

# Aerial Lidar Report

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## Section 1: Lidar Acquisition

### 1.1 Acquisition

The Atlantic Group, LLC (Atlantic) has successfully completed lidar acquisition for the New Mexico Middle Rio Grande Lidar Area of Interest (AOI). Lidar for this AOI was acquired in thirty-one (31) flight missions completed between March 18<sup>th</sup>, 2018 and April 22<sup>nd</sup>, 2018. The project area encompasses 2,487,758 acres - 10,068 square kilometers or 3,887 square miles.

### 1.2 Acquisition Status Report

Upon notification to proceed, the flight crew loaded the flight plans and validated the flight parameters. Atlantic's Director of Flight Operations 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 the GNSS constellations, and performed the first QC 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 at an optimal time.

### 1.3 Acquisition Details

Atlantic acquired four hundred and fifty-one (451) passes of the AOI as a series of perpendicular and/or adjacent flight-lines. Differential GNSS unit in aircraft recorded sample positions at 2 Hz or more frequency. Lidar data was only acquired when a minimum of 6 satellites were in view.

Atlantic lidar sensors are calibrated at a designated site located in Huntsville, Alabama 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.

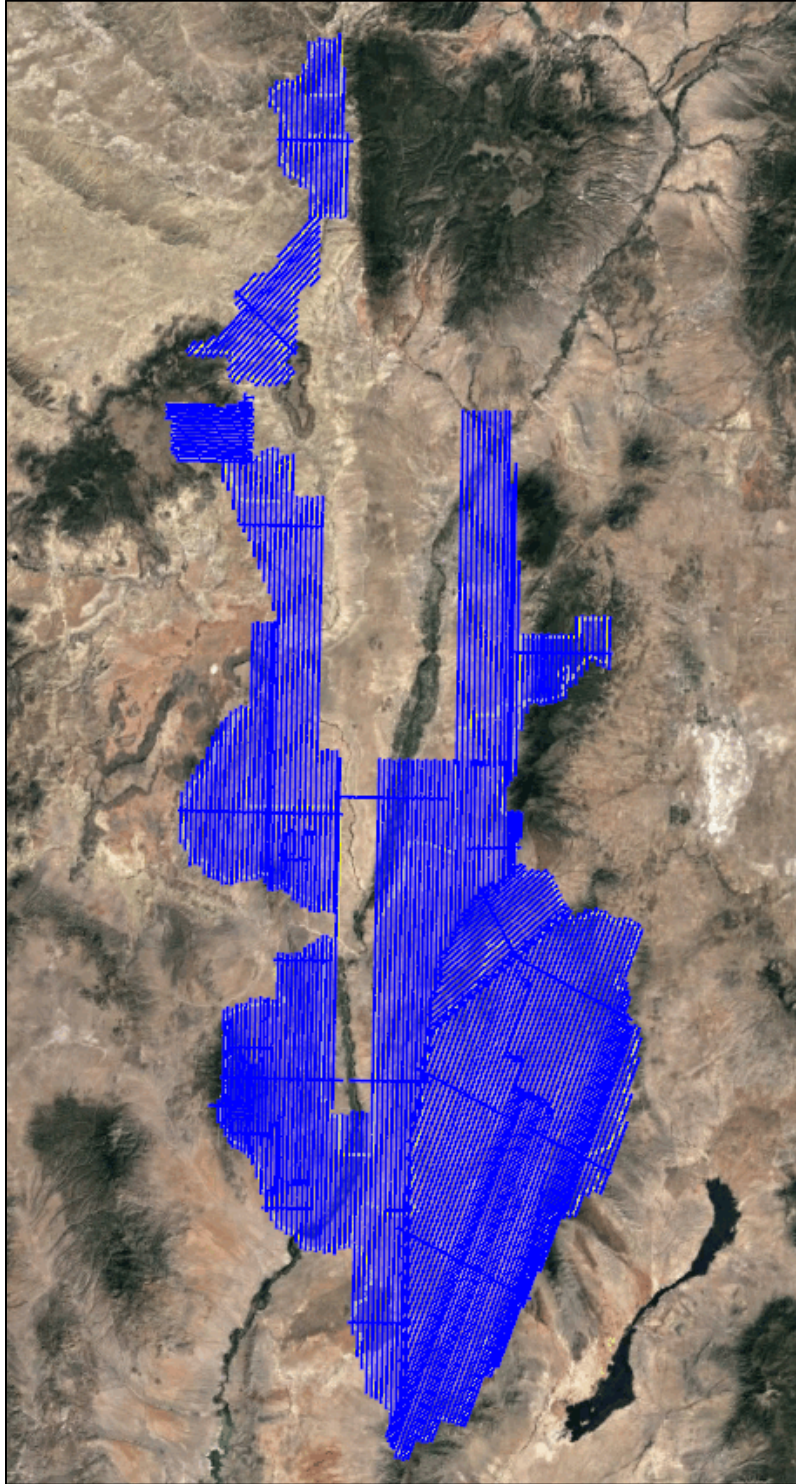


Figure 1: Trajectories as flown by Atlantic



## 1.6 Acquisition Equipment

Atlantic operated a both a Cessna T210L(N732JE) and a Pacific Aerospace PAC750XL(N750VX) each 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)	0.6454
Nominal Pulse Density (pls/m <sup>2</sup> )	2.2
Nominal Flight Height (AGL meters)	2,255
Nominal Flight Speed (kts)	130
Pass Heading (degree)	Varies
Sensor Scan Angle (degree)	40
Scan Frequency (Hz)	347.7
Pulse Rate of Scanner (kHz)	249.2
Line Spacing (m)	1,185
Pulse Duration of Scanner (ns)	4
Pulse Width of Scanner (m)	0.44
Central Wavelength of Sensor Laser (nm)	1064
Sensor Operated with Multiple Pulses	Yes
Beam Divergence (mrad)	0.22
Nominal Swath Width (m)	1,601
Nominal Swath Overlap (%)	20
Scan Pattern	Triangle

Table 2: Atlantic Lidar System Acquisition Parameters

## 1.8 GNSS Reference Station(s)

Five (5) Continuously Operating Reference Stations (CORS) 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.

GNSS Reference Station Coordinates					
Designation	Type	PID	Latitude (N)	Longitude (W)	Elevation
NMSF	CORS	DF4369	35 40 25.62398	105 57 30.93089	2097.239
NMGR	CORS	DI0438	35 12 59.64999	107 55 48.36832	2021.631
ZAB1	CORS	DE6386	35 10 24.85464	106 34 02.41357	1620.623
ZAB2	CORS	DE6388	35 10 24.85235	106 34 02.19263	1620.690
SC01	CORS	DG5392	34 04 04.61326	106 57 59.51190	2098.345

Table 3: GNSS Reference Station Coordinates



Figure 2: GNSS Reference Station(s)

## 1.9 Airborne GNSS Kinematic

Differential GNSS unit in aircraft collected positions at 2 Hz. Airborne GNSS data was processed using the Inertial Explorer (version 8.60.6717) software. Flights were flown with a minimum of 6 satellites in view ( $10^\circ$  above the horizon).

For all flights, the GNSS data can be classified as good, with 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 GNSS, aircraft trajectory, mission information, and ground control files are reviewed and logged into a database.

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

## Section 2: Lidar Processing

### 2.1 Lidar Point Cloud Generation

Atlantic used Leica software products to download the IPAS ABGNSS/IMU data and raw laser scan files from the airborne system. Waypoint Inertial Explorer is used to extract the raw IPAS ABGNSS/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 Lidar ASCII Standard (\*.las) formatted swath point clouds.



Figure 3: Lidar swath data showing complete coverage



## 2.2 Coordinate Reference System

<b>Horizontal Datum:</b>	North American Datum of 1983 (2011)
<b>Coordinate System:</b>	Universal Transverse Mercator Zone 13 North
<b>Vertical Datum:</b>	North American Vertical Datum of 1988
<b>Geoid Model:</b>	Geoid12B
<b>Units of Reference:</b>	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	55,192,314,494
Nominal Pulse Spacing (m)	0.6454
Nominal Pulse Density (pls/m <sup>2</sup> )	2.40
Nominal Pulse Spacing (ft)	2.1173
Nominal Pulse Density (pls/ft <sup>2</sup> )	0.22
Aggregate Total Points	43,490,171,332
Aggregate Nominal Pulse Spacing (m)	0.5324
Aggregate Nominal Pulse Density (pls/m <sup>2</sup> )	3.53
Aggregate Nominal Pulse Spacing (ft)	1.7467
Aggregate Nominal Pulse Density (pls/ft <sup>2</sup> )	0.33

Table 4: Lidar Point Cloud Statistics

## 2.4 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 2,255m; the expected radial horizontal positional error will be RMSEz = 29.0cm.

## 2.5 Smooth Surface Repeatability (Intraswath)

Departures from planarity of first returns within single swaths in non-vegetated areas were assessed at multiple locations with hard surface areas (parking lots or large rooftops) inside the project area. Each area was evaluated using signed difference rasters (maximum elevation – minimum elevation) at a cell size equal to 2 x ANPS, rounded to the next integer. The following graphic depicts a sample of the assessment.

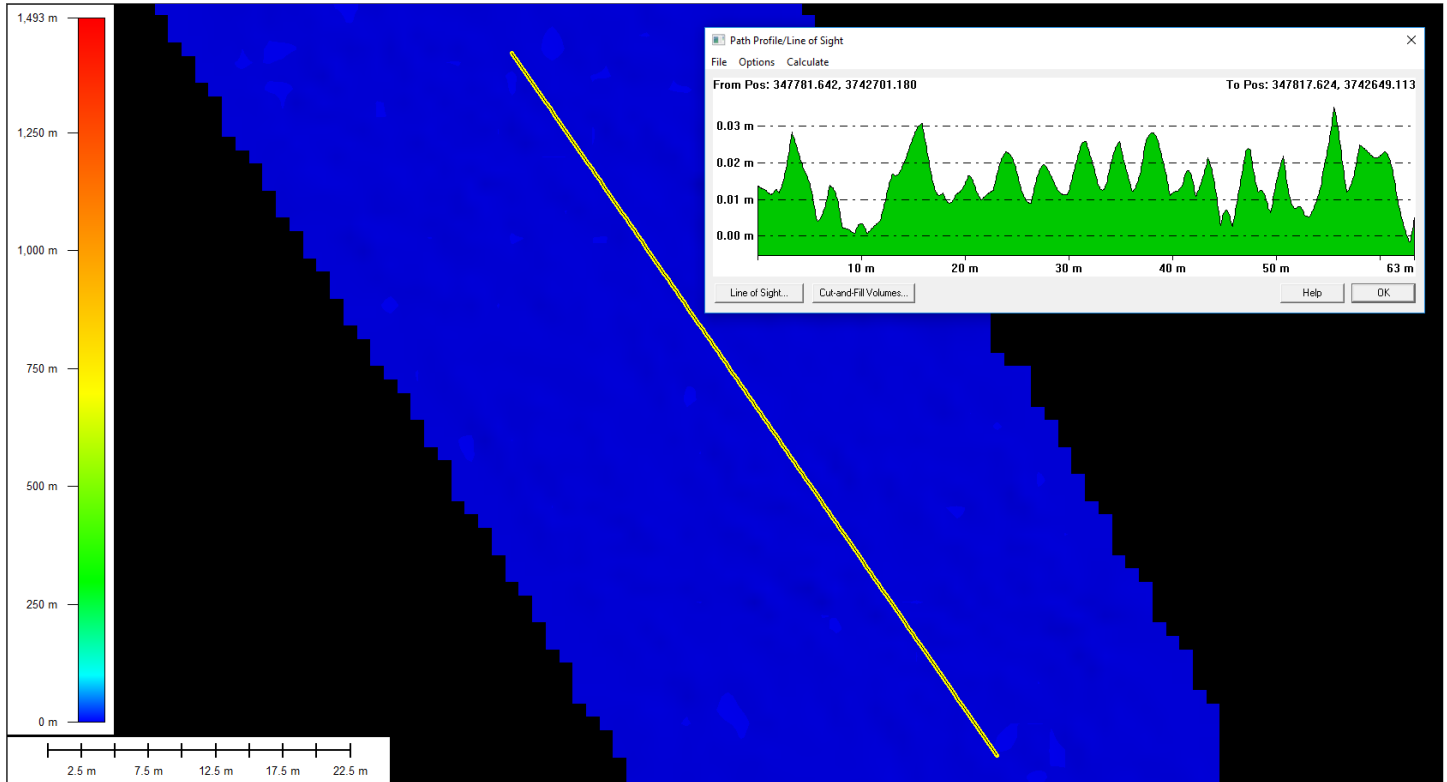


Figure 4: Smooth Surface Repeatability of  $\le 6\text{cm}$

## 2.6 Lidar Calibration

Lidar ranging data were initially calibrated using previous best parameters for this instrument and aircraft. Using a combination of GeoCue, 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  $\le 2\text{cm}$ . A final analysis of the calibrated lidar is preformed using a TerraMatch Tie Line report for an overall statistical model of the project area.

Upon completion of the data calibration, Atlantic runs a complete set of elevation difference intensity rasters (dZ Orthos). 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 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.

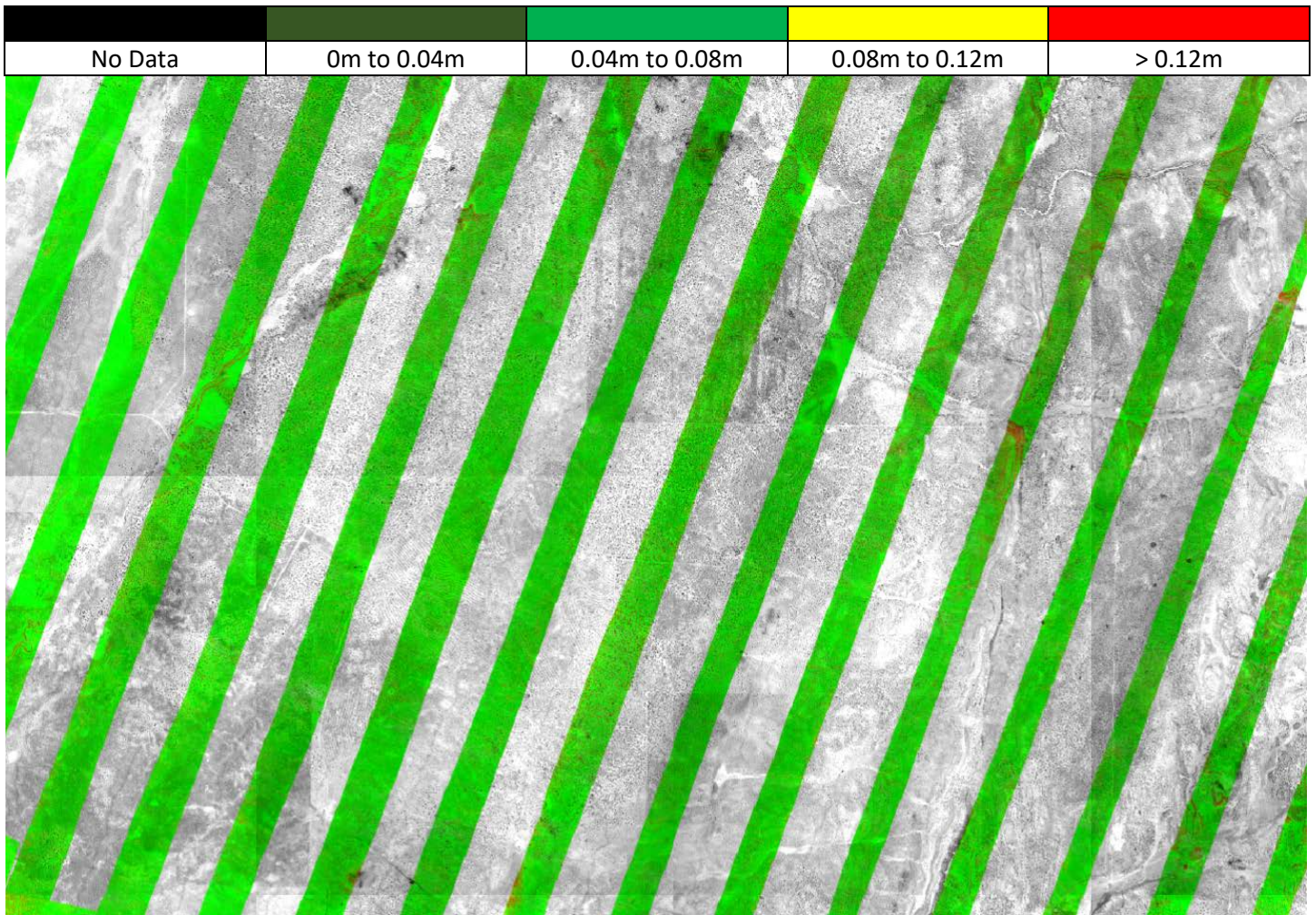


Figure 5: Swath Overlap Difference of  $\leq 8\text{cm}$ , Maximum of  $\pm 16\text{cm}$

## 2.7 Lidar Classification

Atlantic uses multiple automated filtering routines on the calibrated lidar point cloud identifying and extracting bare-earth and above ground features. GeoCue, TerraScan, and TerraModeler software was used for the initial batch processing and manual editing of the lidar point clouds. Atlantic utilized collected breakline data to preform classification for classes' 9-Water and 20-Ignored Ground in LP360. Outlined in Table 9 are the classification codes utilized for this project.

ASPRS Standard Lidar Point Classes	
Code	Description
1	Unclassified
2	Ground
7	Low Noise
9	Water
17	Bridges
18	High Noise
20	Ignored Ground
Flags	Overlap & Withheld

Table 9: Point Cloud Classification Scheme

## Section 3: Lidar Accuracy

### 3.1 Ground Surveyed Check Points

Atlantic established a total of one hundred and eighty-eight (188) check points for this project (105 NVA and 83 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<sub>z</sub> 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 Requirements

Below are the vertical accuracy reporting requirements for this project:

**Vertical Accuracy Reporting Requirements in Meters:**

- RMSE<sub>z</sub> ≤ 10.0cm (Non-Vegetated Swath, DEM)
- NVA ≤ 19.6cm 95% Confidence Level (Swath, DEM)
- VVA ≤ 29.4cm 95<sup>th</sup> Percentile (DEM)

\*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.

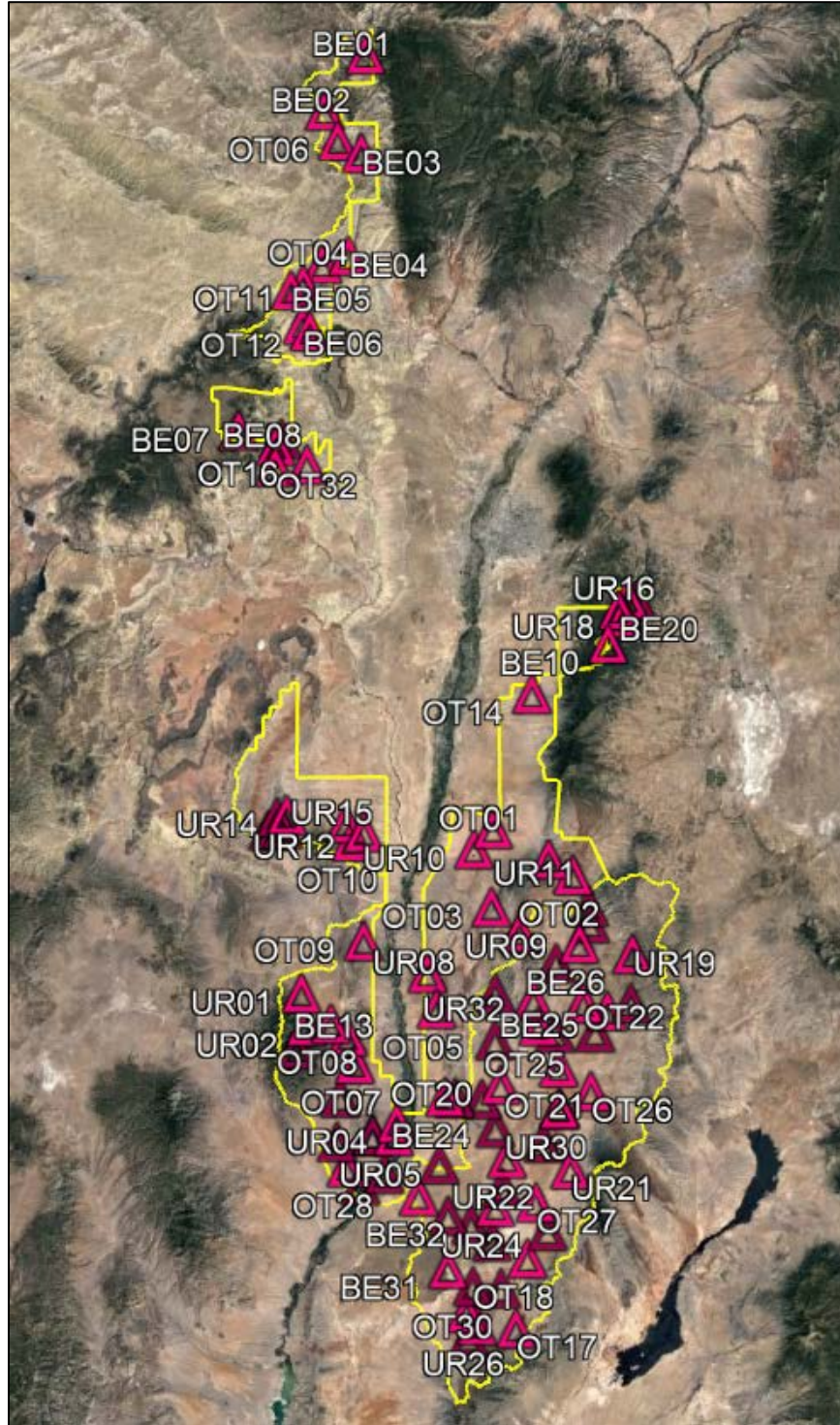


Figure 6: Non-vegetated Vertical Accuracy (NVA) Check Point Distribution



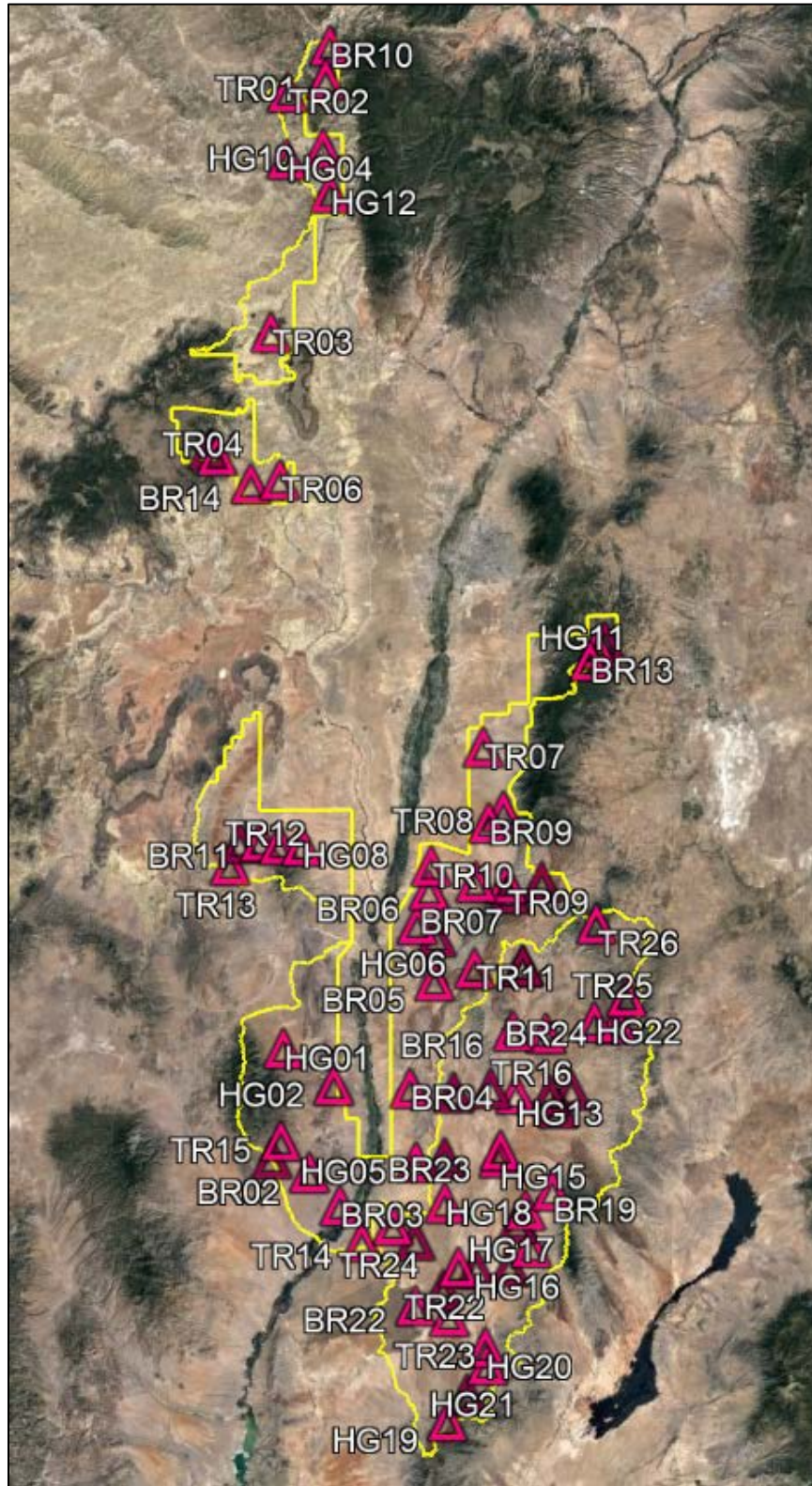


Figure 7: Vegetated Vertical Accuracy (VVA) Check Point Distribution

### 3.4 Vertical Accuracy Results

An overall statistical assessment of the check points can be found in Tables 10 below. The values provided are in meters.

Non-vegetated Vertical Accuracy (NVA) and Vegetated Vertical Accuracy (VVA)				
Broad Land Cover Type	# of Points	RMSEz	95% Confidence Level	95th Percentile
NVA of Point Cloud	105	0.0819	0.1605	
NVA of Bare Earth	105	0.0777	0.1523	
NVA of DEM	105	0.0823	0.1612	
VVA of Bare Earth	83	0.1224		0.1746
VVA of DEM	83	0.1199		0.1821

Table 10: Non-vegetated Vertical Accuracy (NVA) and Vegetated Vertical Accuracy (VVA)

### 3.5 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 11, 12, 13, 14, and 15 below. The coordinates provided are in NAD83 (2011), UTM Zone 13 North, NAVD88 (Geoid12B), Meters.

Non-vegetated Vertical Accuracy (NVA) Check Point Assessment (Point Cloud)						
PointID	Easting	Northing	KnownZ	LaserZ	Description	DeltaZ
BE001	322549.192	4001747.811	2240.981	2241.015	Bare Earth/Open Terrain	0.034
BE002	312491.311	3988270.335	2156.016	2156.098	Bare Earth/Open Terrain	0.082
BE003	321133.691	3977825.699	2039.367	2039.425	Bare Earth/Open Terrain	0.058
BE004	317663.314	3953091.300	1914.493	1914.626	Bare Earth/Open Terrain	0.133
BE005	303623.913	3945072.426	1867.109	1867.201	Bare Earth/Open Terrain	0.092
BE006	306295.603	3936711.876	1868.713	1868.798	Bare Earth/Open Terrain	0.085
BE007	290489.359	3911602.231	2084.458	2084.527	Bare Earth/Open Terrain	0.069
BE008	299454.380	3907730.603	1915.142	1915.278	Bare Earth/Open Terrain	0.136
BE009	382099.383	3866059.649	2257.744	2257.632	Bare Earth/Open Terrain	-0.112
BE010	378445.704	3859006.529	2300.240	2300.413	Bare Earth/Open Terrain	0.173
BE011	298176.527	3818930.113	1801.039	1801.008	Bare Earth/Open Terrain	-0.031
BE012	299596.629	3816085.510	1802.663	1802.708	Bare Earth/Open Terrain	0.045
BE013	314282.134	3766200.126	1721.361	1721.548	Bare Earth/Open Terrain	0.187
BE014	301952.662	3763448.930	2474.143	2474.242	Bare Earth/Open Terrain	0.099
BE015	312302.100	3751563.419	1747.390	1747.279	Bare Earth/Open Terrain	-0.111
BE016	316796.224	3730481.489	1364.103	1364.136	Bare Earth/Open Terrain	0.033
BE017	335864.466	3735239.031	1471.538	1471.532	Bare Earth/Open Terrain	-0.006
BE018	319825.452	3742334.085	1543.755	1543.925	Bare Earth/Open Terrain	0.170
BE019	319935.362	3742386.321	1543.551	1543.691	Bare Earth/Open Terrain	0.140
BE020	381063.195	3867023.827	2279.716	2279.612	Bare Earth/Open Terrain	-0.104
BE021	343242.371	3720649.257	1438.783	1438.855	Bare Earth/Open Terrain	0.072
BE022	349444.943	3743763.699	1483.370	1483.391	Bare Earth/Open Terrain	0.021
BE023	349772.426	3764724.422	1664.664	1664.682	Bare Earth/Open Terrain	0.018
BE024	337509.811	3751343.034	1472.275	1472.382	Bare Earth/Open Terrain	0.107



BE025	379469.845	3755953.427	1770.038	1769.970	Bare Earth/Open Terrain	-0.068
BE026	376832.231	3771254.262	1768.548	1768.699	Bare Earth/Open Terrain	0.151
BE027	370379.542	3787509.799	1838.636	1838.651	Bare Earth/Open Terrain	0.015
BE028	370706.448	3787325.632	1839.226	1839.304	Bare Earth/Open Terrain	0.078
BE029	350002.148	3775872.895	1891.828	1891.807	Bare Earth/Open Terrain	-0.021
BE030	380218.872	3746156.395	1834.395	1834.327	Bare Earth/Open Terrain	-0.068
BE031	360896.606	3739968.097	1515.626	1515.716	Bare Earth/Open Terrain	0.090
BE032	348248.458	3716443.203	1431.108	1431.055	Bare Earth/Open Terrain	-0.053
BE033	342249.743	3693527.324	1625.125	1625.152	Bare Earth/Open Terrain	0.027
BE034	337472.515	3710045.324	1430.565	1430.546	Bare Earth/Open Terrain	-0.019
BE035	330766.018	3727656.991	1467.936	1467.996	Bare Earth/Open Terrain	0.060
OT001	350067.776	3815239.068	1560.850	1560.788	Bare Earth/Open Terrain	-0.062
OT002	369100.386	3803862.736	1890.226	1890.129	Bare Earth/Open Terrain	-0.097
OT003	349381.509	3796607.010	1728.254	1728.295	Bare Earth/Open Terrain	0.041
OT004	311354.887	3951340.522	1947.332	1947.413	Bare Earth/Open Terrain	0.081
OT005	335769.666	3772440.260	1576.698	1576.738	Bare Earth/Open Terrain	0.040
OT006	360481.133	3755423.346	1549.841	1549.769	Bare Earth/Open Terrain	-0.072
OT007	315505.371	3980934.393	2069.050	2069.091	Bare Earth/Open Terrain	0.041
OT008	315954.230	3759605.282	1700.223	1700.331	Bare Earth/Open Terrain	0.108
OT009	355975.041	3833546.435	1605.051	1605.036	Bare Earth/Open Terrain	-0.015
OT010	310377.159	3769294.239	1845.315	1845.344	Bare Earth/Open Terrain	0.029
OT011	318537.173	3788969.695	1540.892	1540.960	Bare Earth/Open Terrain	0.068
OT012	315970.143	3812865.984	1676.532	1676.546	Bare Earth/Open Terrain	0.014
OT013	306612.952	3946360.884	1866.525	1866.650	Bare Earth/Open Terrain	0.125
OT014	308027.108	3935162.288	1794.520	1794.628	Bare Earth/Open Terrain	0.108
OT015	385386.702	3869323.196	2160.698	2160.619	Bare Earth/Open Terrain	-0.079
OT016	359973.900	3847365.970	1673.841	1673.831	Bare Earth/Open Terrain	-0.010
OT017	297953.345	3816024.194	1802.389	1802.544	Bare Earth/Open Terrain	0.155
OT018	306833.965	3903185.701	1861.981	1862.158	Bare Earth/Open Terrain	0.177
OT019	353645.056	3695458.852	1596.638	1596.647	Bare Earth/Open Terrain	0.009
OT020	356672.002	3712262.696	1441.410	1441.514	Bare Earth/Open Terrain	0.104
OT021	350870.864	3729330.857	1440.776	1440.883	Bare Earth/Open Terrain	0.107
OT022	350892.212	3754048.831	1547.576	1547.643	Bare Earth/Open Terrain	0.067
OT023	364901.031	3757973.303	1581.696	1581.741	Bare Earth/Open Terrain	0.045
OT024	371065.117	3773212.719	1691.906	1692.035	Bare Earth/Open Terrain	0.129
OT025	382516.089	3773062.363	1845.836	1845.871	Bare Earth/Open Terrain	0.035
OT026	372798.361	3796257.149	1951.154	1951.193	Bare Earth/Open Terrain	0.039
OT027	360193.034	3767925.519	1654.193	1654.196	Bare Earth/Open Terrain	0.003
OT028	387933.658	3766898.881	1926.039	1925.971	Bare Earth/Open Terrain	-0.068
OT029	372568.520	3752102.205	1663.587	1663.555	Bare Earth/Open Terrain	-0.032
OT030	358877.904	3725654.403	1437.460	1437.598	Bare Earth/Open Terrain	0.138
OT031	337728.611	3722815.462	1447.603	1447.702	Bare Earth/Open Terrain	0.099
OT032	341767.902	3699436.736	1493.292	1493.250	Bare Earth/Open Terrain	-0.042





OT033	364655.555	3783003.714	1743.615	1743.621	Bare Earth/Open Terrain	0.006
OT034	299201.288	3902749.119	1951.062	1951.151	Bare Earth/Open Terrain	0.089
UR001	303378.839	3776741.320	1835.575	1835.624	Urban Terrain	0.049
UR002	304443.206	3768814.438	2010.327	2010.319	Urban Terrain	-0.008
UR003	311298.533	3740991.328	1594.718	1594.765	Urban Terrain	0.047
UR004	325783.403	3745279.834	1376.480	1376.542	Urban Terrain	0.062
UR005	325013.118	3742136.869	1376.144	1376.157	Urban Terrain	0.013
UR006	322627.959	3733171.030	1370.209	1370.304	Urban Terrain	0.095
UR007	339878.748	3751003.768	1528.243	1528.231	Urban Terrain	-0.012
UR008	333759.172	3781066.641	1559.473	1559.613	Urban Terrain	0.140
UR009	353996.193	3820056.796	1586.941	1586.907	Urban Terrain	-0.034
UR010	356074.157	3790470.092	1840.102	1840.050	Urban Terrain	-0.052
UR011	345456.015	3810509.138	1562.141	1562.059	Urban Terrain	-0.082
UR012	363308.935	3807806.264	1776.741	1776.809	Urban Terrain	0.068
UR013	355905.444	3829131.372	1603.622	1603.547	Urban Terrain	-0.075
UR014	319047.425	3814995.015	1585.493	1585.523	Urban Terrain	0.030
UR015	296120.672	3815800.017	1824.198	1824.236	Urban Terrain	0.038
UR016	300621.284	3819400.271	1750.427	1750.406	Urban Terrain	-0.021
UR017	314668.415	3817216.930	1642.688	1642.685	Urban Terrain	-0.003
UR018	383338.368	3869642.477	2181.424	2181.404	Urban Terrain	-0.020
UR019	300804.746	3909507.348	1873.595	1873.768	Urban Terrain	0.173
UR020	382196.736	3865242.874	2226.055	2225.975	Urban Terrain	-0.080
UR021	383057.476	3784767.977	1903.599	1903.618	Urban Terrain	0.019
UR022	373839.102	3766209.141	1687.865	1688.024	Urban Terrain	0.159
UR023	367324.641	3733482.611	1611.752	1611.765	Urban Terrain	0.013
UR024	352095.891	3736299.068	1458.178	1458.194	Urban Terrain	0.016
UR025	346318.292	3750661.424	1524.344	1524.409	Urban Terrain	0.065
UR026	349128.454	3724746.189	1435.500	1435.573	Urban Terrain	0.073
UR027	343403.114	3705768.516	1429.861	1429.773	Urban Terrain	-0.088
UR028	344277.604	3696340.124	1564.918	1564.962	Urban Terrain	0.044
UR029	361642.467	3718803.545	1481.051	1481.084	Urban Terrain	0.033
UR030	373033.699	3792275.553	1929.425	1929.468	Urban Terrain	0.043
UR031	364953.969	3748006.293	1581.308	1581.400	Urban Terrain	0.092
UR032	364949.762	3747995.991	1581.419	1581.537	Urban Terrain	0.118
UR033	364203.775	3766281.941	1607.678	1607.694	Urban Terrain	0.016
UR034	359070.724	3774288.810	1727.985	1728.040	Urban Terrain	0.055
UR035	391180.181	3774003.714	1952.848	1952.834	Urban Terrain	-0.014
UR036	350192.211	3705197.982	1449.973	1449.949	Urban Terrain	-0.024

Table 11: Lidar Point Cloud NVA Assessment



Non-vegetated Vertical Accuracy (NVA) Check Point Assessment (Bare-Earth)						
PointID	Easting	Northing	KnownZ	LaserZ	Description	DeltaZ
BE001	322549.192	4001747.811	2240.981	2240.965	Bare Earth/Open Terrain	-0.016
BE002	312491.311	3988270.335	2156.016	2156.053	Bare Earth/Open Terrain	0.037
BE003	321133.691	3977825.699	2039.367	2039.425	Bare Earth/Open Terrain	0.058
BE004	317663.314	3953091.300	1914.493	1914.611	Bare Earth/Open Terrain	0.118
BE005	303623.913	3945072.426	1867.109	1867.201	Bare Earth/Open Terrain	0.092
BE006	306295.603	3936711.876	1868.713	1868.777	Bare Earth/Open Terrain	0.064
BE007	290489.359	3911602.231	2084.458	2084.527	Bare Earth/Open Terrain	0.069
BE008	299454.380	3907730.603	1915.142	1915.253	Bare Earth/Open Terrain	0.111
BE009	382099.383	3866059.649	2257.744	2257.632	Bare Earth/Open Terrain	-0.112
BE010	378445.704	3859006.529	2300.240	2300.413	Bare Earth/Open Terrain	0.173
BE011	298176.527	3818930.113	1801.039	1801.007	Bare Earth/Open Terrain	-0.032
BE012	299596.629	3816085.510	1802.663	1802.708	Bare Earth/Open Terrain	0.045
BE013	314282.134	3766200.126	1721.361	1721.547	Bare Earth/Open Terrain	0.186
BE014	301952.662	3763448.930	2474.143	2474.211	Bare Earth/Open Terrain	0.068
BE015	312302.100	3751563.419	1747.390	1747.236	Bare Earth/Open Terrain	-0.154
BE016	316796.224	3730481.489	1364.103	1364.133	Bare Earth/Open Terrain	0.030
BE017	335864.466	3735239.031	1471.538	1471.527	Bare Earth/Open Terrain	-0.011
BE018	319825.452	3742334.085	1543.755	1543.838	Bare Earth/Open Terrain	0.083
BE019	319935.362	3742386.321	1543.551	1543.661	Bare Earth/Open Terrain	0.110
BE020	381063.195	3867023.827	2279.716	2279.585	Bare Earth/Open Terrain	-0.131
BE021	343242.371	3720649.257	1438.783	1438.855	Bare Earth/Open Terrain	0.072
BE022	349444.943	3743763.699	1483.370	1483.389	Bare Earth/Open Terrain	0.019
BE023	349772.426	3764724.422	1664.664	1664.608	Bare Earth/Open Terrain	-0.056
BE024	337509.811	3751343.034	1472.275	1472.382	Bare Earth/Open Terrain	0.107
BE025	379469.845	3755953.427	1770.038	1769.954	Bare Earth/Open Terrain	-0.084
BE026	376832.231	3771254.262	1768.548	1768.699	Bare Earth/Open Terrain	0.151
BE027	370379.542	3787509.799	1838.636	1838.651	Bare Earth/Open Terrain	0.015
BE028	370706.448	3787325.632	1839.226	1839.228	Bare Earth/Open Terrain	0.002
BE029	350002.148	3775872.895	1891.828	1891.797	Bare Earth/Open Terrain	-0.031
BE030	380218.872	3746156.395	1834.395	1834.317	Bare Earth/Open Terrain	-0.078
BE031	360896.606	3739968.097	1515.626	1515.647	Bare Earth/Open Terrain	0.021
BE032	348248.458	3716443.203	1431.108	1431.056	Bare Earth/Open Terrain	-0.052
BE033	342249.743	3693527.324	1625.125	1625.152	Bare Earth/Open Terrain	0.027
BE034	337472.515	3710045.324	1430.565	1430.546	Bare Earth/Open Terrain	-0.019
BE035	330766.018	3727656.991	1467.936	1467.994	Bare Earth/Open Terrain	0.058
OT001	350067.776	3815239.068	1560.850	1560.769	Bare Earth/Open Terrain	-0.081
OT002	369100.386	3803862.736	1890.226	1890.050	Bare Earth/Open Terrain	-0.176
OT003	349381.509	3796607.010	1728.254	1728.295	Bare Earth/Open Terrain	0.041
OT004	311354.887	3951340.522	1947.332	1947.413	Bare Earth/Open Terrain	0.081
OT005	335769.666	3772440.260	1576.698	1576.738	Bare Earth/Open Terrain	0.040



OT006	360481.133	3755423.346	1549.841	1549.769	Bare Earth/Open Terrain	-0.072
OT007	315505.371	3980934.393	2069.050	2069.045	Bare Earth/Open Terrain	-0.005
OT008	315954.230	3759605.282	1700.223	1700.331	Bare Earth/Open Terrain	0.108
OT009	355975.041	3833546.435	1605.051	1605.043	Bare Earth/Open Terrain	-0.008
OT010	310377.159	3769294.239	1845.315	1845.329	Bare Earth/Open Terrain	0.014
OT011	318537.173	3788969.695	1540.892	1540.960	Bare Earth/Open Terrain	0.068
OT012	315970.143	3812865.984	1676.532	1676.546	Bare Earth/Open Terrain	0.014
OT013	306612.952	3946360.884	1866.525	1866.624	Bare Earth/Open Terrain	0.099
OT014	308027.108	3935162.288	1794.520	1794.636	Bare Earth/Open Terrain	0.116
OT015	385386.702	3869323.196	2160.698	2160.578	Bare Earth/Open Terrain	-0.120
OT016	359973.900	3847365.970	1673.841	1673.829	Bare Earth/Open Terrain	-0.012
OT017	297953.345	3816024.194	1802.389	1802.437	Bare Earth/Open Terrain	0.048
OT018	306833.965	3903185.701	1861.981	1862.158	Bare Earth/Open Terrain	0.177
OT019	353645.056	3695458.852	1596.638	1596.643	Bare Earth/Open Terrain	0.005
OT020	356672.002	3712262.696	1441.410	1441.411	Bare Earth/Open Terrain	0.001
OT021	350870.864	3729330.857	1440.776	1440.883	Bare Earth/Open Terrain	0.107
OT022	350892.212	3754048.831	1547.576	1547.629	Bare Earth/Open Terrain	0.053
OT023	364901.031	3757973.303	1581.696	1581.688	Bare Earth/Open Terrain	-0.008
OT024	371065.117	3773212.719	1691.906	1691.956	Bare Earth/Open Terrain	0.050
OT025	382516.089	3773062.363	1845.836	1845.871	Bare Earth/Open Terrain	0.035
OT026	372798.361	3796257.149	1951.154	1951.193	Bare Earth/Open Terrain	0.039
OT027	360193.034	3767925.519	1654.193	1654.160	Bare Earth/Open Terrain	-0.033
OT028	387933.658	3766898.881	1926.039	1925.964	Bare Earth/Open Terrain	-0.075
OT029	372568.520	3752102.205	1663.587	1663.503	Bare Earth/Open Terrain	-0.084
OT030	358877.904	3725654.403	1437.460	1437.567	Bare Earth/Open Terrain	0.107
OT031	337728.611	3722815.462	1447.603	1447.702	Bare Earth/Open Terrain	0.099
OT032	341767.902	3699436.736	1493.292	1493.250	Bare Earth/Open Terrain	-0.042
OT033	364655.555	3783003.714	1743.615	1743.561	Bare Earth/Open Terrain	-0.054
OT034	299201.288	3902749.119	1951.062	1951.151	Bare Earth/Open Terrain	0.089
UR001	303378.839	3776741.320	1835.575	1835.624	Urban Terrain	0.049
UR002	304443.206	3768814.438	2010.327	2010.318	Urban Terrain	-0.009
UR003	311298.533	3740991.328	1594.718	1594.704	Urban Terrain	-0.014
UR004	325783.403	3745279.834	1376.480	1376.542	Urban Terrain	0.062
UR005	325013.118	3742136.869	1376.144	1376.125	Urban Terrain	-0.019
UR006	322627.959	3733171.030	1370.209	1370.304	Urban Terrain	0.095
UR007	339878.748	3751003.768	1528.243	1528.231	Urban Terrain	-0.012
UR008	333759.172	3781066.641	1559.473	1559.604	Urban Terrain	0.131
UR009	353996.193	3820056.796	1586.941	1586.907	Urban Terrain	-0.034
UR010	356074.157	3790470.092	1840.102	1840.046	Urban Terrain	-0.056
UR011	345456.015	3810509.138	1562.141	1562.057	Urban Terrain	-0.084
UR012	363308.935	3807806.264	1776.741	1776.787	Urban Terrain	0.046
UR013	355905.444	3829131.372	1603.622	1603.547	Urban Terrain	-0.075
UR014	319047.425	3814995.015	1585.493	1585.488	Urban Terrain	-0.005

UR015	296120.672	3815800.017	1824.198	1824.236	Urban Terrain	0.038
UR016	300621.284	3819400.271	1750.427	1750.406	Urban Terrain	-0.021
UR017	314668.415	3817216.930	1642.688	1642.685	Urban Terrain	-0.003
UR018	383338.368	3869642.477	2181.424	2181.387	Urban Terrain	-0.037
UR019	300804.746	3909507.348	1873.595	1873.713	Urban Terrain	0.118
UR020	382196.736	3865242.874	2226.055	2225.975	Urban Terrain	-0.080
UR021	383057.476	3784767.977	1903.599	1903.602	Urban Terrain	0.003
UR022	373839.102	3766209.141	1687.865	1687.971	Urban Terrain	0.106
UR023	367324.641	3733482.611	1611.752	1611.736	Urban Terrain	-0.016
UR024	352095.891	3736299.068	1458.178	1458.227	Urban Terrain	0.049
UR025	346318.292	3750661.424	1524.344	1524.395	Urban Terrain	0.051
UR026	349128.454	3724746.189	1435.500	1435.305	Urban Terrain	-0.195
UR027	343403.114	3705768.516	1429.861	1429.773	Urban Terrain	-0.088
UR028	344277.604	3696340.124	1564.918	1564.926	Urban Terrain	0.008
UR029	361642.467	3718803.545	1481.051	1481.042	Urban Terrain	-0.009
UR030	373033.699	3792275.553	1929.425	1929.467	Urban Terrain	0.042
UR031	364953.969	3748006.293	1581.308	1581.400	Urban Terrain	0.092
UR032	364949.762	3747995.991	1581.419	1581.537	Urban Terrain	0.118
UR033	364203.775	3766281.941	1607.678	1607.694	Urban Terrain	0.016
UR034	359070.724	3774288.810	1727.985	1728.003	Urban Terrain	0.018
UR035	391180.181	3774003.714	1952.848	1952.794	Urban Terrain	-0.054
UR036	350192.211	3705197.982	1449.973	1449.949	Urban Terrain	-0.024

Table 12: Bare Earth Lidar NVA Assessment

Non-vegetated Vertical Accuracy (NVA) Check Point Assessment (DEM)						
PointID	Easting	Northing	KnownZ	DEMZ	Description	DeltaZ
BE001	322549.192	4001747.811	2240.981	2240.894	Bare Earth/Open Terrain	-0.087
BE002	312491.311	3988270.335	2156.016	2155.964	Bare Earth/Open Terrain	-0.052
BE003	321133.691	3977825.699	2039.367	2039.336	Bare Earth/Open Terrain	-0.031
BE004	317663.314	3953091.300	1914.493	1914.531	Bare Earth/Open Terrain	0.038
BE005	303623.913	3945072.426	1867.109	1867.116	Bare Earth/Open Terrain	0.007
BE006	306295.603	3936711.876	1868.713	1868.702	Bare Earth/Open Terrain	-0.011
BE007	290489.359	3911602.231	2084.458	2084.453	Bare Earth/Open Terrain	-0.005
BE008	299454.380	3907730.603	1915.142	1915.174	Bare Earth/Open Terrain	0.032
BE009	382099.383	3866059.649	2257.744	2257.645	Bare Earth/Open Terrain	-0.099
BE010	378445.704	3859006.529	2300.240	2300.398	Bare Earth/Open Terrain	0.158
BE011	298176.527	3818930.113	1801.039	1800.941	Bare Earth/Open Terrain	-0.099
BE012	299596.629	3816085.510	1802.663	1802.618	Bare Earth/Open Terrain	-0.045
BE013	314282.134	3766200.126	1721.361	1721.471	Bare Earth/Open Terrain	0.110
BE014	301952.662	3763448.930	2474.143	2474.151	Bare Earth/Open Terrain	0.008
BE015	312302.100	3751563.419	1747.390	1747.174	Bare Earth/Open Terrain	-0.216
BE016	316796.224	3730481.489	1364.103	1364.074	Bare Earth/Open Terrain	-0.029
BE017	335864.466	3735239.031	1471.538	1471.503	Bare Earth/Open Terrain	-0.035
BE018	319825.452	3742334.085	1543.755	1543.793	Bare Earth/Open Terrain	0.038





BE019	319935.362	3742386.321	1543.551	1543.583	Bare Earth/Open Terrain	0.032
BE020	381063.195	3867023.827	2279.716	2279.576	Bare Earth/Open Terrain	-0.140
BE021	343242.371	3720649.257	1438.783	1438.801	Bare Earth/Open Terrain	0.018
BE022	349444.943	3743763.699	1483.370	1483.328	Bare Earth/Open Terrain	-0.042
BE023	349772.426	3764724.422	1664.664	1664.599	Bare Earth/Open Terrain	-0.065
BE024	337509.811	3751343.034	1472.275	1472.376	Bare Earth/Open Terrain	0.101
BE025	379469.845	3755953.427	1770.038	1769.881	Bare Earth/Open Terrain	-0.157
BE026	376832.231	3771254.262	1768.548	1768.629	Bare Earth/Open Terrain	0.081
BE027	370379.542	3787509.799	1838.636	1838.566	Bare Earth/Open Terrain	-0.070
BE028	370706.448	3787325.632	1839.226	1839.163	Bare Earth/Open Terrain	-0.063
BE029	350002.148	3775872.895	1891.828	1891.729	Bare Earth/Open Terrain	-0.100
BE030	380218.872	3746156.395	1834.395	1834.200	Bare Earth/Open Terrain	-0.195
BE031	360896.606	3739968.097	1515.626	1515.526	Bare Earth/Open Terrain	-0.100
BE032	348248.458	3716443.203	1431.108	1431.009	Bare Earth/Open Terrain	-0.099
BE033	342249.743	3693527.324	1625.125	1625.077	Bare Earth/Open Terrain	-0.048
BE034	337472.515	3710045.324	1430.565	1430.538	Bare Earth/Open Terrain	-0.027
BE035	330766.018	3727656.991	1467.936	1468.009	Bare Earth/Open Terrain	0.073
OT001	350067.776	3815239.068	1560.850	1560.751	Bare Earth/Open Terrain	-0.099
OT002	369100.386	3803862.736	1890.226	1890.079	Bare Earth/Open Terrain	-0.147
OT003	349381.509	3796607.010	1728.254	1728.177	Bare Earth/Open Terrain	-0.077
OT004	311354.887	3951340.522	1947.332	1947.328	Bare Earth/Open Terrain	-0.004
OT005	335769.666	3772440.260	1576.698	1576.731	Bare Earth/Open Terrain	0.033
OT006	360481.133	3755423.346	1549.841	1549.663	Bare Earth/Open Terrain	-0.178
OT007	315505.371	3980934.393	2069.050	2068.961	Bare Earth/Open Terrain	-0.089
OT008	315954.230	3759605.282	1700.223	1700.253	Bare Earth/Open Terrain	0.030
OT009	355975.041	3833546.435	1605.051	1605.027	Bare Earth/Open Terrain	-0.024
OT010	310377.159	3769294.239	1845.315	1845.247	Bare Earth/Open Terrain	-0.068
OT011	318537.173	3788969.695	1540.892	1540.882	Bare Earth/Open Terrain	-0.010
OT012	315970.143	3812865.984	1676.532	1676.478	Bare Earth/Open Terrain	-0.054
OT013	306612.952	3946360.884	1866.525	1866.529	Bare Earth/Open Terrain	0.004
OT014	308027.108	3935162.288	1794.520	1794.565	Bare Earth/Open Terrain	0.045
OT015	385386.702	3869323.196	2160.698	2160.560	Bare Earth/Open Terrain	-0.138
OT016	359973.900	3847365.970	1673.841	1673.772	Bare Earth/Open Terrain	-0.069
OT017	297953.345	3816024.194	1802.389	1802.337	Bare Earth/Open Terrain	-0.052
OT018	306833.965	3903185.701	1861.981	1862.078	Bare Earth/Open Terrain	0.097
OT019	353645.056	3695458.852	1596.638	1596.515	Bare Earth/Open Terrain	-0.123
OT020	356672.002	3712262.696	1441.410	1441.382	Bare Earth/Open Terrain	-0.028
OT021	350870.864	3729330.857	1440.776	1440.761	Bare Earth/Open Terrain	-0.015
OT022	350892.212	3754048.831	1547.576	1547.578	Bare Earth/Open Terrain	0.002
OT023	364901.031	3757973.303	1581.696	1581.632	Bare Earth/Open Terrain	-0.064
OT024	371065.117	3773212.719	1691.906	1691.861	Bare Earth/Open Terrain	-0.045
OT025	382516.089	3773062.363	1845.836	1845.782	Bare Earth/Open Terrain	-0.054
OT026	372798.361	3796257.149	1951.154	1951.131	Bare Earth/Open Terrain	-0.023



OT027	360193.034	3767925.519	1654.193	1654.091	Bare Earth/Open Terrain	-0.102
OT028	387933.658	3766898.881	1926.039	1925.891	Bare Earth/Open Terrain	-0.148
OT029	372568.520	3752102.205	1663.587	1663.471	Bare Earth/Open Terrain	-0.116
OT030	358877.904	3725654.403	1437.460	1437.500	Bare Earth/Open Terrain	0.040
OT031	337728.611	3722815.462	1447.603	1447.612	Bare Earth/Open Terrain	0.008
OT032	341767.902	3699436.736	1493.292	1493.180	Bare Earth/Open Terrain	-0.112
OT033	364655.555	3783003.714	1743.615	1743.500	Bare Earth/Open Terrain	-0.115
OT034	299201.288	3902749.119	1951.062	1951.069	Bare Earth/Open Terrain	0.007
UR001	303378.839	3776741.320	1835.575	1835.524	Urban Terrain	-0.051
UR002	304443.206	3768814.438	2010.327	2010.242	Urban Terrain	-0.085
UR003	311298.533	3740991.328	1594.718	1594.637	Urban Terrain	-0.081
UR004	325783.403	3745279.834	1376.480	1376.521	Urban Terrain	0.041
UR005	325013.118	3742136.869	1376.144	1376.044	Urban Terrain	-0.101
UR006	322627.959	3733171.030	1370.209	1370.213	Urban Terrain	0.004
UR007	339878.748	3751003.768	1528.243	1528.237	Urban Terrain	-0.006
UR008	333759.172	3781066.641	1559.473	1559.588	Urban Terrain	0.115
UR009	353996.193	3820056.796	1586.941	1586.912	Urban Terrain	-0.029
UR010	356074.157	3790470.092	1840.102	1840.064	Urban Terrain	-0.038
UR011	345456.015	3810509.138	1562.141	1562.039	Urban Terrain	-0.102
UR012	363308.935	3807806.264	1776.741	1776.676	Urban Terrain	-0.065
UR013	355905.444	3829131.372	1603.622	1603.550	Urban Terrain	-0.072
UR014	319047.425	3814995.015	1585.493	1585.419	Urban Terrain	-0.074
UR015	296120.672	3815800.017	1824.198	1824.144	Urban Terrain	-0.054
UR016	300621.284	3819400.271	1750.427	1750.341	Urban Terrain	-0.086
UR017	314668.415	3817216.930	1642.688	1642.621	Urban Terrain	-0.067
UR018	383338.368	3869642.477	2181.424	2181.388	Urban Terrain	-0.036
UR019	300804.746	3909507.348	1873.595	1873.640	Urban Terrain	0.045
UR020	382196.736	3865242.874	2226.055	2225.972	Urban Terrain	-0.084
UR021	383057.476	3784767.977	1903.599	1903.522	Urban Terrain	-0.077
UR022	373839.102	3766209.141	1687.865	1687.911	Urban Terrain	0.046
UR023	367324.641	3733482.611	1611.752	1611.634	Urban Terrain	-0.118
UR024	352095.891	3736299.068	1458.178	1458.101	Urban Terrain	-0.077
UR025	346318.292	3750661.424	1524.344	1524.321	Urban Terrain	-0.023
UR026	349128.454	3724746.189	1435.500	1435.357	Urban Terrain	-0.143
UR027	343403.114	3705768.516	1429.861	1429.750	Urban Terrain	-0.111
UR028	344277.604	3696340.124	1564.918	1564.884	Urban Terrain	-0.034
UR029	361642.467	3718803.545	1481.051	1480.919	Urban Terrain	-0.132
UR030	373033.699	3792275.553	1929.425	1929.423	Urban Terrain	-0.002
UR031	364953.969	3748006.293	1581.308	1581.351	Urban Terrain	0.043
UR032	364949.762	3747995.991	1581.419	1581.467	Urban Terrain	0.048
UR033	364203.775	3766281.941	1607.678	1607.578	Urban Terrain	-0.100
UR034	359070.724	3774288.810	1727.985	1727.949	Urban Terrain	-0.036
UR035	391180.181	3774003.714	1952.848	1952.709	Urban Terrain	-0.139



UR036	350192.211	3705197.982	1449.973	1449.938	Urban Terrain	-0.035
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Table 13: Bare Earth DEM NVA Assessment

Vegetated Vertical Accuracy (VVA) Check Point Assessment (Bare Earth)						
PointID	Easting	Northing	KnownZ	LaserZ	Description	DeltaZ
BR001	343795.497	3798383.006	1649.409	1649.317	Brush	-0.092
BR002	313339.334	3744154.733	1620.207	1620.358	Brush	0.151
BR003	320326.664	3736380.403	1405.435	1405.590	Brush	0.155
BR004	337111.423	3763377.196	1593.595	1593.754	Brush	0.159
BR005	343268.445	3788214.860	1727.405	1727.286	Brush	-0.119
BR006	342319.759	3809202.697	1531.263	1531.198	Brush	-0.065
BR007	353245.893	3810894.491	1596.959	1596.914	Brush	-0.045
BR008	368528.225	3810620.322	1766.650	1766.775	Brush	0.125
BR009	356445.446	3824515.810	1599.670	1599.658	Brush	-0.012
BR010	322485.878	4005907.591	2267.551	2267.599	Brush	0.048
BR011	303267.288	3821150.780	1732.435	1732.489	Brush	0.054
BR012	384222.639	3866089.335	2227.578	2227.660	Brush	0.082
BR013	380626.798	3861594.689	2326.324	2326.164	Brush	-0.160
BR014	302438.616	3904075.793	1949.764	1949.922	Brush	0.158
BR015	387894.374	3798861.290	2041.882	2042.572	Brush	0.690
BR016	361305.661	3776238.460	1694.850	1694.909	Brush	0.059
BR017	369560.698	3761110.821	1628.575	1628.646	Brush	0.071
BR018	383363.394	3753055.897	1899.382	1899.166	Brush	-0.216
BR019	369840.751	3739043.069	1674.536	1674.552	Brush	0.016
BR020	359681.520	3721576.019	1453.645	1453.723	Brush	0.078
BR021	351833.485	3721225.692	1427.830	1427.875	Brush	0.045
BR022	337553.631	3712820.343	1434.732	1434.844	Brush	0.112
BR023	357932.076	3748604.014	1516.683	1516.780	Brush	0.097
BR024	385626.420	3777412.440	1901.768	1901.699	Brush	-0.069
BR025	363789.431	3791221.098	1869.882	1869.822	Brush	-0.060
BR026	363798.890	3791220.352	1869.562	1869.477	Brush	-0.085
BR027	337744.449	3728043.791	1455.230	1455.274	Brush	0.044
BR028	356445.420	3824515.817	1599.673	1599.658	Brush	-0.015
HG001	307782.643	3773036.216	1854.548	1854.711	High Grass	0.163
HG002	319363.186	3764389.656	1585.435	1585.355	High Grass	-0.080
HG003	304691.205	3747577.262	1816.173	1816.290	High Grass	0.117
HG004	311974.291	3979498.109	2114.569	2114.632	High Grass	0.063
HG005	338188.882	3746208.250	1546.488	1546.344	High Grass	-0.144
HG006	339422.470	3801343.163	1595.327	1595.170	High Grass	-0.157
HG007	360902.020	3808209.324	1836.230	1836.455	High Grass	0.225
HG008	312894.682	3819897.238	1637.290	1637.115	High Grass	-0.175
HG009	298530.596	3820820.102	1839.666	1839.617	High Grass	-0.049
HG010	320506.634	3981792.255	2058.348	2058.399	High Grass	0.051
HG011	382269.123	3864459.650	2252.360	2252.339	High Grass	-0.021



HG012	321975.851	3971446.703	2010.212	2010.341	High Grass	0.129
HG013	361743.502	3761624.040	1584.479	1584.516	High Grass	0.037
HG014	347268.945	3762156.118	1648.249	1648.199	High Grass	-0.050
HG015	357590.908	3746955.104	1515.437	1515.400	High Grass	-0.037
HG016	364694.526	3725958.948	1540.965	1540.943	High Grass	-0.022
HG017	363515.019	3734616.219	1531.829	1531.894	High Grass	0.065
HG018	344755.177	3736568.250	1457.015	1457.071	High Grass	0.056
HG019	344558.414	3685789.452	1811.482	1811.647	High Grass	0.165
HG020	353676.099	3702799.376	1488.236	1488.204	High Grass	-0.032
HG021	354026.392	3698768.022	1537.865	1537.933	High Grass	0.068
HG022	380278.425	3777977.739	1833.728	1833.860	High Grass	0.132
HG023	388188.887	3760048.636	1897.636	1897.600	High Grass	-0.036
HG024	374574.164	3762366.616	1690.575	1690.599	High Grass	0.024
HG025	344052.092	3716363.734	1439.850	1439.923	High Grass	0.073
HG026	359917.469	3820090.938	1686.136	1686.163	High Grass	0.027
HG027	359365.968	3830131.231	1715.314	1715.275	High Grass	-0.039
TR001	321426.851	3998107.060	2183.788	2183.837	Trees	0.049
TR002	312368.897	3995259.112	2210.373	2210.567	Trees	0.194
TR003	307663.810	3939123.553	1868.497	1868.603	Trees	0.106
TR004	294618.775	3910753.499	1956.472	1956.488	Trees	0.016
TR005	292732.885	3912195.006	2001.813	2001.860	Trees	0.047
TR006	309203.264	3904861.875	1830.174	1830.181	Trees	0.007
TR007	355461.841	3842074.877	1588.479	1588.462	Trees	-0.017
TR008	359891.642	3827107.438	1708.593	1708.674	Trees	0.081
TR009	360336.730	3810490.346	1738.600	1738.544	Trees	-0.056
TR010	342881.594	3814707.839	1519.953	1519.890	Trees	-0.063
TR011	352591.281	3790895.129	1783.708	1783.628	Trees	-0.080
TR012	307658.529	3820299.206	1691.888	1691.904	Trees	0.016
TR013	296128.449	3815767.518	1825.183	1825.147	Trees	-0.036
TR014	325281.943	3727953.446	1486.219	1486.390	Trees	0.171
TR015	306847.435	3751673.939	1915.733	1915.834	Trees	0.101
TR016	368928.138	3775556.922	1687.508	1687.522	Trees	0.014
TR017	355908.320	3763026.706	1681.785	1681.754	Trees	-0.031
TR018	371518.856	3758182.309	1649.224	1649.271	Trees	0.047
TR019	382798.927	3742838.477	1930.719	1930.612	Trees	-0.107
TR020	344927.181	3747021.839	1540.921	1540.905	Trees	-0.016
TR021	361530.399	3731701.695	1485.366	1485.482	Trees	0.116
TR022	347722.385	3721590.508	1438.219	1438.362	Trees	0.143
TR023	345370.210	3710259.281	1429.080	1428.992	Trees	-0.088
TR024	332590.254	3731616.629	1461.359	1461.528	Trees	0.169
TR025	387892.840	3783727.263	1953.773	1953.768	Trees	-0.005
TR026	381094.317	3800748.515	2113.940	2113.998	Trees	0.058
TR027	349251.740	3691995.313	1672.433	1672.518	Trees	0.085





TR028	360345.401	3810461.773	1739.573	1739.611	Trees	0.038
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Table 15: Bare Earth Lidar VVA Assessment

Vegetated Vertical Accuracy (VVA) Check Point Assessment (DEM)						
PointID	Easting	Northing	KnownZ	LaserZ	Description	DeltaZ
BR001	343795.497	3798383.006	1649.409	1649.308	Brush	0.101
BR002	313339.334	3744154.733	1620.207	1620.270	Brush	-0.063
BR003	320326.664	3736380.403	1405.435	1405.525	Brush	-0.090
BR004	337111.423	3763377.196	1593.595	1593.762	Brush	-0.167
BR005	343268.445	3788214.860	1727.405	1727.289	Brush	0.116
BR006	342319.759	3809202.697	1531.263	1531.199	Brush	0.064
BR007	353245.893	3810894.491	1596.959	1596.896	Brush	0.063
BR008	368528.225	3810620.322	1766.650	1766.696	Brush	-0.046
BR009	356445.446	3824515.810	1599.670	1599.674	Brush	-0.004
BR010	322485.878	4005907.591	2267.551	2267.521	Brush	0.030
BR011	303267.288	3821150.780	1732.435	1732.413	Brush	0.022
BR012	384222.639	3866089.335	2227.578	2227.674	Brush	-0.096
BR013	380626.798	3861594.689	2326.324	2326.149	Brush	0.175
BR014	302438.616	3904075.793	1949.764	1949.840	Brush	-0.076
BR015	387894.374	3798861.290	2041.882	2042.482	Brush	-0.600
BR016	361305.661	3776238.460	1694.850	1694.810	Brush	0.040
BR017	369560.698	3761110.821	1628.575	1628.586	Brush	-0.011
BR018	383363.394	3753055.897	1899.382	1899.080	Brush	0.302
BR019	369840.751	3739043.069	1674.536	1674.449	Brush	0.087
BR020	359681.520	3721576.019	1453.645	1453.616	Brush	0.029
BR021	351833.485	3721225.692	1427.830	1427.814	Brush	0.016
BR022	337553.631	3712820.343	1434.732	1434.772	Brush	-0.040
BR023	357932.076	3748604.014	1516.683	1516.632	Brush	0.051
BR024	385626.420	3777412.440	1901.768	1901.611	Brush	0.157
BR025	363789.431	3791221.098	1869.882	1869.784	Brush	0.098
BR026	363798.890	3791220.352	1869.562	1869.443	Brush	0.119
BR027	337744.449	3728043.791	1455.230	1455.217	Brush	0.013
BR028	356445.420	3824515.817	1599.673	1599.674	Brush	-0.001
HG001	307782.643	3773036.216	1854.548	1854.654	High Grass	-0.106
HG002	319363.186	3764389.656	1585.435	1585.276	High Grass	0.159
HG003	304691.205	3747577.262	1816.173	1816.211	High Grass	-0.038
HG004	311974.291	3979498.109	2114.569	2114.568	High Grass	0.001
HG005	338188.882	3746208.250	1546.488	1546.329	High Grass	0.159
HG006	339422.470	3801343.163	1595.327	1595.231	High Grass	0.096
HG007	360902.020	3808209.324	1836.230	1836.412	High Grass	-0.182
HG008	312894.682	3819897.238	1637.290	1637.046	High Grass	0.244

HG009	298530.596	3820820.102	1839.666	1839.548	High Grass	0.118
HG010	320506.634	3981792.255	2058.348	2058.317	High Grass	0.031
HG011	382269.123	3864459.650	2252.360	2252.330	High Grass	0.030
HG012	321975.851	3971446.703	2010.212	2010.337	High Grass	-0.125
HG013	361743.502	3761624.040	1584.479	1584.414	High Grass	0.065
HG014	347268.945	3762156.118	1648.249	1648.138	High Grass	0.111
HG015	357590.908	3746955.104	1515.437	1515.256	High Grass	0.181
HG016	364694.526	3725958.948	1540.965	1540.813	High Grass	0.152
HG017	363515.019	3734616.219	1531.829	1531.802	High Grass	0.027
HG018	344755.177	3736568.250	1457.015	1456.964	High Grass	0.051
HG019	344558.414	3685789.452	1811.482	1811.549	High Grass	-0.067
HG020	353676.099	3702799.376	1488.236	1488.153	High Grass	0.083
HG021	354026.392	3698768.022	1537.865	1537.773	High Grass	0.092
HG022	380278.425	3777977.739	1833.728	1833.745	High Grass	-0.017
HG023	388188.887	3760048.636	1897.636	1897.515	High Grass	0.121
HG024	374574.164	3762366.616	1690.575	1690.525	High Grass	0.050
HG025	344052.092	3716363.734	1439.850	1439.844	High Grass	0.006
HG026	359917.469	3820090.938	1686.136	1686.148	High Grass	-0.012
HG027	359365.968	3830131.231	1715.314	1715.266	High Grass	0.048
TR001	321426.851	3998107.060	2183.788	2183.716	Trees	0.072
TR002	312368.897	3995259.112	2210.373	2210.441	Trees	-0.068
TR003	307663.810	3939123.553	1868.497	1868.523	Trees	-0.026
TR004	294618.775	3910753.499	1956.472	1956.425	Trees	0.047
TR005	292732.885	3912195.006	2001.813	2001.774	Trees	0.040
TR006	309203.264	3904861.875	1830.174	1830.093	Trees	0.081
TR007	355461.841	3842074.877	1588.479	1588.470	Trees	0.009
TR008	359891.642	3827107.438	1708.593	1708.720	Trees	-0.127
TR009	360336.730	3810490.346	1738.600	1738.469	Trees	0.131
TR010	342881.594	3814707.839	1519.953	1519.894	Trees	0.059
TR011	352591.281	3790895.129	1783.708	1783.536	Trees	0.172
TR012	307658.529	3820299.206	1691.888	1691.828	Trees	0.061
TR013	296128.449	3815767.518	1825.183	1825.076	Trees	0.107
TR014	325281.943	3727953.446	1486.219	1486.276	Trees	-0.057
TR015	306847.435	3751673.939	1915.733	1915.760	Trees	-0.027
TR016	368928.138	3775556.922	1687.508	1687.450	Trees	0.058
TR017	355908.320	3763026.706	1681.785	1681.614	Trees	0.171
TR018	371518.856	3758182.309	1649.224	1649.153	Trees	0.071
TR019	382798.927	3742838.477	1930.719	1930.522	Trees	0.197
TR020	344927.181	3747021.839	1540.921	1540.916	Trees	0.005
TR021	361530.399	3731701.695	1485.366	1485.411	Trees	-0.045



<b>TR022</b>	347722.385	3721590.508	1438.219	1438.210	Trees	0.010
<b>TR023</b>	345370.210	3710259.281	1429.080	1428.930	Trees	0.150
<b>TR024</b>	332590.254	3731616.629	1461.359	1461.494	Trees	-0.135
<b>TR025</b>	387892.840	3783727.263	1953.773	1953.690	Trees	0.083
<b>TR026</b>	381094.317	3800748.515	2113.940	2113.914	Trees	0.026
<b>TR027</b>	349251.740	3691995.313	1672.433	1672.517	Trees	-0.084
<b>TR028</b>	360345.401	3810461.773	1739.573	1739.498	Trees	0.075

Table 15: Bare Earth DEM VVA Assessment

## Section 4: Certification

### 4.1 Limitations of Use

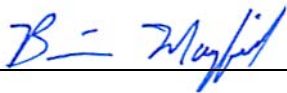
The accuracy assessment confirms that the data may be used for the intended applications stated in the **Project Purpose** section of this document. The dataset may also be used as a topographic input for other applications but the user should be aware that this lidar dataset was designed with a specific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

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





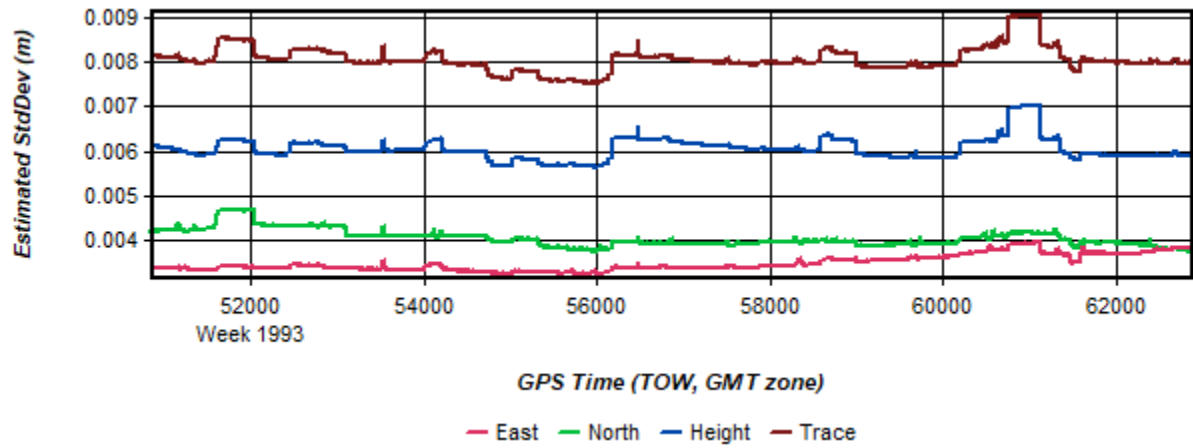
## Section 5: GNSS Processing

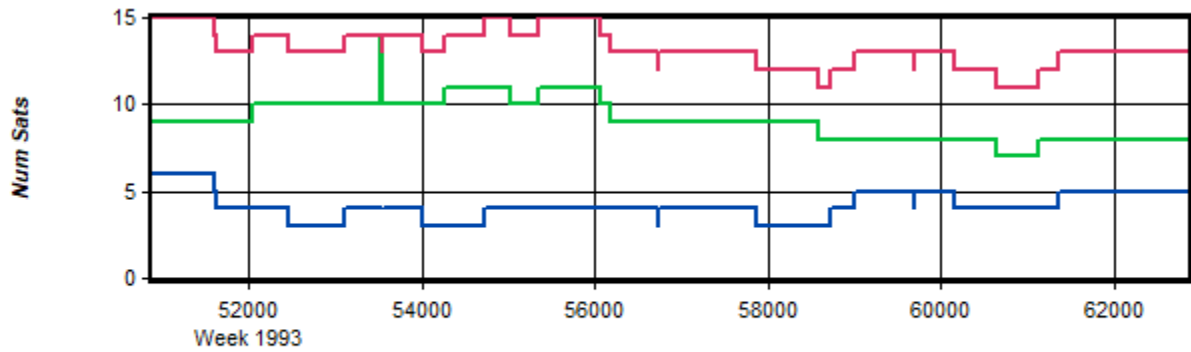
Inertial Explorer version 8.60.6717

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

<b>Coverage Map</b>	The Coverage Map plot shows the Aircraft GNSS-IMU Trajectory in reference to localized GNSS Reference Stations.
<b>Estimated Position Accuracy</b>	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.
<b>Number of Satellites</b>	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.
<b>Combined Separation</b>	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.
<b>PDOP</b>	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.

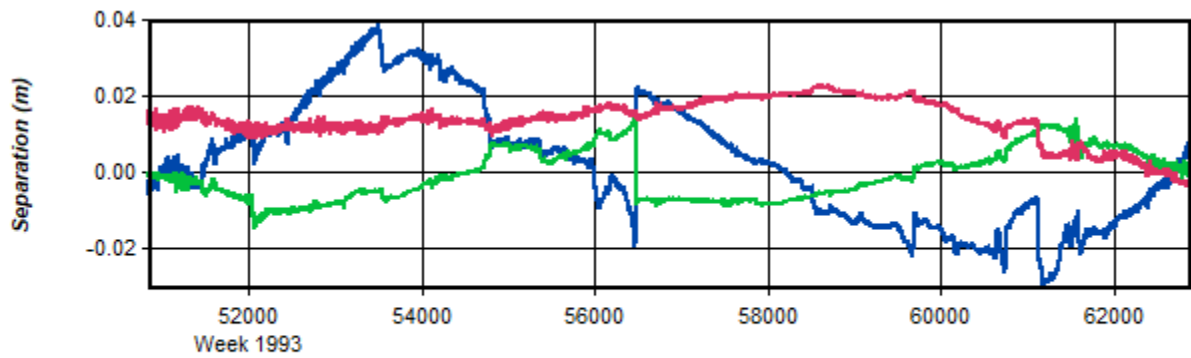
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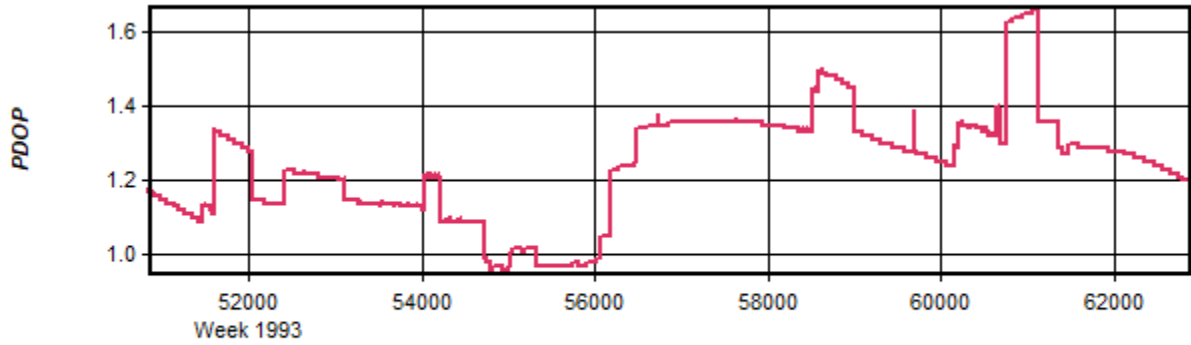
GPS Time (TOW, GMT zone)

— Num Sats — GPS — GLONASS — BeiDou



GPS Time (TOW, GMT zone)

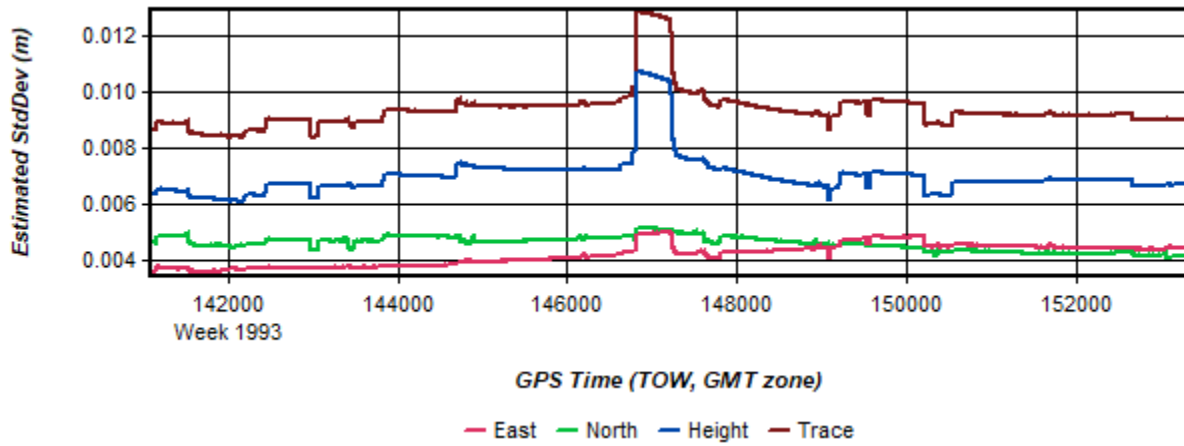
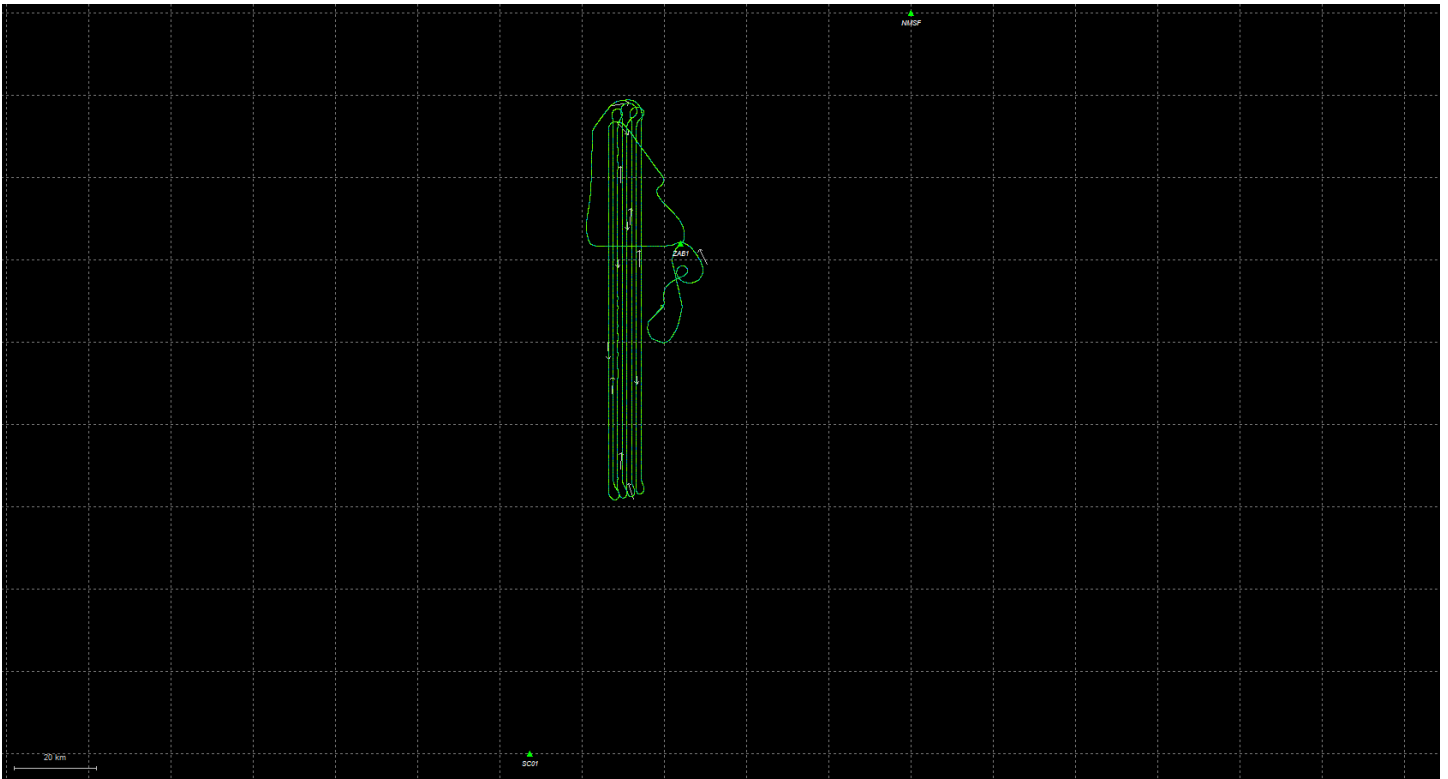
— East — North — Up



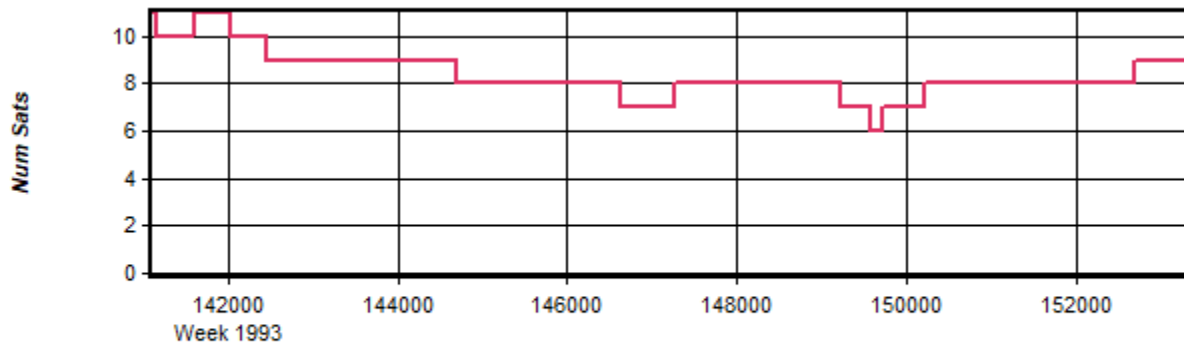
GPS Time (TOW, GMT zone)

— PDOP

123\_20180319\_2

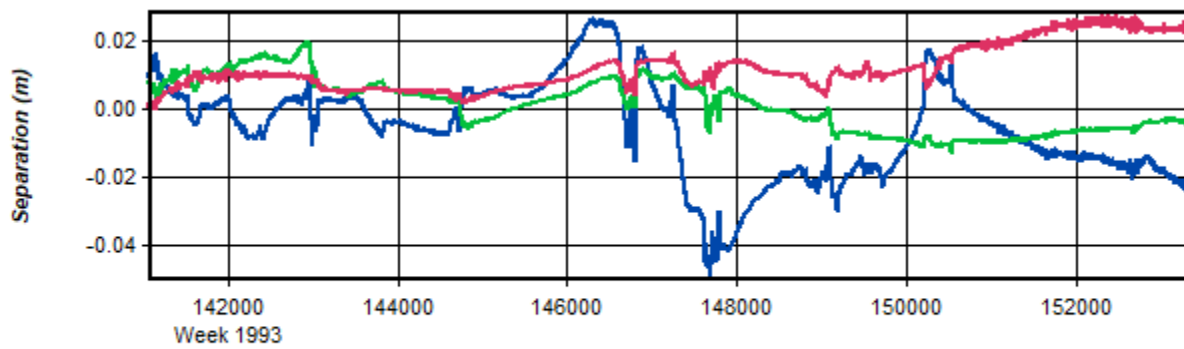






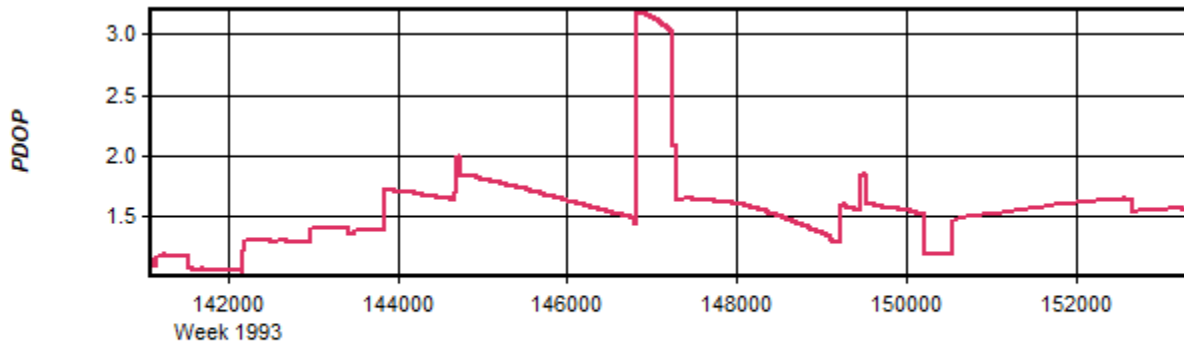
GPS Time (TOW, GMT zone)

— Num Sats — GPS — GLONASS — BeiDou



GPS Time (TOW, GMT zone)

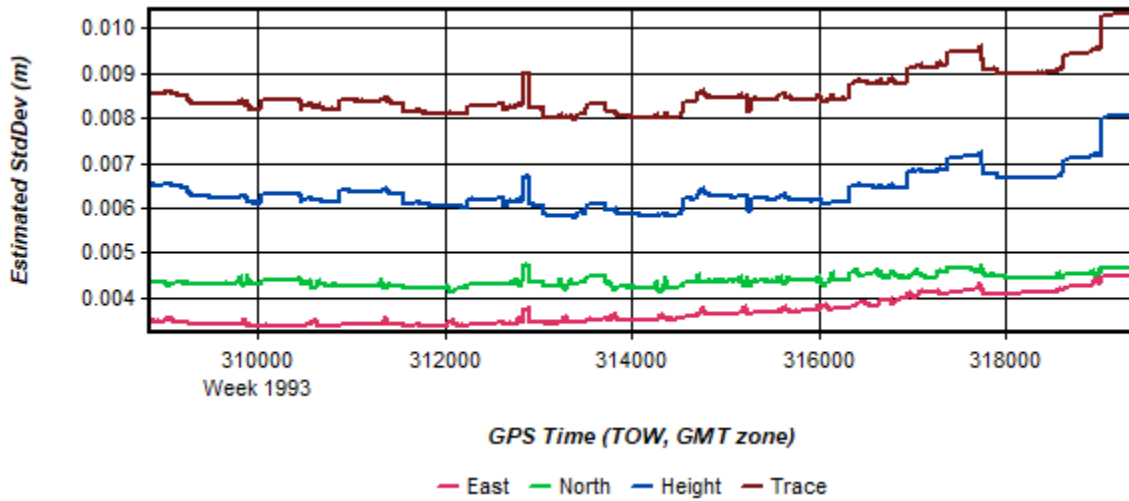
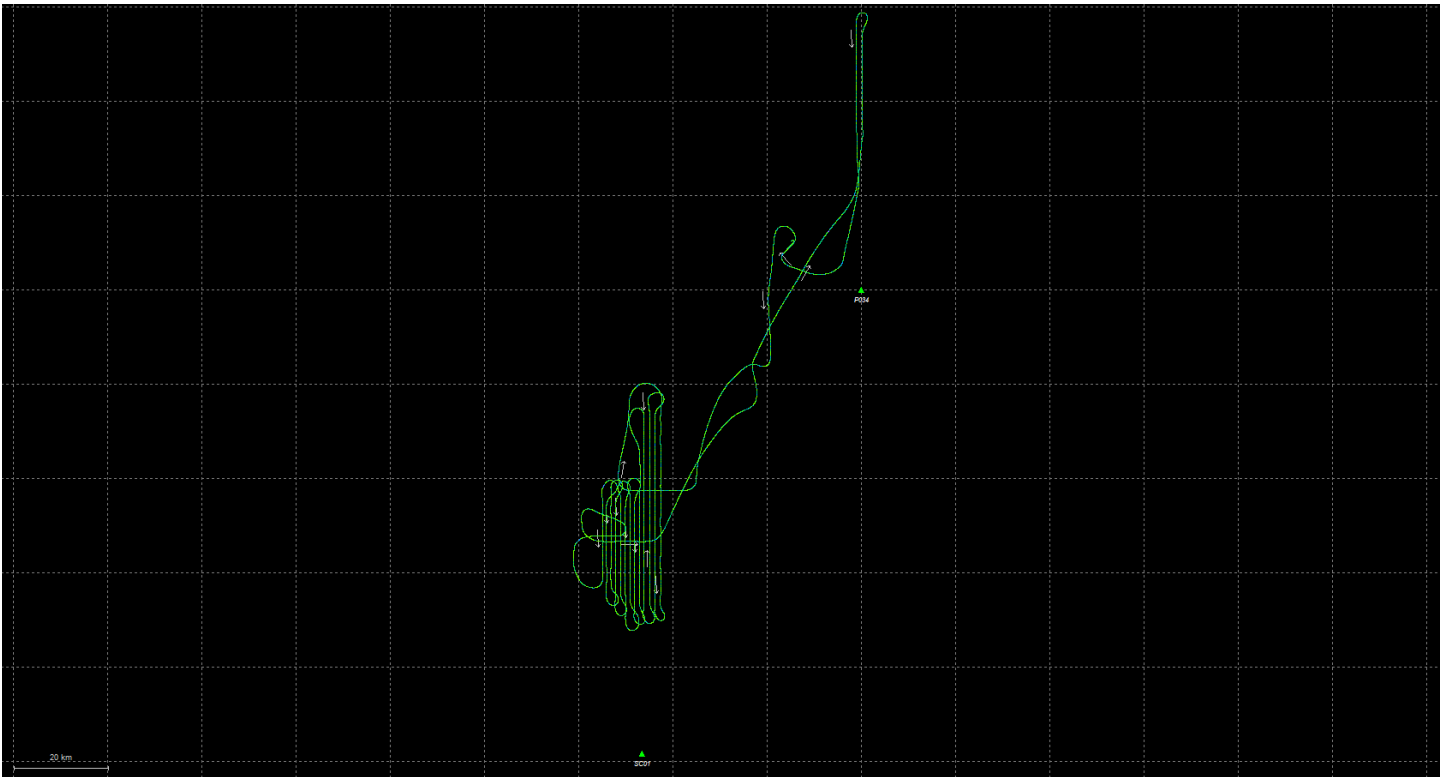
— East — North — Up

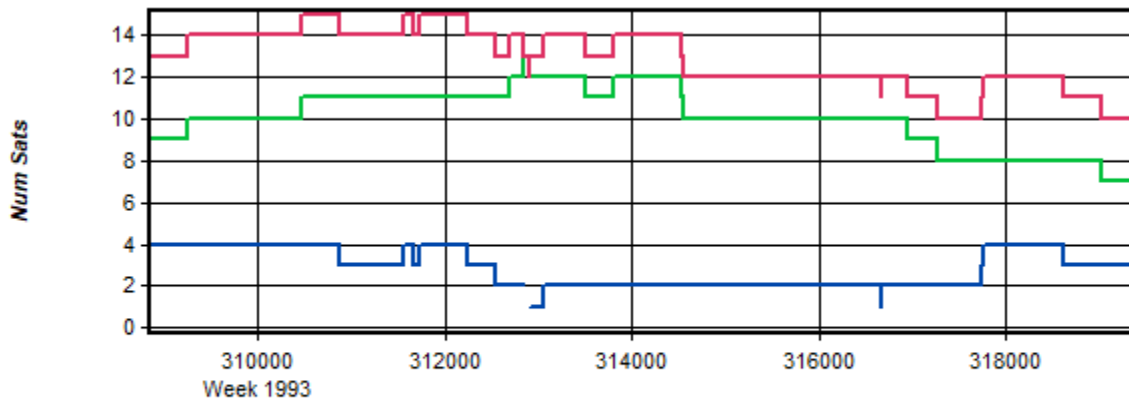


GPS Time (TOW, GMT zone)

— PDOP

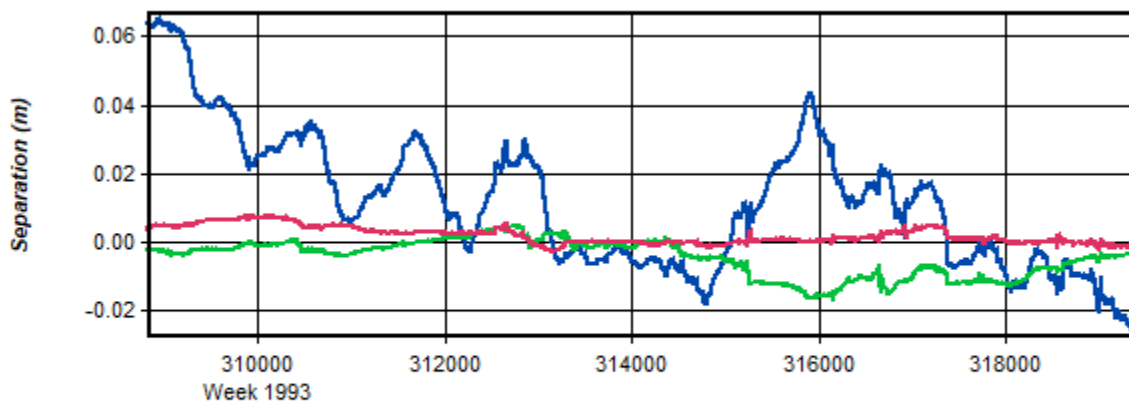
123\_20180321\_1





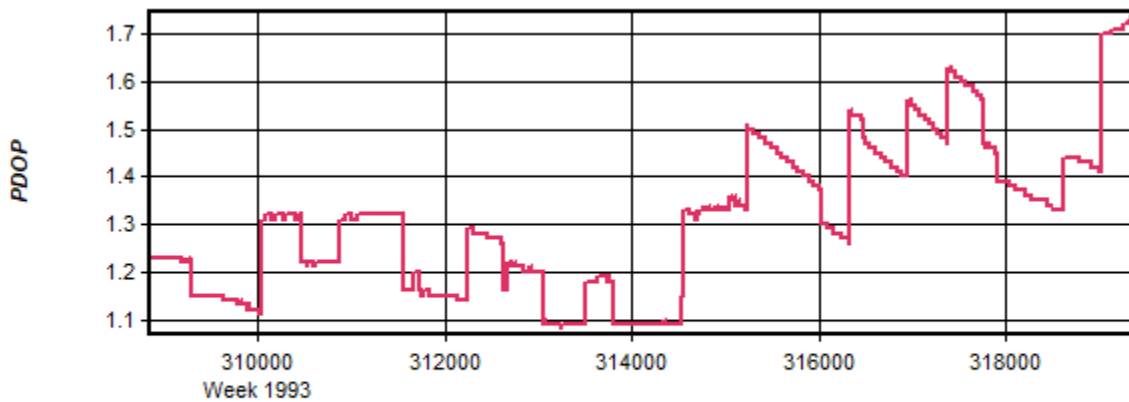
GPS Time (TOW, GMT zone)

— Num Sats — GPS — GLONASS — BeiDou



GPS Time (TOW, GMT zone)

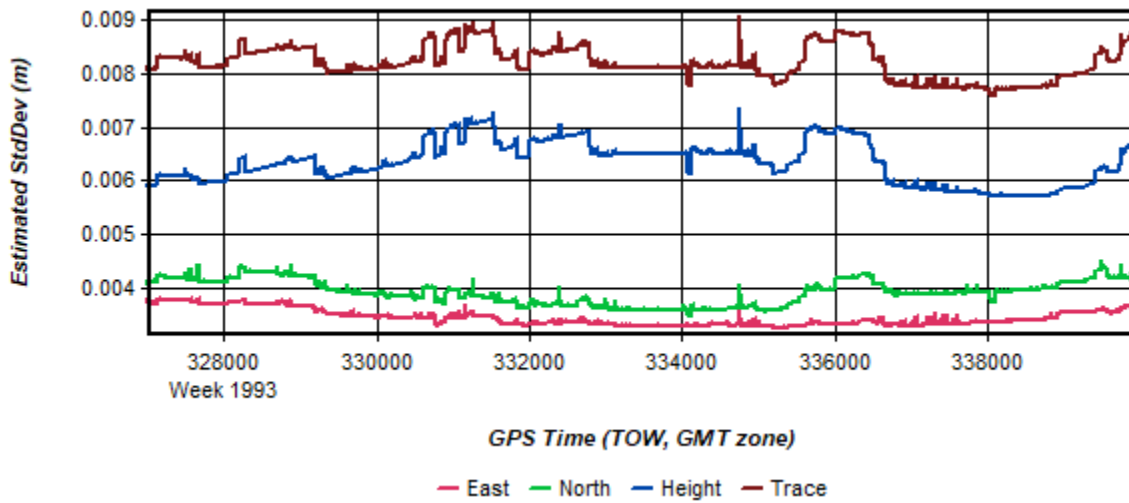
— East — North — Up



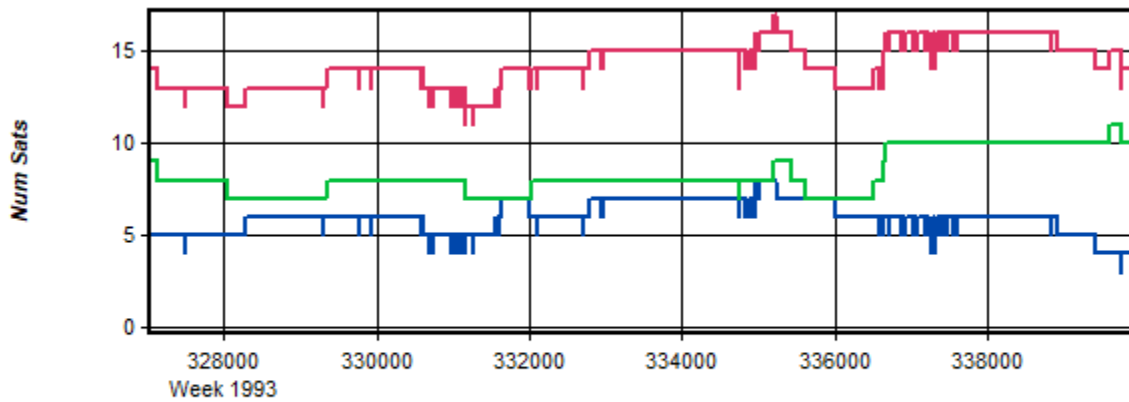
GPS Time (TOW, GMT zone)

— PDOP

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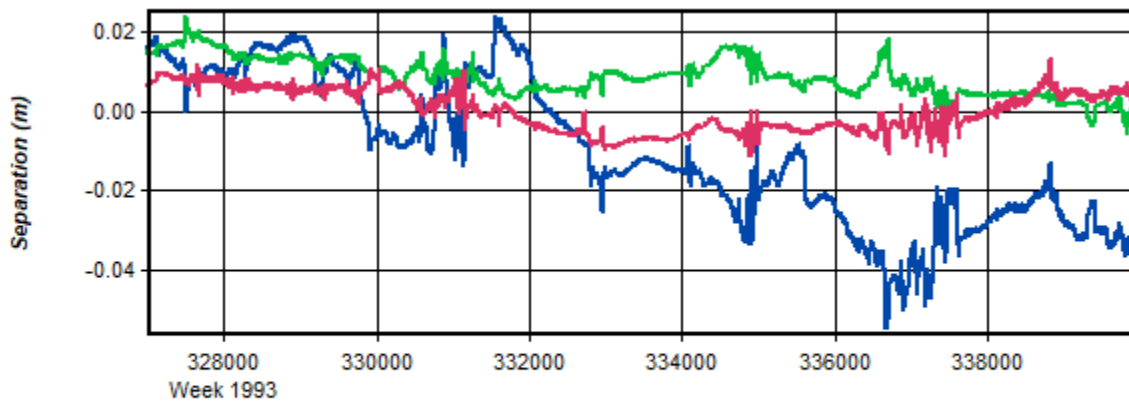






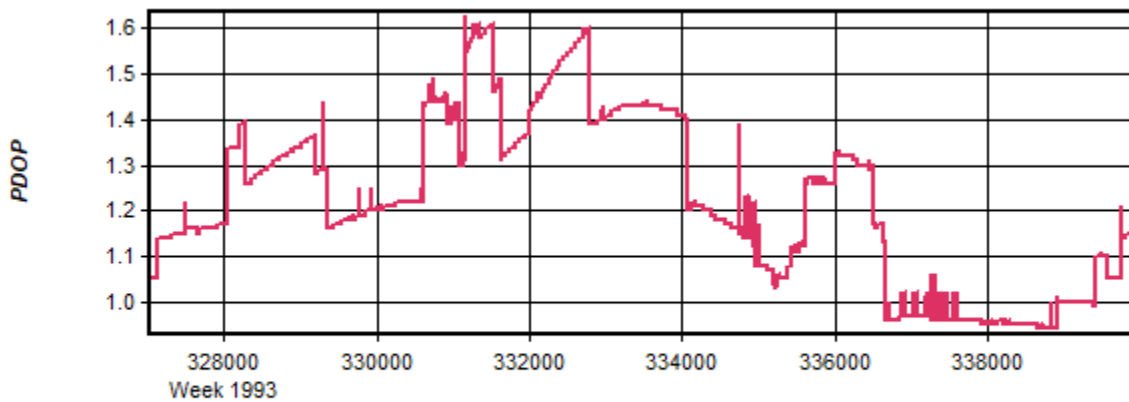
GPS Time (TOW, GMT zone)

— Num Sats — GPS — GLONASS — BeiDou



GPS Time (TOW, GMT zone)

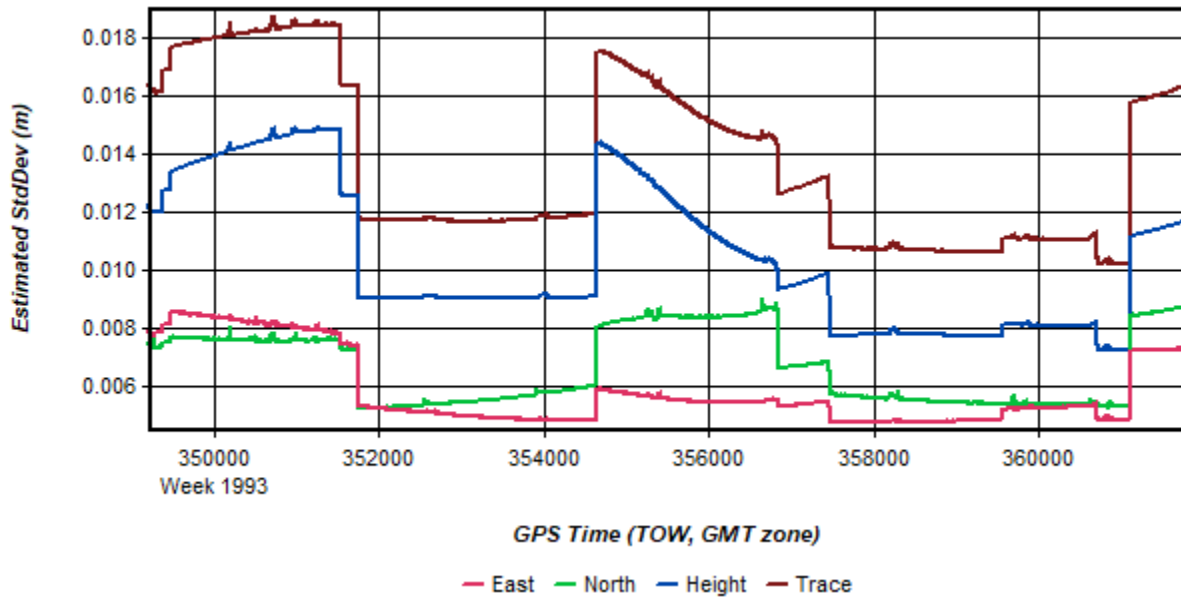
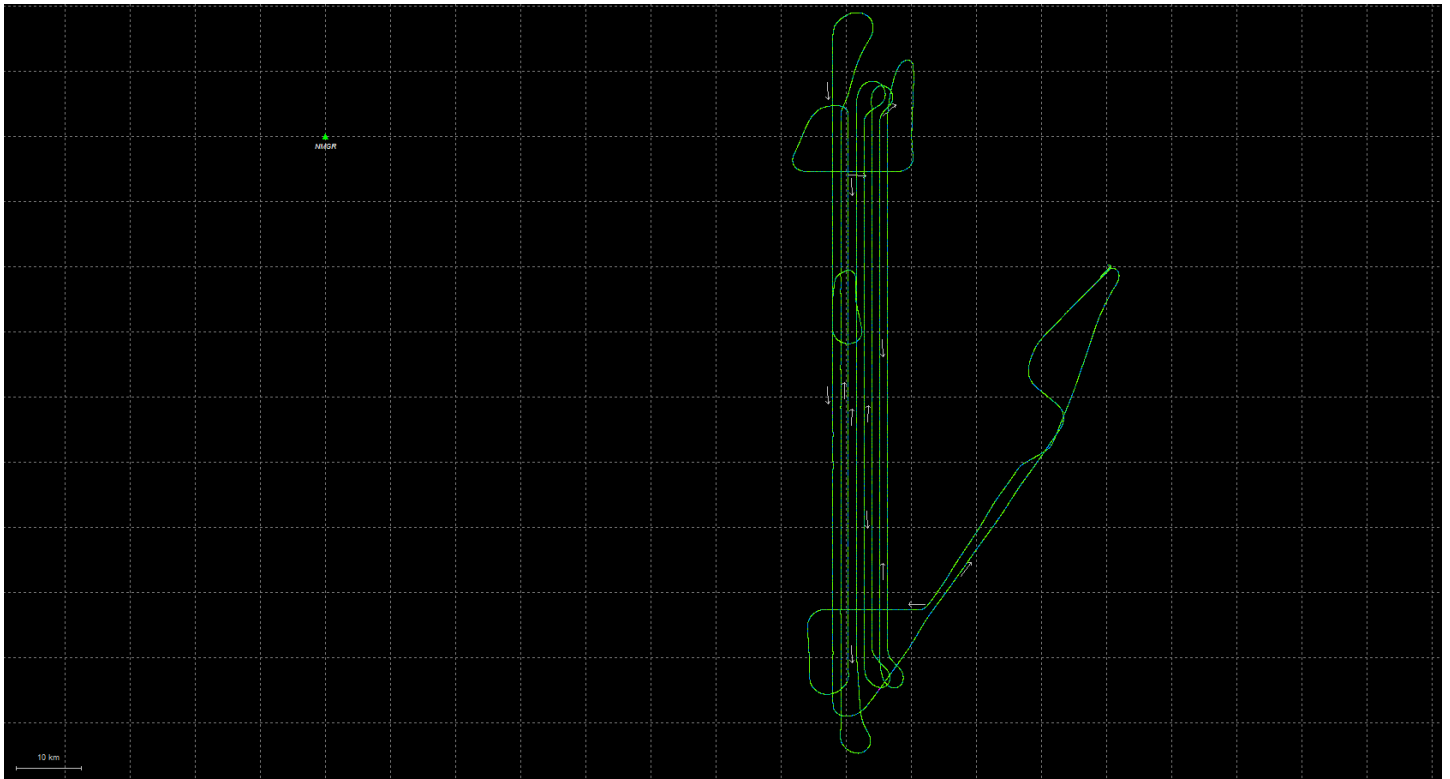
— East — North — Up

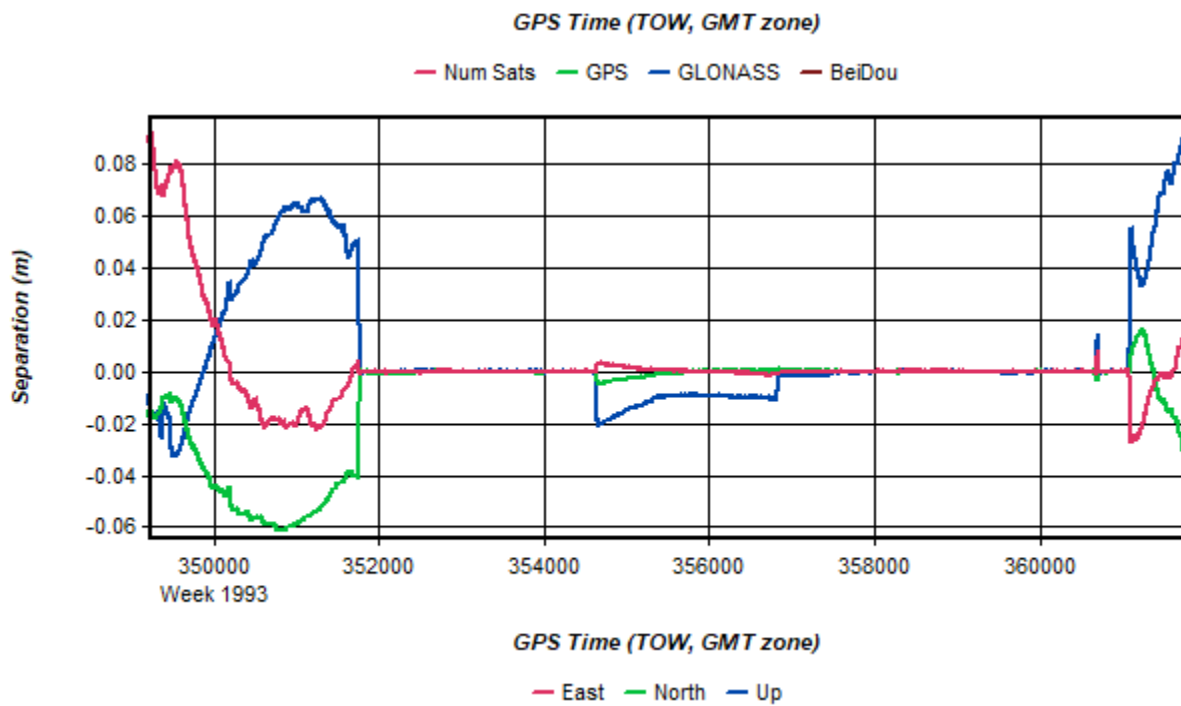
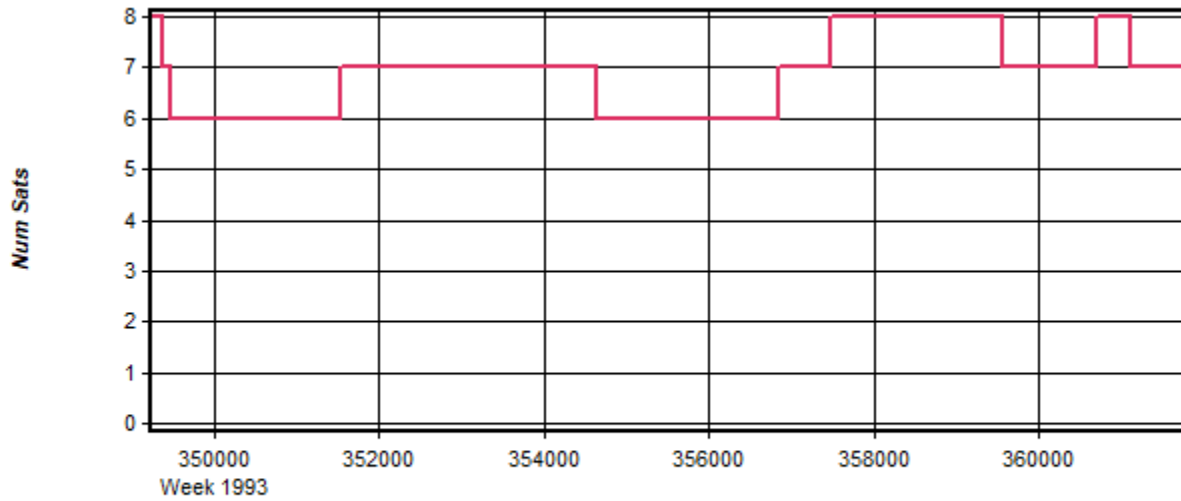


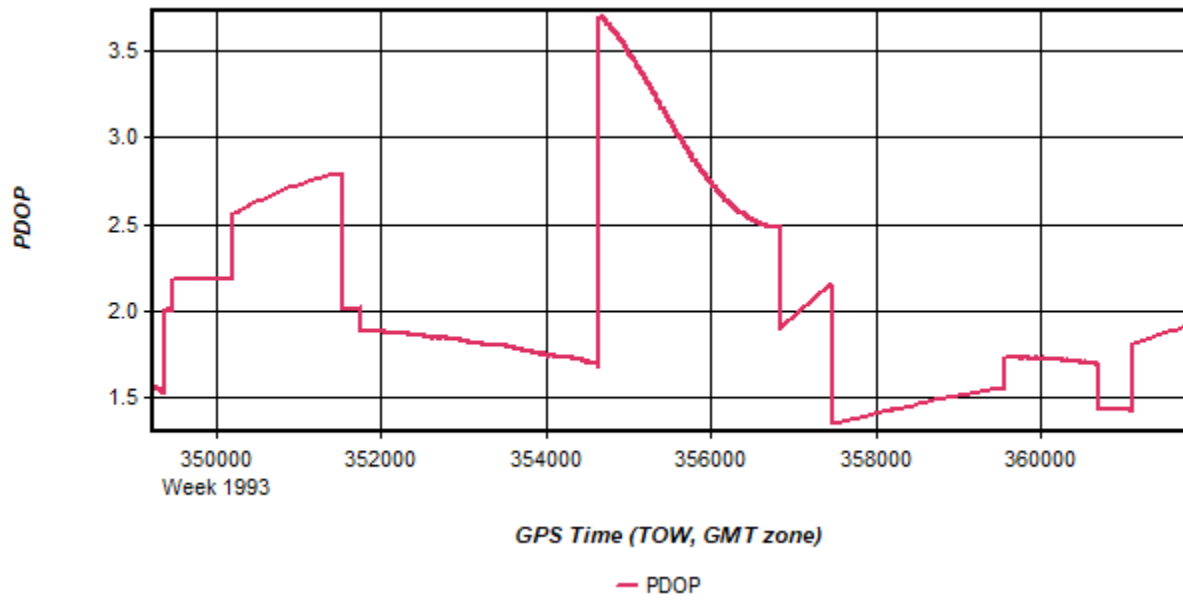
GPS Time (TOW, GMT zone)

— PDOP

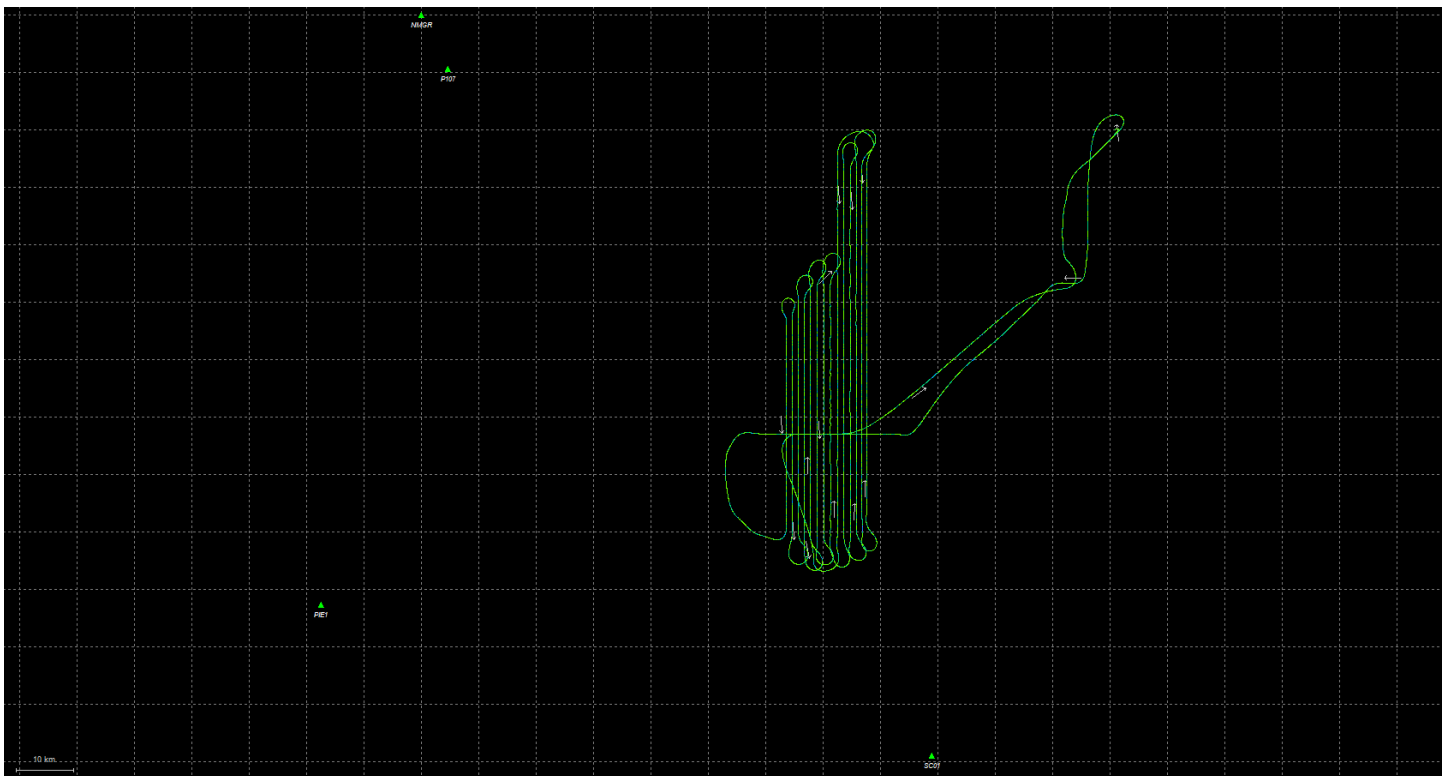
123\_20180321\_3



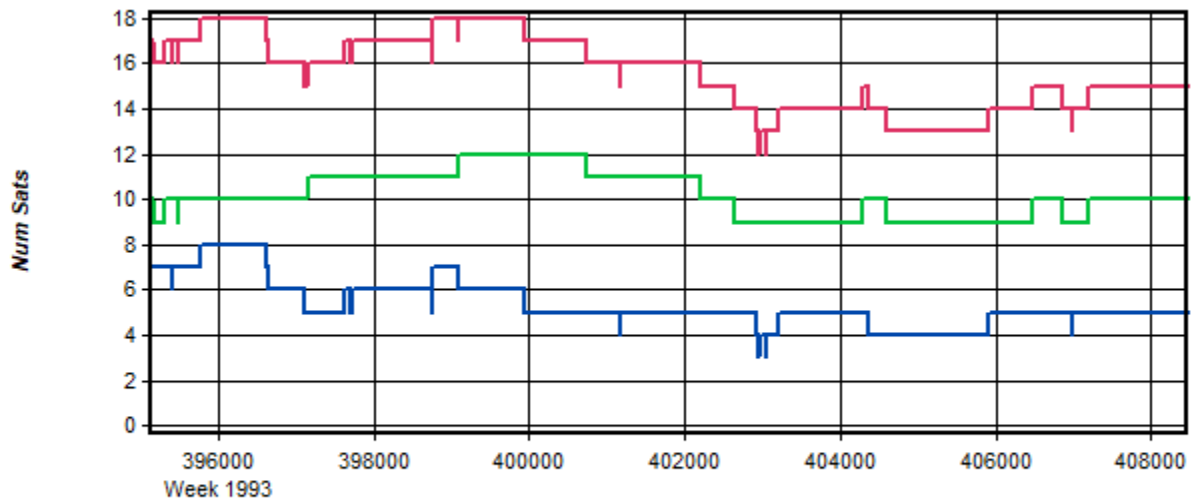
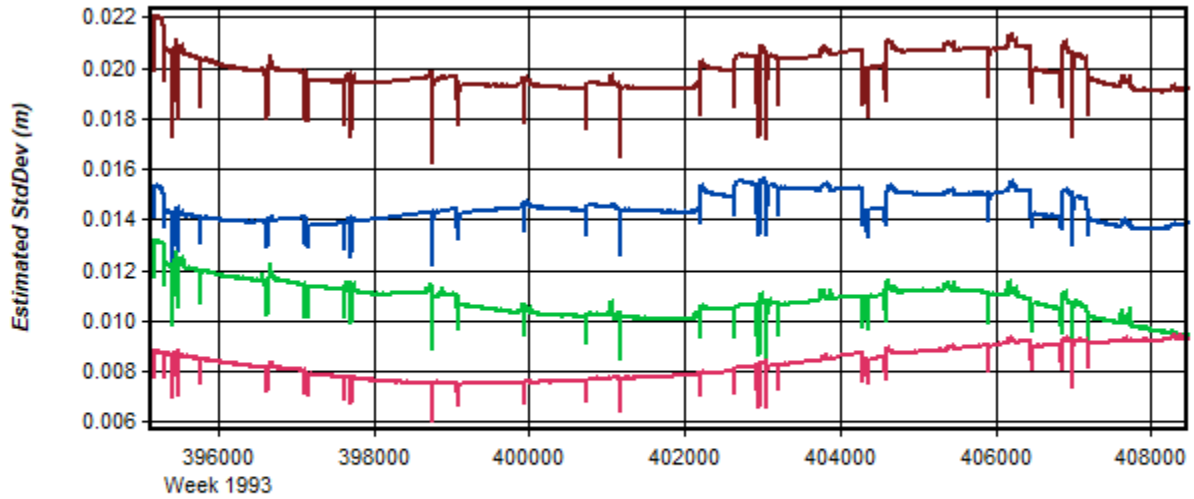


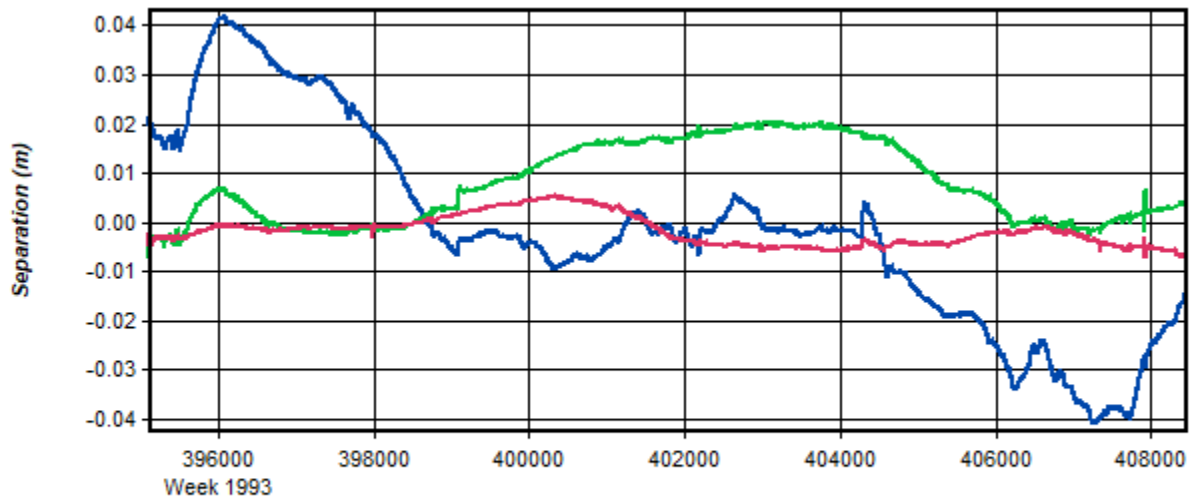


123\_20180322\_1



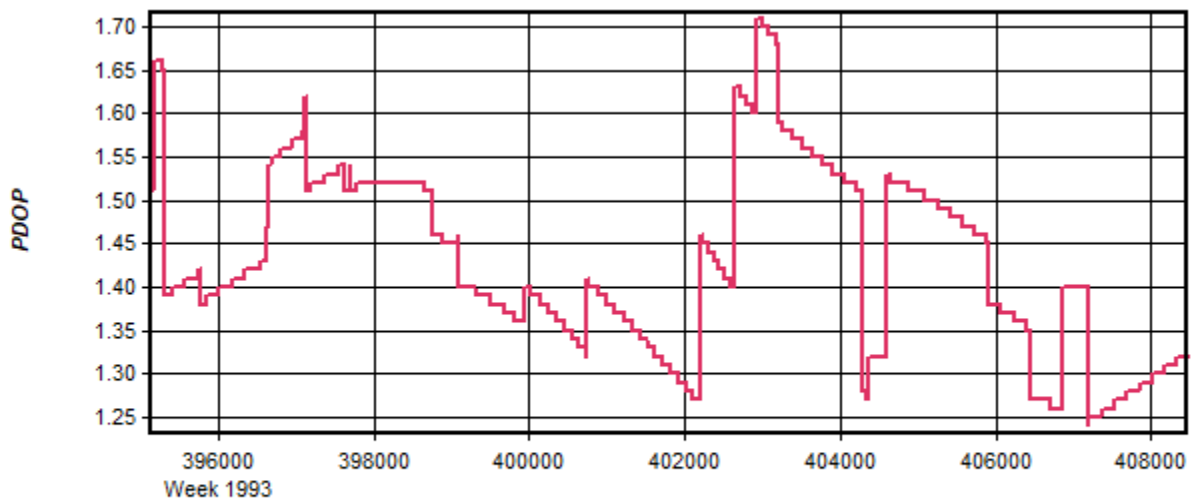






GPS Time (TOW, GMT zone)

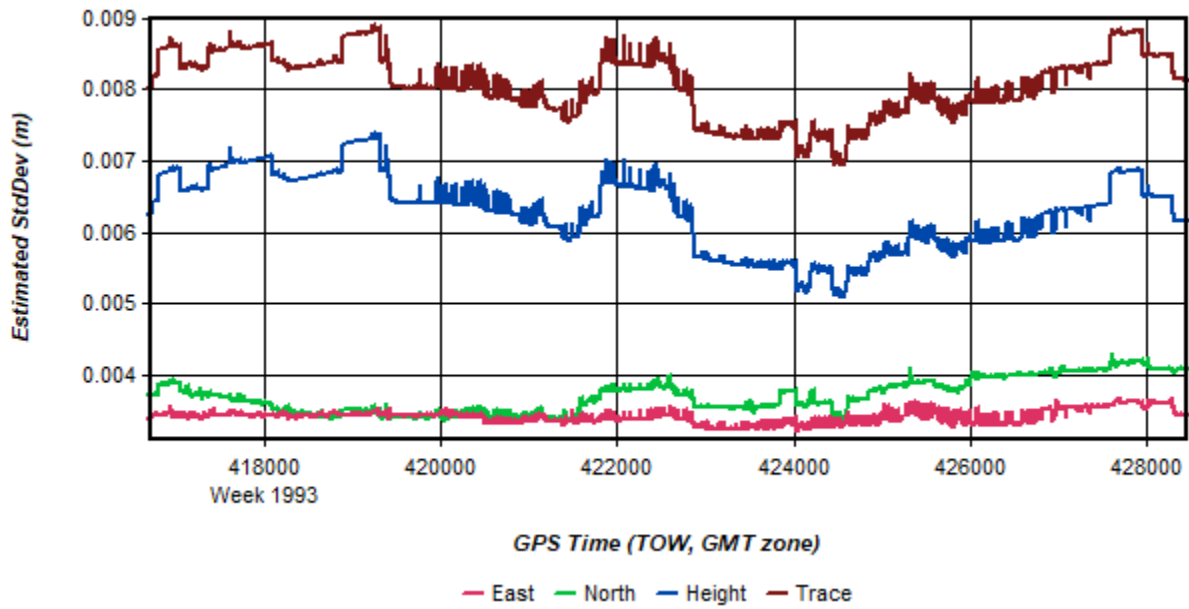
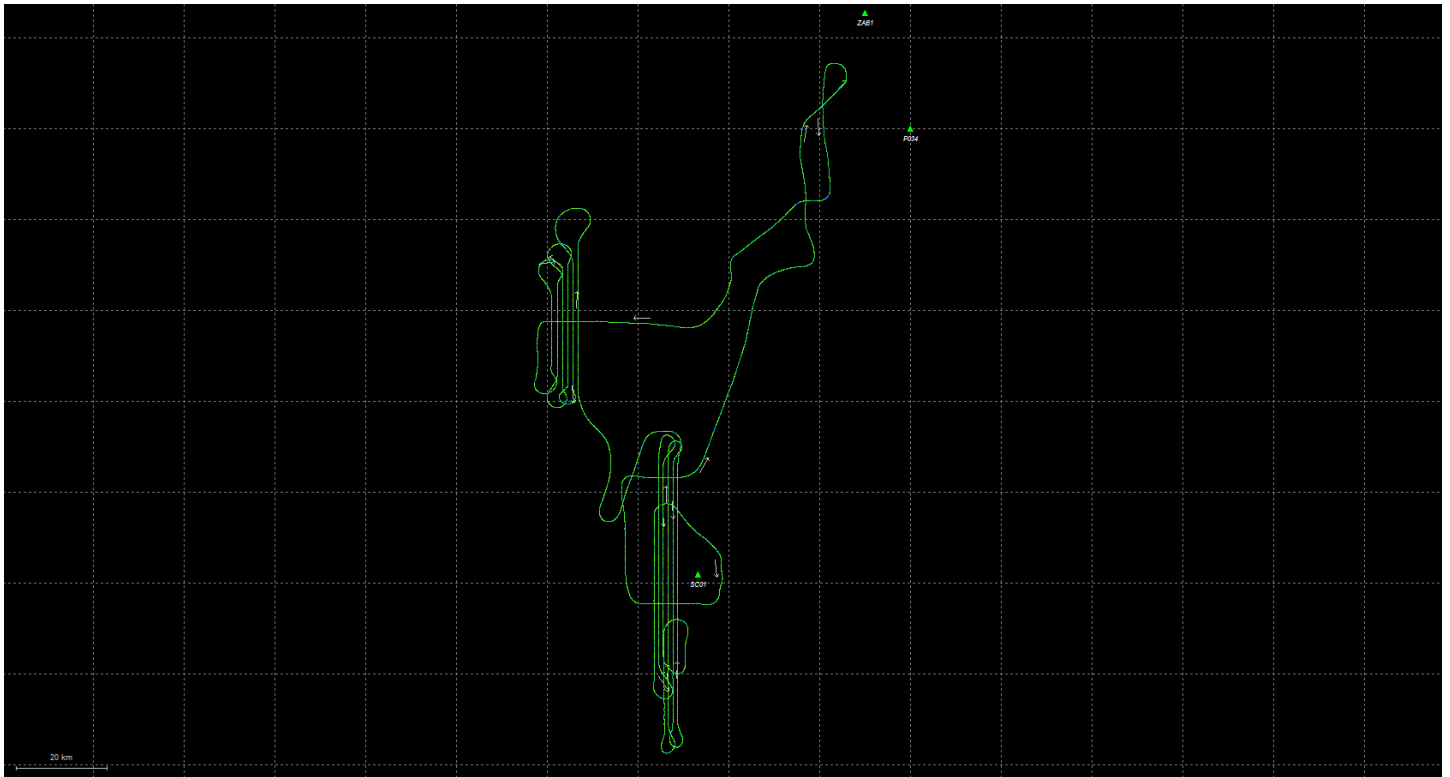
— East — North — Up

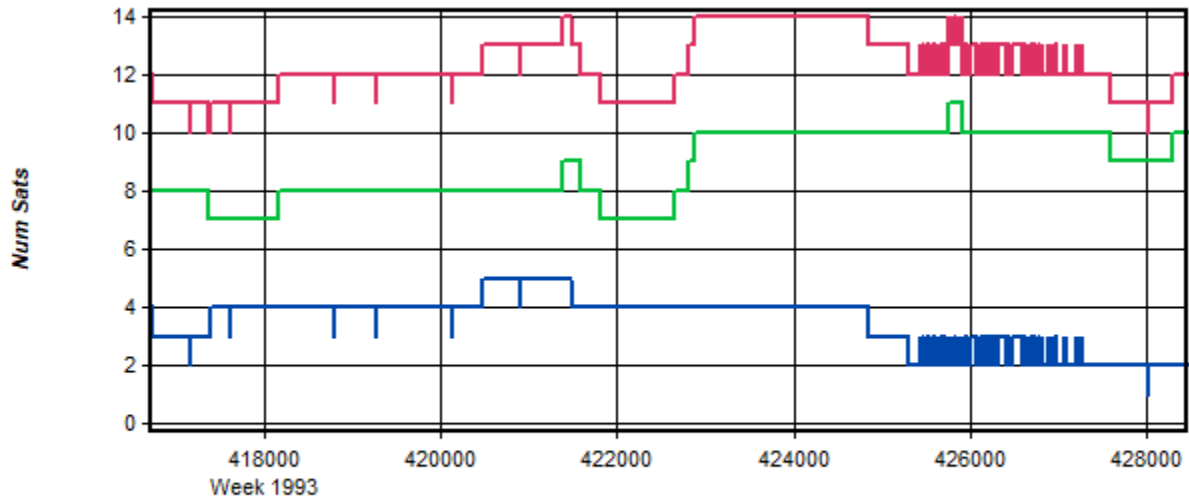


GPS Time (TOW, GMT zone)

— PDOP

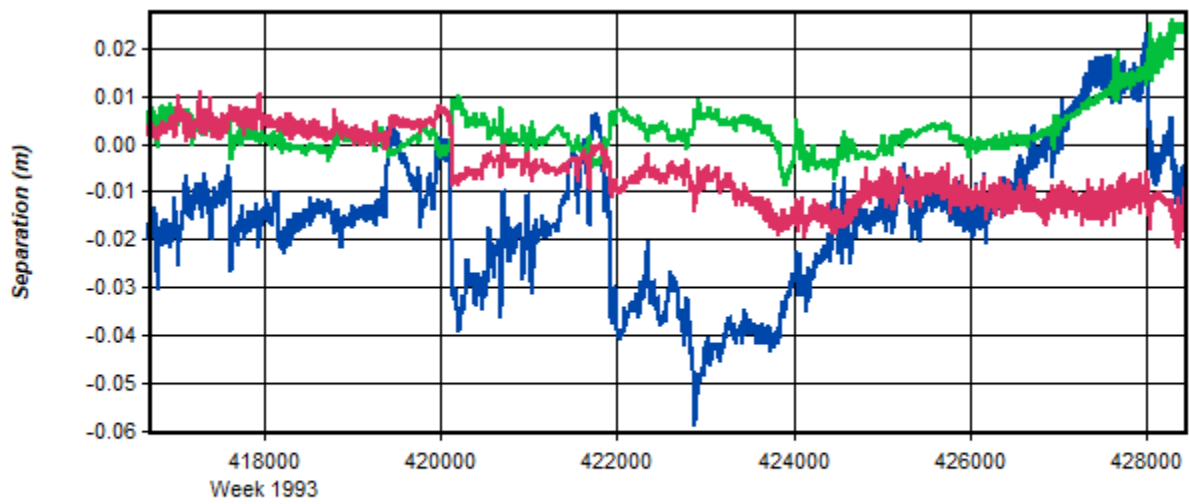
123\_20180322\_2





GPS Time (TOW, GMT zone)

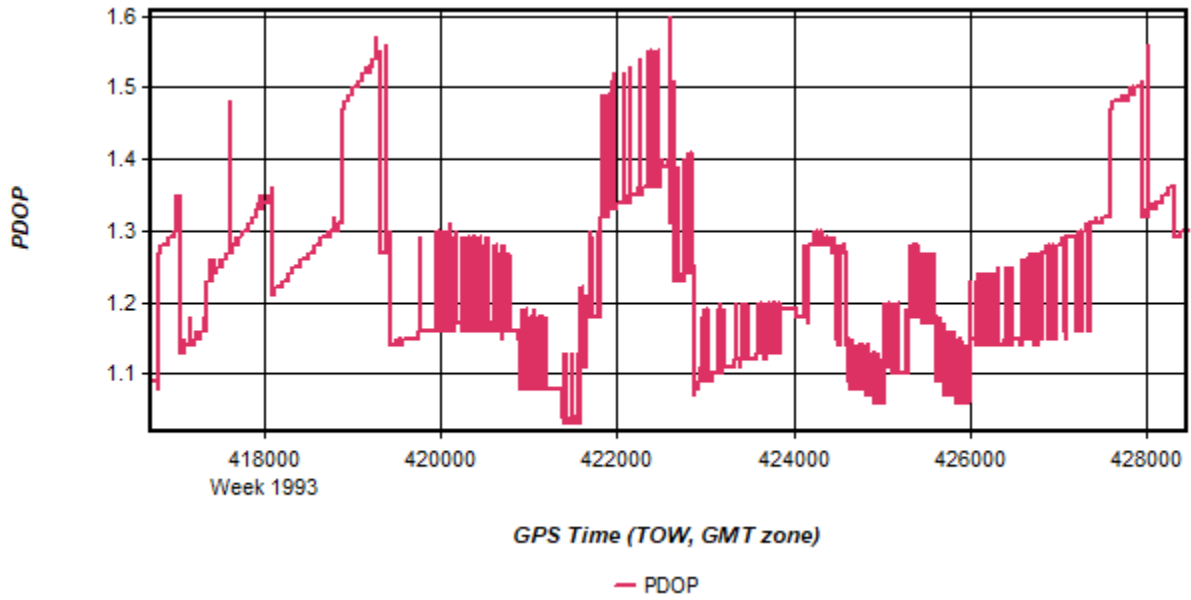
— Num Sats — GPS — GLONASS — BeiDou



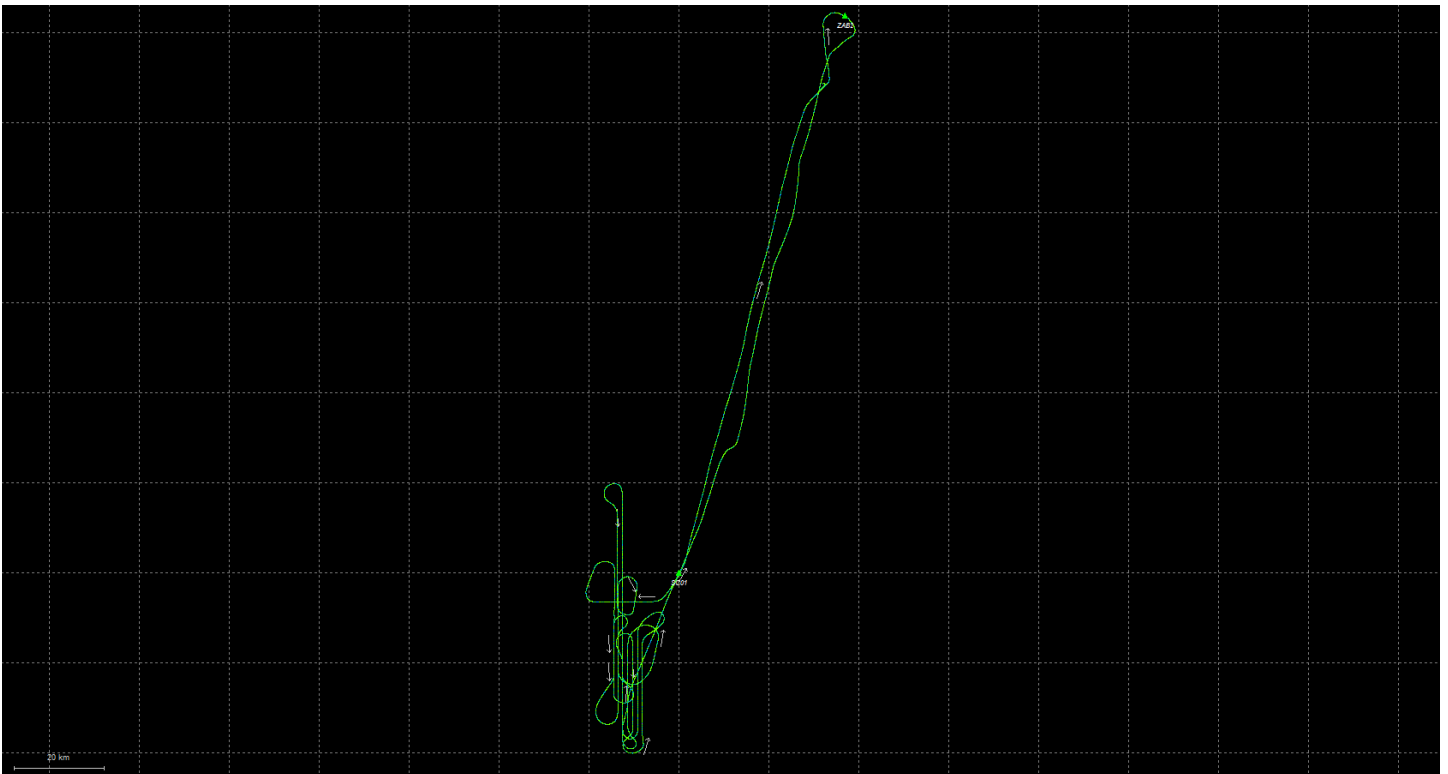
GPS Time (TOW, GMT zone)

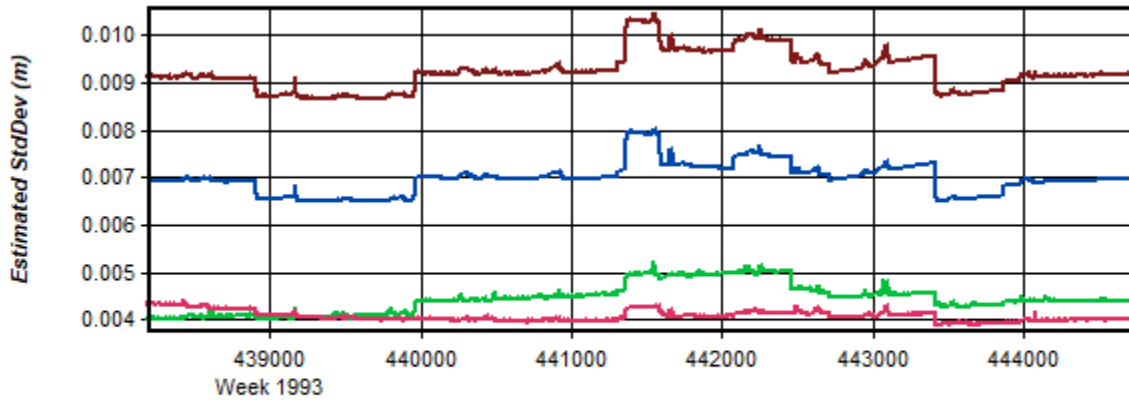
— East — North — Up





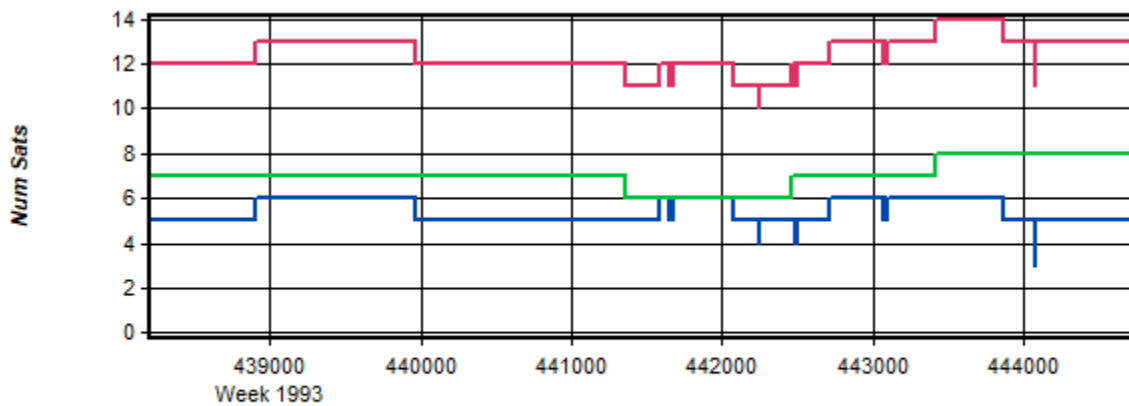
123\_20180322\_3





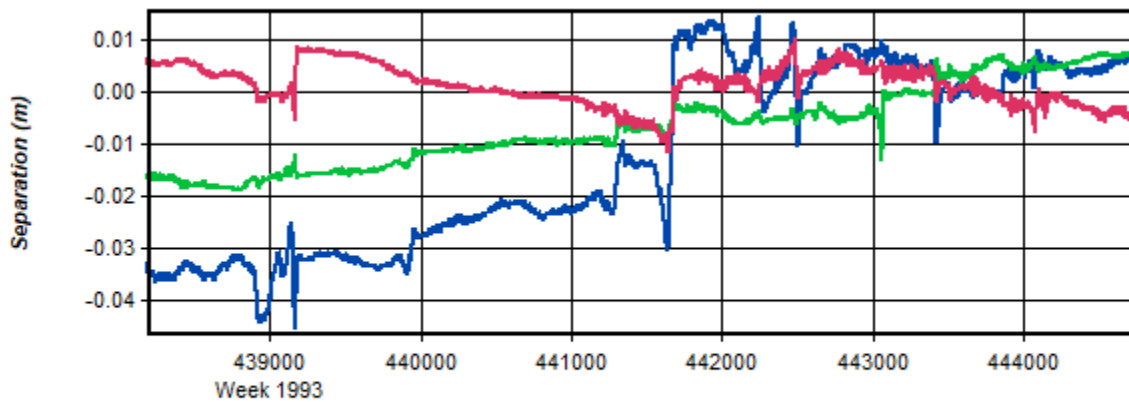
GPS Time (TOW, GMT zone)

— East — North — Height — Trace



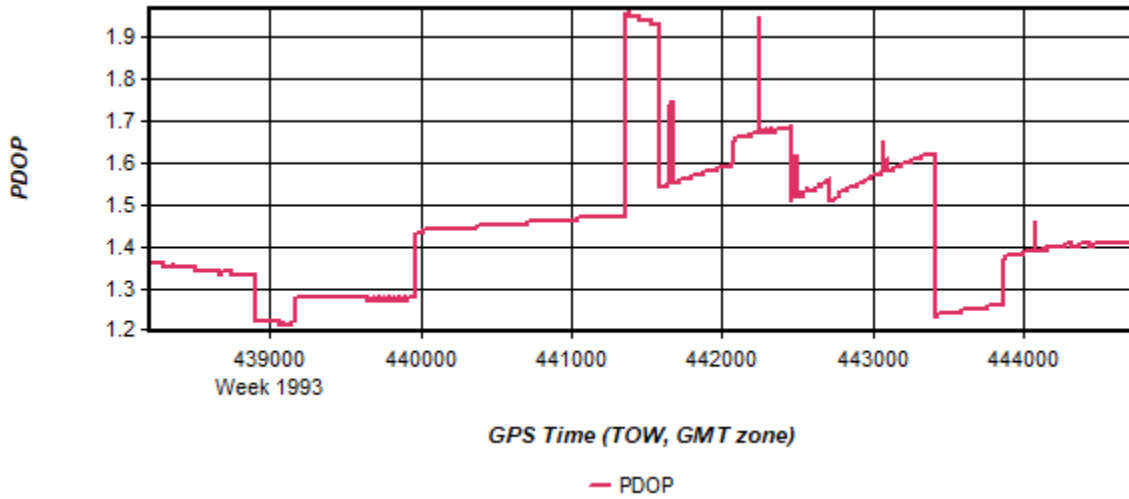
GPS Time (TOW, GMT zone)

— Num Sats — GPS — GLONASS — BeiDou

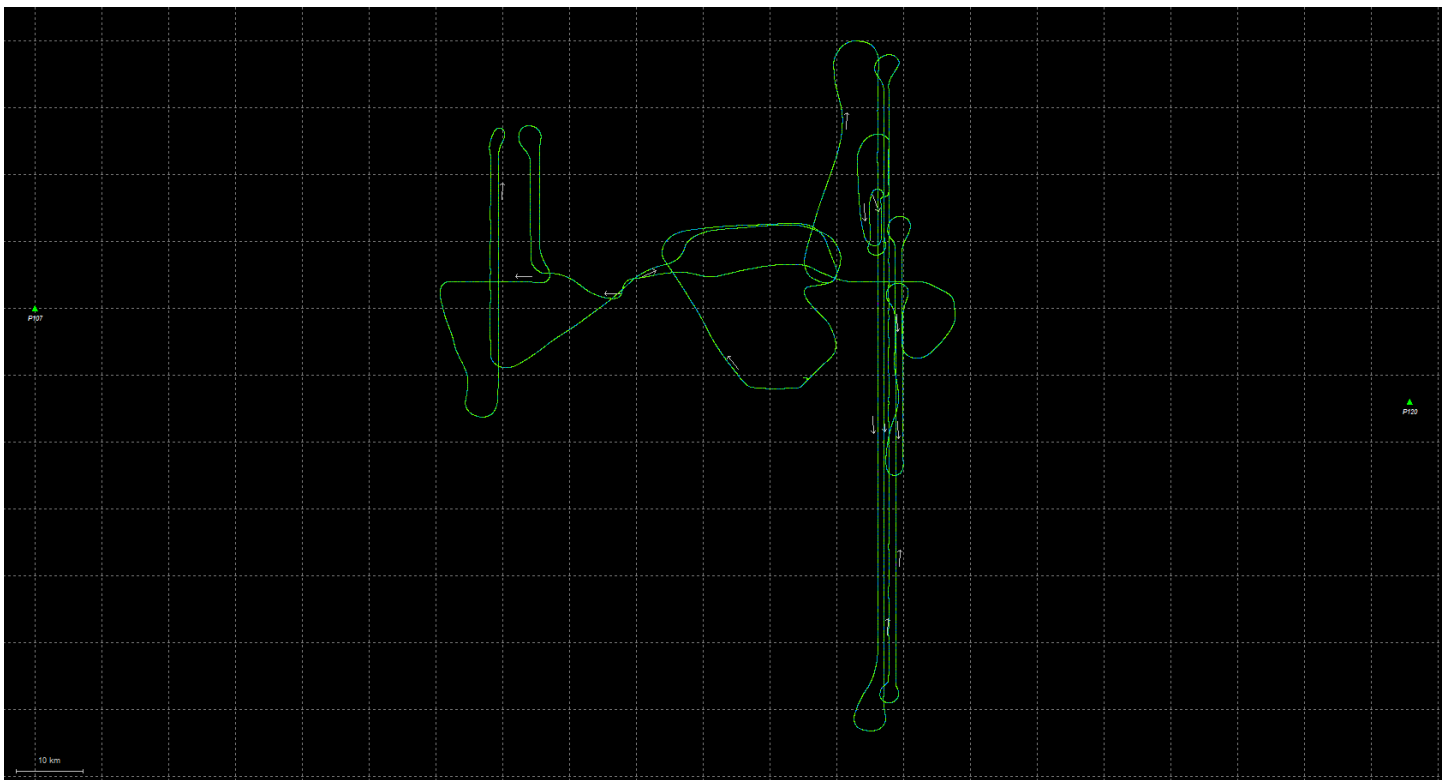


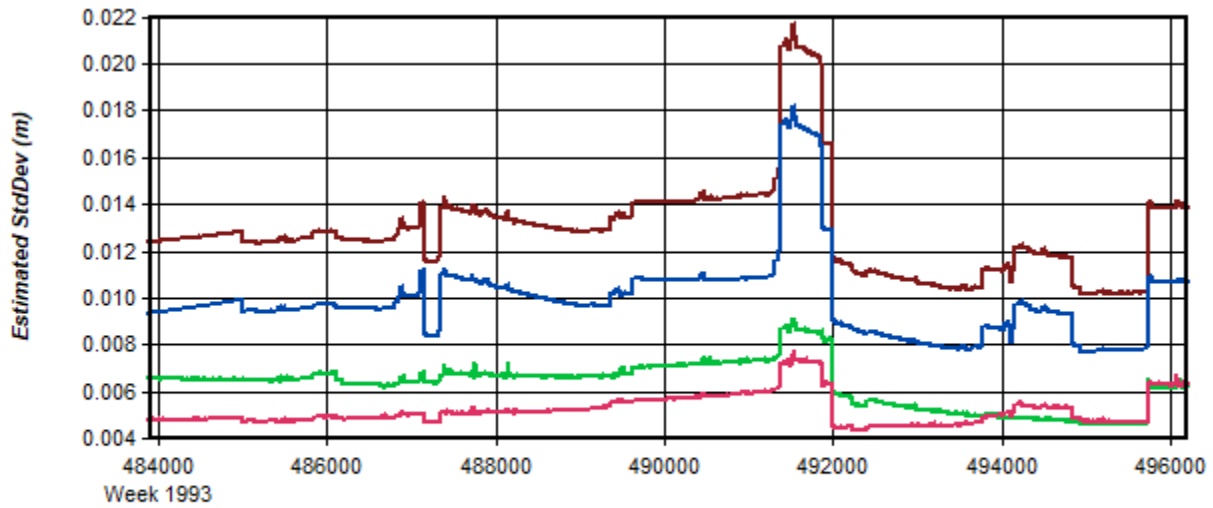
GPS Time (TOW, GMT zone)

— East — North — Up



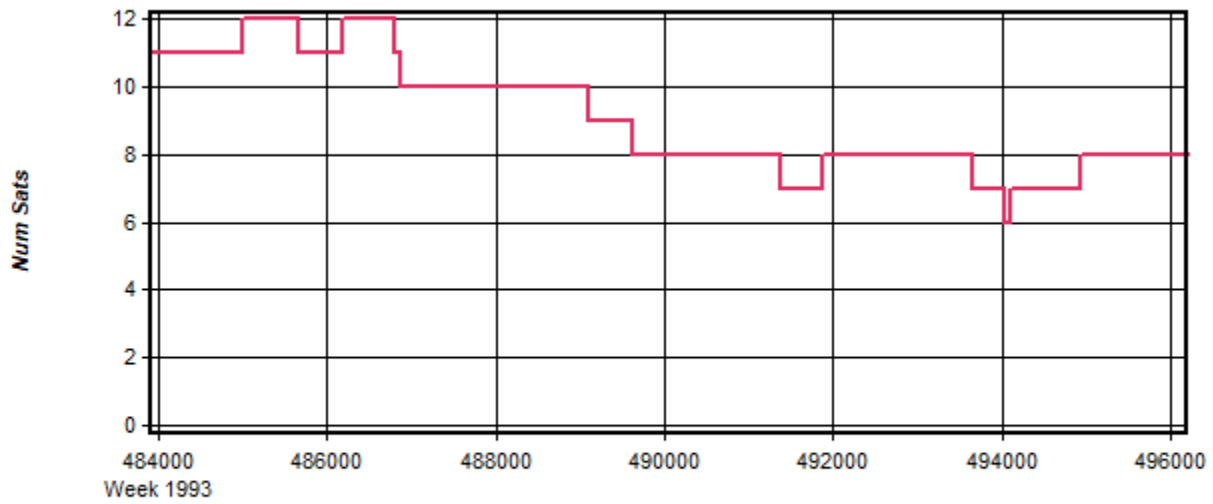
123\_20180323\_1





GPS Time (TOW, GMT zone)

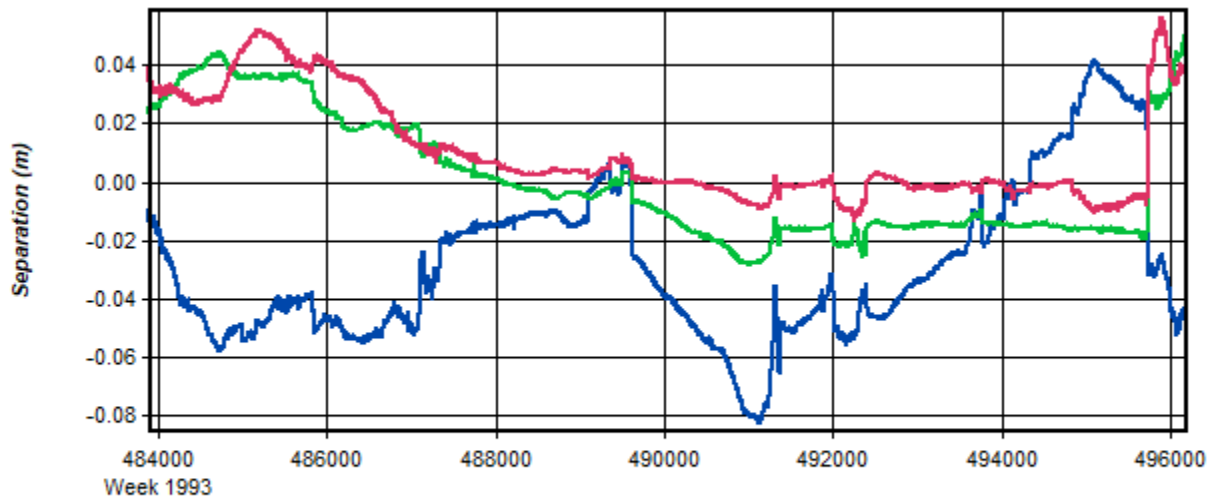
— East — North — Height — Trace



GPS Time (TOW, GMT zone)

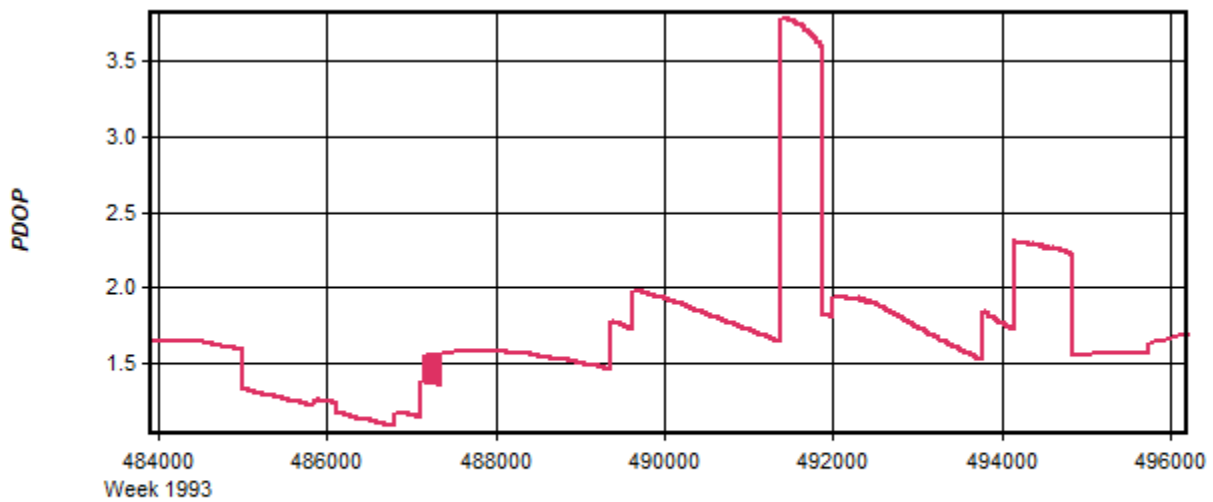
— Num Sats — GPS — GLONASS — BeiDou





GPS Time (TOW, GMT zone)

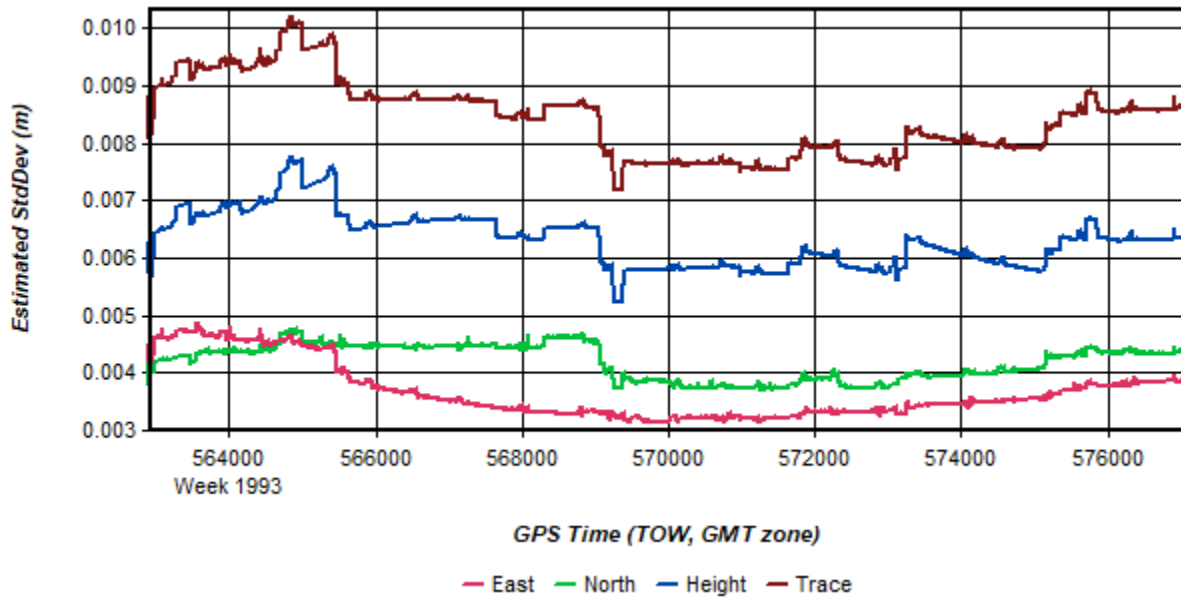
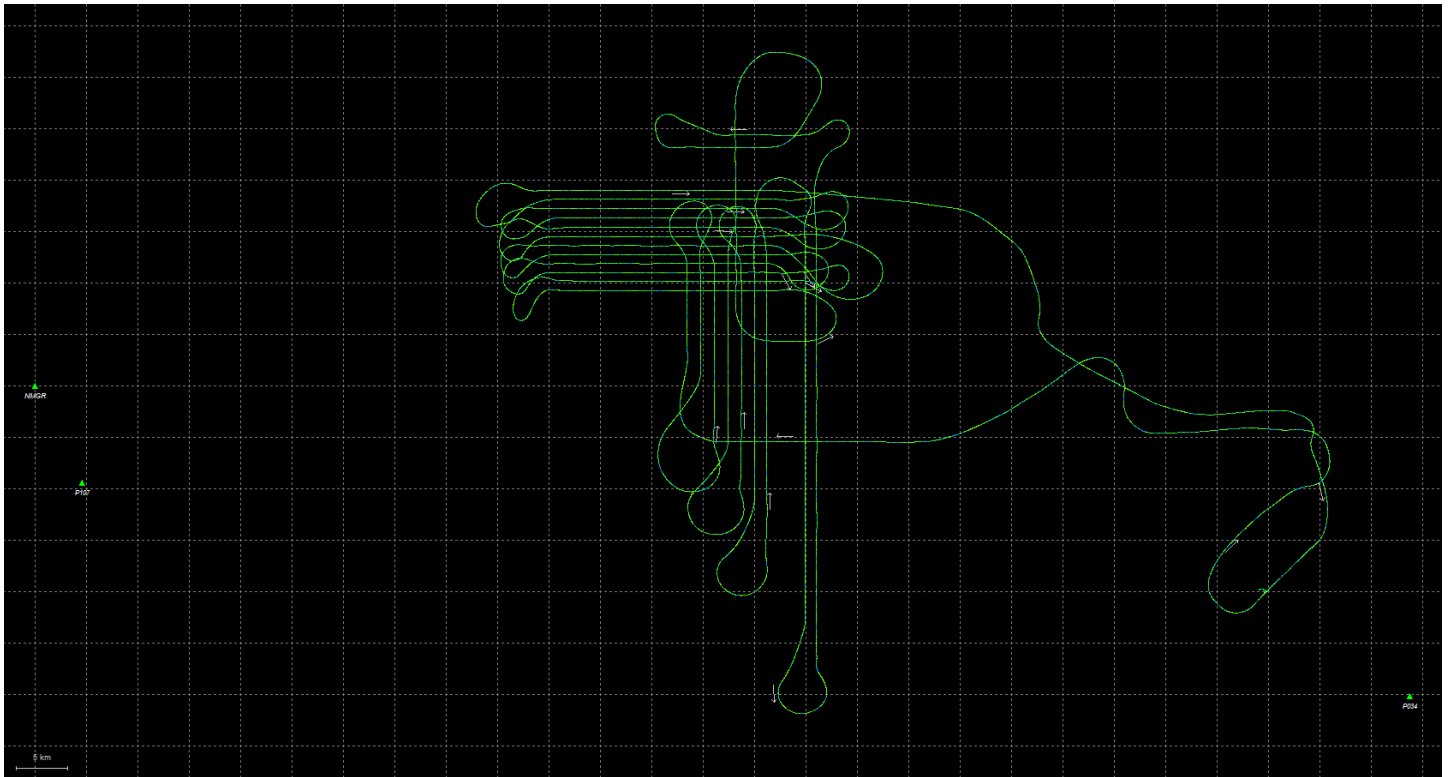
— East — North — Up

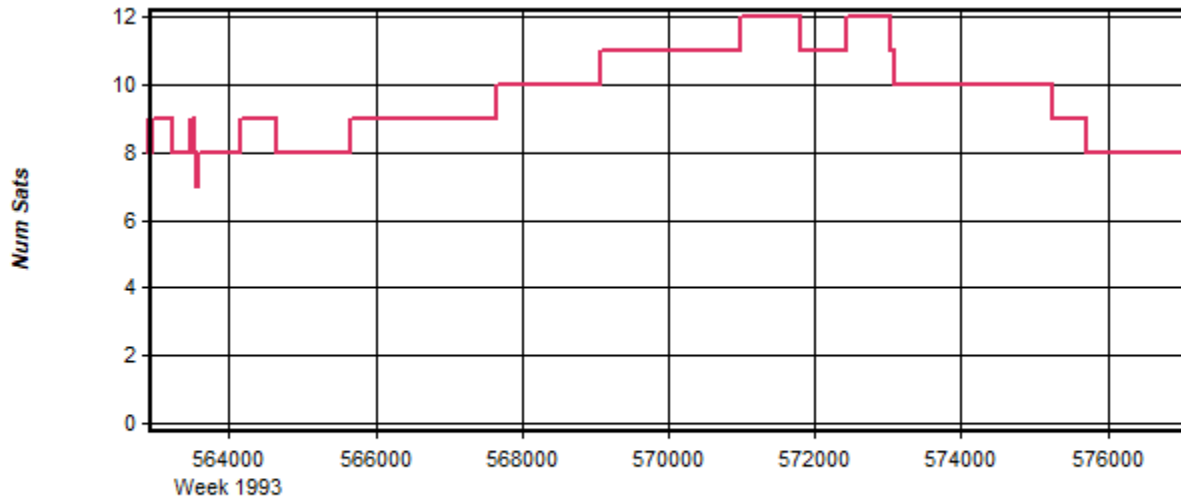


GPS Time (TOW, GMT zone)

— PDOP

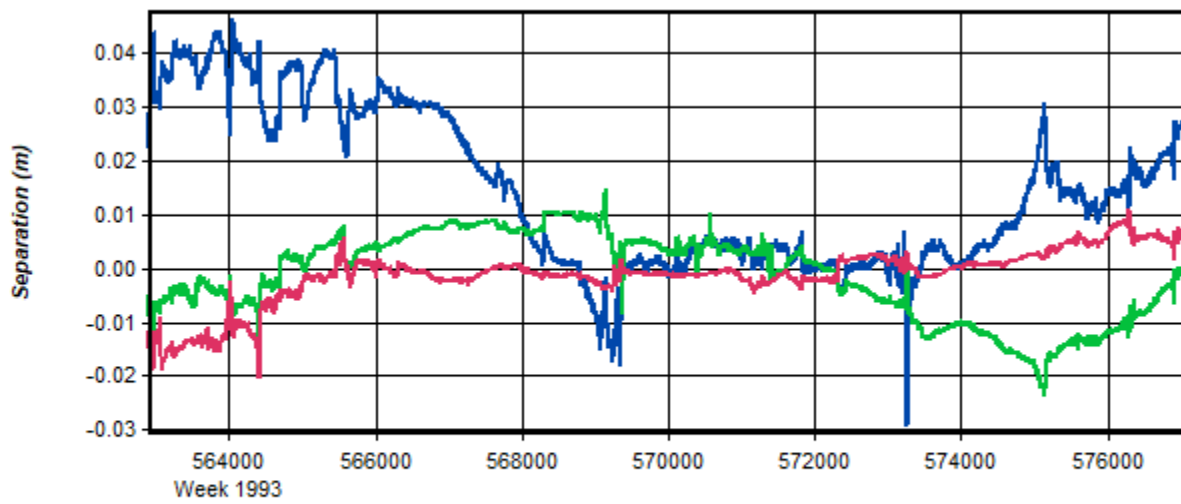
123\_20180324\_1





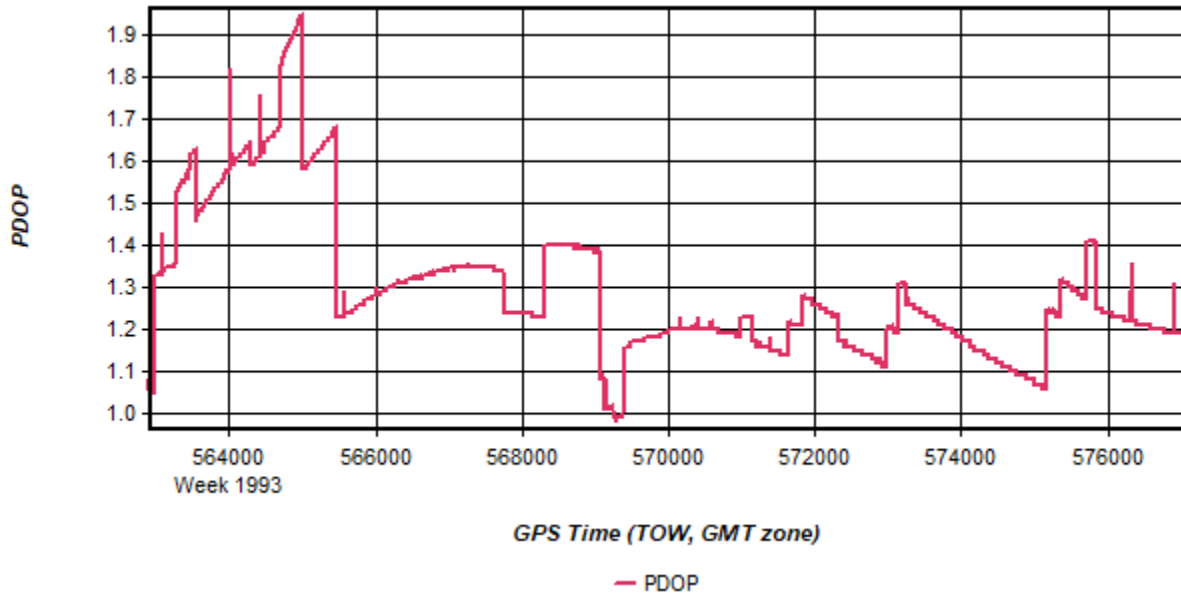
GPS Time (TOW, GMT zone)

— Num Sats — GPS — GLONASS — BeiDou

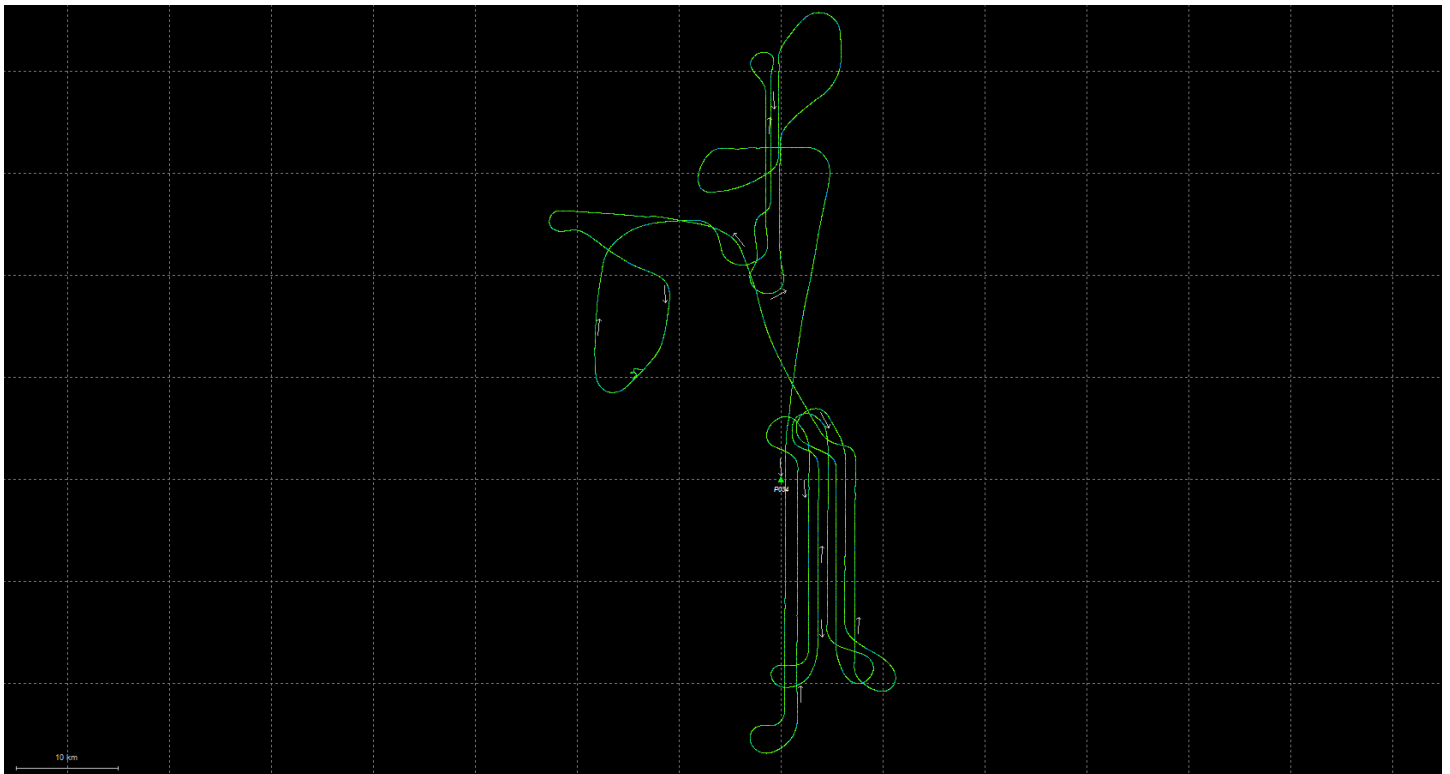


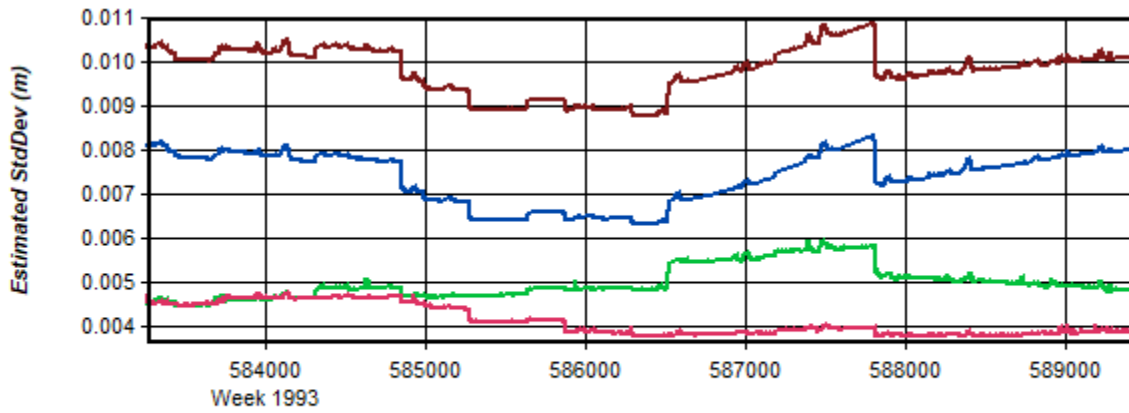
GPS Time (TOW, GMT zone)

— East — North — Up



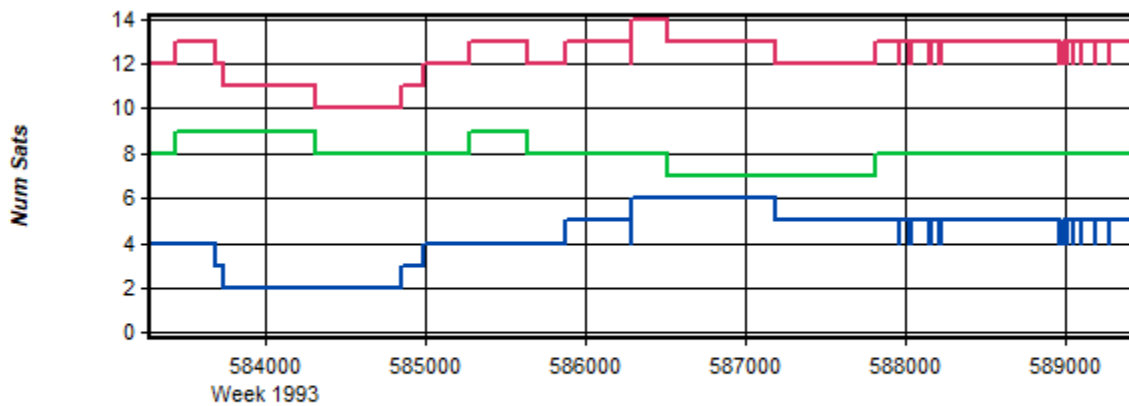
123\_20180324\_2





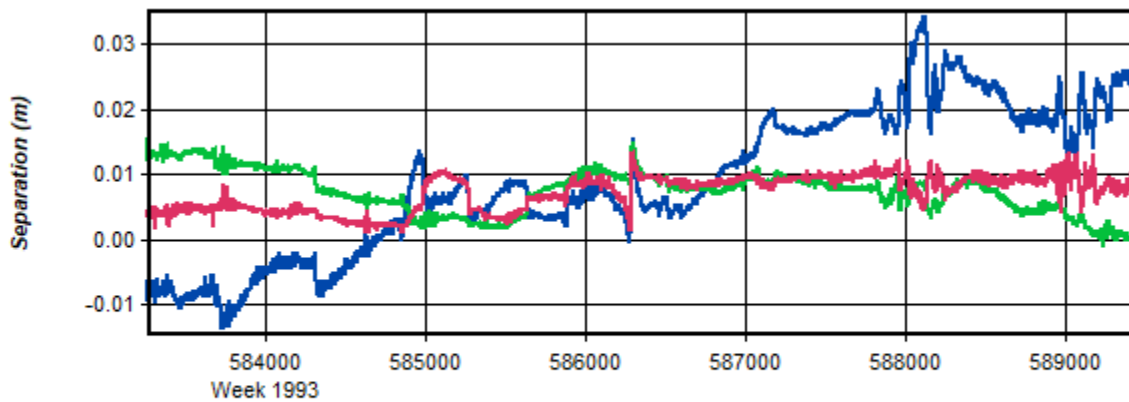
GPS Time (TOW, GMT zone)

— East — North — Height — Trace



GPS Time (TOW, GMT zone)

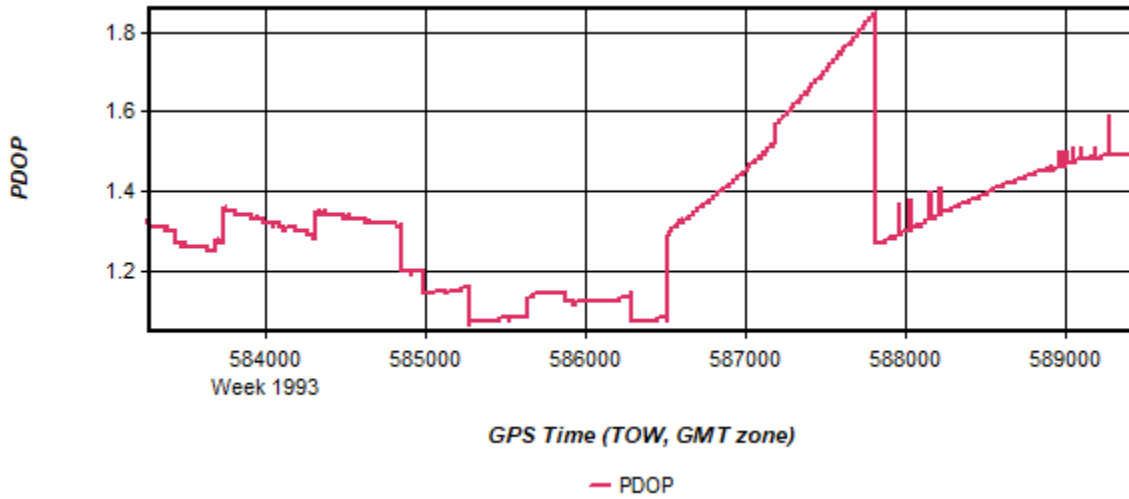
— Num Sats — GPS — GLONASS — BeiDou



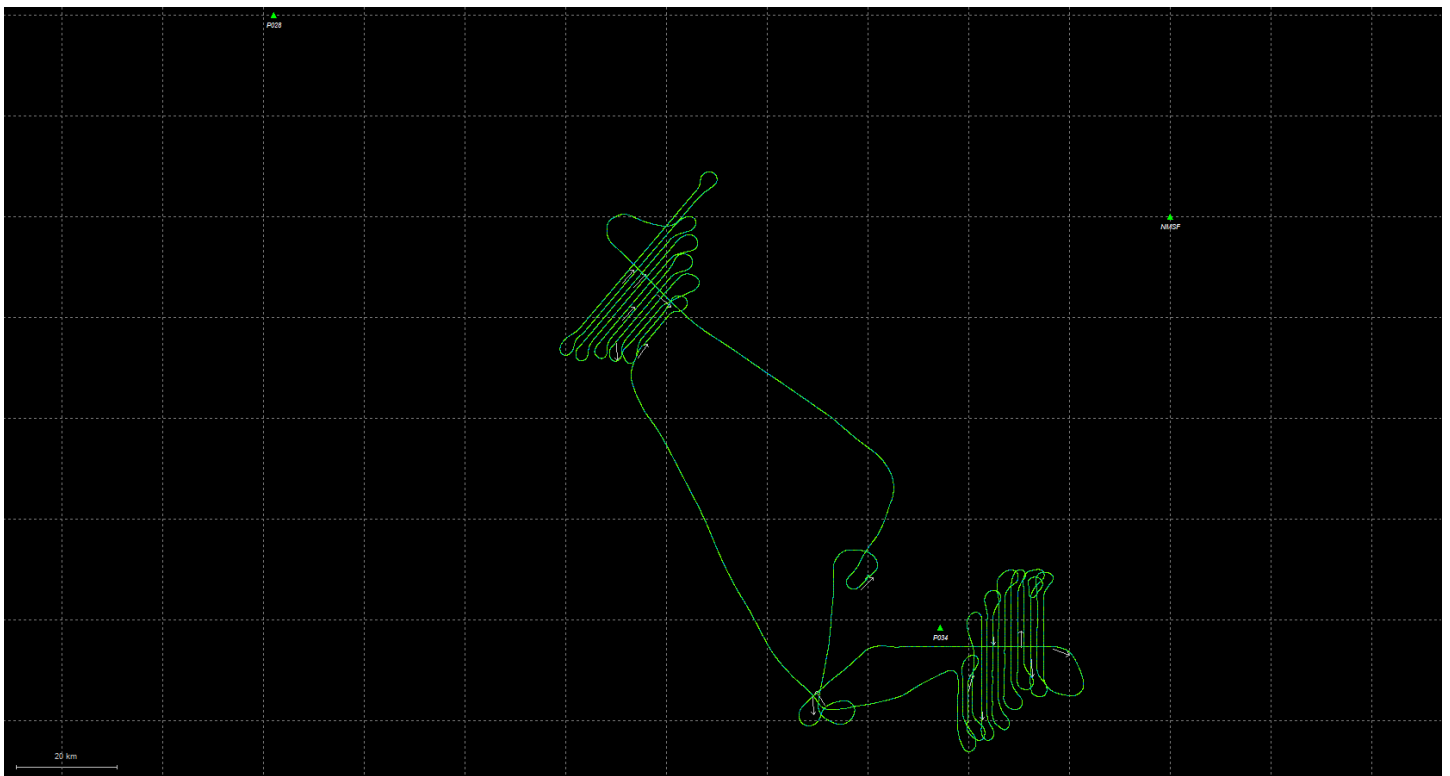
GPS Time (TOW, GMT zone)

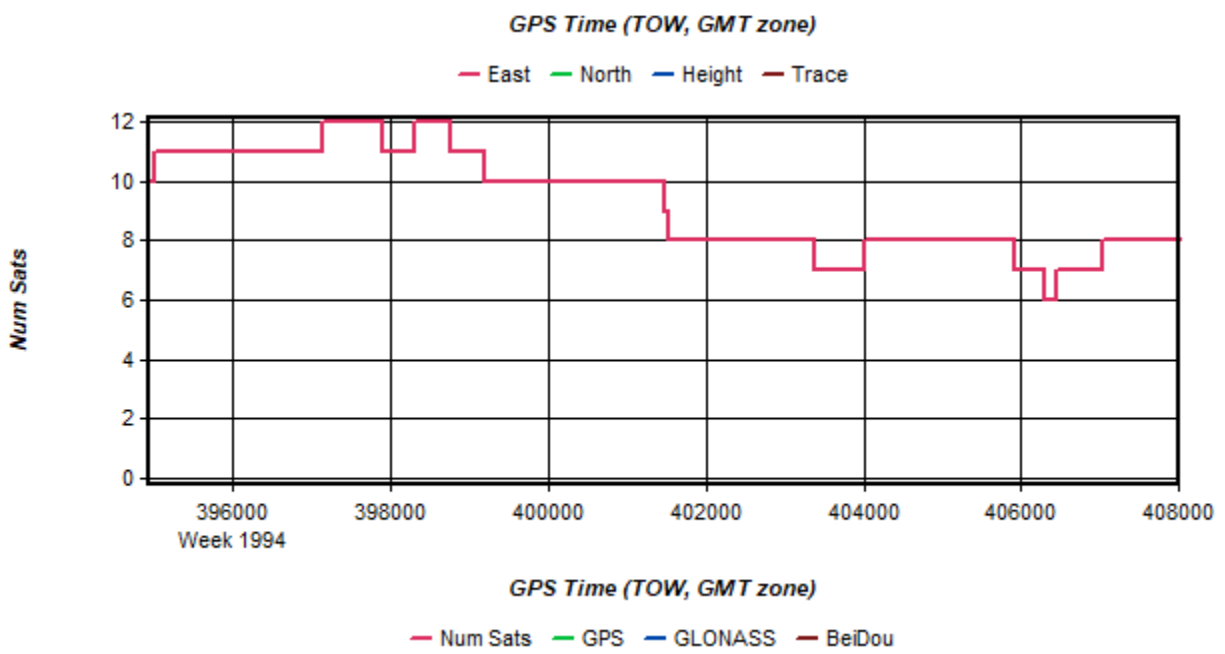
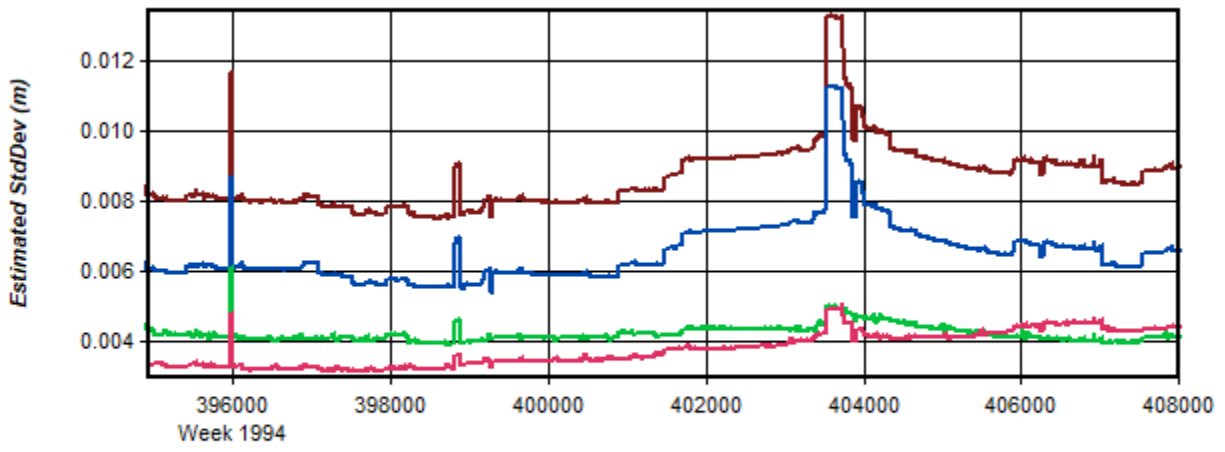
— East — North — Up

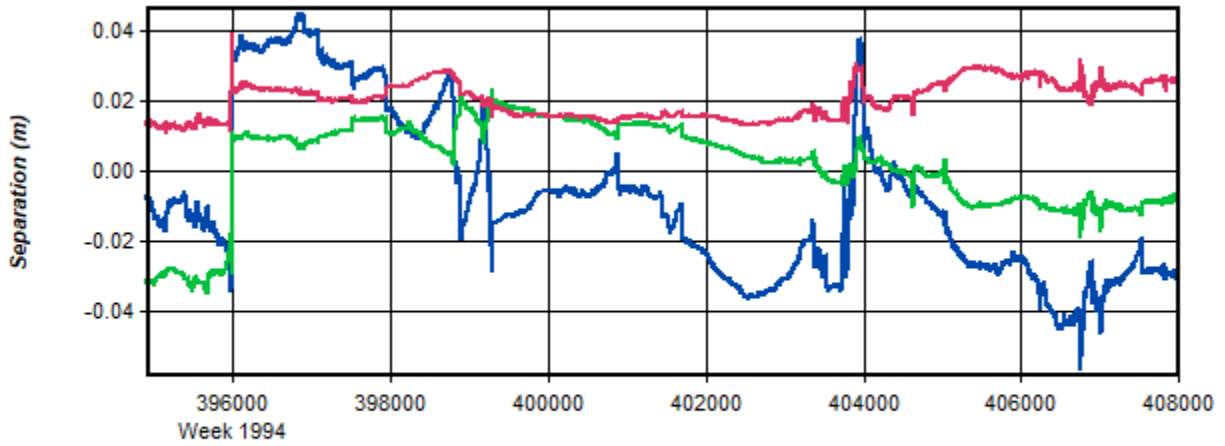




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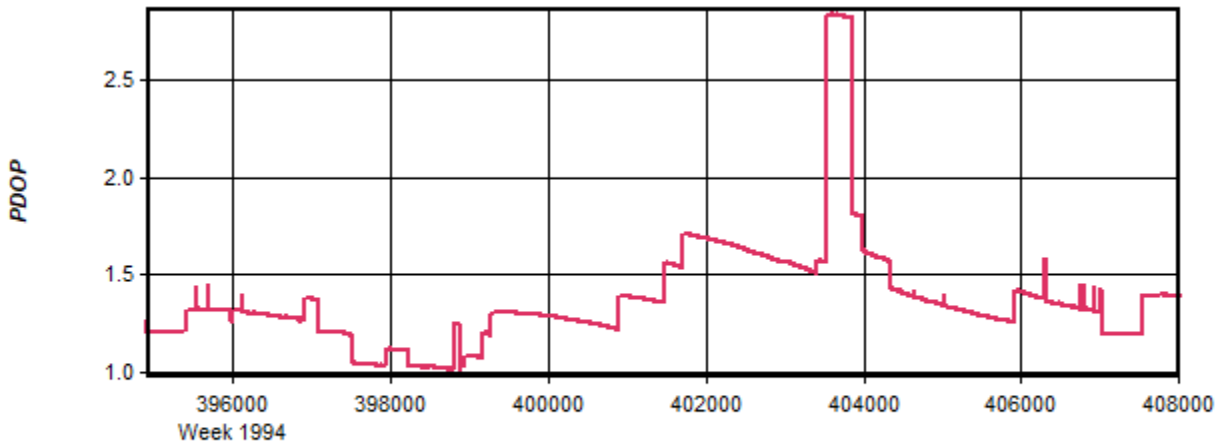






GPS Time (TOW, GMT zone)

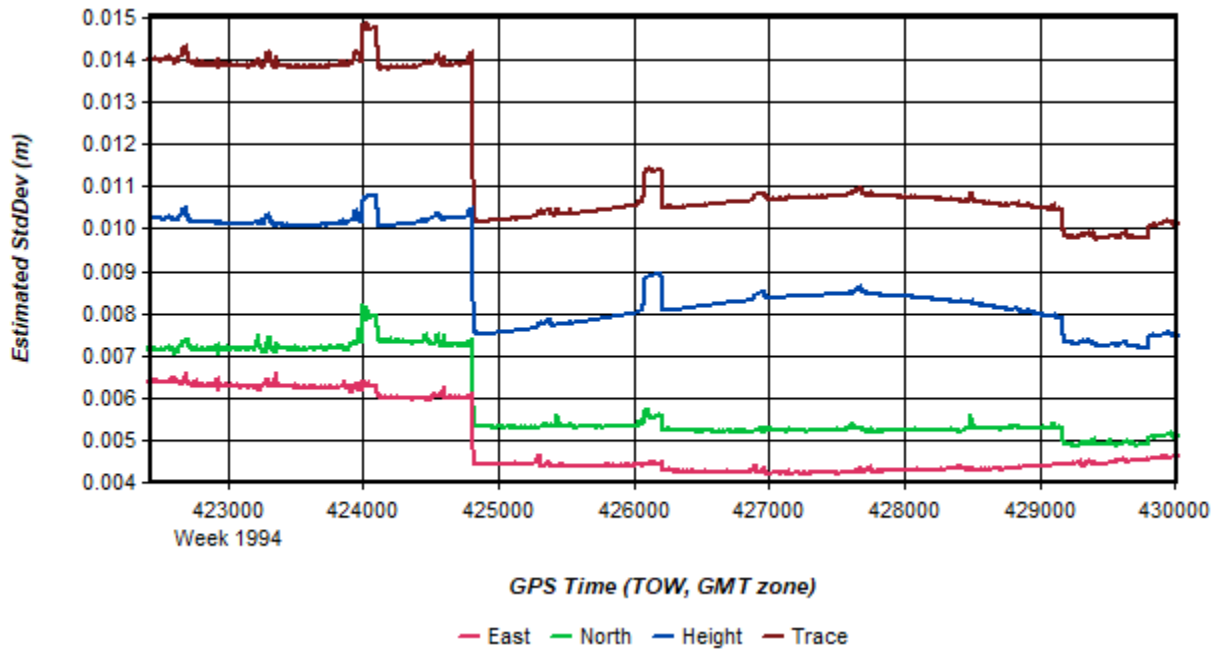
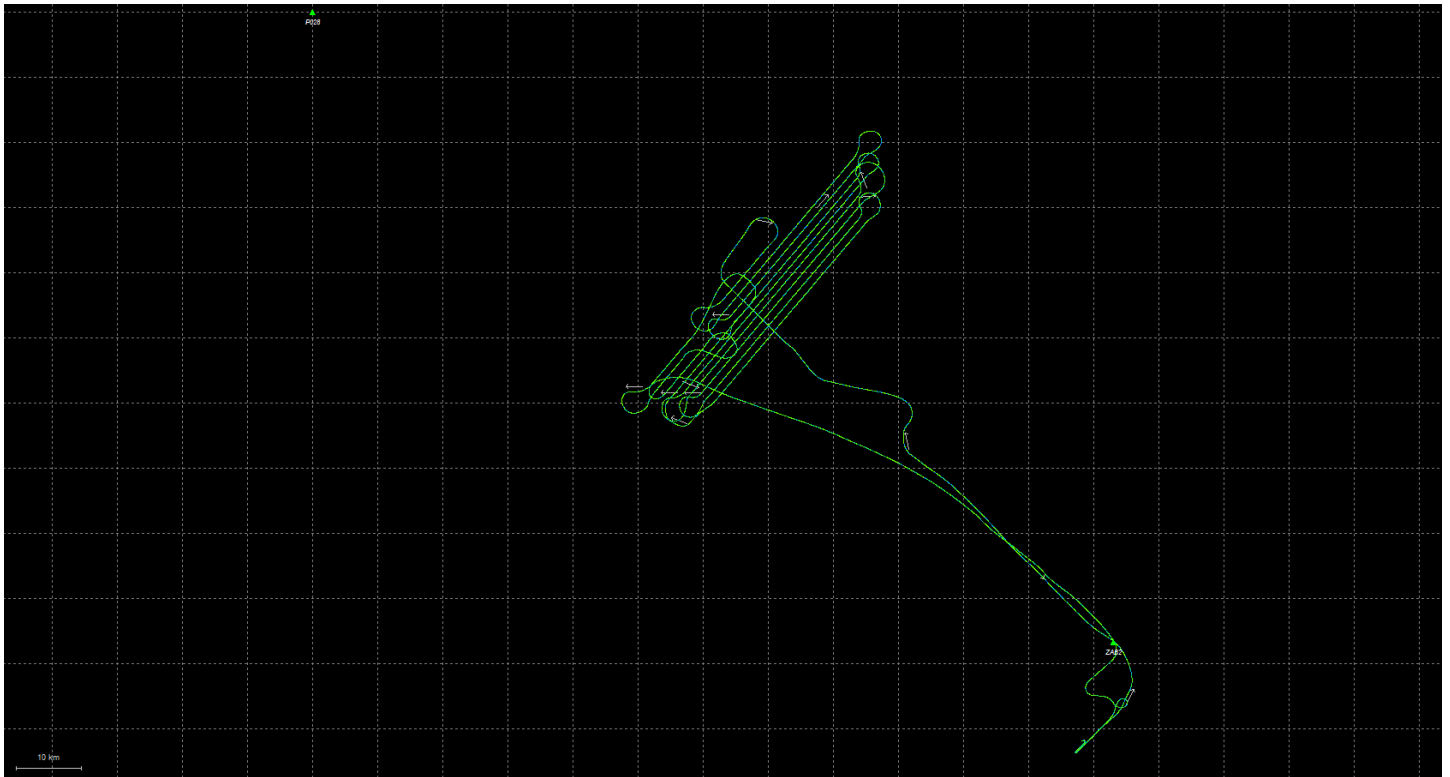
— East — North — Up

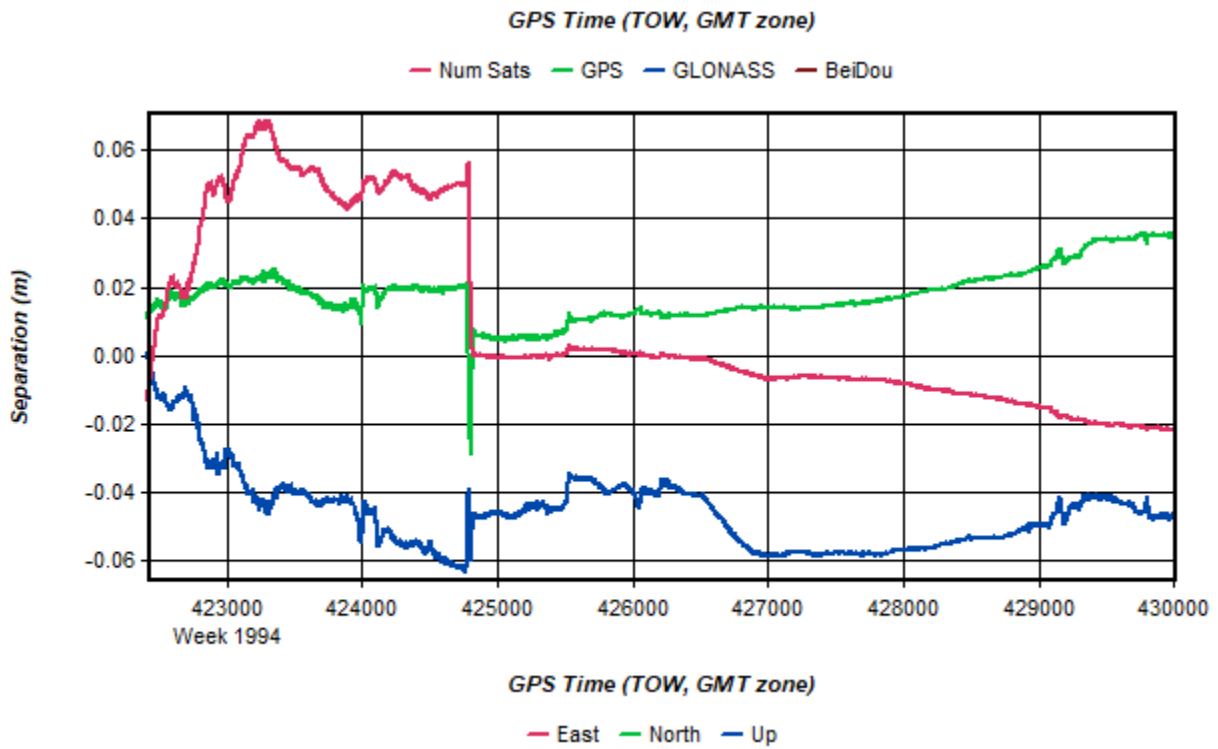
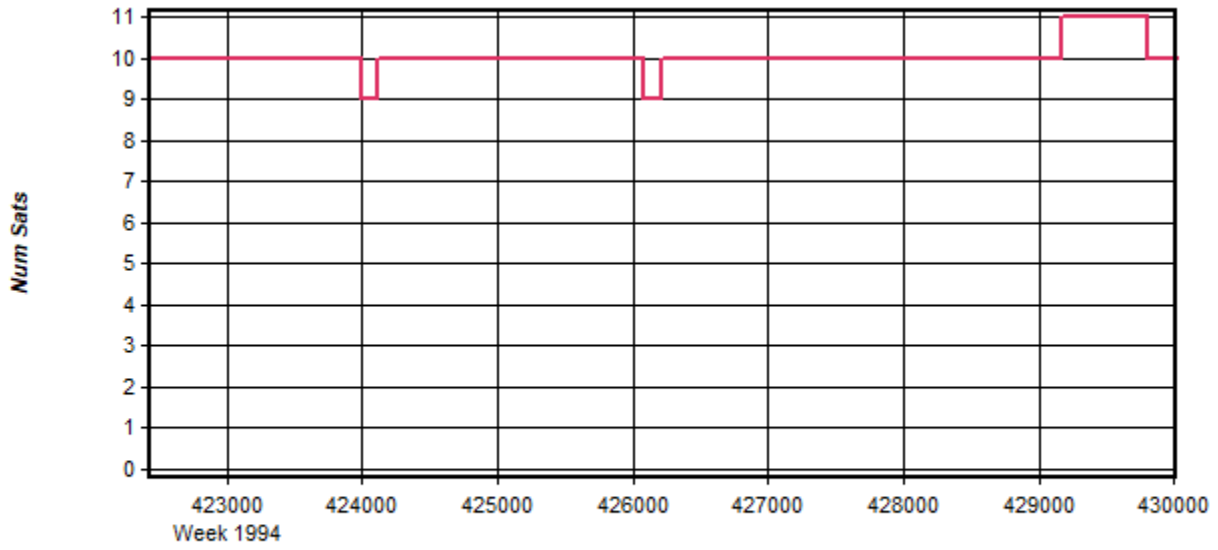


GPS Time (TOW, GMT zone)

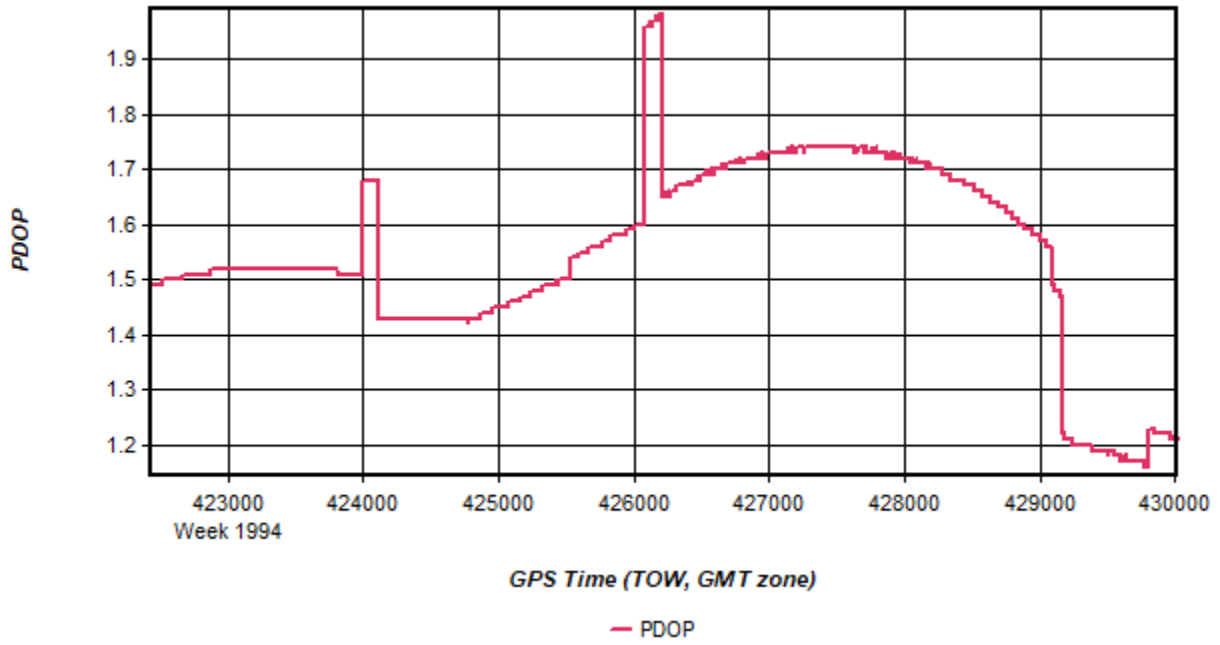
— PDOP

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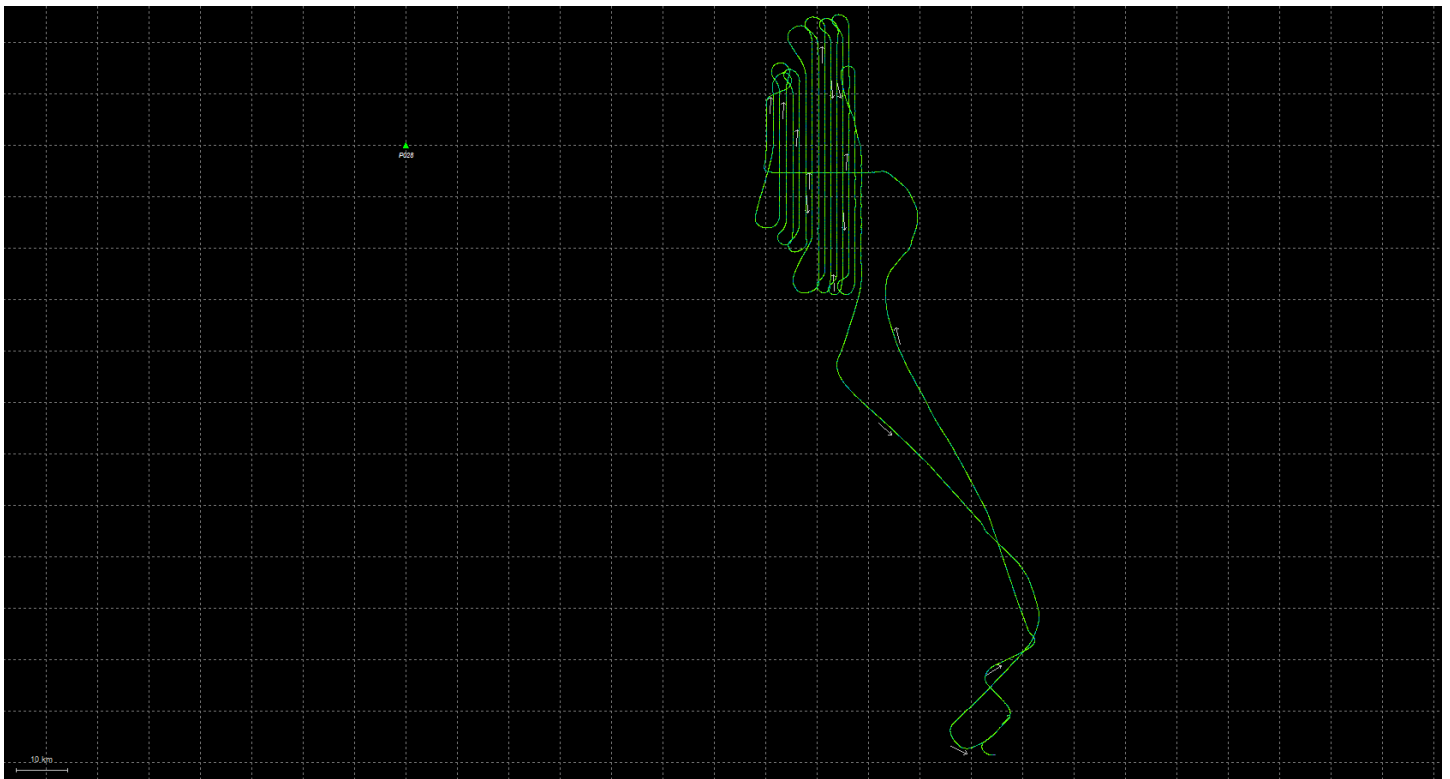


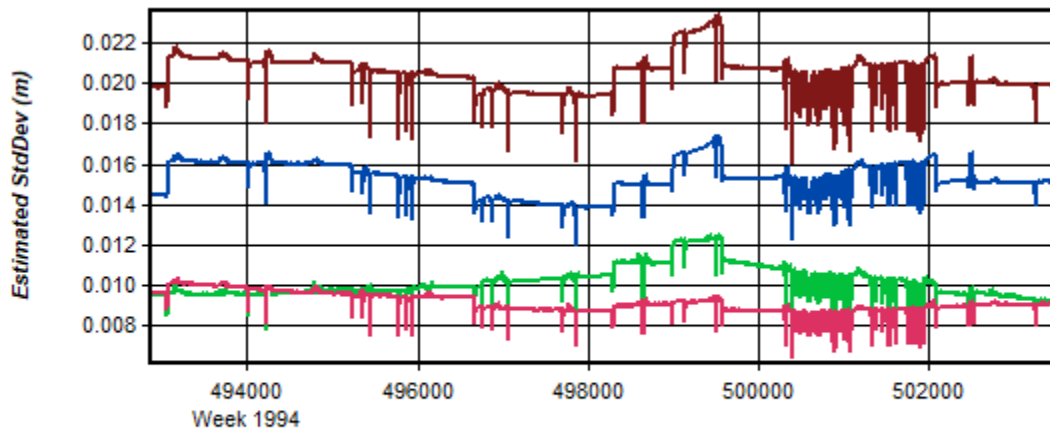






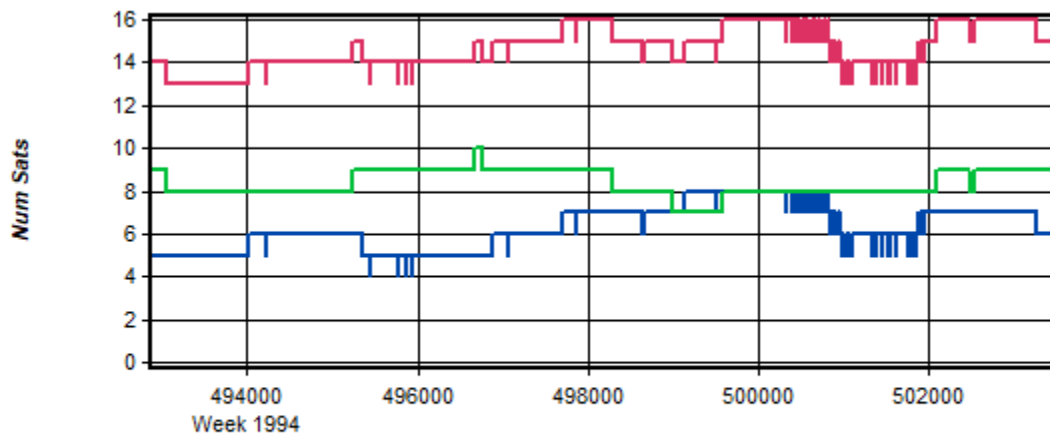
123\_20180330\_1





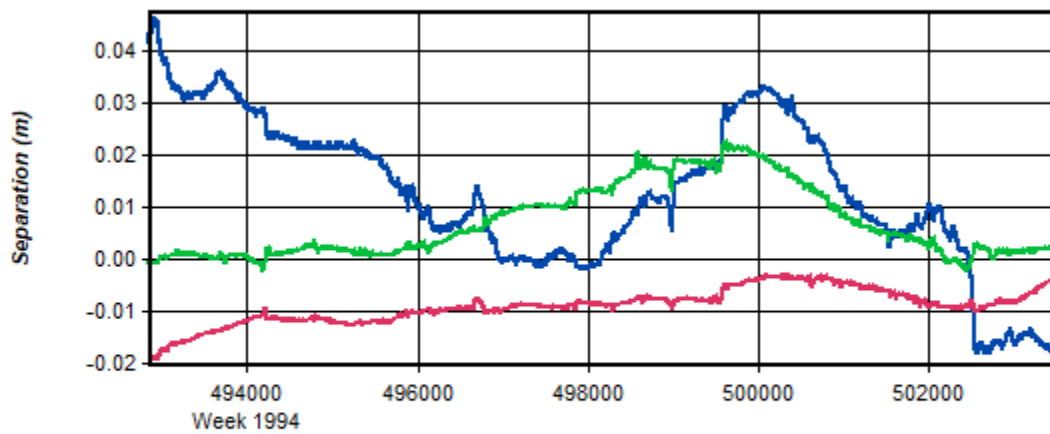
GPS Time (TOW, GMT zone)

— East — North — Height — Trace



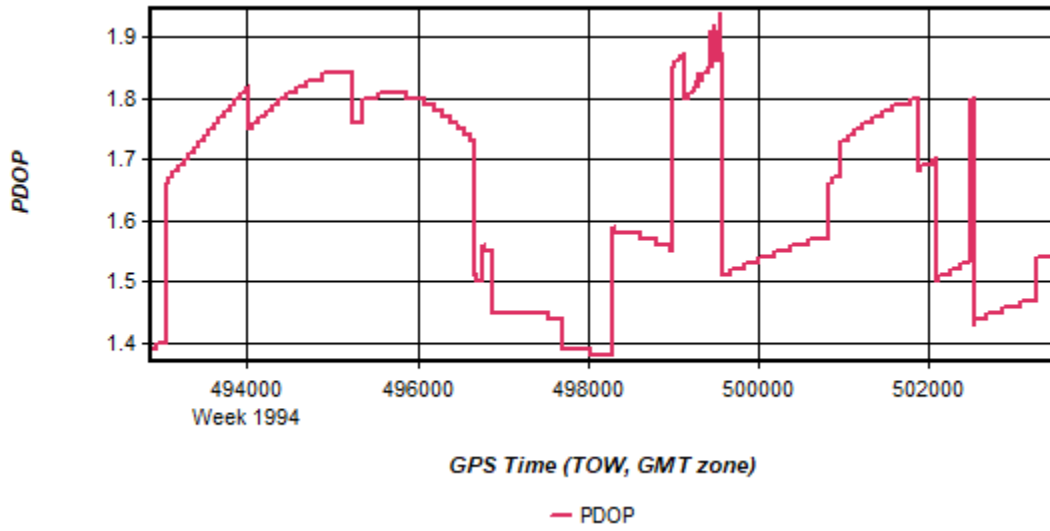
GPS Time (TOW, GMT zone)

— Num Sats — GPS — GLONASS — BeiDou

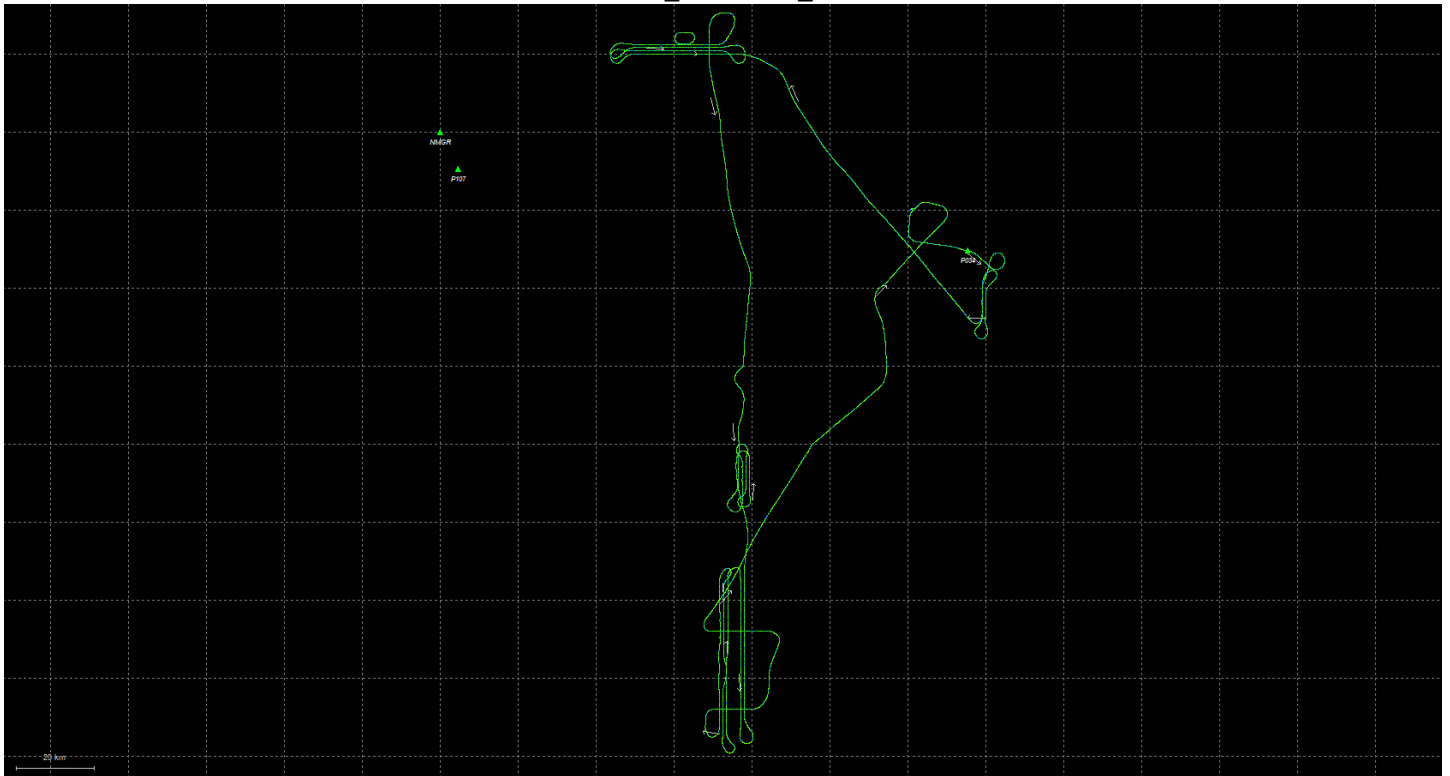


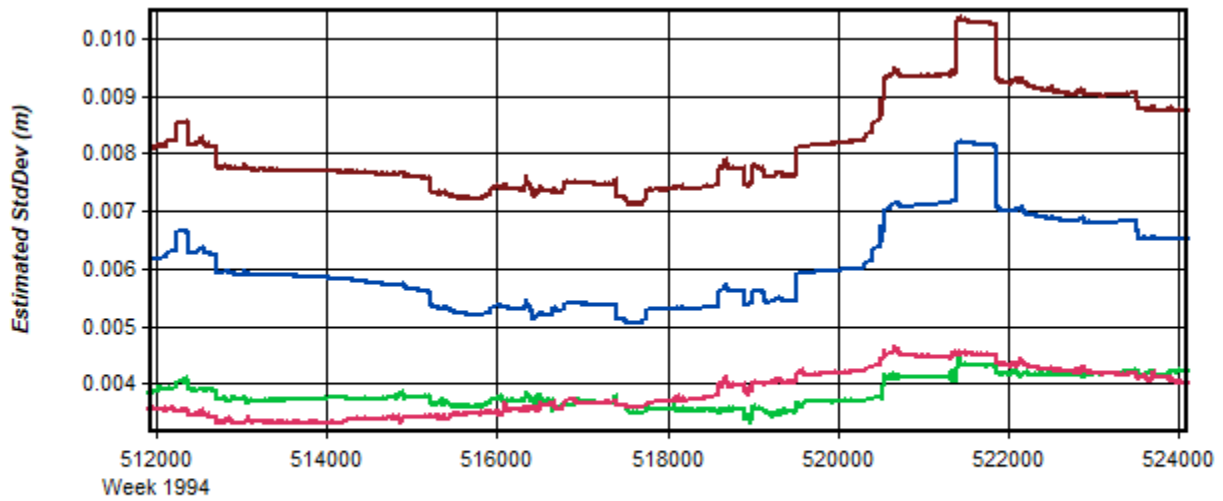
GPS Time (TOW, GMT zone)

— East — North — Up



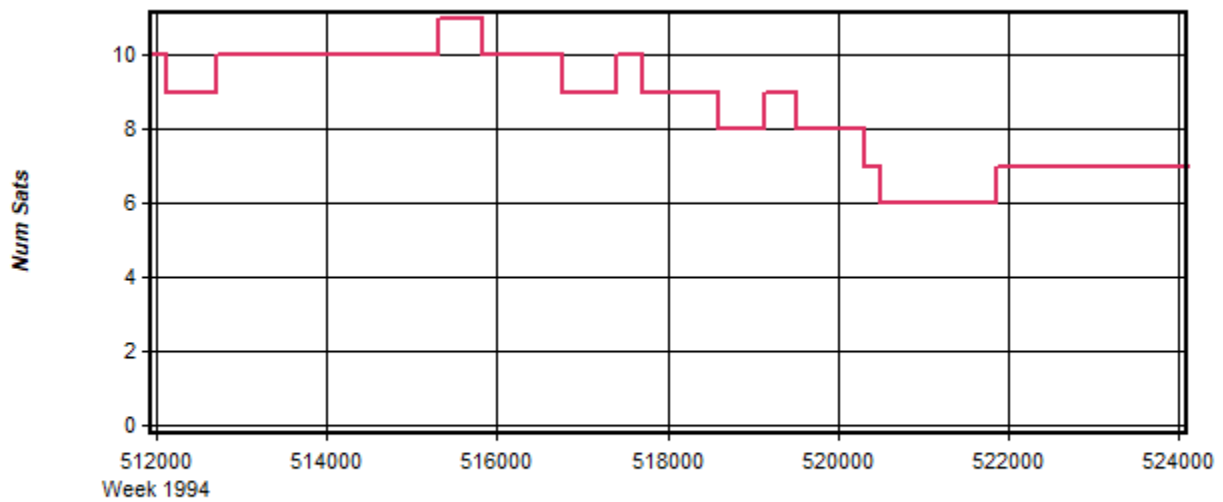
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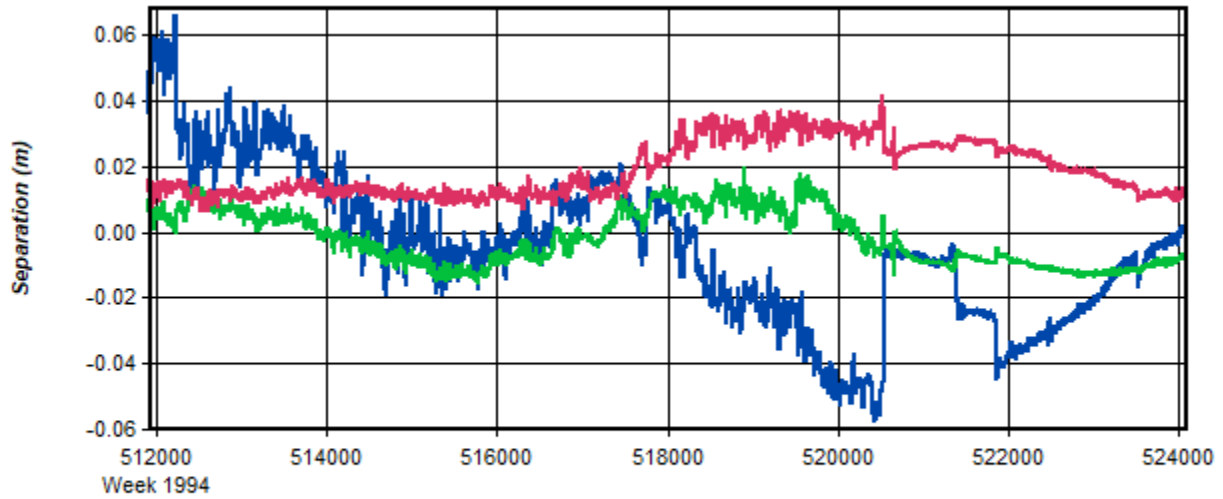
GPS Time (TOW, GMT zone)

— East — North — Height — Trace



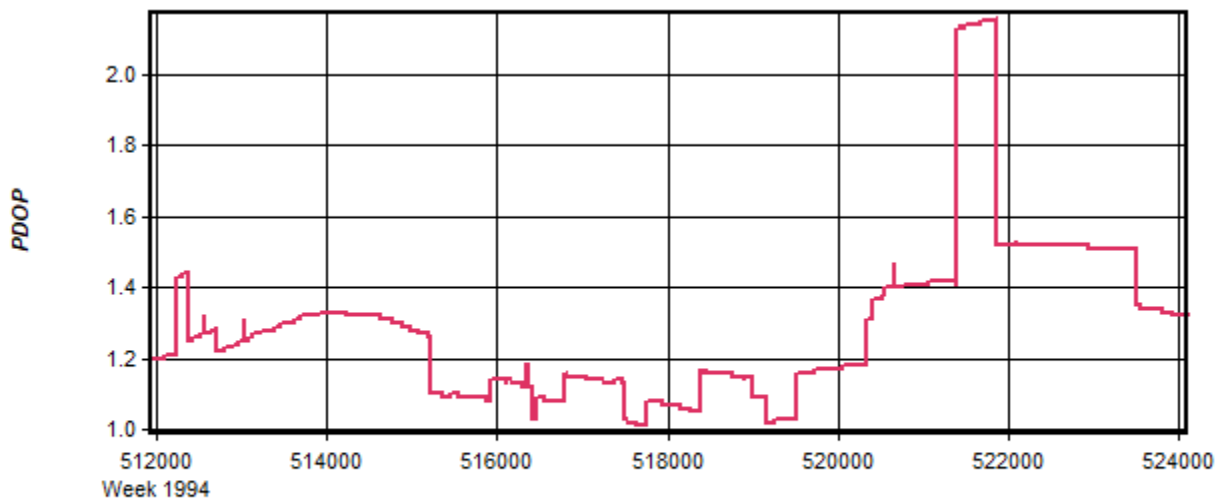
GPS Time (TOW, GMT zone)

— Num Sats — GPS — GLONASS — BeiDou



GPS Time (TOW, GMT zone)

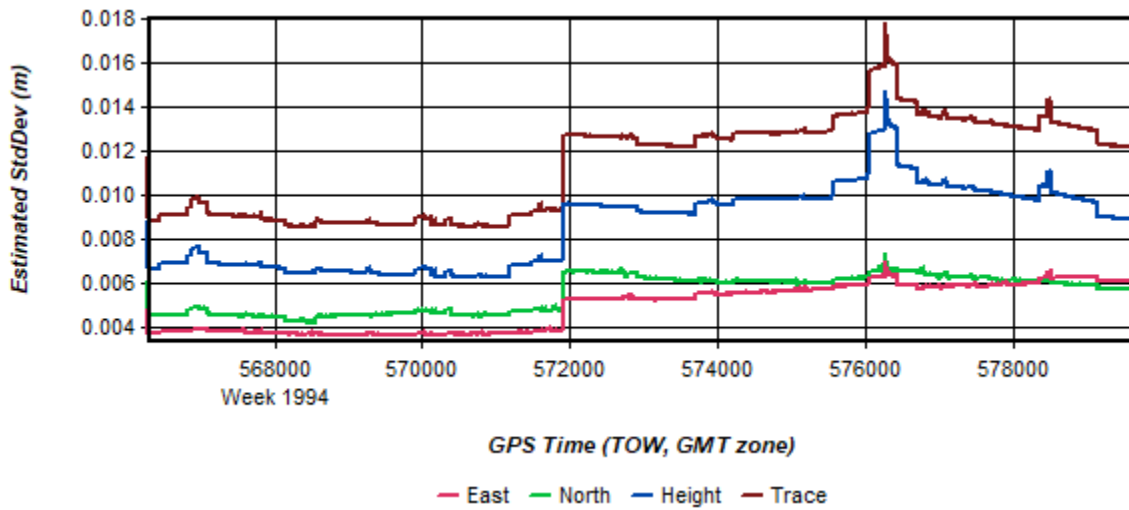
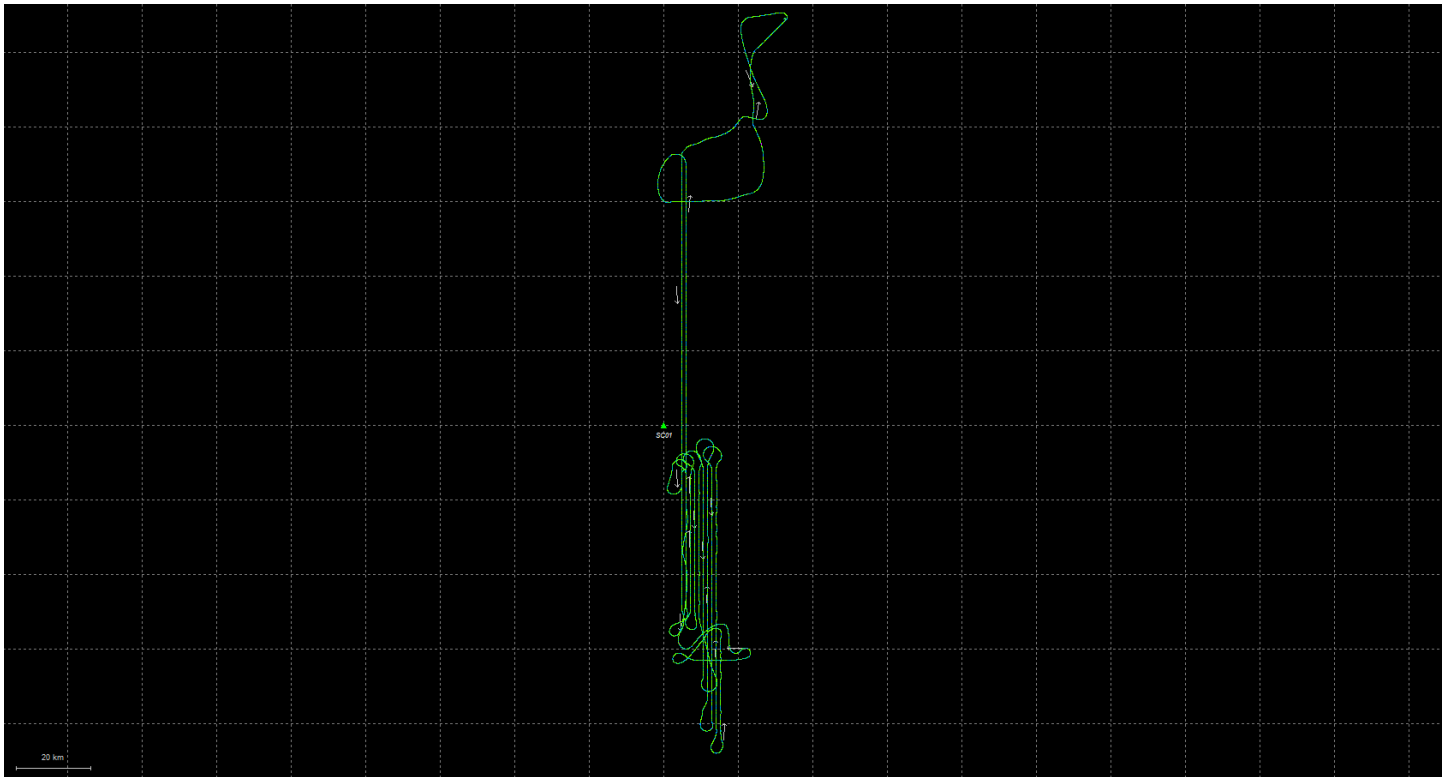
— East — North — Up



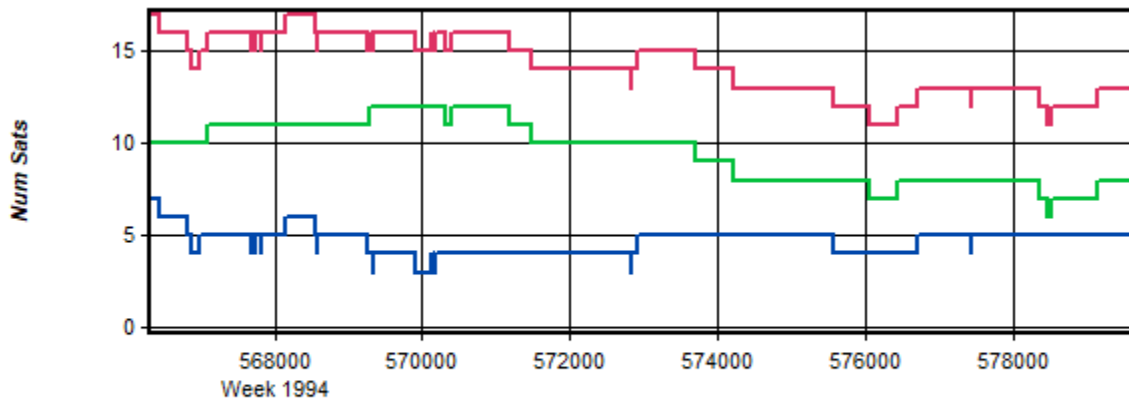
GPS Time (TOW, GMT zone)

— PDOP

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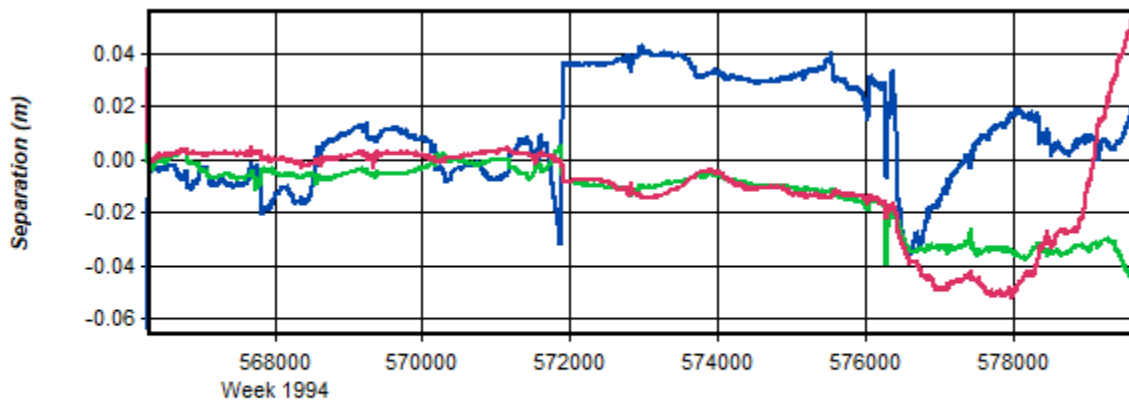






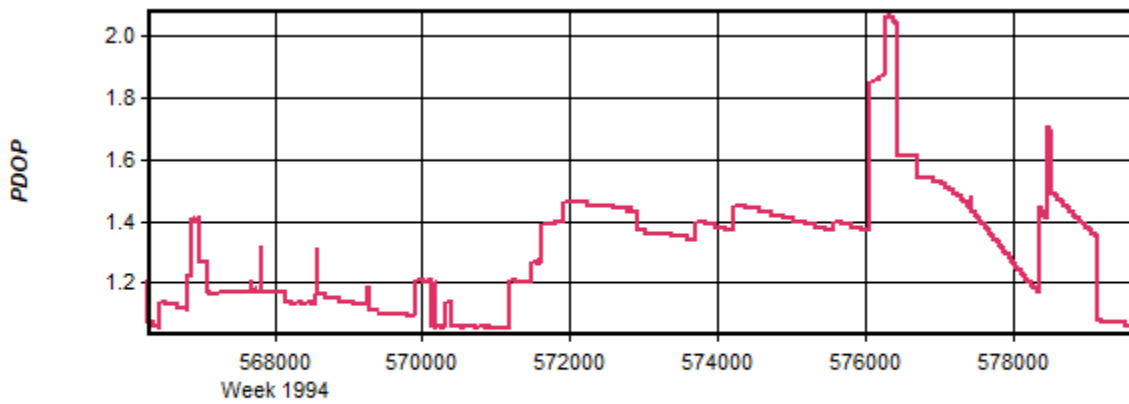
GPS Time (TOW, GMT zone)

— Num Sats — GPS — GLONASS — BeiDou



GPS Time (TOW, GMT zone)

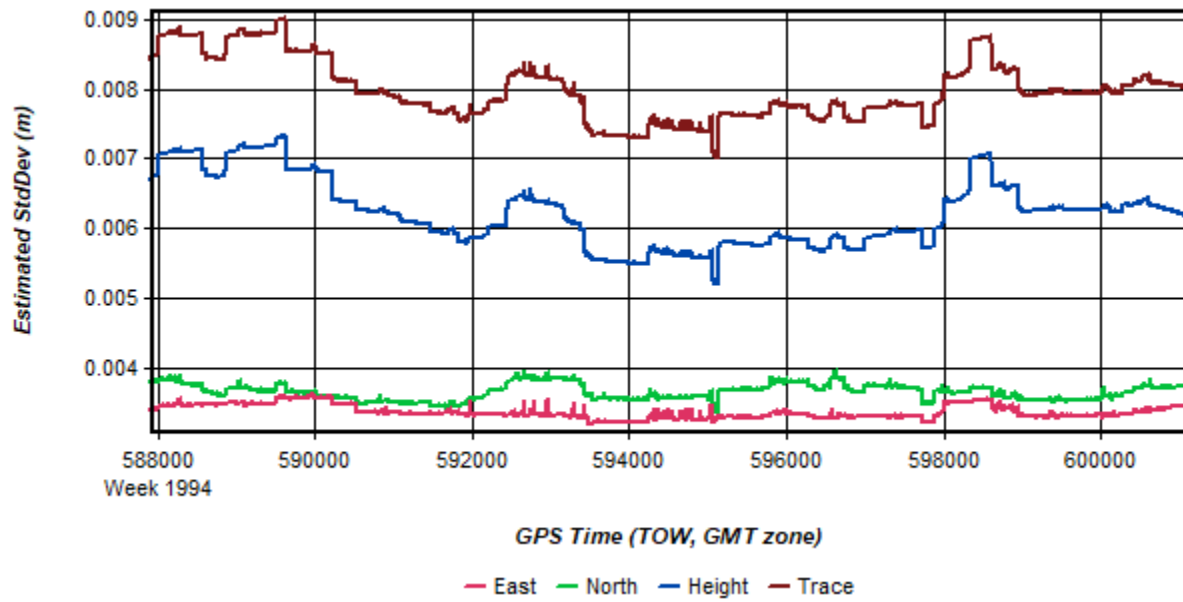
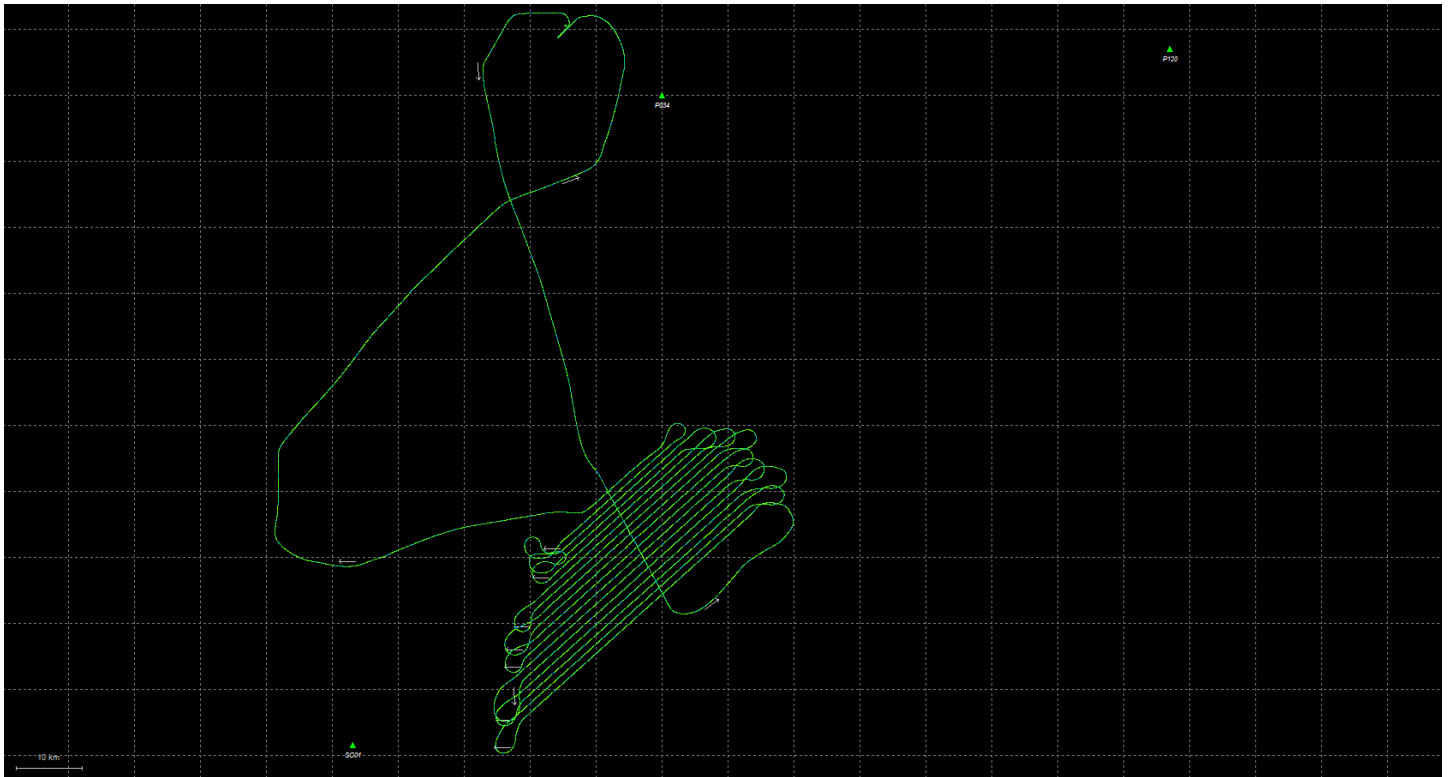
— East — North — Up

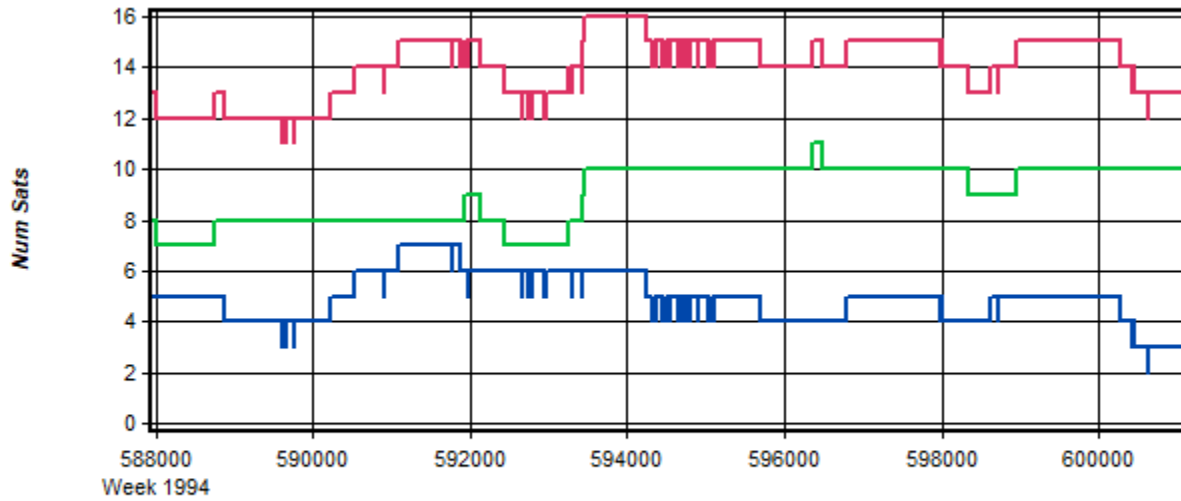


GPS Time (TOW, GMT zone)

— PDOP

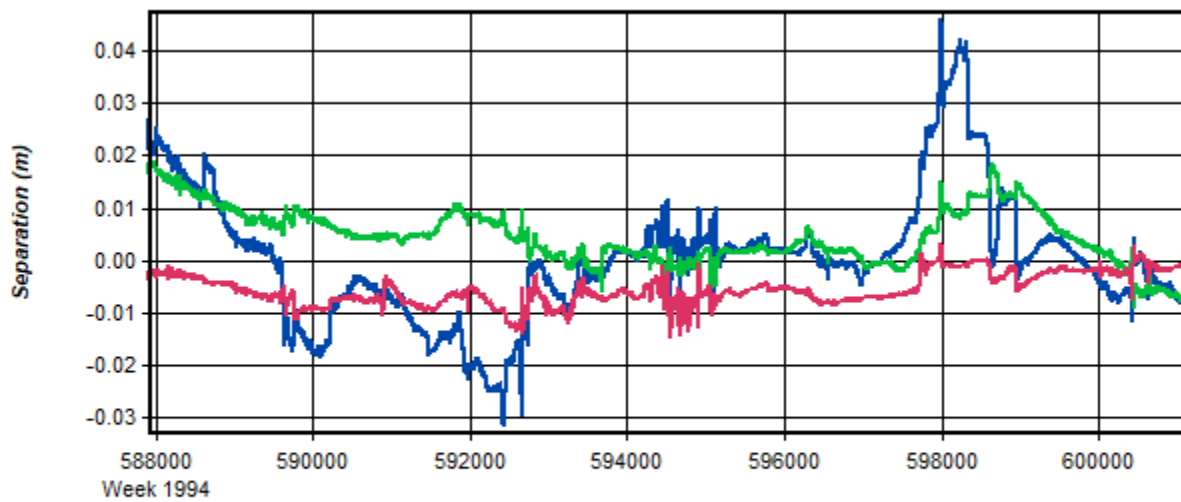
123\_20180331\_2





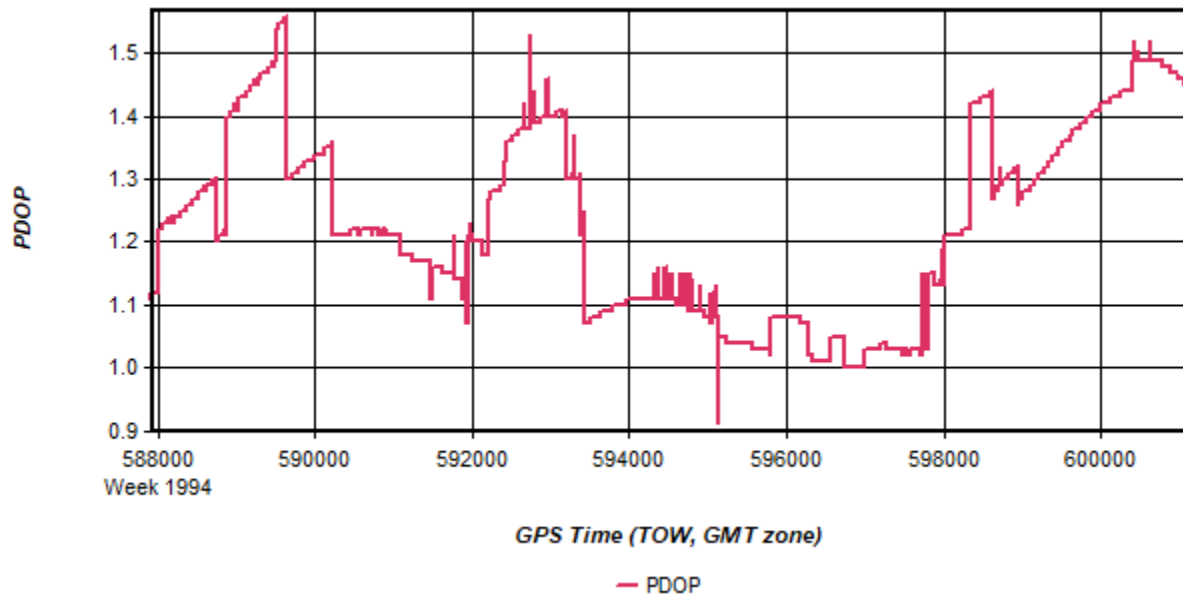
GPS Time (TOW, GMT zone)

— Num Sats — GPS — GLONASS — BeiDou



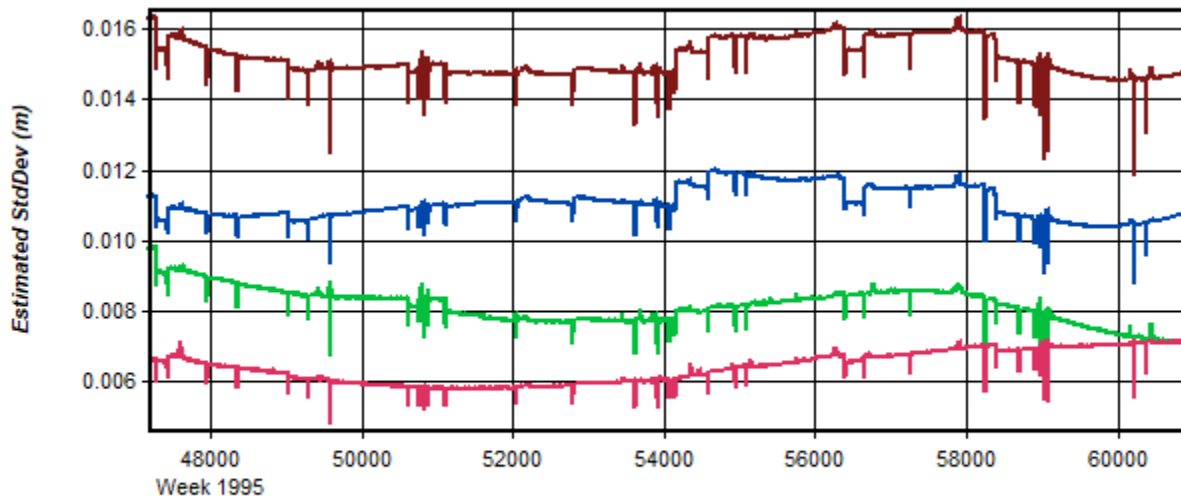
GPS Time (TOW, GMT zone)

— East — North — Up



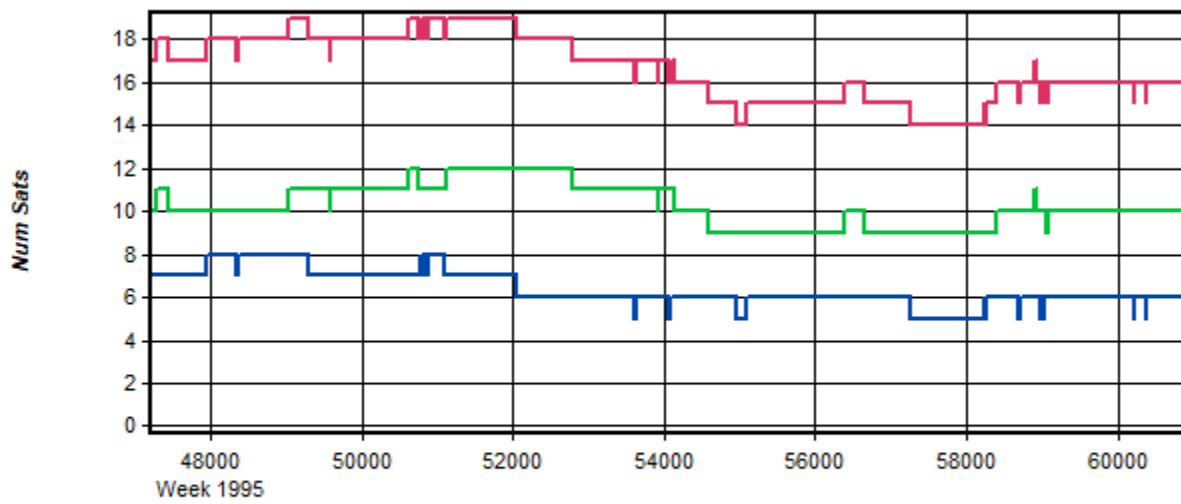
123\_20180401\_1





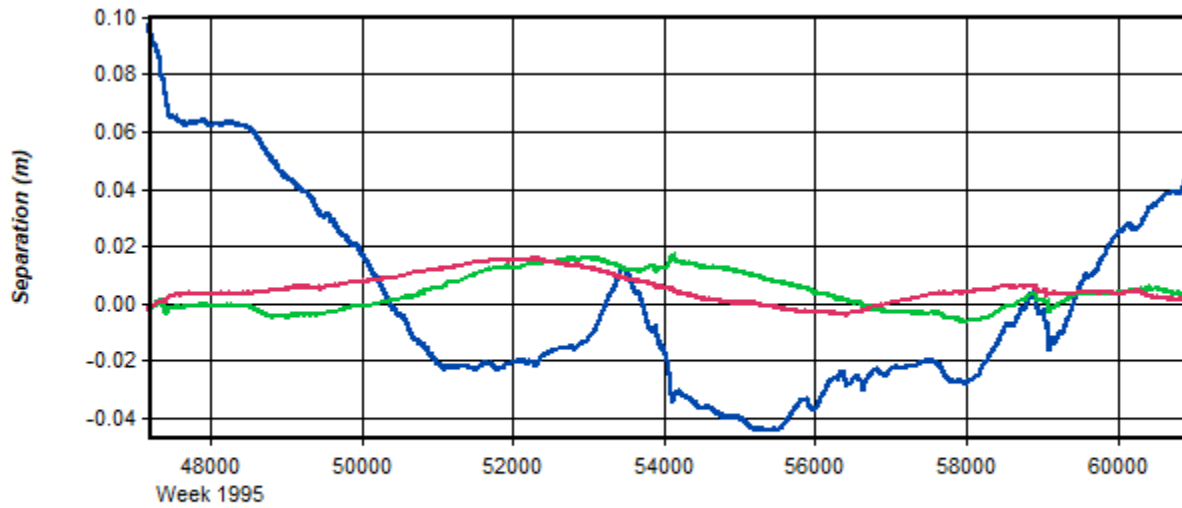
GPS Time (TOW, GMT zone)

— East — North — Height — Trace



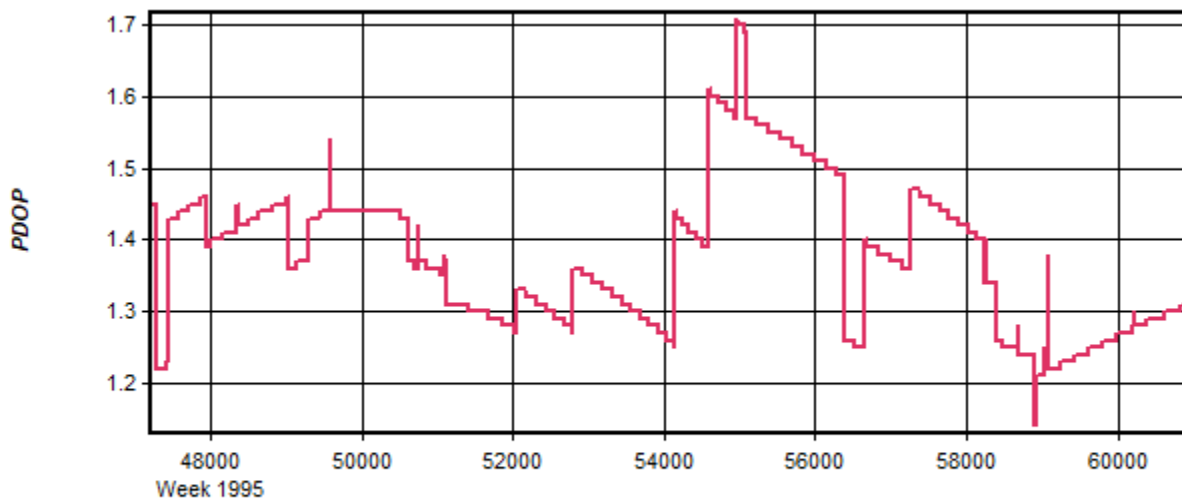
GPS Time (TOW, GMT zone)

— Num Sats — GPS — GLONASS — BeiDou



GPS Time (TOW, GMT zone)

— East — North — Up

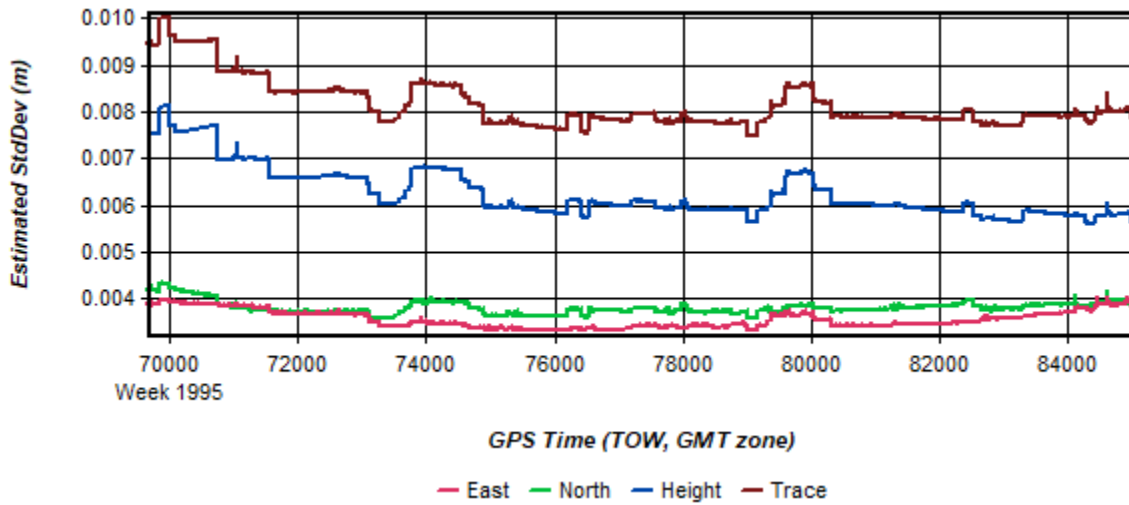


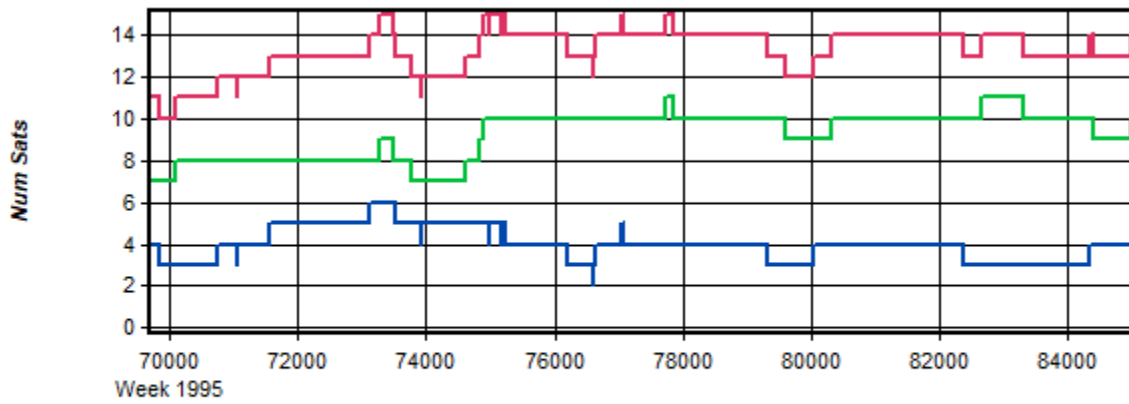
GPS Time (TOW, GMT zone)

— PDOP



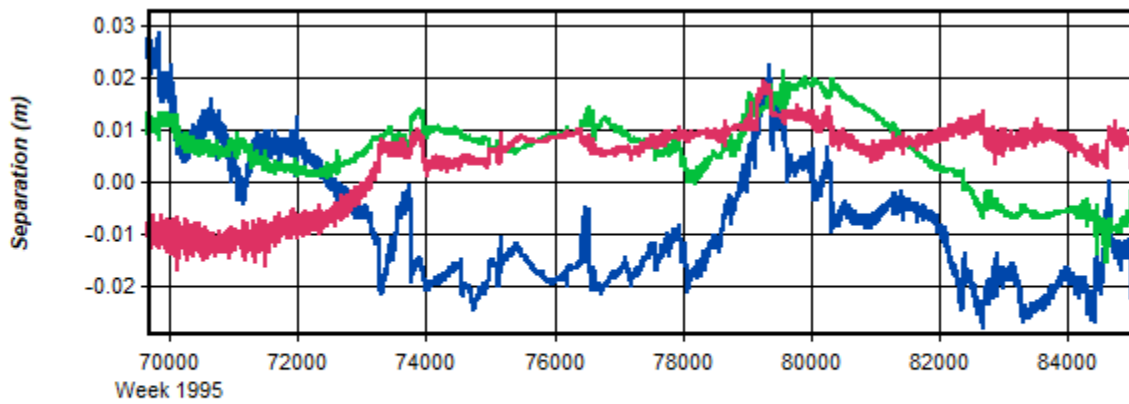
123\_20180401\_2





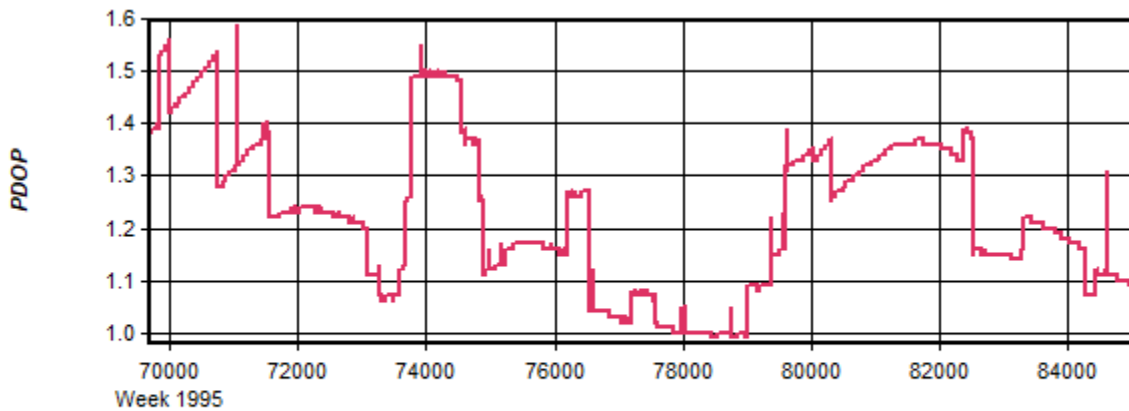
GPS Time (TOW, GMT zone)

— Num Sats — GPS — GLONASS — BeiDou



GPS Time (TOW, GMT zone)

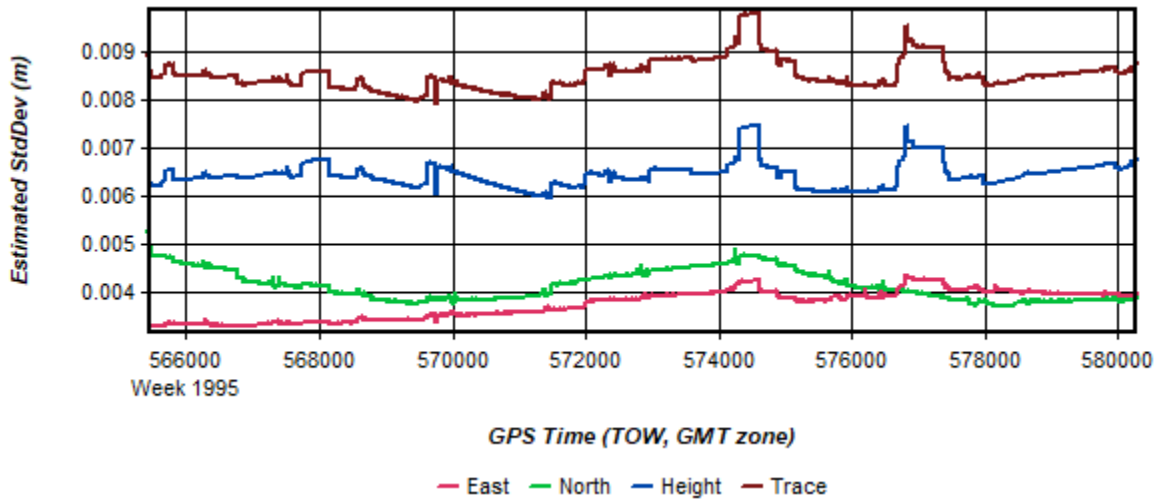
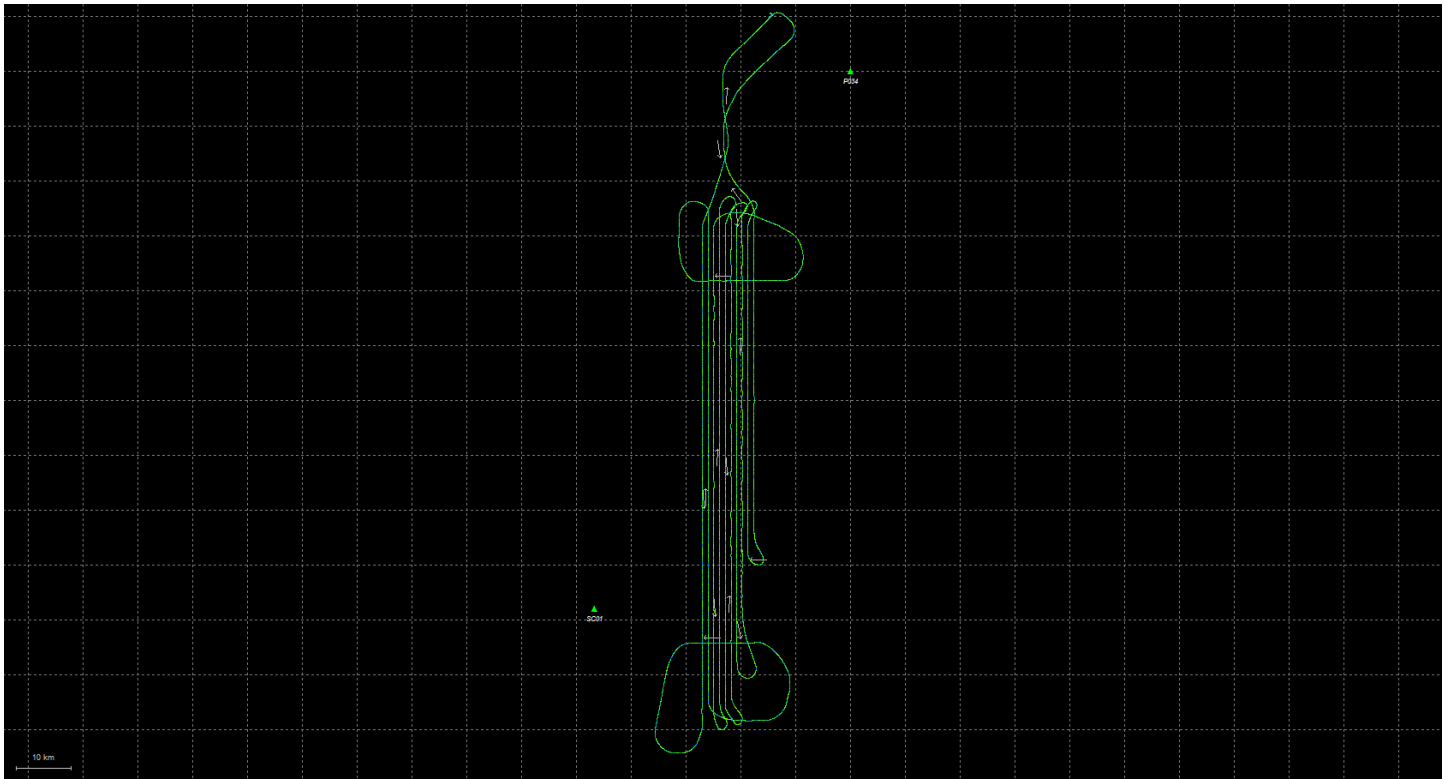
— East — North — Up

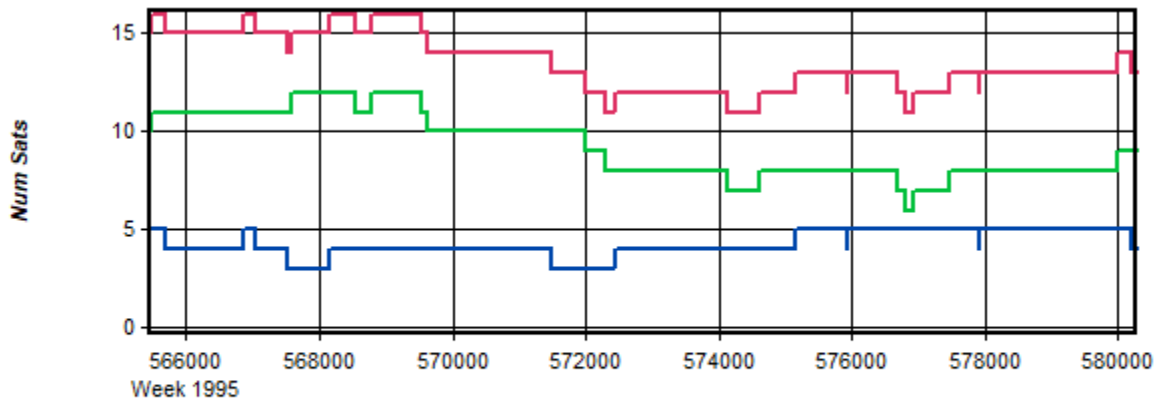


GPS Time (TOW, GMT zone)

— PDOP

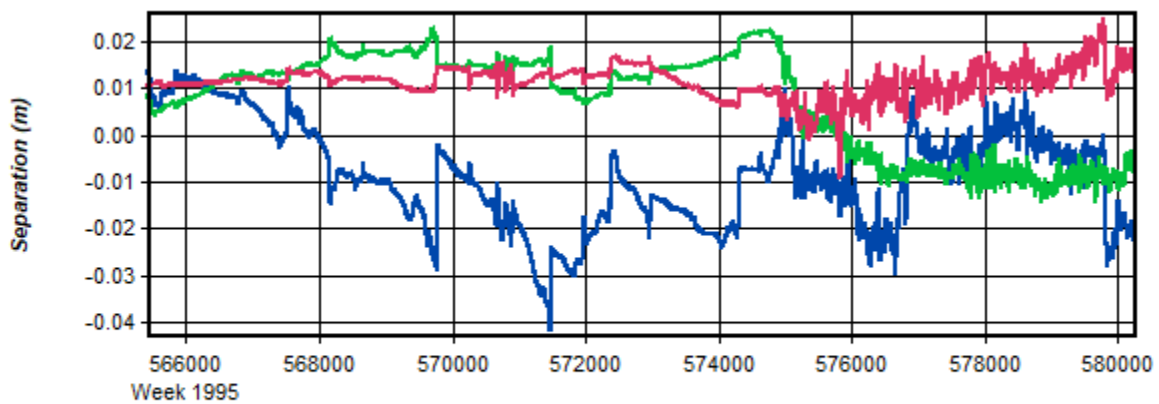
123\_20180407\_1





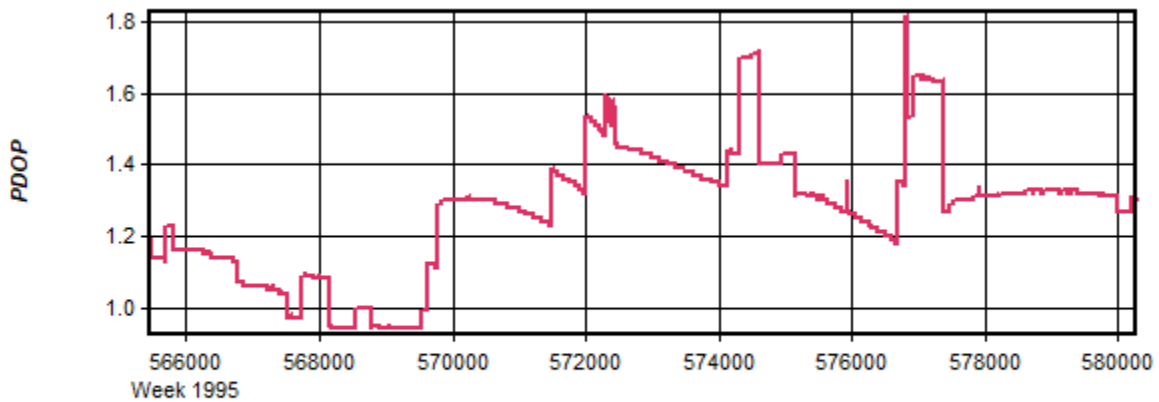
GPS Time (TOW, GMT zone)

— Num Sats — GPS — GLONASS — BeiDou



GPS Time (TOW, GMT zone)

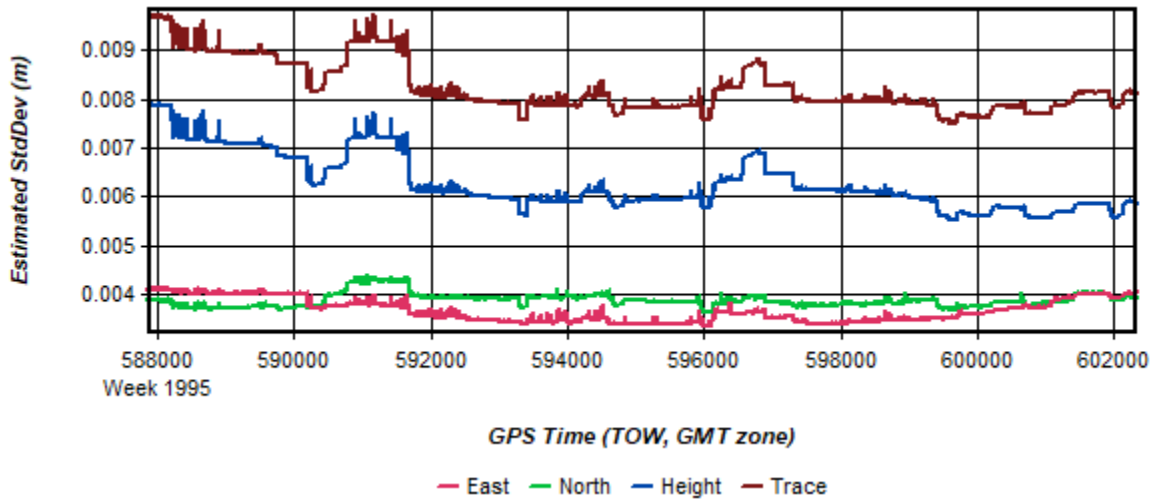
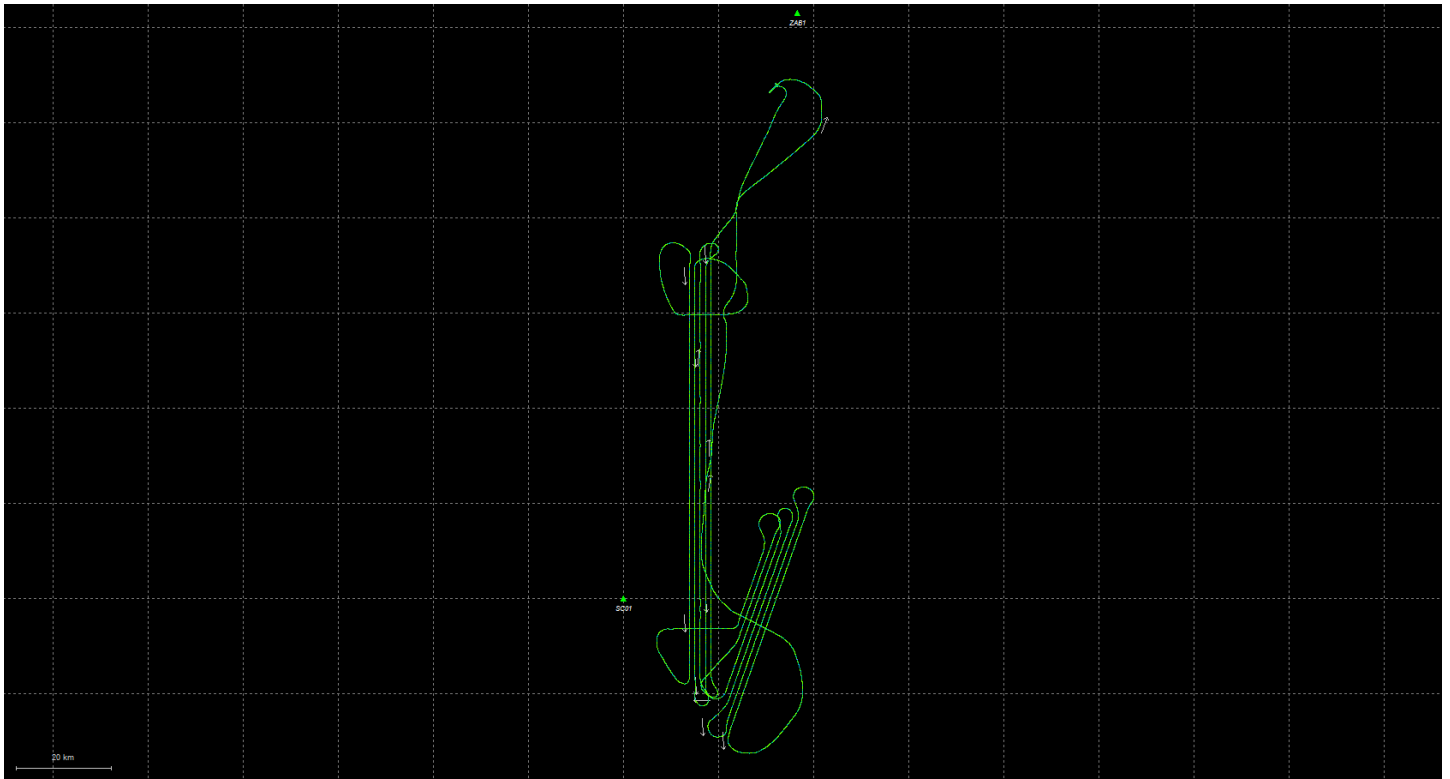
— East — North — Up

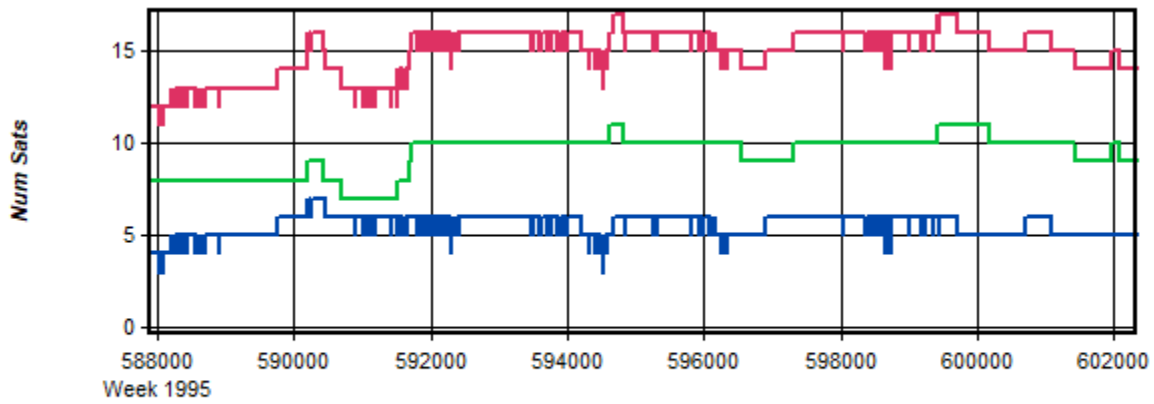


GPS Time (TOW, GMT zone)

— PDOP

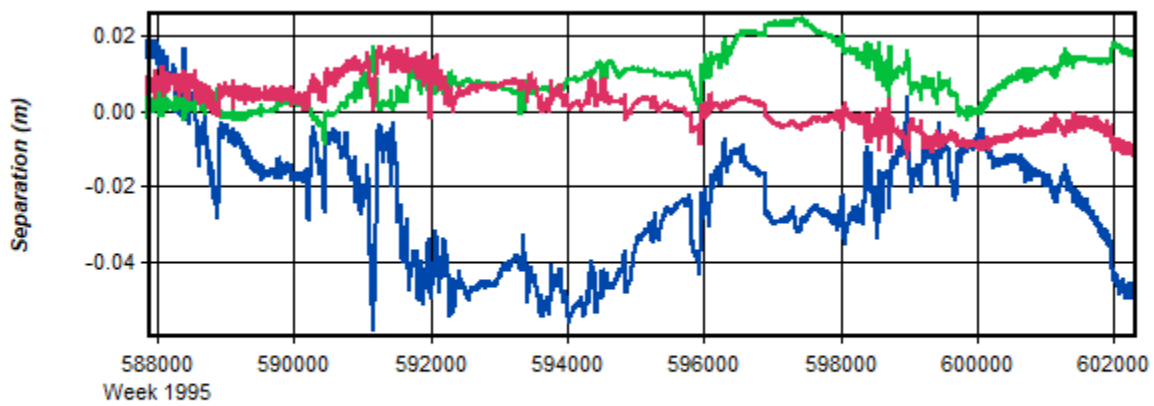
123\_20180407\_2





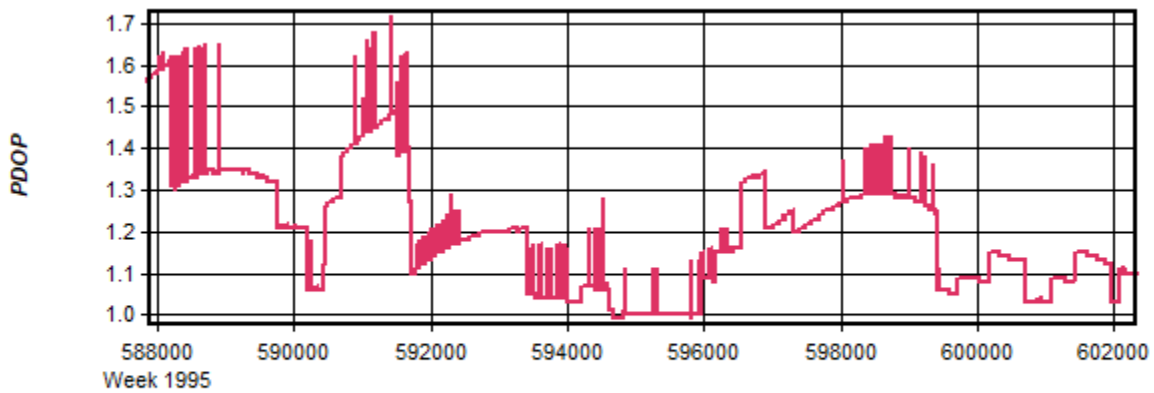
GPS Time (TOW, GMT zone)

— Num Sats — GPS — GLONASS — BeiDou



GPS Time (TOW, GMT zone)

— East — North — Up

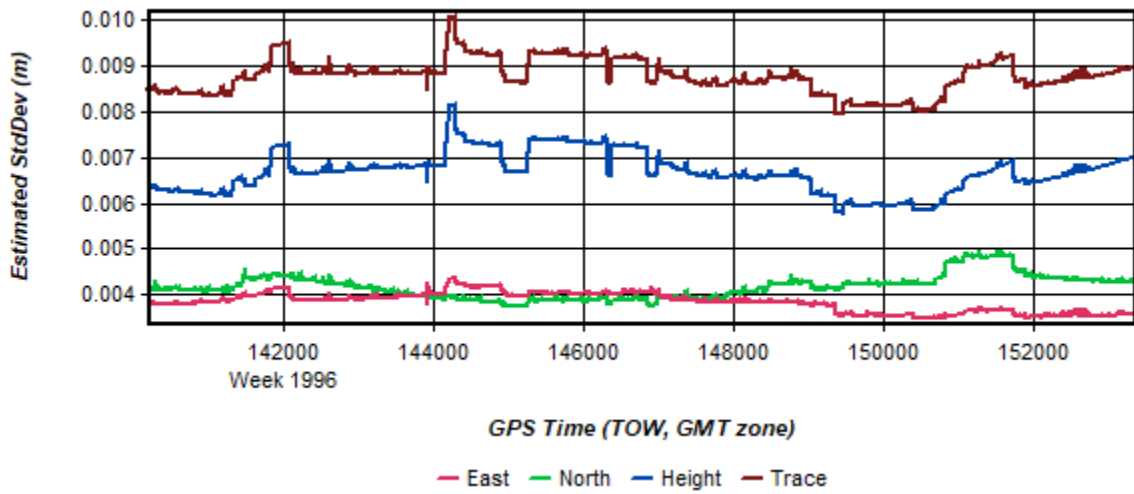


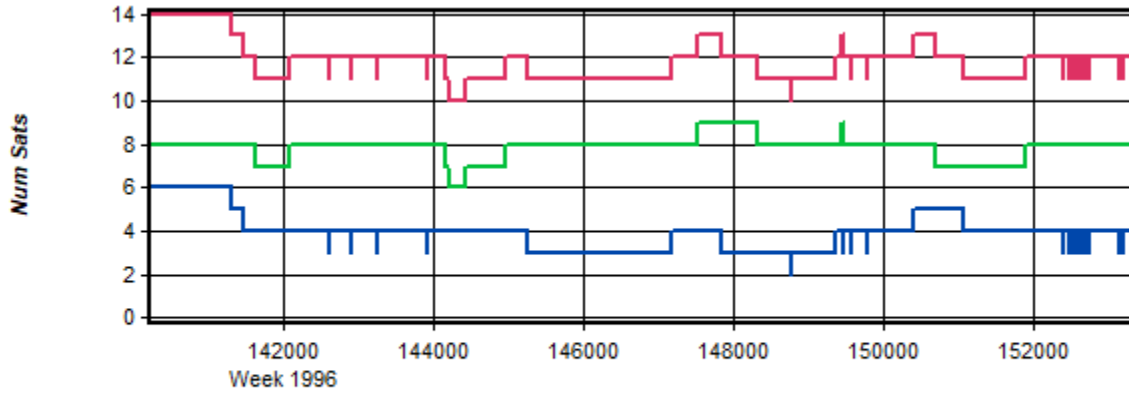
GPS Time (TOW, GMT zone)

— PDOP



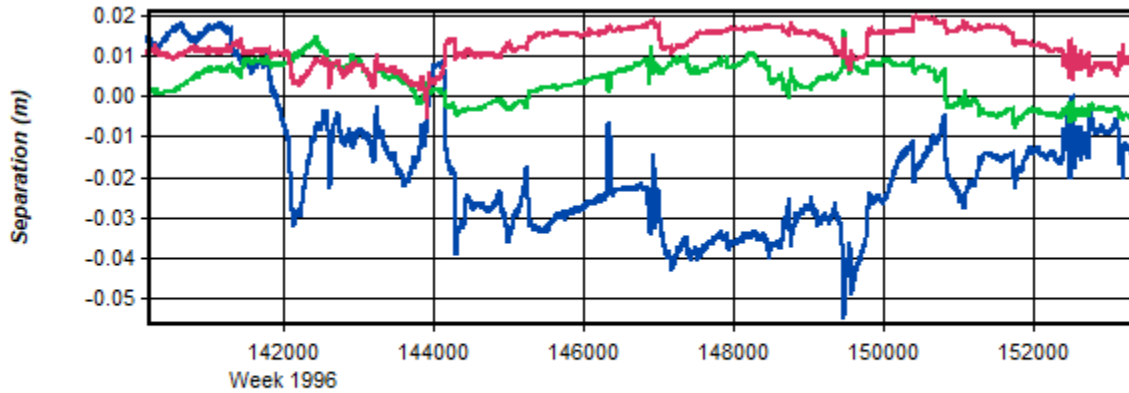
123\_20180409\_1





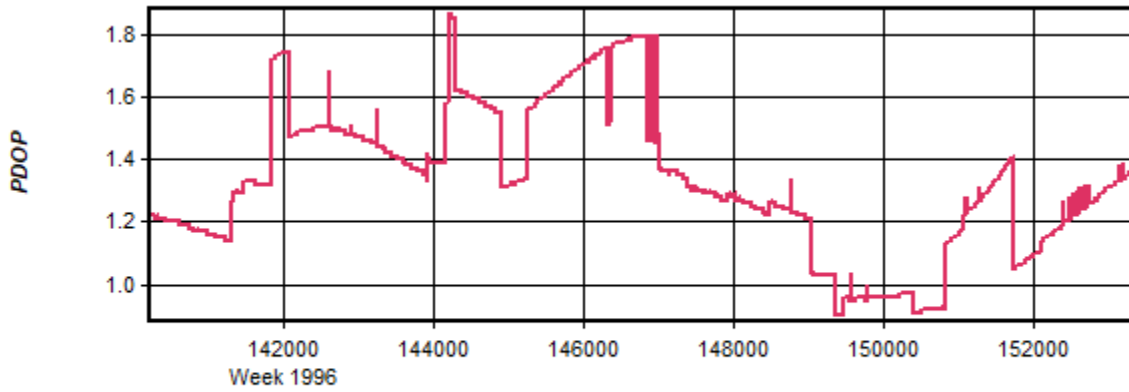
GPS Time (TOW, GMT zone)

— Num Sats — GPS — GLONASS — BeiDou



GPS Time (TOW, GMT zone)

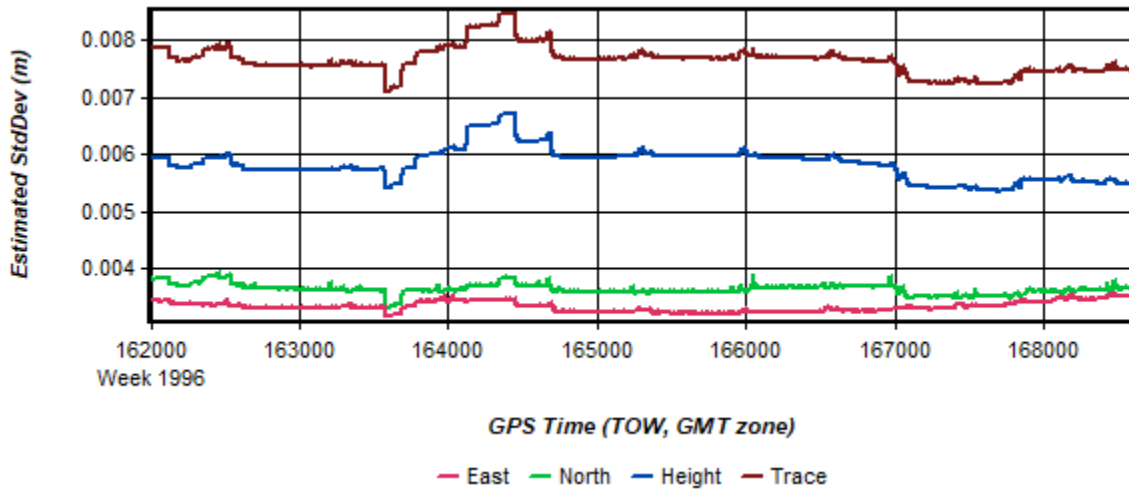
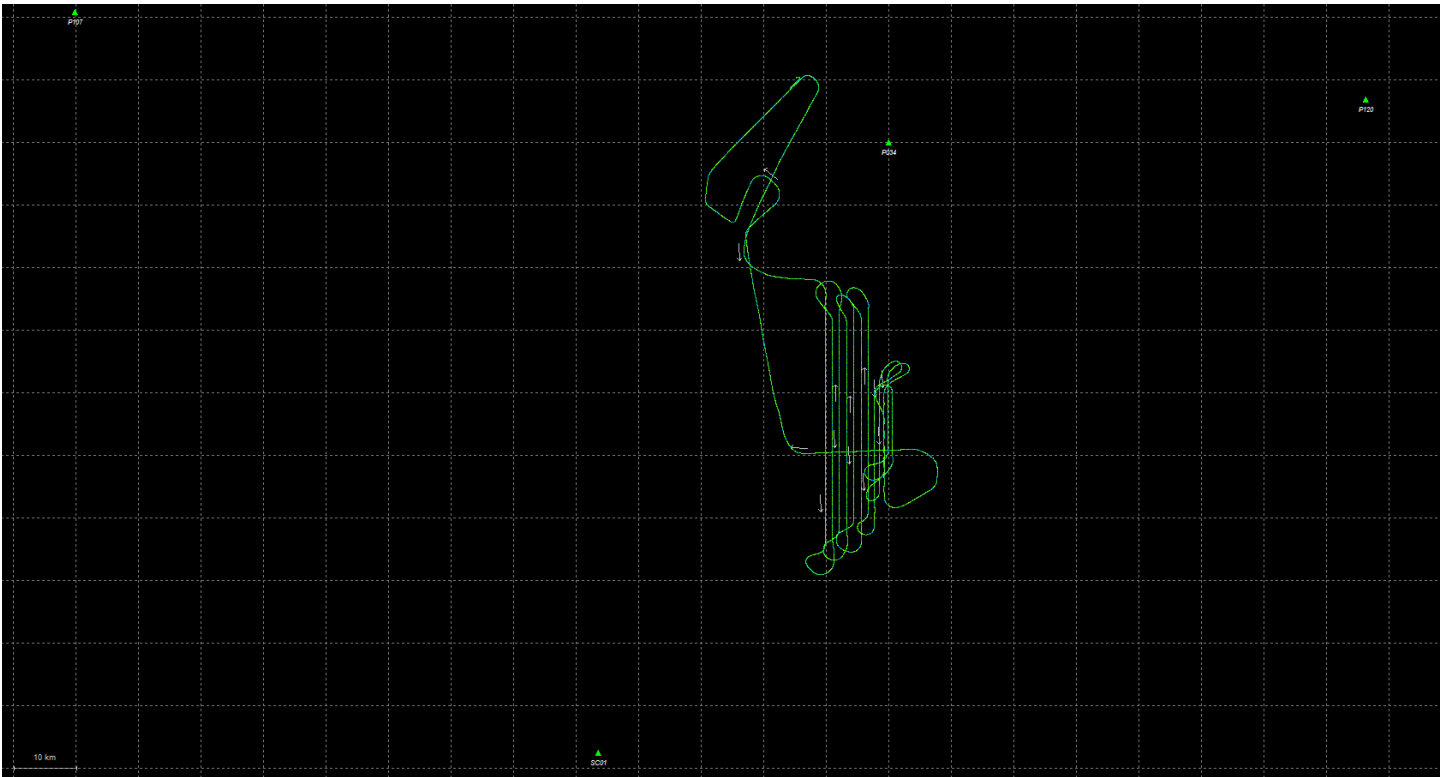
— East — North — Up

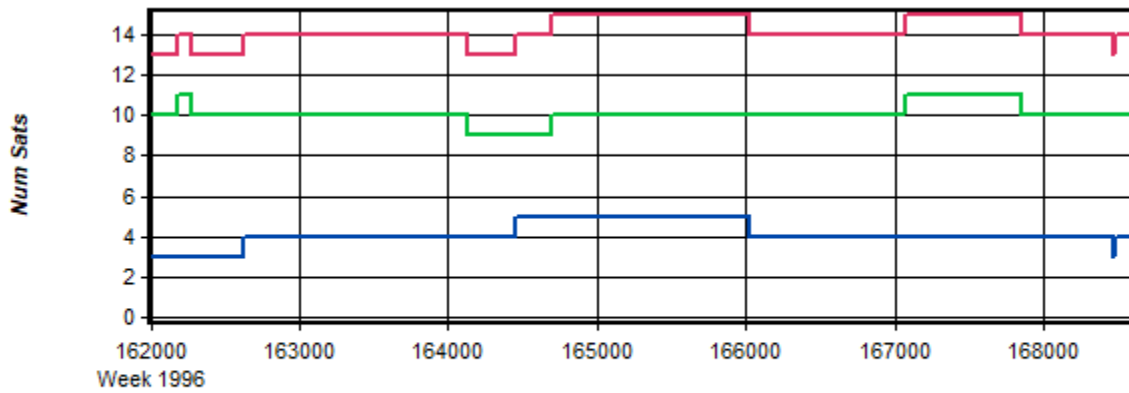


GPS Time (TOW, GMT zone)

— PDOP

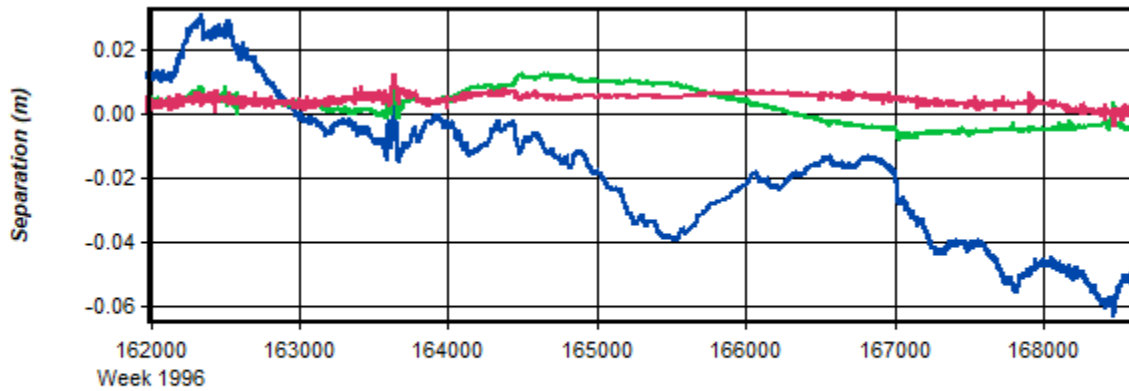
123\_20180409\_2





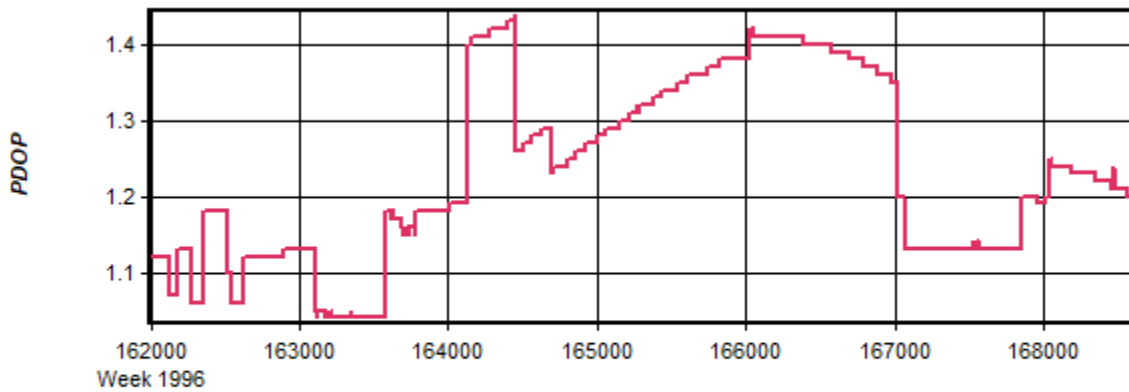
GPS Time (TOW, GMT zone)

— Num Sats — GPS — GLONASS — BeiDou



GPS Time (TOW, GMT zone)

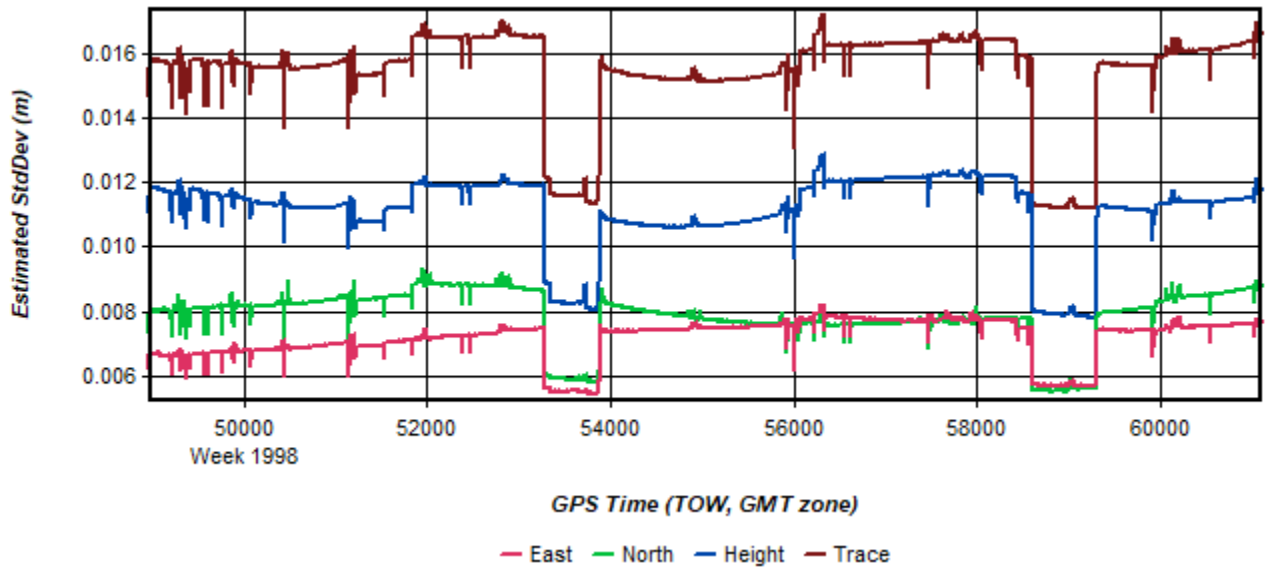
— East — North — Up

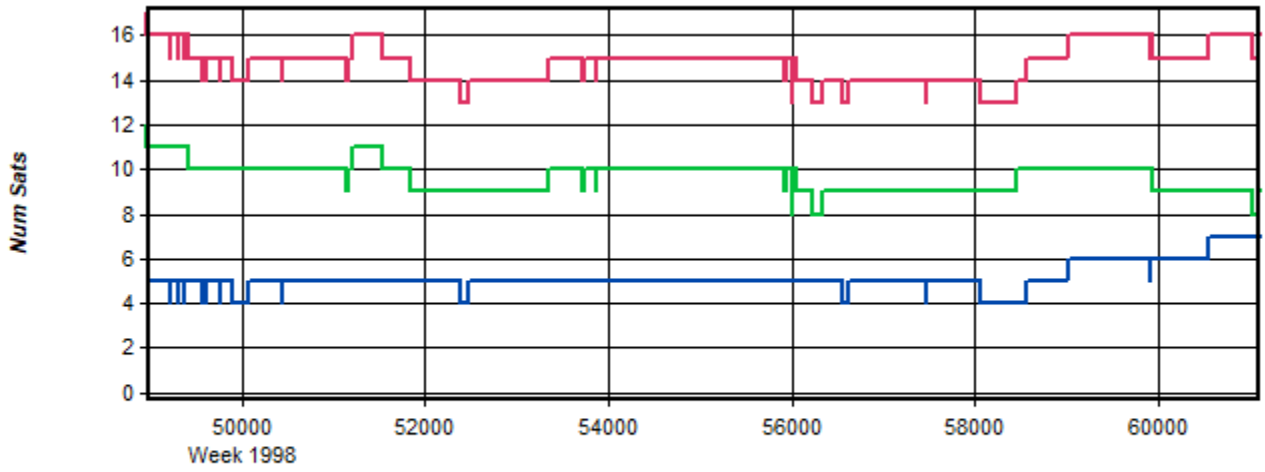


GPS Time (TOW, GMT zone)

— PDOP

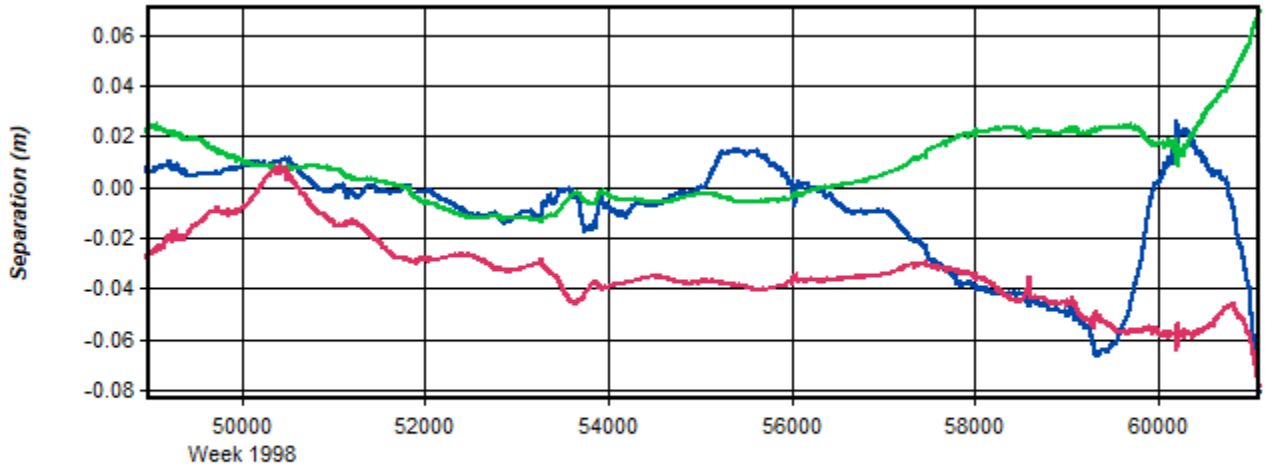
225\_20180422\_1





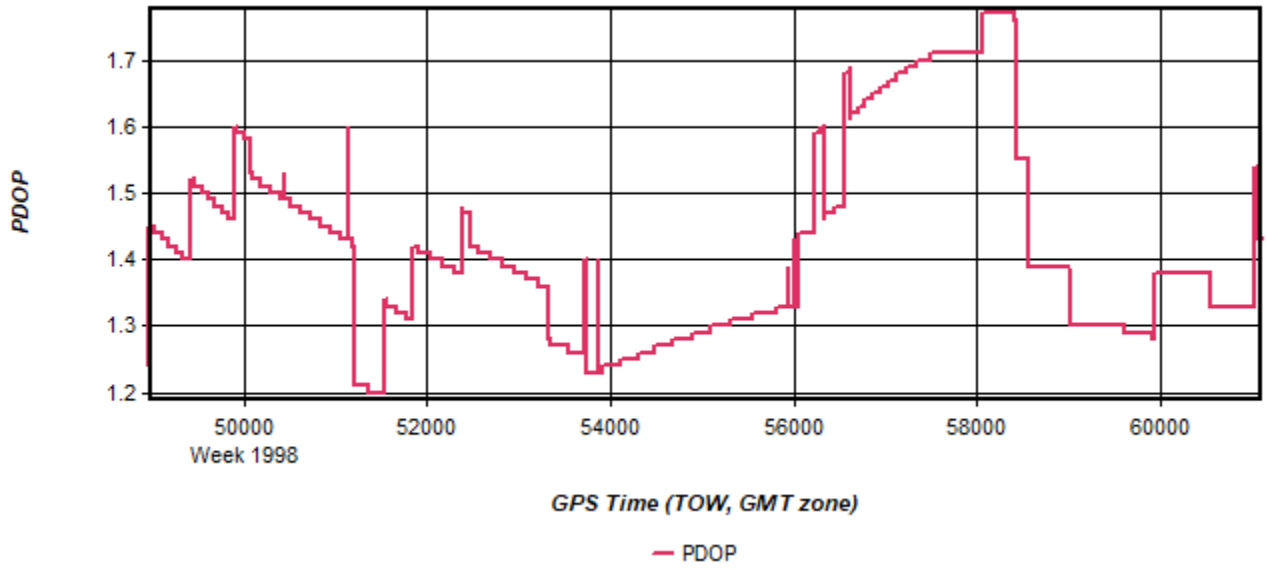
GPS Time (TOW, GMT zone)

— Num Sats — GPS — GLONASS — BeiDou



GPS Time (TOW, GMT zone)

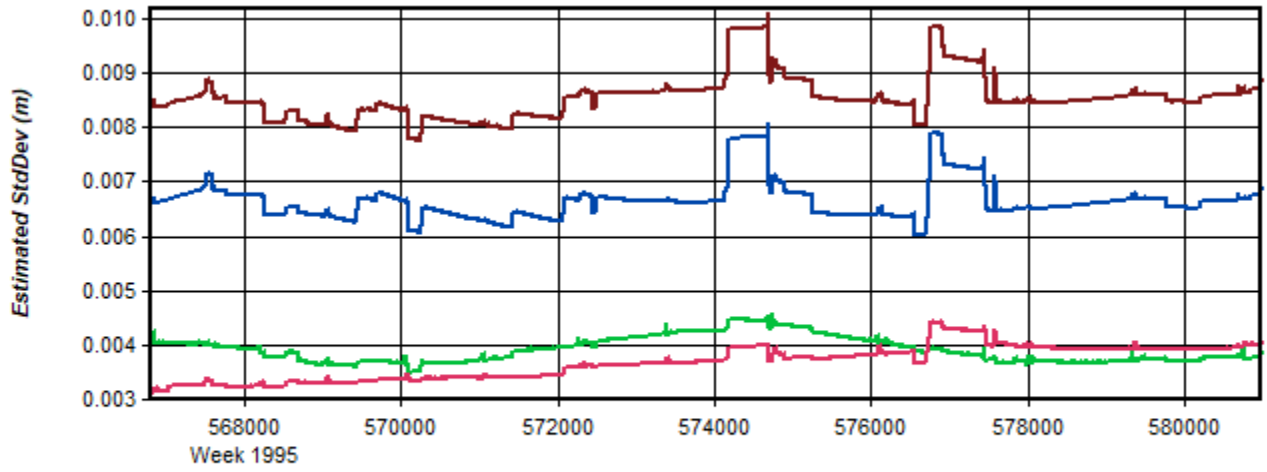
— East — North — Up



225\_20180407\_2

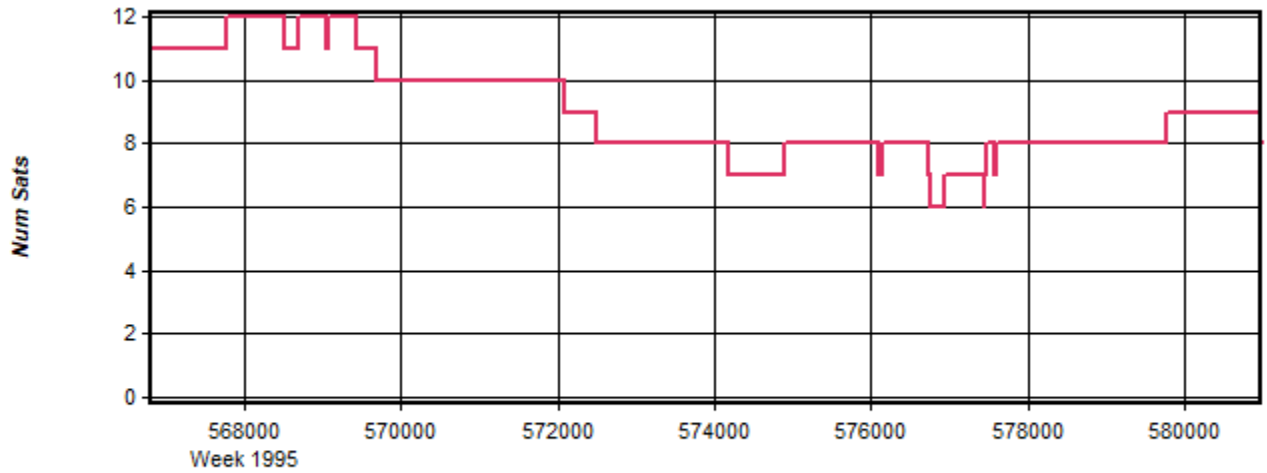






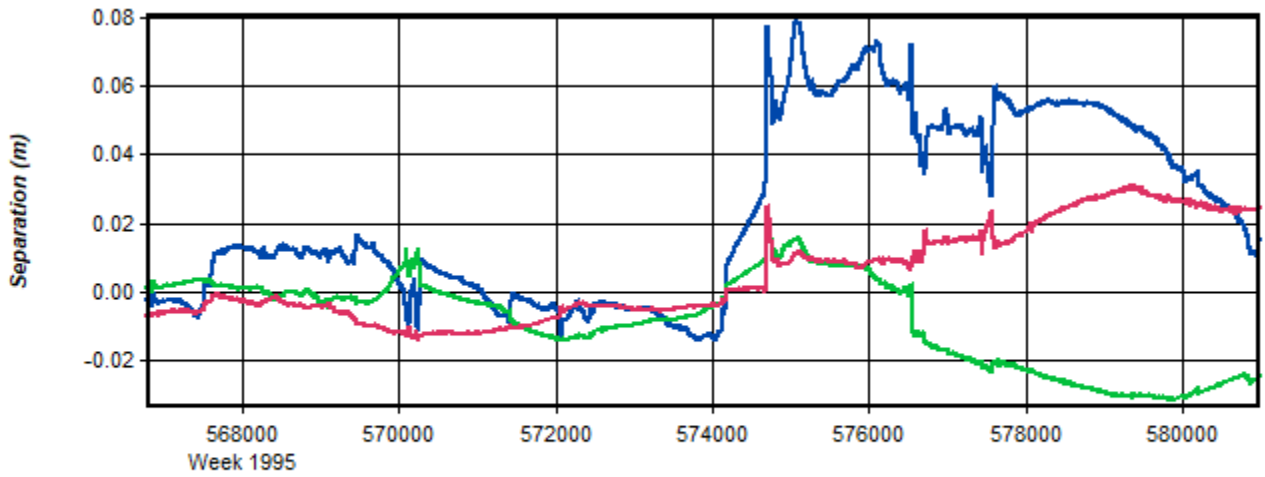
GPS Time (TOW, GMT zone)

— East — North — Height — Trace



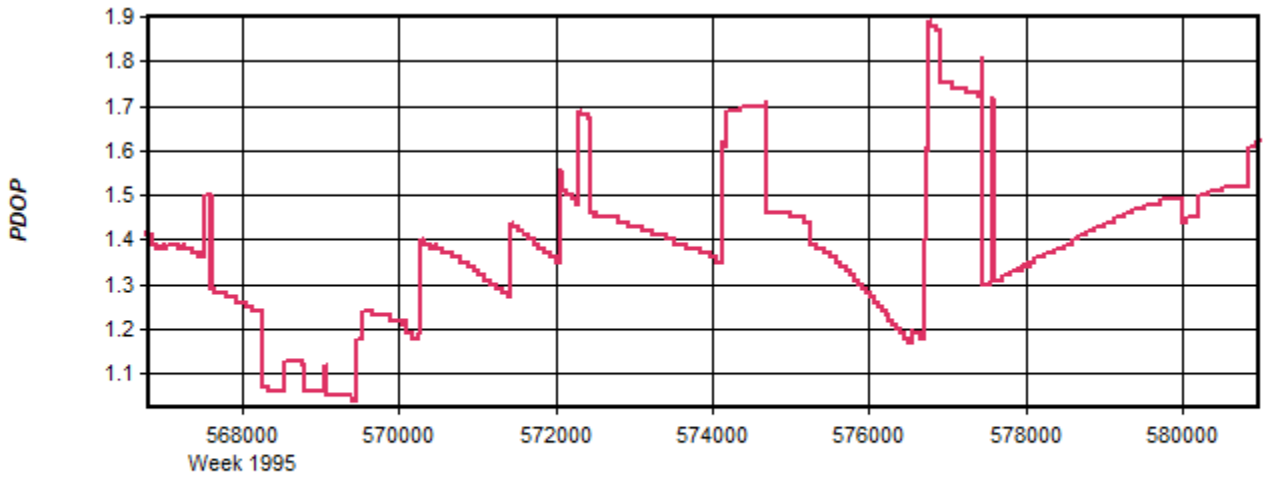
GPS Time (TOW, GMT zone)

— Num Sats — GPS — GLONASS — BeiDou



GPS Time (TOW, GMT zone)

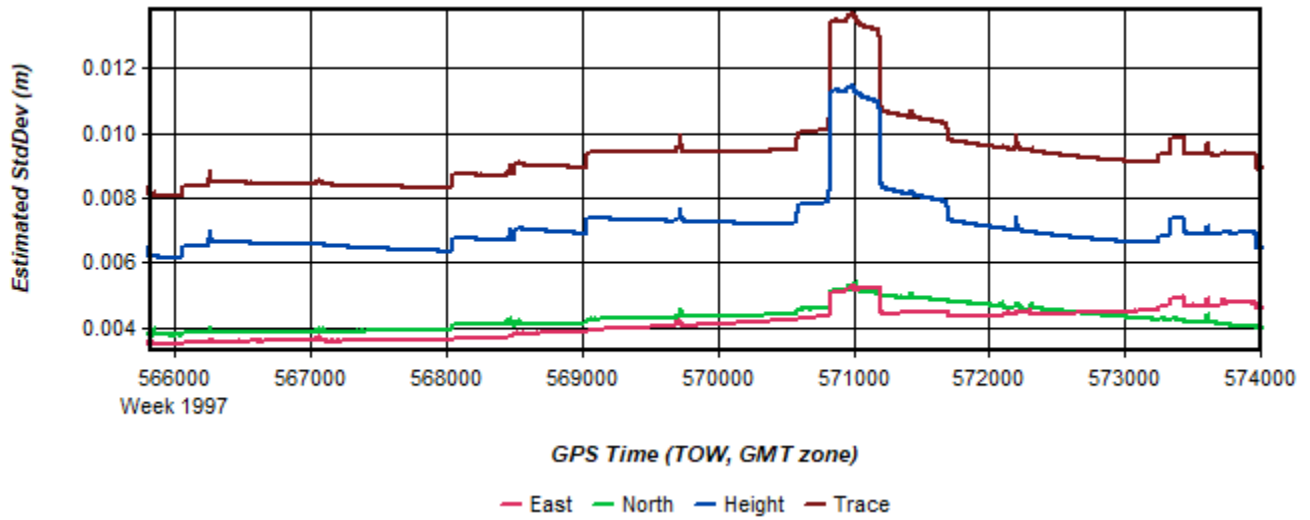
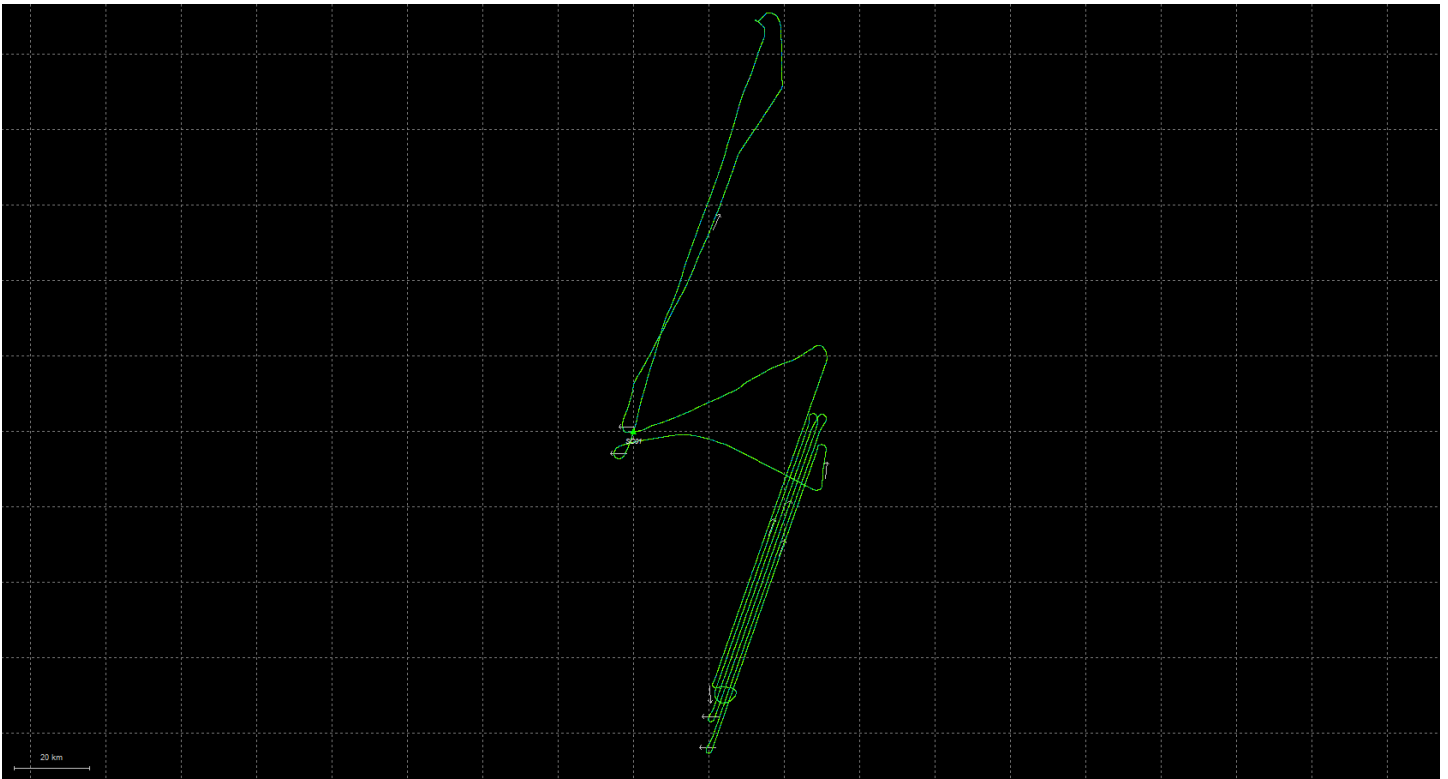
— East — North — Up

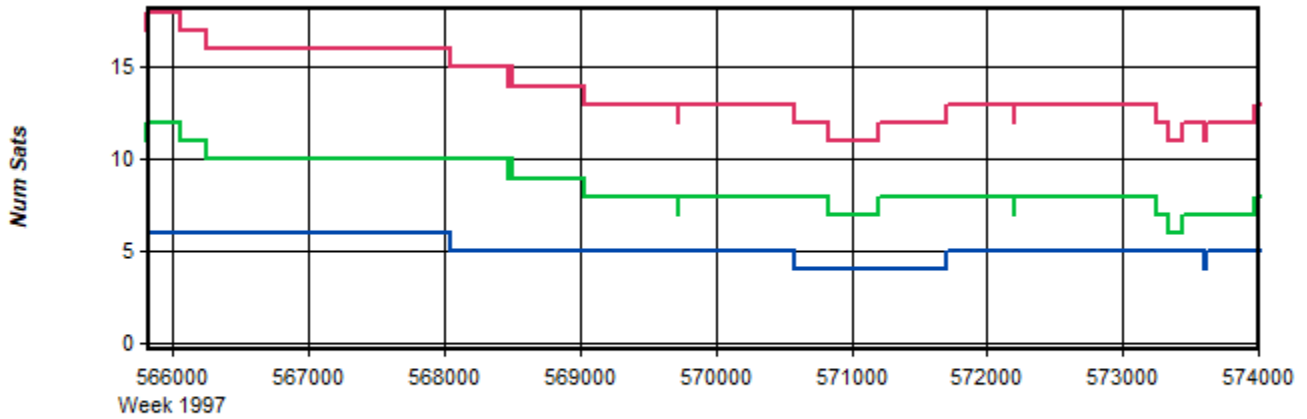


GPS Time (TOW, GMT zone)

— PDOP

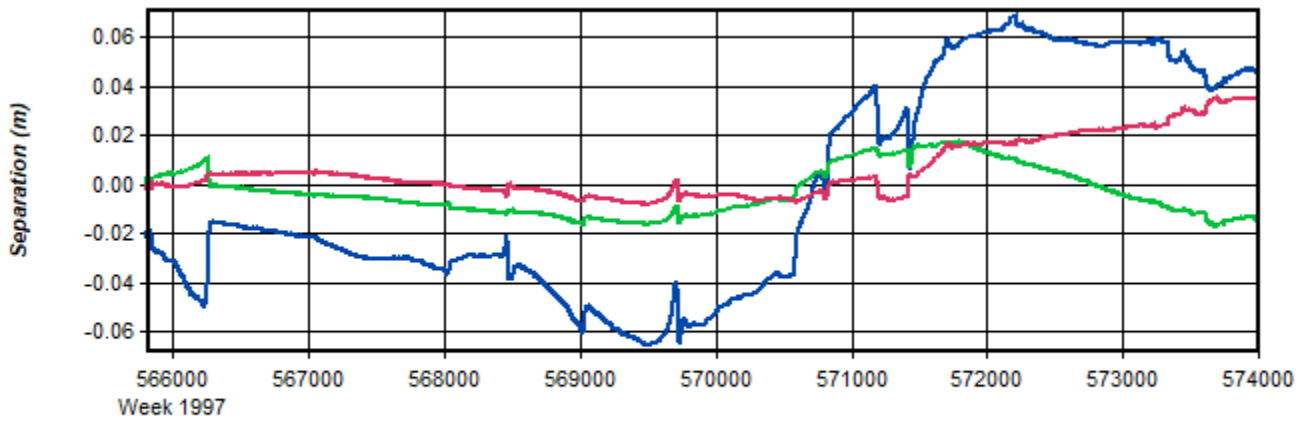
225\_20180421\_1





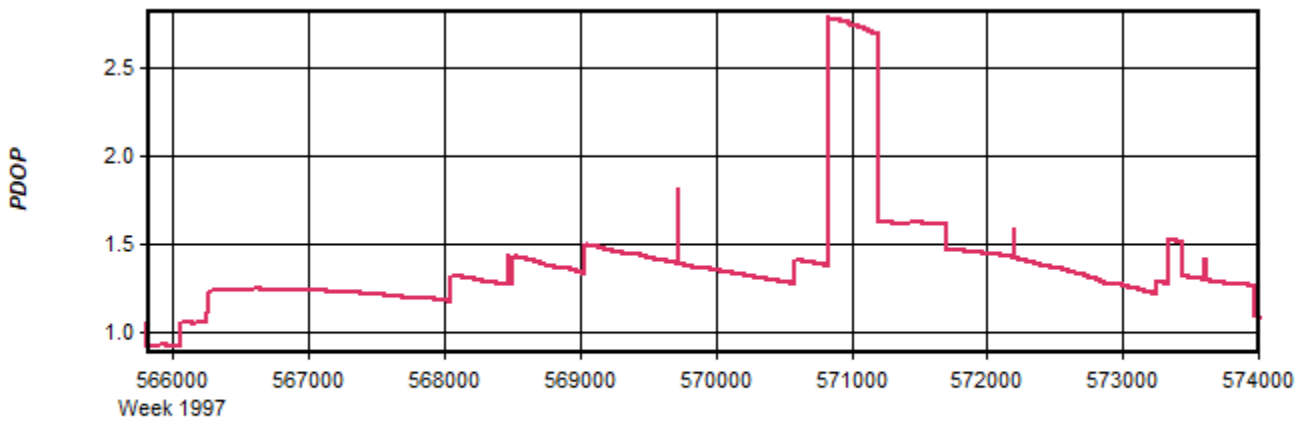
GPS Time (TOW, GMT zone)

— Num Sats — GPS — GLONASS — BeiDou



GPS Time (TOW, GMT zone)

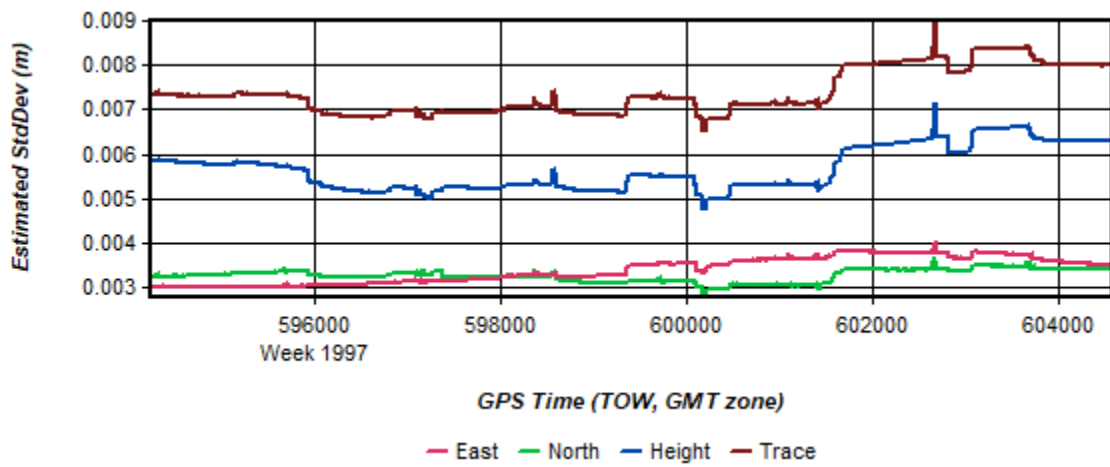
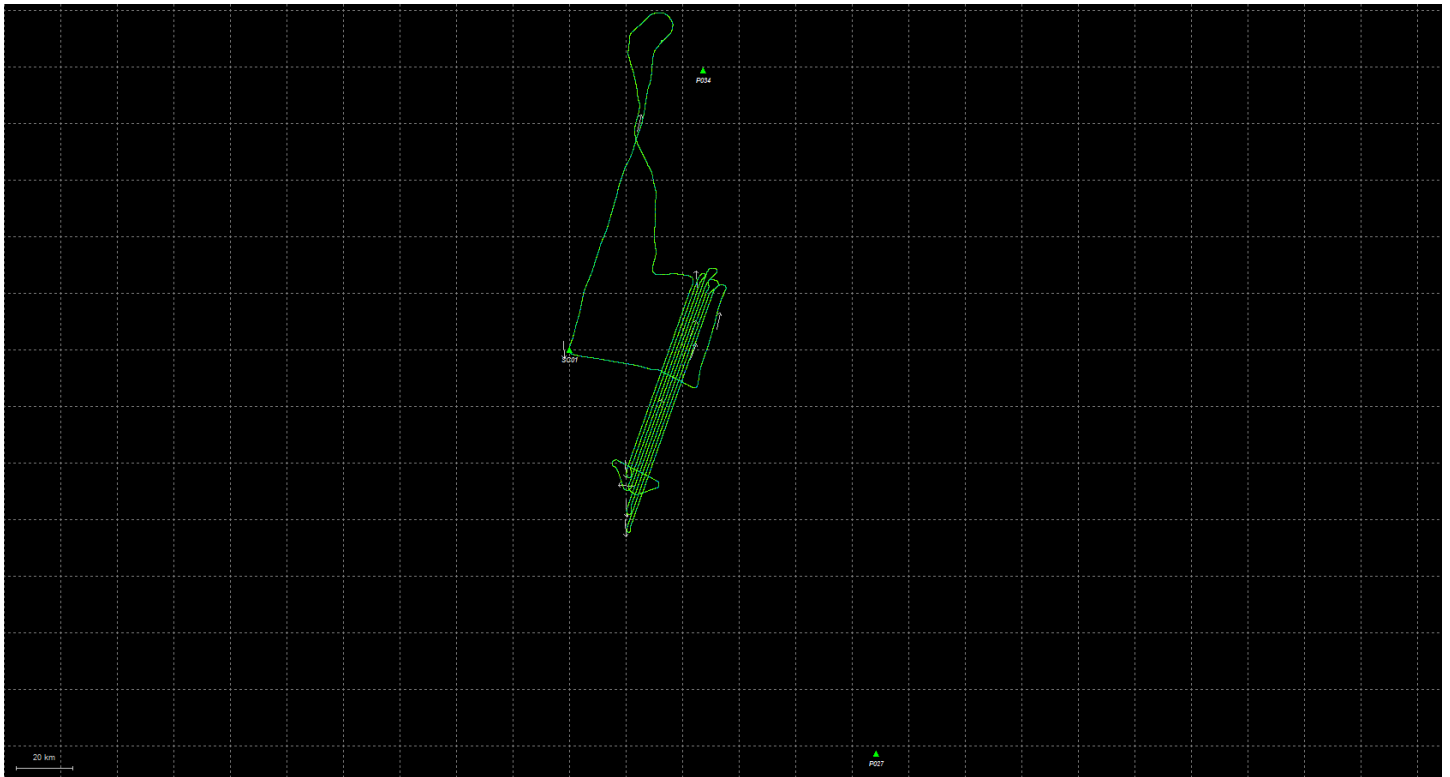
— East — North — Up

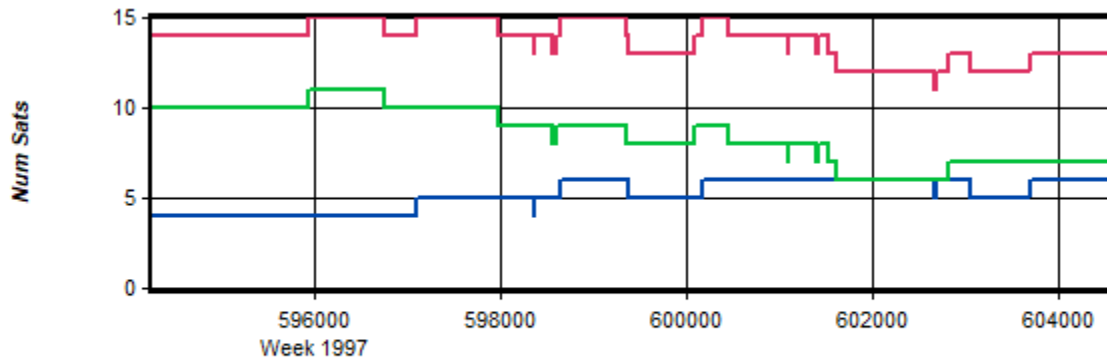


GPS Time (TOW, GMT zone)

— PDOP

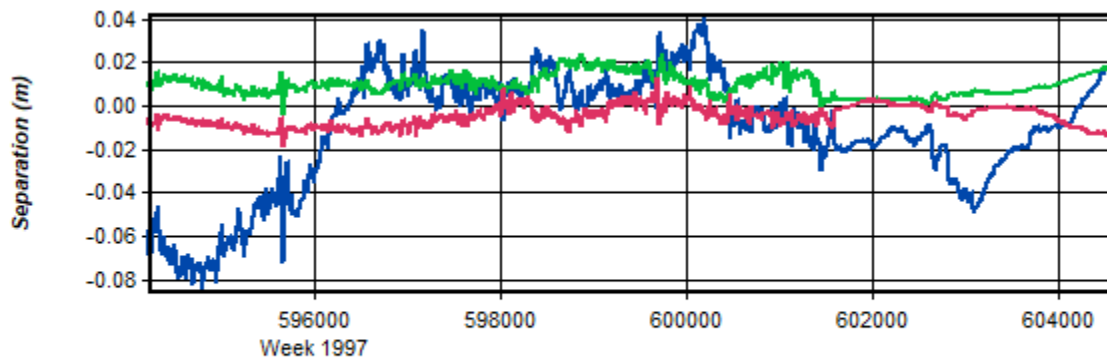
225\_20180421\_2





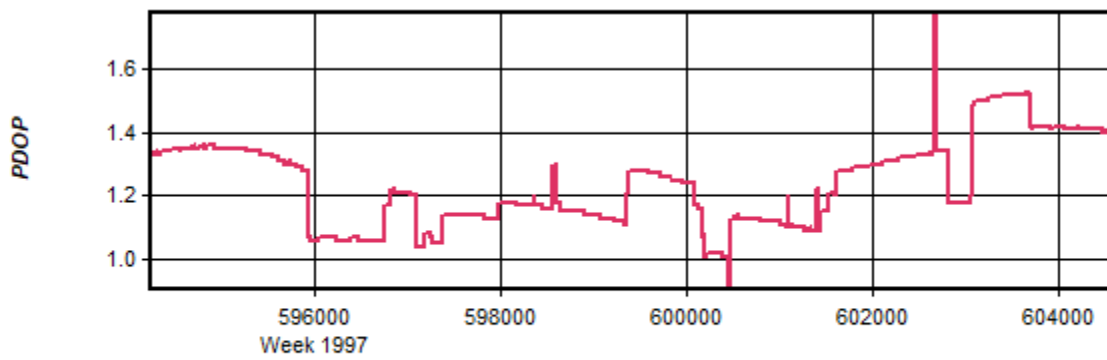
GPS Time (TOW, GMT zone)

— Num Sats — GPS — GLONASS — BeiDou



GPS Time (TOW, GMT zone)

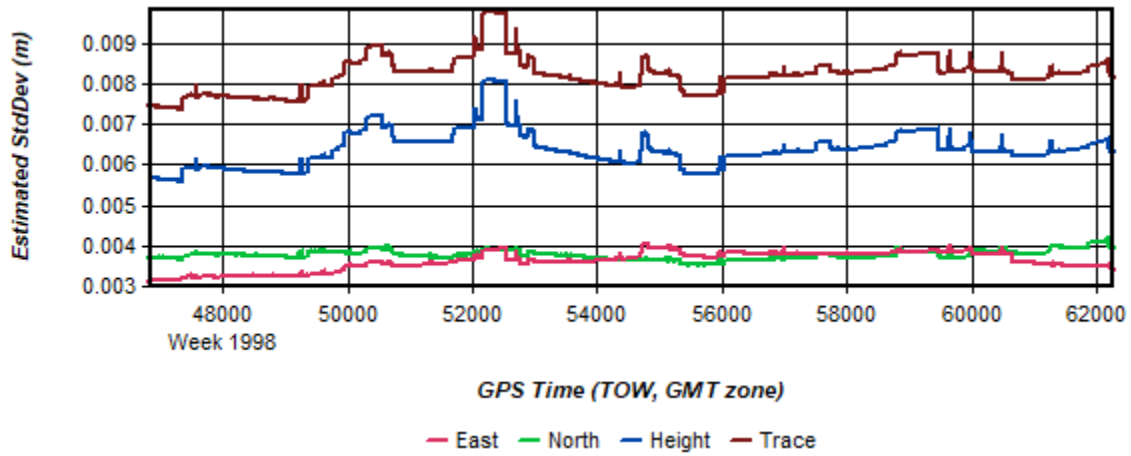
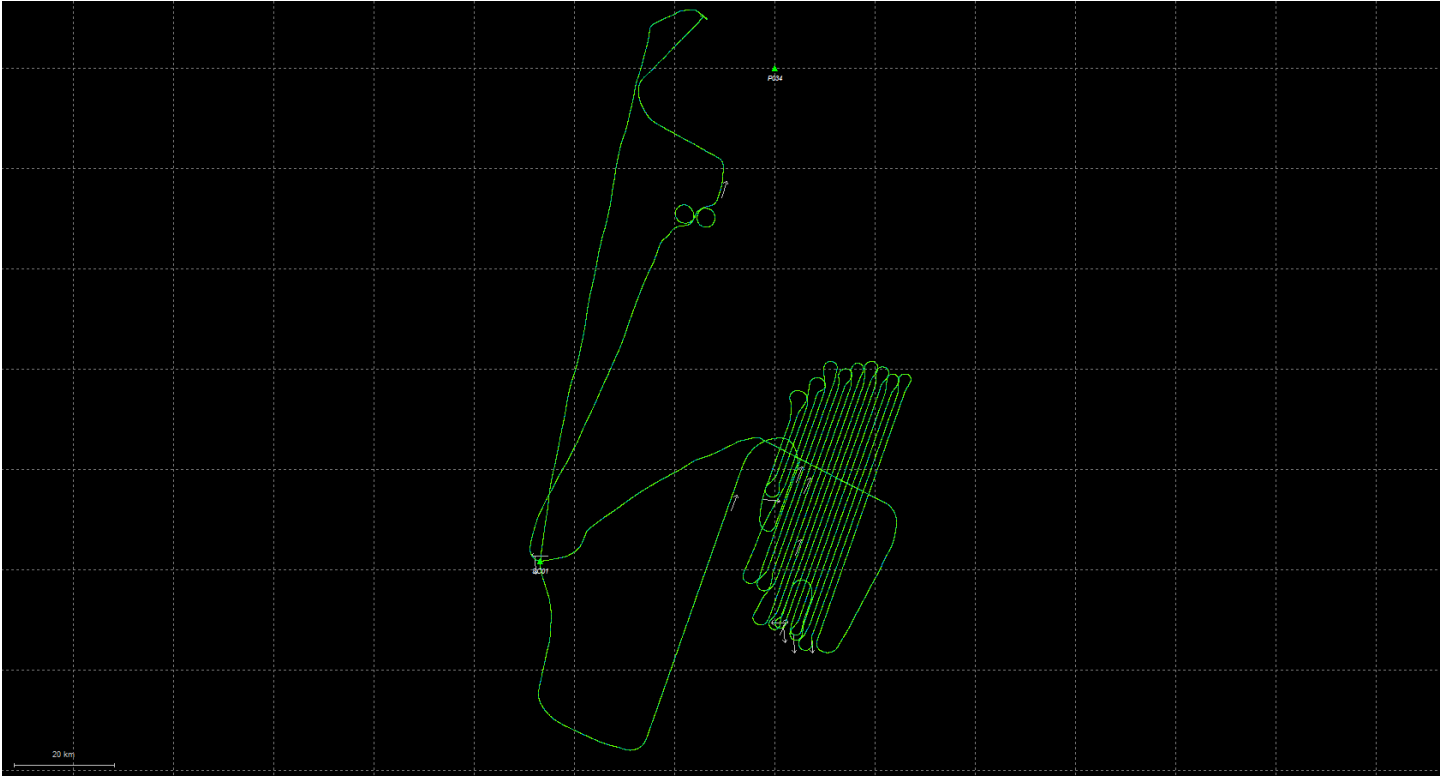
— East — North — Up

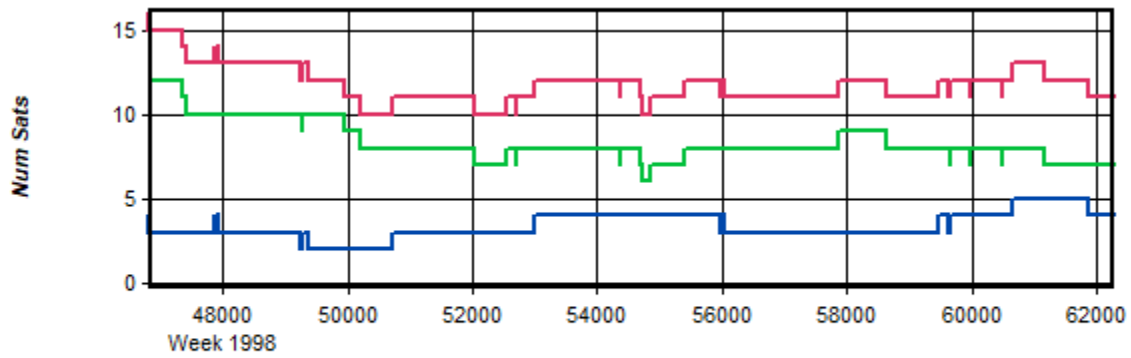


GPS Time (TOW, GMT zone)

— PDOP

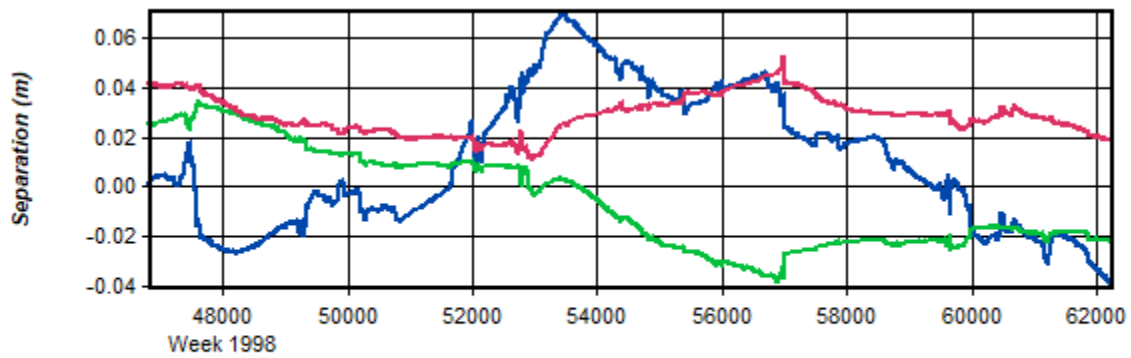
225\_20180422\_1





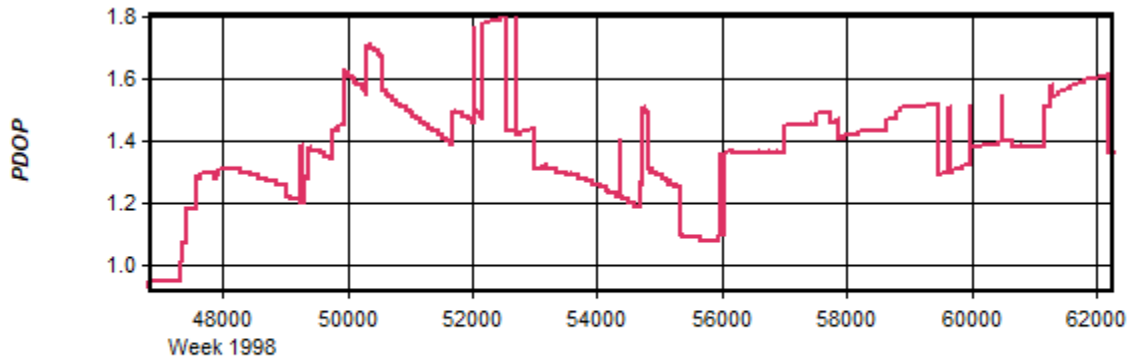
GPS Time (TOW, GMT zone)

— Num Sats — GPS — GLONASS — BeiDou



GPS Time (TOW, GMT zone)

— East — North — Up

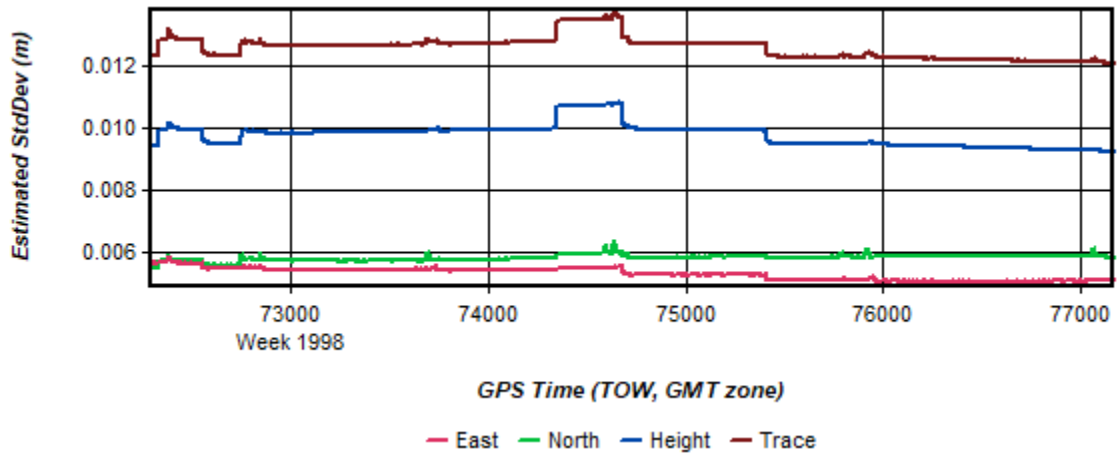
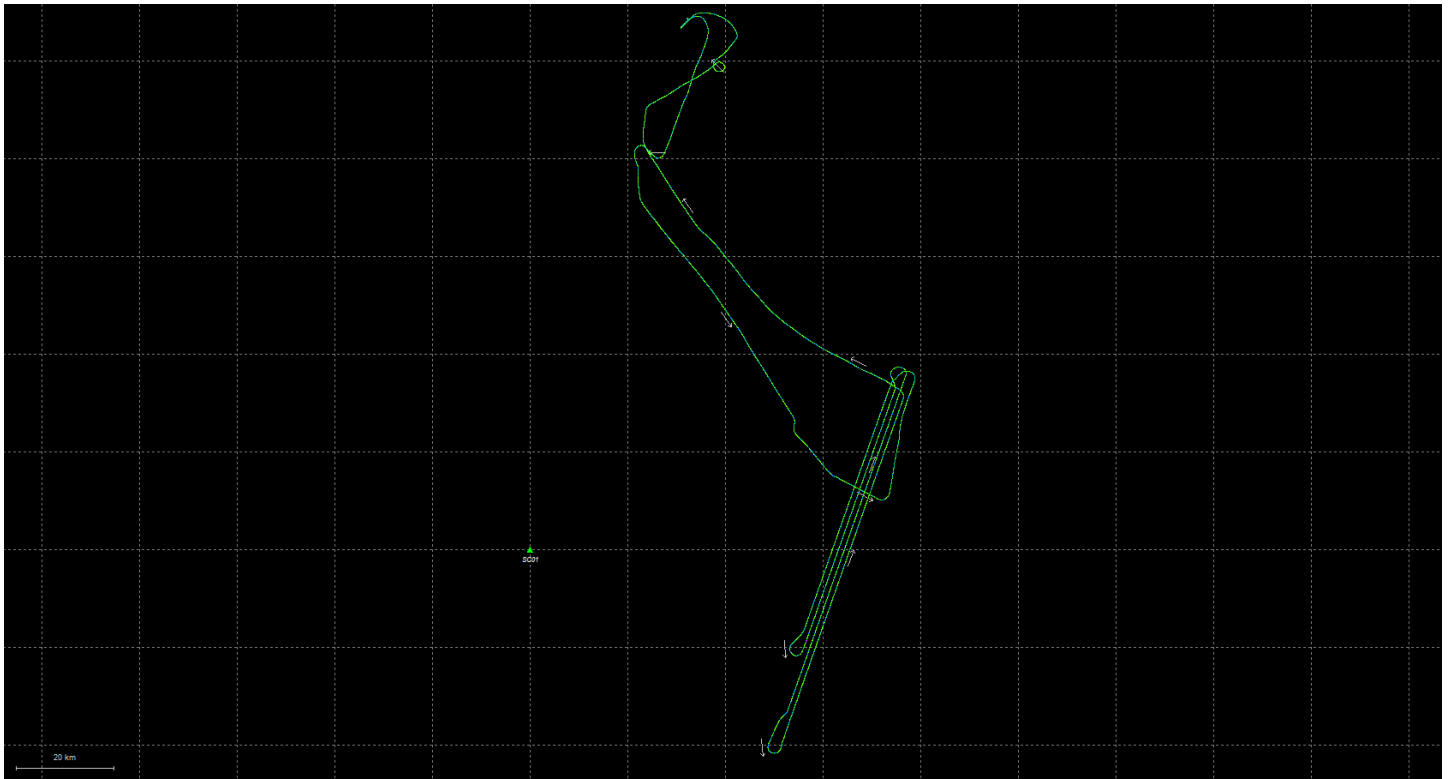


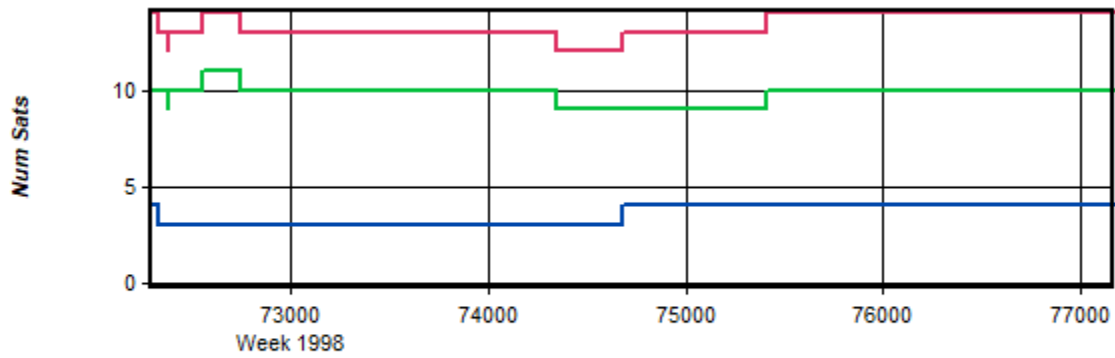
GPS Time (TOW, GMT zone)

— PDOP



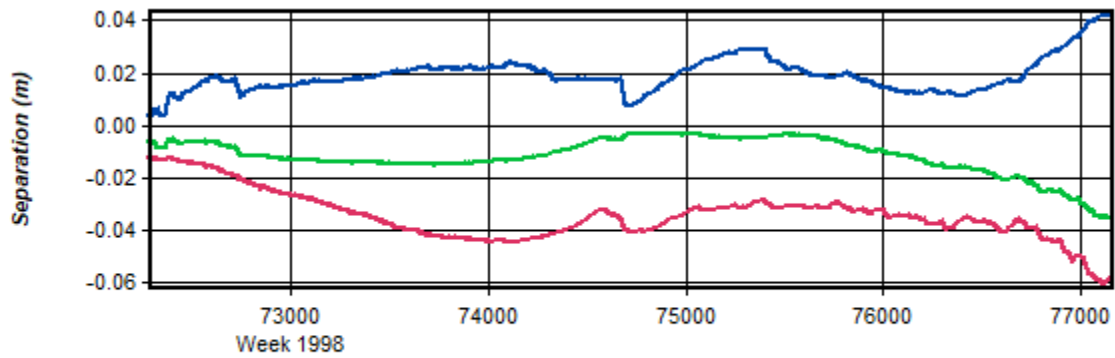
225\_20180422\_2





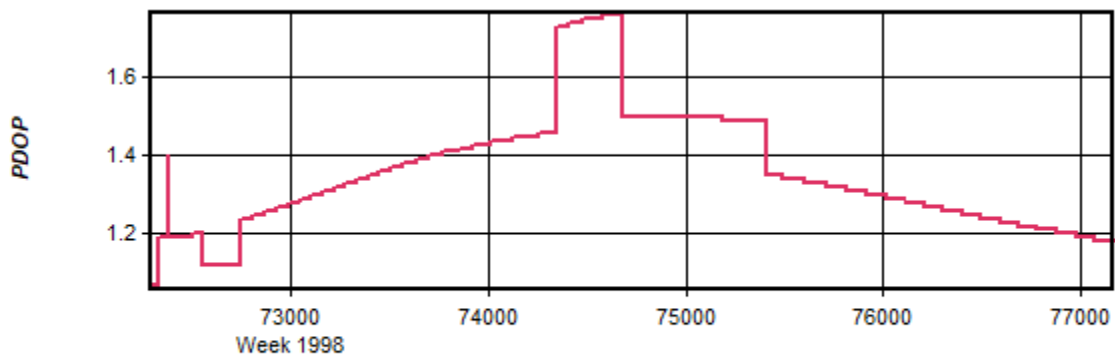
GPS Time (TOW, GMT zone)

— Num Sats — GPS — GLONASS — BeiDou



GPS Time (TOW, GMT zone)

— East — North — Up



GPS Time (TOW, GMT zone)

— PDOP