165	4318083.343	742.210	742.187	Open Terrain/Bare Earth	-0.023
OT30	429781.645	4330069.222	680.610	680.556	Open Terrain/Bare Earth	-0.054
OT31	438660.933	4326874.811	704.092	704.133	Open Terrain/Bare Earth	0.041
OT32	422383.503	4312461.751	749.189	749.275	Open Terrain/Bare Earth	0.086
OT33	436518.078	4315966.463	723.099	723.151	Open Terrain/Bare Earth	0.052
OT34	441554.779	4317120.023	700.740	700.677	Open Terrain/Bare Earth	-0.063
OT35	442719.679	4373551.415	695.285	695.263	Open Terrain/Bare Earth	-0.022
OT36	465898.445	4374861.995	634.844	634.782	Open Terrain/Bare Earth	-0.062
OT37	474824.804	4373309.614	587.568	587.585	Open Terrain/Bare Earth	0.017
OT38	486567.195	4371748.218	576.730	576.659	Open Terrain/Bare Earth	-0.071
OT39	417607.417	4415382.835	750.381	750.398	Open Terrain/Bare Earth	0.017
OT40	420728.634	4405815.420	715.528	715.568	Open Terrain/Bare Earth	0.040

OT41	413274.659	4394628.074	766.288	766.333	Open Terrain/Bare Earth	0.045
OT42	429683.520	4382922.044	700.972	701.059	Open Terrain/Bare Earth	0.087
OT43	454307.873	4410054.929	673.471	673.471	Open Terrain/Bare Earth	0.000
OT44	463702.044	4415212.492	682.831	682.849	Open Terrain/Bare Earth	0.018
OT45	464009.644	4394276.547	594.833	594.720	Open Terrain/Bare Earth	-0.113
OT46	463813.916	4386662.758	594.527	594.480	Open Terrain/Bare Earth	-0.047
OT47	464144.597	4367011.047	592.920	592.899	Open Terrain/Bare Earth	-0.021
OT48	463992.032	4356844.539	577.587	577.667	Open Terrain/Bare Earth	0.080
OT49	483608.595	4388262.640	544.005	543.975	Open Terrain/Bare Earth	-0.030
OT50	453972.358	4368688.956	664.882	664.827	Open Terrain/Bare Earth	-0.055
OT51	487760.166	4342835.198	629.124	628.951	Open Terrain/Bare Earth	-0.173
OT52	478530.570	4365239.414	532.389	532.289	Open Terrain/Bare Earth	-0.100
OT53	478530.515	4365239.381	532.264	532.290	Open Terrain/Bare Earth	0.026
OT54	487740.837	4350916.789	580.354	580.407	Open Terrain/Bare Earth	0.053
OT55	442933.475	4344626.772	699.999	699.941	Open Terrain/Bare Earth	-0.058
OT56	420613.697	4396143.777	739.752	739.813	Open Terrain/Bare Earth	0.061
OT57	455764.473	4383902.497	650.733	650.705	Open Terrain/Bare Earth	-0.028
OT58	484679.182	4379835.744	570.287	570.172	Open Terrain/Bare Earth	-0.115
OT59	463894.578	4405109.052	612.736	612.706	Open Terrain/Bare Earth	-0.030
OT60	422716.196	4305973.968	736.536	736.616	Open Terrain/Bare Earth	0.080
OT61	423652.668	4411138.358	719.636	719.651	Open Terrain/Bare Earth	0.015
OT62	436426.027	4310727.960	700.687	700.729	Open Terrain/Bare Earth	0.042
OT63	427460.574	4303548.877	709.325	709.406	Open Terrain/Bare Earth	0.081
OT64	436918.556	4423393.436	701.133	701.172	Open Terrain/Bare Earth	0.039
OT65	401442.299	4409210.000	770.547	770.545	Open Terrain/Bare Earth	-0.002
OT66	402644.743	4387545.916	776.097	776.146	Open Terrain/Bare Earth	0.049
OT67	452017.461	4420093.006	636.650	636.639	Open Terrain/Bare Earth	-0.011
OT68	475168.116	4424796.127	636.449	636.404	Open Terrain/Bare Earth	-0.045
OT69	436972.619	4388002.816	620.267	620.368	Open Terrain/Bare Earth	0.101
OT70	484725.395	4395098.302	534.385	534.356	Open Terrain/Bare Earth	-0.029
OT71	435386.587	4299434.373	682.097	682.221	Open Terrain/Bare Earth	0.124
OT72	441457.798	4293007.848	644.959	645.041	Open Terrain/Bare Earth	0.082
OT73	407868.704	4290645.240	727.042	727.161	Open Terrain/Bare Earth	0.119
OT74	424528.906	4318472.026	743.660	743.580	Open Terrain/Bare Earth	-0.080
OT75	435861.530	4323655.459	711.916	711.910	Open Terrain/Bare Earth	-0.006
OT76	445054.416	4370344.856	679.125	679.166	Open Terrain/Bare Earth	0.041
OT77	464266.197	4373438.419	638.315	638.315	Open Terrain/Bare Earth	0.000
OT78	483372.057	4371759.740	585.143	584.995	Open Terrain/Bare Earth	-0.148
OT79	418025.545	4425160.228	745.293	745.212	Open Terrain/Bare Earth	-0.081
OT80	419112.206	4409037.649	723.773	723.735	Open Terrain/Bare Earth	-0.038
OT81	422016.704	4386584.532	679.230	679.238	Open Terrain/Bare Earth	0.008
OT82	466930.841	4365397.712	575.867	575.910	Open Terrain/Bare Earth	0.043

OT83	479839.911	4385831.669	589.693	589.655	Open Terrain/Bare Earth	-0.038
OT84	453438.431	4365451.761	625.959	625.964	Open Terrain/Bare Earth	0.005
OT85	478493.710	4362447.524	550.668	550.668	Open Terrain/Bare Earth	0.000
OT86	439858.317	4352795.926	672.161	672.165	Open Terrain/Bare Earth	0.004
OT87	487846.342	4347682.042	596.443	596.429	Open Terrain/Bare Earth	-0.014
OT88	444494.822	4341056.480	698.863	698.867	Open Terrain/Bare Earth	0.004
OT89	454192.272	4343182.514	691.115	691.000	Open Terrain/Bare Earth	-0.115
OT90	462971.656	4338047.386	668.861	668.956	Open Terrain/Bare Earth	0.095
OT91	410239.780	4410764.203	753.042	753.074	Open Terrain/Bare Earth	0.032
OT92	449606.551	4418483.702	640.864	640.822	Open Terrain/Bare Earth	-0.042
OT93	432185.746	4294218.377	657.968	658.149	Open Terrain/Bare Earth	0.181
OT94	435836.188	4316154.375	724.101	724.136	Open Terrain/Bare Earth	0.035
OT95	483113.837	4349218.760	606.438	606.464	Open Terrain/Bare Earth	0.026
UB01	454162.612	4339476.988	685.417	685.543	Urban Terrain	0.126
UB02	406222.440	4409230.589	767.406	767.403	Urban Terrain	-0.003
UB03	406205.416	4409230.749	767.325	767.315	Urban Terrain	-0.010
UB04	403818.789	4383481.696	738.653	738.670	Urban Terrain	0.017
UB05	402639.951	4383506.629	740.656	740.695	Urban Terrain	0.039
UB06	454392.985	4422041.960	631.155	631.105	Urban Terrain	-0.050
UB07	454393.093	4422026.230	631.077	631.062	Urban Terrain	-0.015
UB08	441300.646	4389585.407	622.026	622.026	Urban Terrain	0.000
UB09	439694.669	4389586.976	623.430	623.456	Urban Terrain	0.026
UB10	435710.518	4315252.924	717.716	717.812	Urban Terrain	0.096
UB11	435708.215	4315190.064	719.383	719.471	Urban Terrain	0.088
UB12	424080.149	4425087.620	716.328	716.307	Urban Terrain	-0.021
UB13	424087.122	4425060.355	716.930	716.911	Urban Terrain	-0.019
UB14	420423.806	4386554.007	675.150	675.169	Urban Terrain	0.019
UB15	418842.728	4386111.318	680.334	680.374	Urban Terrain	0.040
UB16	464394.507	4363815.342	574.714	574.769	Urban Terrain	0.055
UB17	464329.217	4363807.954	576.314	576.375	Urban Terrain	0.061
UB18	440903.866	4356811.500	625.269	625.262	Urban Terrain	-0.007
UB19	440904.157	4356819.527	625.166	625.229	Urban Terrain	0.063
UB20	451683.174	4345380.345	684.365	684.279	Urban Terrain	-0.086
UB21	451569.405	4345557.193	687.571	687.472	Urban Terrain	-0.099

Table 11: Bare-Earth Surface NVA Assessment

Vegetated Vertical Accuracy (VVA) Check Point Assessment (DEM)						
PointID	**Easting**	**Northing**	**KnownZ**	**LaserZ**	**Description**	**DeltaZ**
BR01	406661.271	4306185.734	735.493	735.441	Brush	-0.052
BR02	406804.655	4313235.049	769.112	769.088	Brush	-0.024
BR03	416747.437	4327862.791	719.653	719.608	Brush	-0.045
BR04	453172.590	4376760.122	676.137	676.110	Brush	-0.027
BR05	486438.823	4360521.680	569.556	569.571	Brush	0.015
BR06	455153.010	4347752.533	647.641	647.616	Brush	-0.025
BR07	431274.707	4317094.726	738.923	738.828	Brush	-0.095
BR08	441717.120	4423589.581	673.777	673.838	Brush	0.061
BR09	407867.363	4409493.558	734.573	734.646	Brush	0.073
BR10	404125.769	4383089.644	725.052	725.096	Brush	0.044
BR11	454488.121	4423281.855	629.705	629.710	Brush	0.005
BR12	472854.374	4424829.543	636.355	636.351	Brush	-0.004
BR13	471695.607	4416752.620	648.843	648.780	Brush	-0.063
BR14	437012.373	4383200.215	683.839	683.924	Brush	0.085
BR15	440875.166	4304269.093	698.941	698.991	Brush	0.050
BR16	423613.747	4300057.251	699.046	699.140	Brush	0.094
BR17	486575.782	4369049.671	546.981	546.952	Brush	-0.029
BR18	420931.188	4426707.261	730.486	730.488	Brush	0.002
BR19	418820.807	4389275.732	707.427	707.556	Brush	0.129
BR20	454158.547	4338296.098	677.981	678.036	Brush	0.055
BR21	442494.504	4351074.850	658.658	658.718	Brush	0.060
BR22	487585.497	4352936.279	573.990	573.998	Brush	0.008
BR23	467348.918	4338053.956	653.534	653.682	Brush	0.148
HG01	439663.757	4386396.561	667.974	667.938	High Grass	-0.036
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HG04	430713.769	4305485.282	728.020	728.099	High Grass	0.079
HG05	422600.011	4302789.109	717.239	717.279	High Grass	0.040
HG06	437608.295	4291790.906	685.686	685.794	High Grass	0.108
HG07	428742.336	4288244.435	701.739	701.807	High Grass	0.068
HG08	408022.760	4294893.607	683.320	683.327	High Grass	0.007
HG09	407067.941	4323153.906	773.902	773.956	High Grass	0.054
HG10	434238.145	4323634.918	710.703	710.803	High Grass	0.100
HG11	411343.345	4423627.053	733.389	733.359	High Grass	-0.030
HG12	421238.374	4425106.636	730.447	730.449	High Grass	0.002
HG13	418850.545	4386087.442	678.607	678.624	High Grass	0.017
HG14	464069.167	4405575.916	615.403	615.439	High Grass	0.036
HG15	441546.022	4364029.747	643.138	643.220	High Grass	0.082
HG16	443121.212	4354287.228	644.612	644.640	High Grass	0.028
HG17	474426.823	4354085.857	599.953	599.890	High Grass	-0.063

HG18	465394.497	4338887.695	655.624	655.731	High Grass	0.107
HG19	422664.392	4307578.569	738.445	738.555	High Grass	0.110
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HG22	430679.255	4302716.416	714.365	714.515	High Grass	0.150
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HG27	483061.749	4400311.725	560.569	560.389	High Grass	-0.180
HG28	437613.753	4289161.730	692.472	692.539	High Grass	0.067
HG29	422032.233	4289972.645	696.468	696.570	High Grass	0.102
HG30	404742.180	4293350.955	706.580	706.632	High Grass	0.052
HG31	415467.914	4304444.064	719.201	719.196	High Grass	-0.005
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HG36	441846.812	4373599.598	683.637	683.593	High Grass	-0.044
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HG42	441306.942	4357022.089	619.463	619.518	High Grass	0.055
HG43	442917.664	4341387.446	702.516	702.493	High Grass	-0.023
HG44	454174.565	4345007.353	686.250	686.262	High Grass	0.012
HG45	464800.407	4341262.638	667.695	667.790	High Grass	0.095

Table 12: Bare-Earth Surface VVA Assessment

3.5 Vertical Accuracy Results

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

Check Points Error Statistics								
Category	**# of**	**Min**	**Max**	**Mean**	**Median**	**Skew**	**Std Dev**	**$RMSE_Z$**
Open Terrain/Bare Earth	95	-0.173	0.181	0.000	0.005	-0.100	0.061	0.060
Urban Terrain	21	-0.099	0.126	0.015	0.017	-0.119	0.057	0.057
High Grass	45	-0.180	0.169	0.027	0.030	-0.415	0.064	0.069
Brush	23	-0.095	0.148	0.020	0.008	0.248	0.063	0.064
Consolidated	184	-0.180	0.181	0.011	0.009	-0.115	0.062	0.063

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	95	0.118		
Urban Terrain	21			0.096
High Grass	45			0.110
Brush	23			0.126
Consolidated	184		0.108	

Table 14: Check Points Vertical Accuracy Assessment

Non-vegetated Vertical Accuracy (NVA) and Vegetated Vertical Accuracy (VVA)				
Broad Land Cover Type	**# of Points**	**$RMSE_Z$ (m)**	**95% Confidence Level (m)**	**95th Percentile (m)**
NVA of Point Cloud	114	0.065	0.128	
NVA of DEM	116	0.060	0.117	
VVA of DEM	68	0.068		0.122

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 (m)**	**NDEP FVA, plus SVAs and CVA based on 95th Percentile (m)**	**NDEP Accuracy Term**	**ASPRS Vertical Accuracy (m)**	**ASPRS Accuracy Term**
Open Terrain/Bare Earth	0.118	0.089	FVA	0.117	NVA
Urban Terrain	0.112	0.096	SVA		
High Grass	0.136	0.110	SVA	0.122	VVA
Brush	0.126	0.126	SVA		
Consolidated	0.123	0.108	CVA	n/a	n/a

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

3.6 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.

Section 4: Certification

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

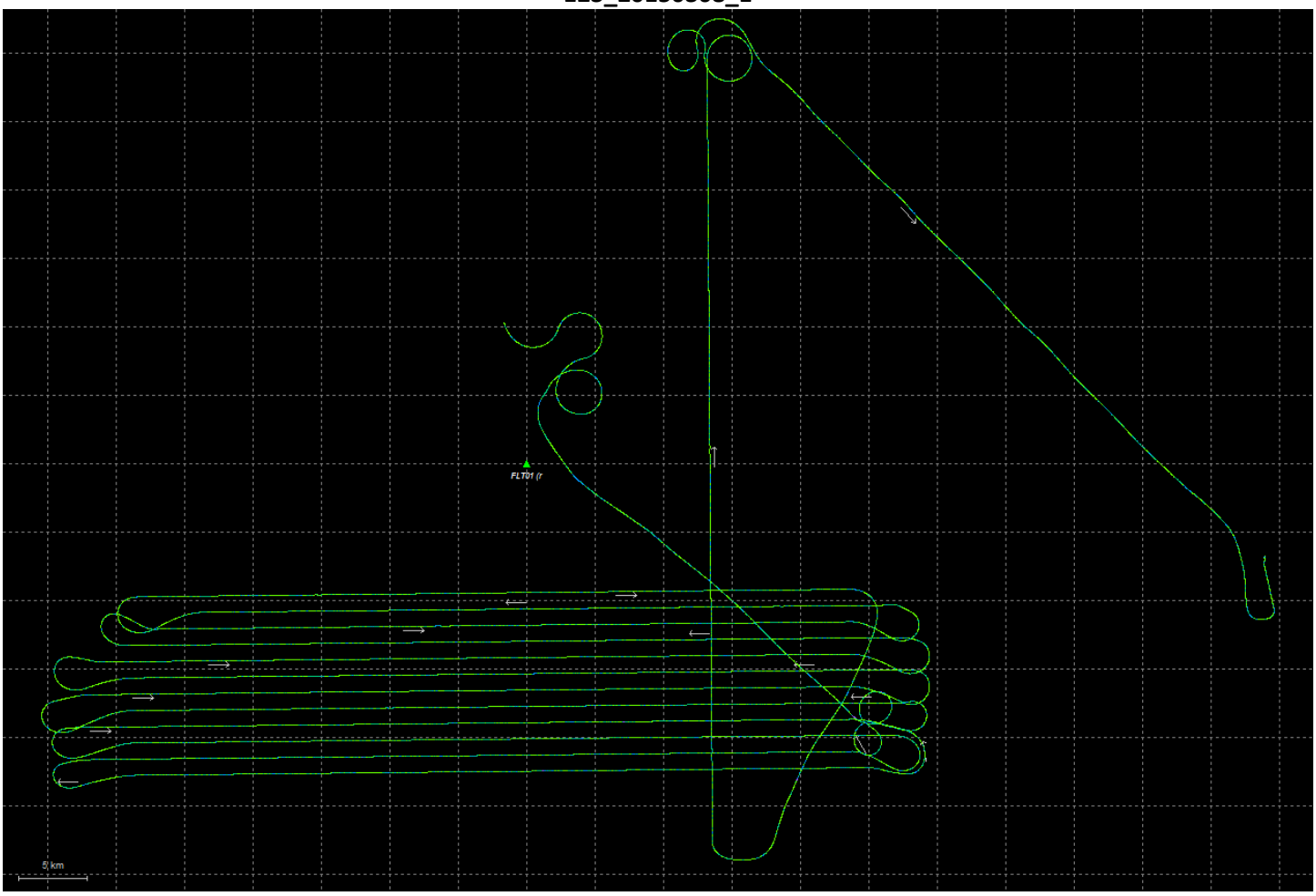
Brian J. Mayfield, ASPRS Certified Photogrammetrist #R1276

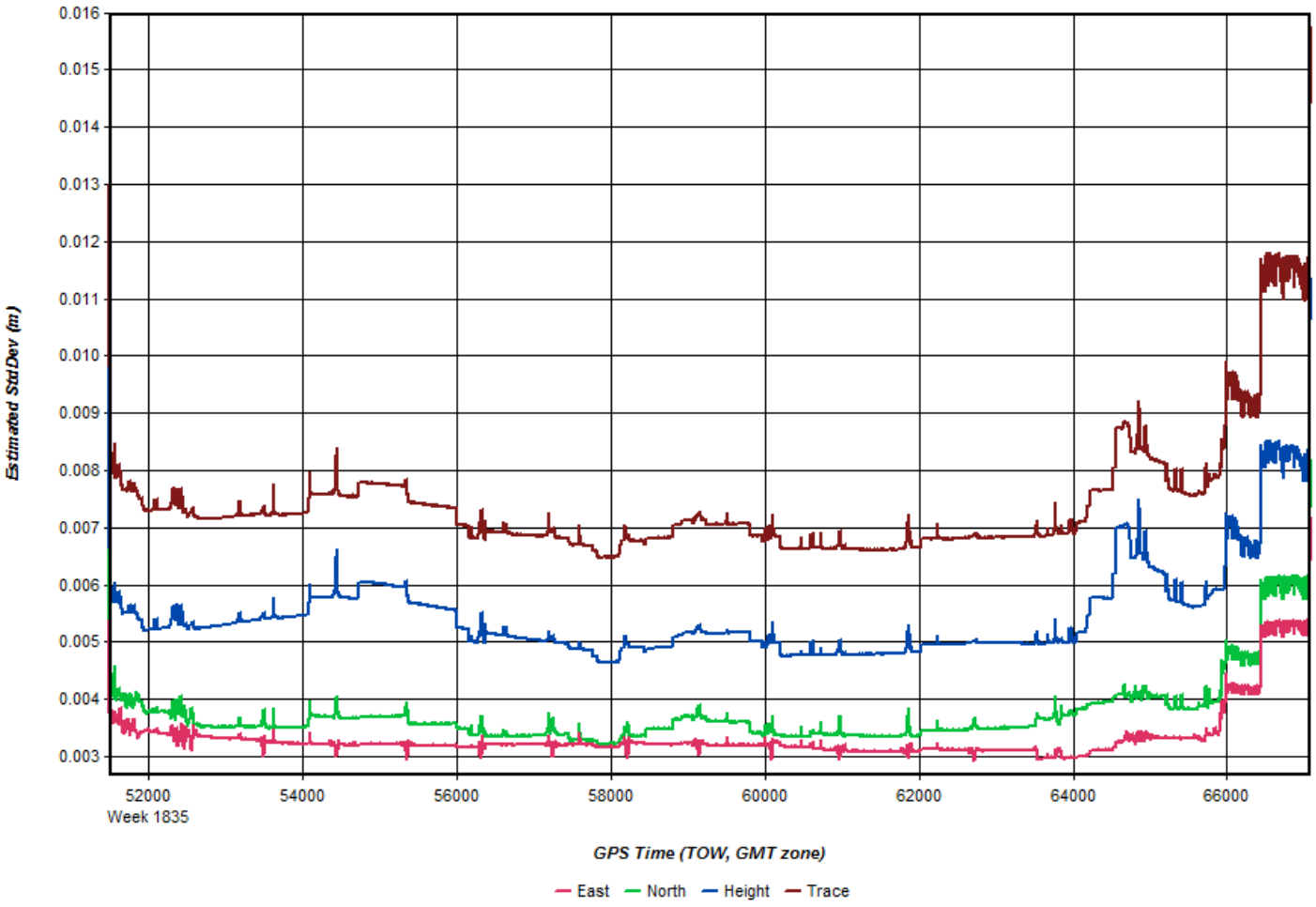
Section 5: GPS Processing

Inertial Explorer Version 8.50.4320

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

123_20150308_1

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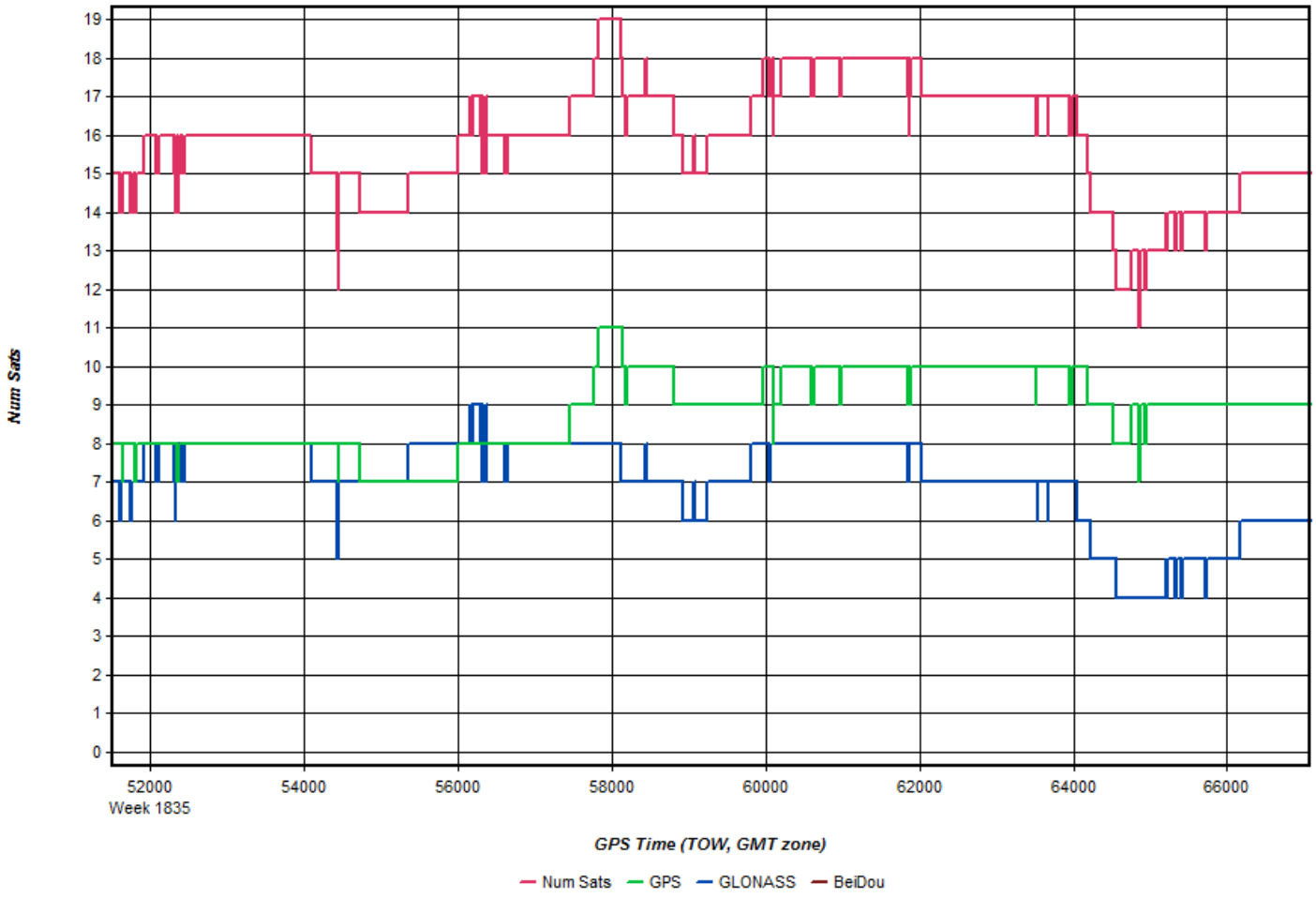
East
North
Height
Trace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GPS
GLONASS
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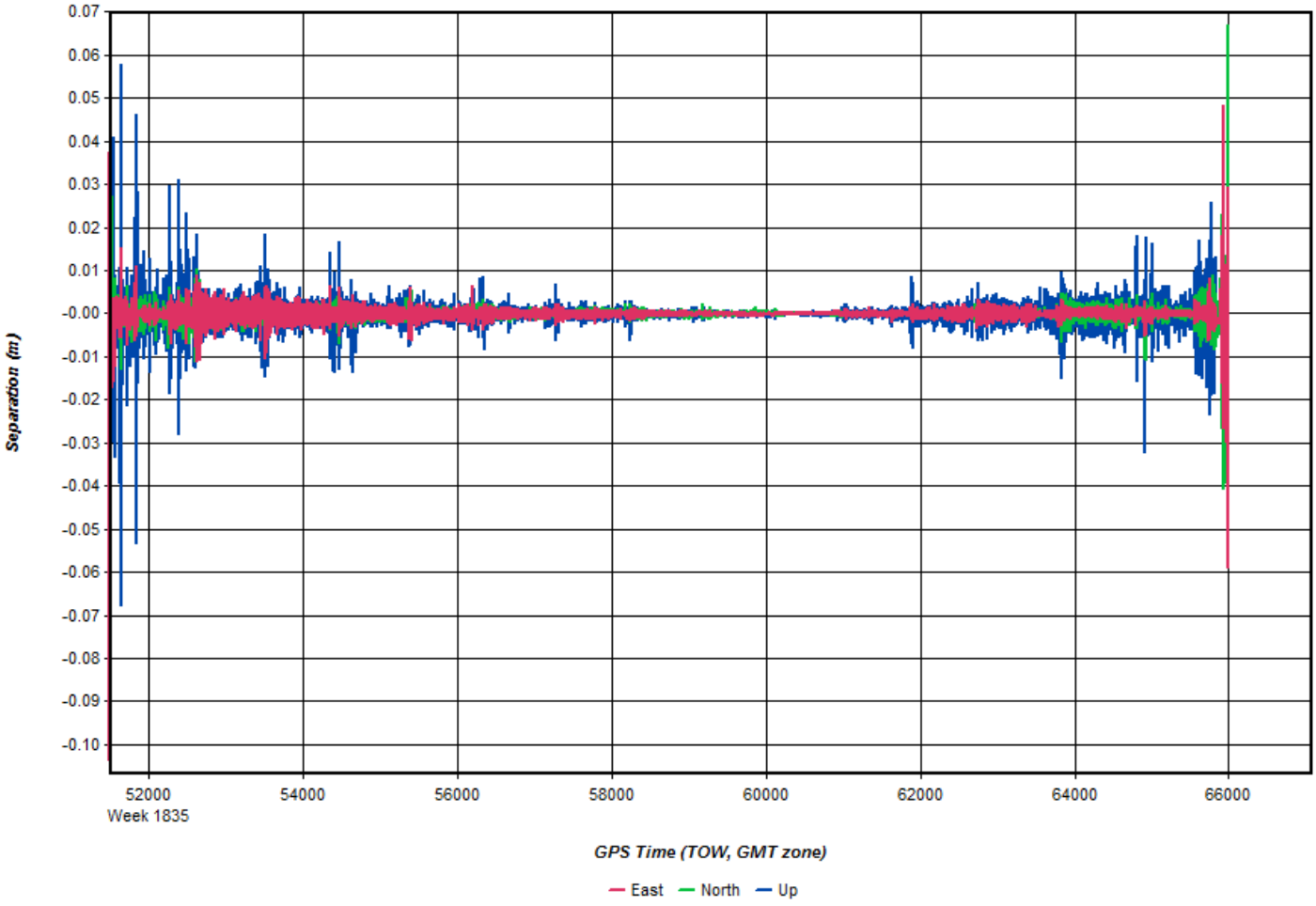
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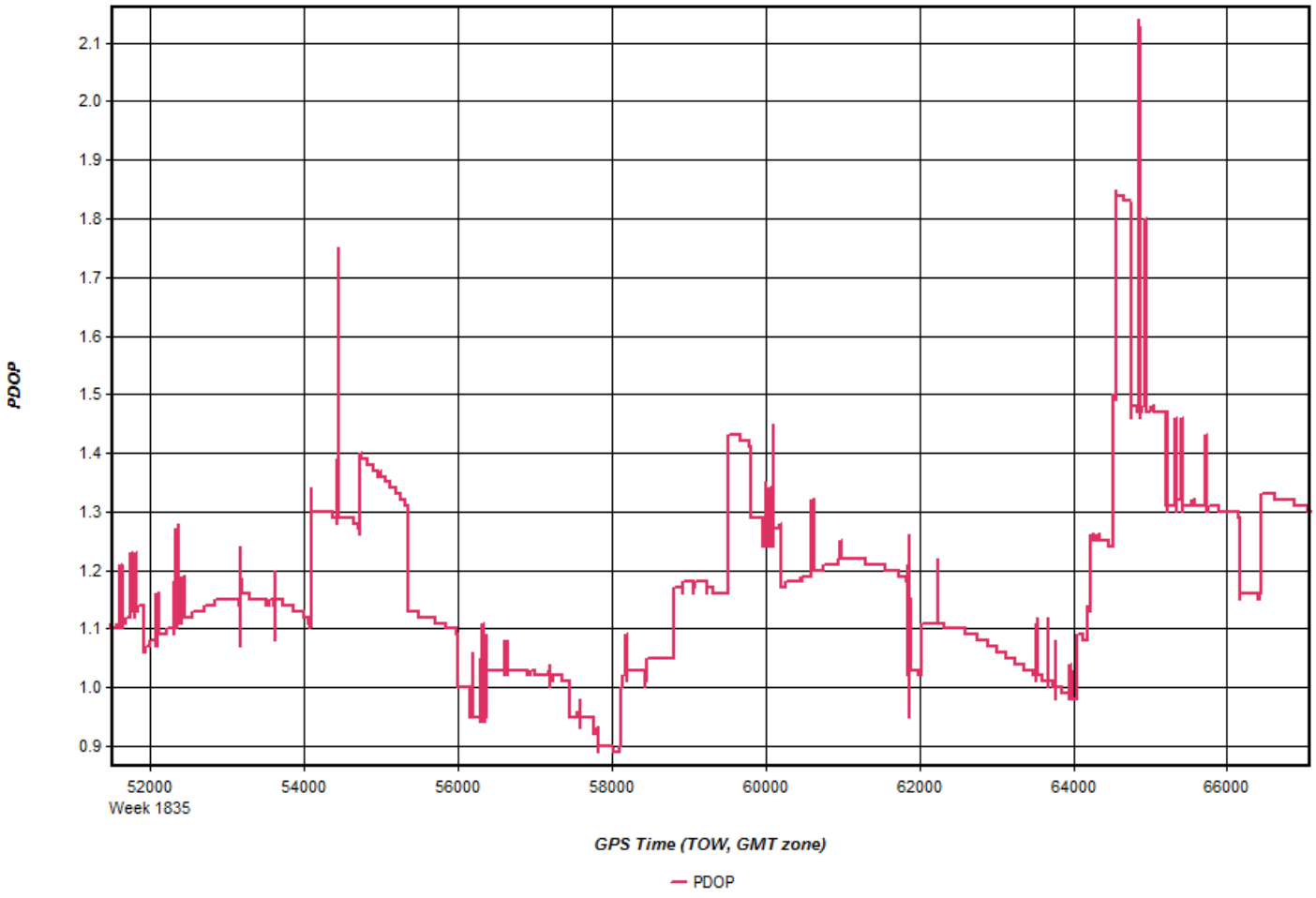
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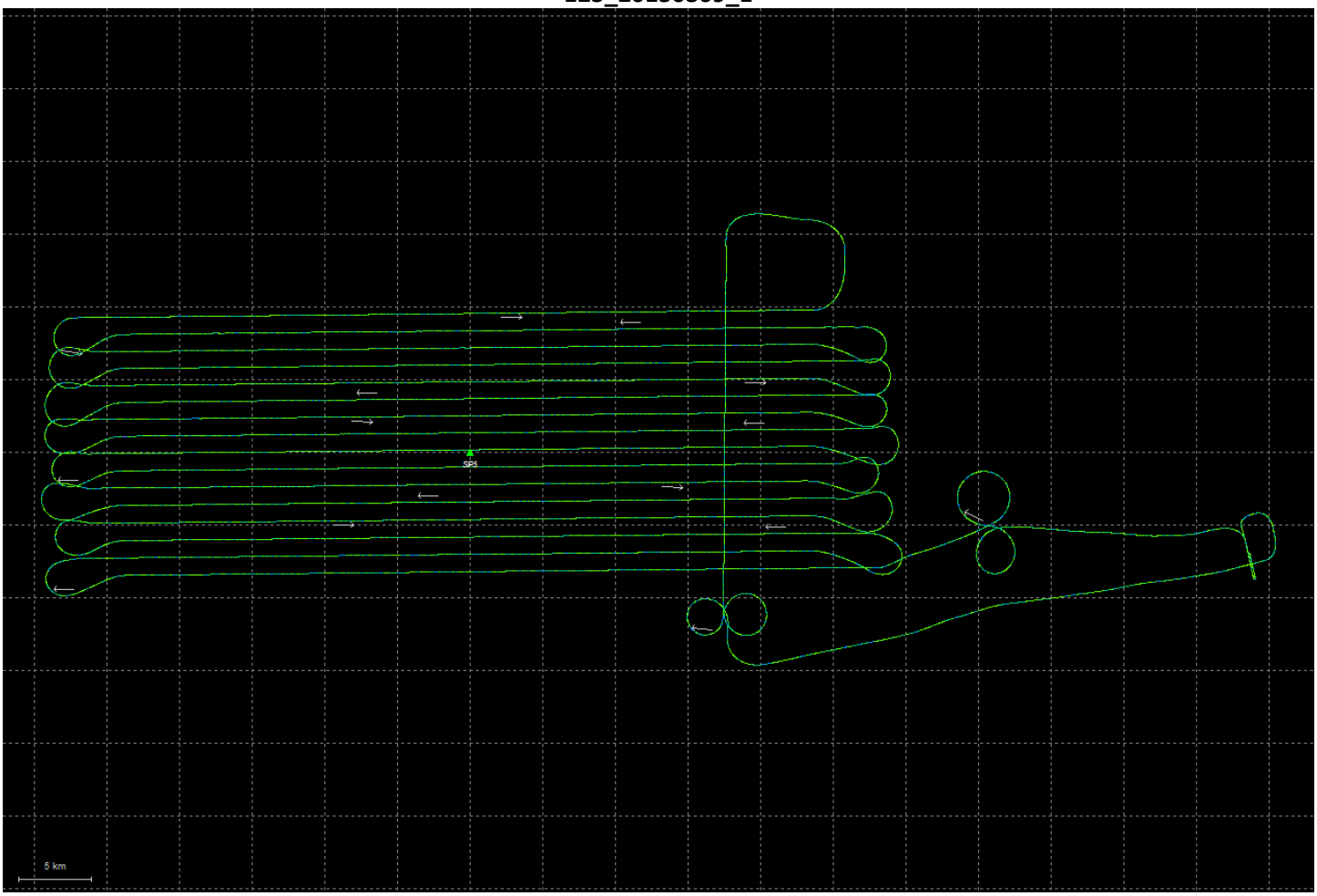

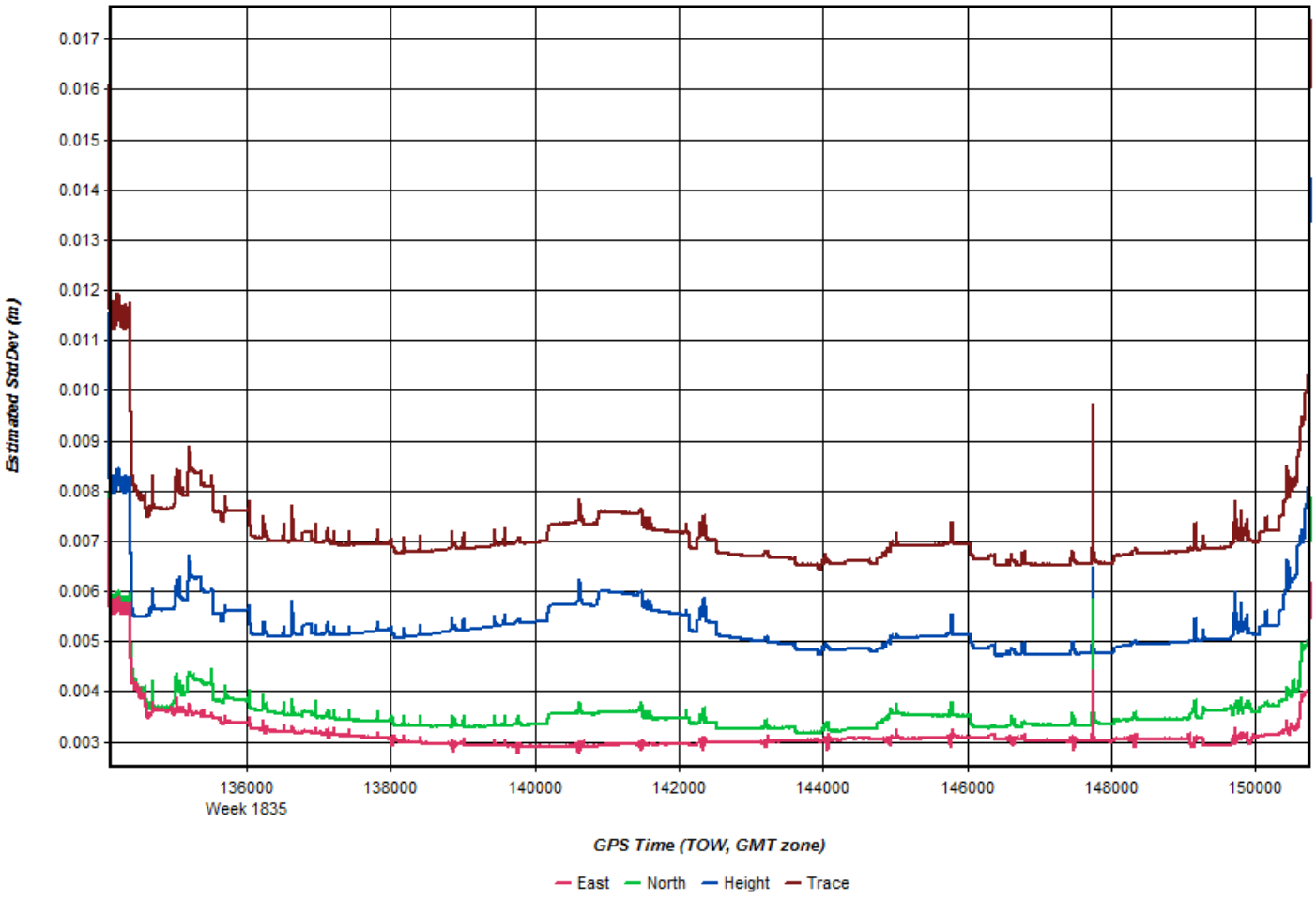
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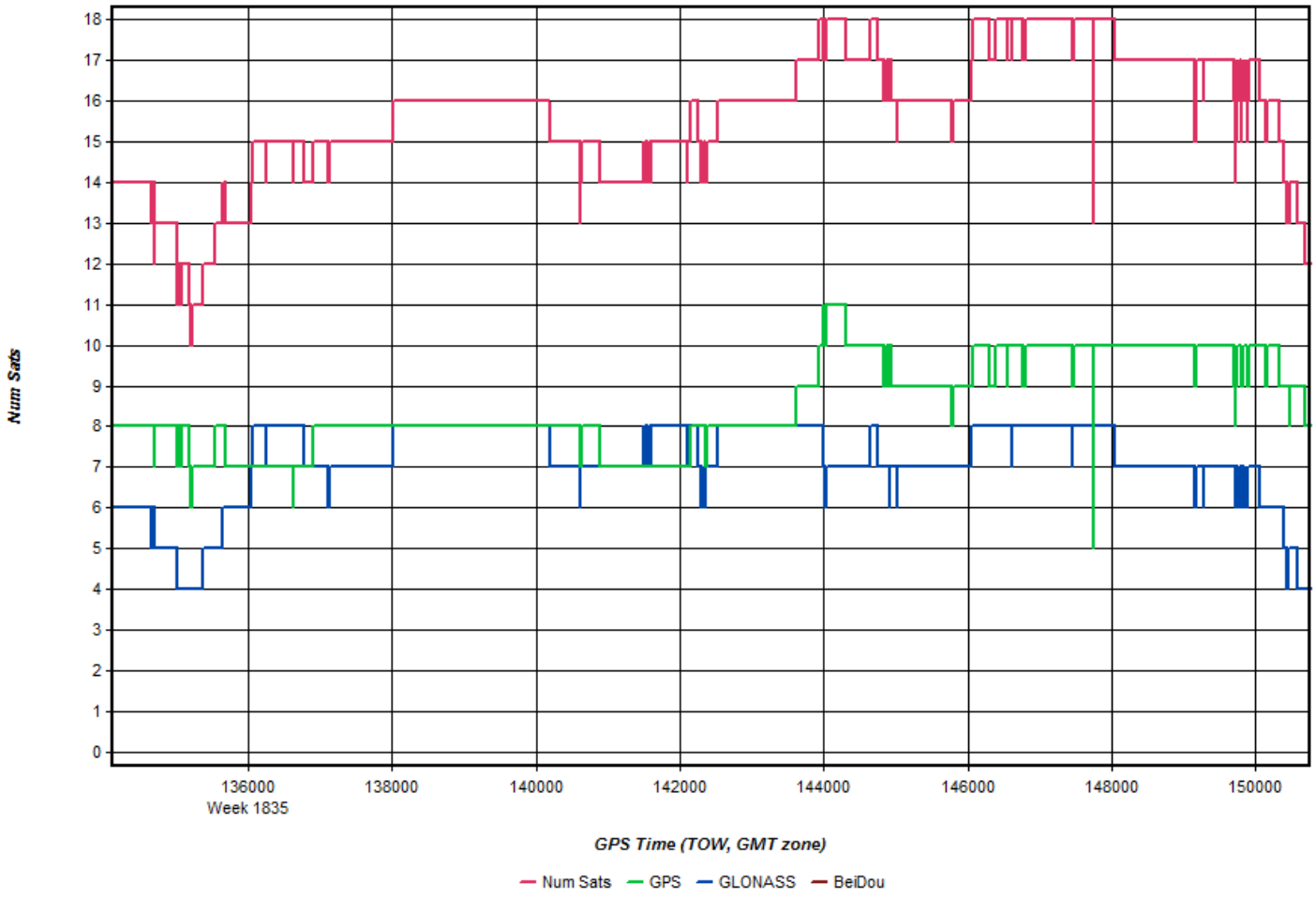
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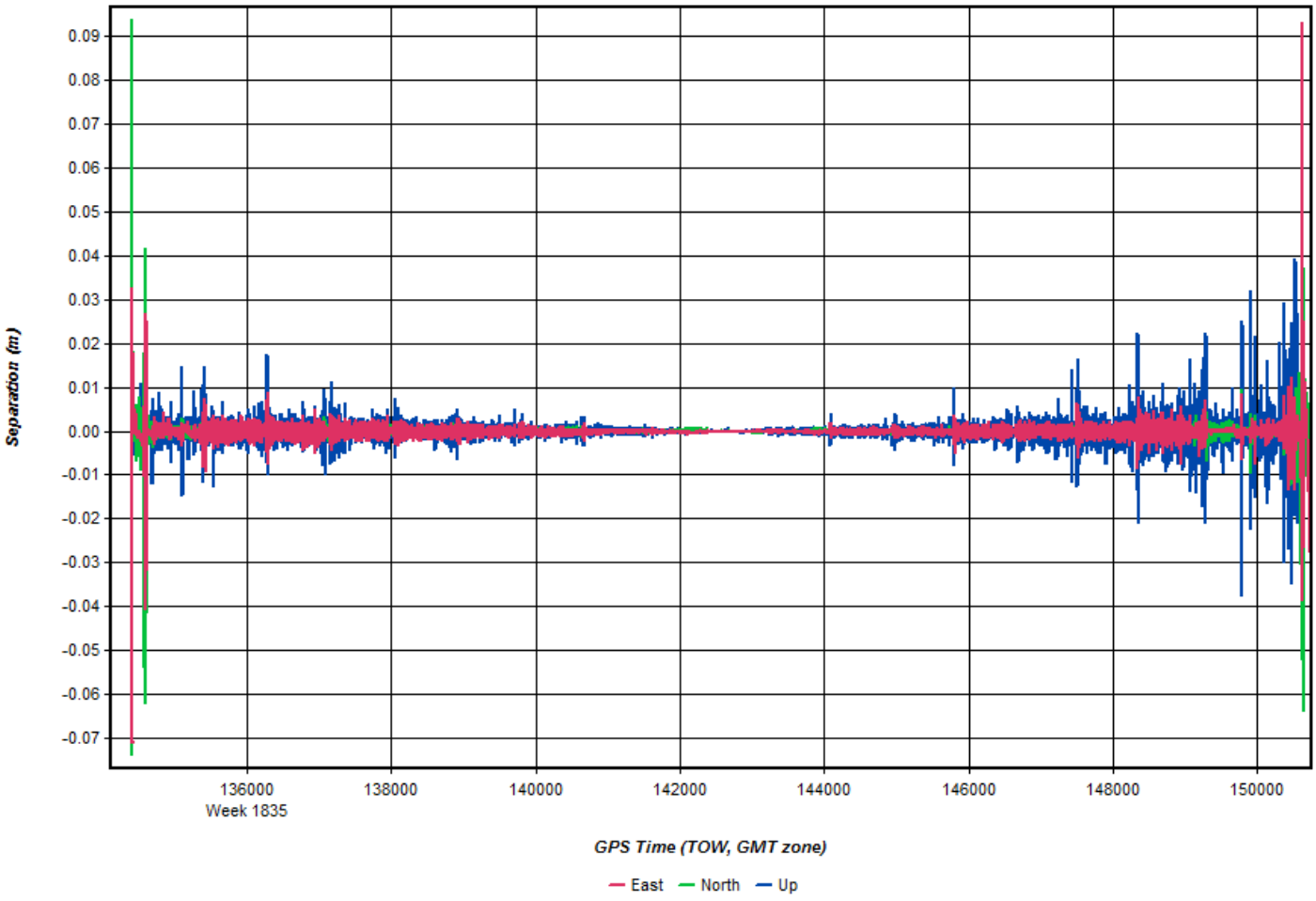
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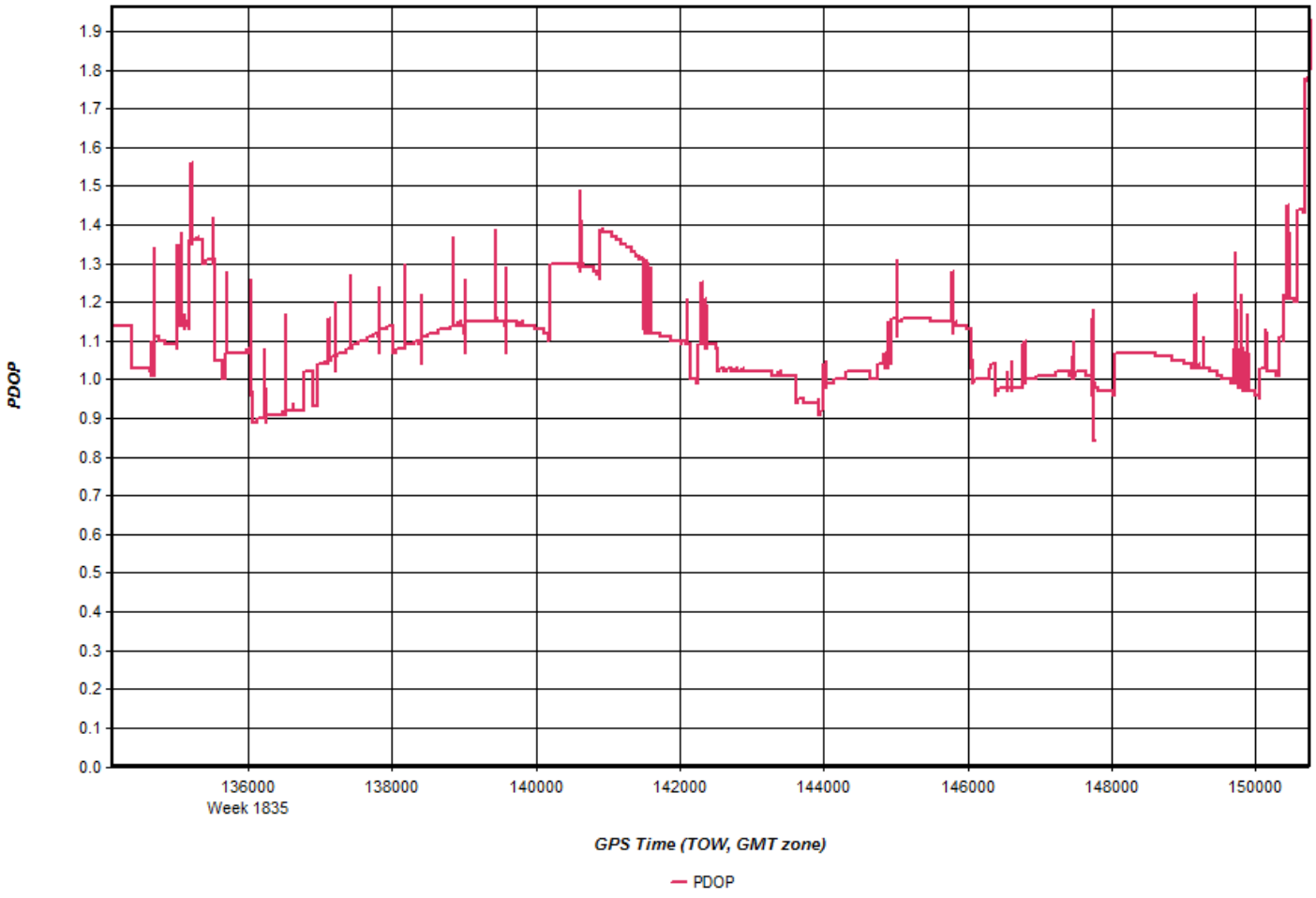
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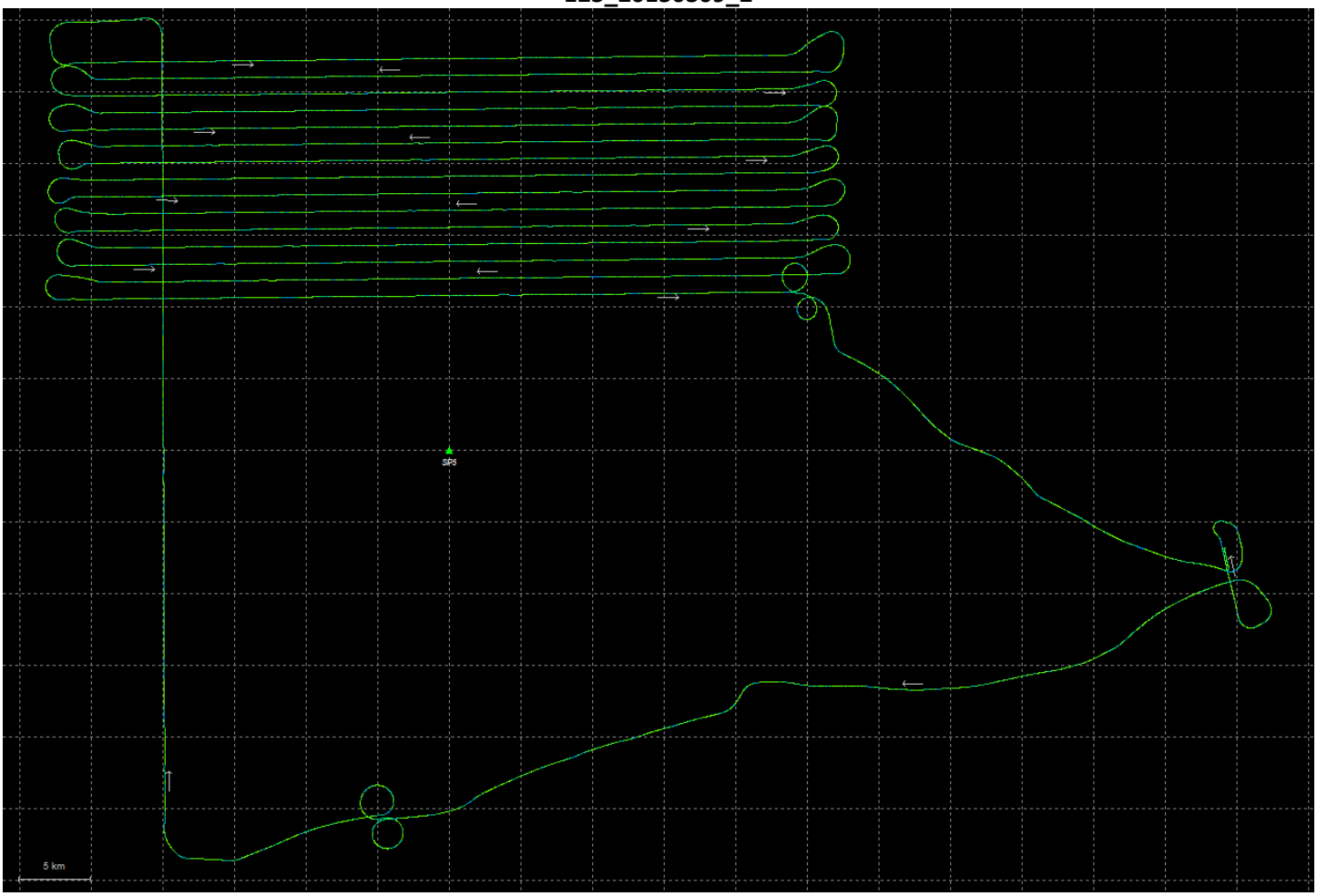

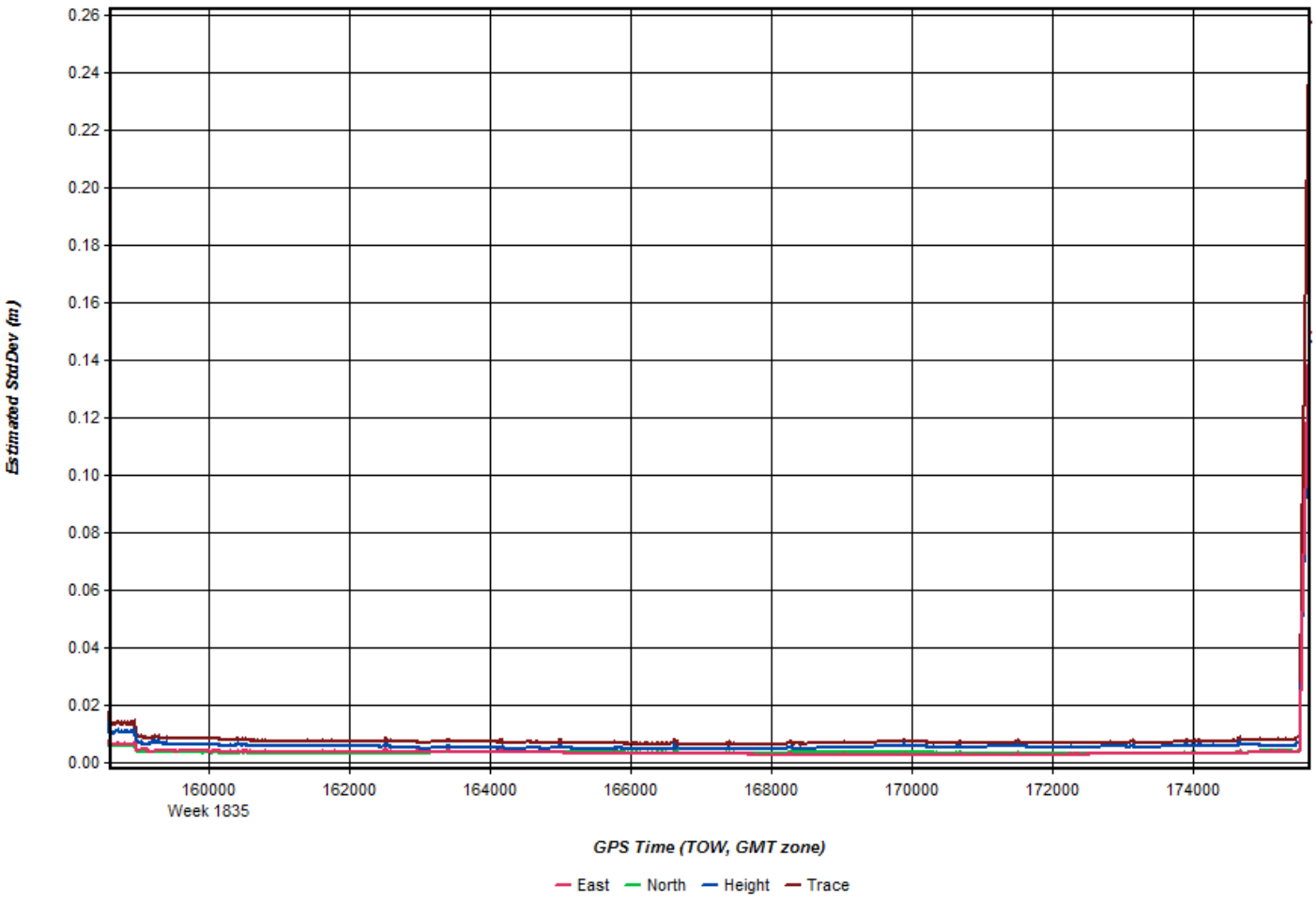
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Height
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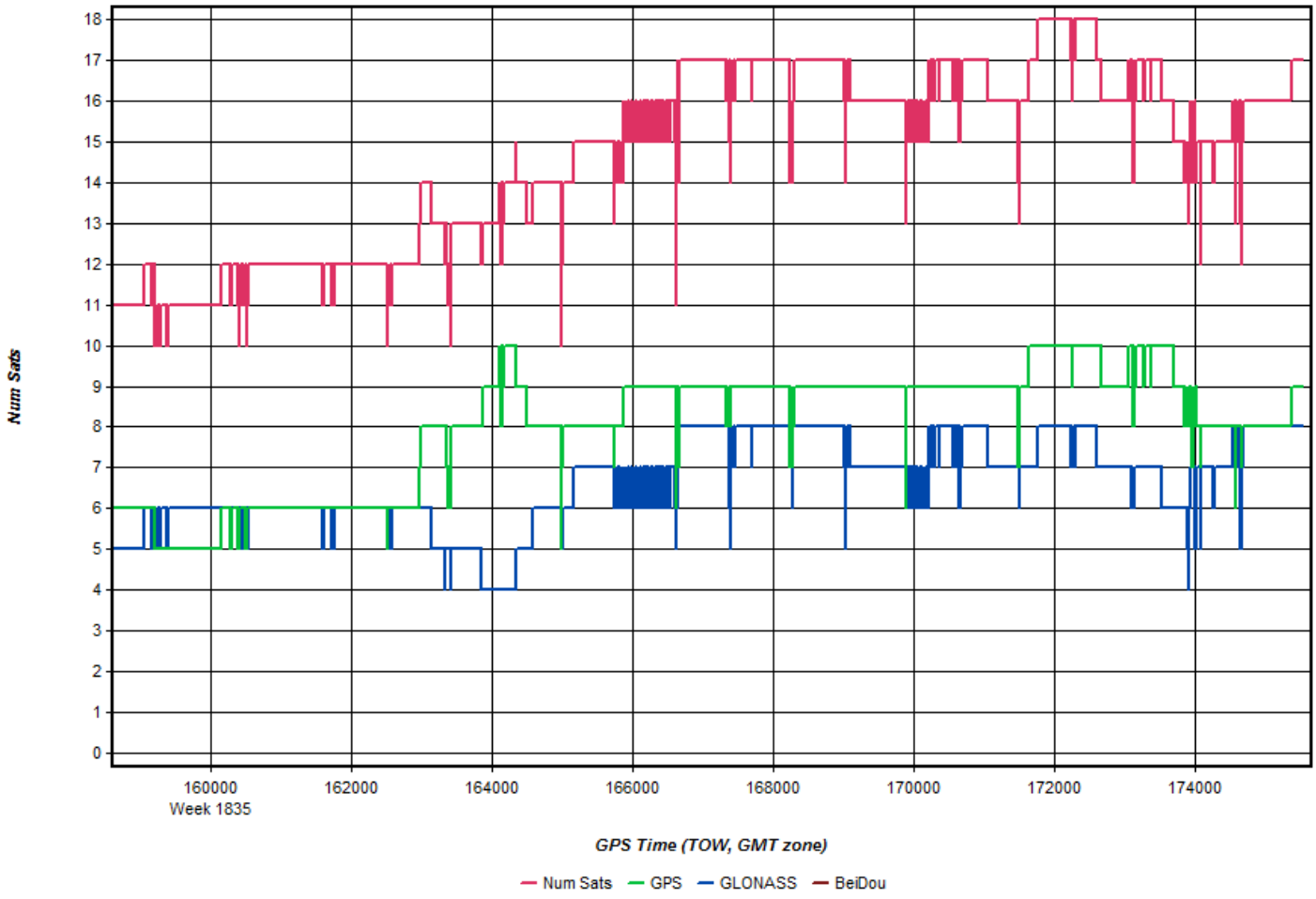
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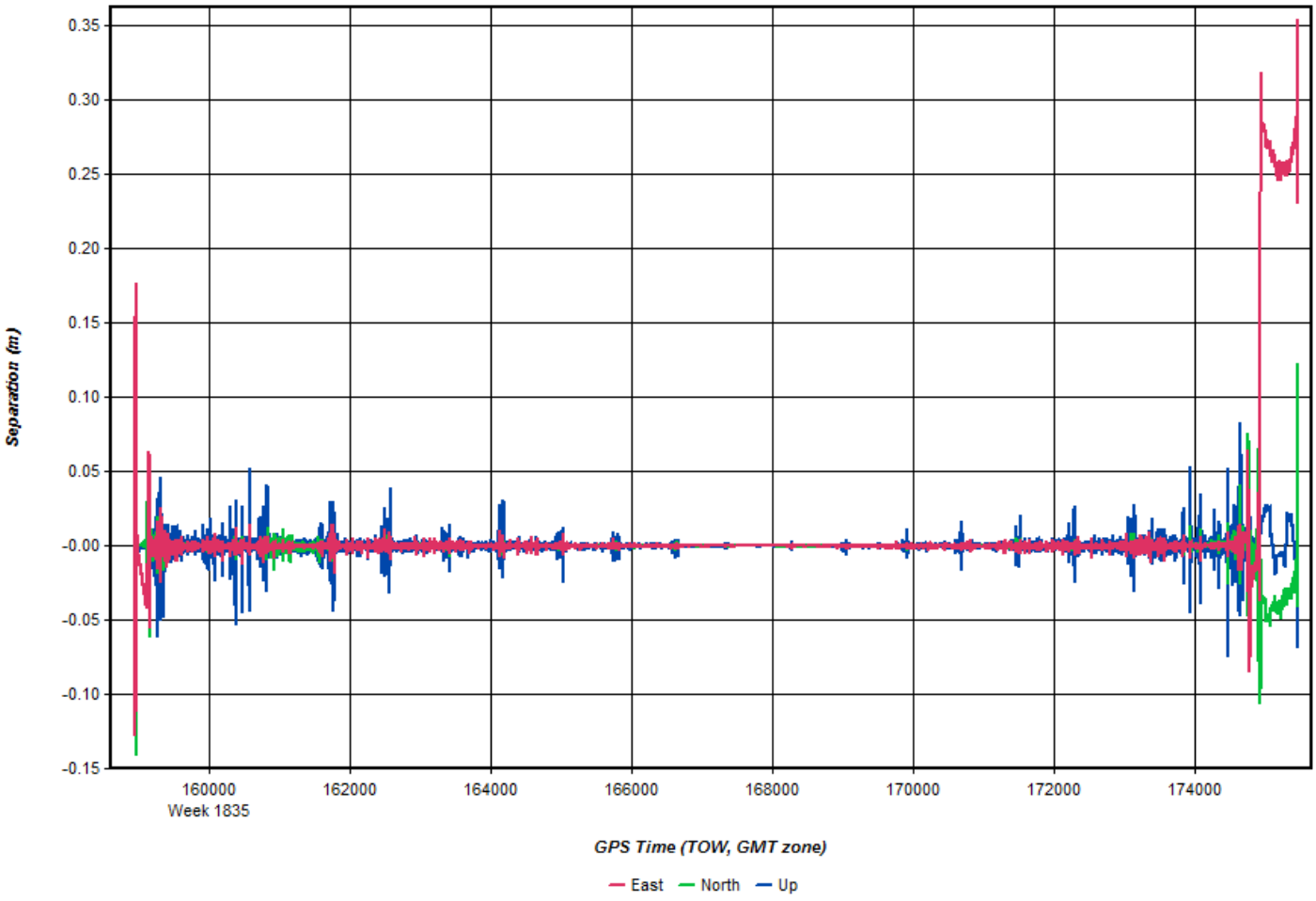
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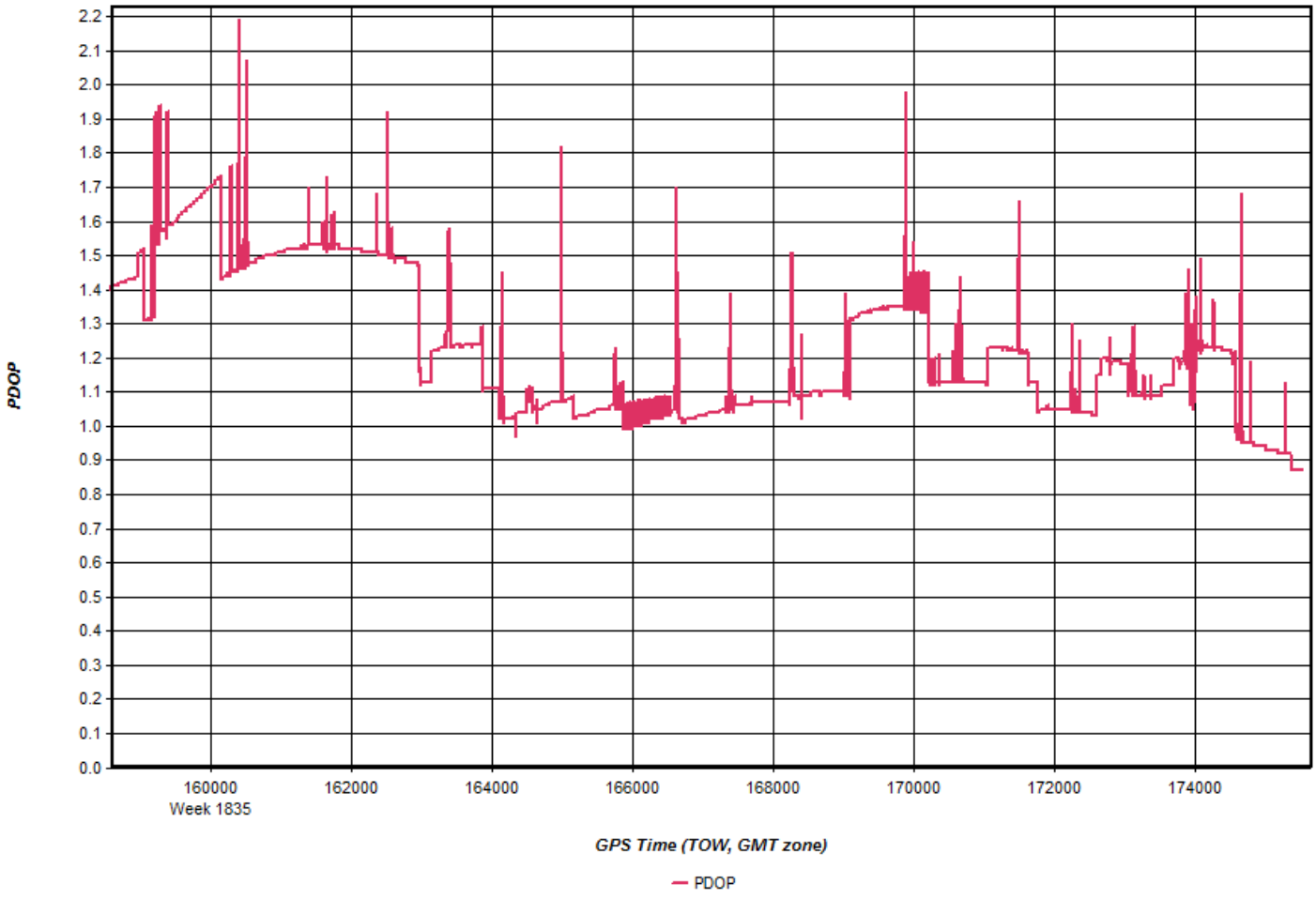
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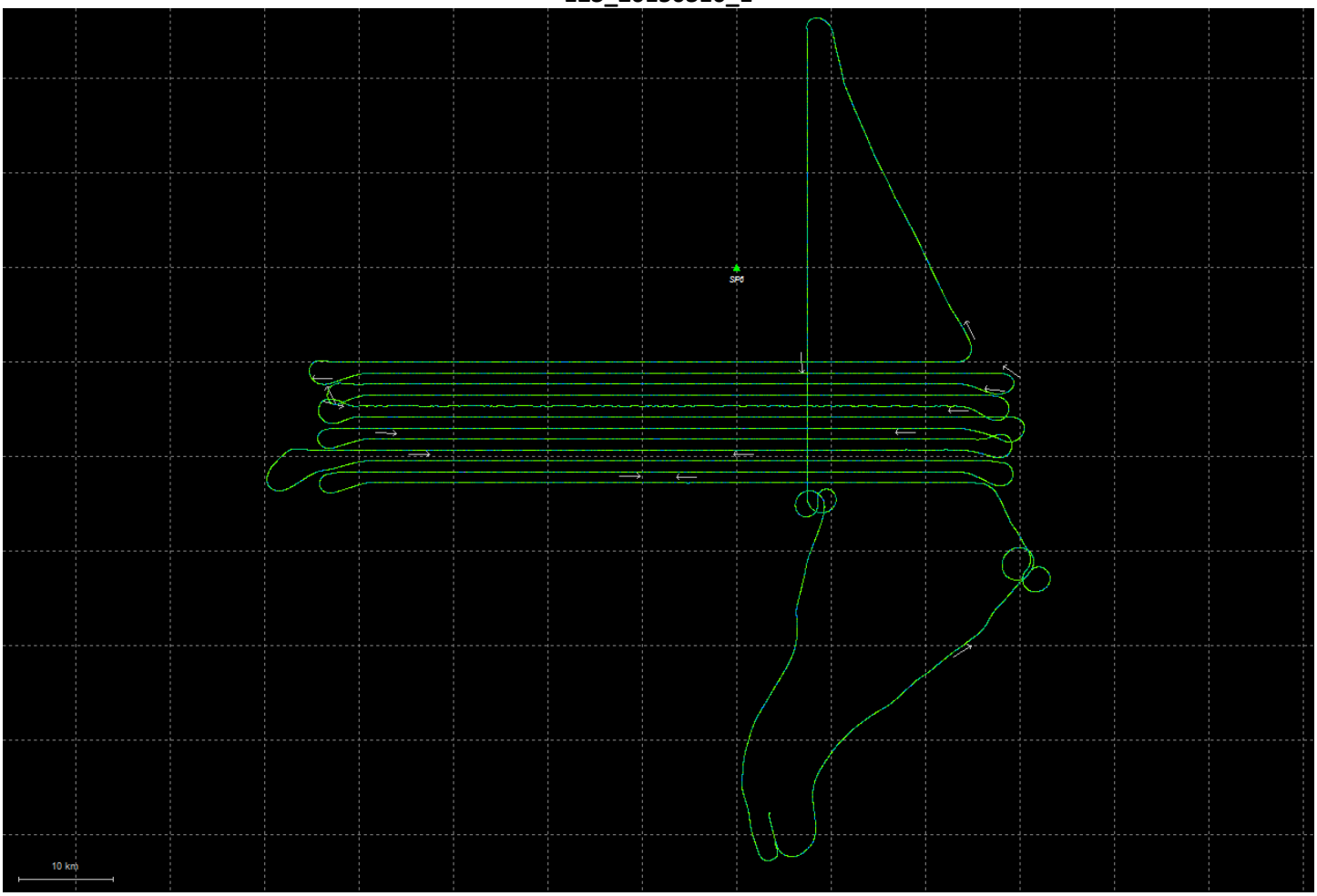

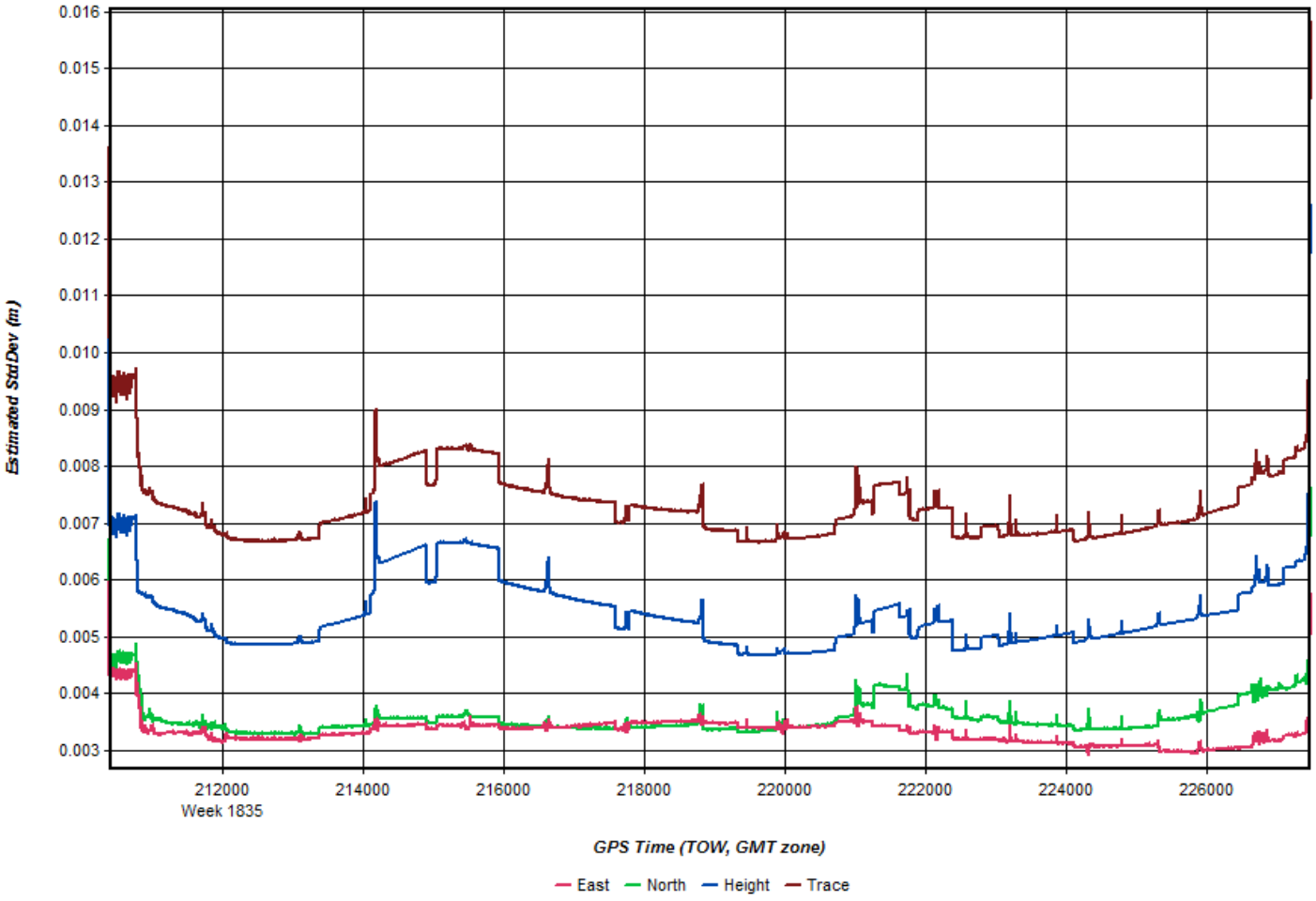
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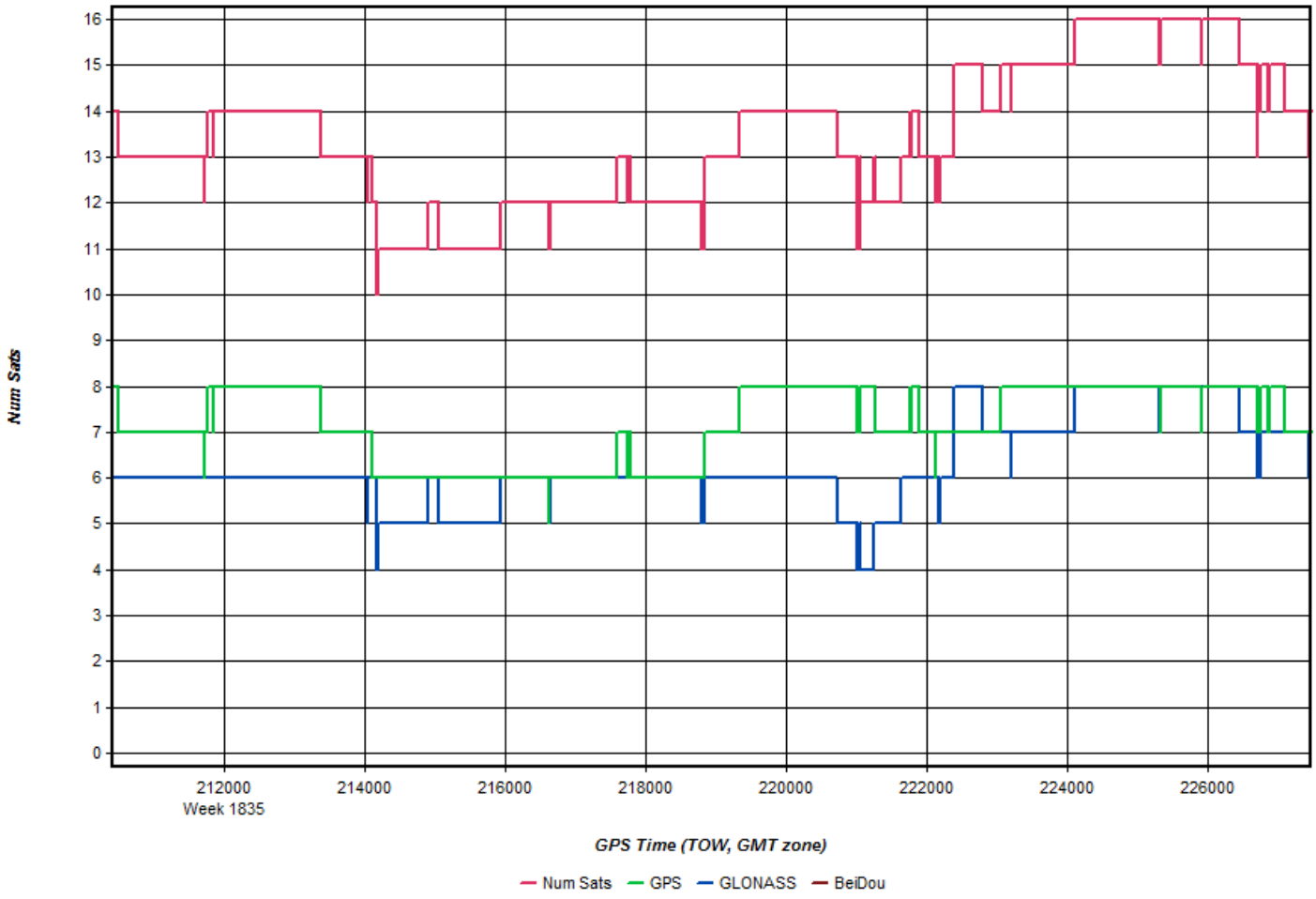
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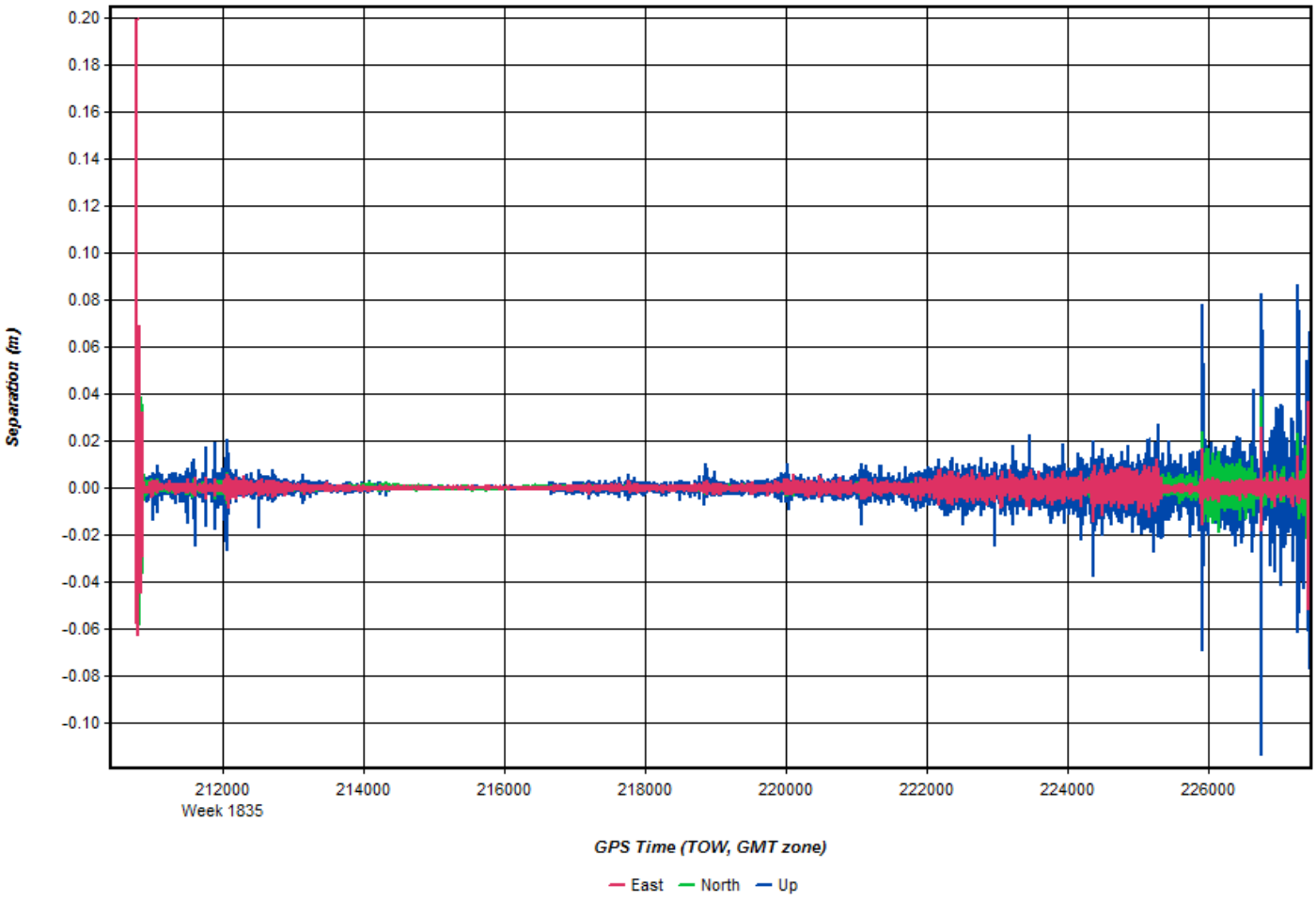
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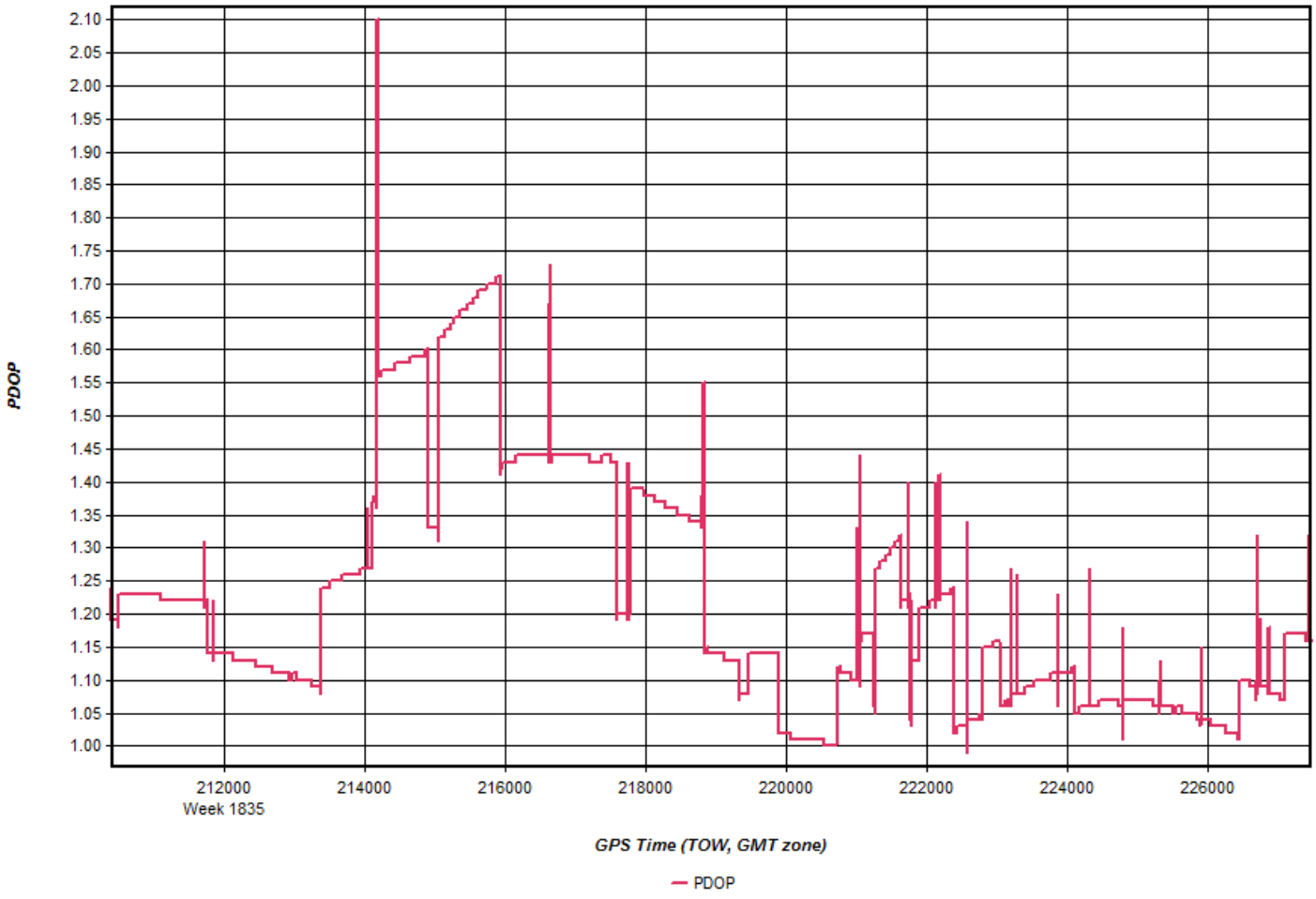
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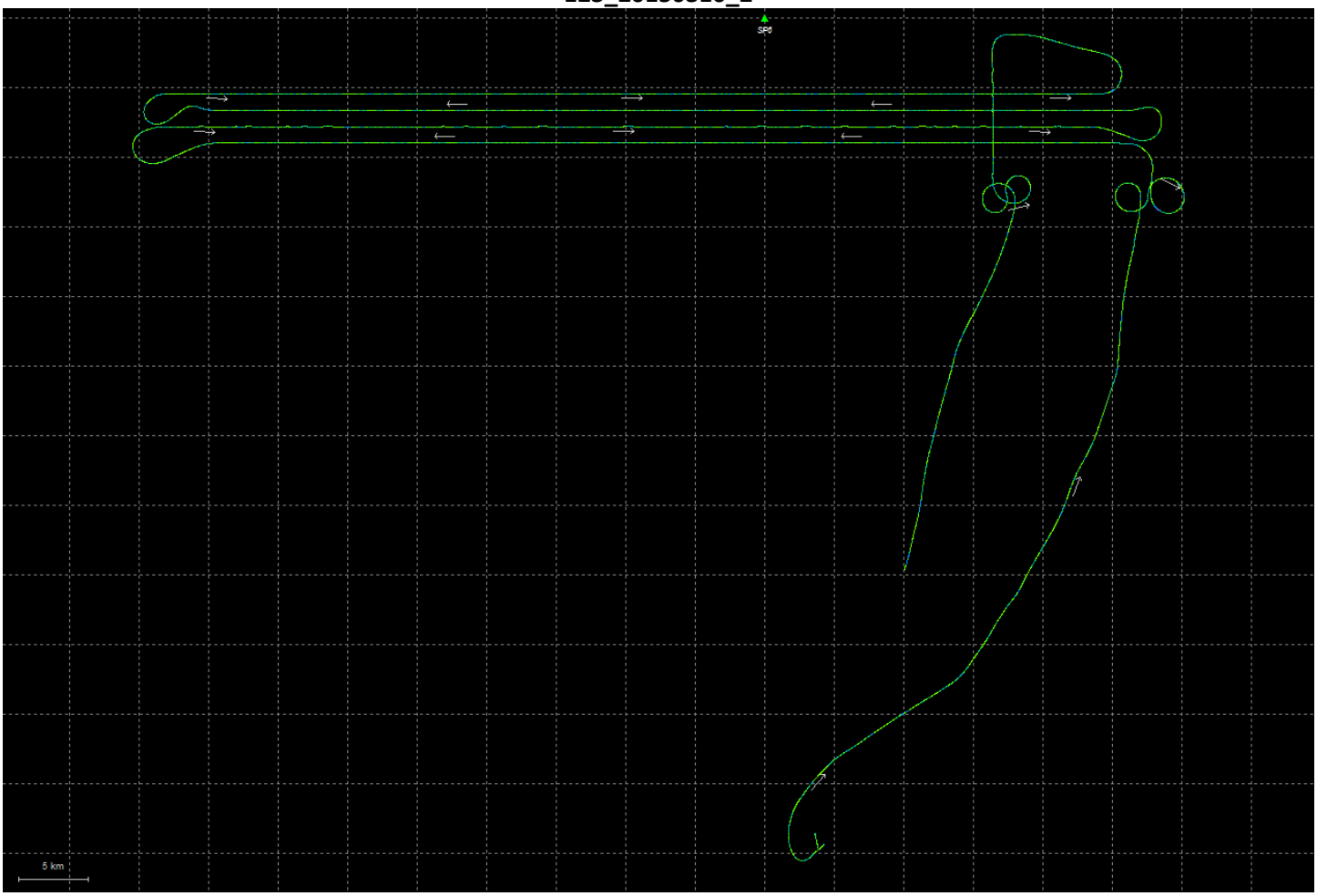
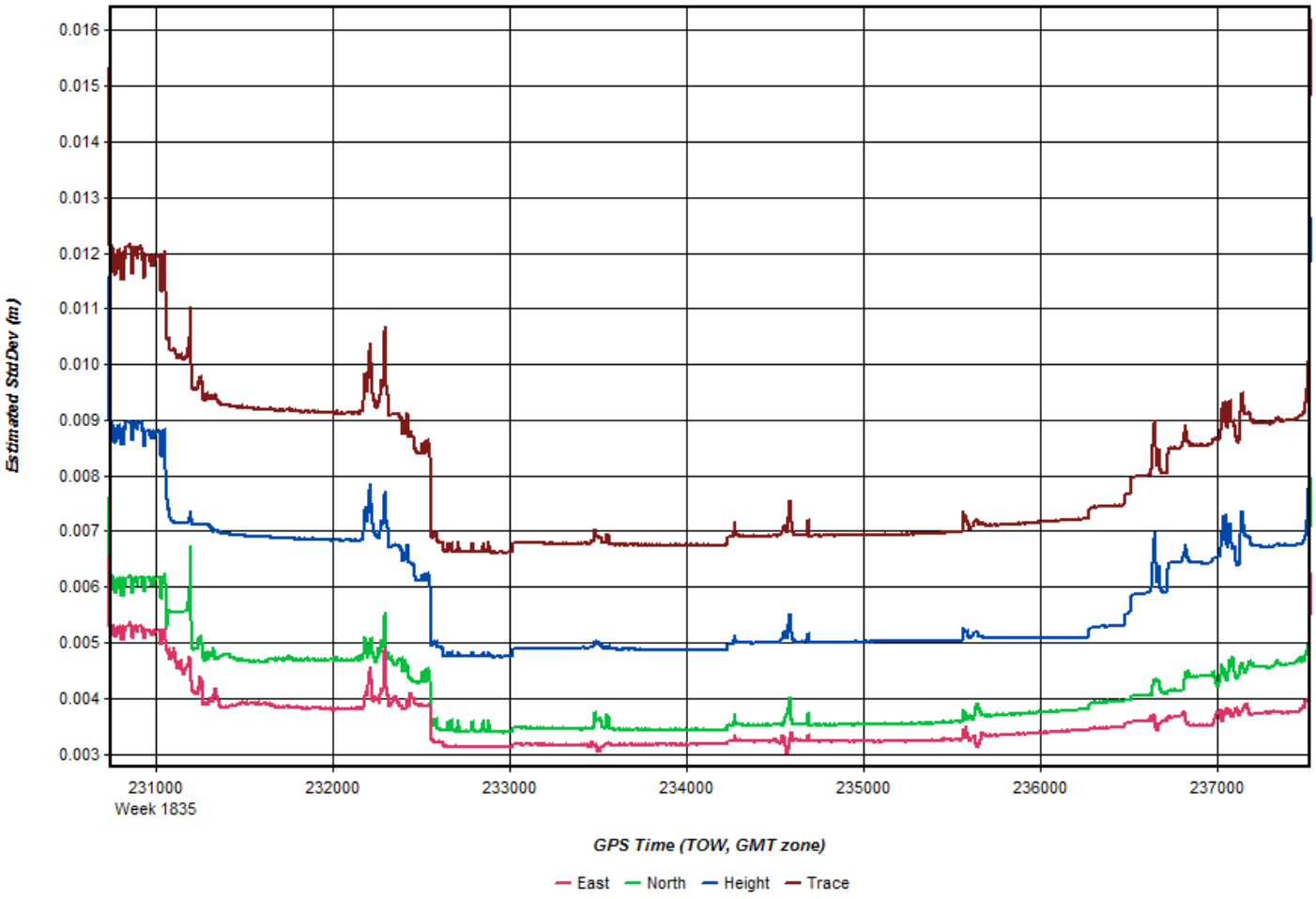
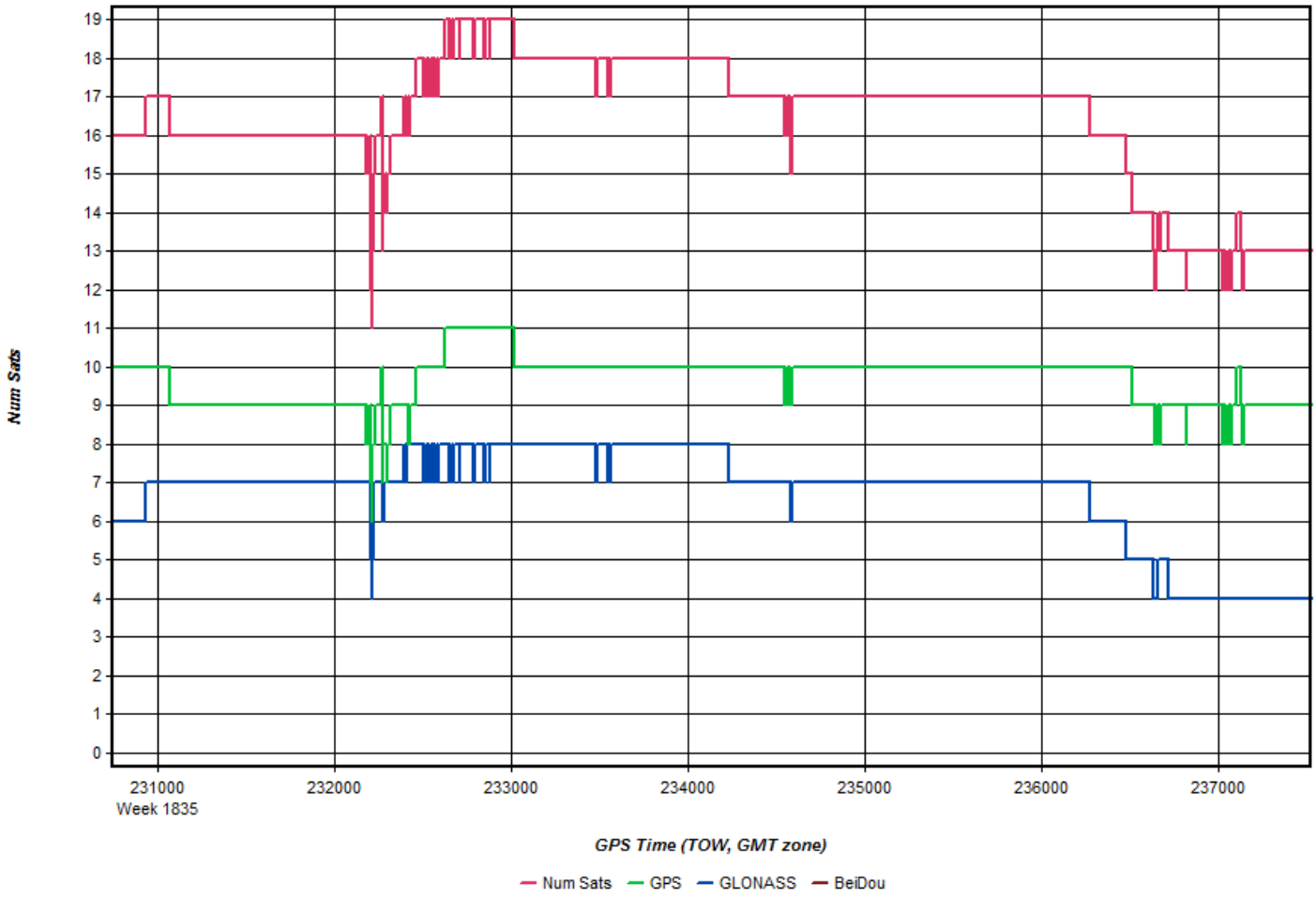
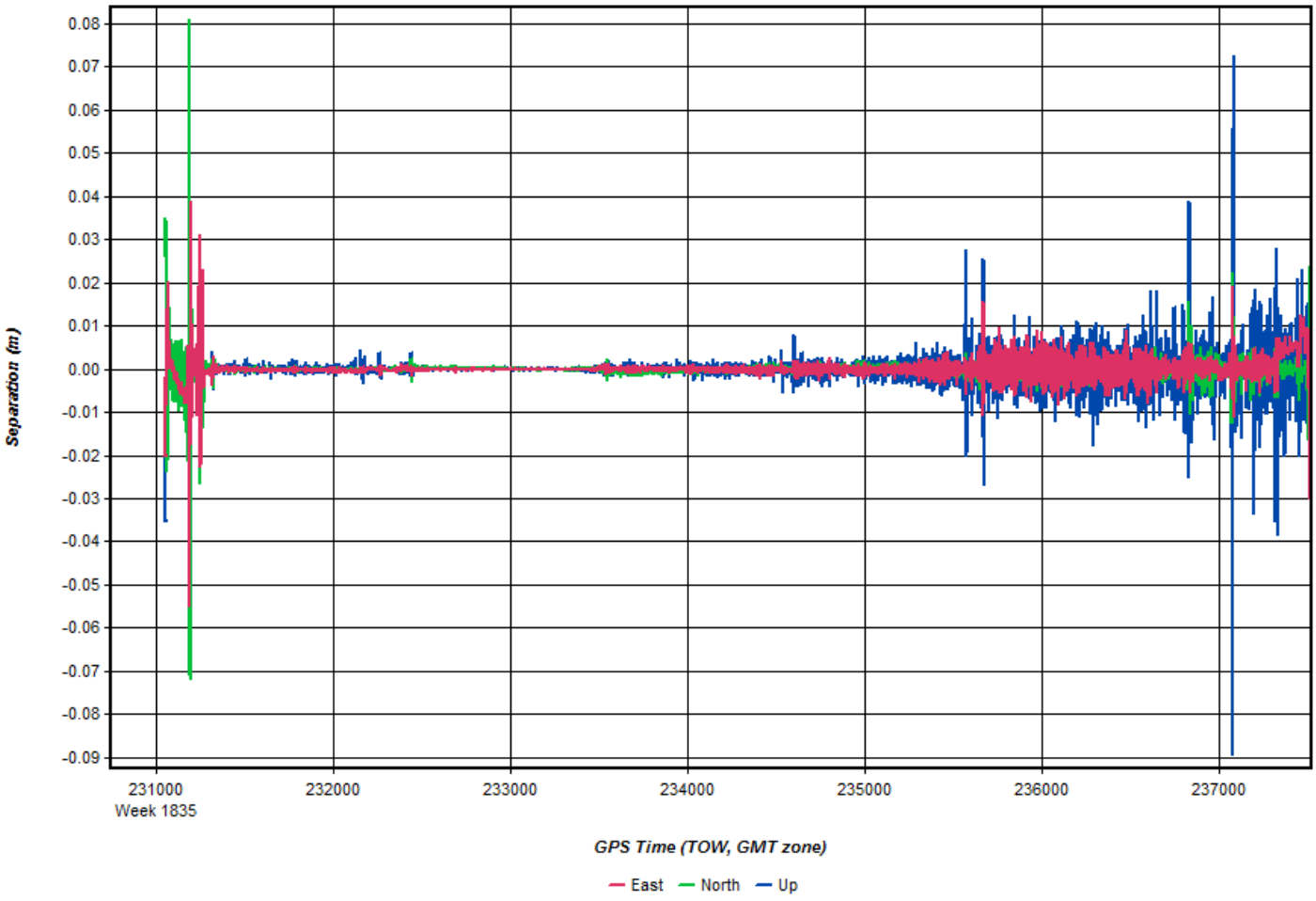
1.80
1.75
1.70
1.65
1.60
1.55
1.50
1.45
1.40
1.35
1.30
1.25
1.20
1.15
1.10
1.05
1.00
212000
Week 1835
214000
216000
218000
220000
222000
224000
226000
GPS Time (TOW, GMT zone)
PDOP

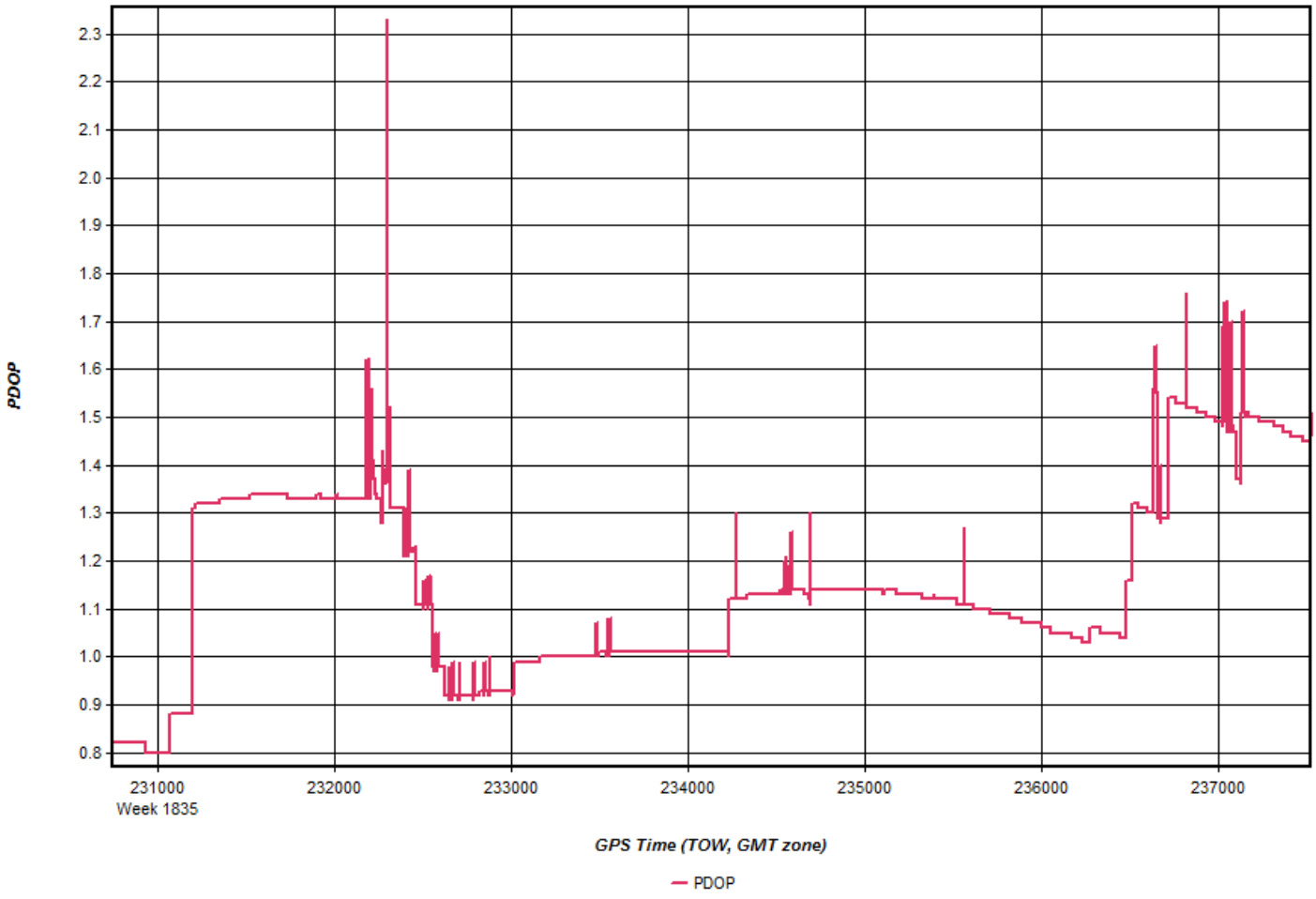
123_20150310_2



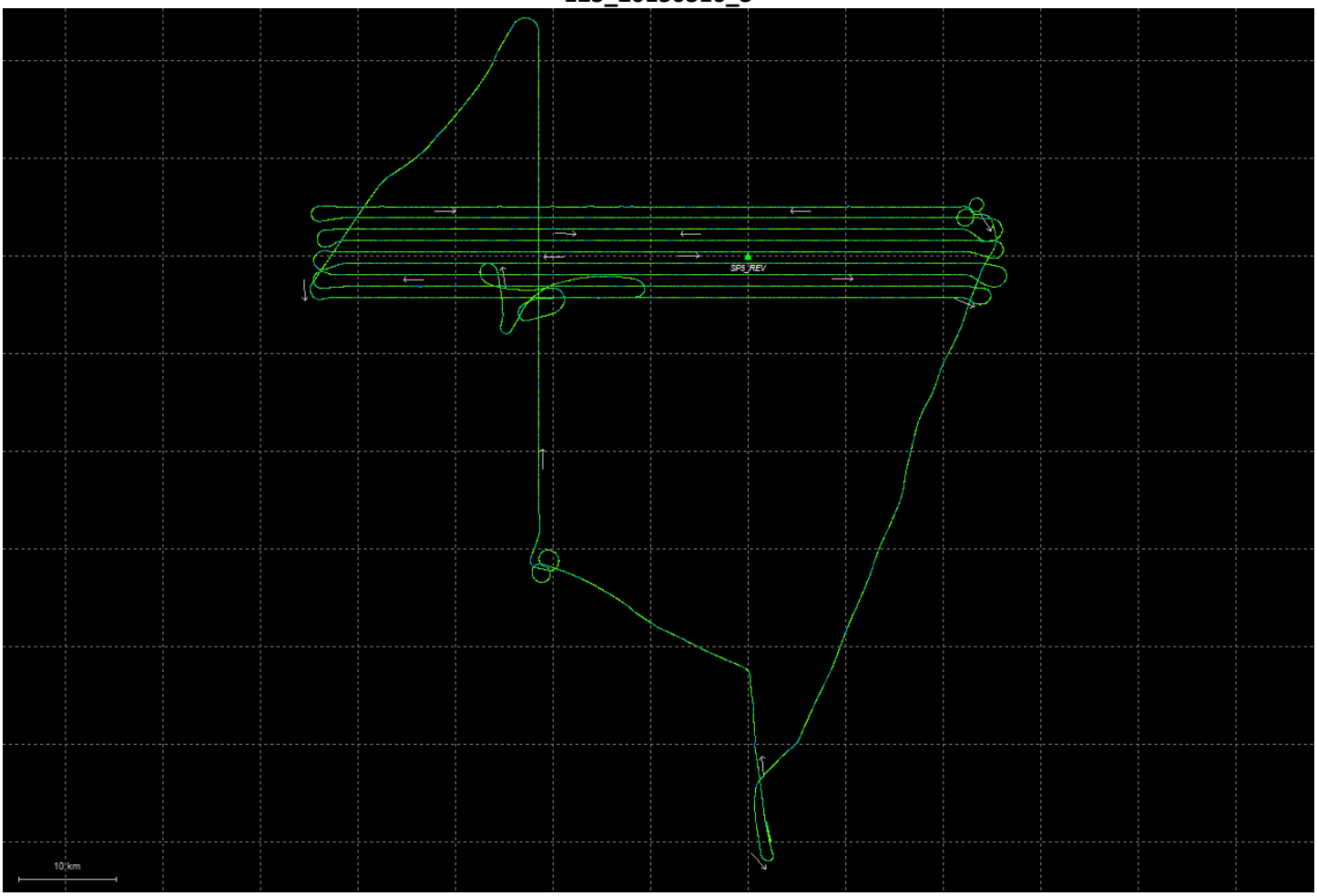

Estimated StdDev (m)
0.016
0.015
0.014
0.013
0.012
0.011
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
231000
Week 1835
232000
233000
234000
235000
236000
237000
GPS Time (TOW, GMT zone)
East
North
Height
Trace

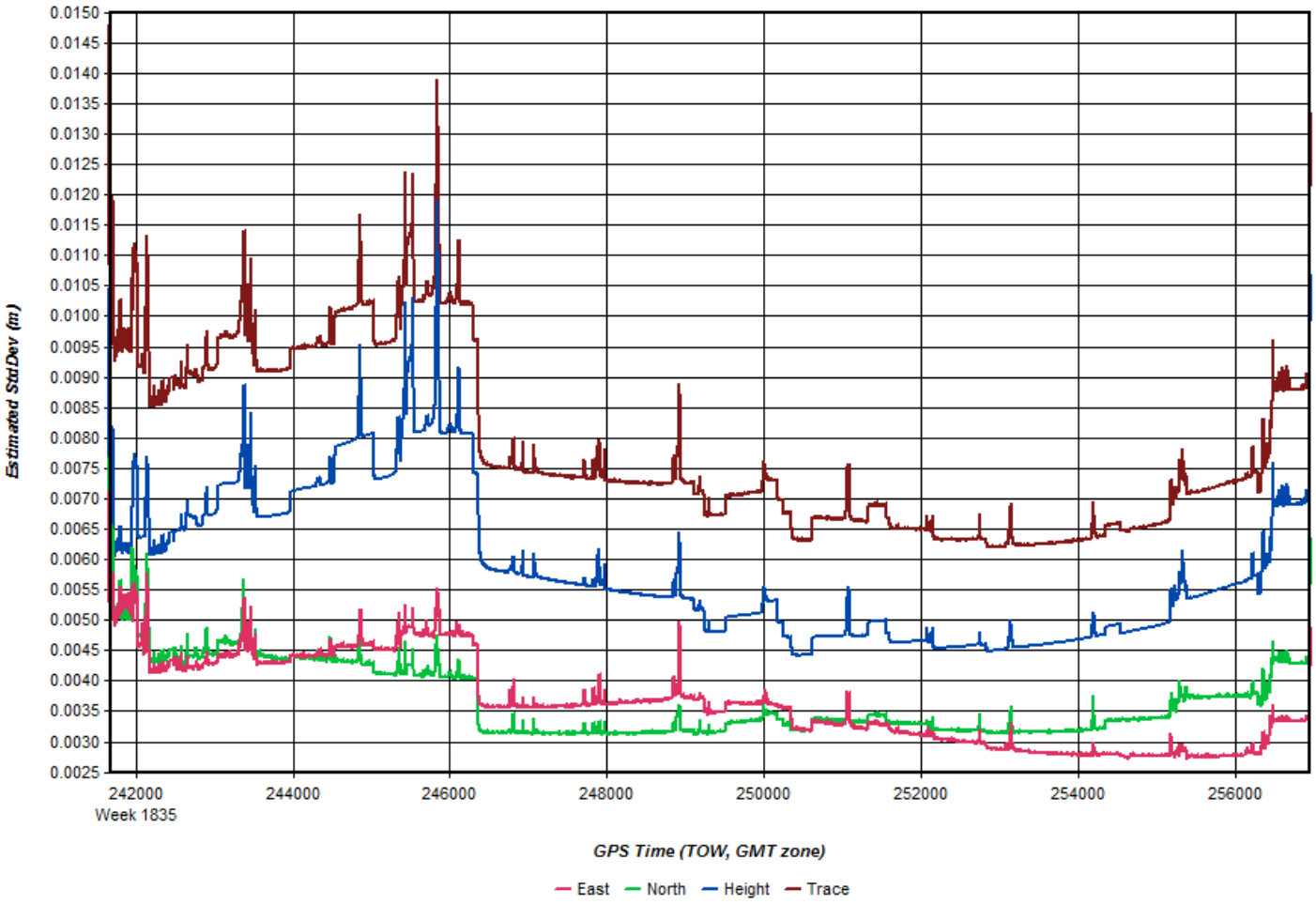

Num Sats
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
231000
Week 1835
232000
233000
234000
235000
236000
237000
GPS Time (TOW, GMT zone)
Num Sats
GPS
GLONASS
BeiDou

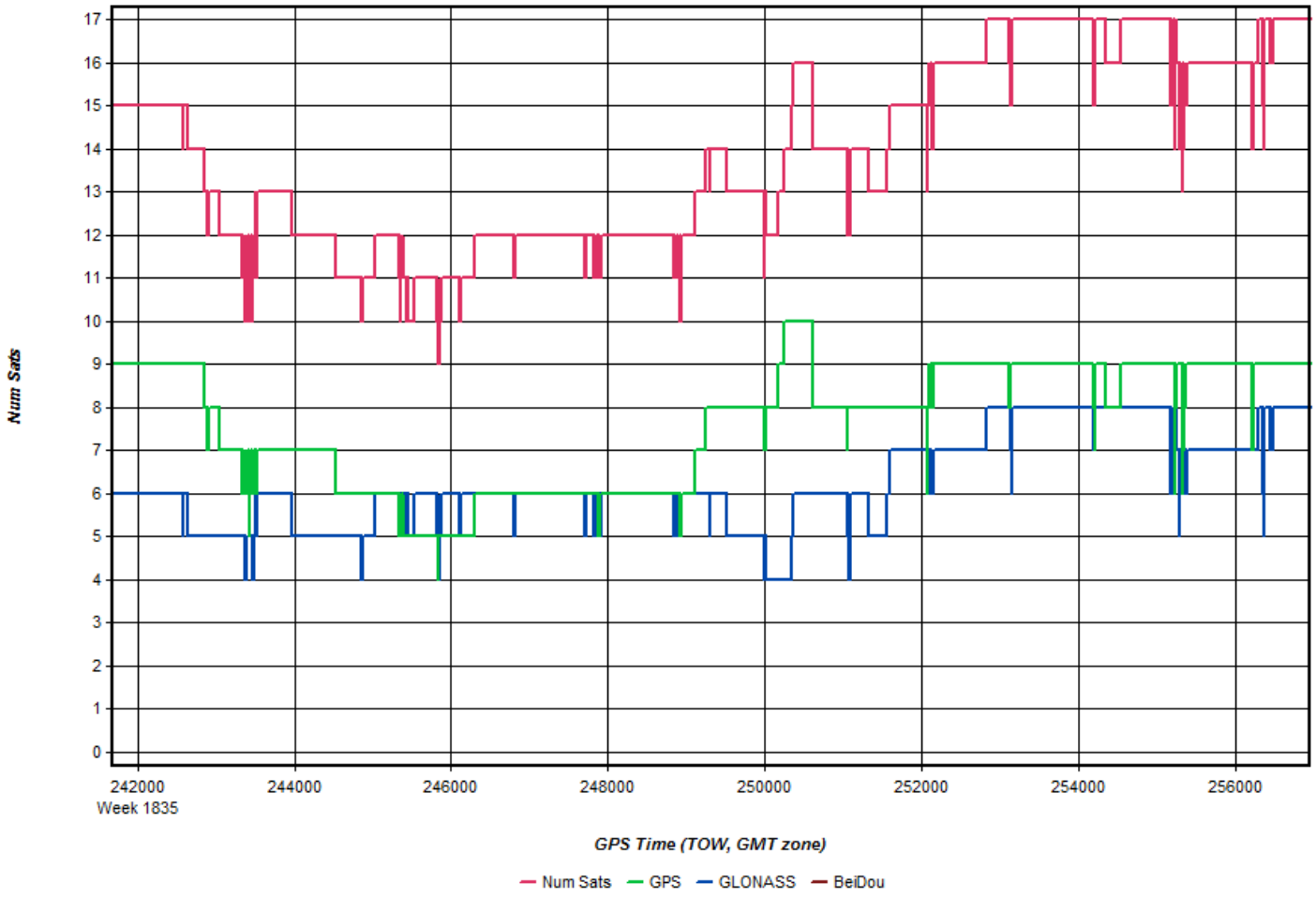

0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
-0.07
-0.08
-0.09
Separation (m)
231000
Week 1835
232000
233000
234000
235000
236000
237000
GPS Time (TOW, GMT zone)
East
North
Up

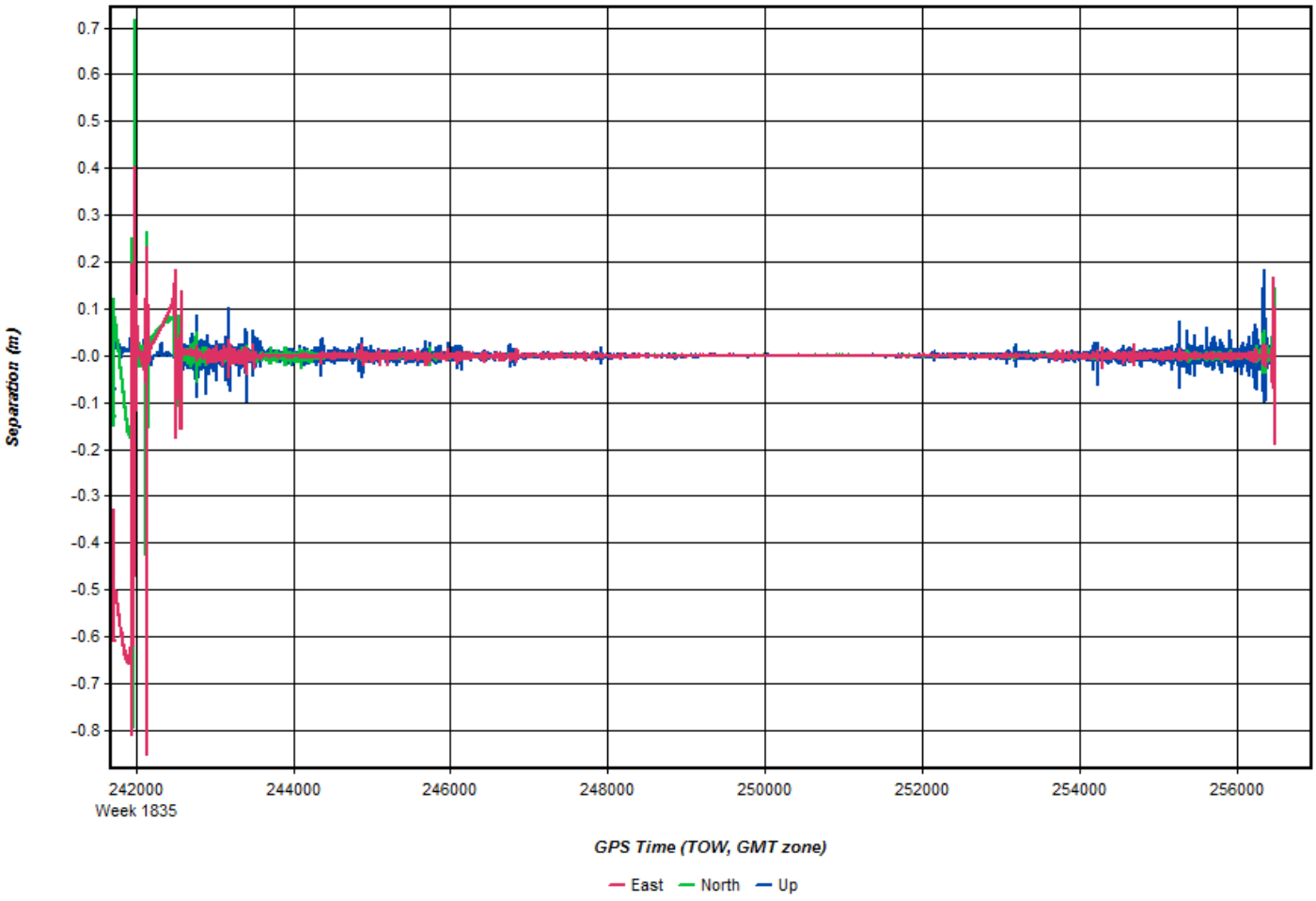

PDOP
2.3
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
231000
Week 1835
232000
233000
234000
235000
236000
237000
GPS Time (TOW, GMT zone)
PDOP

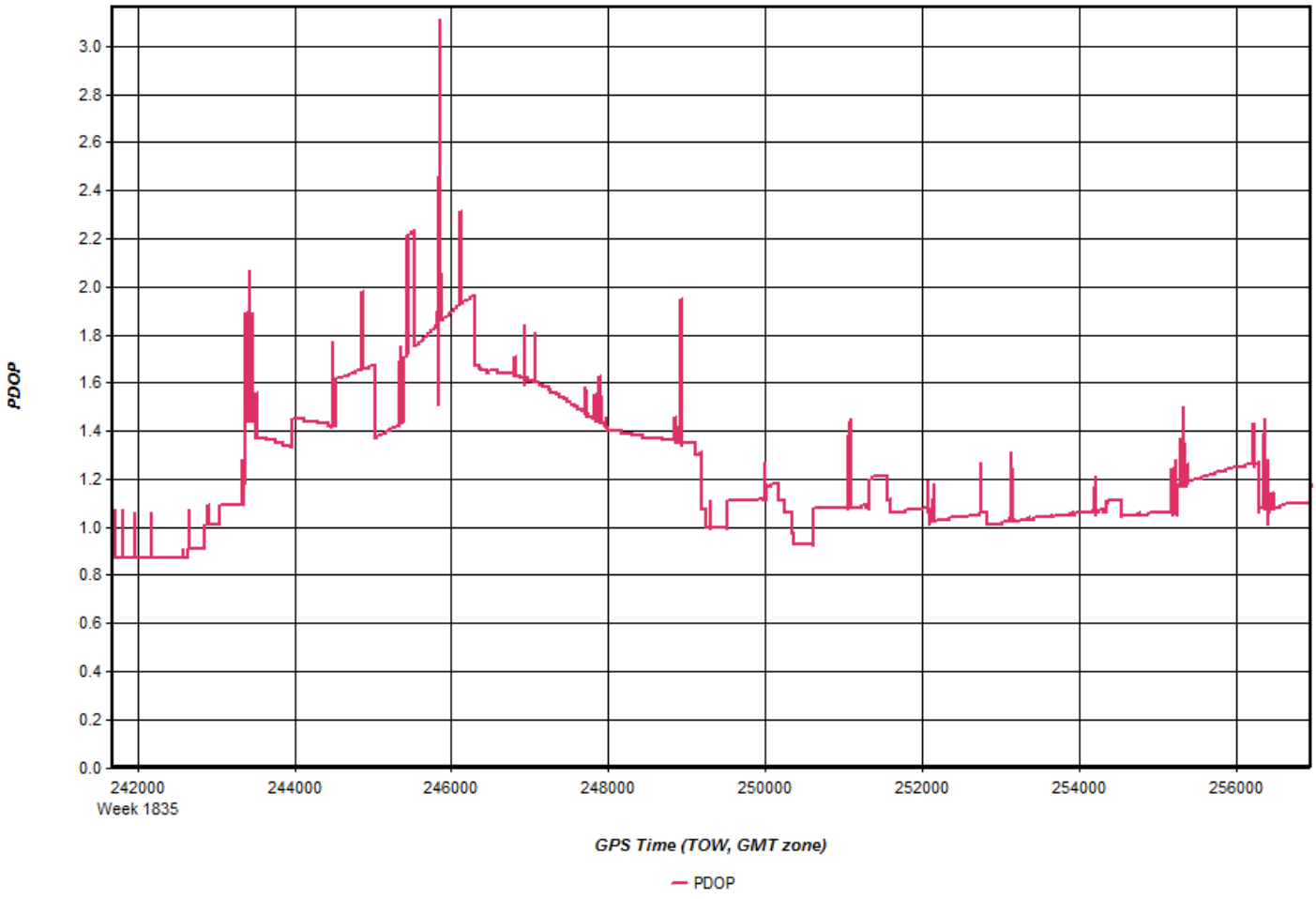
123_20150310_3



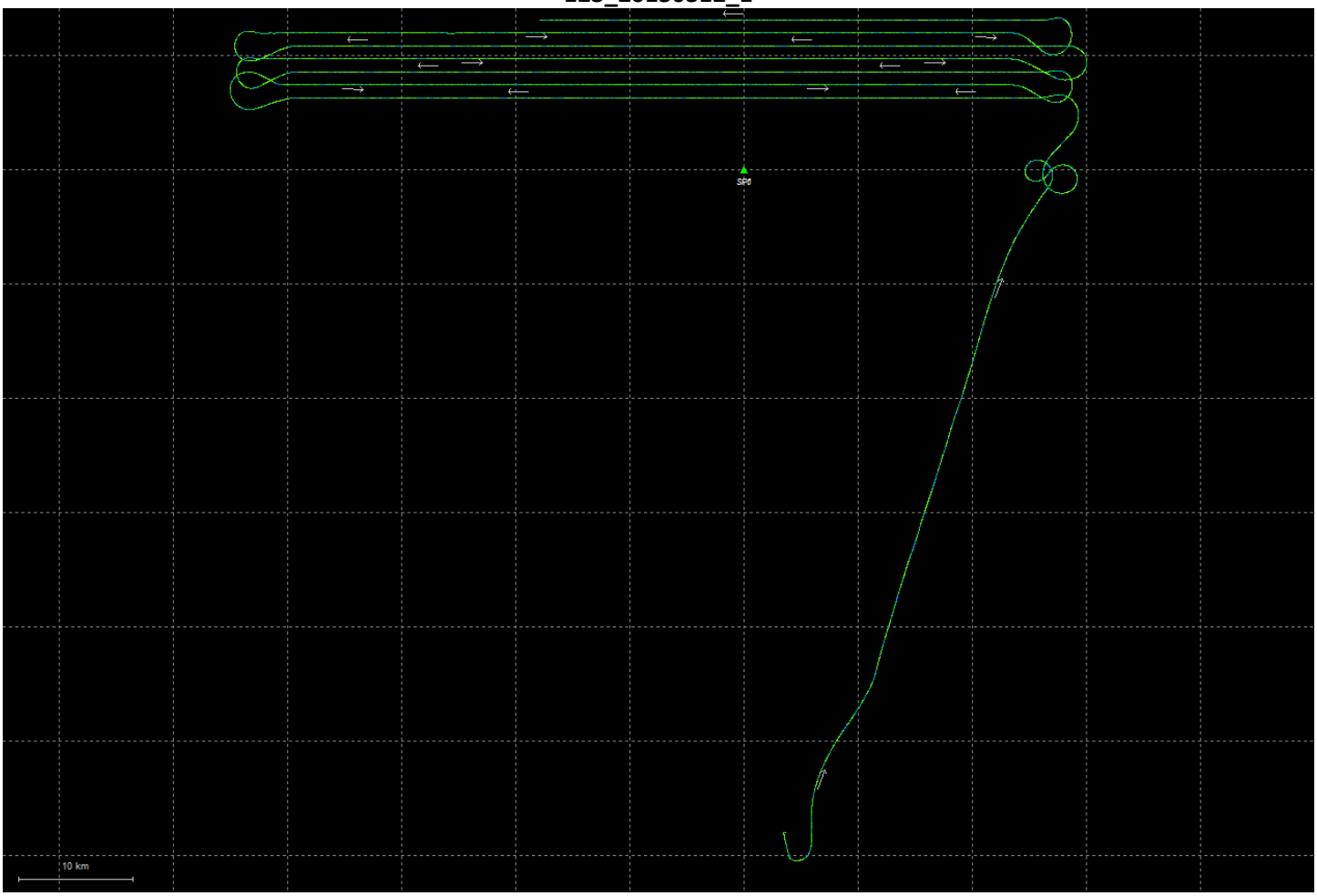

Estimated StdDev (m)
0.0150
0.0145
0.0140
0.0135
0.0130
0.0125
0.0120
0.0115
0.0110
0.0105
0.0100
0.0095
0.0090
0.0085
0.0080
0.0075
0.0070
0.0065
0.0060
0.0055
0.0050
0.0045
0.0040
0.0035
0.0030
0.0025
242000
Week 1835
244000
246000
248000
250000
252000
254000
256000
GPS Time (TOW, GMT zone)
East
North
Height
Trace

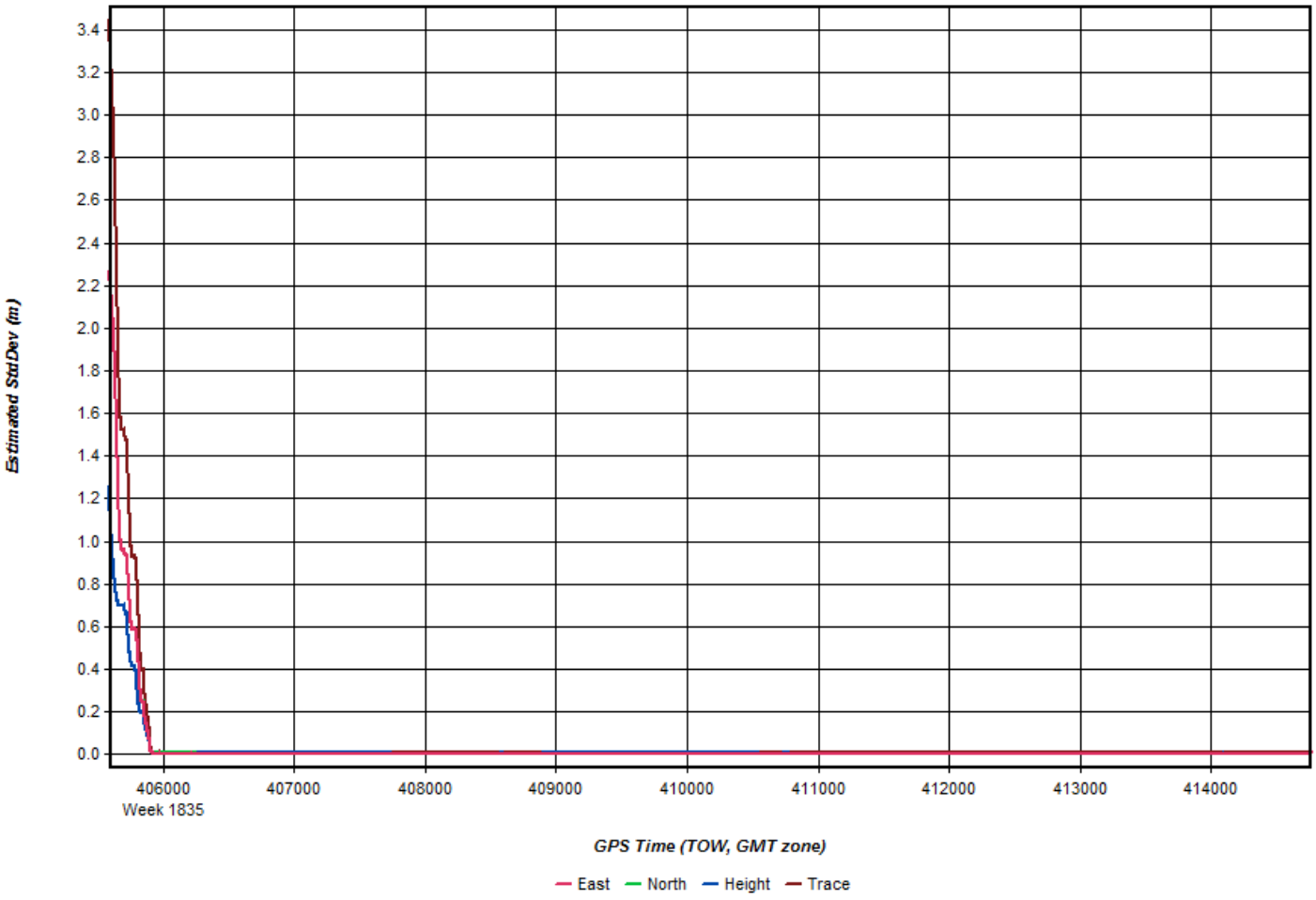

Num Sats
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
242000
Week 1835
244000
246000
248000
250000
252000
254000
256000
GPS Time (TOW, GMT zone)
Num Sats
GPS
GLONASS
BeiDou

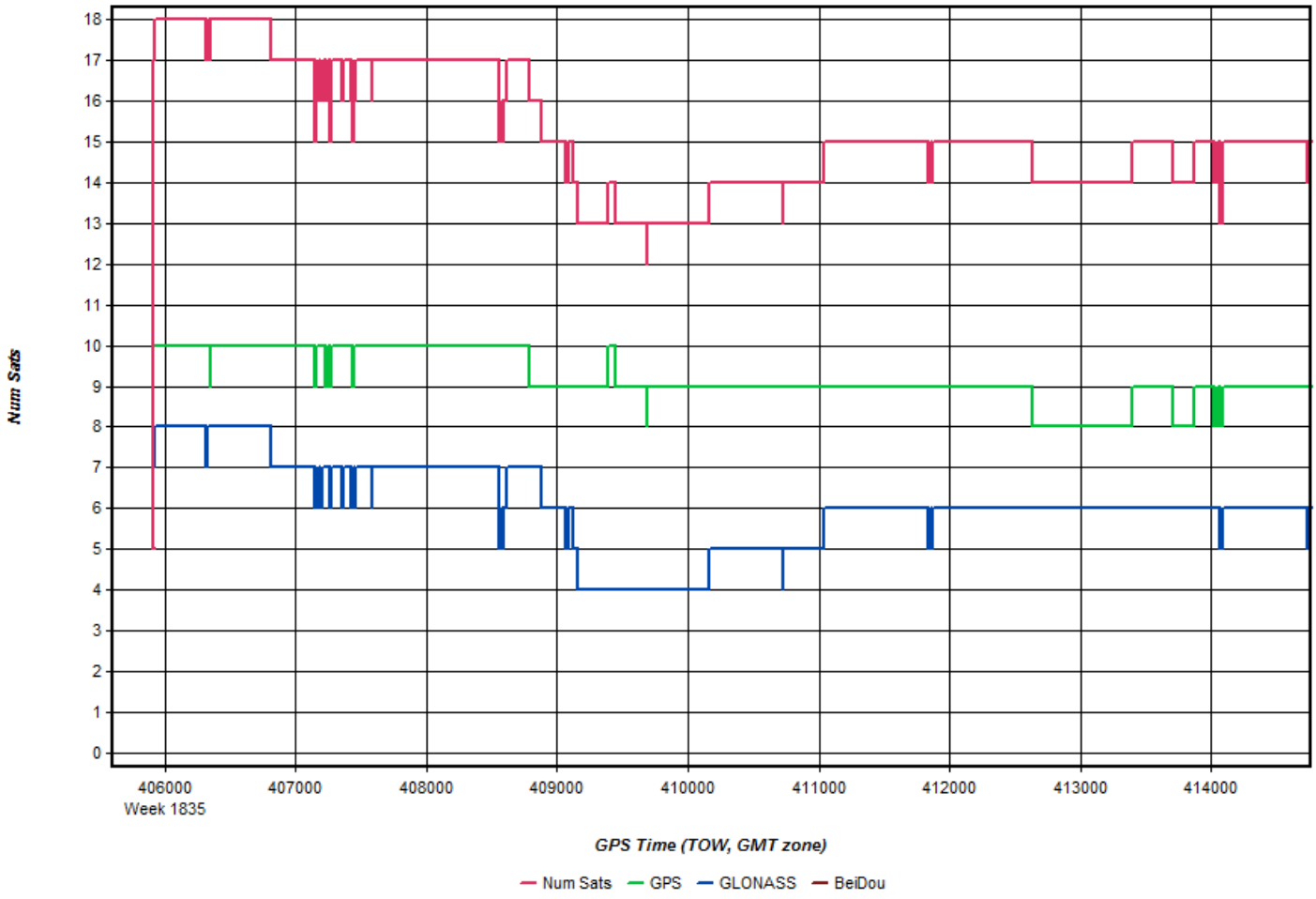

Separation (m)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
-0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
242000
Week 1835
244000
246000
248000
250000
252000
254000
256000
GPS Time (TOW, GMT zone)
East
North
Up

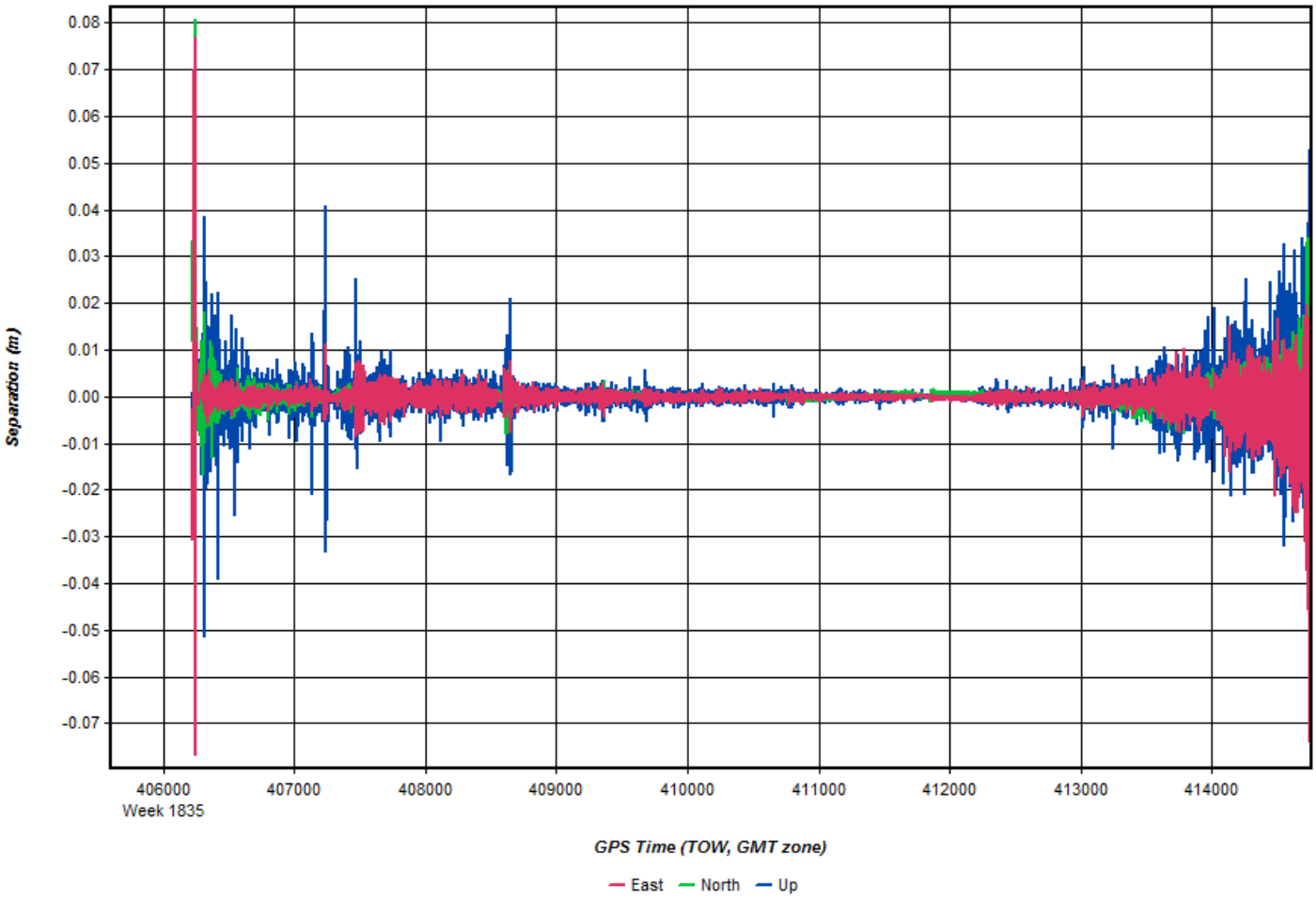

PDOP
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
242000
Week 1835
244000
246000
248000
250000
252000
254000
256000
GPS Time (TOW, GMT zone)
PDOP

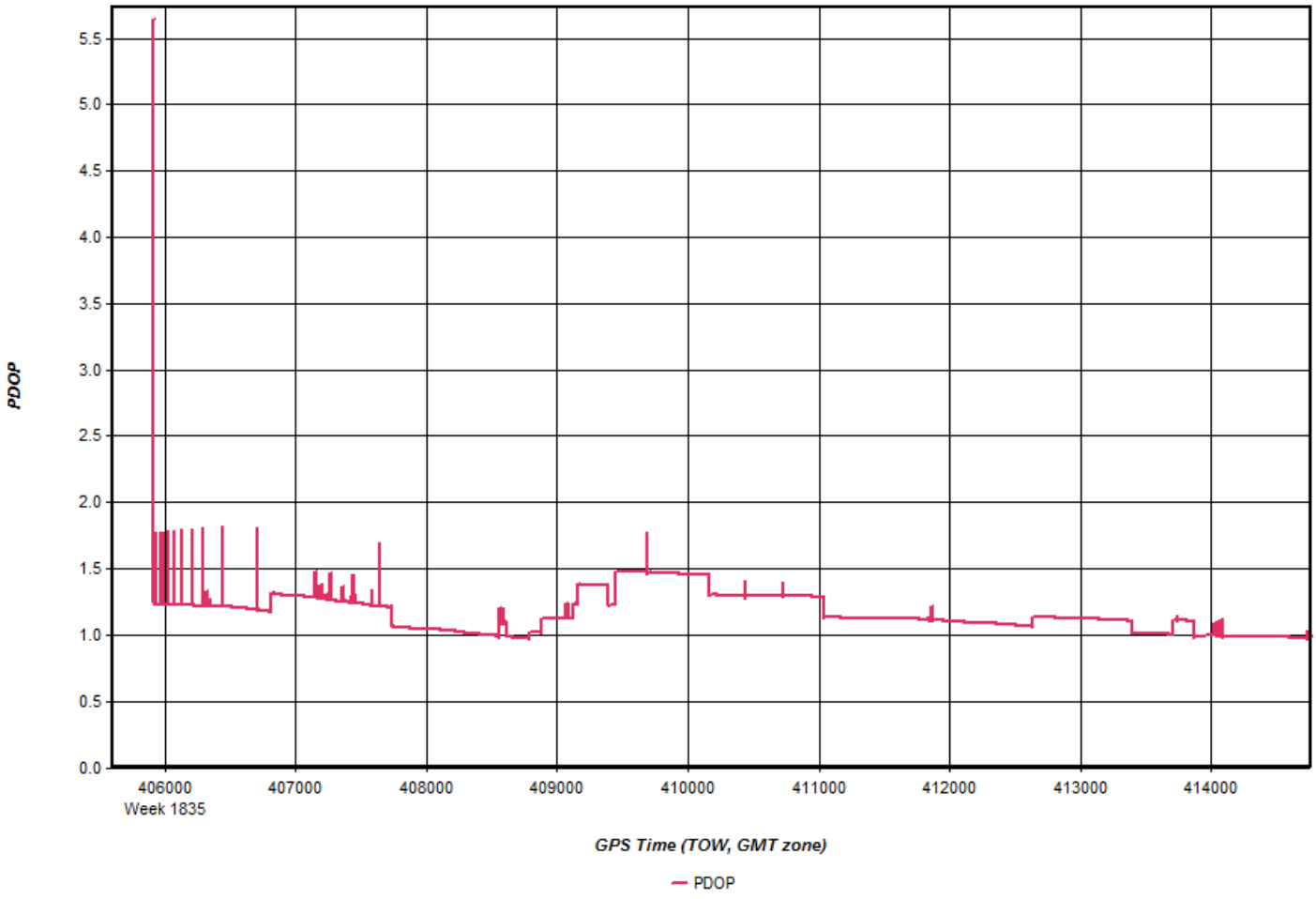
123_20150312_1



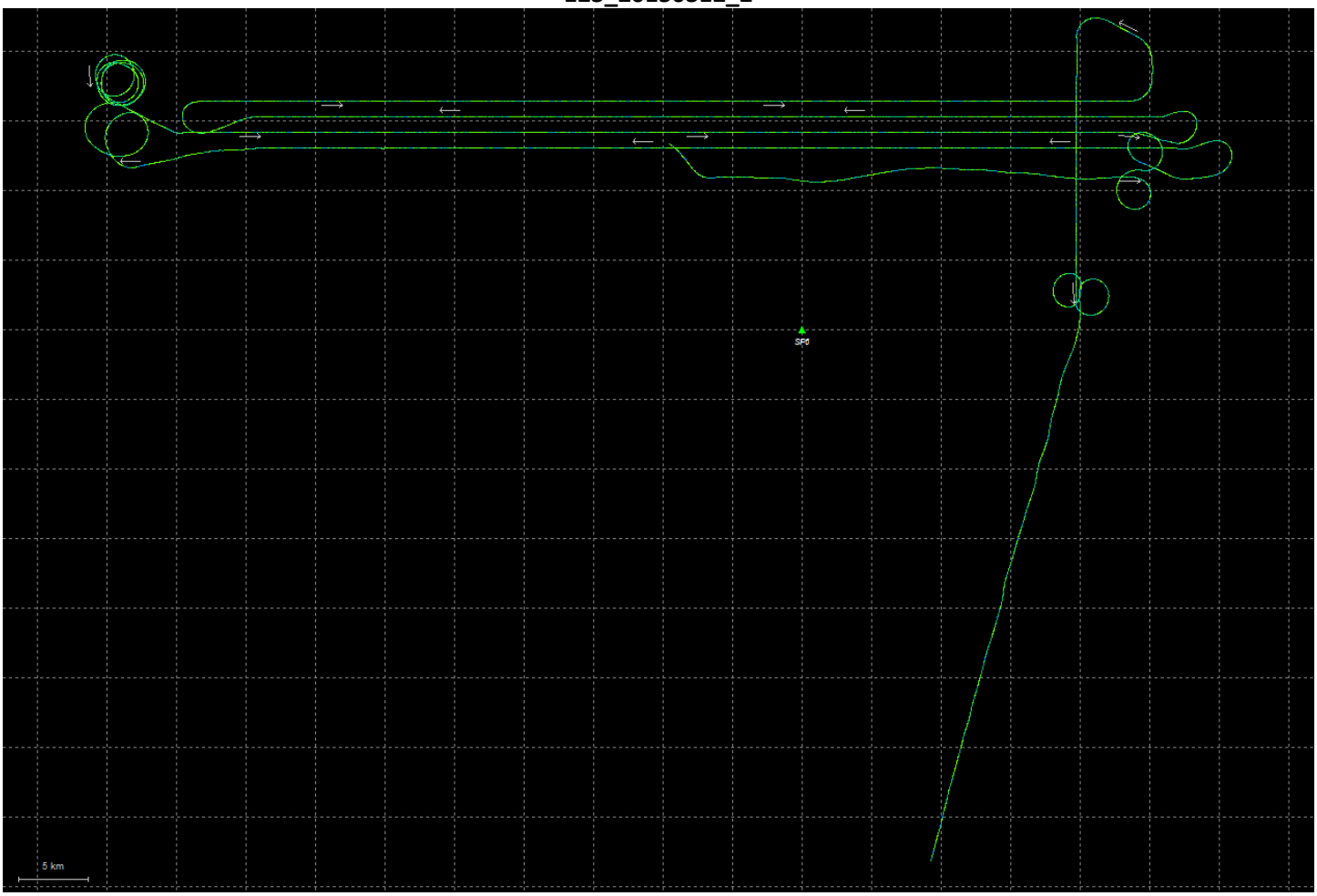

Estimated StdDev (m)
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
406000
Week 1835
407000
408000
409000
410000
411000
412000
413000
414000
GPS Time (TOW, GMT zone)
East
North
Height
Trace

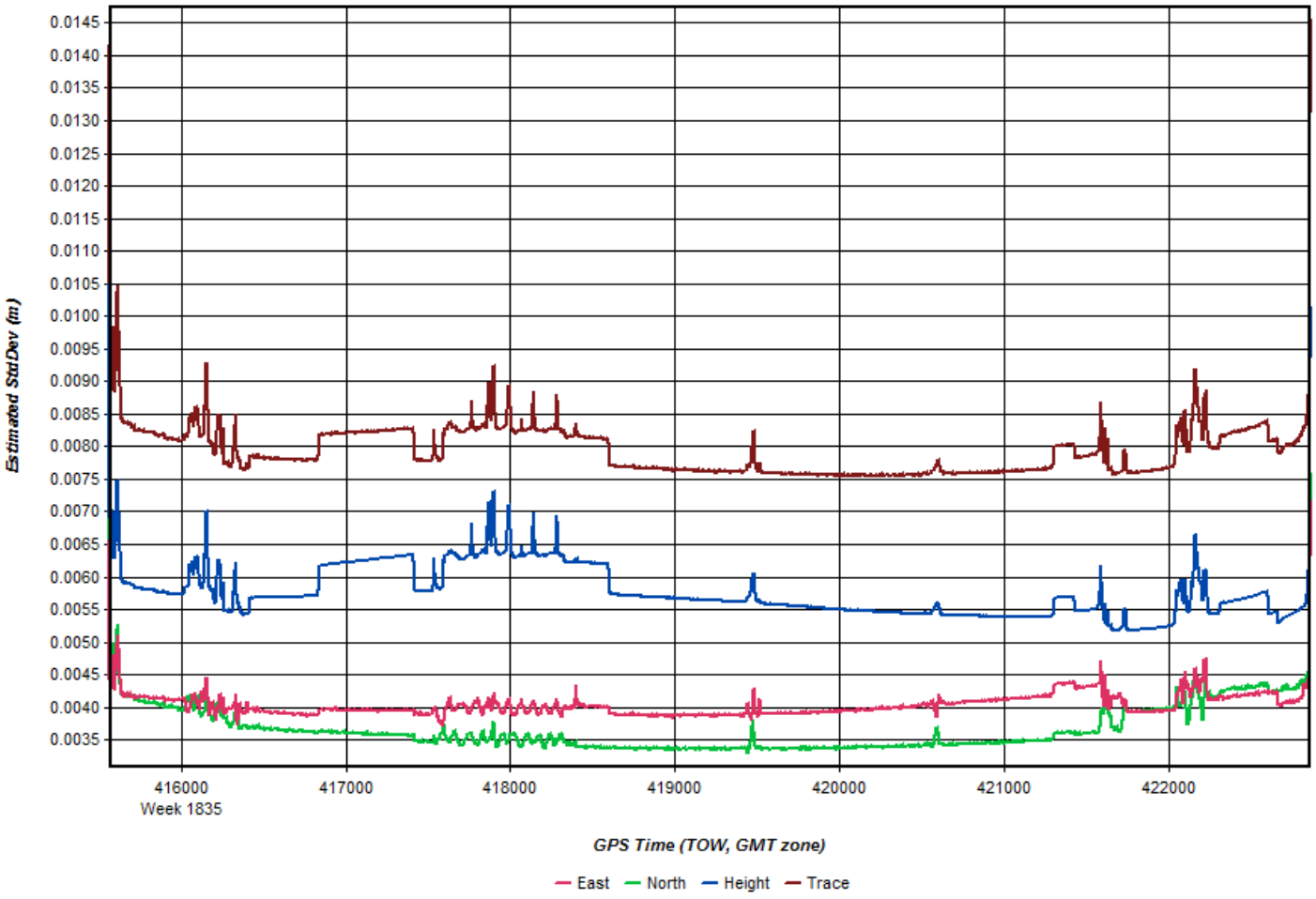

Num Sats
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
406000
Week 1835
407000
408000
409000
410000
411000
412000
413000
414000
GPS Time (TOW, GMT zone)
Num Sats
GPS
GLONASS
BeiDou

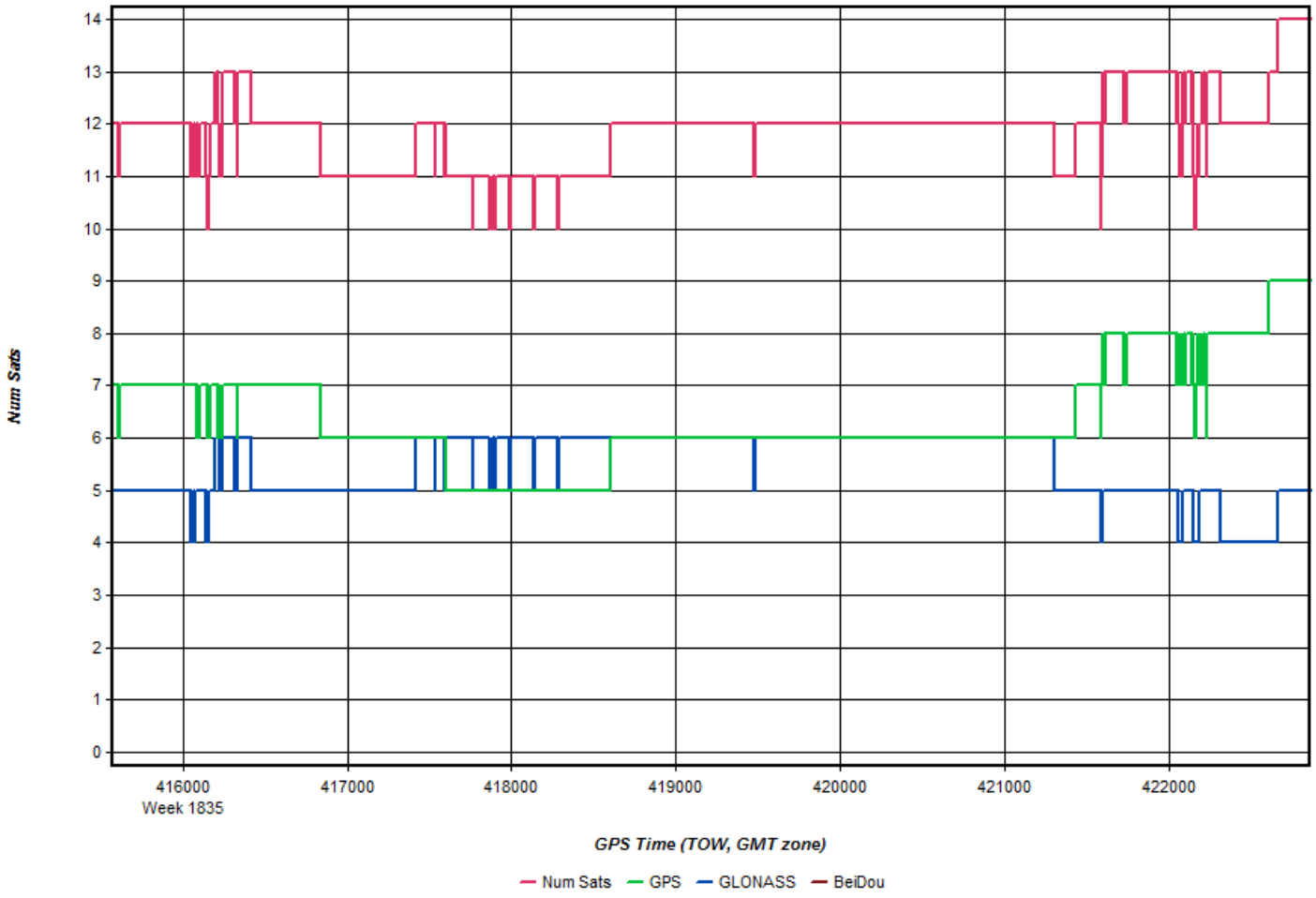

0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
-0.07
Separation (m)
406000
Week 1835
407000
408000
409000
410000
411000
412000
413000
414000
GPS Time (TOW, GMT zone)
East
North
Up

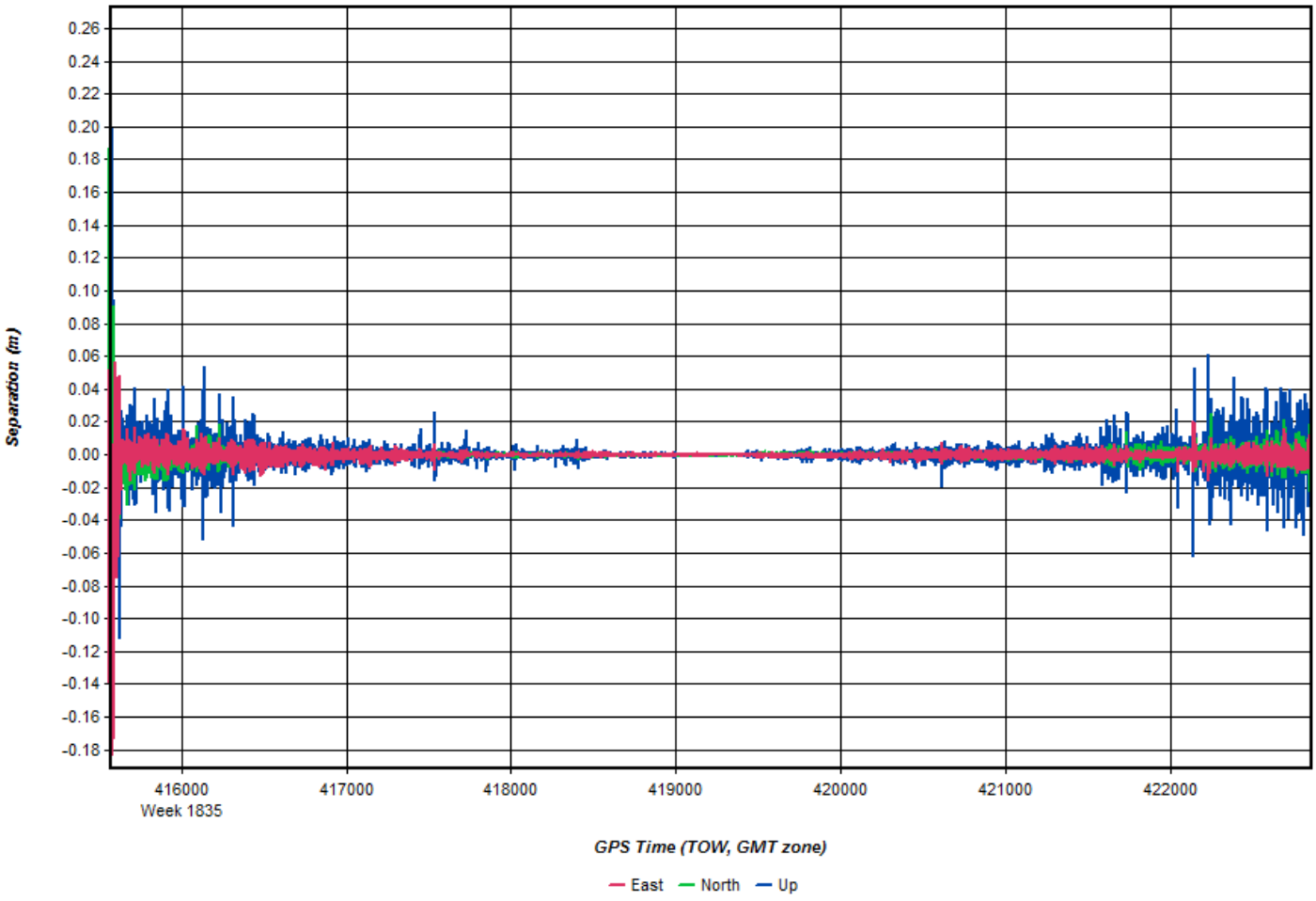

PDOP
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
406000
Week 1835
407000
408000
409000
410000
411000
412000
413000
414000
GPS Time (TOW, GMT zone)
PDOP

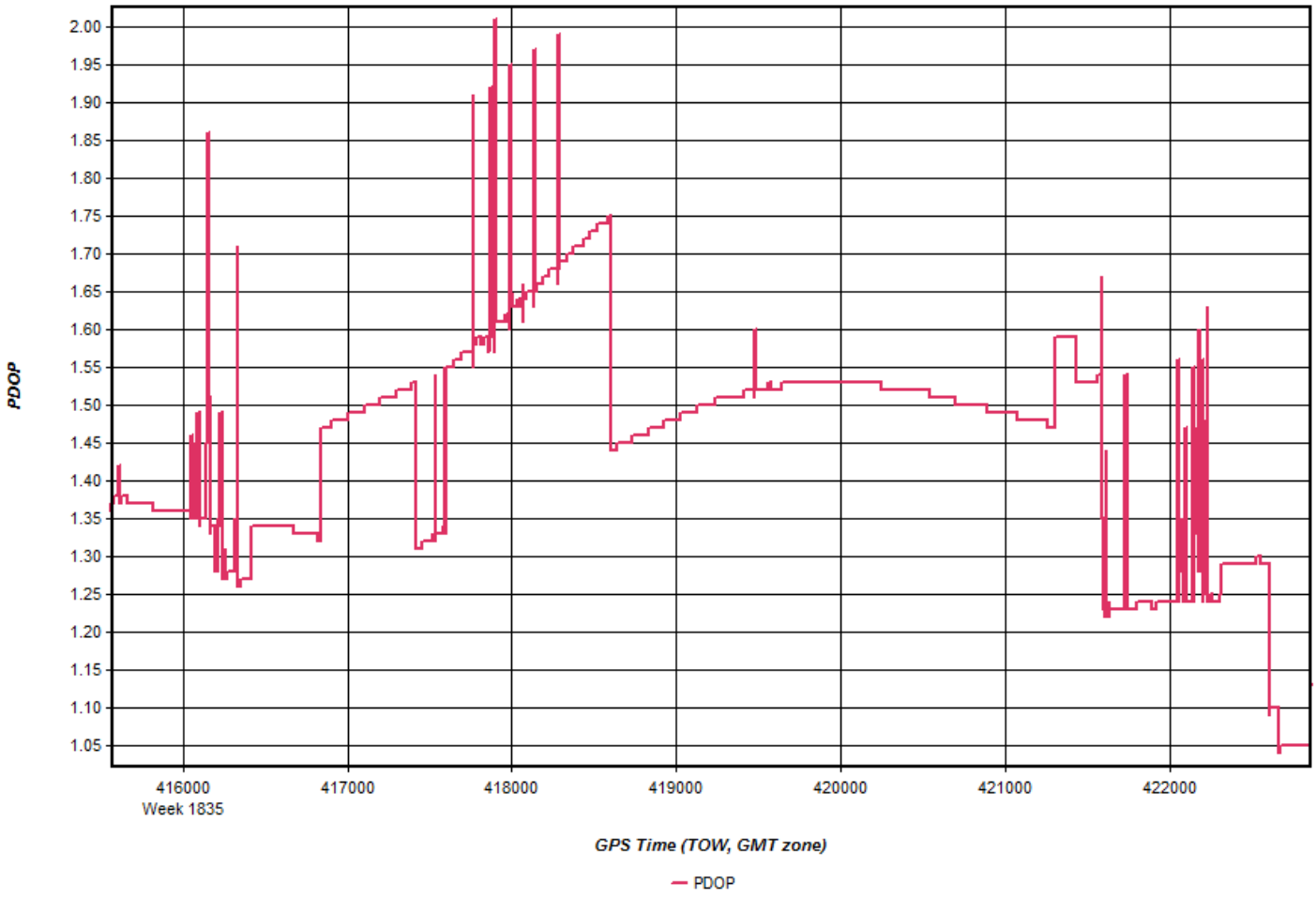
123_20150312_2



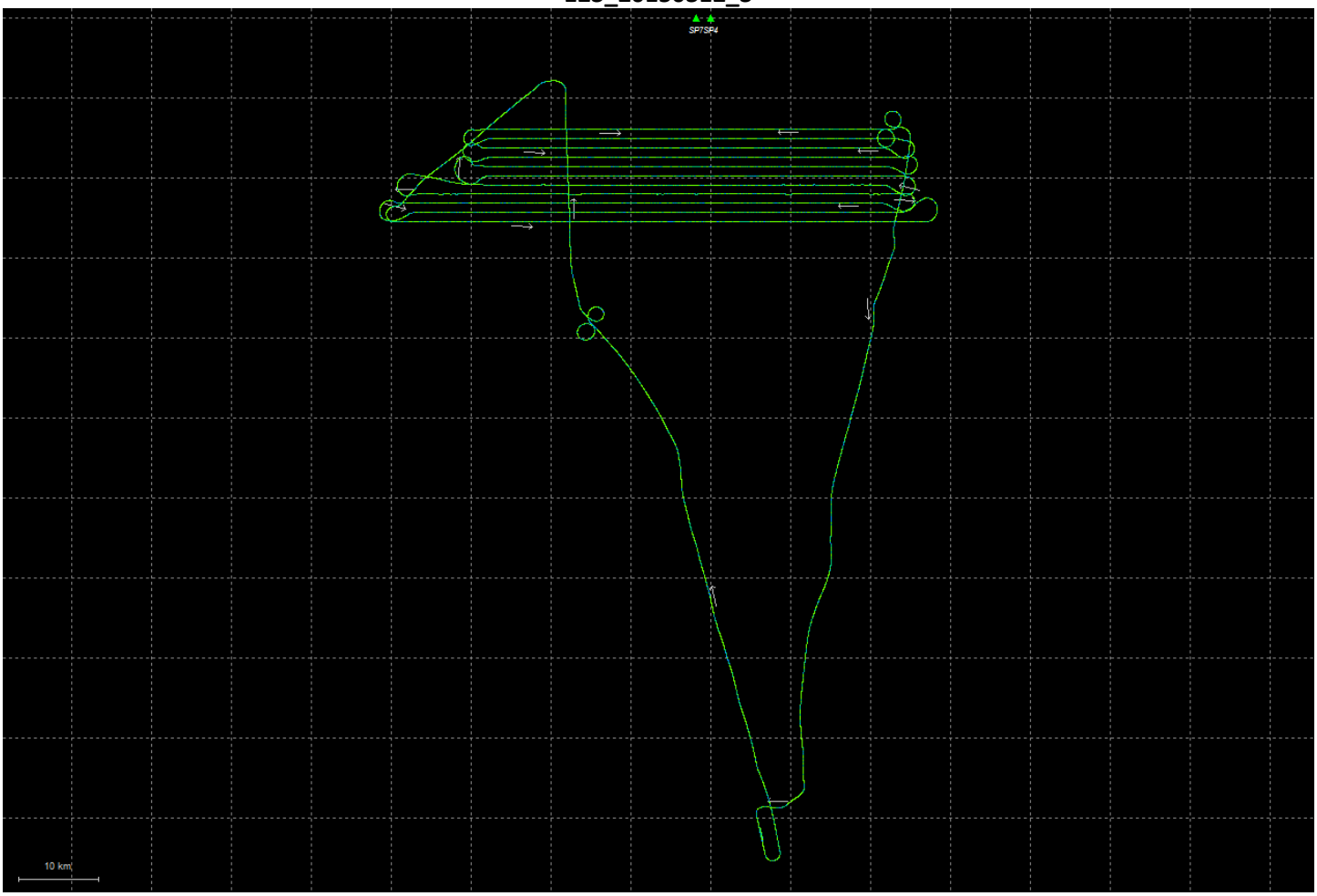

Estimated StdDev (m)
0.0145
0.0140
0.0135
0.0130
0.0125
0.0120
0.0115
0.0110
0.0105
0.0100
0.0095
0.0090
0.0085
0.0080
0.0075
0.0070
0.0065
0.0060
0.0055
0.0050
0.0045
0.0040
0.0035
416000
Week 1835
417000
418000
419000
420000
421000
422000
GPS Time (TOW, GMT zone)
East
North
Height
Trace

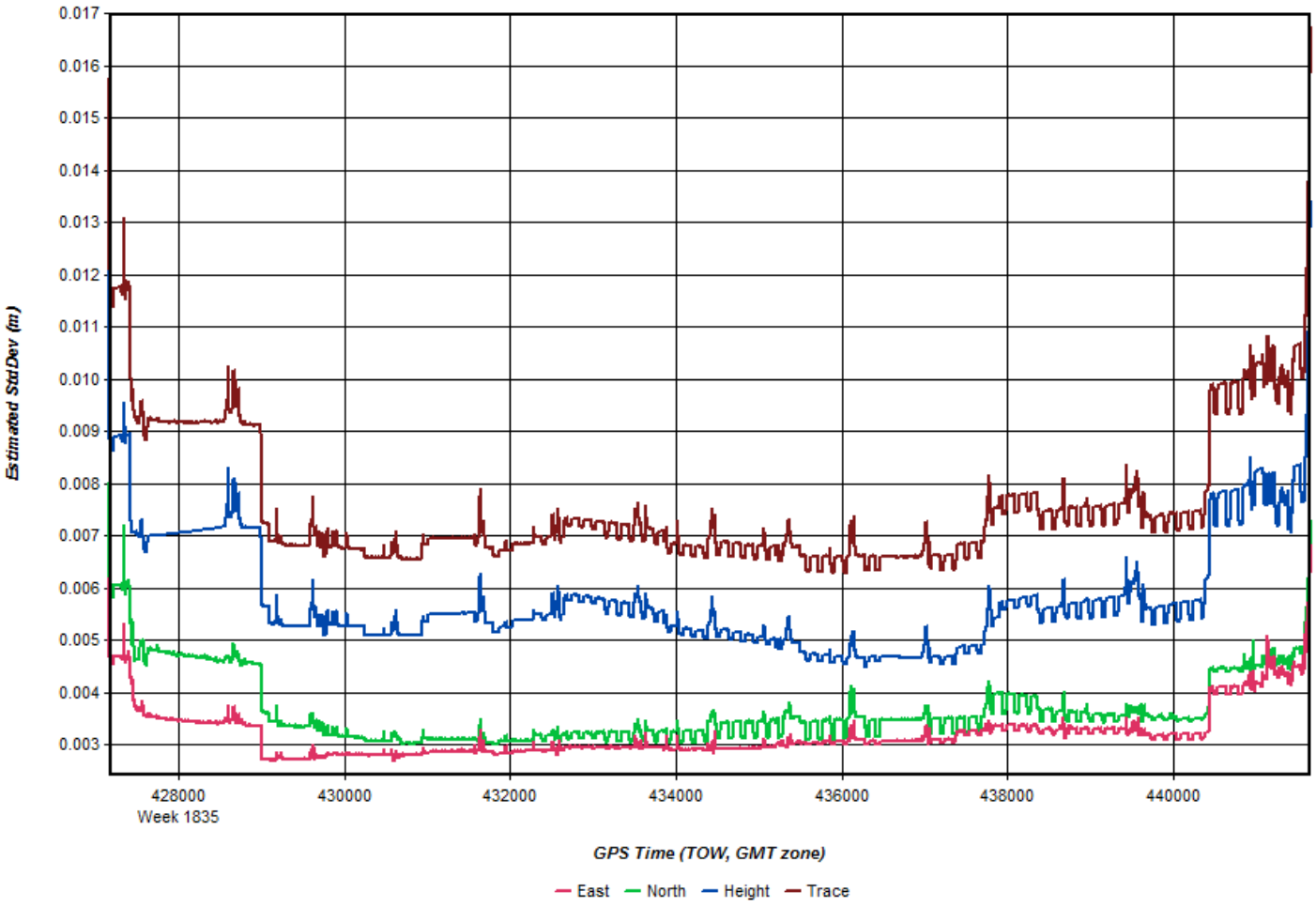

Num Sats
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
416000
Week 1835
417000
418000
419000
420000
421000
422000
GPS Time (TOW, GMT zone)
Num Sats
GPS
GLONASS
BeiDou

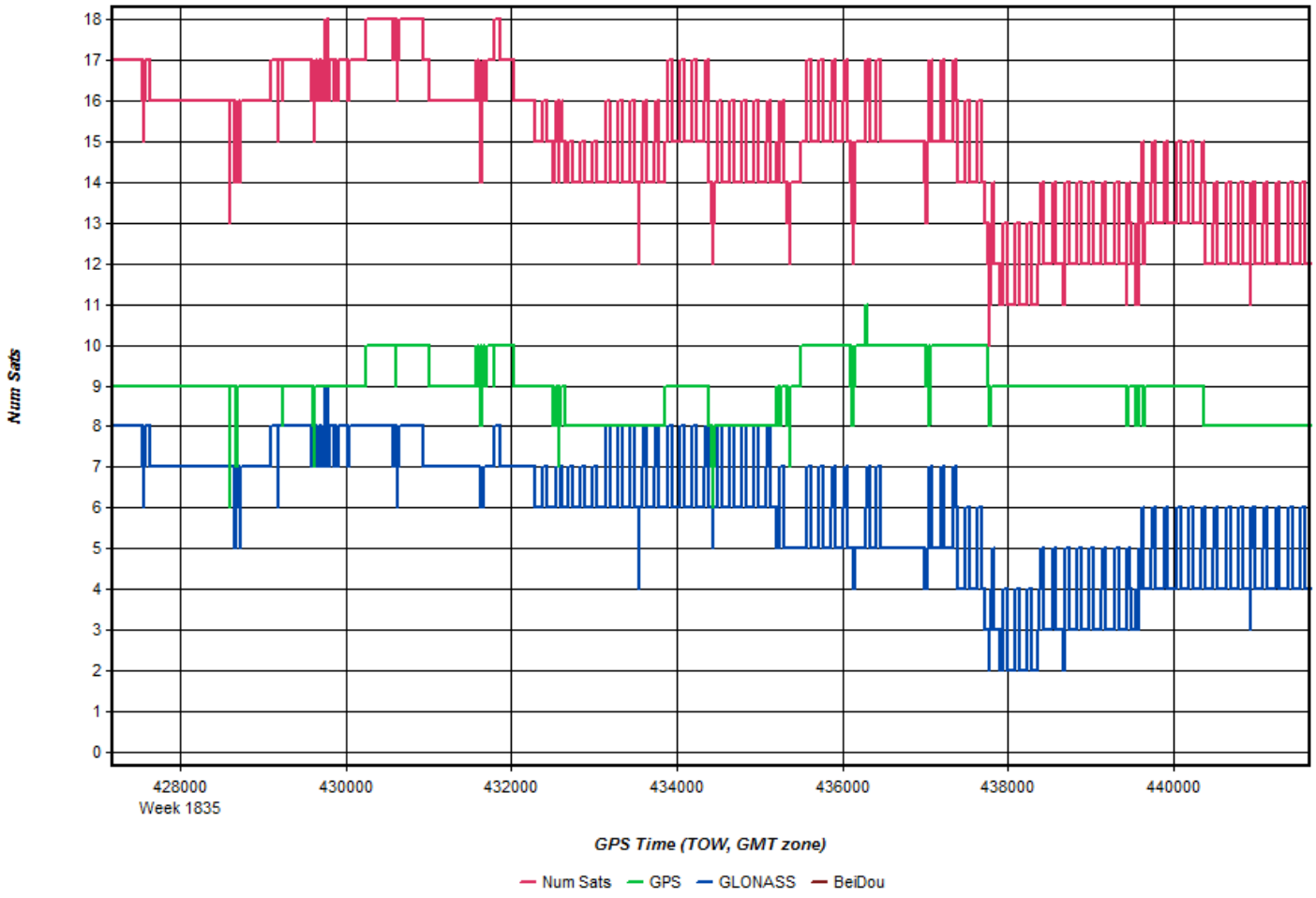

Separation (m)
0.26
0.24
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.12
-0.14
-0.16
-0.18
416000
Week 1835
417000
418000
419000
420000
421000
422000
GPS Time (TOW, GMT zone)
East
North
Up

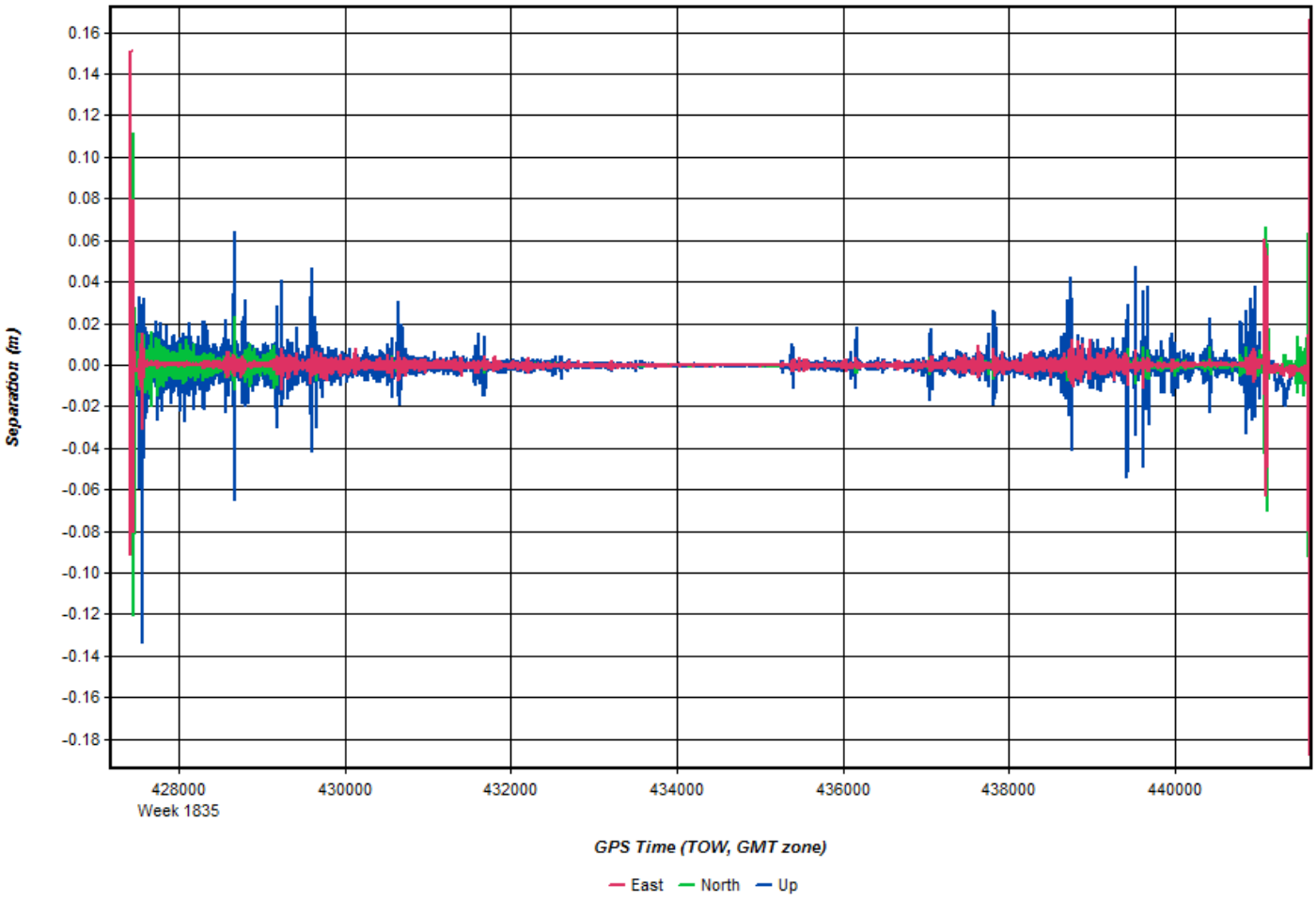

PDOP
2.00
1.95
1.90
1.85
1.80
1.75
1.70
1.65
1.60
1.55
1.50
1.45
1.40
1.35
1.30
1.25
1.20
1.15
1.10
1.05
416000
Week 1835
417000
418000
419000
420000
421000
422000
GPS Time (TOW, GMT zone)
PDOP

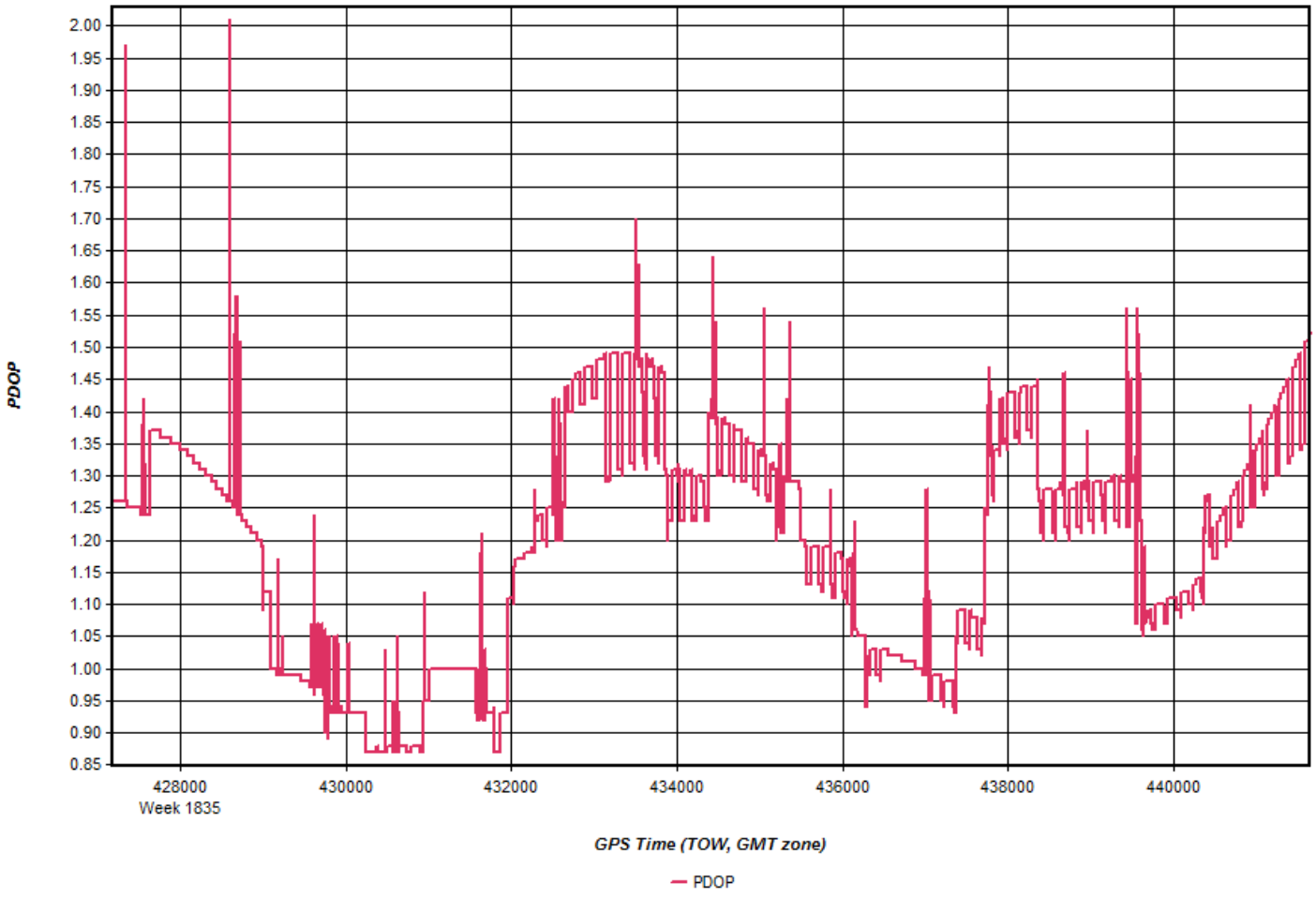
123_20150312_3



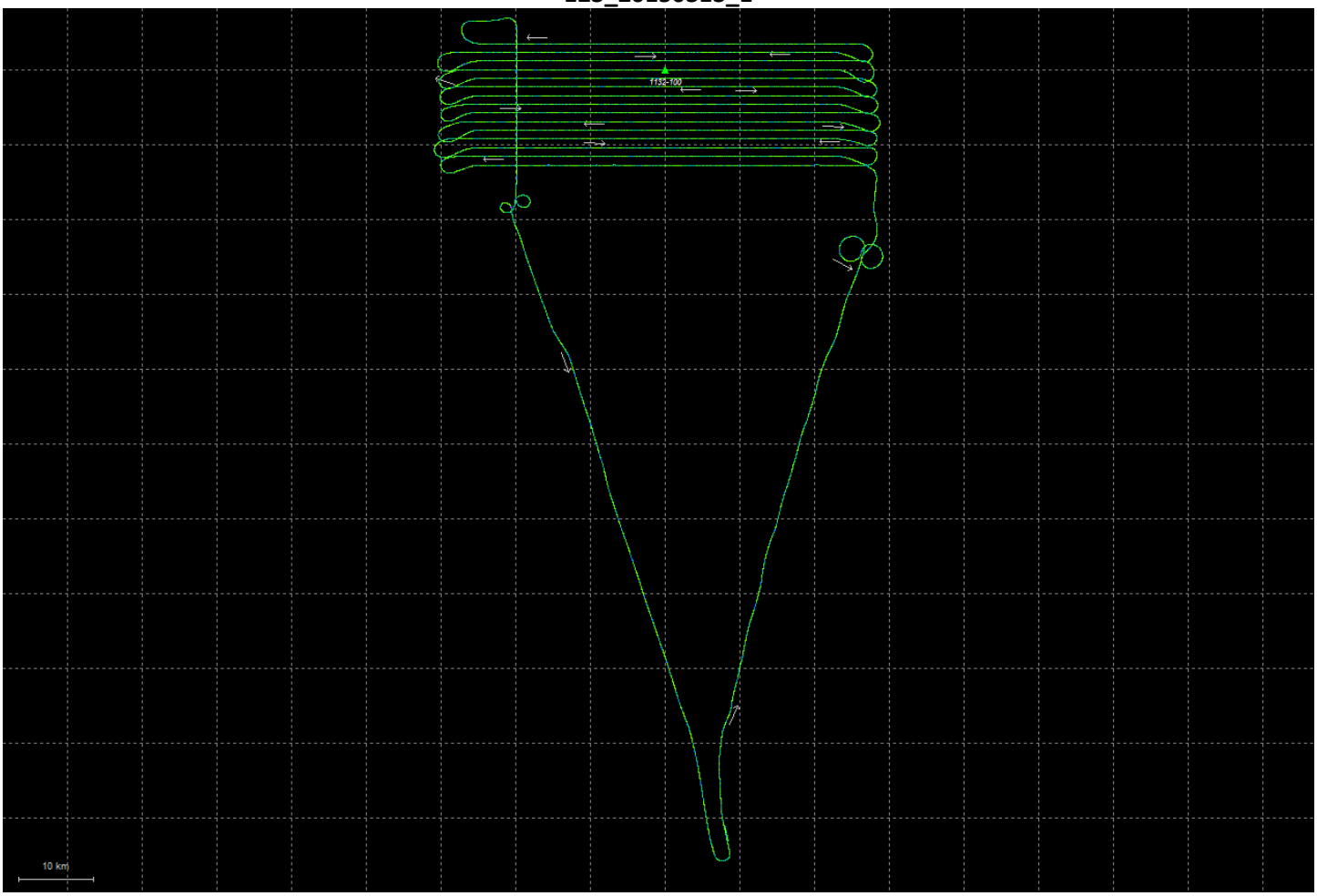

0.017
0.016
0.015
0.014
0.013
0.012
0.011
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
Estimated StdDev (m)
428000
Week 1835
430000
432000
434000
436000
438000
440000
GPS Time (TOW, GMT zone)
East
North
Height
Trace

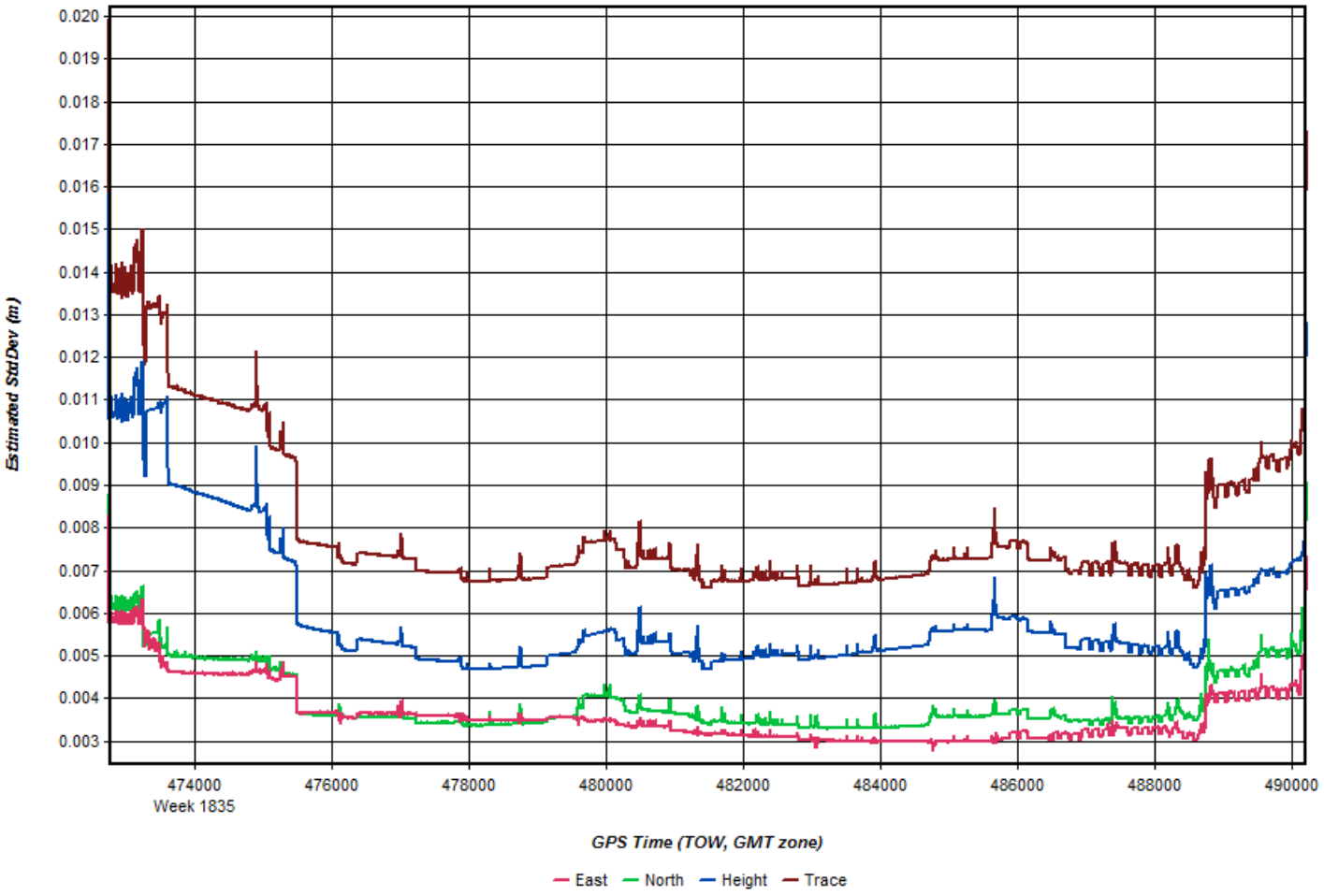

Num Sats
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
428000
Week 1835
430000
432000
434000
436000
438000
440000
GPS Time (TOW, GMT zone)
Num Sats
GPS
GLONASS
BeiDou

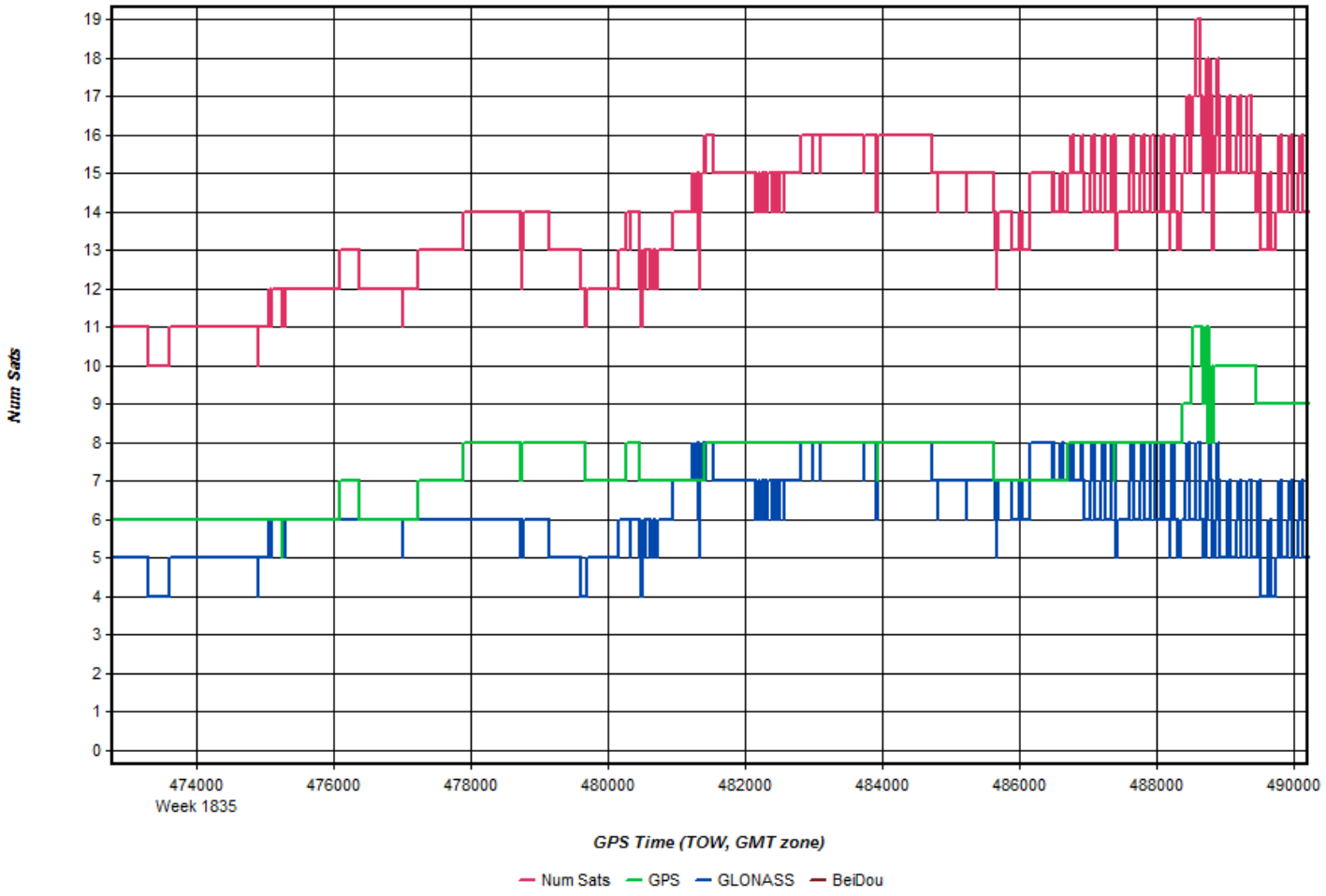

Separation (m)
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.12
-0.14
-0.16
-0.18
428000
Week 1835
430000
432000
434000
436000
438000
440000
GPS Time (TOW, GMT zone)
East
North
Up

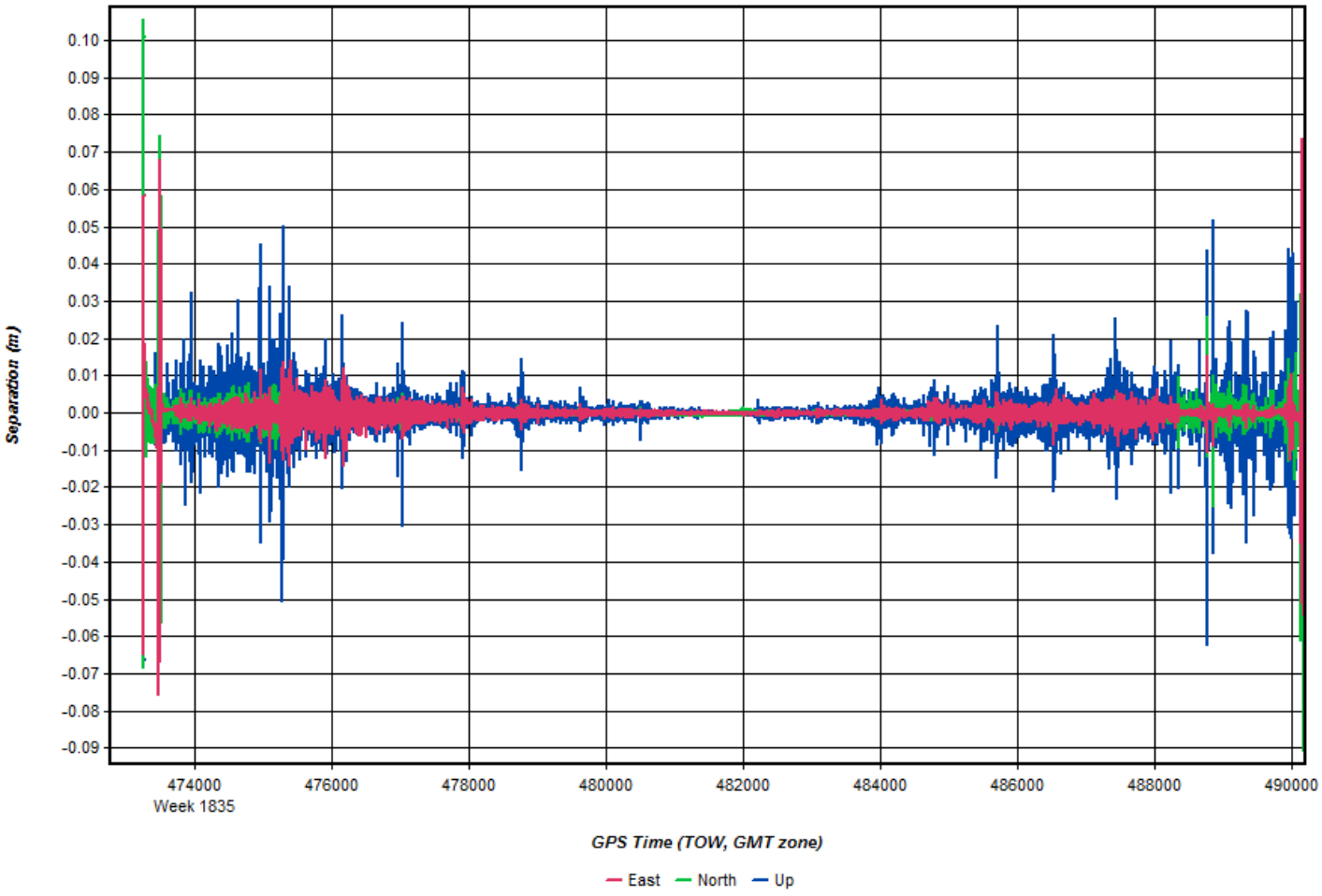

PDOP
2.00
1.95
1.90
1.85
1.80
1.75
1.70
1.65
1.60
1.55
1.50
1.45
1.40
1.35
1.30
1.25
1.20
1.15
1.10
1.05
1.00
0.95
0.90
0.85
428000
Week 1835
430000
432000
434000
436000
438000
440000
GPS Time (TOW, GMT zone)
PDOP

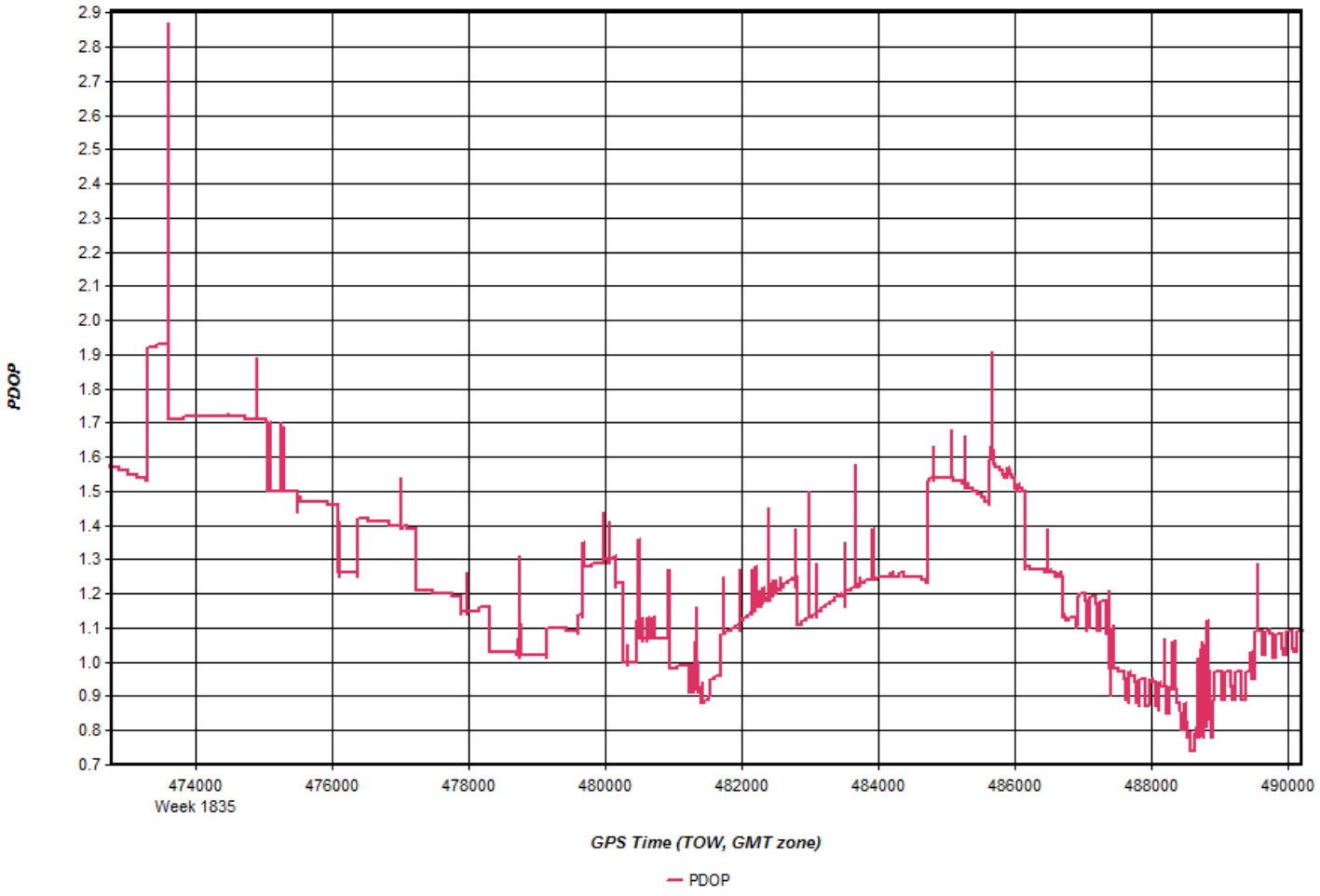
123_20150313_1



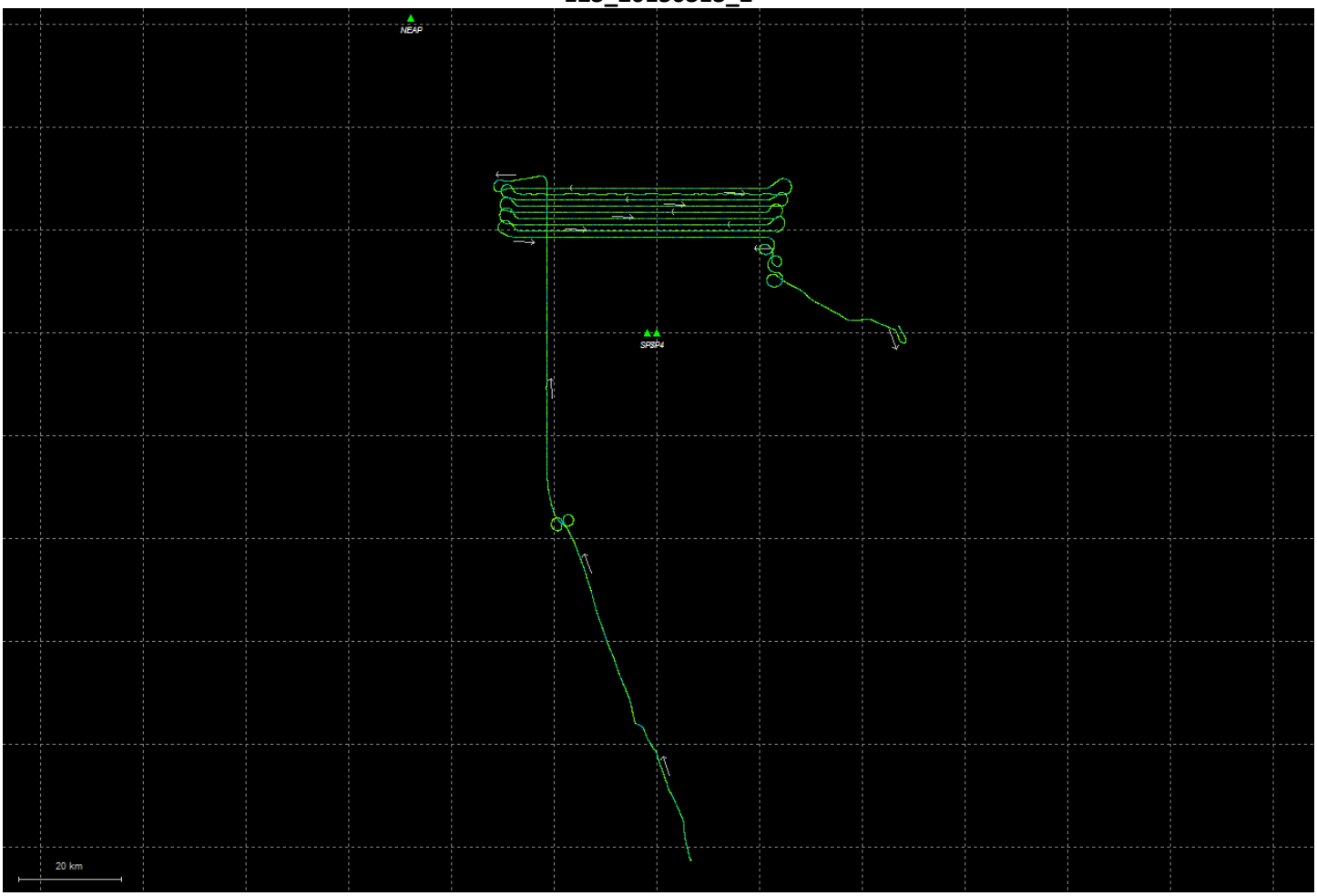

Estimated StdDev (m)
0.020
0.019
0.018
0.017
0.016
0.015
0.014
0.013
0.012
0.011
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
474000
Week 1835
476000
478000
480000
482000
484000
486000
488000
490000
GPS Time (TOW, GMT zone)
East
North
Height
Trace

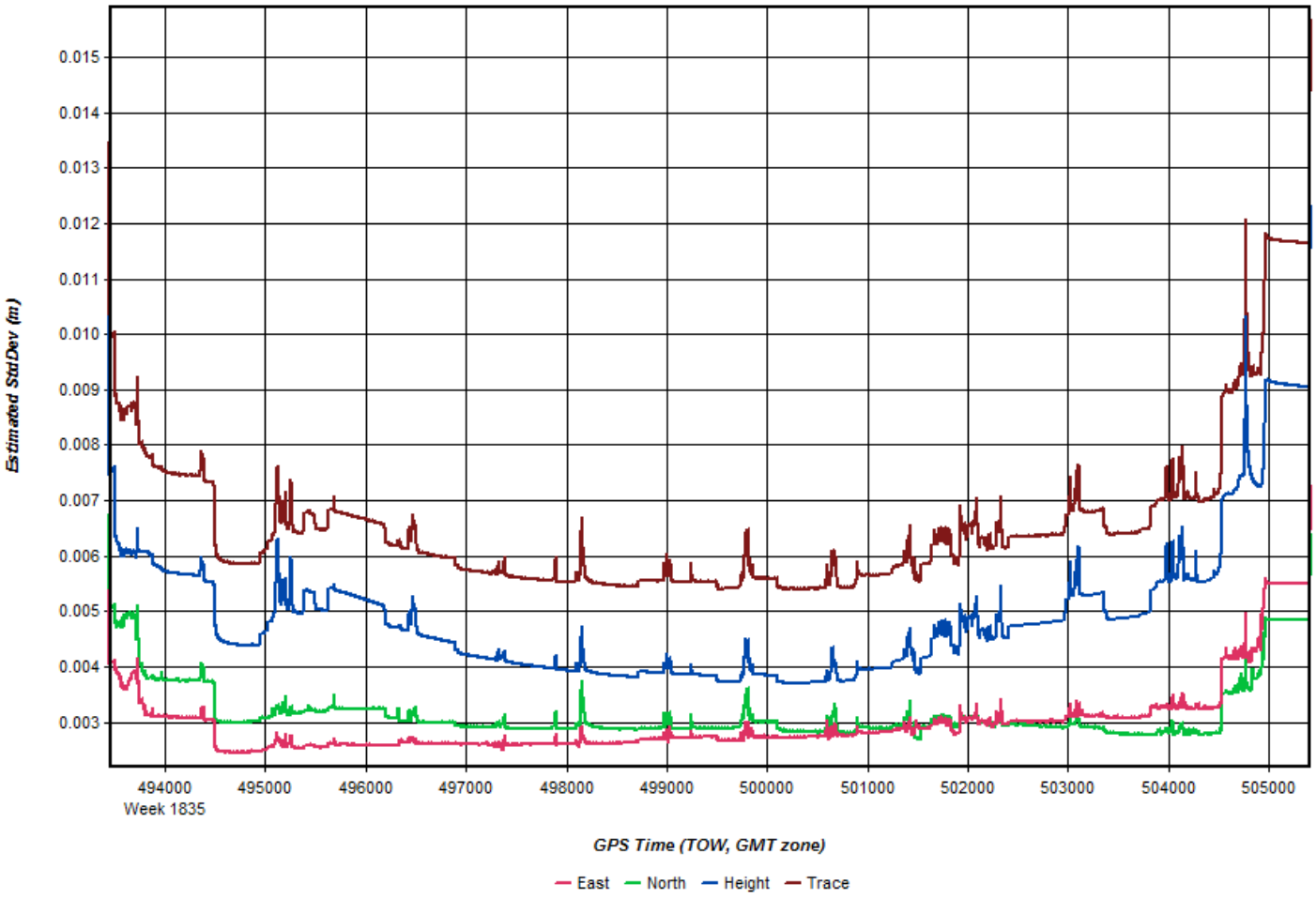

Num Sats
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
474000
Week 1835
476000
478000
480000
482000
484000
486000
488000
490000
GPS Time (TOW, GMT zone)
Num Sats
GPS
GLONASS
BeiDou

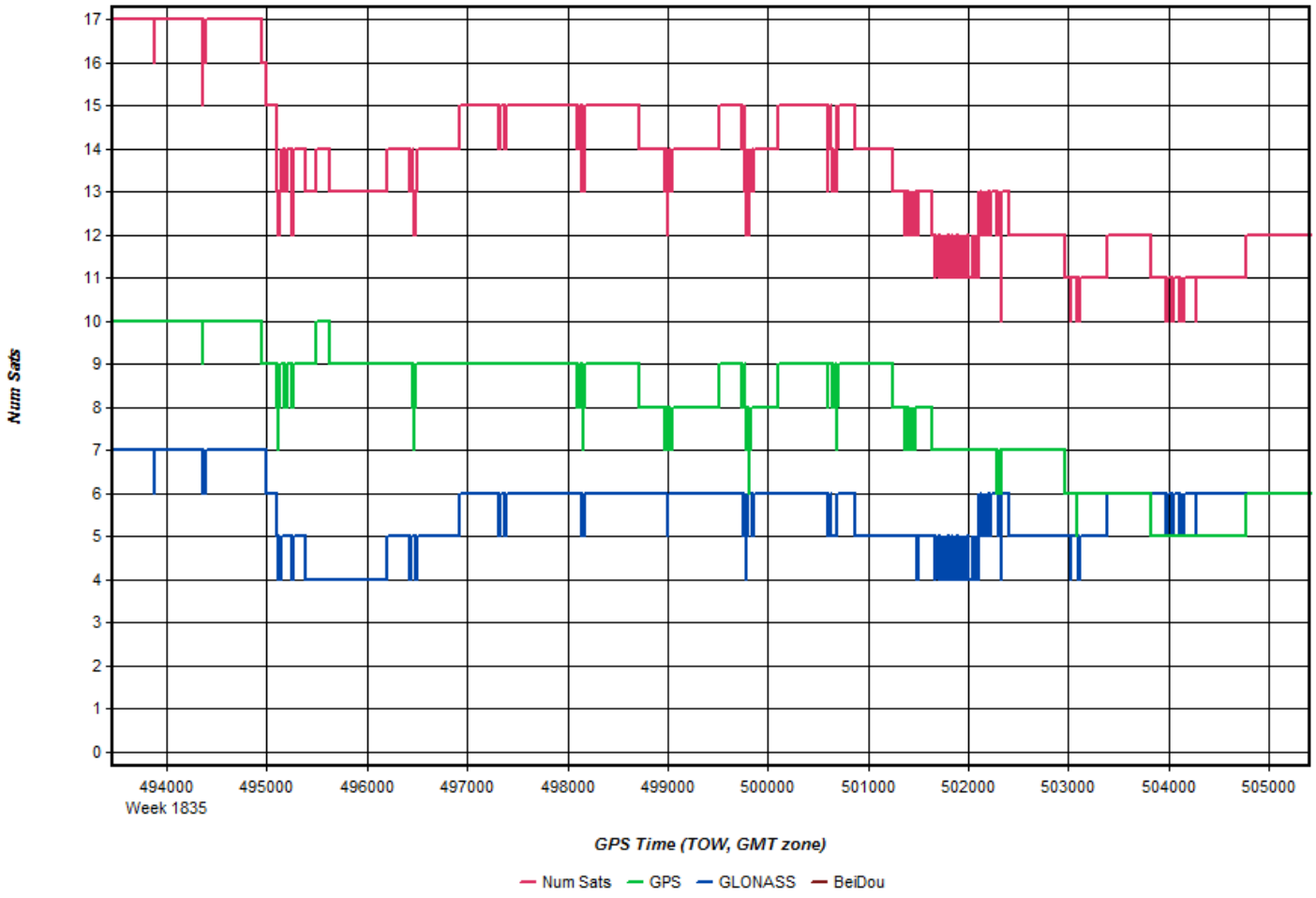

Separation (m)
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
-0.07
-0.08
-0.09
474000
Week 1835
476000
478000
480000
482000
484000
486000
488000
490000
GPS Time (TOW, GMT zone)
East
North
Up

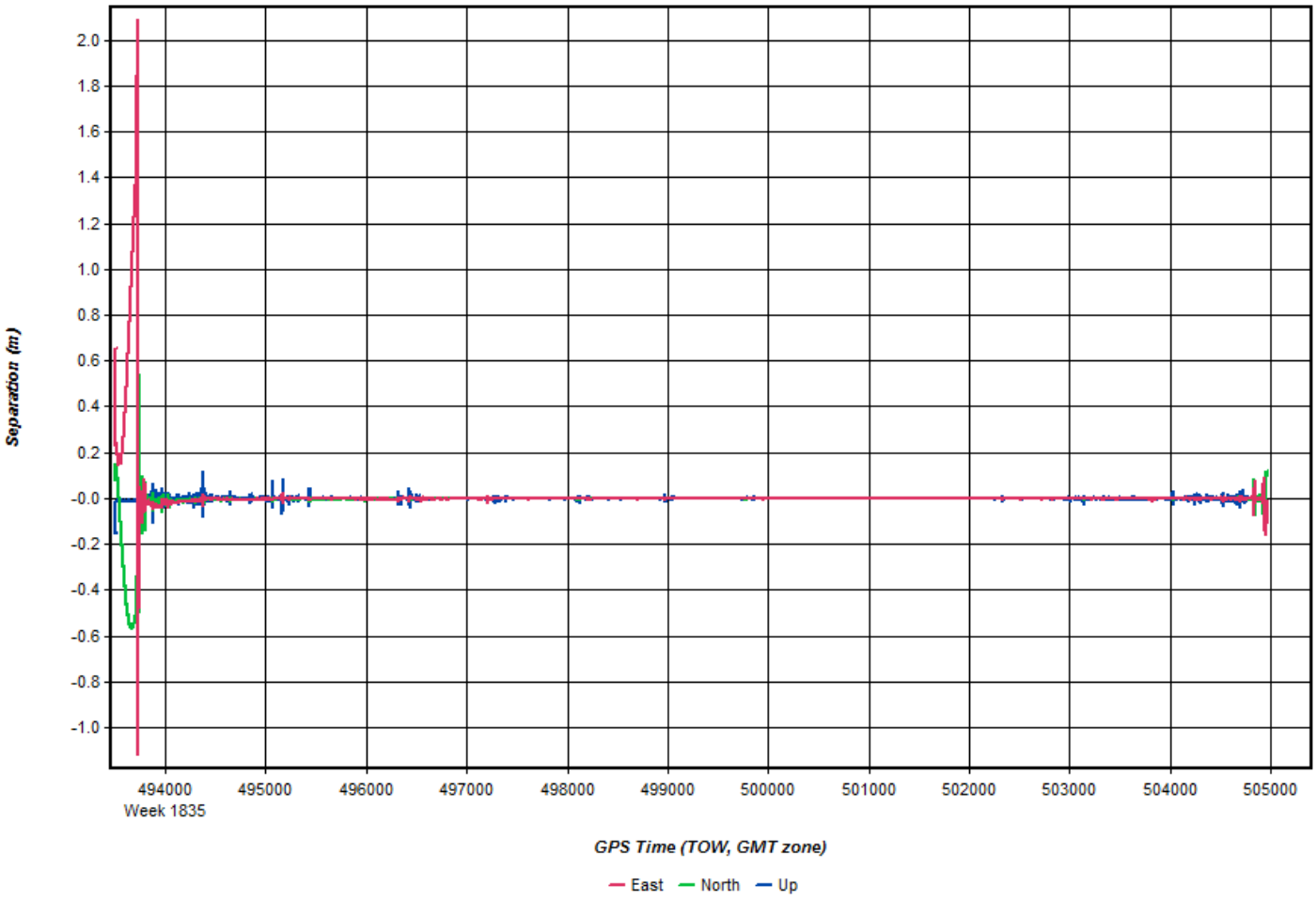

PDOP
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
474000
Week 1835
476000
478000
480000
482000
484000
486000
488000
490000
GPS Time (TOW, GMT zone)
PDOP

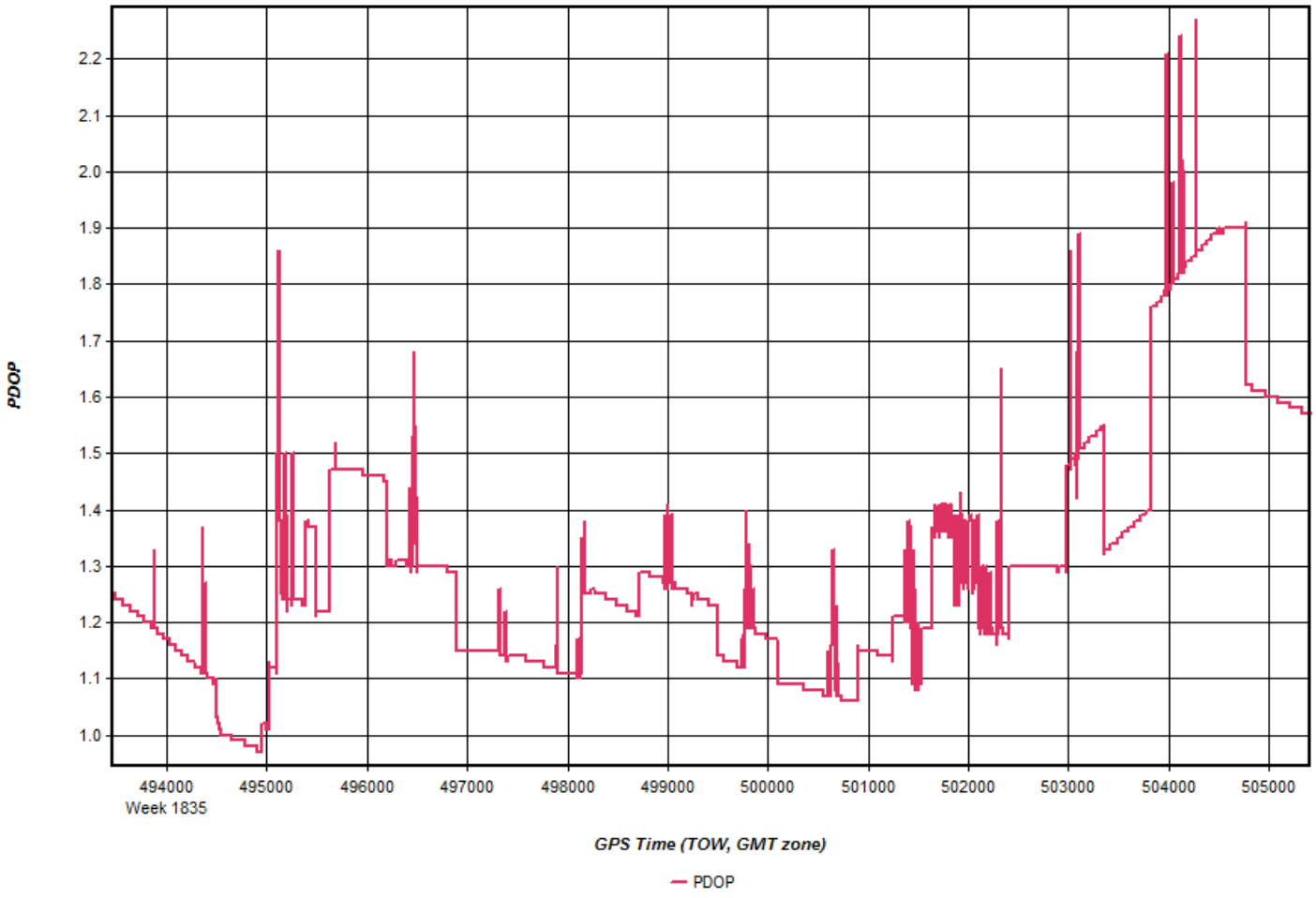
123_20150313_2



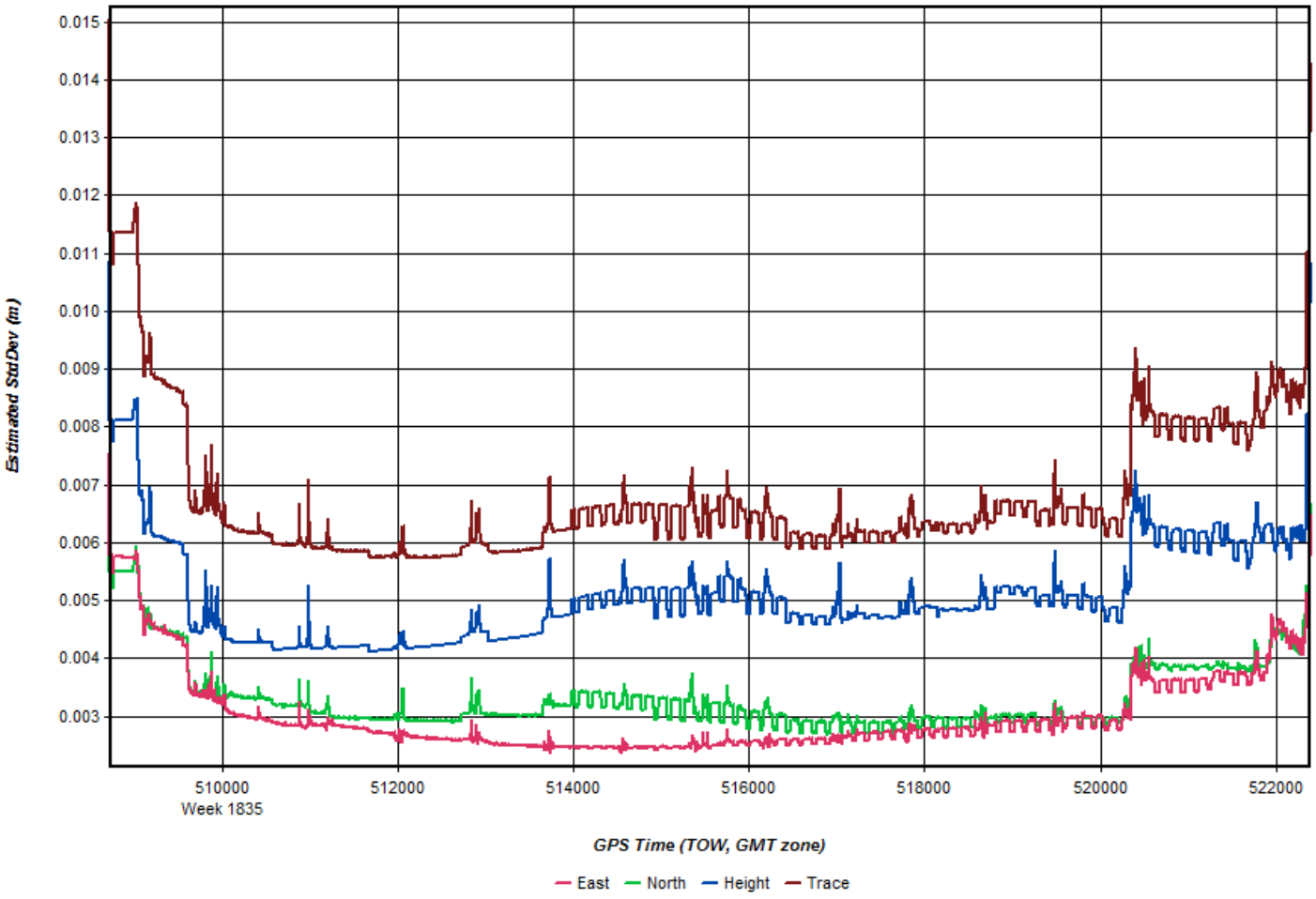

Estimated StdDev (m)
0.015
0.014
0.013
0.012
0.011
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
494000
Week 1835
495000
496000
497000
498000
499000
500000
501000
502000
503000
504000
505000
GPS Time (TOW, GMT zone)
East
North
Height
Trace

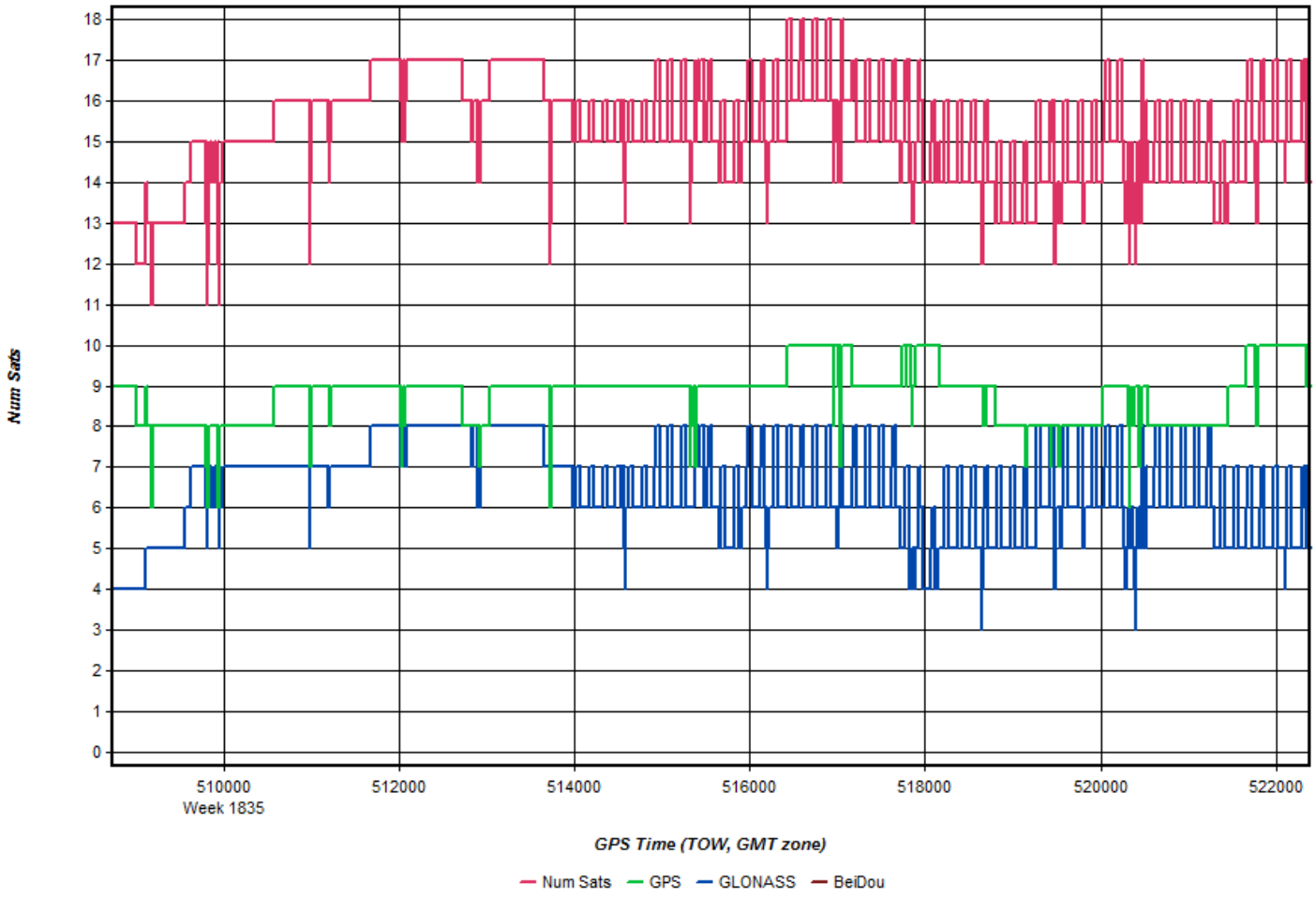

Num Sats
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
494000
Week 1835
495000
496000
497000
498000
499000
500000
501000
502000
503000
504000
505000
GPS Time (TOW, GMT zone)
Num Sats
GPS
GLONASS
BeiDou

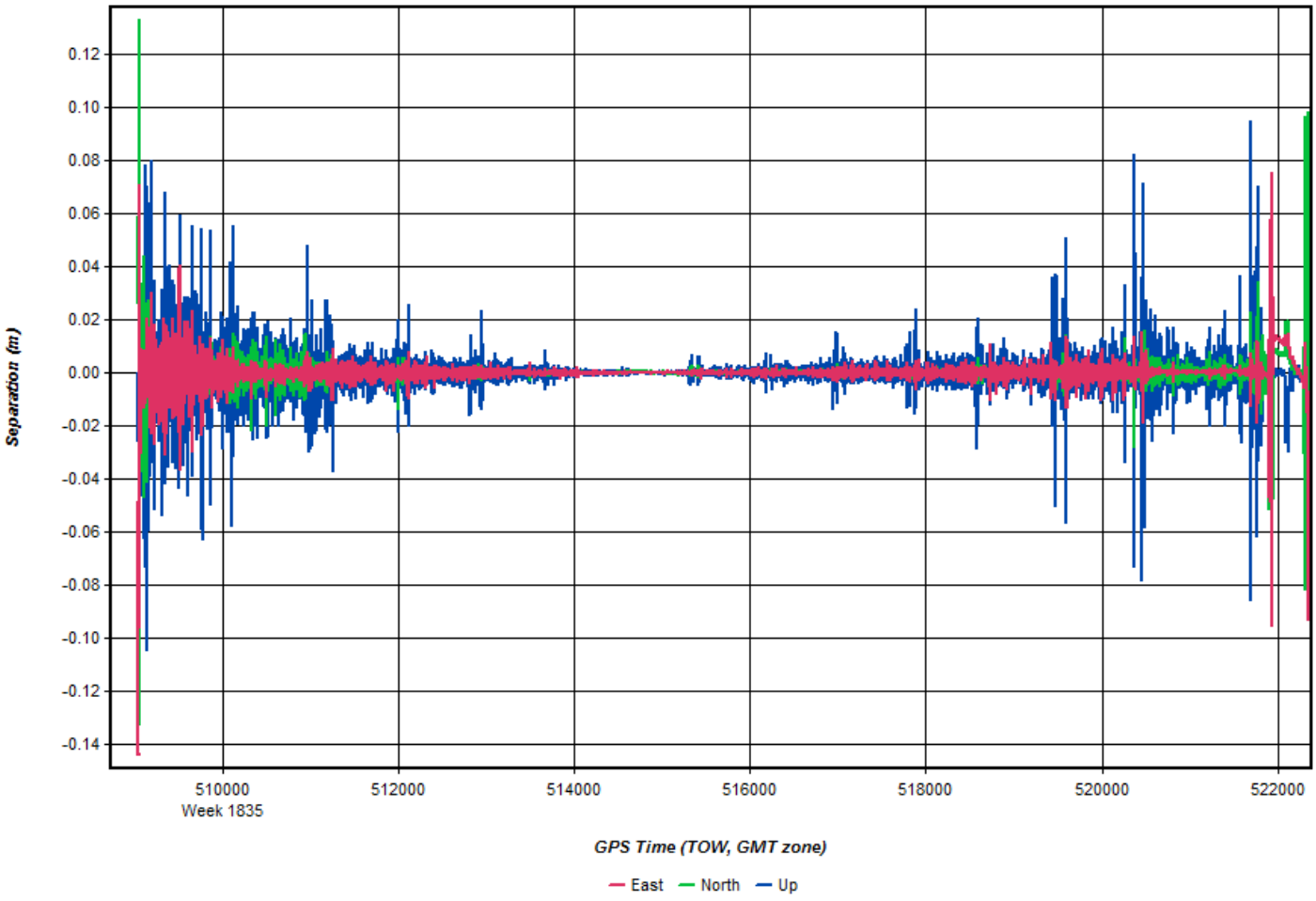

Separation (m)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
-0.0
-0.2
-0.4
-0.6
-0.8
-1.0
494000
Week 1835
495000
496000
497000
498000
499000
500000
501000
502000
503000
504000
505000
GPS Time (TOW, GMT zone)
East
North
Up

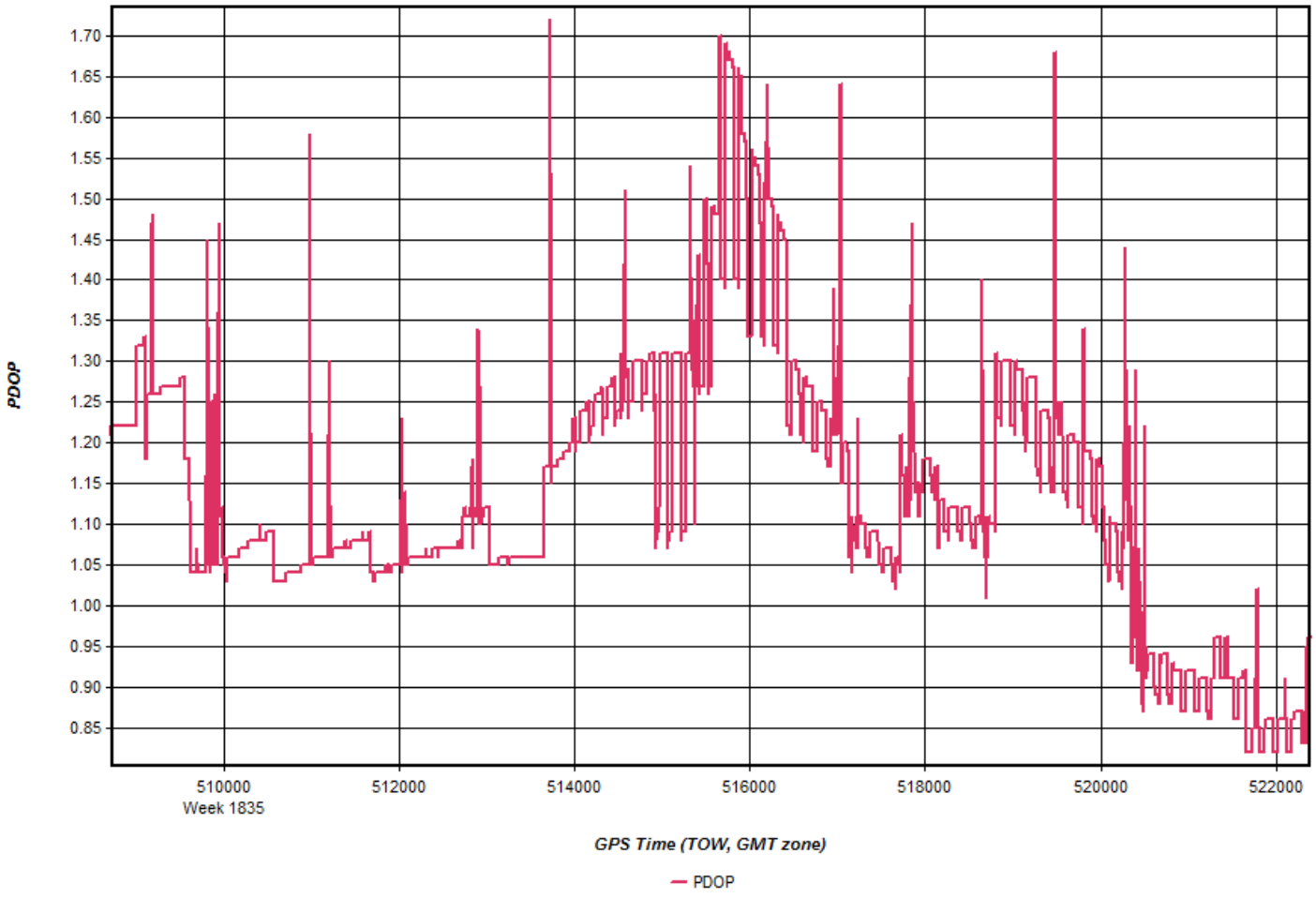

PDOP
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
494000
Week 1835
495000
496000
497000
498000
499000
500000
501000
502000
503000
504000
505000
GPS Time (TOW, GMT zone)
PDOP

123_20150313_3

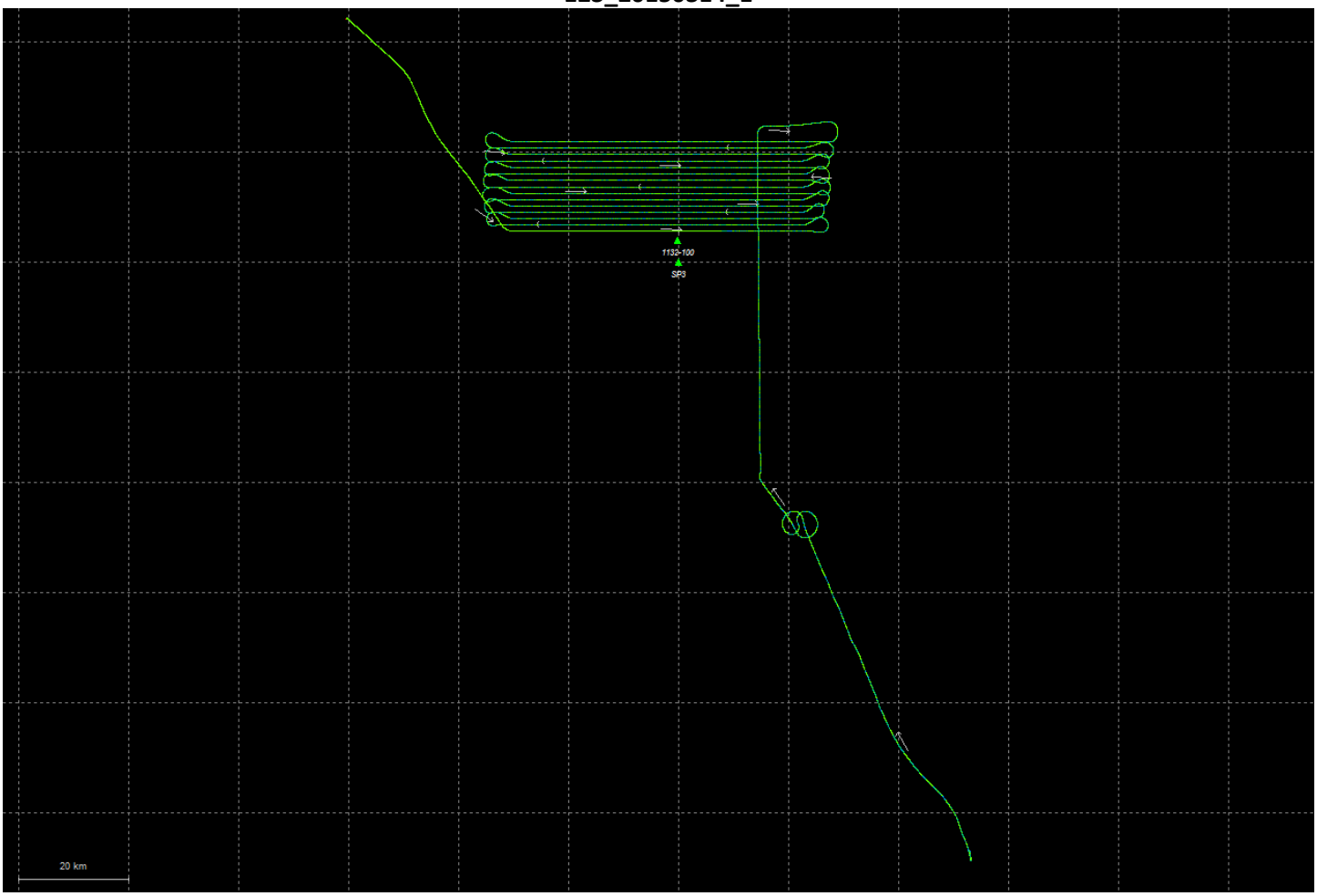

Estimated StdDev (m)
0.015
0.014
0.013
0.012
0.011
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
510000
Week 1835
512000
514000
516000
518000
520000
522000
GPS Time (TOW, GMT zone)
East
North
Height
Trace

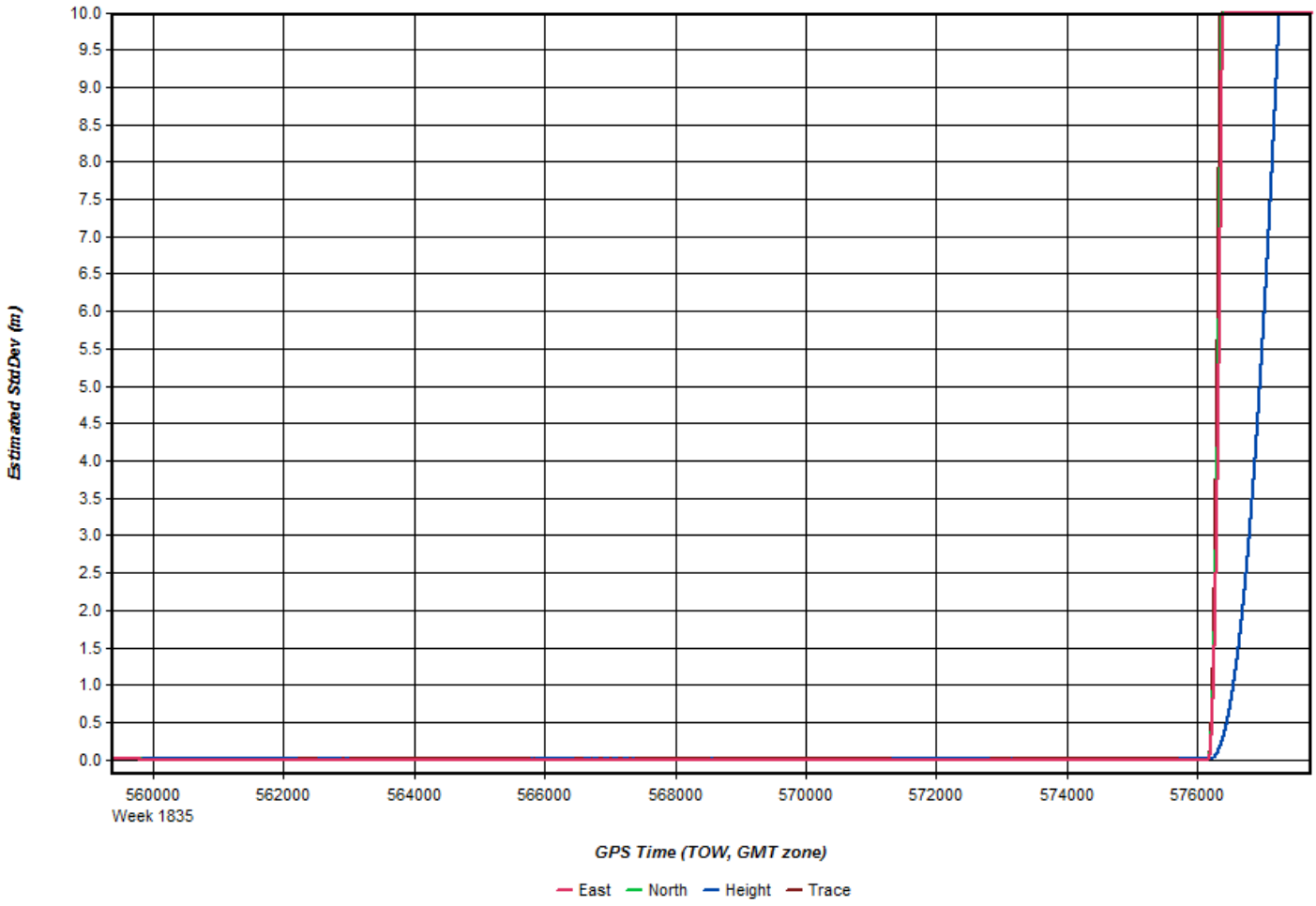

Num Sats
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
510000
Week 1835
512000
514000
516000
518000
520000
522000
GPS Time (TOW, GMT zone)
Num Sats
GPS
GLONASS
BeiDou

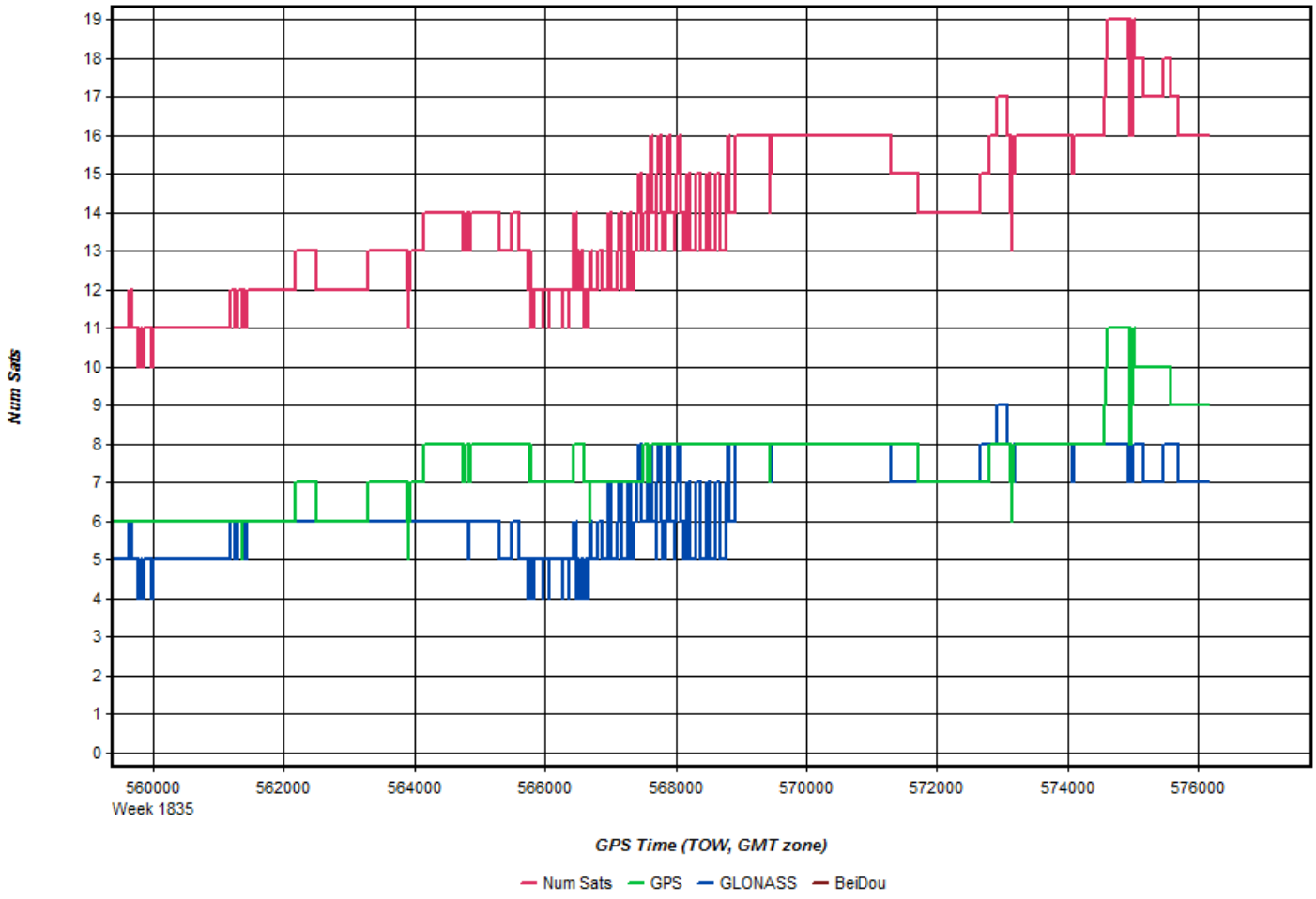

Separation (m)
0.12
0.10
0.08
0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.12
-0.14
510000
Week 1835
512000
514000
516000
518000
520000
522000
GPS Time (TOW, GMT zone)
East
North
Up

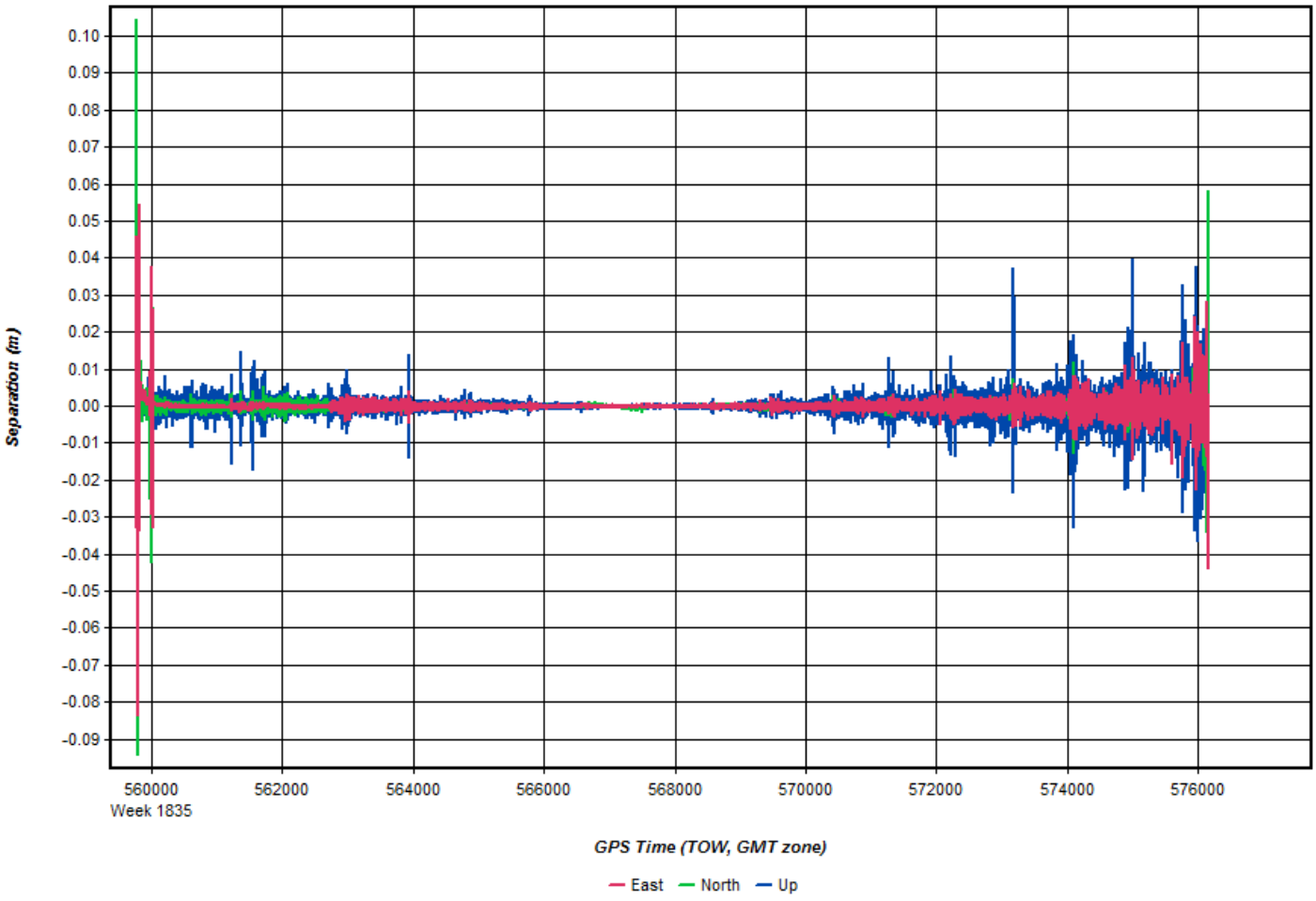

PDOP
1.70
1.65
1.60
1.55
1.50
1.45
1.40
1.35
1.30
1.25
1.20
1.15
1.10
1.05
1.00
0.95
0.90
0.85
510000
Week 1835
512000
514000
516000
518000
520000
522000
GPS Time (TOW, GMT zone)
PDOP

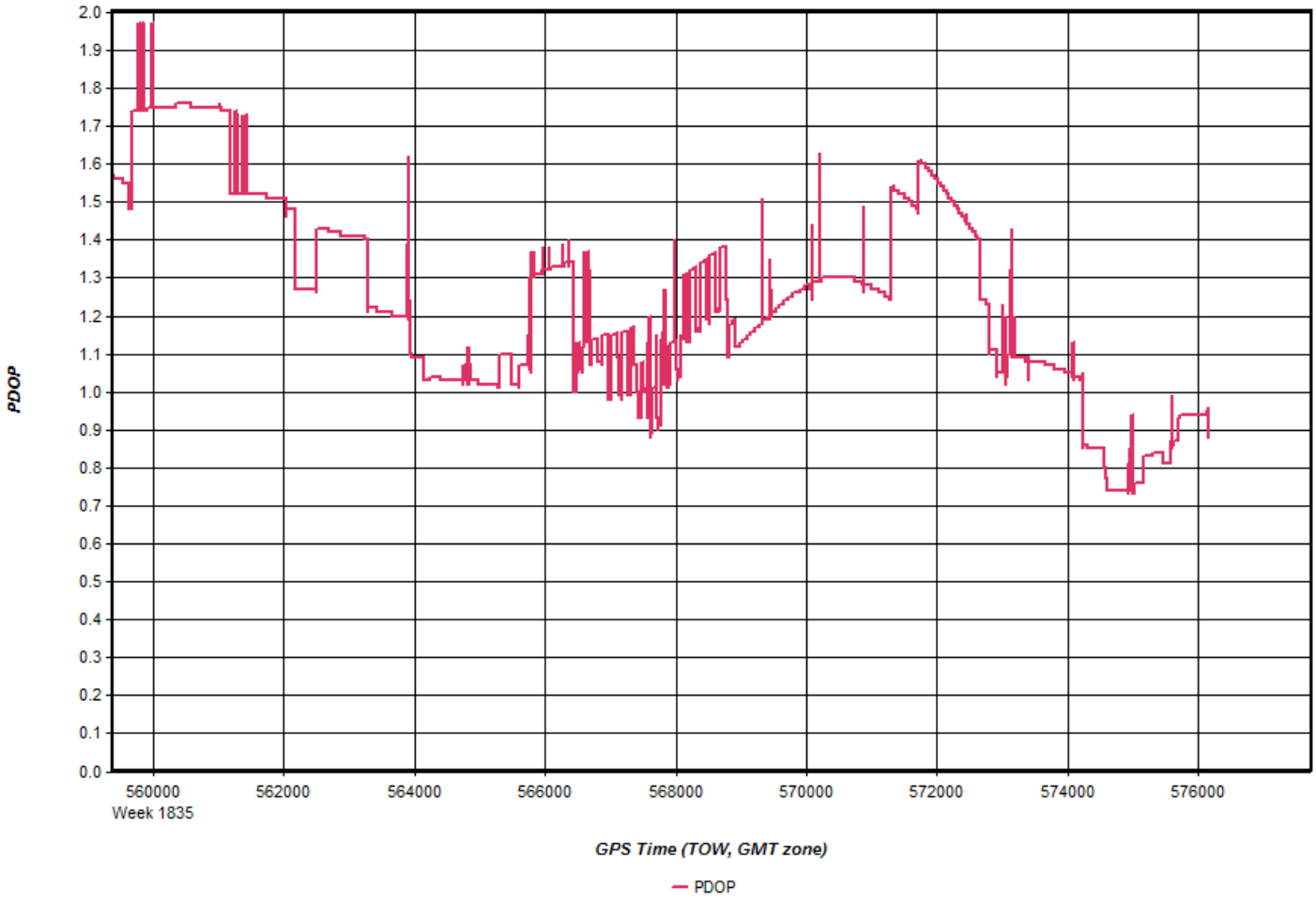
123_20150314_1



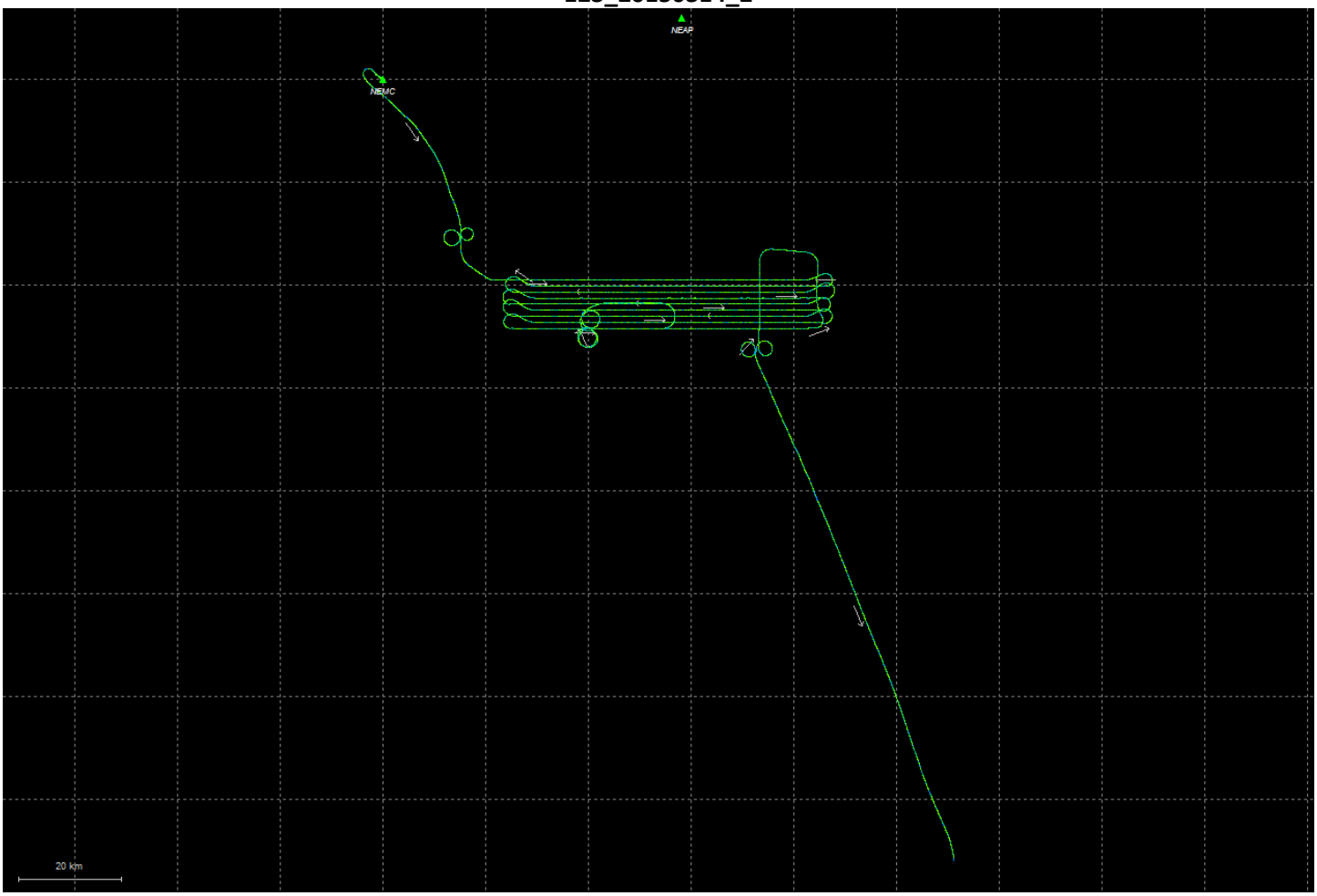

Estimated StdDev (m)
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
560000
Week 1835
562000
564000
566000
568000
570000
572000
574000
576000
GPS Time (TOW, GMT zone)
East
North
Height
Trace

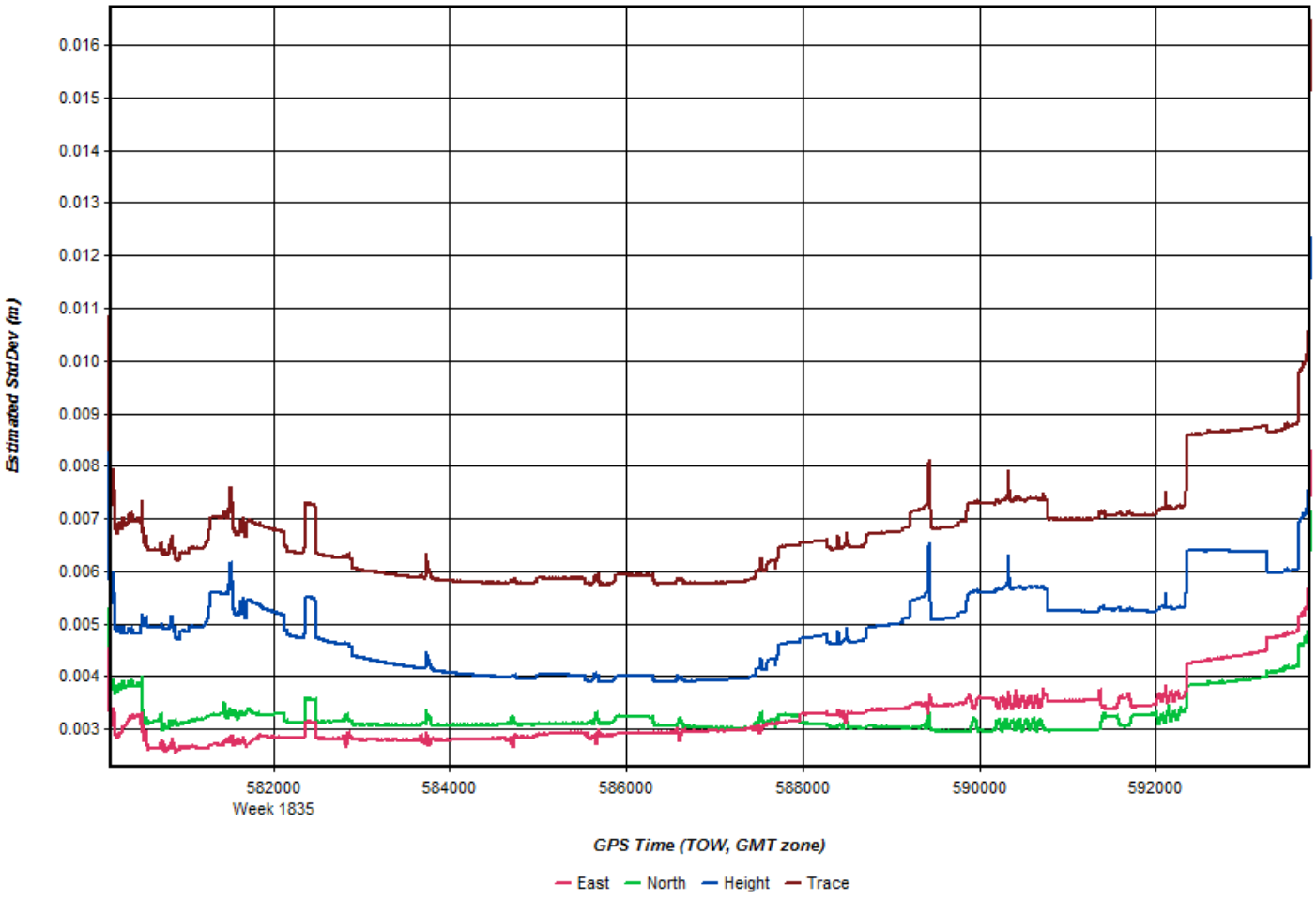

Num Sats
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
560000
Week 1835
562000
564000
566000
568000
570000
572000
574000
576000
GPS Time (TOW, GMT zone)
Num Sats
GPS
GLONASS
BeiDou

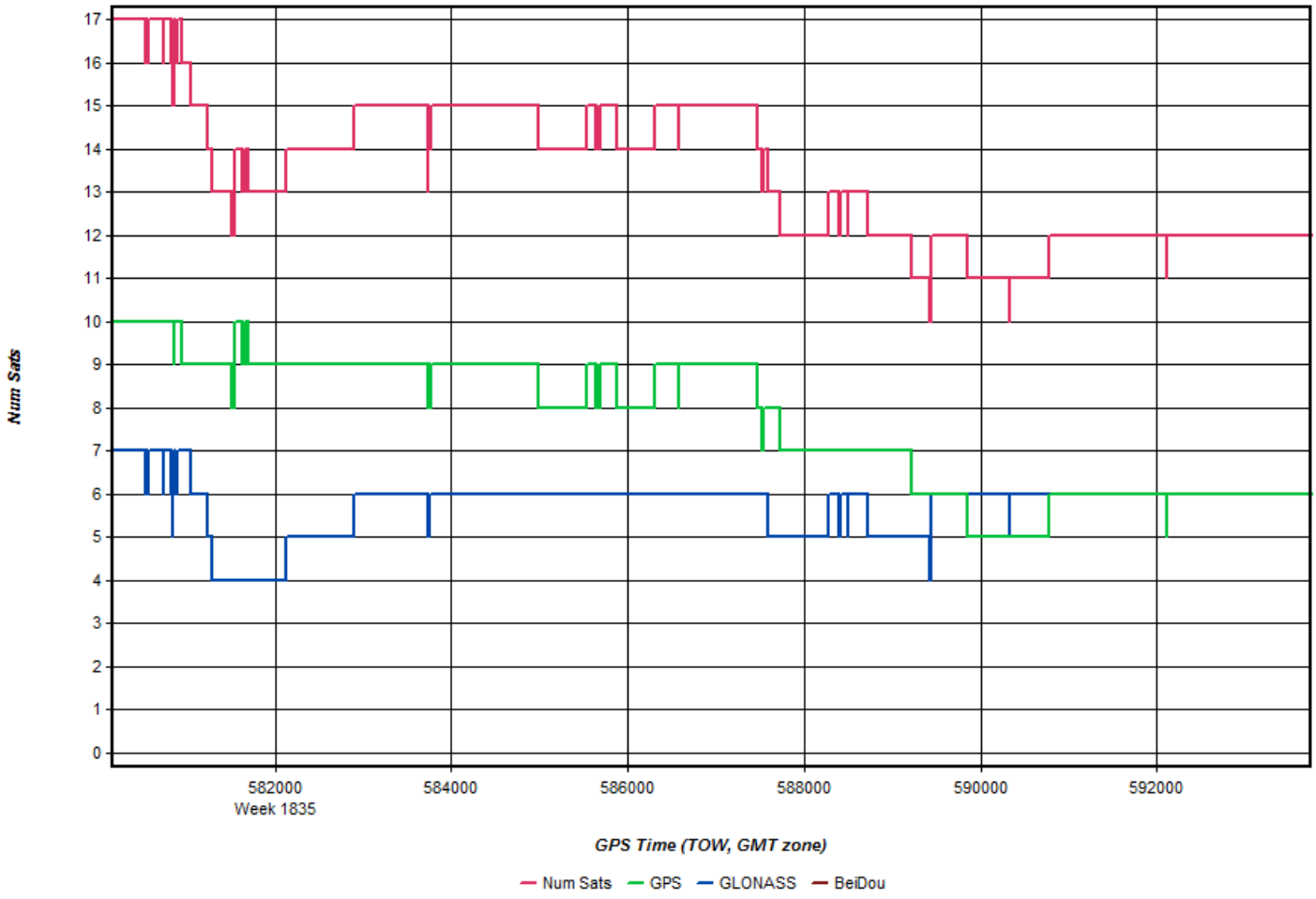

0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
-0.07
-0.08
-0.09
Separation (m)
560000
Week 1835
562000
564000
566000
568000
570000
572000
574000
576000
GPS Time (TOW, GMT zone)
East
North
Up

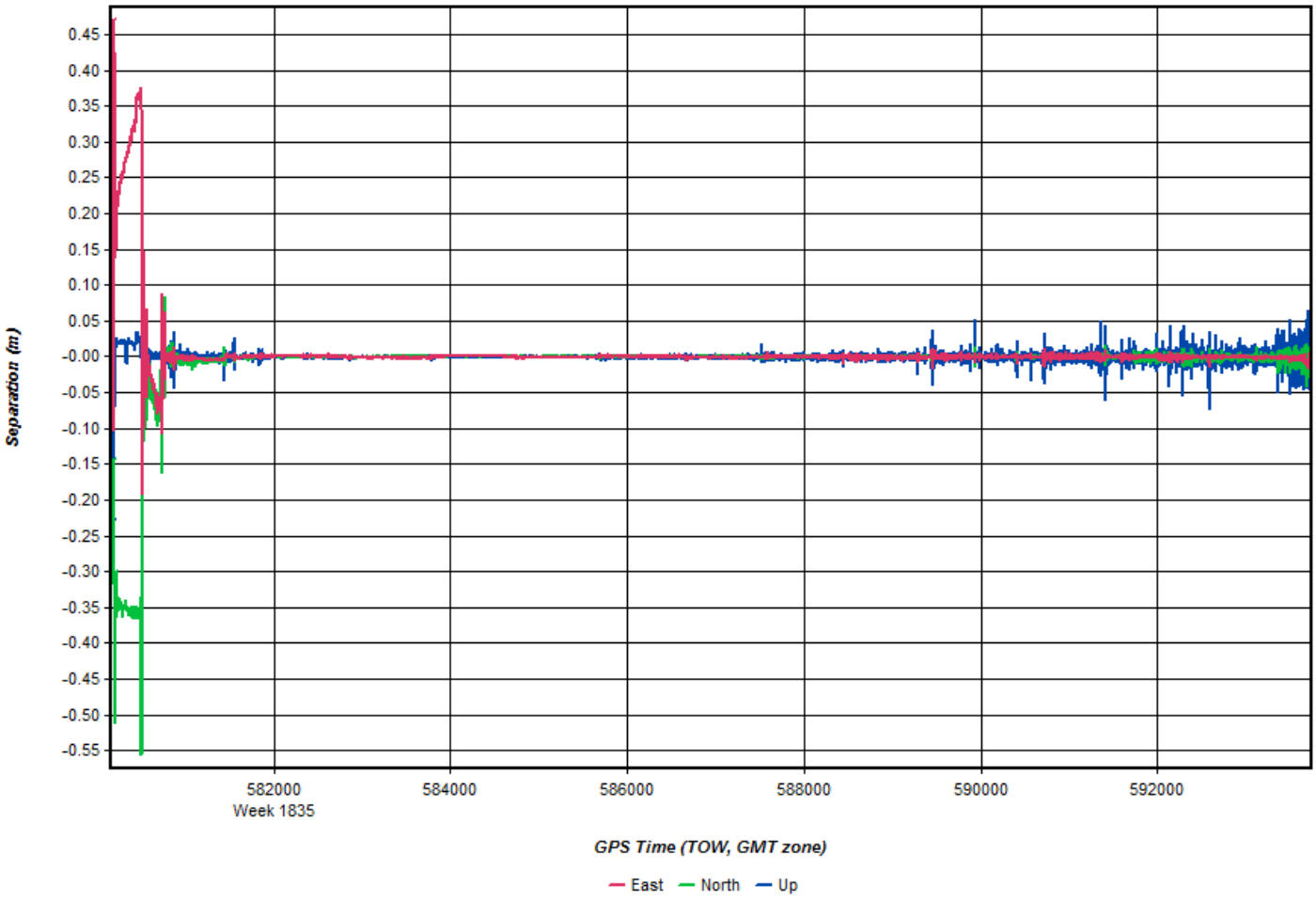

PDOP
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
560000
Week 1835
562000
564000
566000
568000
570000
572000
574000
576000
GPS Time (TOW, GMT zone)
PDOP

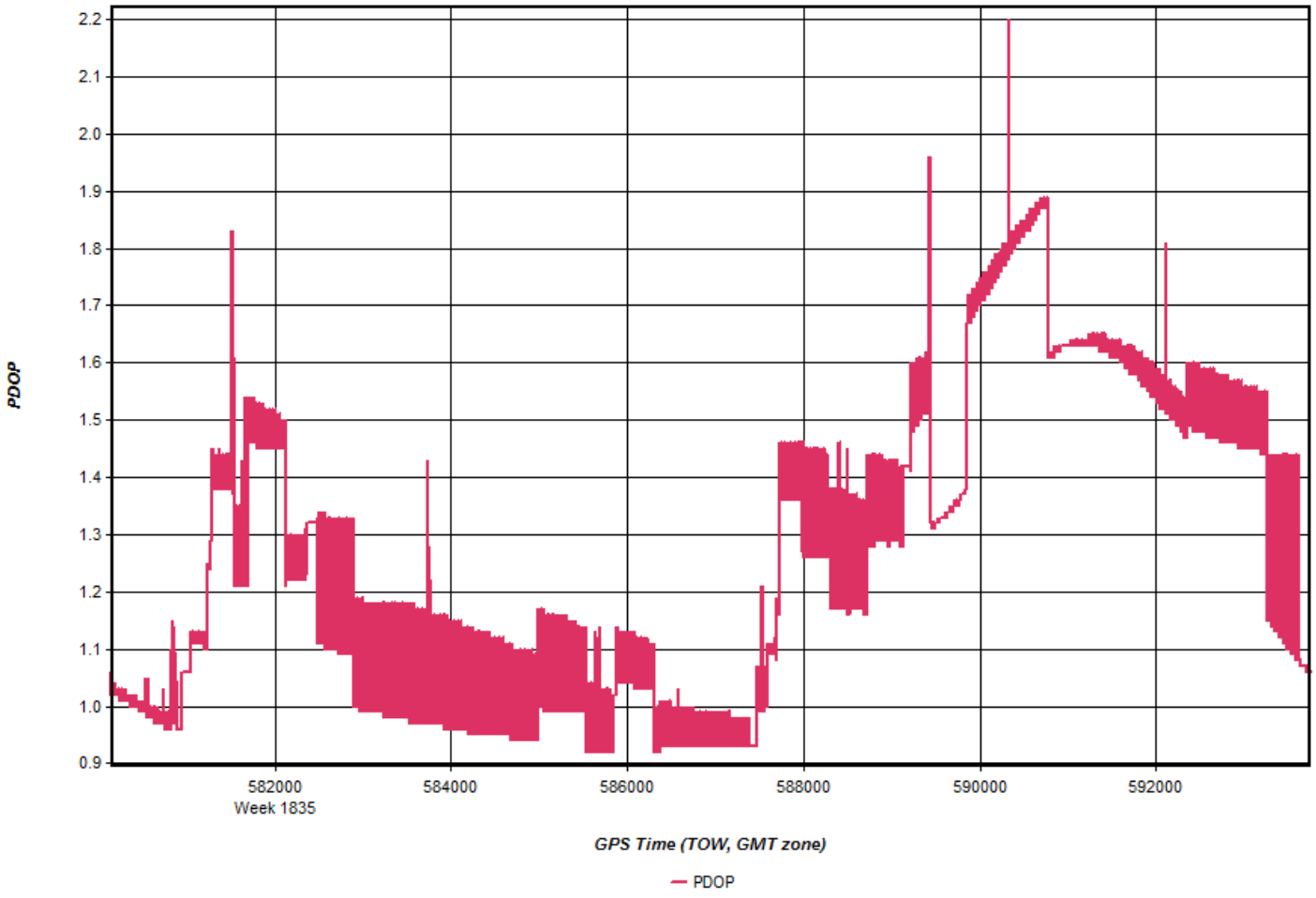
123_20150314_2



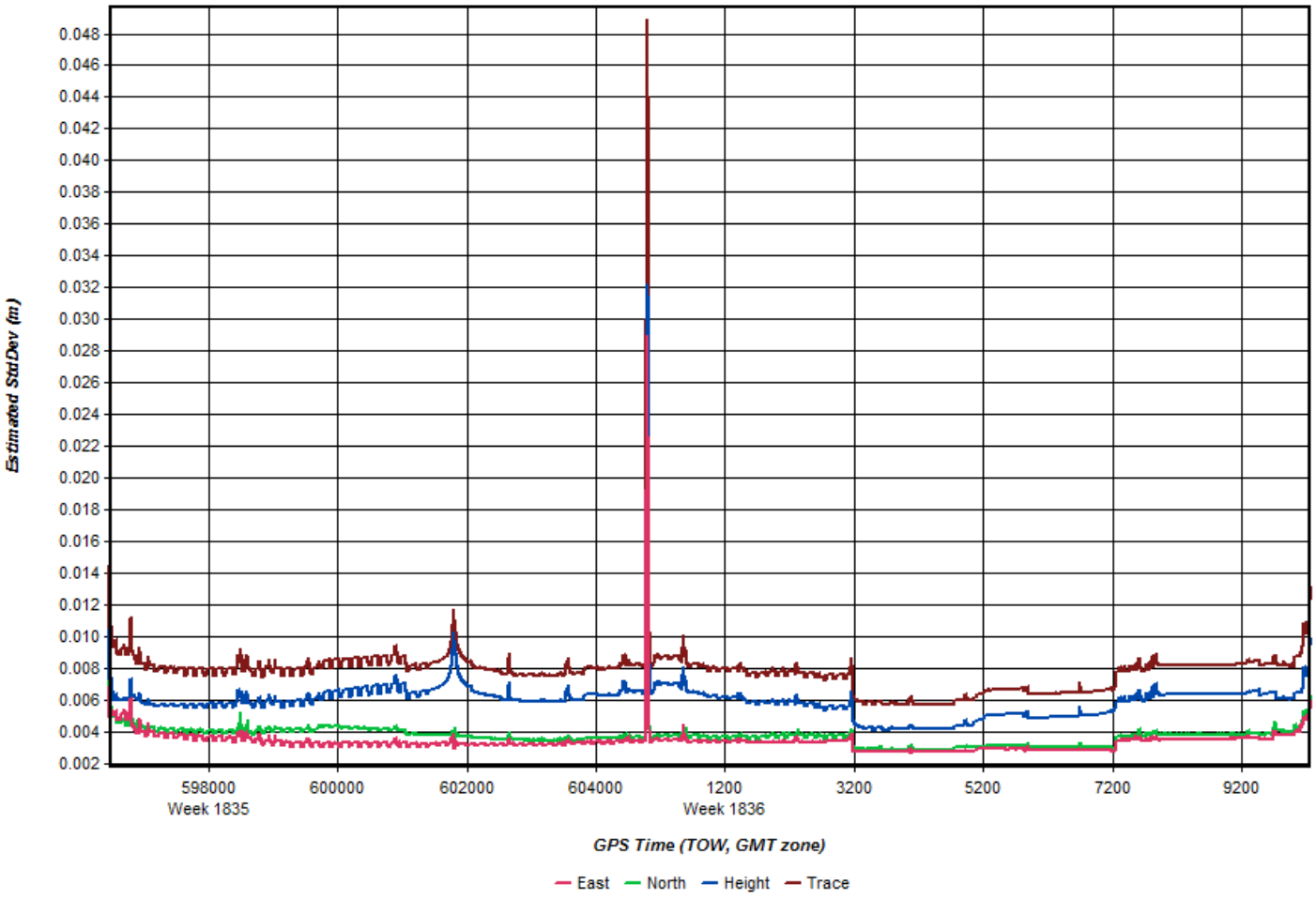

Estimated StdDev (m)
0.016
0.015
0.014
0.013
0.012
0.011
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
582000
Week 1835
584000
586000
588000
590000
592000
GPS Time (TOW, GMT zone)
East
North
Height
Trace

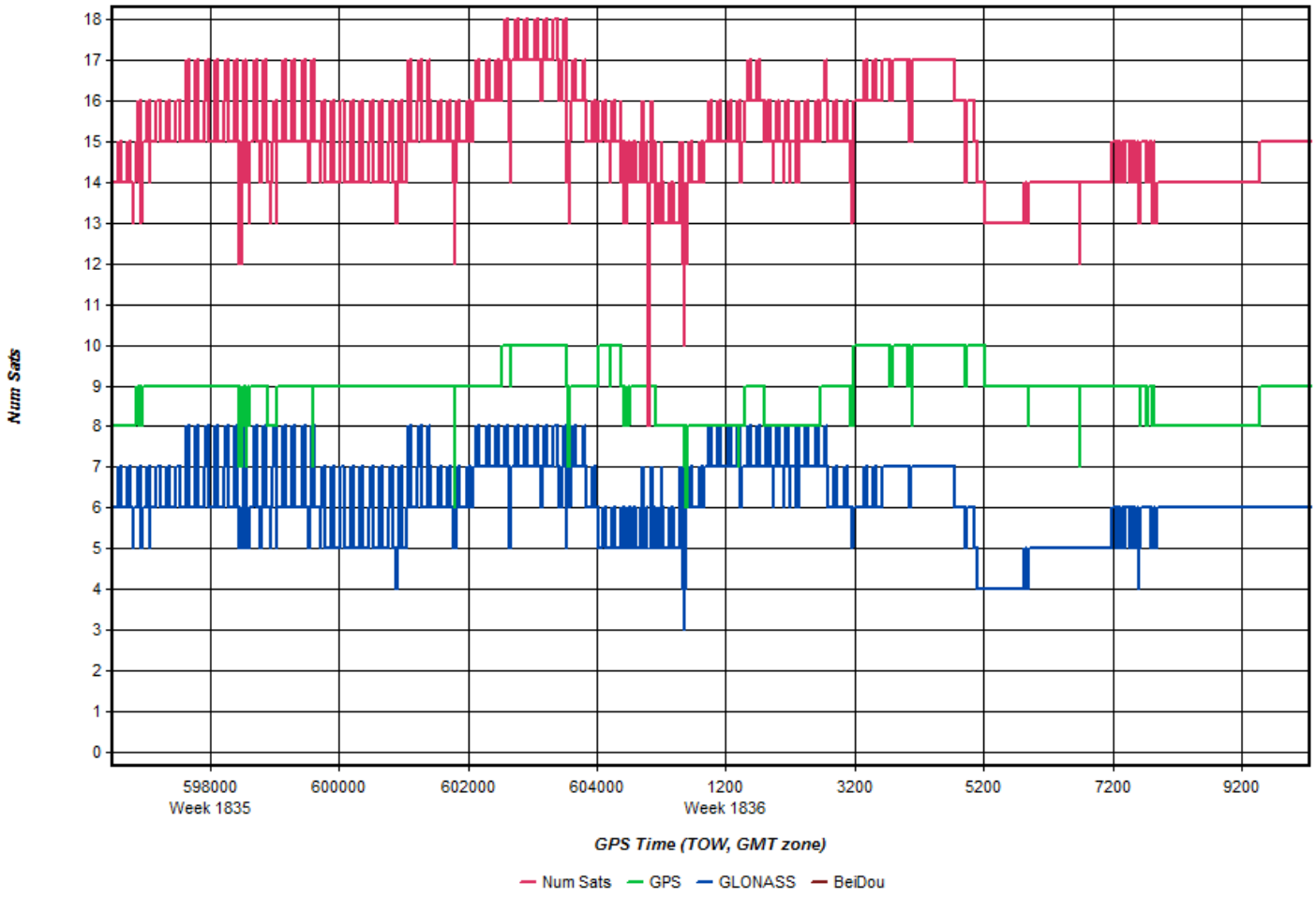

Num Sats
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
582000
Week 1835
584000
586000
588000
590000
592000
GPS Time (TOW, GMT zone)
Num Sats
GPS
GLONASS
BeiDou

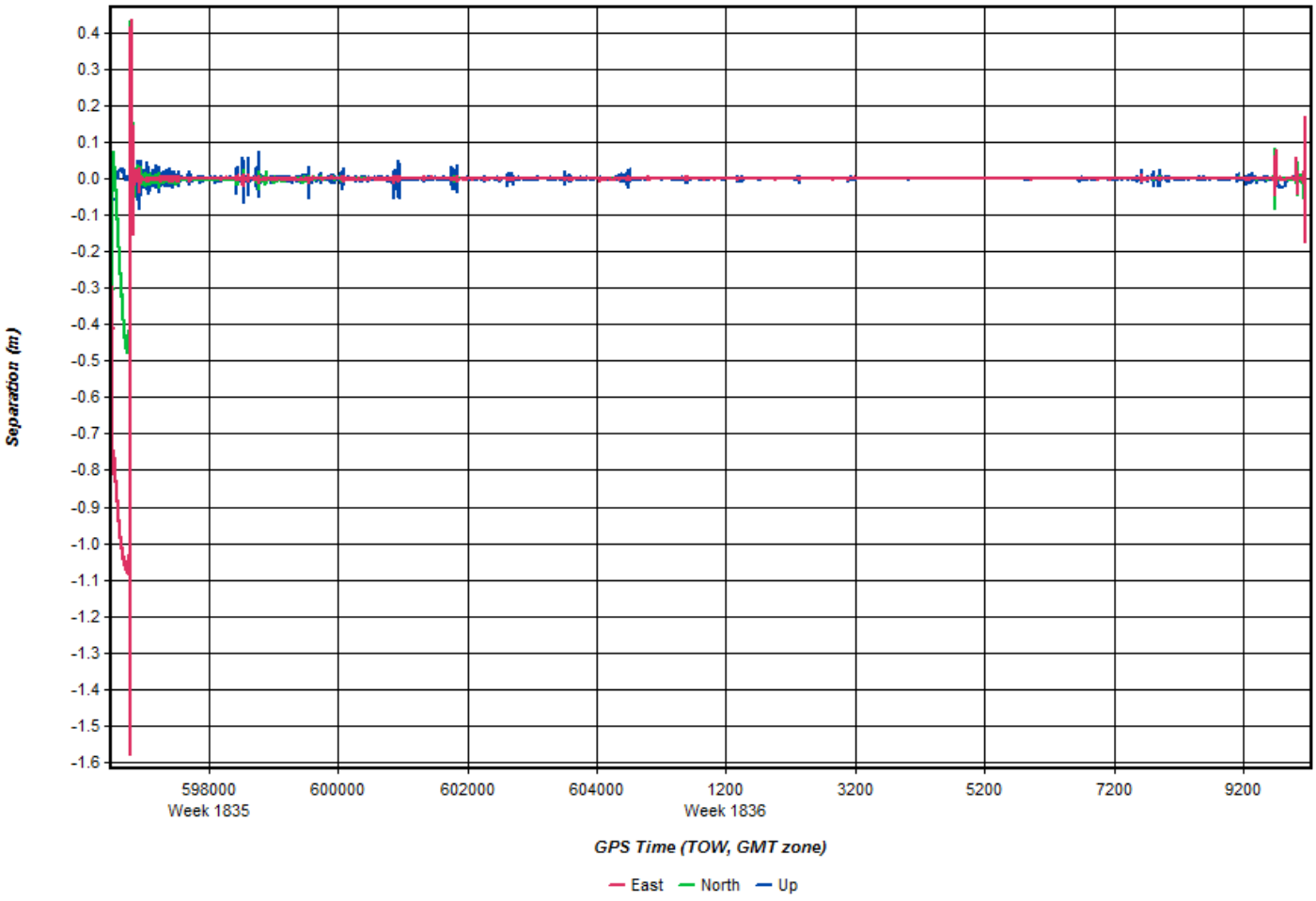

Separation (m)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
-0.00
-0.05
-0.10
-0.15
-0.20
-0.25
-0.30
-0.35
-0.40
-0.45
-0.50
-0.55
582000
Week 1835
584000
586000
588000
590000
592000
GPS Time (TOW, GMT zone)
East
North
Up

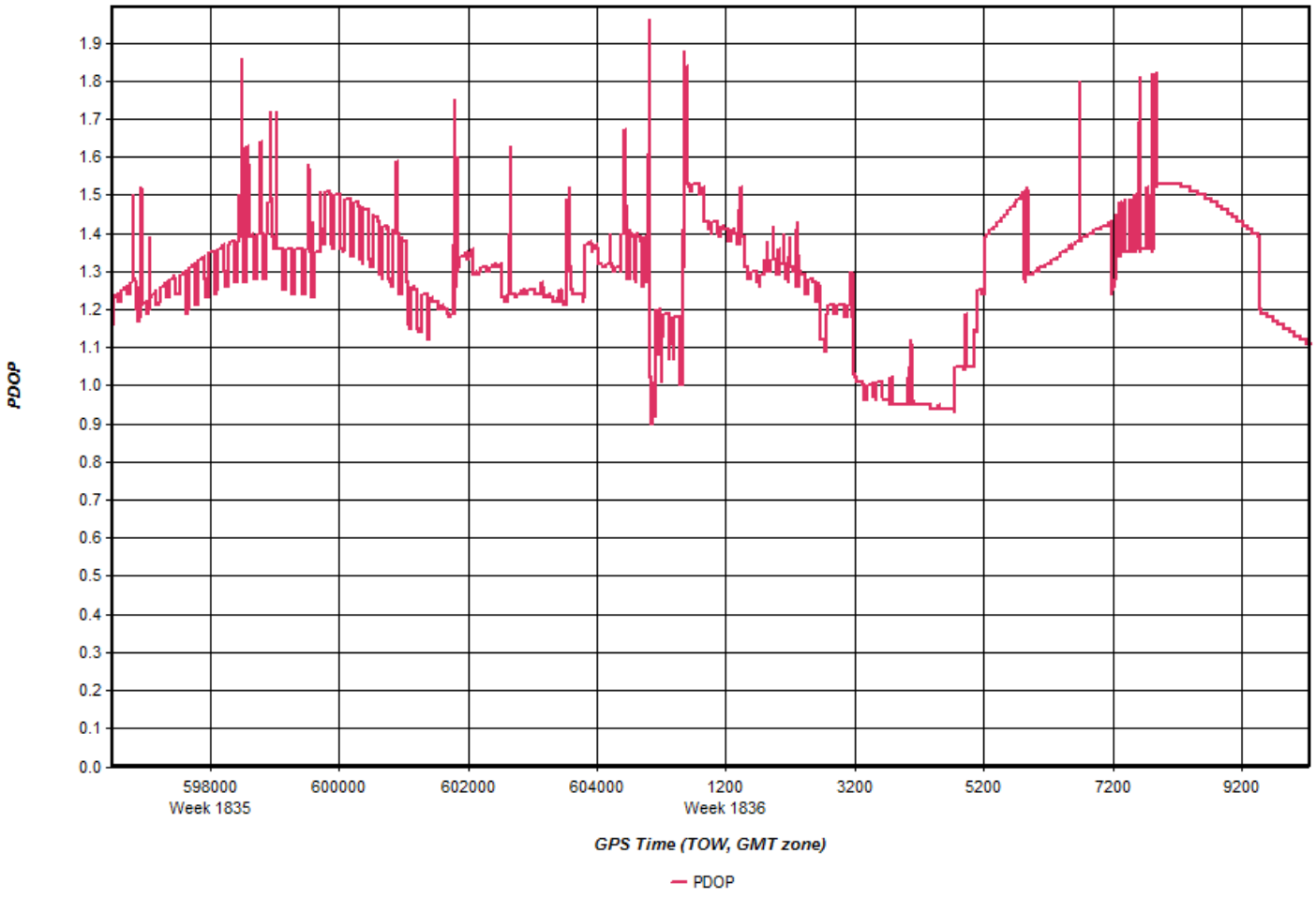

PDOP
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
582000
Week 1835
584000
586000
588000
590000
592000
GPS Time (TOW, GMT zone)
PDOP

123_20150314_3

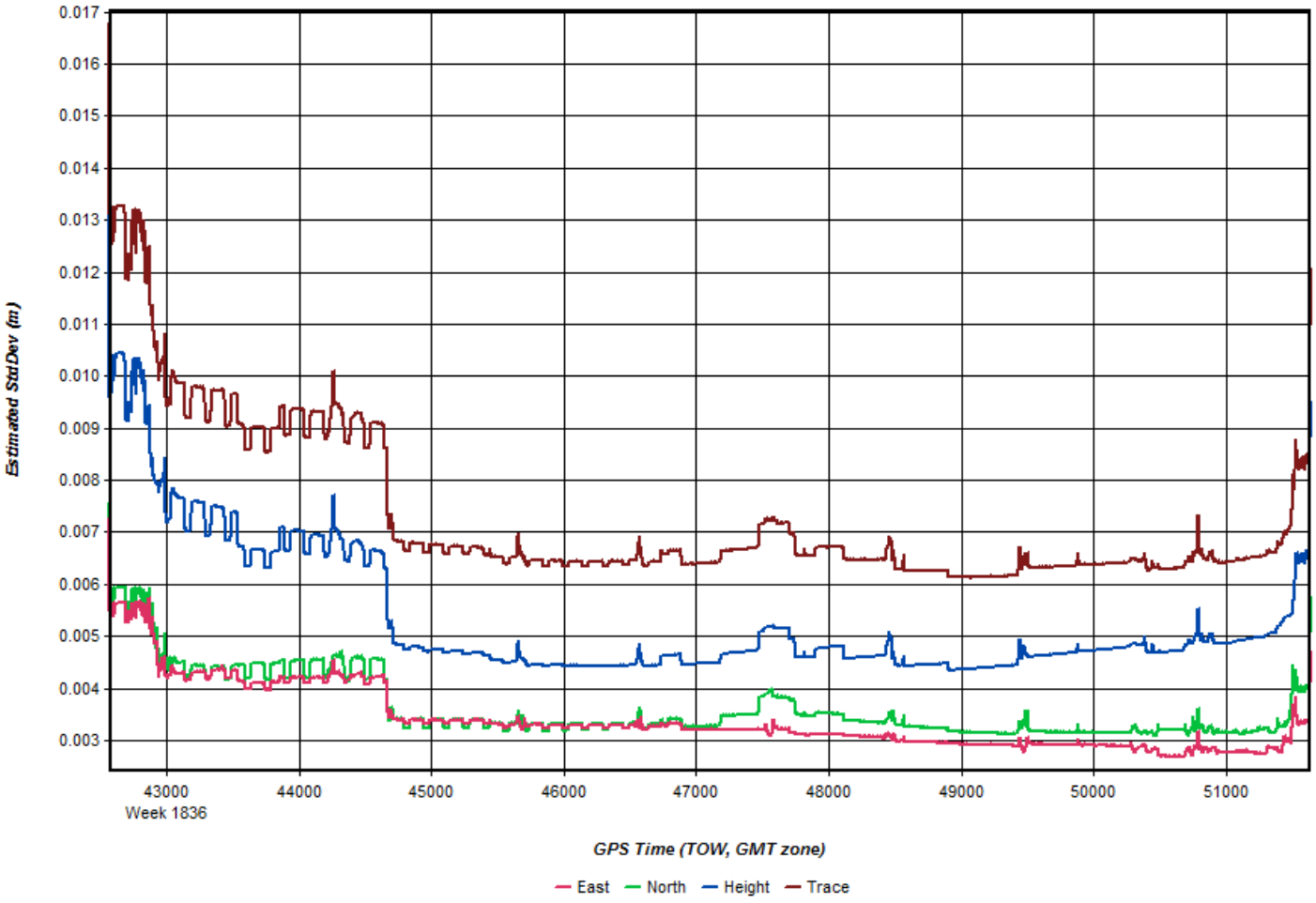

Estimated StdDev (m)
0.048
0.046
0.044
0.042
0.040
0.038
0.036
0.034
0.032
0.030
0.028
0.026
0.024
0.022
0.020
0.018
0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
598000
Week 1835
600000
602000
604000
1200
Week 1836
3200
5200
7200
9200
GPS Time (TOW, GMT zone)
East
North
Height
Trace

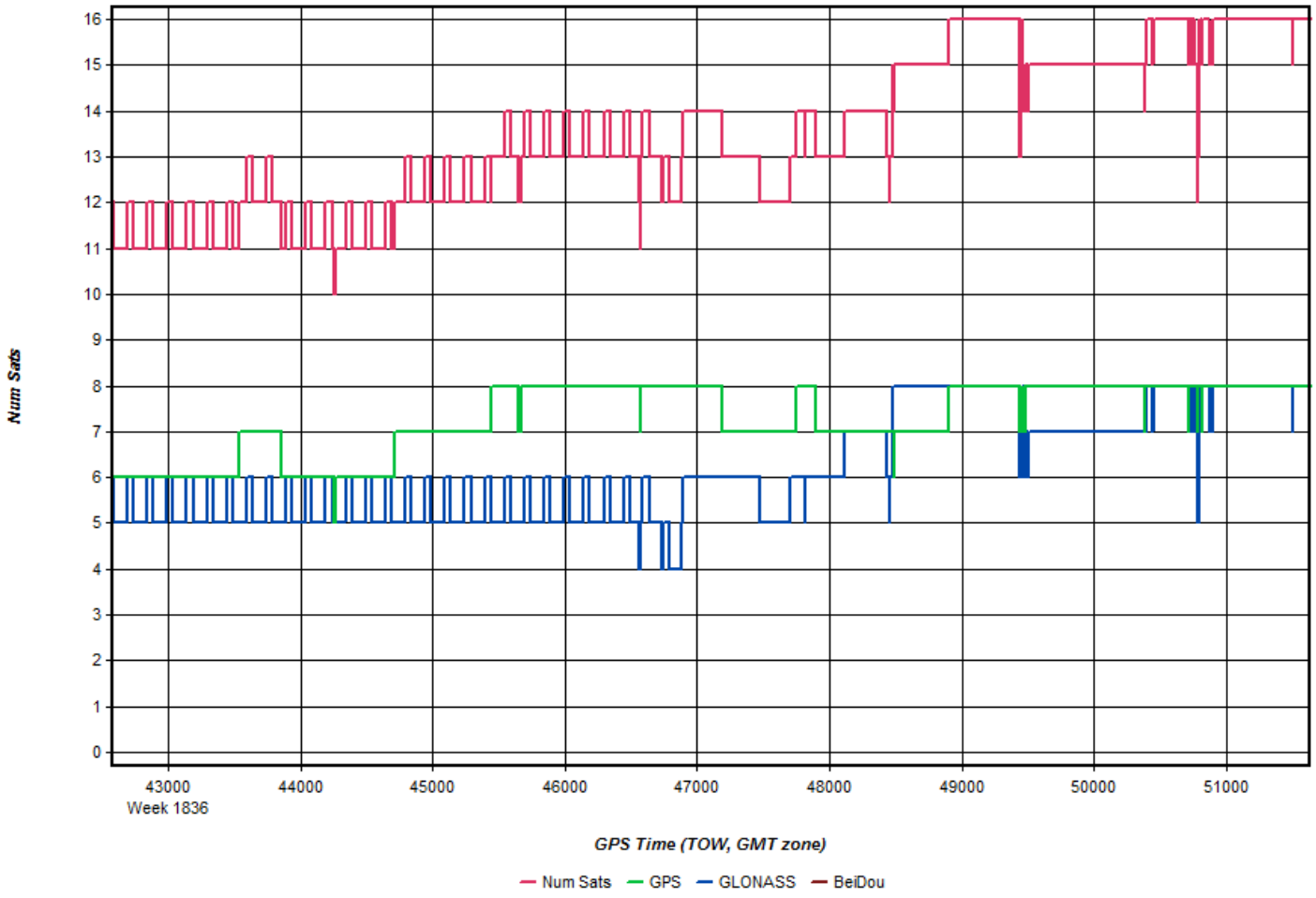

Num Sats
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
598000
Week 1835
600000
602000
604000
1200
Week 1836
3200
5200
7200
9200
GPS Time (TOW, GMT zone)
Num Sats
GPS
GLONASS
BeiDou

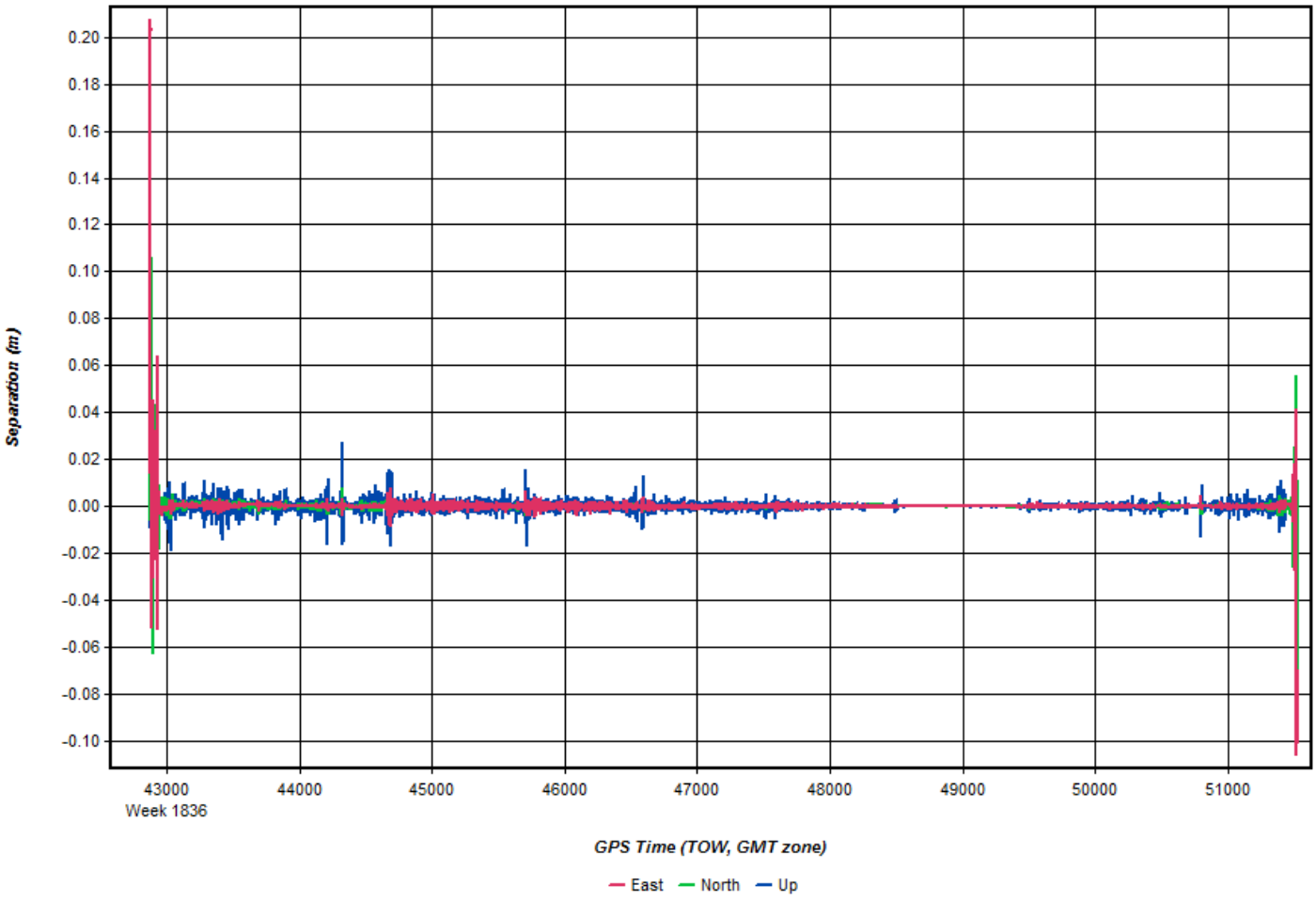

Separation (m)
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1.0
-1.1
-1.2
-1.3
-1.4
-1.5
-1.6
598000
Week 1835
600000
602000
604000
1200
Week 1836
3200
5200
7200
9200
GPS Time (TOW, GMT zone)
East
North
Up

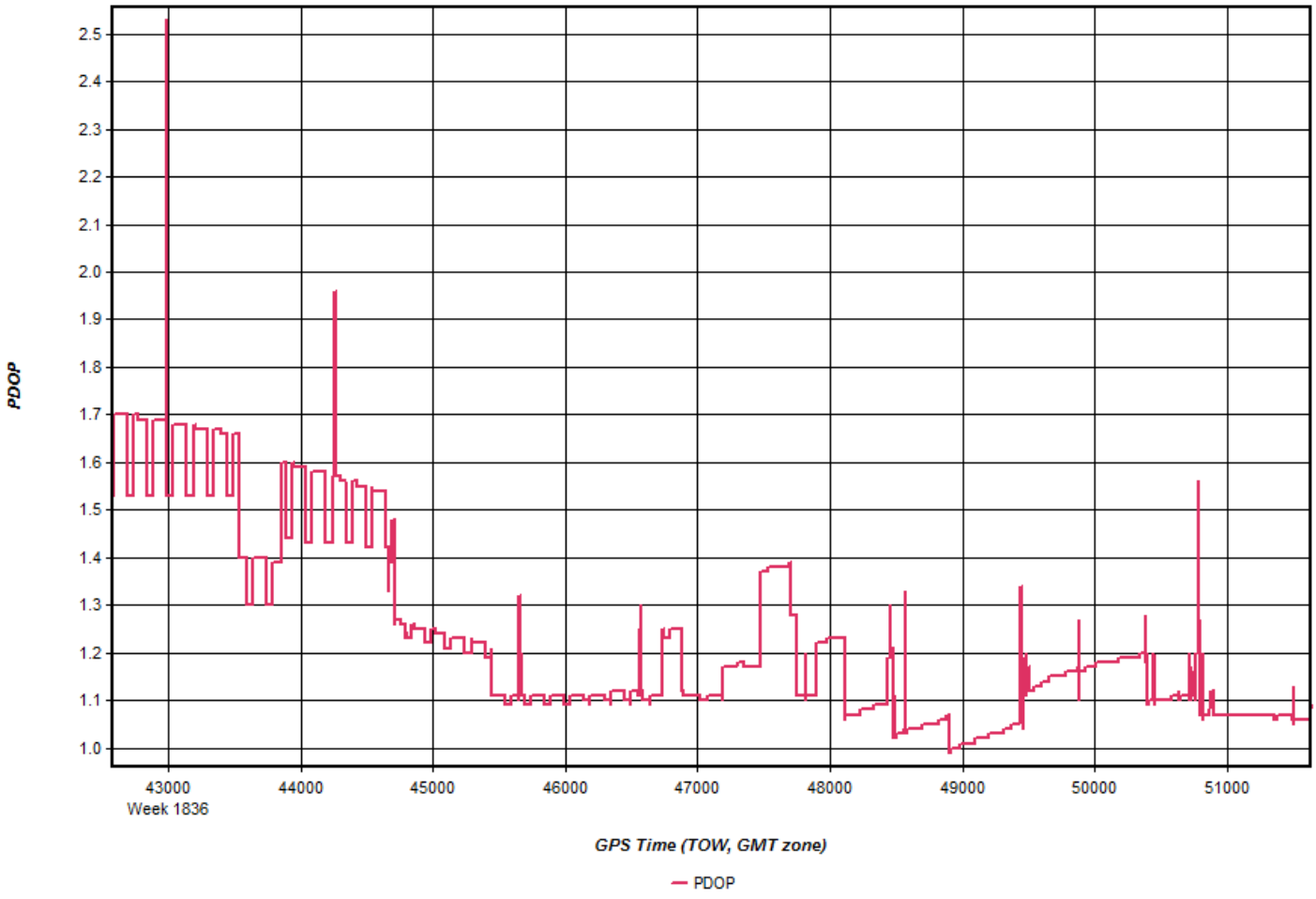

PDOP
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
598000
Week 1835
600000
602000
604000
1200
Week 1836
3200
5200
7200
9200
GPS Time (TOW, GMT zone)
PDOP

123_20150315_1

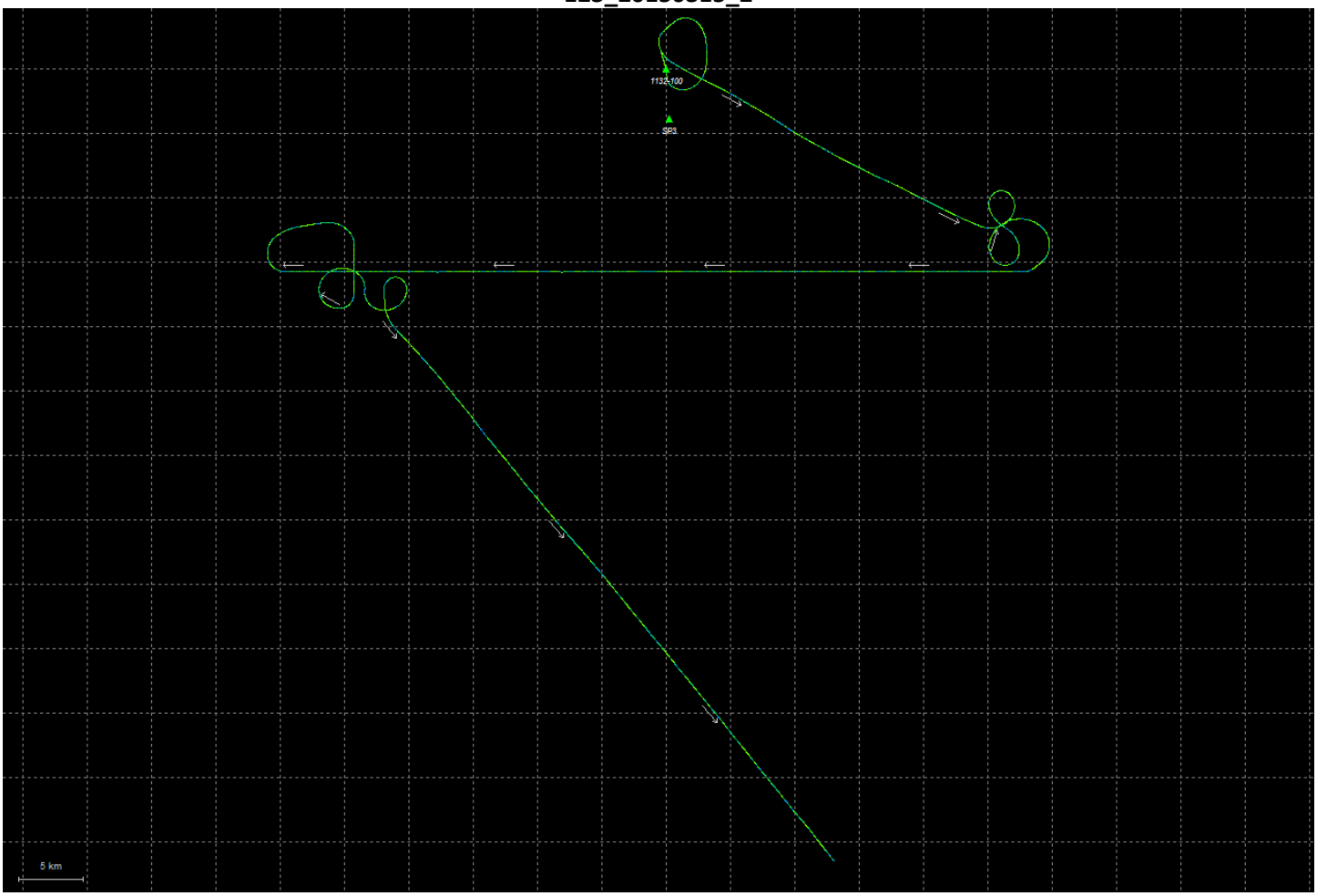

Estimated StdDev (m)
0.017
0.016
0.015
0.014
0.013
0.012
0.011
0.010
0.009
0.008
0.007
0.006
0.005
0.004
0.003
43000
Week 1836
44000
45000
46000
47000
48000
49000
50000
51000
GPS Time (TOW, GMT zone)
East
North
Height
Trace

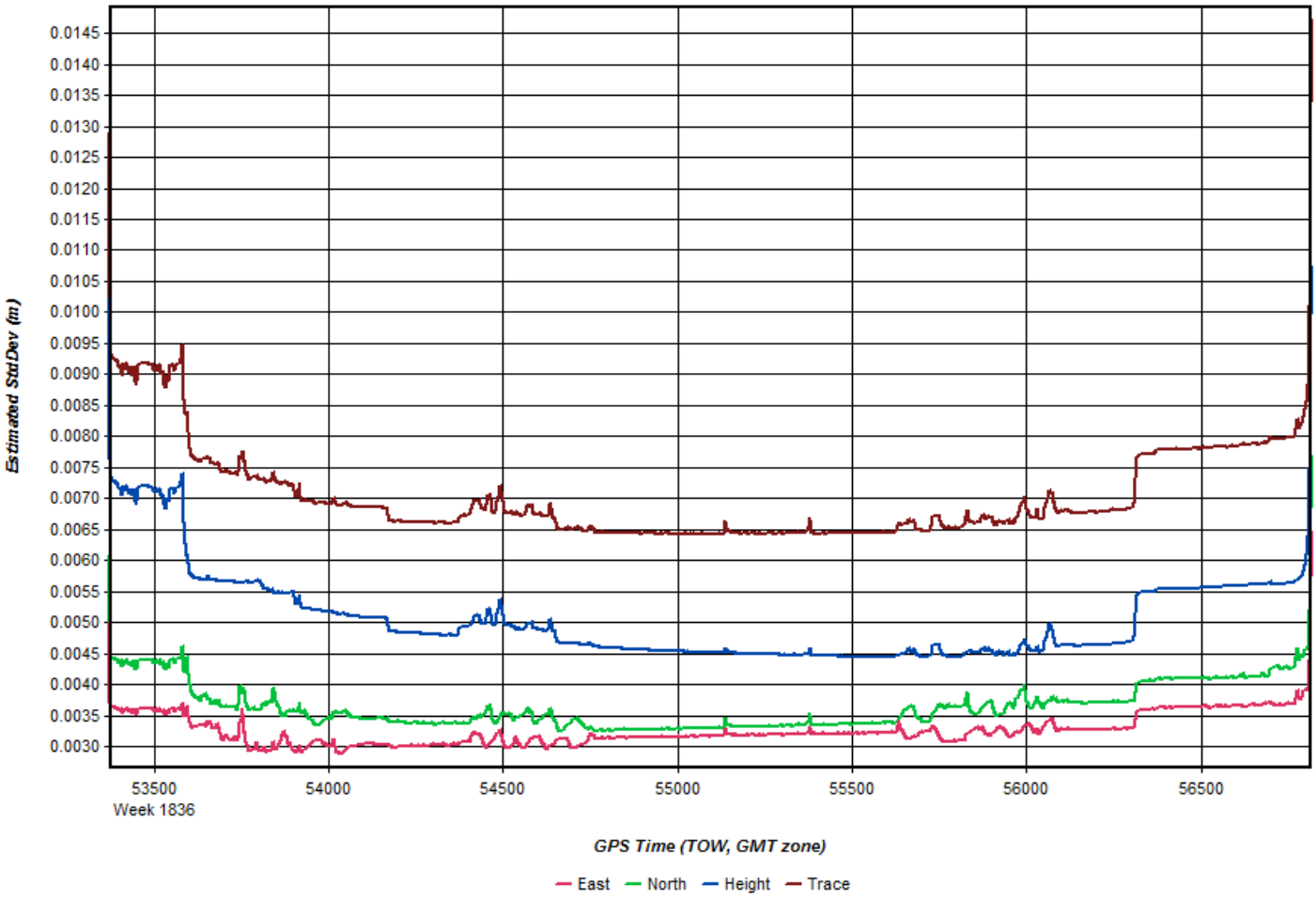

Num Sats
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
43000
Week 1836
44000
45000
46000
47000
48000
49000
50000
51000
GPS Time (TOW, GMT zone)
Num Sats
GPS
GLONASS
BeiDou

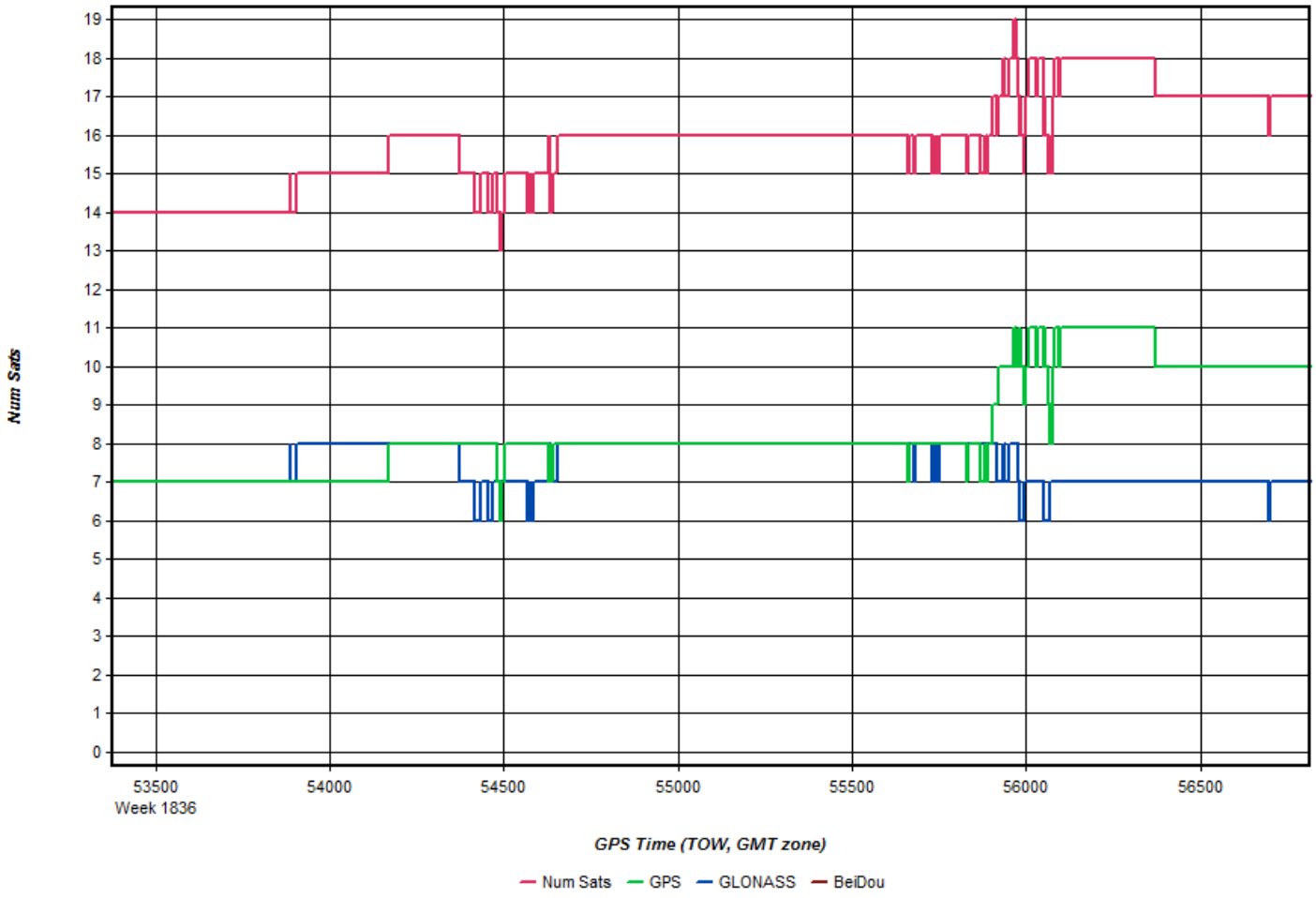

Separation (m)
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
43000
Week 1836
44000
45000
46000
47000
48000
49000
50000
51000
GPS Time (TOW, GMT zone)
East
North
Up

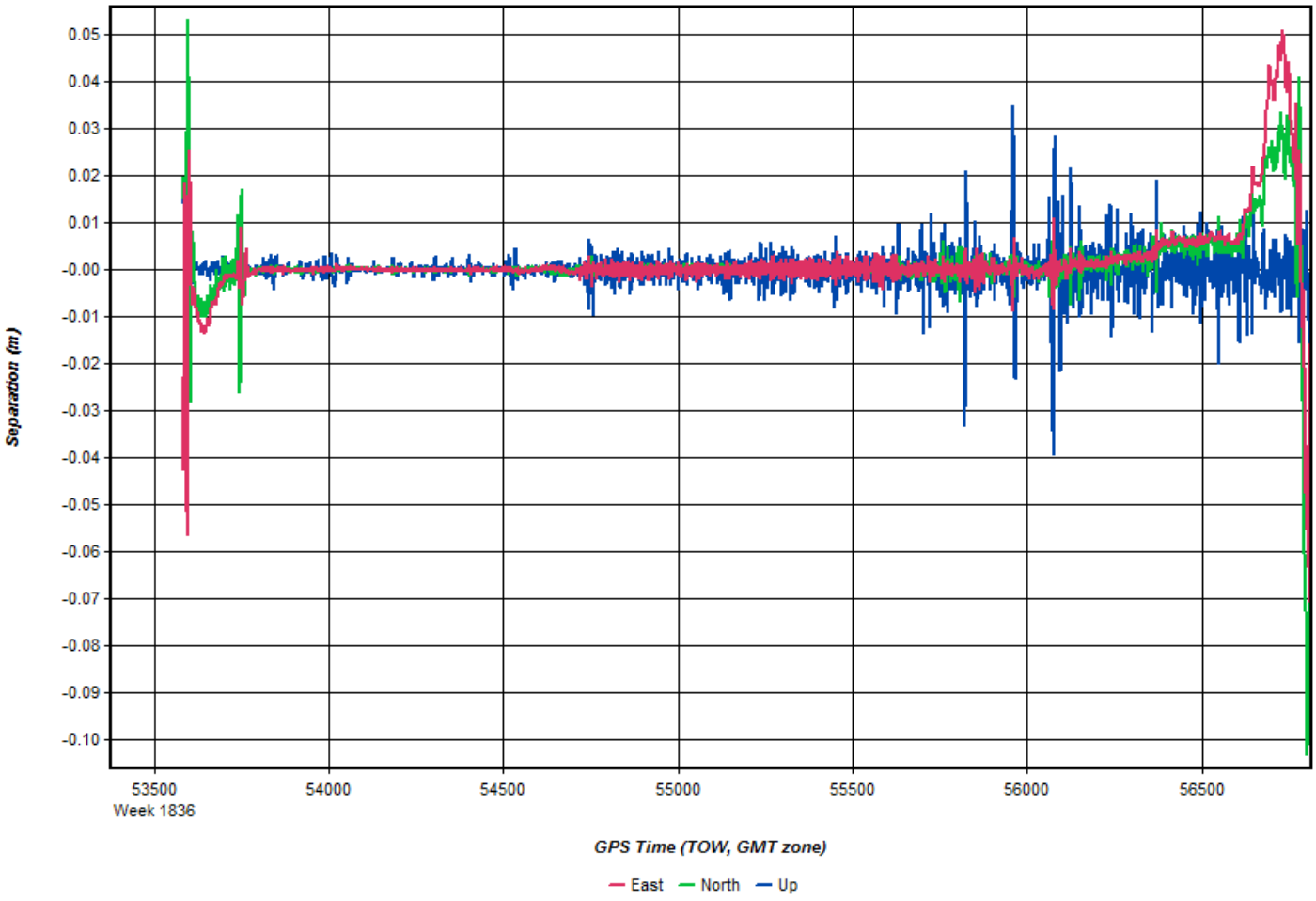

PDOP
2.5
2.4
2.3
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
43000
Week 1836
44000
45000
46000
47000
48000
49000
50000
51000
GPS Time (TOW, GMT zone)
PDOP

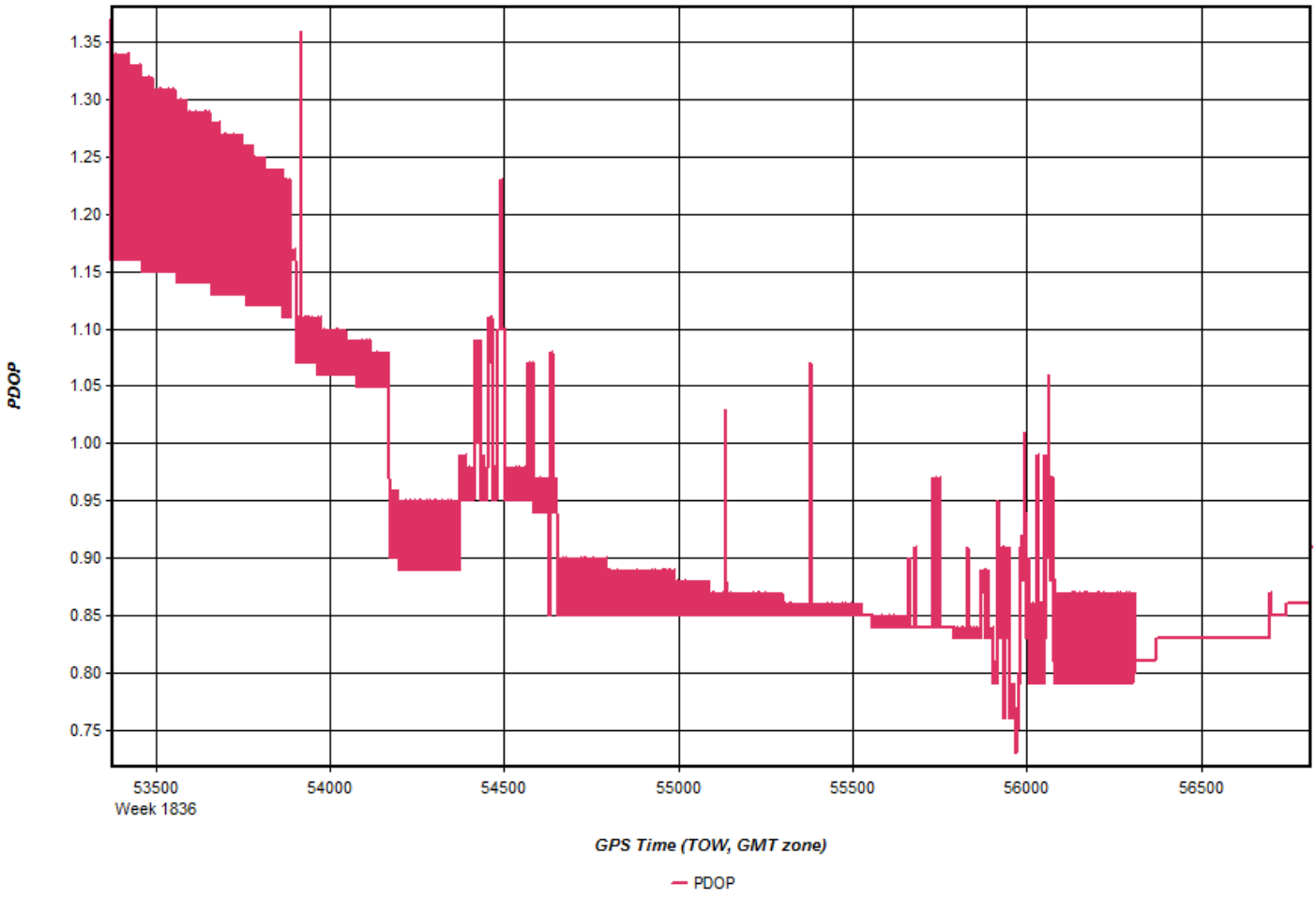
123_20150315_2



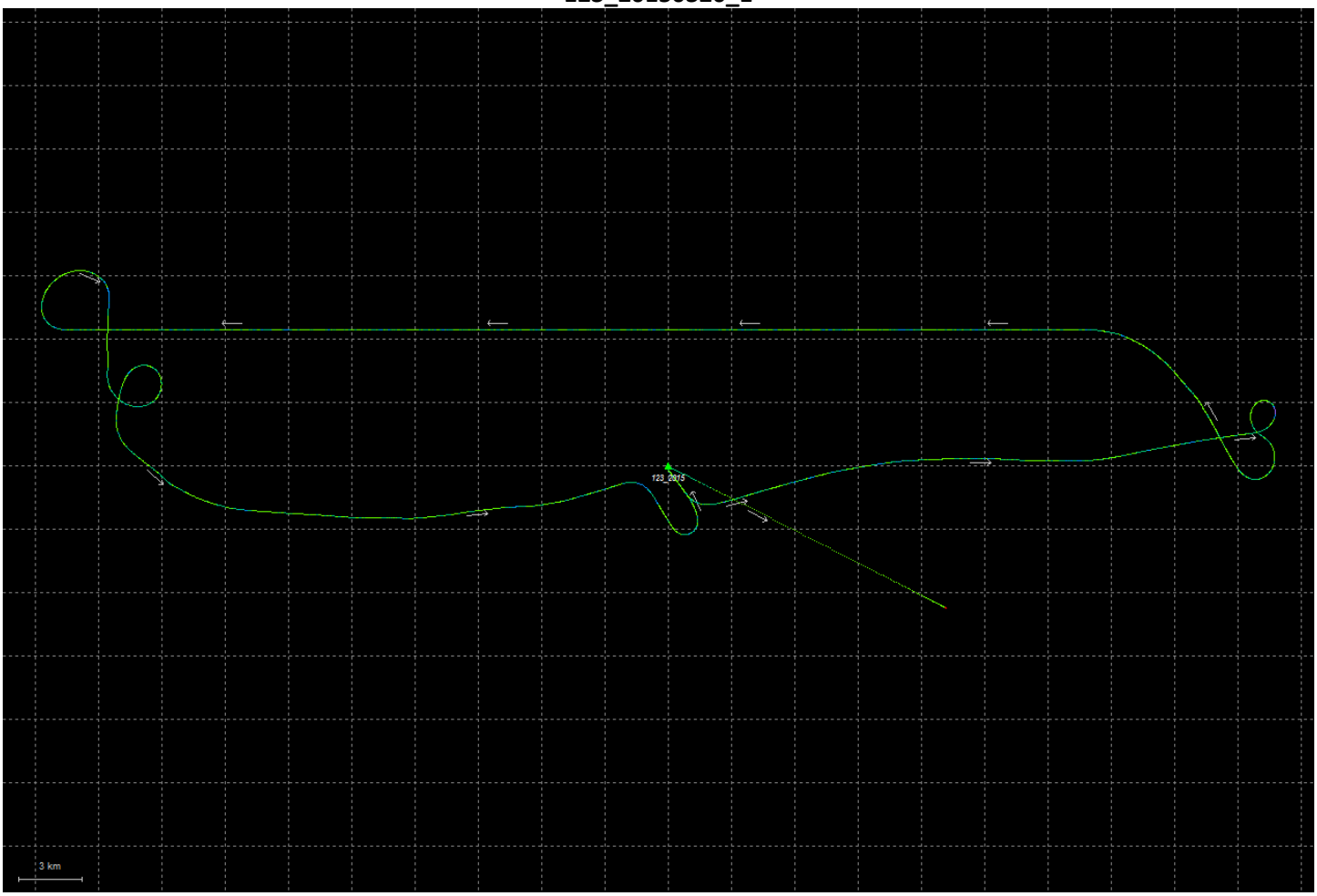

Estimated StdDev (m)
0.0145
0.0140
0.0135
0.0130
0.0125
0.0120
0.0115
0.0110
0.0105
0.0100
0.0095
0.0090
0.0085
0.0080
0.0075
0.0070
0.0065
0.0060
0.0055
0.0050
0.0045
0.0040
0.0035
0.0030
53500
Week 1836
54000
54500
55000
55500
56000
56500
GPS Time (TOW, GMT zone)
East
North
Height
Trace

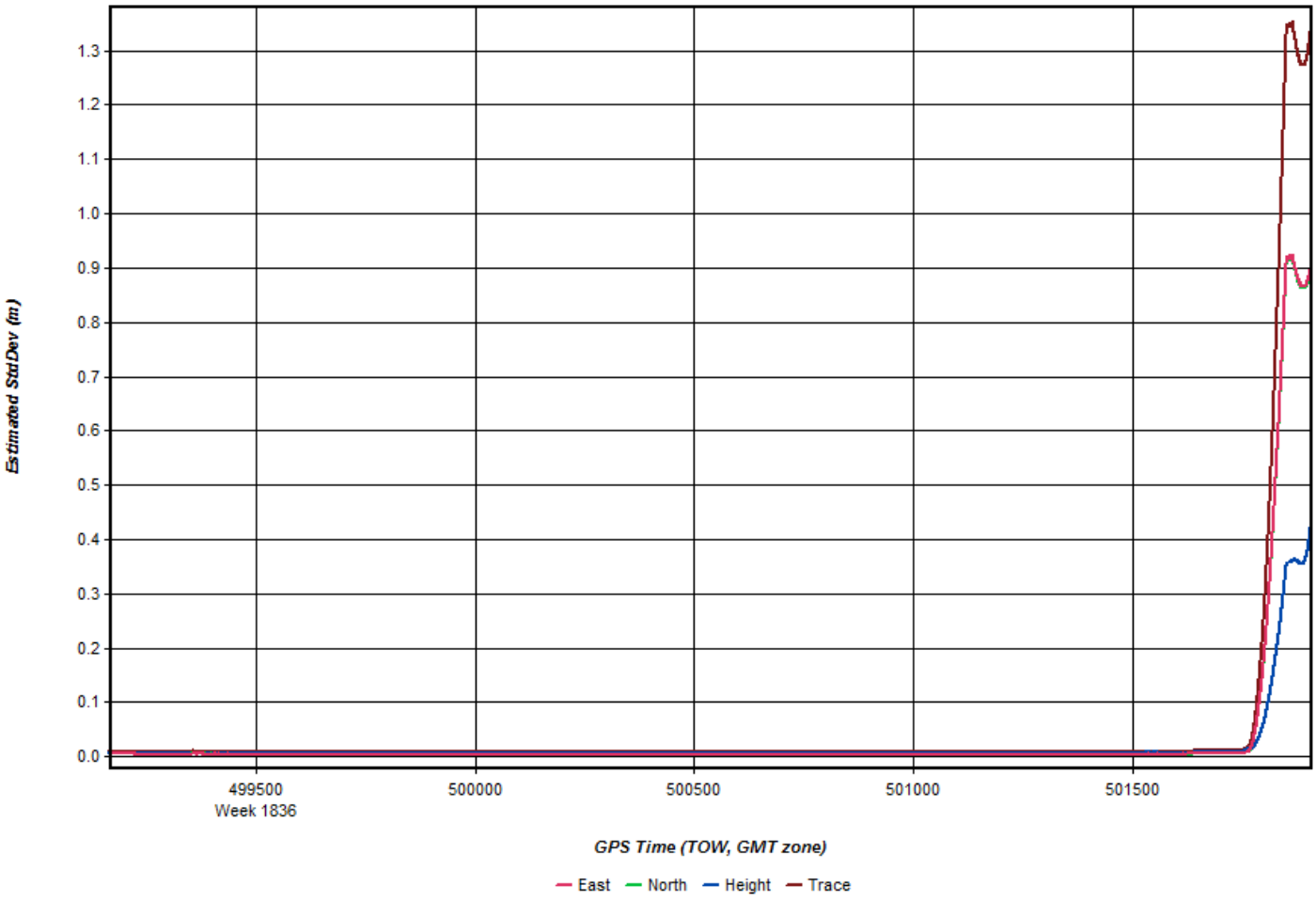

Num Sats
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
53500
Week 1836
54000
54500
55000
55500
56000
56500
GPS Time (TOW, GMT zone)
Num Sats
GPS
GLONASS
BeiDou

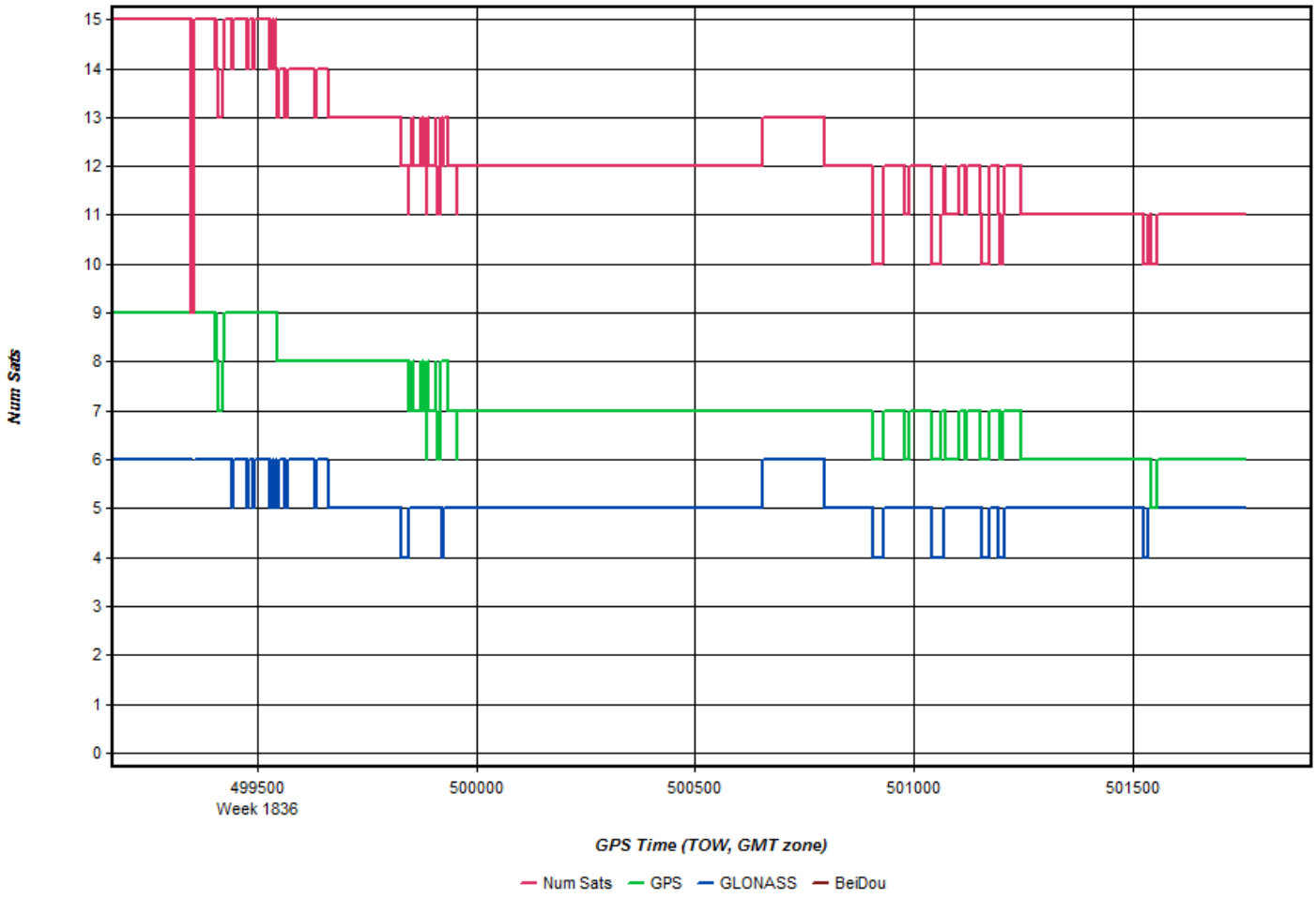

0.05
0.04
0.03
0.02
0.01
-0.00
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
-0.07
-0.08
-0.09
-0.10
Separation (m)
53500
Week 1836
54000
54500
55000
55500
56000
56500
GPS Time (TOW, GMT zone)
East
North
Up

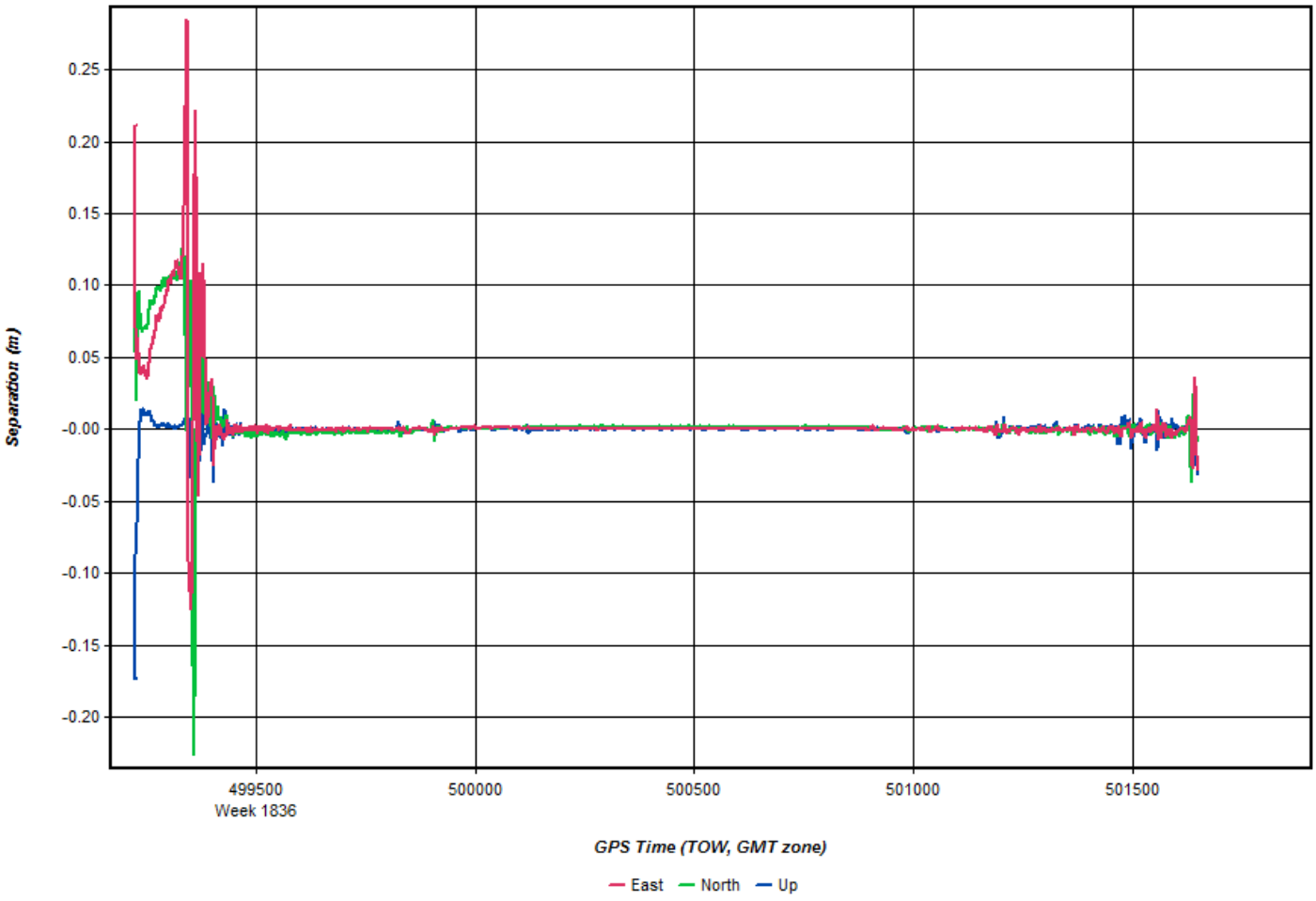

PDOP
1.35
1.30
1.25
1.20
1.15
1.10
1.05
1.00
0.95
0.90
0.85
0.80
0.75
53500
Week 1836
54000
54500
55000
55500
56000
56500
GPS Time (TOW, GMT zone)
PDOP

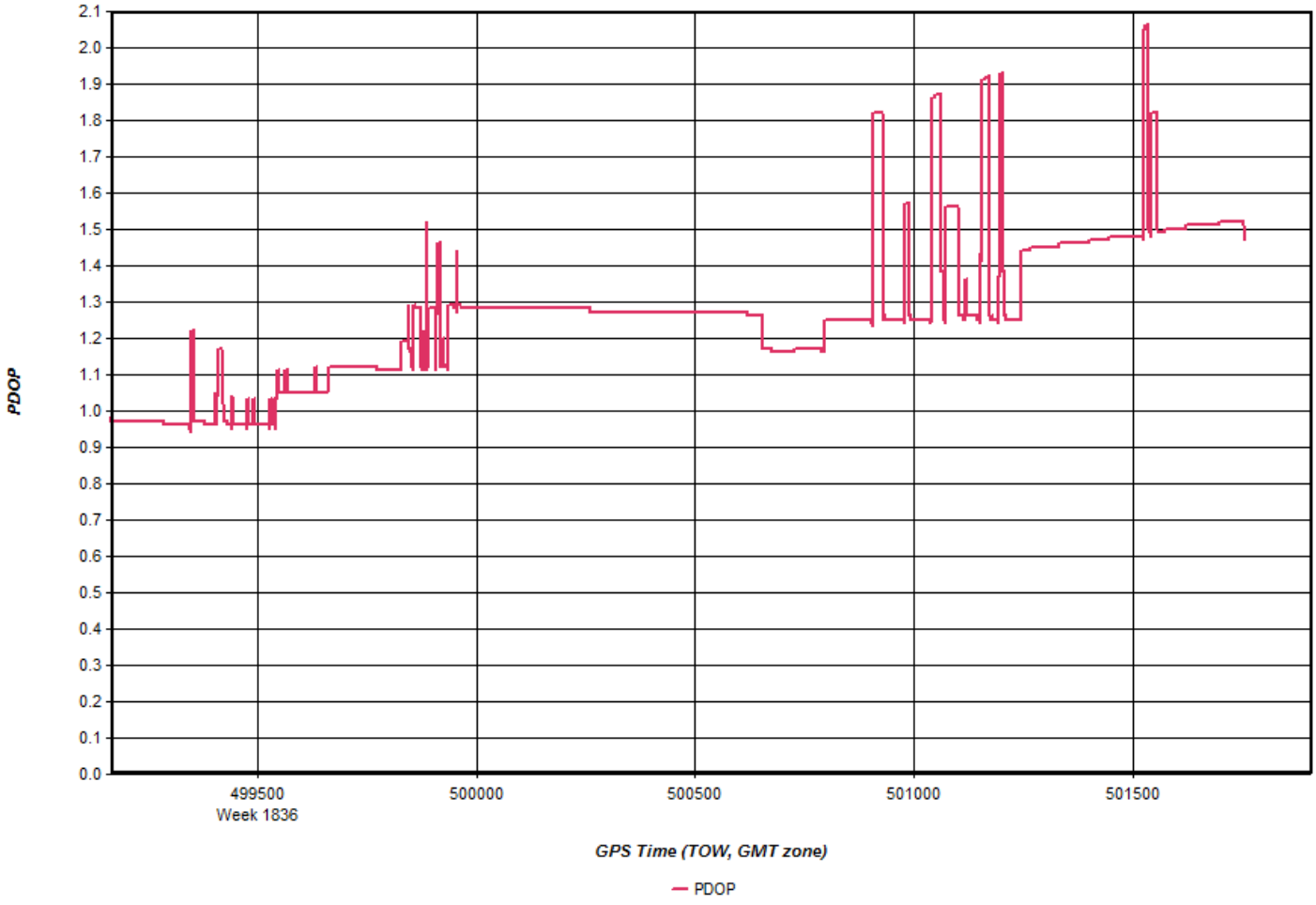
123_20150320_1




Estimated StdDev (m)
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
499500
Week 1836
500000
500500
501000
501500
GPS Time (TOW, GMT zone)
East
North
Height
Trace


Num Sats
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
499500
Week 1836
500000
500500
501000
501500
GPS Time (TOW, GMT zone)
Num Sats
GPS
GLONASS
BeiDou


0.25
0.20
0.15
0.10
0.05
-0.00
-0.05
-0.10
-0.15
-0.20
Separation (m)
499500
Week 1836
500000
500500
501000
501500
GPS Time (TOW, GMT zone)
East
North
Up


PDOP
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
499500
Week 1836
500000
500500
501000
501500
GPS Time (TOW, GMT zone)
PDOP