



sanborn
www.sanborn.com | 1.866.726.2676

Humboldt Nevada - QL2 Lidar

Project ID: 223212

Work Unit: 300241

Work Unit Name: NV_Humboldt_3_2021

Lidar Mapping Report

May 2023

EXECUTIVE SUMMARY

[The Sanborn Map Company, Inc.](#) (Sanborn) was tasked to provide remote sensing services in the form of lidar. Utilizing a multi-return system, Light Detection and Ranging (Lidar) detects 3-dimensional positions and attributes to form a point cloud. The high accuracy airborne system is integrated with both Global Navigation Satellite System (GNSS) and an Inertial Measure Unit (IMU) for accurate position and orientation. Acquisition of the project area's ~5656 mi² was completed on October 16th, 2021.

The Leica TerrainMapper was used to collect data for the aerial survey campaign. The sensor is attached to the aircraft's underside and emits rapid laser pulses that are used to calculate ranges between the aircraft and subsequent terrain below. The Airborne Lidar System (ALS) is boresighted by completing multiple passes over a known ground surface before the project acquisition. During data processing, the system calibration parameters are updated and used during post-processing of the lidar point cloud.

Differential GNSS unit in aircraft sampled positions at 2Hz or higher frequency. Lidar data was only acquired when GNSS PDOP is ≤ 4 and at least 6 satellites are in view. The atmosphere was free of clouds and fog between the aircraft and ground. The ground was free of snow and extensive flooding or any other type of inundation.

The contents of this report summarize the methods used to establish the base station coordinates, perform the lidar data acquisition and processing as well as the results of these methods.

CONTENTS

EXECUTIVE SUMMARY	1
CONTENTS	2
1.0 INTRODUCTION	3
1.1 CONTACT INFORMATION.....	3
1.2 PURPOSE OF LIDAR ACQUISITION	3
1.3 PROJECT LOCATION	3
2.0 ACQUISITION.....	4
2.1 INTRODUCTION	4
2.2 ACQUISITION PARAMETERS	4
2.3 FIELD WORK PROCEDURES.....	4
3.0 PROCESSING	7
3.1 INTRODUCTION	7
3.2 COORDINATE REFERENCE SYSTEM	8
3.3 LIDAR MATCHING.....	9
3.4 LIDAR CLASSIFICATION	15
3.5 ACCURACY ASSESSMENT.....	15
4.0 PRODUCT GENERATION	18
CLASSIFIED POINT CLOUD	18
BARE-EARTH DIGITAL ELEVATION MODEL (DEM).....	19
BREAKLINES	20
MAXIMUM SURFACE HEIGHT RASTERS (MSHR).....	21
FIRST-RETURN INTENSITY IMAGES	22
LAST-RETURN SWATH SEPARATION IMAGES	23
SWATH POLYGONS	24
OTHER DELIVERABLES	24
APPENDIX A – ABGNSS/IMU PLOTS.....	25

1.0 INTRODUCTION

This document contains the technical write-up of the lidar campaign, including system calibration techniques, and the collection and processing of the lidar data.

1.1 Contact Information

Questions regarding the technical aspects of this report should be addressed to:

Shawn Benham, PMP
Vice President of Programs
The Sanborn Map Company, Inc.
1935 Jamboree Drive, Suite 100
Colorado Springs, CO 80920
(719) 502-1296
sbenham@sanborn.com

1.2 Purpose of Lidar Acquisition

The objective of this project is to collect accurate measurements of the bare-earth surface as well as above ground features to be provided as geometric inputs for surface and/or change modeling as is relates survey assessments.

1.3 Project Location

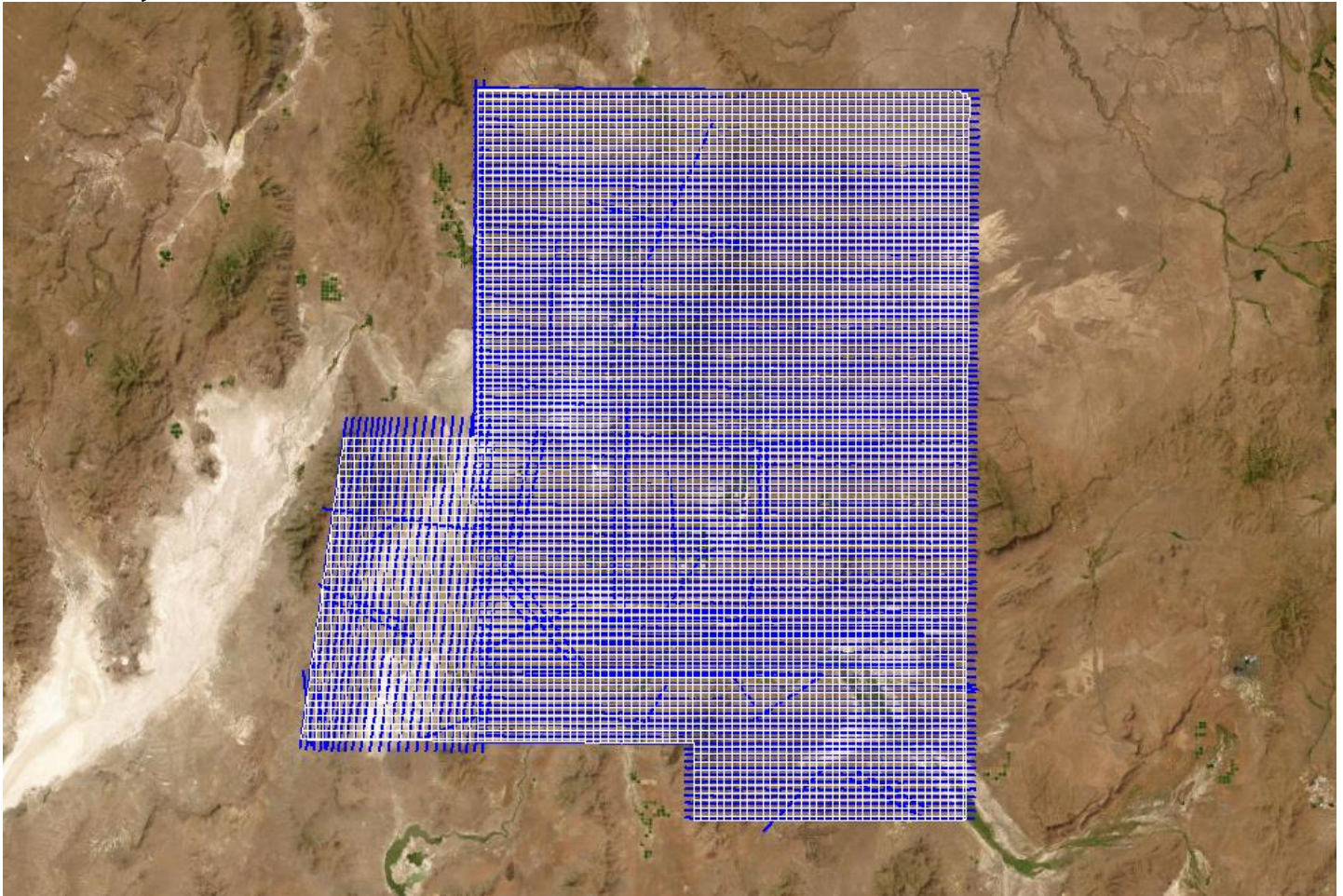


Figure 1: Tile Index and Trajectories As-Flown

2.0 ACQUISITION

2.1 Introduction

This section outlines the lidar system, flight reporting, and data acquisition methodology used during the collection of the lidar campaign. Although Sanborn conducts all lidar missions with the same rigorous and strict procedures and processes, all lidar collections are unique.

2.2 Acquisition Parameters

Sanborn specifically defined the collection parameters to accomplish the desired project specifications. **Table 1** shows the planned acquisition parameters utilized for this aerial survey with the sensor(s) installed.

Planned Acquisition Parameters	
Aircraft	N500Q, N27282, N100NE
Sensor	Leica TerrainMapper
Max Number of Returns	15
Point Spacing (m)	0.67
Point Density (pls/m²)	2.2
Flying Height (AGL) (m)	3375
Air Speed (kts)	160
Field of View (degrees)	40
Scan Rate (Hz)	86.1
Pulse Rate (kHz)	700
Laser Footprint (m)	0.79
Wavelength (nm)	1064
Multi-Pulse	Yes
Swath Width (m)	2457
Overlap (%)	20

Table 1: Lidar Acquisition Parameters

2.3 Field Work Procedures

Sanborn's standard procedure before every mission is to perform pre-flight checks to ensure correct operation of all systems. All cables were checked, and the sensor head glass was cleaned. A three-minute static session was conducted on the ground with the engines running prior to take-off to establish fine-alignment of the IMU and to resolve GNSS ambiguities.

The project acquisition consisted of thirty (30) missions. During the data collection, the operator recorded information on log sheets which includes weather conditions, lidar operation parameters, flight line statistics and PDOP.

Preliminary data processing was performed in the field immediately following the missions for quality control of GNSS data and to ensure sufficient coverage of the project AOI. Any problematic data could then be re-flown immediately as required. Final data processing was completed in the Colorado Springs, CO office. **Table 2** below shows the flight acquisition metrics for the entire collection. **Table 3** contains the base station names and locations in operation during acquisition. Base station coordinates are provided in NAD83 (2011), Geographic Coordinate System, Ellipsoid, Meters.

Date	Sensor	Serial #	Tail #	MissionID	PDOP	Start (UTC)	End (UTC)
9/13/2021	Leica TerrainMapper	TM91555	N500Q	20210913A_500Q_TM91555	1.5	14:26:24	19:54:36
9/14/2021	Leica TerrainMapper	TM91555	N500Q	20210914A_500Q_TM91555	1.6	18:03:57	0:13:04
9/15/2021	Leica TerrainMapper	TM91555	N500Q	20210915A_500Q_TM91555	1.5	14:43:06	20:05:13
9/15/2021	Leica TerrainMapper	TM91520	N100NE	20210915A_100NE_TM91520	1.5	15:21:18	18:55:27
9/15/2021	Leica TerrainMapper	TM91520	N100NE	20210915B_100NE_TM91520	1.5	19:53:42	21:58:50
9/16/2021	Leica TerrainMapper	TM91555	N500Q	20210916A_500Q_TM91555	1.5	16:07:33	21:52:42
9/16/2021	Leica TerrainMapper	TM91520	N100NE	20210916A_100NE_TM91520	1.5	16:09:06	19:40:50
9/17/2021	Leica TerrainMapper	TM91555	N500Q	20210917A_500Q_TM91555	1.6	14:49:51	20:27:11
9/20/2021	Leica TerrainMapper	TM91555	N500Q	20210920B_500Q_TM91555	1.5	22:41:24	2:28:04
9/21/2021	Leica TerrainMapper	TM91555	N500Q	20210921A_500Q_TM91555	1.5	16:28:18	21:16:30
9/21/2021	Leica TerrainMapper	TM91555	N500Q	20210921B_500Q_TM91555	1.5	23:25:54	1:14:08
9/22/2021	Leica TerrainMapper	TM91555	N500Q	20210922A_500Q_TM91555	1.5	16:13:42	19:24:08
9/23/2021	Leica TerrainMapper	TM91555	N500Q	20210923A_500Q_TM91555	1.5	17:09:48	21:57:29
9/24/2021	Leica TerrainMapper	TM91555	N500Q	20210924A_500Q_TM91555	1.6	18:19:27	21:17:32
9/24/2021	Leica TerrainMapper	TM91555	N500Q	20210924C_500Q_TM91555	1.5	1:09:03	3:30:59
9/25/2021	Leica TerrainMapper	TM91555	N500Q	20210925A_500Q_TM91555	1.5	15:01:21	19:16:06
9/25/2021	Leica TerrainMapper	TM91555	N500Q	20210925B_500Q_TM91555	1.7	21:07:36	23:31:06
9/26/2021	Leica TerrainMapper	TM91555	N500Q	20210926A_500Q_TM91555	1.5	15:25:51	20:04:24
9/27/2021	Leica TerrainMapper	TM91520	N100NE	20210927A_100NE_TM91520	1.5	15:05:42	19:09:09
9/27/2021	Leica TerrainMapper	TM91520	N100NE	20210927B_100NE_TM91520	1.6	21:14:51	0:35:06
9/29/2021	Leica TerrainMapper	TM91555	N500Q	20210929A_500Q_TM91555	1.5	14:51:15	19:13:23
9/29/2021	Leica TerrainMapper	TM91555	N500Q	20210929B_500Q_TM91555	1.5	20:51:06	1:20:33
9/29/2021	Leica TerrainMapper	TM91520	N100NE	20210929A_100NE_TM91520	1.4	14:15:57	18:00:52
9/29/2021	Leica TerrainMapper	TM91520	N100NE	20210929B_100NE_TM91520	1.6	20:23:12	23:28:35
10/10/2021	Leica TerrainMapper	TM91520	N27282	20211010A_27282_TM91520	1.6	17:35:45	20:15:52
10/10/2021	Leica TerrainMapper	TM91520	N27282	20211010B_27282_TM91520	1.5	22:44:36	1:06:52
10/15/2021	Leica TerrainMapper	TM91520	N27282	20211015A_27282_TM91520	1.6	16:33:21	21:09:17
10/15/2021	Leica TerrainMapper	TM91520	N27282	20211015B_27282_TM91520	1.5	23:46:03	3:27:09
10/16/2021	Leica TerrainMapper	TM91520	N27282	20211016A_27282_TM91520	1.6	17:35:21	21:02:36
10/16/2021	Leica TerrainMapper	TM91520	N27282	20211016B_27282_TM91520	1.5	22:19:42	1:27:40

Table 2: Collection Date Time by Mission

Designation	Type	PID	Latitude (N)	Longitude (W)	Elevation
BURN	CORS	AH8524	42 46 46.20416	117 50 36.70844	1180.982
COF1	CORS	DG6525	39 36 18.06563	119 14 26.28325	1251.937
MDMT	CORS	DH3761	42 25 06.02794	121 13 17.76558	1710.612
P347	CORS	DK6408	41 11 00.03540	120 56 54.46391	1268.834
QUIN	CORS	AF9564	39 58 28.39435	120 56 39.94502	1106.353
STEA	CORS	DE6260	39 37 31.95513	119 53 01.22705	1534.217
UPSA	CORS	AI8814	39 37 37.60298	118 48 08.20934	1233.369

Table 3: GNSS Reference Station Coordinates

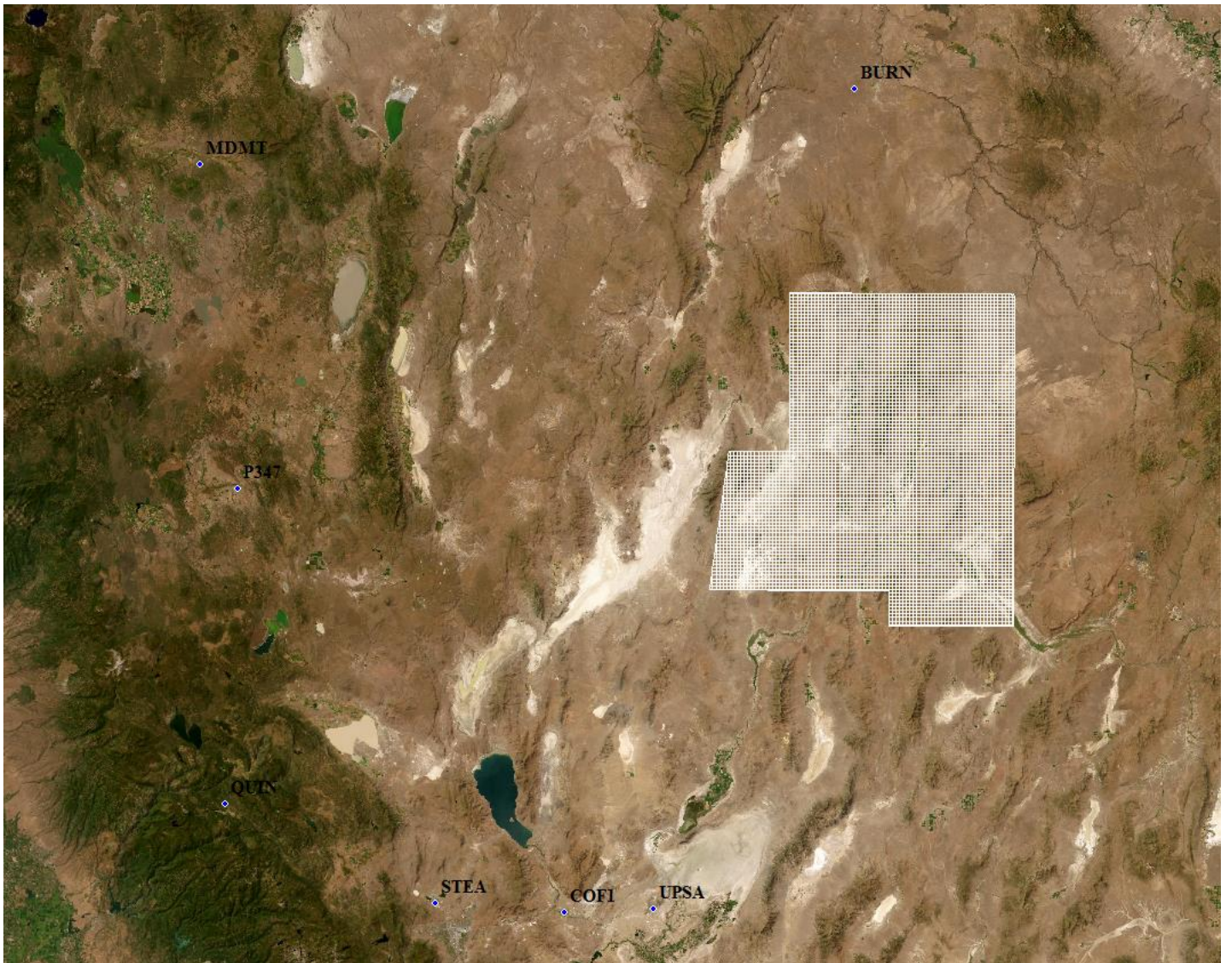


Figure 2: GNSS Reference Stations

3.0 PROCESSING

3.1 Introduction

The GNSS/IMU data was post-processed using Waypoint Inertial Explorer software to create Smoothed Best Estimate Trajectory (SBET) file(s). The SBET was then combined with the laser range measurements in Leica HexMap software to produce the 3-dimensional coordinates resulting in an accurate set of Raw Point Cloud (RPC) mass points. These raw swath (*.las) files are output in WGS84, UTM, Ellipsoid, Meters and transformed to the project Coordinate Reference System (CRS) upon ingest into GeoCue before project wide lidar matching.

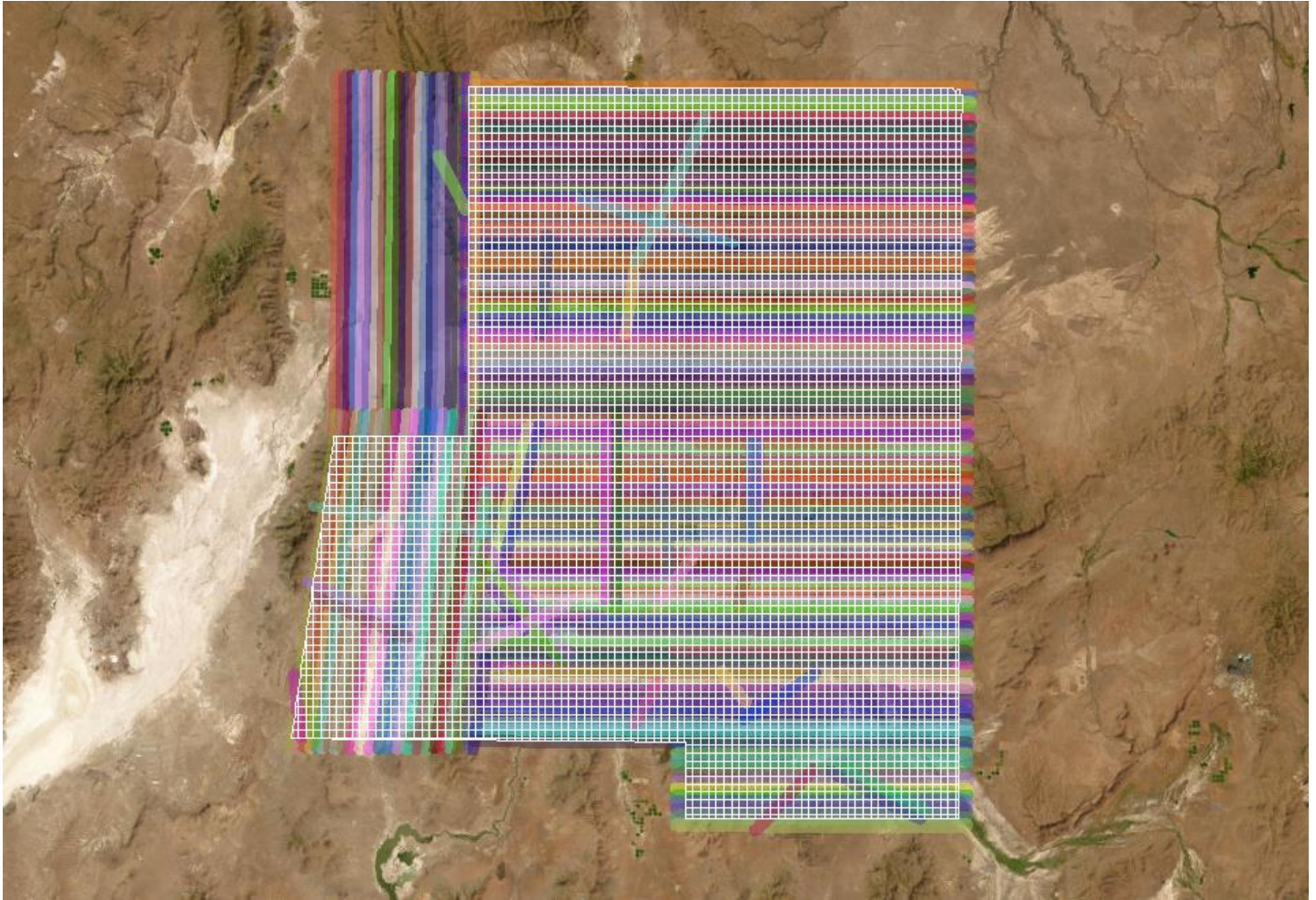


Figure 3: Raw Swath Coverage

The Leica HexMap pre-processing software created raw swath files with all return values. This multi-return information was processed and classified to obtain the required feature for delivery. All lidar data is processed using the ASPRS binary LAS format version 1.4. **Table 4** illustrates the achieved point cloud statistics.

Category	Value
Aggregate Total Points	70,226,288,628
Aggregate Nominal Pulse Spacing (m)	0.49
Aggregate Nominal Pulse Density (pls/m ²)	4.2
Aggregate Nominal Pulse Spacing (ft)	1.60
Aggregate Nominal Pulse Density (pls/ft ²)	0.4

Table 4: Point Cloud Statistics

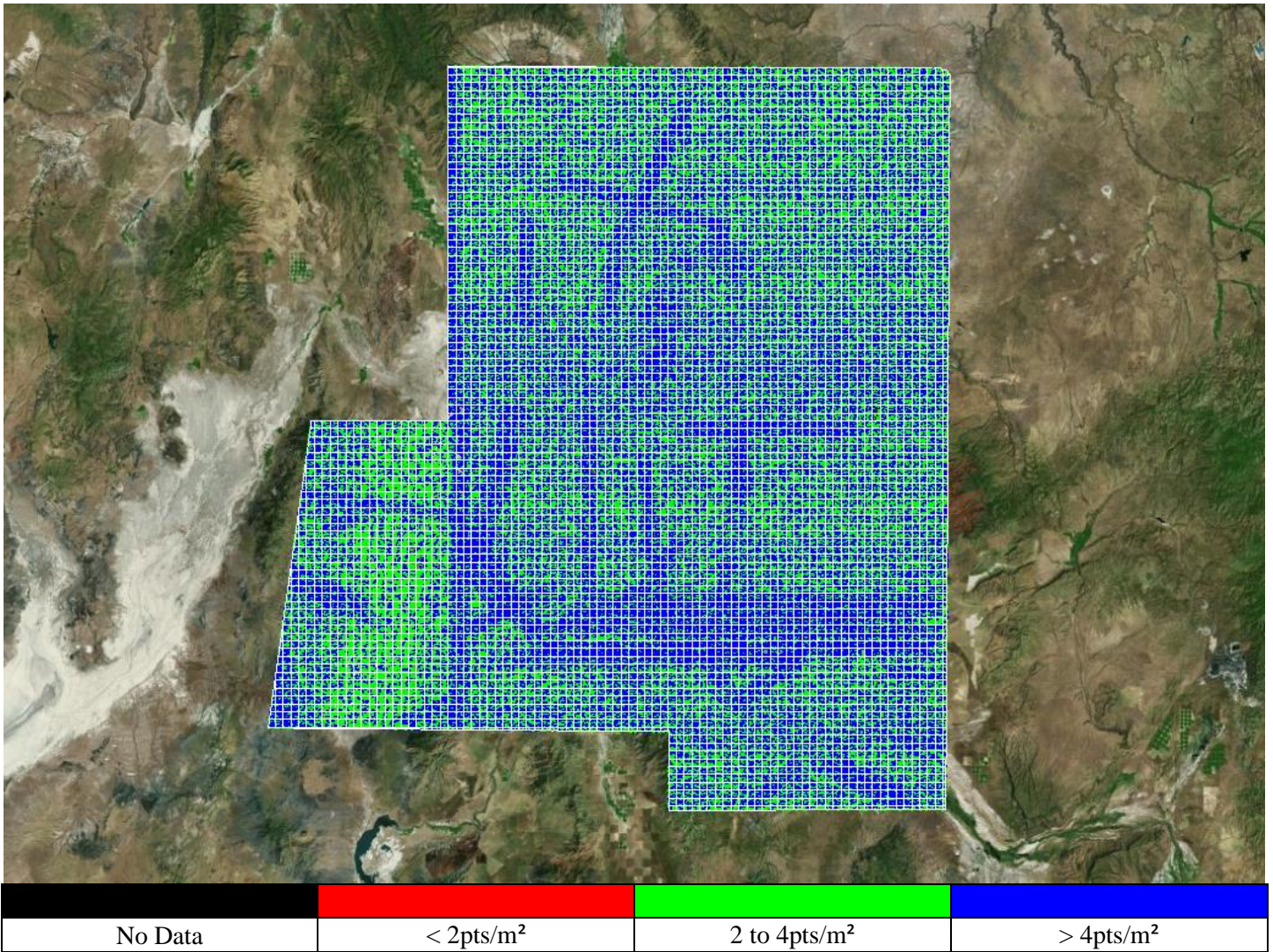


Figure 4: Point Cloud Density

3.2 Coordinate Reference System

Horizontal Datum: North American Datum of 1983 (2011)
Projection: Universal Transverse Mercator Zone 11 North
Vertical Datum: North American Vertical Datum of 1988
Geoid Model: Geoid18
Units: Meters

3.3 Lidar Matching

Sanborn uses pre-processing software and the latest boresight values to combine the processed SBET with the laser scan files to produce the lidar point cloud. The data is processed by mission and/or block and is output in ASPRS LASv1.4 Point Data Record Format (PDRF) 6 with 16bit linearly scaled intensities to the nearest 0.001 3D position. Each mission is produced in WGS84, UTM, Ellipsoid, Meters and transformed to the project CRS upon import into GeoCue.

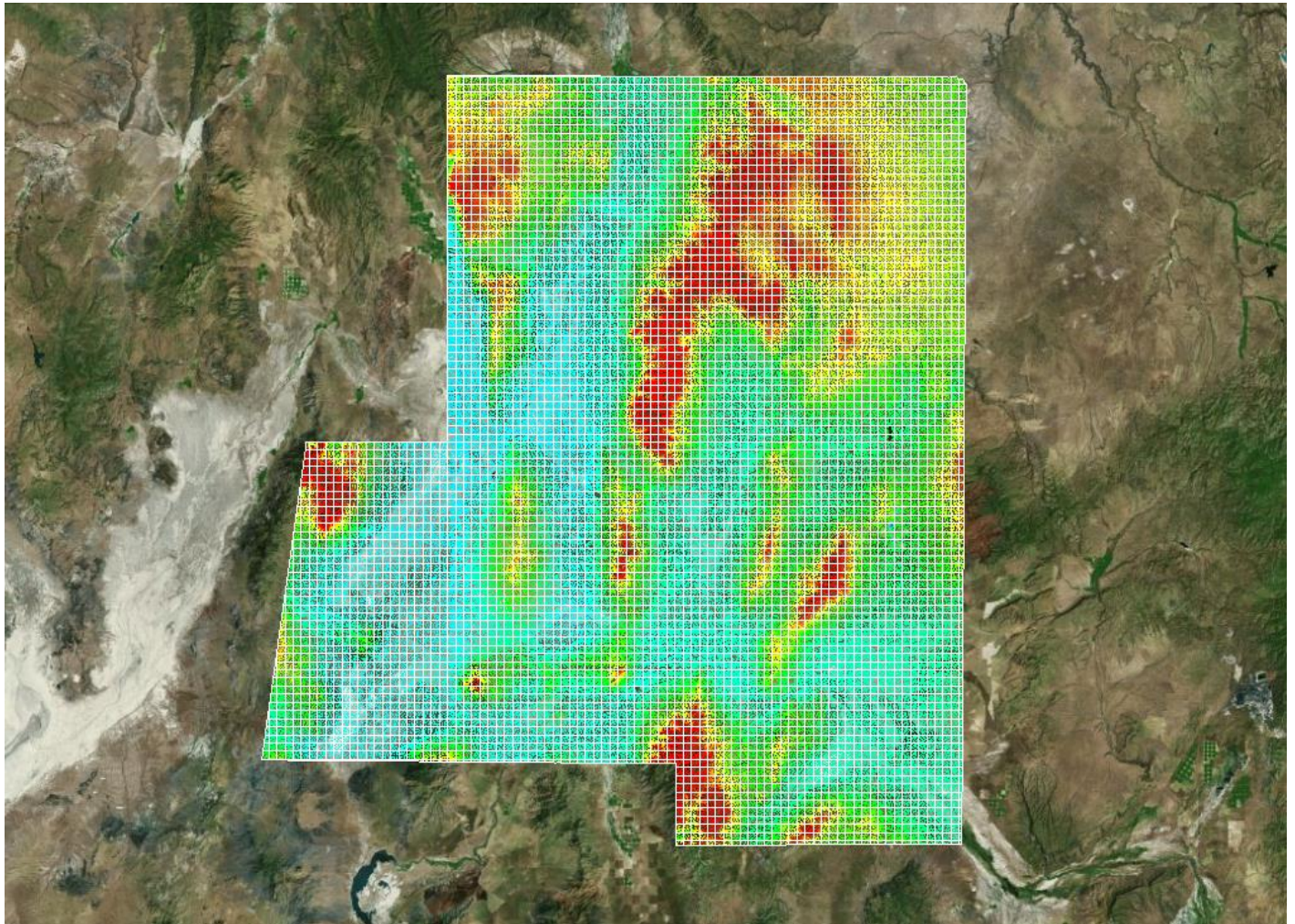


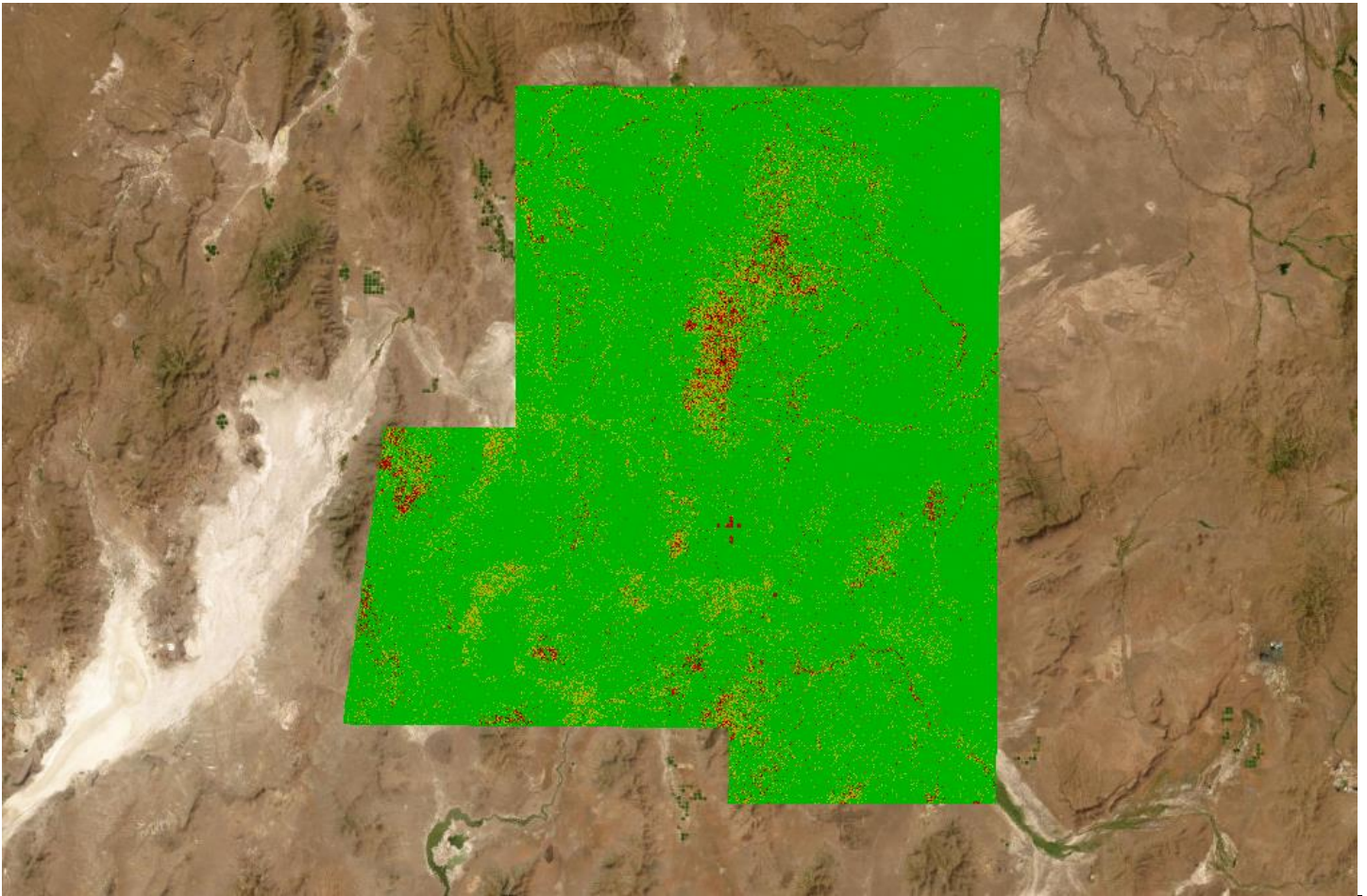
Figure 5: Point Cloud Elevation

Each mission is imported into GeoCue where each individual flight line is assigned a unique Source ID number. The SBET is cut per swath into TerraScan Trajectory files based on Source ID number and timestamp; these are utilized during the lidar matching process. The project area(s) are broken into logical blocks based on AOIs or predetermined delivery blocks and the individual flight lines are populated into lidar matching tile grids. These lidar matching tile grids are prepared for scanner, line, mission, block and eventual project wide lidar matching routines by first running point cloud filters to identify ground and building features to be used during any TerraMatch processes.

Sanborn takes advantage of both visual and statistical validation methodologies to review and ensure both the individual precision and alignment of the lidar dataset. Swath Precision Images modulated by Intensity are representative of the intraswath alignment and provide a holistic qualitative look at the goodness of fit within each swath. Swath Separation Images modulated by Intensity are representative of the interswath alignment and provide a holistic qualitative look at the positional quality of the point cloud. The images are reviewed in their entirety. Furthermore, the set of TerraMatch Tie Lines are used to produce a Tie Line Report to statistically assess the X, Y, and Z offset averages and magnitudes for the whole project including each line individually. This visual and statistical review guarantees the relative accuracy of the lidar dataset. **Table 5** outlines the relative accuracy requirements of the project. **Tables 6 – 9** are the relative accuracies achieved.

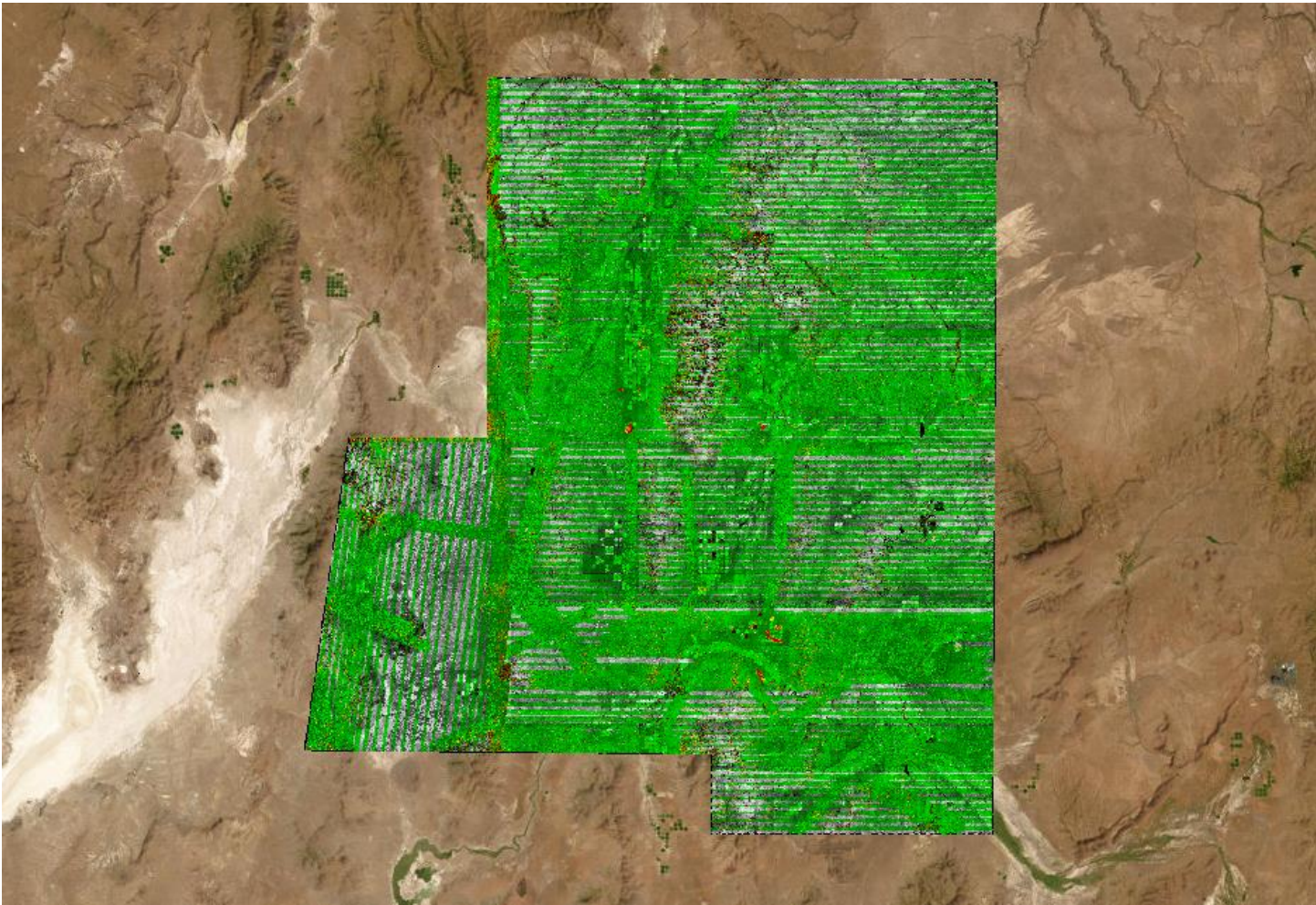
Category	Value (m)	Value (ft)
Smooth Surface Repeatability	≤0.060	≤0.197
Swath overlap difference, RMSDz	≤0.080	≤0.262

Table 5: Relative Accuracy Requirements



No Data	< 0.06m	0.06m to 0.12m	0.12m to 0.18m	> 0.18m
No Data	< 0.197ft	0.197ft to 0.394ft	0.394ft to 0.591ft	> 0.591ft

Figure 6: Swath Precision



No Data	< 0.08m	0.08m to 0.16m	0.16m to 0.24m	> 0.24m
No Data	< 0.262ft	0.262ft to 0.524ft	0.524ft to 0.786ft	> 0.786ft

Figure 7: Swath Separation

Line	X	Y	Z	Line	X	Y	Z	Line	X	Y	Z
1	-	-	0.008	174	-	-	0.008	427	-	-	0.009
2	-	-	0.009	175	-	-	0.009	428	-	-	0.008
3	-	-	0.010	176	0.016	0.034	0.008	429	-	-	0.009
4	0.001	0.012	0.010	177	0.014	0.031	0.009	430	-	-	0.009
5	0.001	0.012	0.009	178	0.021	0.030	0.008	431	-	-	0.010
6	-	-	0.008	179	0.015	0.029	0.007	432	-	-	0.011
7	-	-	0.008	180	0.011	0.026	0.007	433	-	-	0.011
8	-	-	0.007	181	0.015	0.034	0.008	434	-	-	0.011
9	-	-	0.007	182	0.043	0.018	0.008	435	-	-	0.009
10	0.018	0.020	0.009	183	0.020	0.042	0.008	436	-	-	0.010
11	0.014	0.016	0.012	184	0.015	0.033	0.007	437	0.013	0.020	0.010
12	-	-	0.008	185	0.024	0.018	0.007	438	0.016	0.024	0.009
13	-	-	0.008	186	0.021	0.029	0.009	439	0.090	0.010	0.008
14	-	-	0.009	187	0.021	0.025	0.007	440	0.060	0.007	0.008
15	-	-	0.007	188	0.021	0.023	0.008	441	-	-	0.008
16	-	-	0.009	189	0.020	0.024	0.007	442	-	-	0.009
17	-	-	0.008	190	0.019	0.028	0.007	443	-	-	0.009
18	-	-	0.008	191	0.019	0.030	0.007	444	-	-	0.008
19	-	-	0.008	192	0.019	0.029	0.010	445	-	-	0.010
20	-	-	0.007	193	0.021	0.023	0.008	501	-	-	0.009
21	-	-	0.008	194	0.023	0.029	0.009	502	-	-	0.010
22	-	-	0.008	195	0.025	0.023	0.009	503	-	-	0.010
23	-	-	0.007	196	0.022	0.019	0.008	504	-	-	0.010
24	-	-	0.007	197	0.025	0.021	0.008	505	-	-	0.009
25	-	-	0.009	198	0.033	0.023	0.008	506	-	-	0.008
26	-	-	0.009	199	0.034	0.015	0.009	507	-	-	0.009
27	-	-	0.010	200	-	-	0.009	508	0.001	0.027	0.009
28	-	-	0.010	201	-	-	0.007	509	0.000	0.011	0.008
29	-	-	0.009	202	0.015	0.015	0.008	510	-	-	0.008
30	-	-	0.009	203	0.020	0.033	0.007	511	-	-	0.010
31	-	-	0.010	204	0.021	0.040	0.007	512	-	-	0.009
32	-	-	0.010	205	0.018	0.012	0.007	513	-	-	0.008
33	-	-	0.009	206	0.023	0.028	0.007	514	-	-	0.008
34	-	-	0.008	207	0.023	0.027	0.008	515	-	-	0.008
35	-	-	0.008	208	-	-	0.008	516	-	-	0.008
36	-	-	0.011	209	-	-	0.008	517	-	-	0.008
37	-	-	0.007	301	-	-	0.008	518	0.001	0.028	0.008
101	0.021	0.028	0.008	302	-	-	0.009	519	0.006	0.043	0.009
102	0.020	0.028	0.009	303	0.063	0.007	0.008	520	0.006	0.033	0.008
103	0.014	0.025	0.008	304	0.041	0.024	0.008	521	0.002	0.024	0.008
104	0.018	0.028	0.009	305	0.006	0.039	0.008	522	-	-	0.008
105	0.016	0.025	0.009	306	-	-	0.009	523	-	-	0.011

106	0.011	0.016	0.008	307	-	-	0.008	524	-	-	-
107	0.016	0.052	0.008	308	0.015	0.004	0.009	526	-	-	0.007
108	0.013	0.043	0.010	309	0.017	0.005	0.009	1001	-	-	0.008
109	-	-	0.012	310	0.019	0.006	0.009	1002	-	-	0.009
110	-	-	0.012	311	0.019	0.036	0.009	1003	-	-	0.008
111	-	-	0.010	312	0.020	0.055	0.009	1004	-	-	0.008
112	-	-	0.009	313	-	-	0.009	1005	-	-	0.009
113	-	-	0.009	314	0.013	0.002	0.008	1006	-	-	0.007
114	-	-	0.009	315	0.012	0.002	0.009	1007	-	-	0.009
115	-	-	0.009	316	-	-	0.009	1008	-	-	0.009
116	-	-	0.009	317	-	-	0.009	1009	-	-	0.008
117	-	-	0.008	318	-	-	0.010	1010	-	-	0.007
118	-	-	0.009	319	-	-	0.010	1011	-	-	0.008
119	-	-	0.009	320	-	-	0.009	1012	-	-	0.009
120	-	-	0.009	321	-	-	0.009	1013	-	-	0.006
121	-	-	0.009	322	-	-	0.009	1014	-	-	0.007
122	-	-	0.010	323	-	-	0.010	1015	-	-	0.008
123	-	-	0.009	324	-	-	0.010	1016	-	-	0.007
124	-	-	0.009	325	-	-	0.009	1017	-	-	0.009
125	-	-	0.010	326	-	-	0.009	1018	-	-	0.010
126	-	-	0.009	327	-	-	0.009	1019	0.023	0.018	0.010
127	-	-	0.009	328	-	-	0.008	1020	-	-	0.007
128	-	-	0.008	329	-	-	0.009	1021	-	-	0.007
129	-	-	0.010	330	-	-	0.009	1022	-	-	0.007
130	-	-	0.010	331	-	-	0.010	1023	-	-	0.008
131	-	-	0.010	332	-	-	0.009	1024	-	-	0.008
132	-	-	0.009	333	-	-	0.008	1025	0.030	0.003	0.009
133	-	-	0.009	334	-	-	0.009	1026	-	-	0.008
134	-	-	0.009	335	-	-	0.010	1027	-	-	0.007
135	-	-	0.010	336	-	-	0.007	1028	-	-	0.007
136	-	-	0.008	337	-	-	0.016	1029	-	-	0.008
137	-	-	0.008	338	-	-	0.006	1030	-	-	0.007
138	-	-	0.008	339	-	-	0.009	1031	-	-	0.006
139	-	-	0.009	340	-	-	0.009	1032	-	-	0.007
140	-	-	0.009	341	-	-	0.007	1034	-	-	0.004
141	-	-	0.009	342	-	-	0.012	1035	-	-	0.003
142	-	-	0.009	343	-	-	0.010	1036	-	-	0.008
143	-	-	0.009	344	-	-	0.009	1037	-	-	0.007
144	-	-	0.008	345	-	-	0.009	1038	-	-	0.008
145	-	-	0.009	346	-	-	0.009	1039	-	-	0.006
146	-	-	0.009	347	-	-	0.009	1040	0.061	0.020	0.007
147	-	-	0.009	348	-	-	0.009	1041	-	-	0.004
148	-	-	0.009	401	-	-	0.011	1042	-	-	0.007

149	-	-	0.009	402	-	-	0.008	1043	-	-	0.007
150	-	-	0.008	403	-	-	0.009	1044	-	-	0.011
151	-	-	0.009	404	-	-	0.010	1045	-	-	0.008
152	-	-	0.008	405	-	-	0.010	1046	-	-	0.007
153	-	-	0.007	406	-	-	0.008	1047	-	-	0.005
154	-	-	0.007	407	-	-	0.009	1048	-	-	0.007
155	-	-	0.006	408	-	-	0.010	1049	0.018	0.034	0.010
156	-	-	0.007	409	-	-	0.011	1050	-	-	0.008
157	-	-	0.007	410	-	-	0.011	1051	0.015	0.031	0.008
158	-	-	0.008	411	0.007	0.002	0.010	1052	0.011	0.024	0.008
159	-	-	0.009	412	0.005	0.002	0.011	1053	0.037	0.029	0.008
160	-	-	0.009	413	0.068	0.026	0.009	1054	0.016	0.030	0.007
161	-	-	0.009	414	0.068	0.027	0.009	1055	0.016	0.023	0.007
162	-	-	0.009	415	0.036	0.023	0.009	1056	0.025	0.020	0.007
163	-	-	0.008	416	0.042	0.018	0.009	1057	0.022	0.021	0.011
164	-	-	0.008	417	0.035	0.017	0.010	1058	0.027	0.023	0.010
165	-	-	0.008	418	0.039	0.018	0.010	1059	0.025	0.020	0.006
166	-	-	0.008	419	-	-	0.009	1060	-	-	0.007
167	-	-	0.009	420	-	-	0.009	1061	-	-	0.006
168	-	-	0.009	421	-	-	0.008	1062	-	-	0.008
169	-	-	0.009	422	-	-	0.009	1063	0.022	0.026	0.007
170	-	-	0.008	423	-	-	0.009	1064	-	-	0.006
171	-	-	0.009	424	-	-	0.010	1065	-	-	0.009
172	-	-	0.008	425	-	-	0.010				
173	-	-	0.008	426	-	-	0.009				

Table 6: Average Magnitudes by Line (Meters)

Category	X	Y	Z
Average Magnitude	0.021	0.025	0.009
RMS Values	0.032	0.039	0.012
Maximum Values	0.158	0.159	0.153
Observation Weight	17700.0	17700.0	337700.0

Table 7: Internal Observation Statistics (Meters)

Category	Mismatch
Average 3D Mismatch	0.01038
Average XY Mismatch	0.03956
Average Z Mismatch	0.00864

Table 8: Overall Relative Accuracy (Meters)

Category	Observations
Section Lines	122,785
Roof Lines	7,707

Table 9: Vector Observations

3.4 Lidar Classification

Lidar filtering was accomplished using GeoCue with TerraSolid processing and modeling software. The filtering process reclassifies all the data into classes within the point cloud classification scheme. Once the data is classified, the entire dataset is reviewed and manually edited for anomalies that are outside the required guidelines of the product specification or contract requirements. This can include, but is not limited to, classifying bridges, structures, filling culverts, and manually analyzing the bare-earth surface by classifying features that belong in non-extraneous classification codes. **Table 10** outlines a statistical summary of the point classes leveraged in the lidar dataset.

Code	Class	Points
1	Unclassified	20,594,208,396
2	Ground	49,250,535,487
7	Low Noise	291,299,516
9	Water	138,326
17	Bridge Decks	215,087
18	High Noise	89,829,935
20	Ignored Ground	61,881
Flag	Withheld	381,129,451

Table 10: Lidar Classification Statistics

3.5 Accuracy Assessment

The lidar dataset was evaluated using a total of one hundred ninety (190) check points (111 NVA + 79 VVA). The result provided a vertical accuracy that fell within project specifications. Please see the **Attachment A** for the full Vertical Accuracy Report and the project *Metadata* for an in-depth accuracy assessment. **Table 11** outlines the absolute accuracy requirements of the project. **Table 12** shows high level statistics and mean errors for the area processed by Sanborn.

Category	Value (m)	Value (ft)
RMSEz	≤0.100	≤0.328
@ 95-Percent Confidence Level	≤0.196	≤0.643
@ 95 th Percentile	≤0.300	≤0.984

Table 11: Absolute Accuracy Requirements

Broad Land Cover Type	# of Points	RMSEz	95% Confidence Level	95th Percentile
NVA of Point Cloud	111	0.095	0.186	
NVA of Bare Earth	111	0.095	0.185	
NVA of DEM	111	0.096	0.187	
VVA of Bare Earth	79	0.104		0.188
VVA of DEM	79	0.104		0.186

Table 12: Vertical Accuracy Assessment of Check Points (Meters)

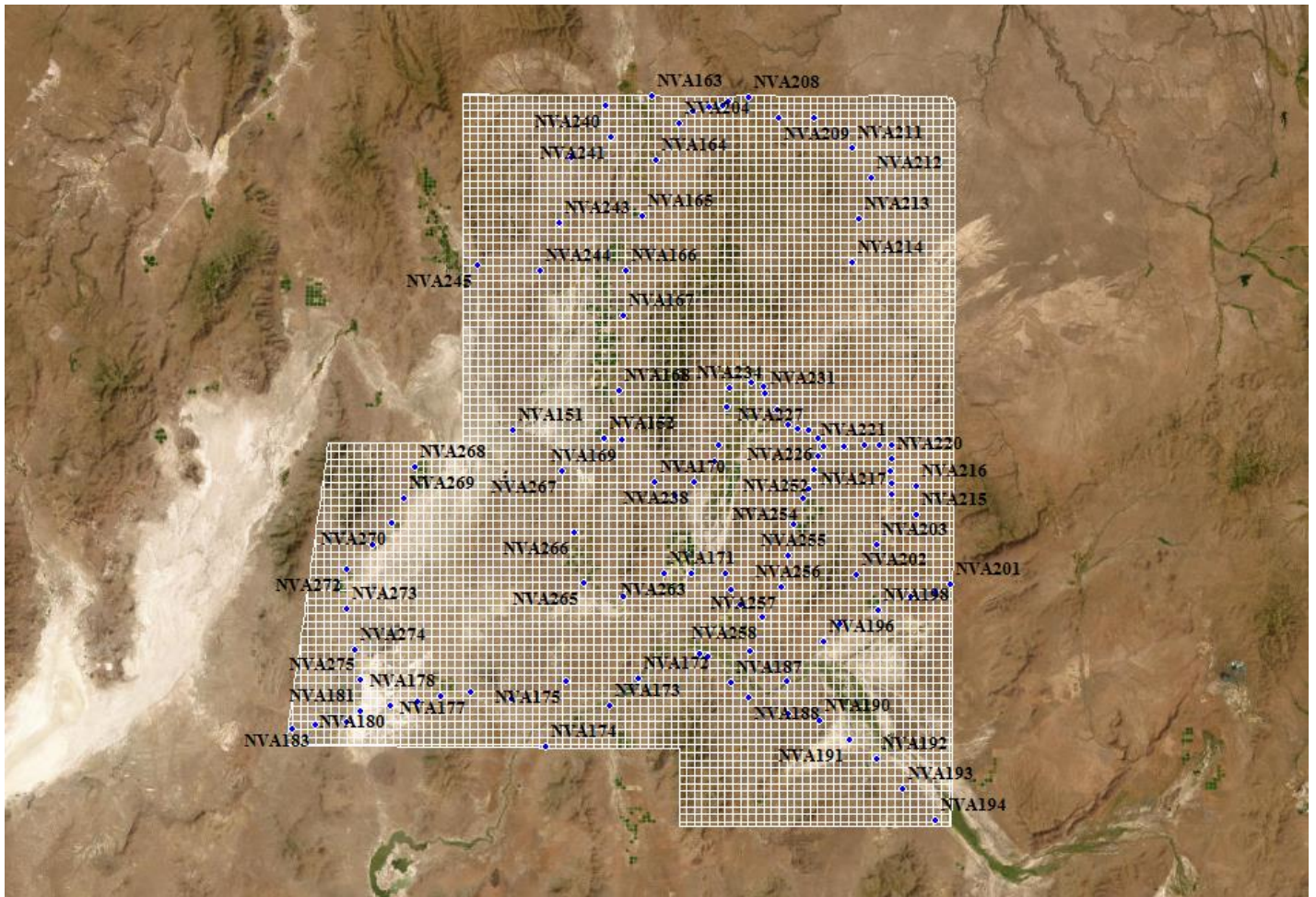


Figure 8: Non-vegetated Check Point Distribution

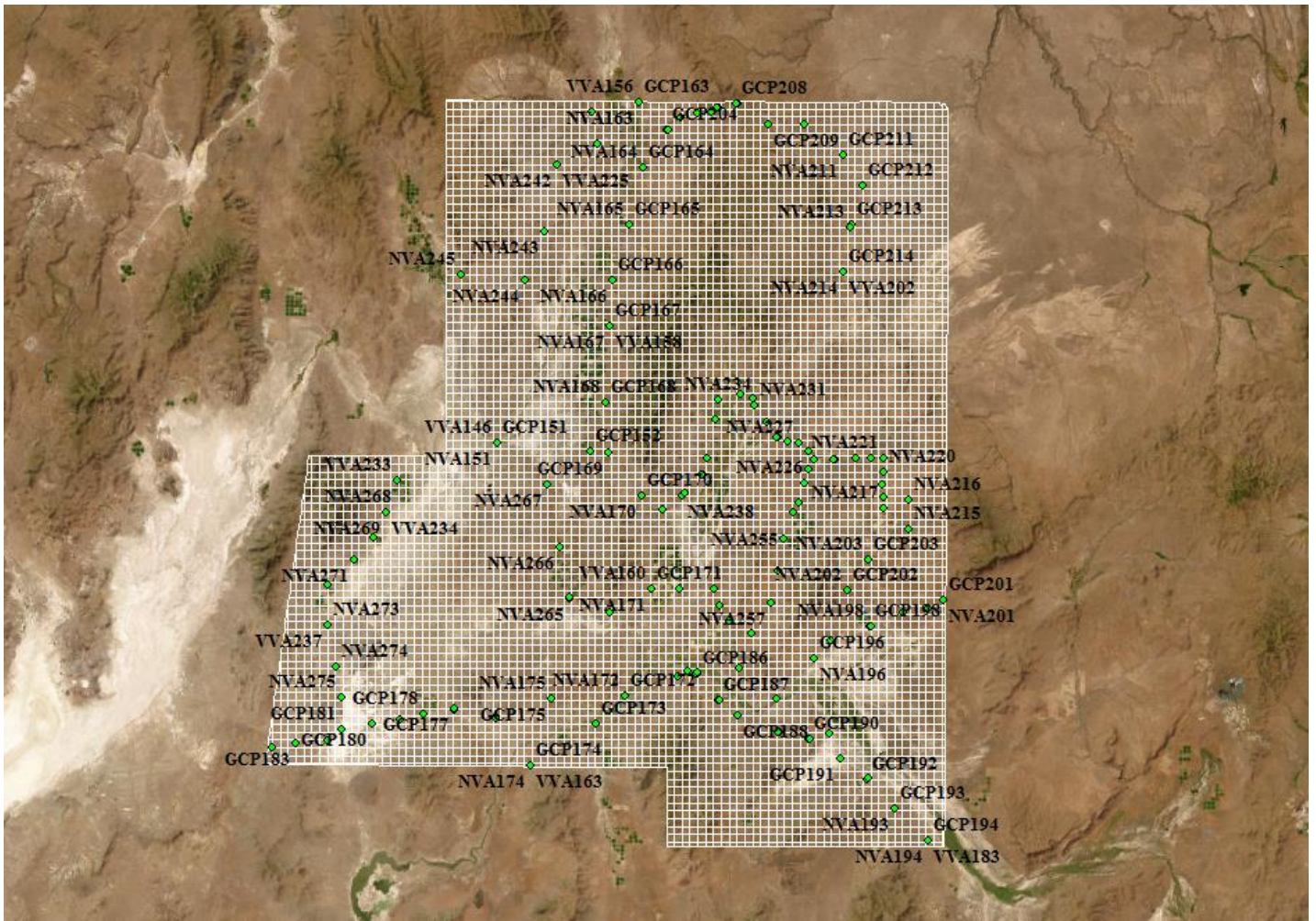


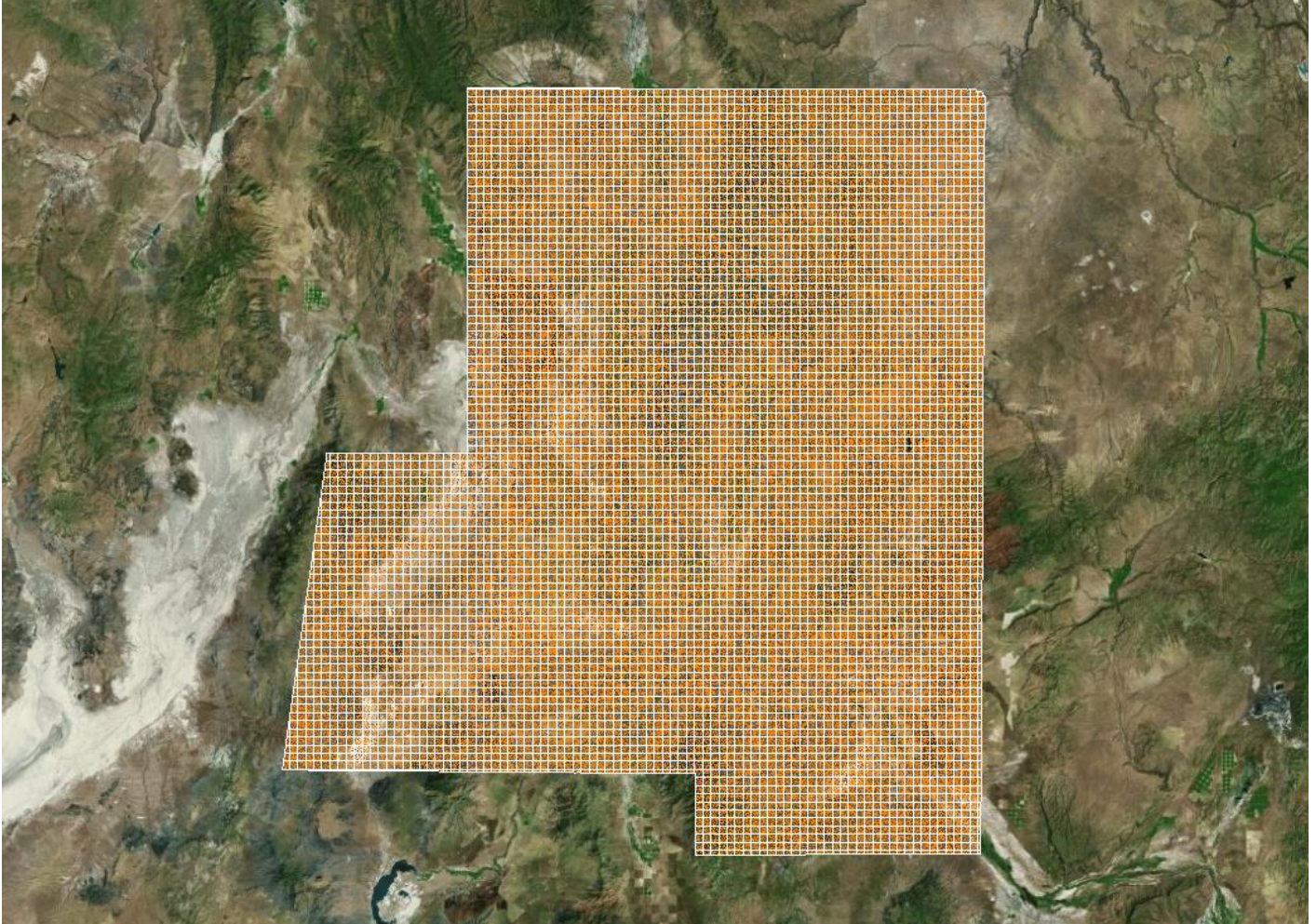
Figure 9: Vegetated Check Point Distribution

4.0 PRODUCT GENERATION

The following products were generated using the final coordinate system as defined in the contract:

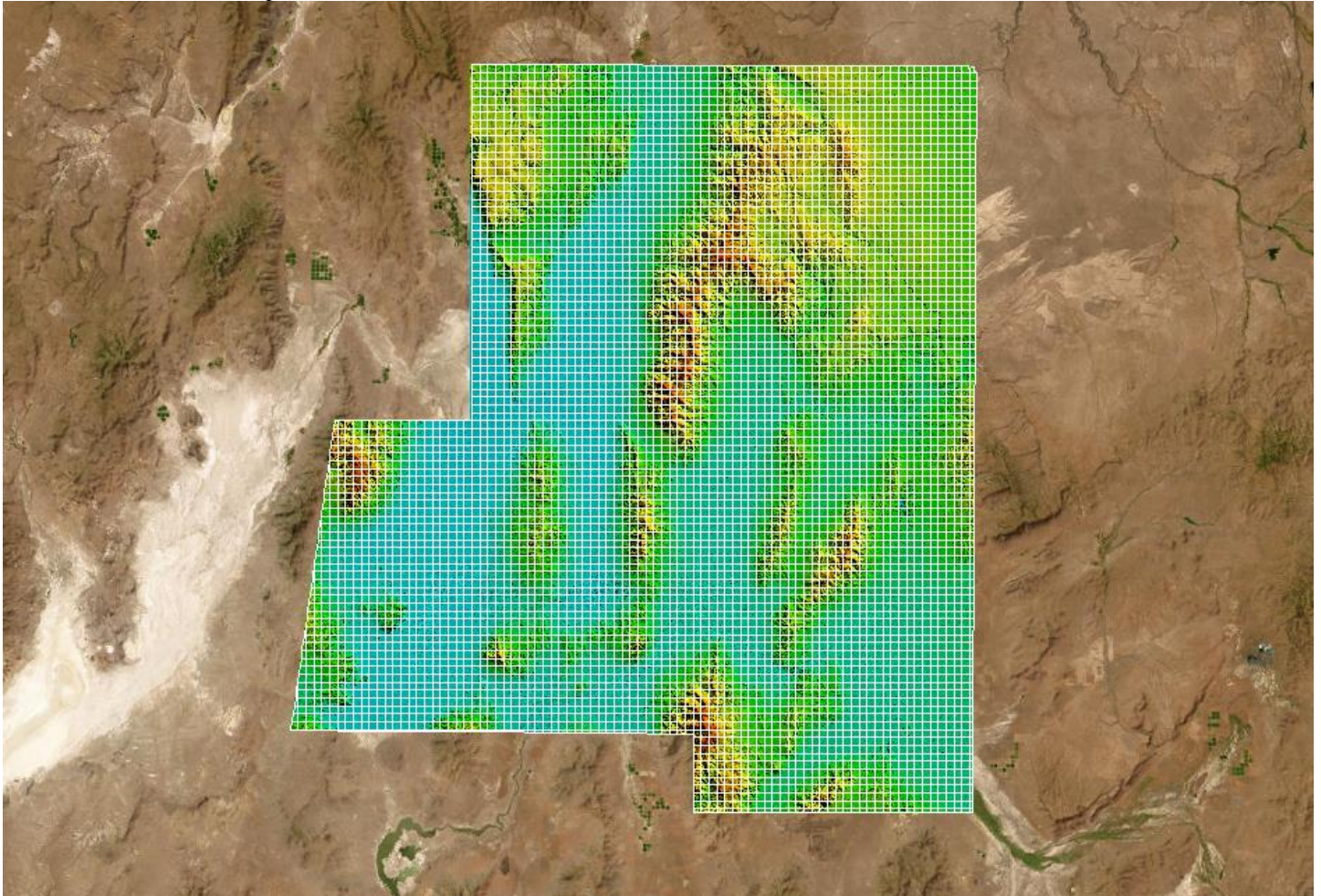
Classified Point Cloud

The Classified Point Cloud, containing all returns, is delivered in LASv1.4 (*.las) format and meets project specifications. National Geospatial Program Lidar Base Specification 2021, Revision A. The Classified Point Cloud contains file names referencing the tile index.



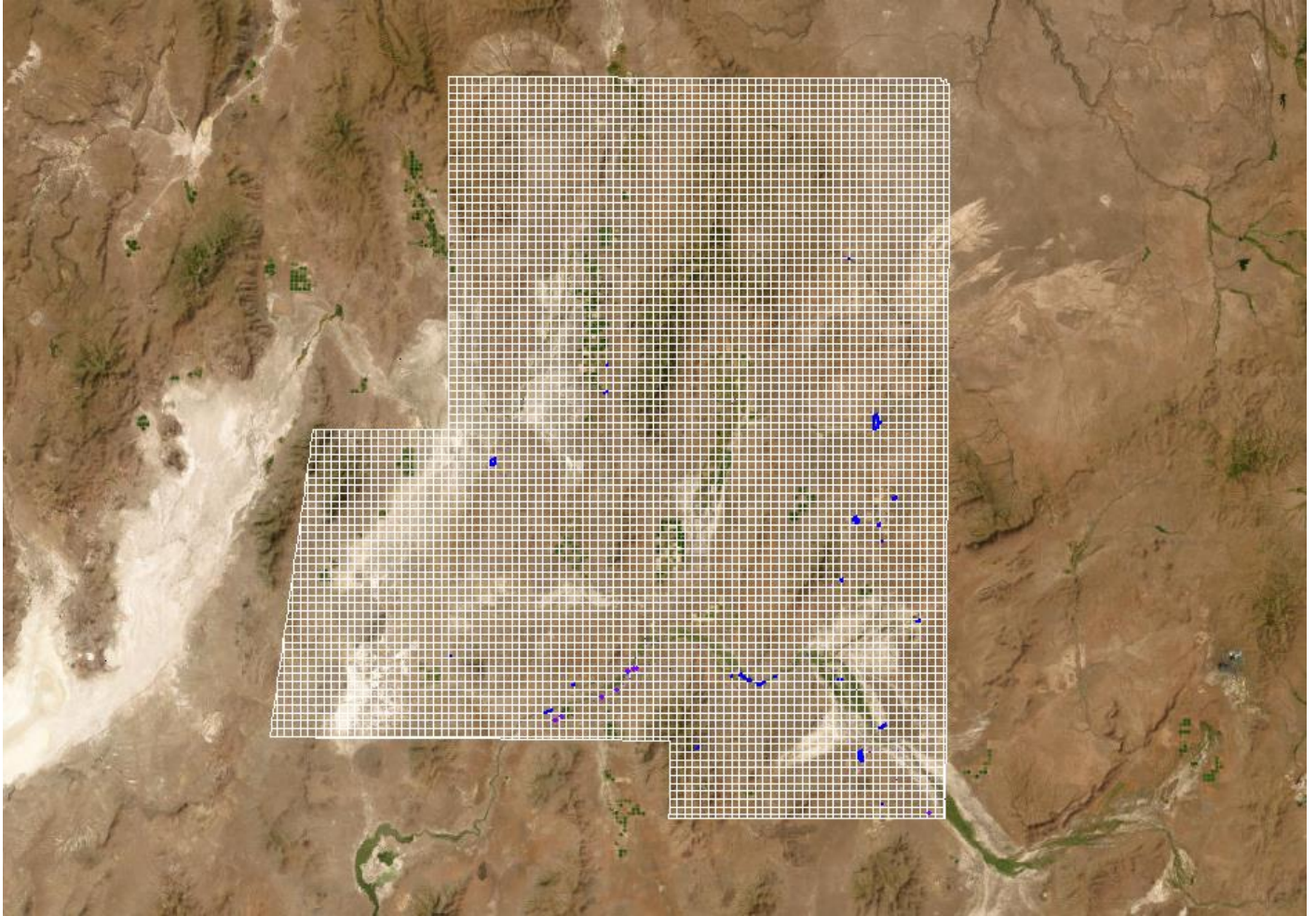
Bare-earth Digital Elevation Model (DEM)

32-bit GeoTIFF (*.tif) elevation rasters were created from the bare-earth points in the processed lidar dataset and hydro-flattened breaklines. Bare-earth rasters were produced the bilinear interpolation methodology and GDAL v2.4.0 was used to define the CRS. Each pixel contains an elevation.



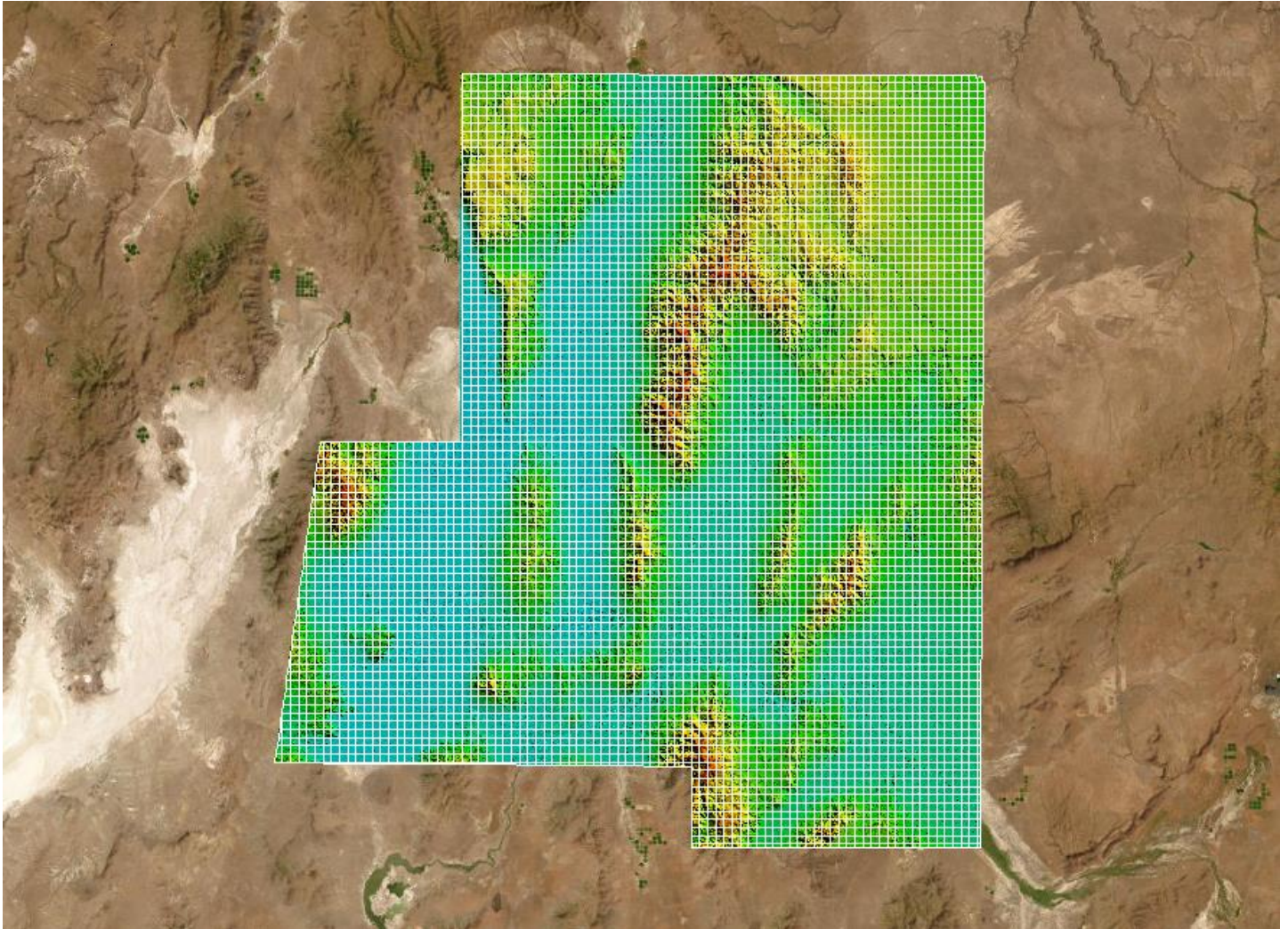
Breaklines

Hydro-flattened breaklines were generated from digitized water features conflated to the elevations derived from the bare-earth points in the processed lidar dataset. Delivered in Esri (*.gdb) format.



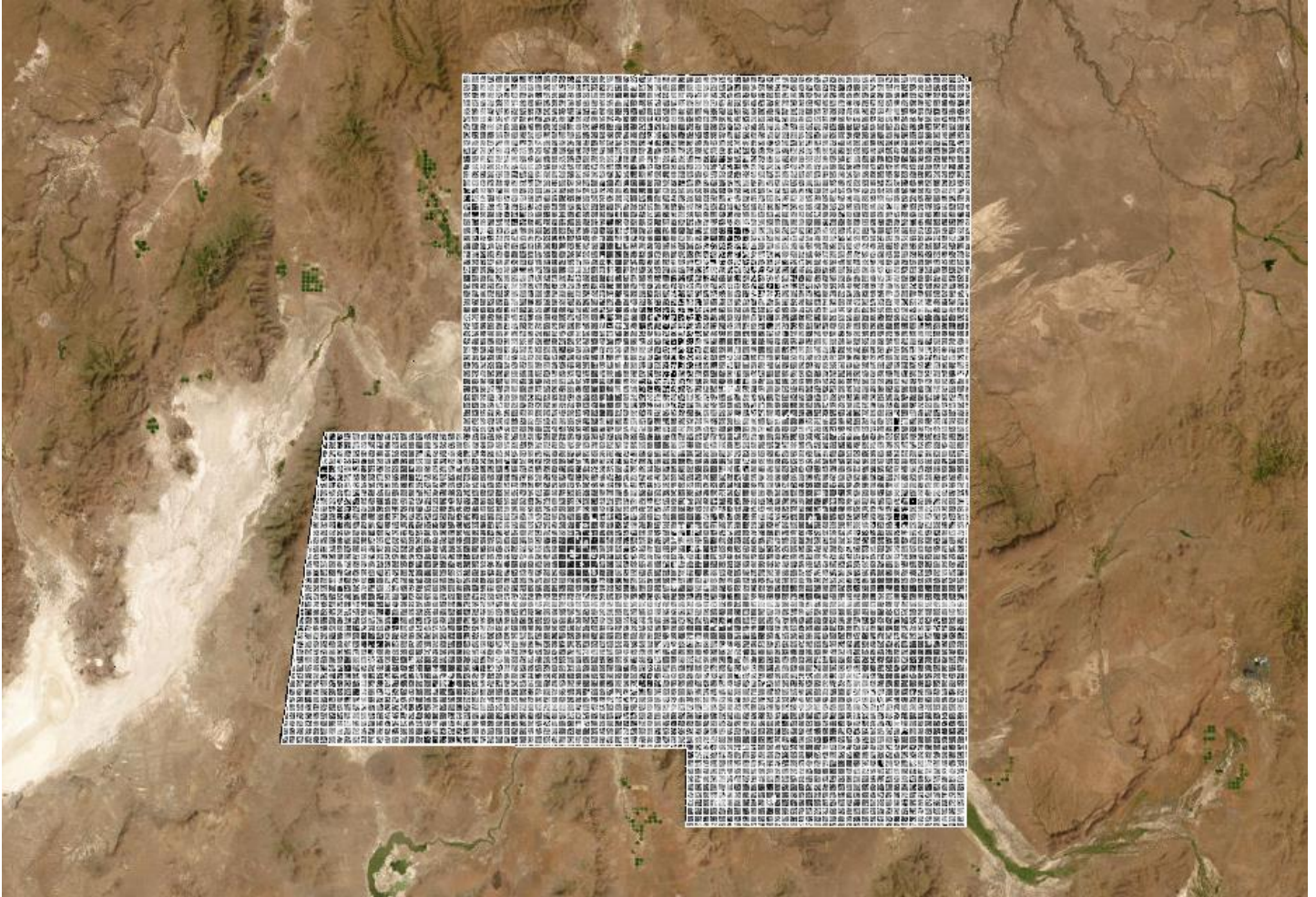
Maximum Surface Height Rasters (MSHR)

32-bit GeoTIFF (*.tif) elevation rasters were created from all return points in the processed lidar dataset. The rasters were produced the bilinear interpolation methodology and GDAL v2.4.0 was used to define the CRS. Each pixel contains an elevation.



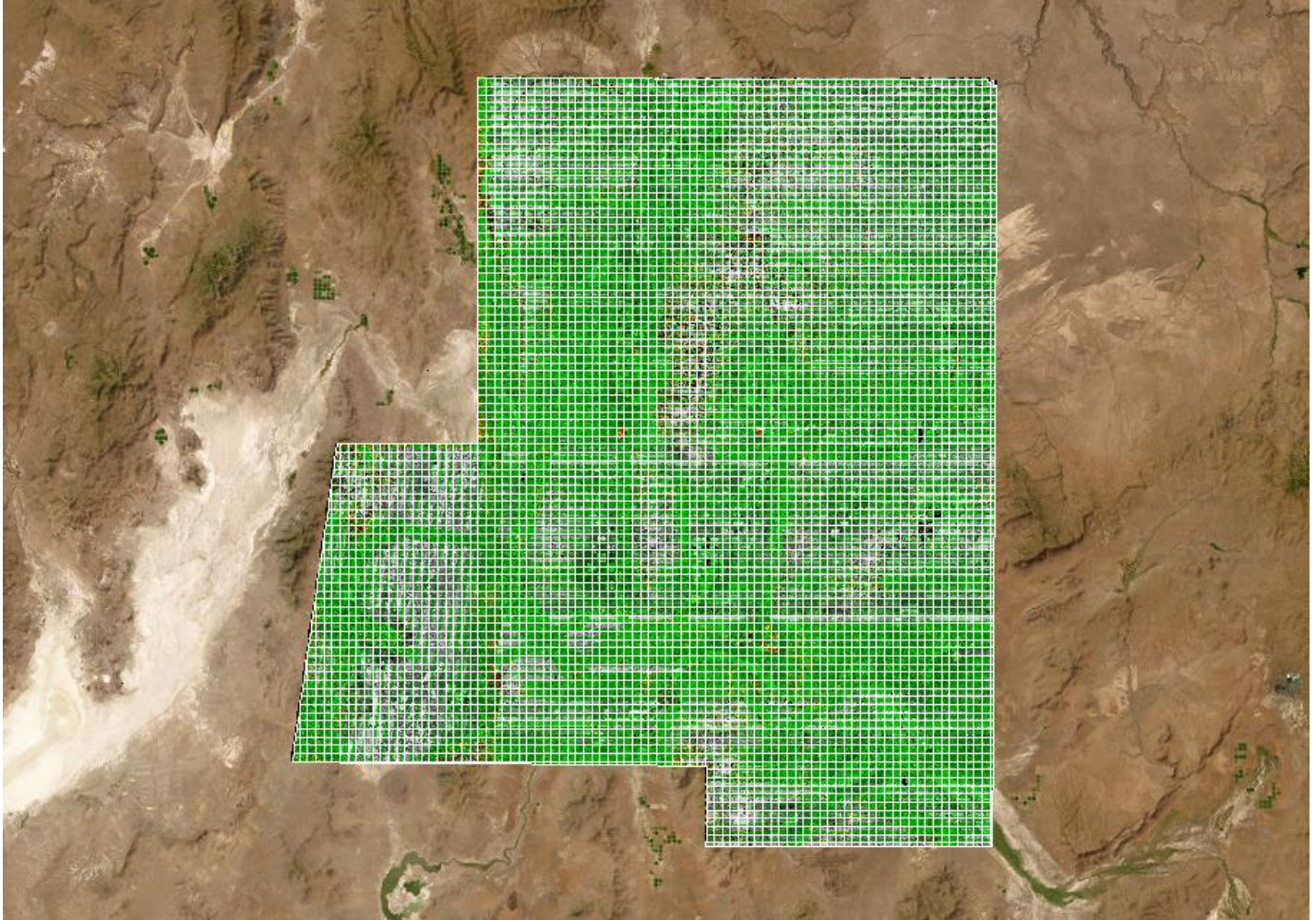
First-return Intensity Images

8-bit GeoTIFF (*.tif) intensity rasters were created from the first-return points in the processed lidar dataset. GDAL v2.4.0 was used to define the CRS.



Last-return Swath Separation Images

24-bit GeoTIFF (*.tif) swath separation images modulated by intensity were created from the last-return points in the processed lidar dataset. GDAL v2.4.0 was used to define the CRS.



Swath Polygons

Polygons features representing either the convex or concave hull of swaths, where each record is an individual swath or channel within a swath. Delivered in Esri (*.shp) format.



Other Deliverables

Metadata

Vertical Accuracy Report

A final quality assurance process was undertaken to validate all deliverables for the project. Prior to release of data for delivery, Sanborn's Quality Control/Quality Assurance department reviews the data and then releases it for delivery.

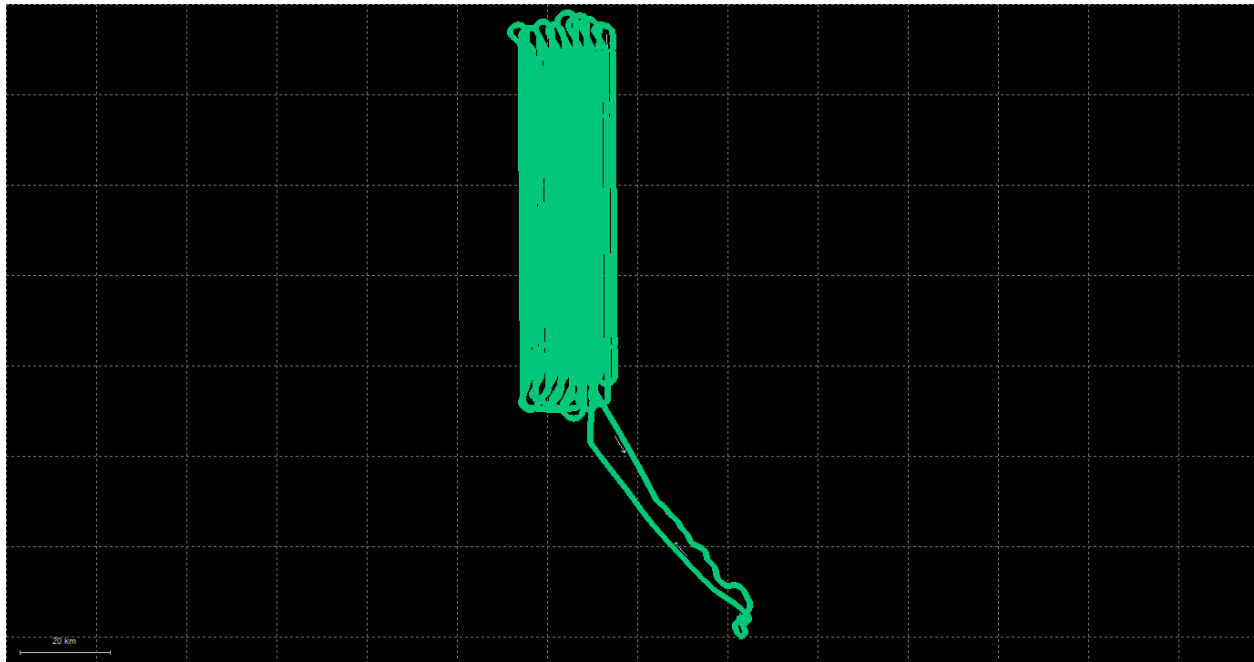
APPENDIX A – ABGNSS/IMU PLOTS

Coverage Map	Plots the Aircraft GNSS-IMU Trajectory in reference to localized GNSS Reference Stations.
Estimated Position Accuracy	Plots the standard deviations of the east, north, and up directions versus time for the solution. The total standard deviation with a distance dependent component is also plotted.
Number of Satellites	Plots the number of satellites used in the solution as a function of time. The number of GPS, GLONASS, and the total number of satellites are distinguished with separate color coded lines.
Combined Separation	Plots the north, east, and height position difference between any two solutions loaded into the project. These are most often the forward and reverse processing results, unless other solutions have been loaded from the Combine Solutions dialog. Plotting the difference between forward and reverse solutions can be very helpful in quality checking. When processing both directions, no information is shared between forward and reverse processing. Thus both directions are processed independently of each other. When forward and reverse solutions agree closely, it helps provide confidence in the solution. To a lesser extent, this plot can also help gauge solution accuracy.
PDOP	PDOP is a unitless 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 were the antenna angle is unfavorable; these spikes while aesthetically unfavorable do not generally reduce the accuracy of the acquired data.

Output Results for 20210913A_GnssImu

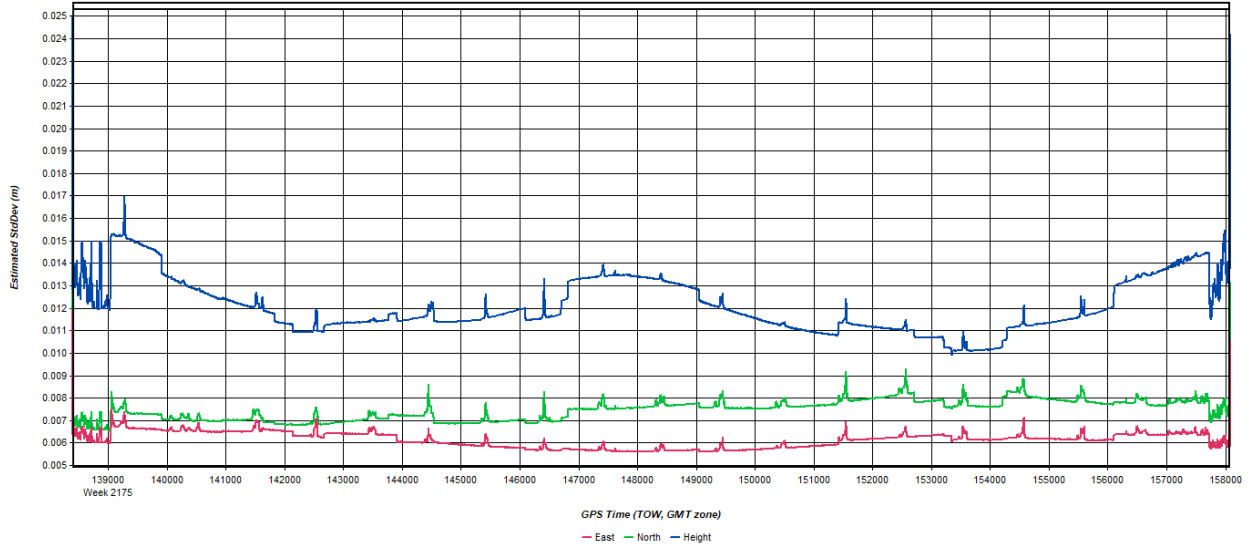
Inertial Explorer Version 8.90.2124
09/17/2021

Figure 1: Smoothed TC Combined - Map



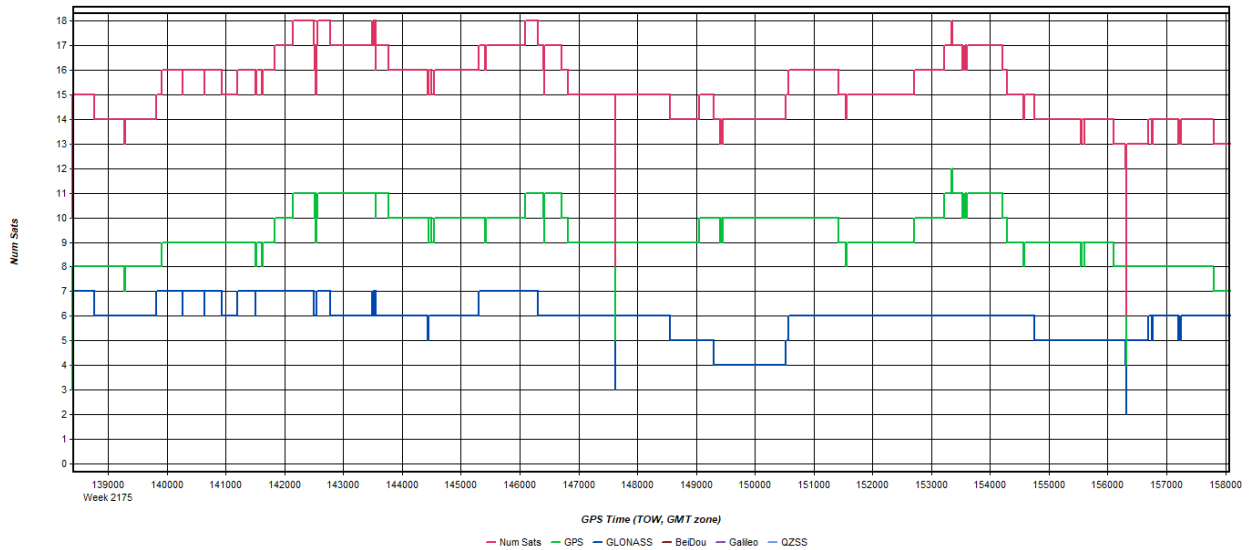
Process	20210913A_GnssImu	by Unknown	on 9/17/2021	at 13:36:01
---------	-------------------	------------	--------------	-------------

Figure 2: 20210913A_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



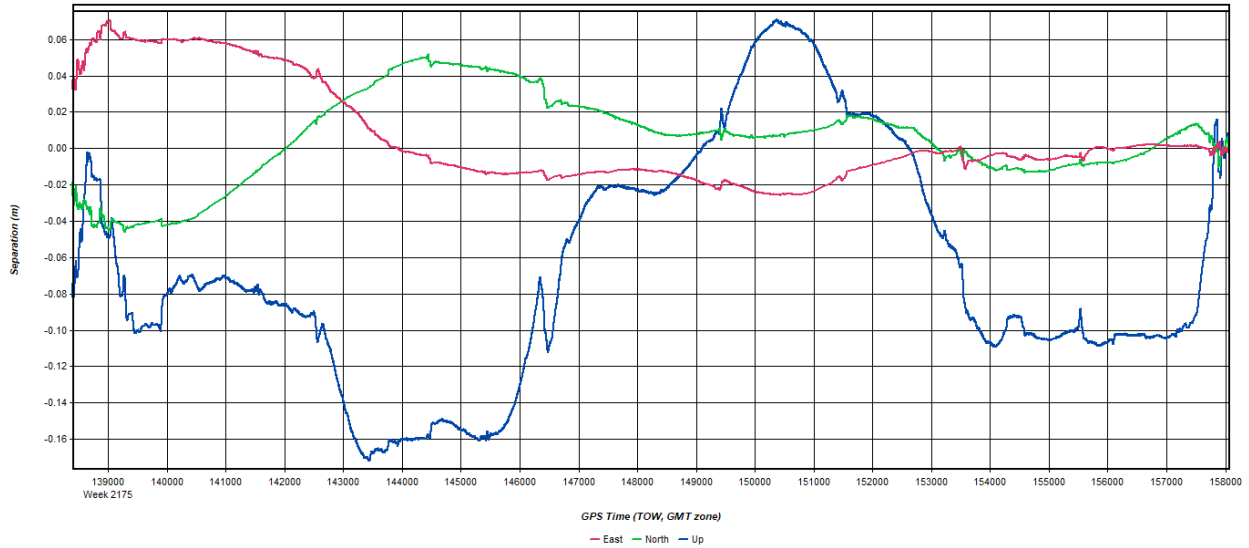
Process 20210913A_GnssImu by Unknown on 9/17/2021 at 13:36:01

Figure 3: 20210913A_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



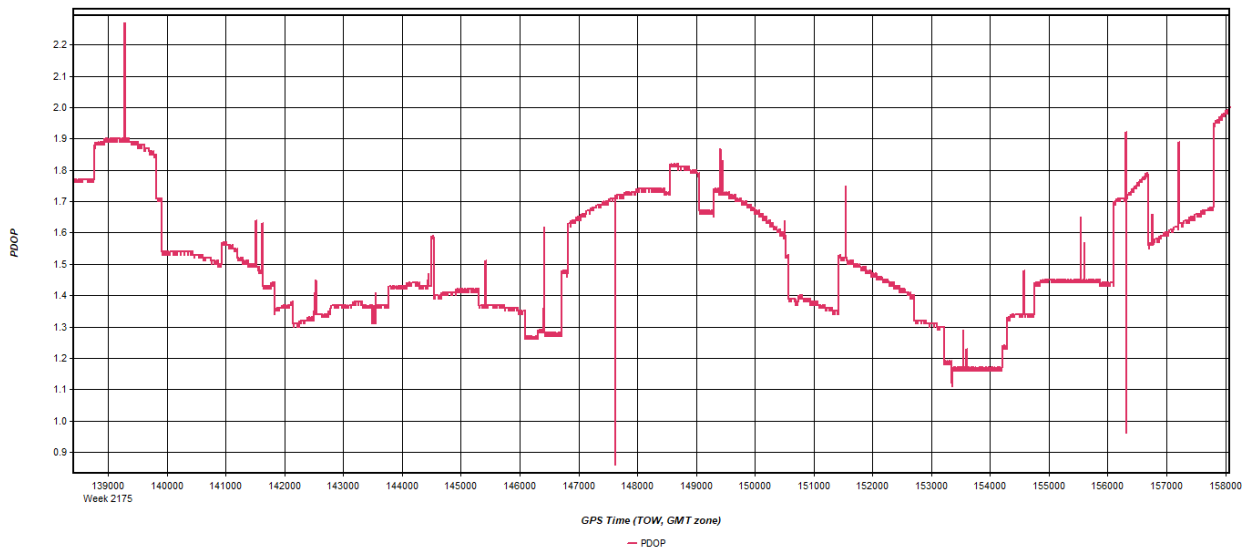
Process 20210913A_GnssImu by Unknown on 9/17/2021 at 13:36:01

Figure 4: 20210913A_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210913A_GnssImu by Unknown on 9/17/2021 at 13:36:01

Figure 5: 20210913A_GnssImu [Smoothed TC Combined] - PDOP Plot

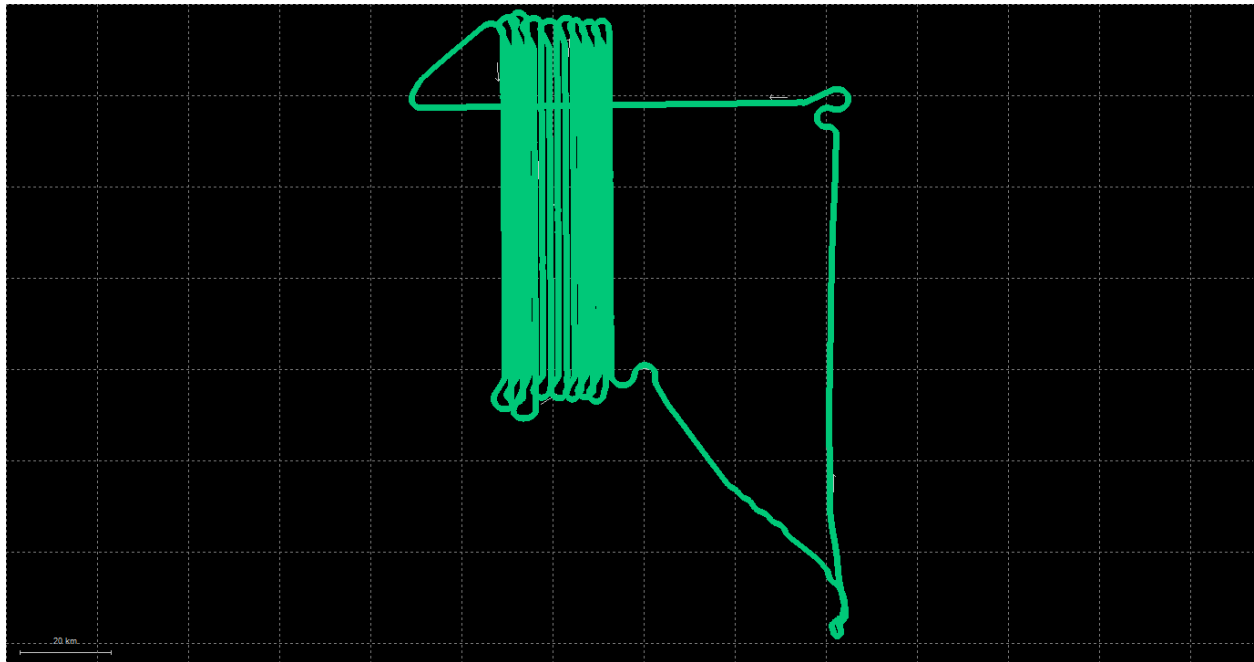


Process 20210913A_GnssImu by Unknown on 9/17/2021 at 13:36:01

Output Results for 20210914A_GnssImu

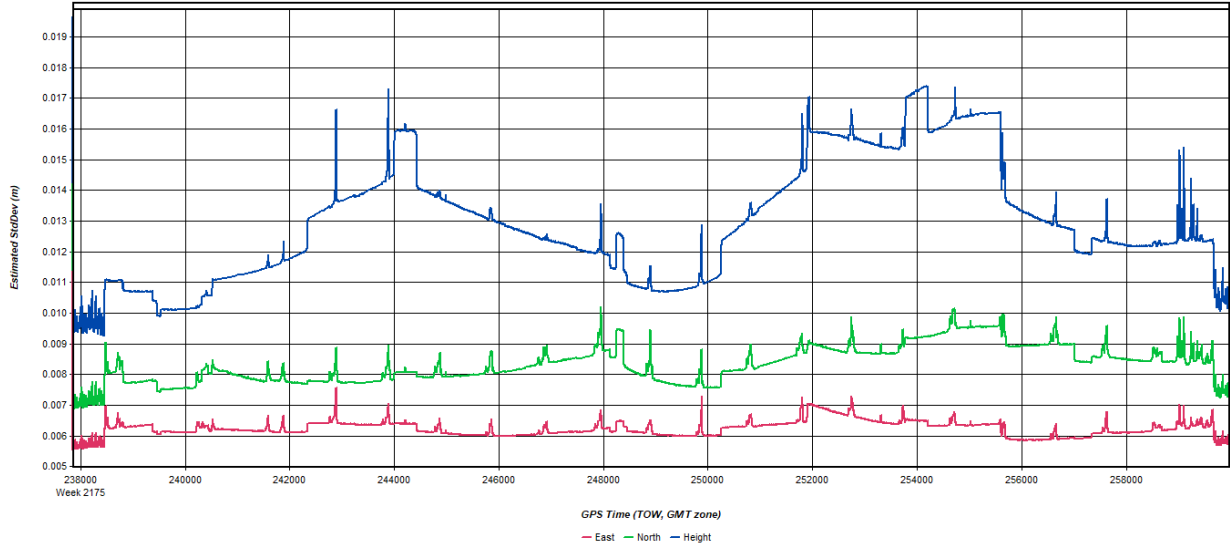
Inertial Explorer Version 8.90.2124
09/17/2021

Figure 1: Smoothed TC Combined - Map



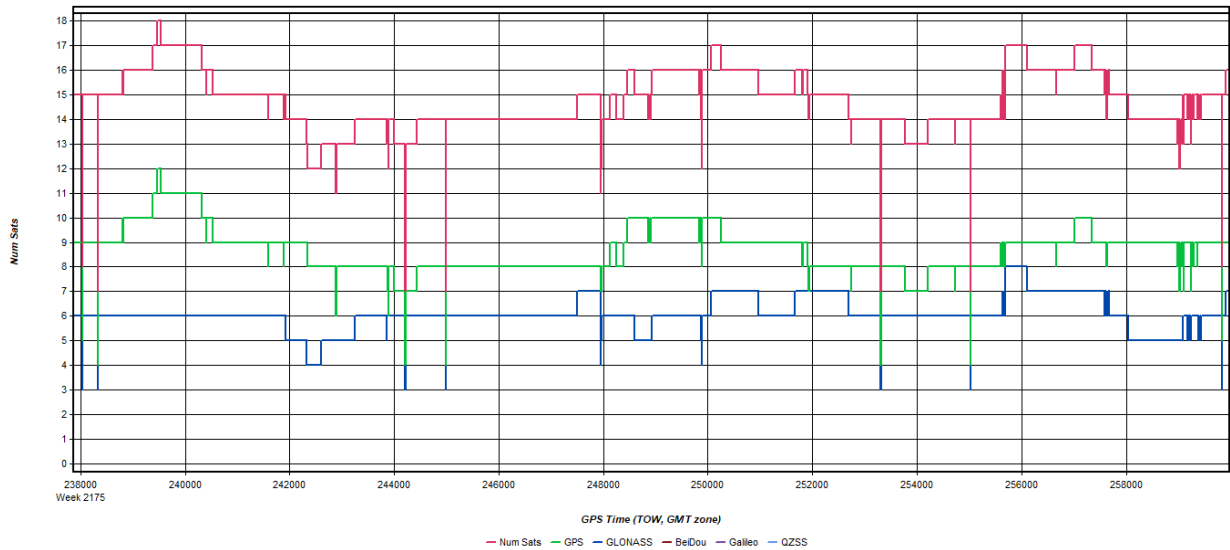
Process	20210914A_GnssImu	by Unknown	on 9/17/2021	at 15:30:19
---------	-------------------	------------	--------------	-------------

Figure 2: 20210914A_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



Process 20210914A_GnssImu by Unknown on 9/17/2021 at 15:30:19

Figure 3: 20210914A_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



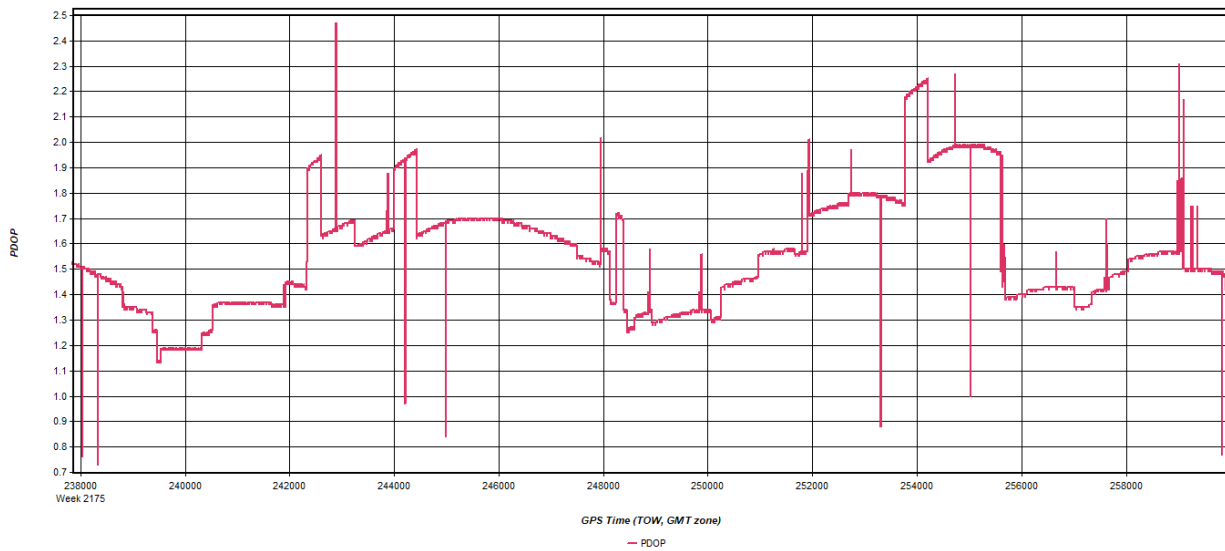
Process 20210914A_GnssImu by Unknown on 9/17/2021 at 15:30:19

Figure 4: 20210914A_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210914A_GnssImu by Unknown on 9/17/2021 at 15:30:19

Figure 5: 20210914A_GnssImu [Smoothed TC Combined] - PDOP Plot

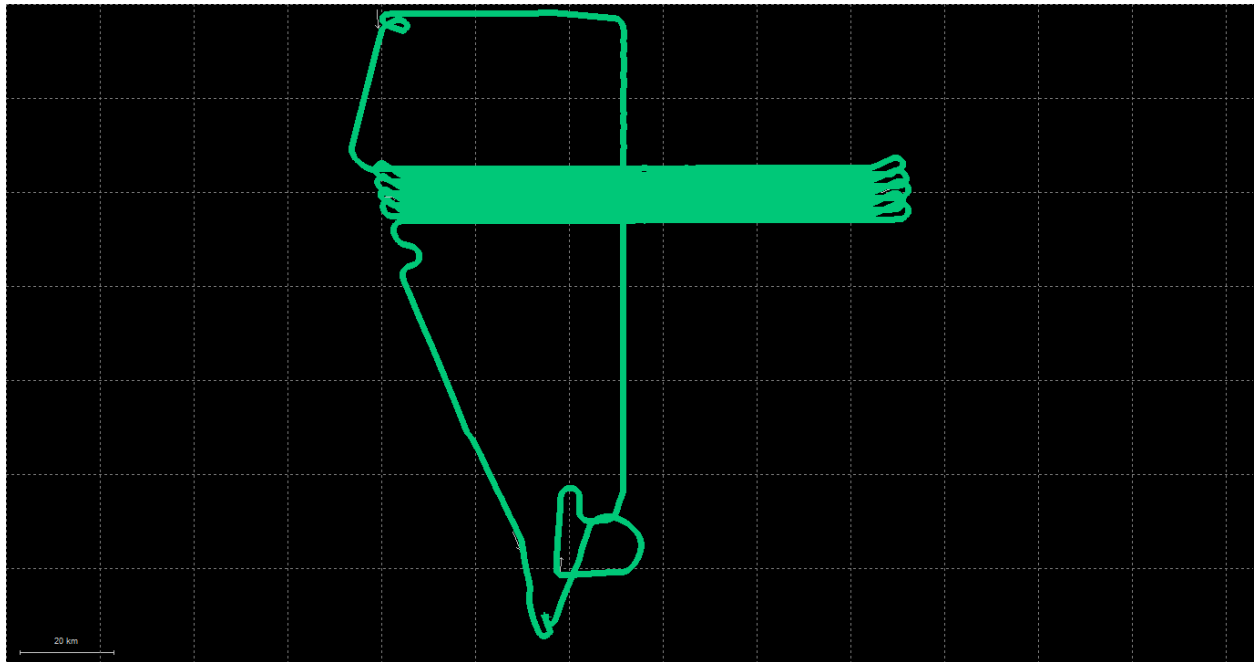


Process 20210914A_GnssImu by Unknown on 9/17/2021 at 15:30:19

Output Results for 20210915A_GnssImu

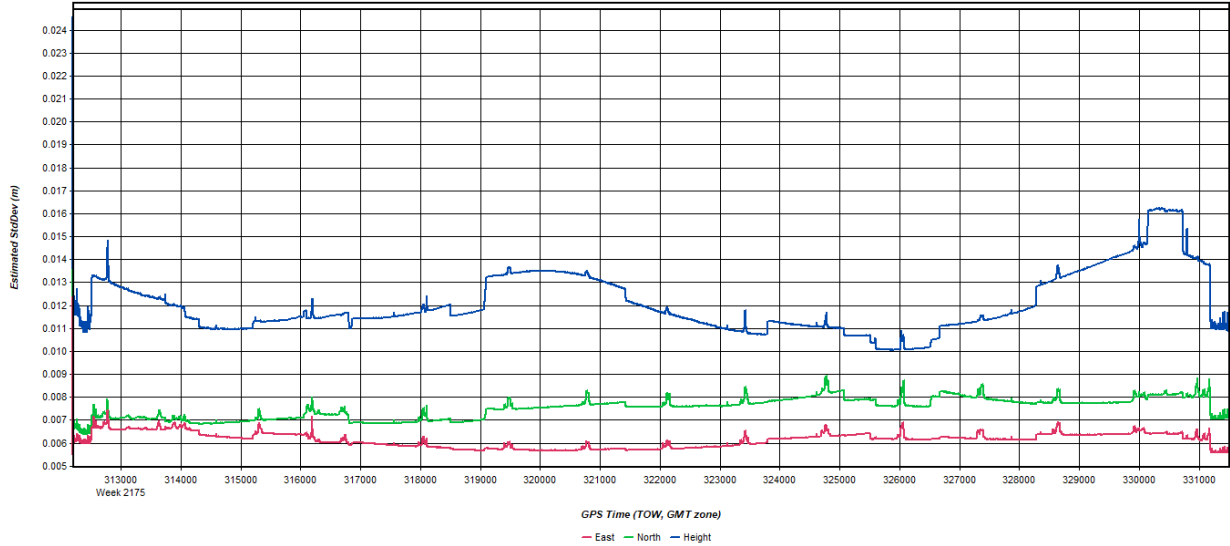
Inertial Explorer Version 8.90.2124
09/17/2021

Figure 1: Smoothed TC Combined - Map



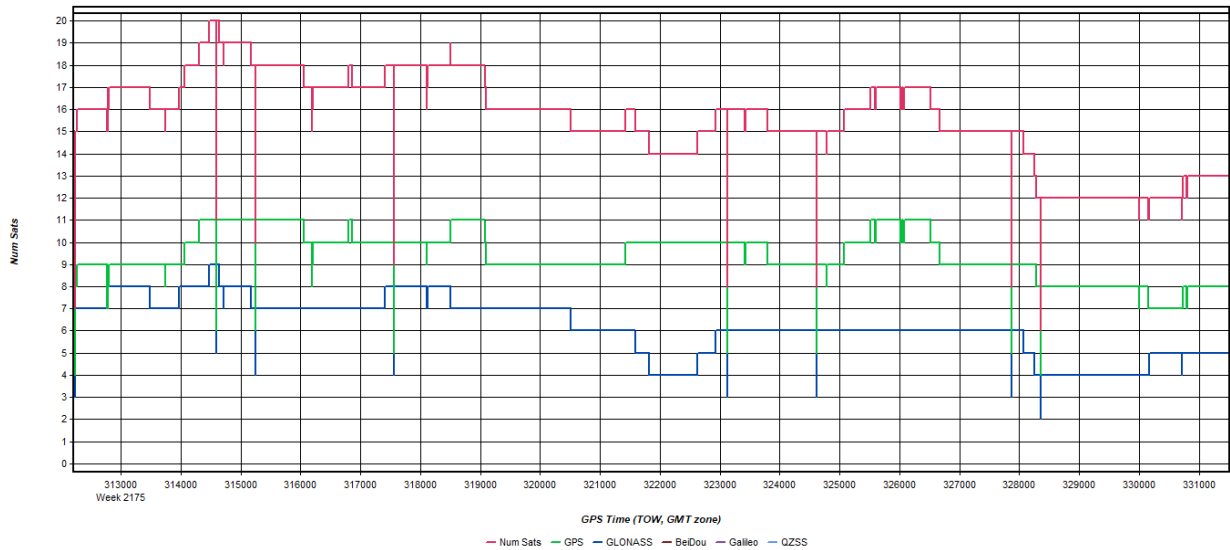
Process	20210915A_GnssImu	by Unknown	on 9/17/2021	at 16:18:27
---------	-------------------	------------	--------------	-------------

Figure 2: 20210915A_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



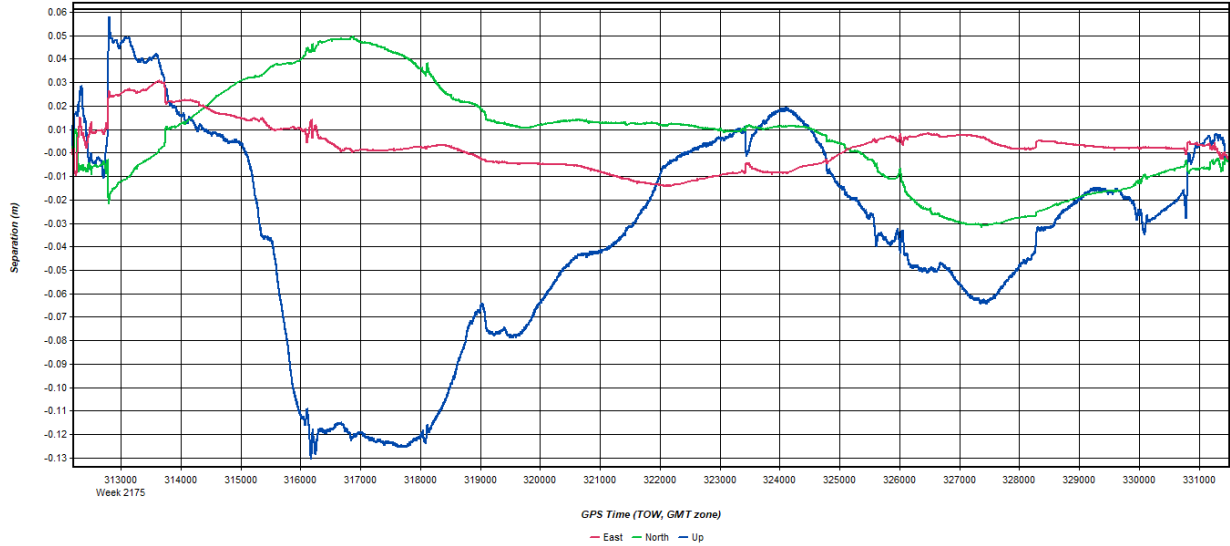
Process 20210915A_GnssImu by Unknown on 9/17/2021 at 16:18:27

Figure 3: 20210915A_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



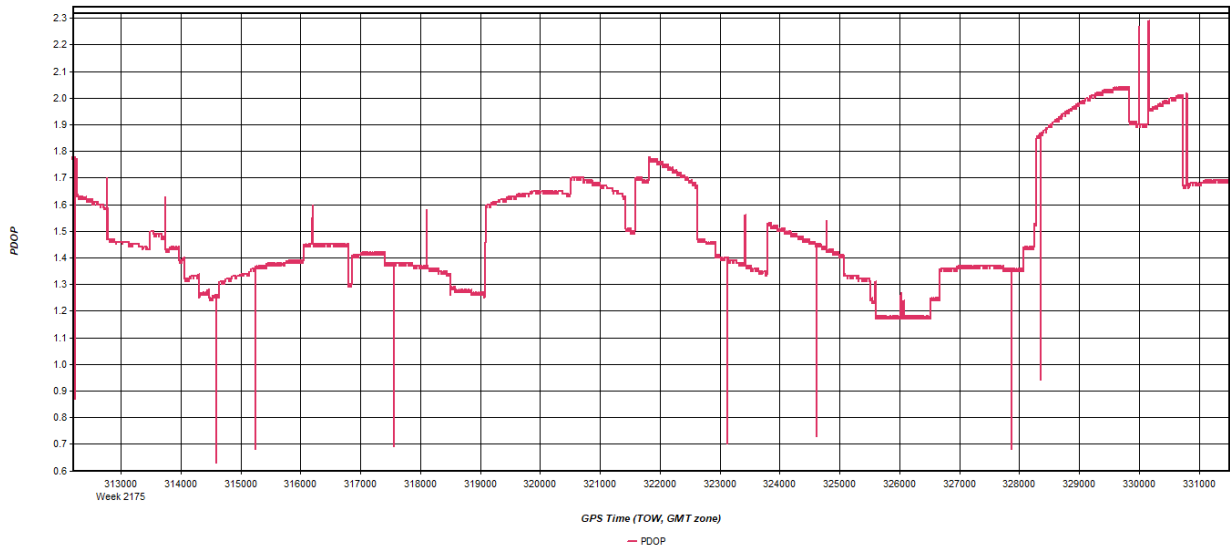
Process 20210915A_GnssImu by Unknown on 9/17/2021 at 16:18:27

Figure 4: 20210915A_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210915A_GnssImu by Unknown on 9/17/2021 at 16:18:27

Figure 5: 20210915A_GnssImu [Smoothed TC Combined] - PDOP Plot

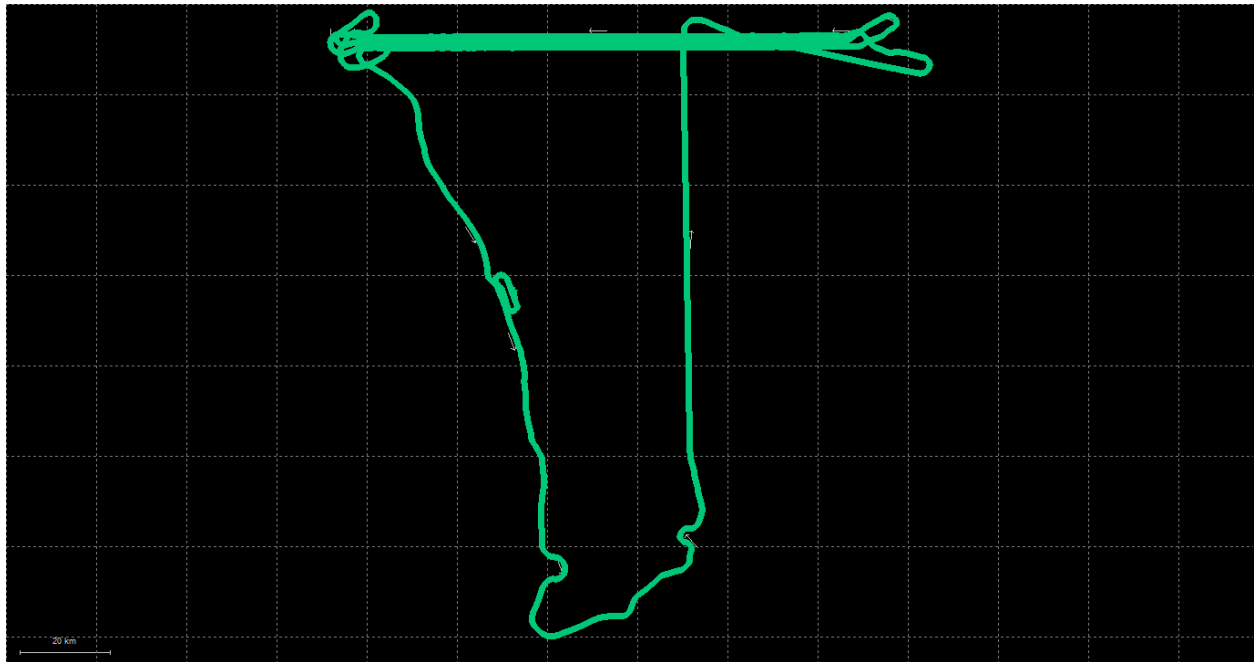


Process 20210915A_GnssImu by Unknown on 9/17/2021 at 16:18:27

Output Results for 20210915A_GnssImu

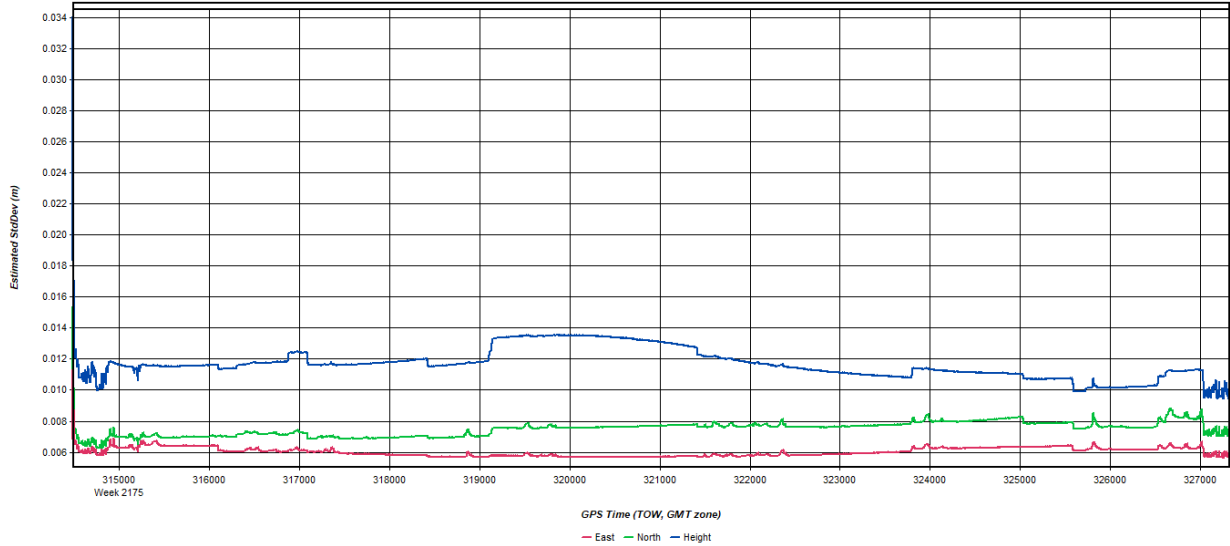
Inertial Explorer Version 8.90.2124
09/20/2021

Figure 1: Smoothed TC Combined - Map



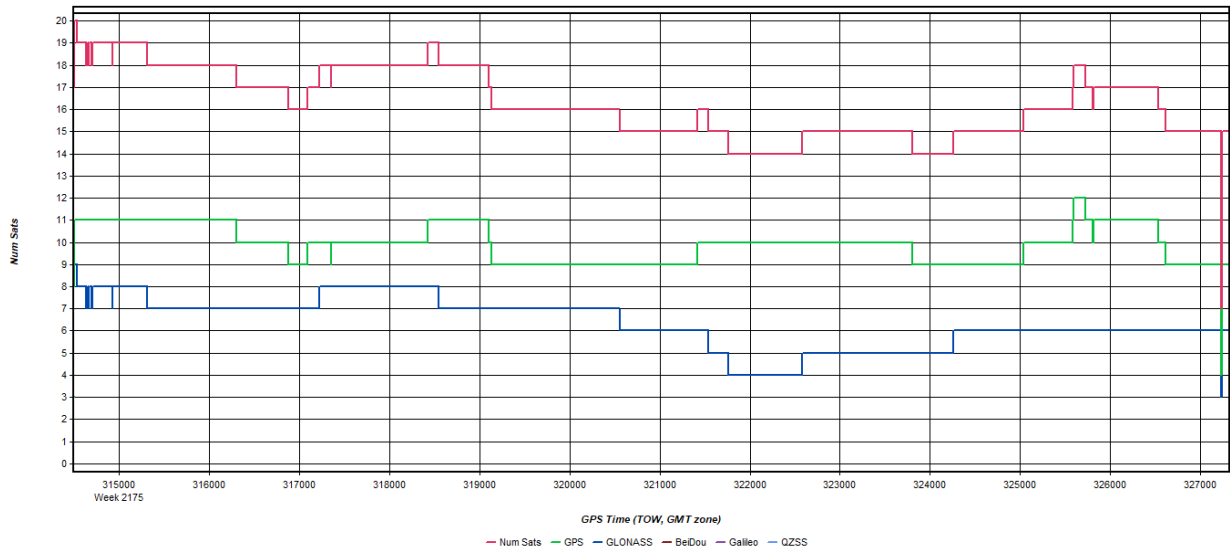
Process	20210915A_GnssImu	by Unknown	on 9/17/2021	at 18:36:28
---------	-------------------	------------	--------------	-------------

Figure 2: 20210915A_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



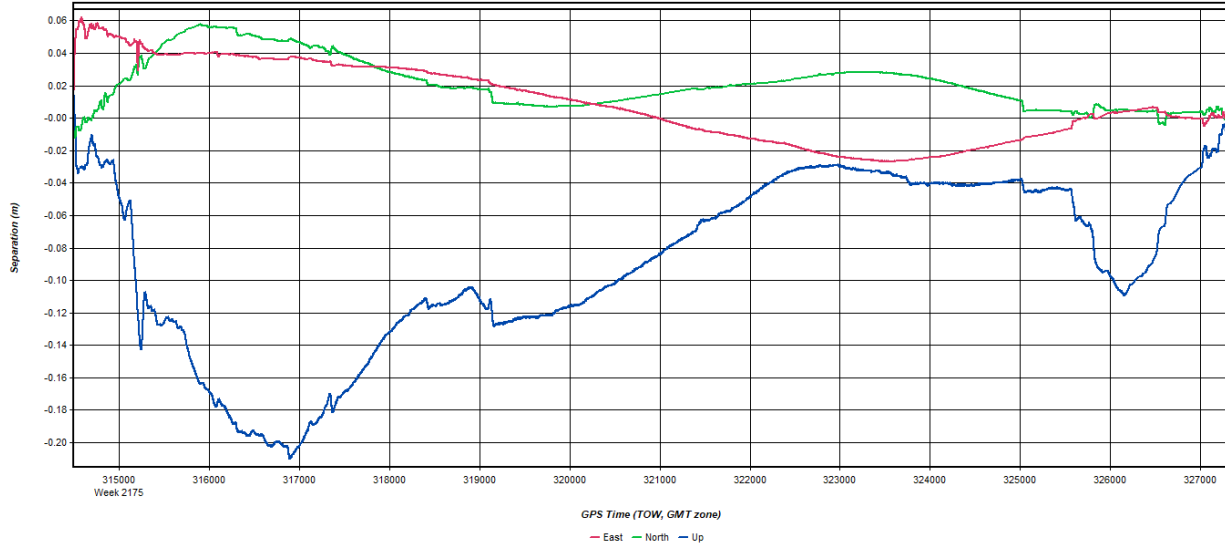
Process 20210915A_GnssImu by Unknown on 9/17/2021 at 18:36:28

Figure 3: 20210915A_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



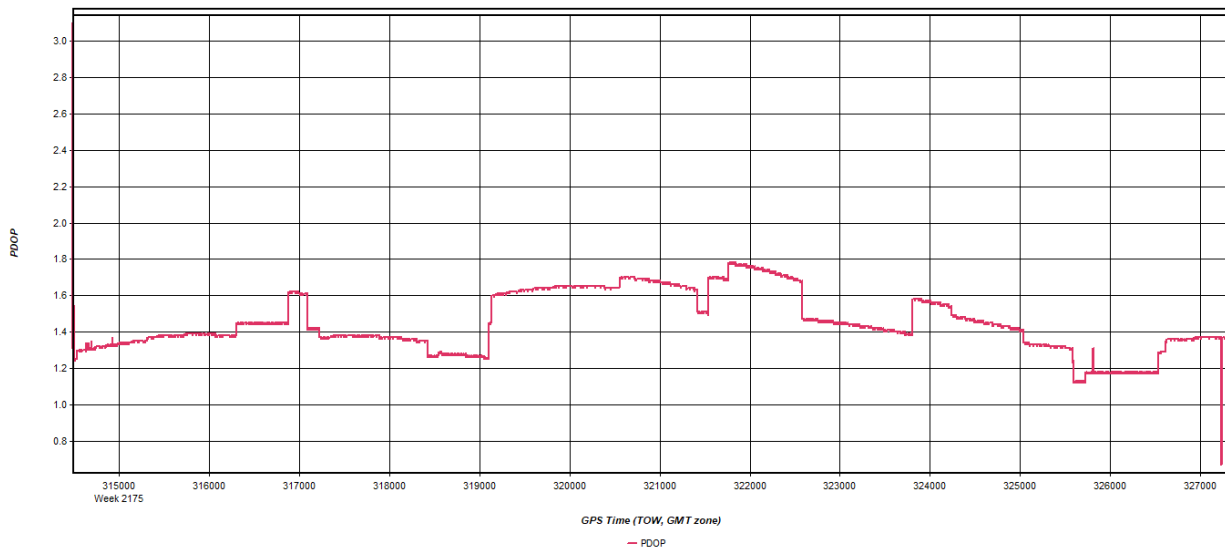
Process 20210915A_GnssImu by Unknown on 9/17/2021 at 18:36:28

Figure 4: 20210915A_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210915A_GnssImu by Unknown on 9/17/2021 at 18:36:28

Figure 5: 20210915A_GnssImu [Smoothed TC Combined] - PDOP Plot



Process 20210915A_GnssImu by Unknown on 9/17/2021 at 18:36:28

Output Results for 20210915B_GnssImu

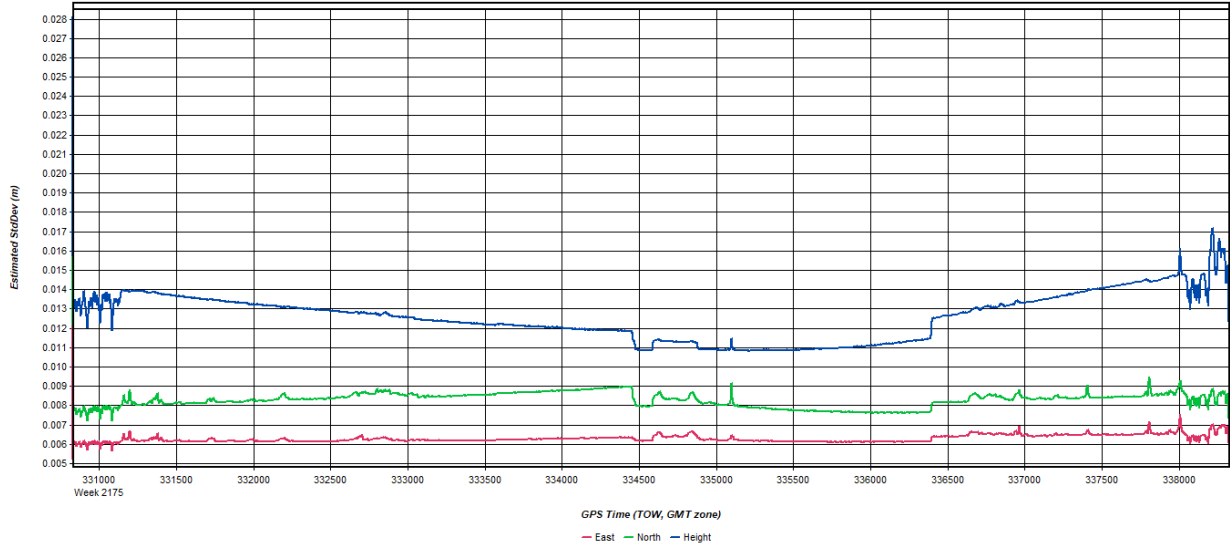
Inertial Explorer Version 8.90.2124
09/20/2021

Figure 1: Smoothed TC Combined - Map



Process	20210915B_GnssImu	by Unknown	on 9/20/2021	at 10:16:15
---------	-------------------	------------	--------------	-------------

Figure 2: 20210915B_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



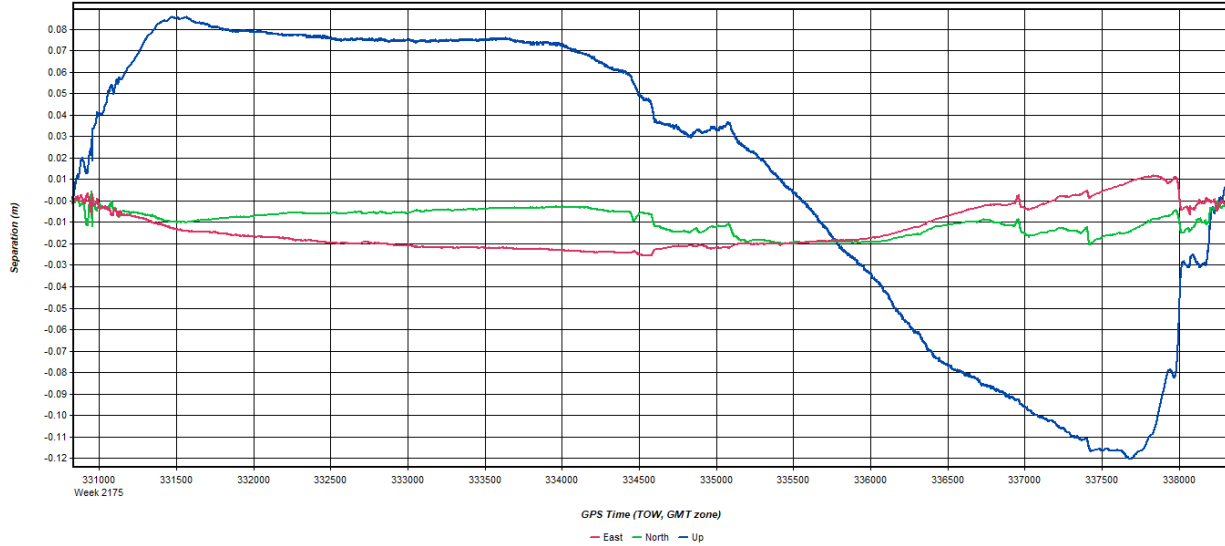
Process 20210915B_GnssImu by Unknown on 9/20/2021 at 10:16:15

Figure 3: 20210915B_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



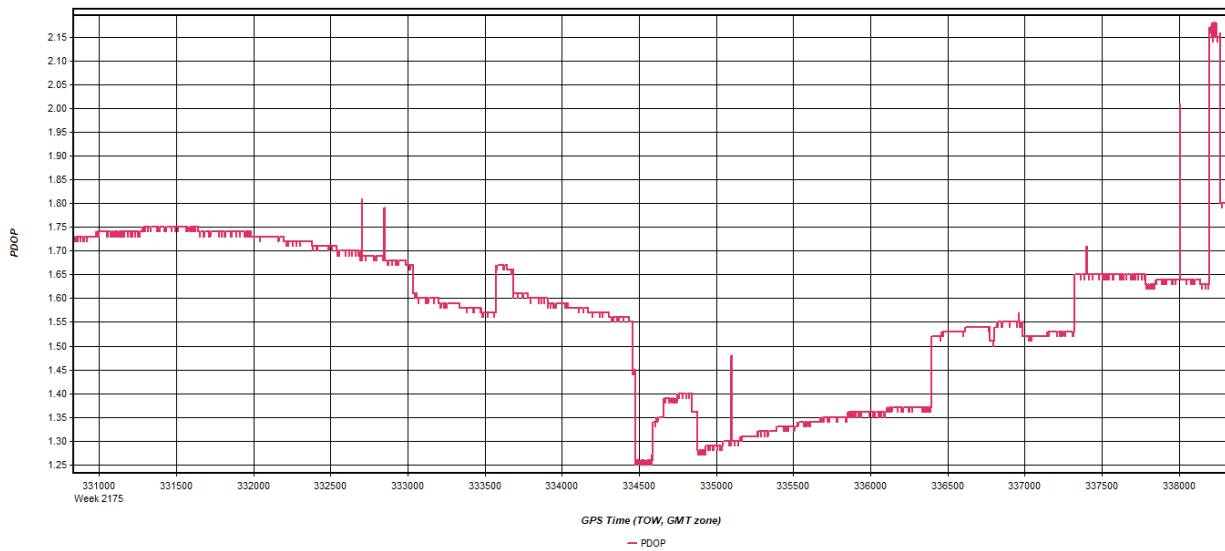
Process 20210915B_GnssImu by Unknown on 9/20/2021 at 10:16:15

Figure 4: 20210915B_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210915B_GnssImu by Unknown on 9/20/2021 at 10:16:15

Figure 5: 20210915B_GnssImu [Smoothed TC Combined] - PDOP Plot

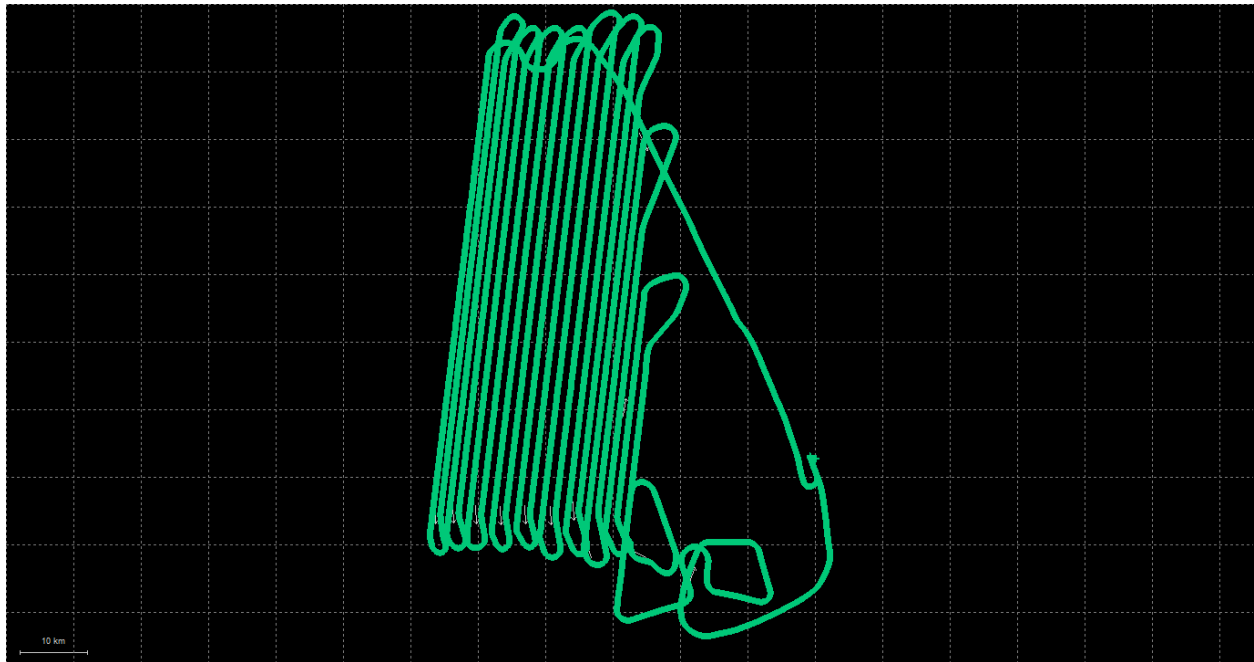


Process 20210915B_GnssImu by Unknown on 9/20/2021 at 10:16:15

Output Results for 20210916A_GnssImu

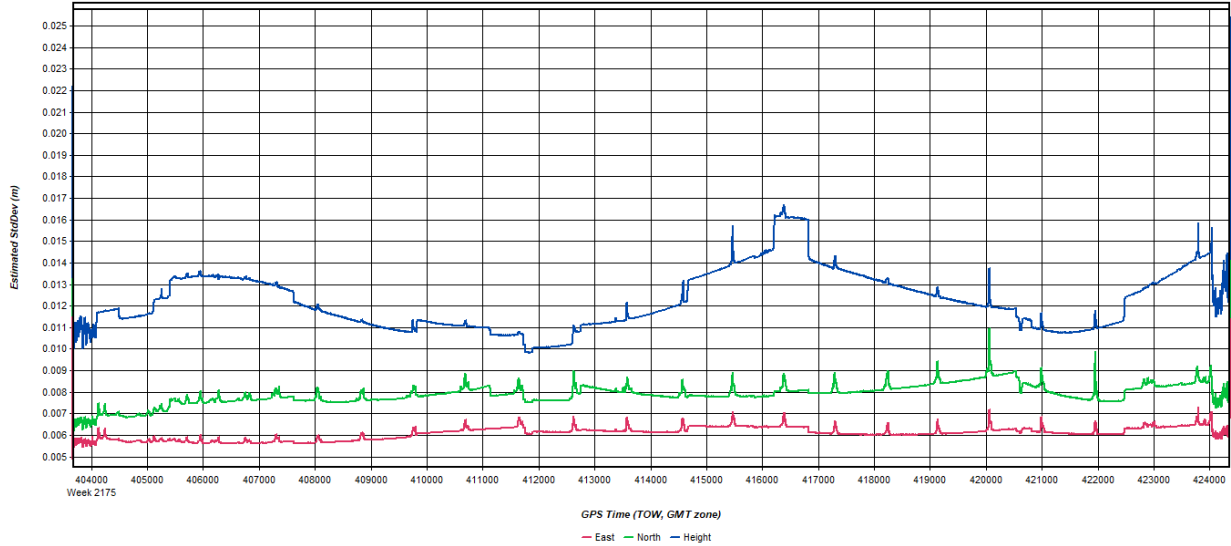
Inertial Explorer Version 8.90.2124
09/20/2021

Figure 1: Smoothed TC Combined - Map



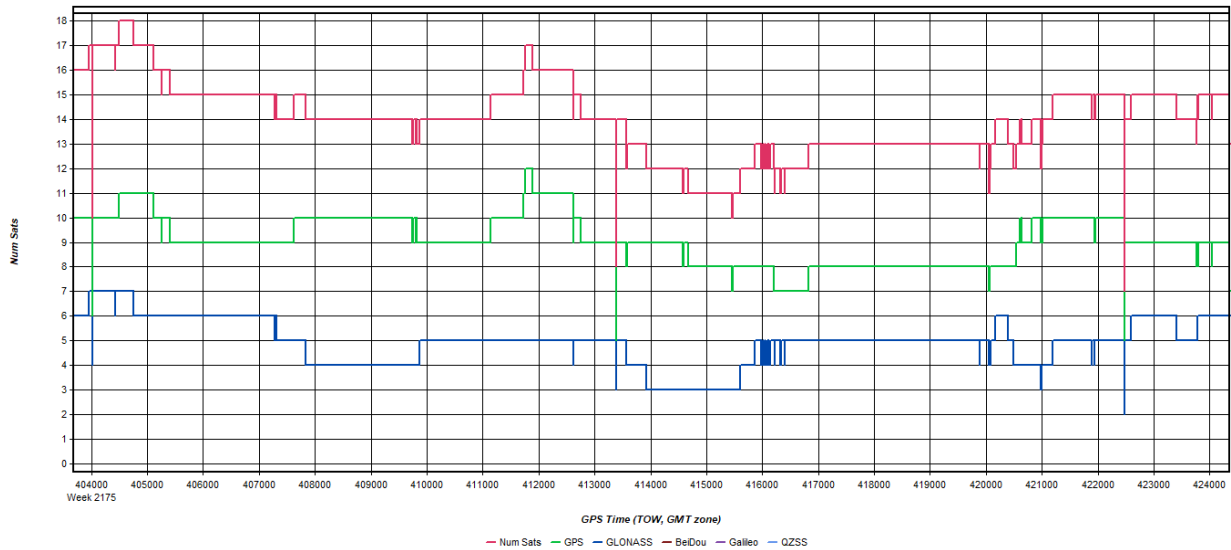
Process	20210916A_GnssImu	by Unknown	on 9/20/2021	at 12:34:05
---------	-------------------	------------	--------------	-------------

Figure 2: 20210916A_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



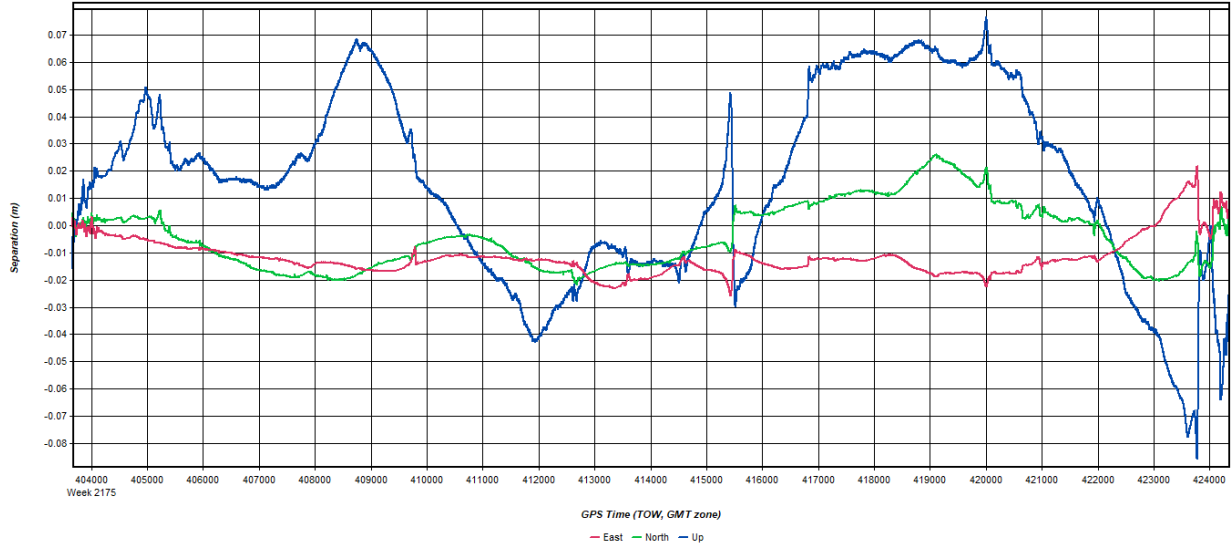
Process 20210916A_GnssImu by Unknown on 9/20/2021 at 12:34:05

Figure 3: 20210916A_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



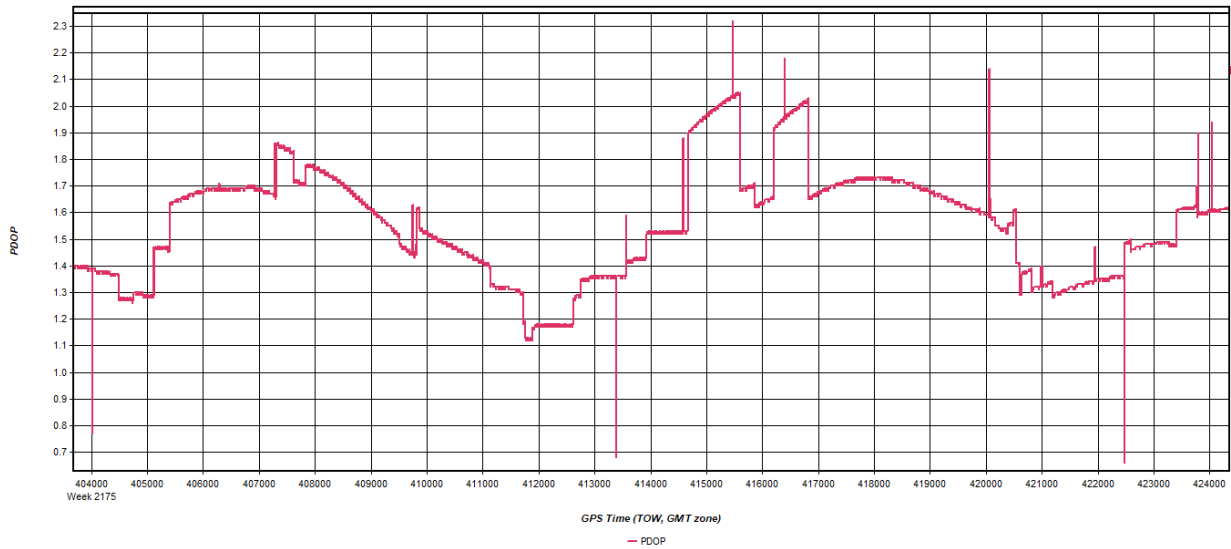
Process 20210916A_GnssImu by Unknown on 9/20/2021 at 12:34:05

Figure 4: 20210916A_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210916A_GnssImu by Unknown on 9/20/2021 at 12:34:05

Figure 5: 20210916A_GnssImu [Smoothed TC Combined] - PDOP Plot

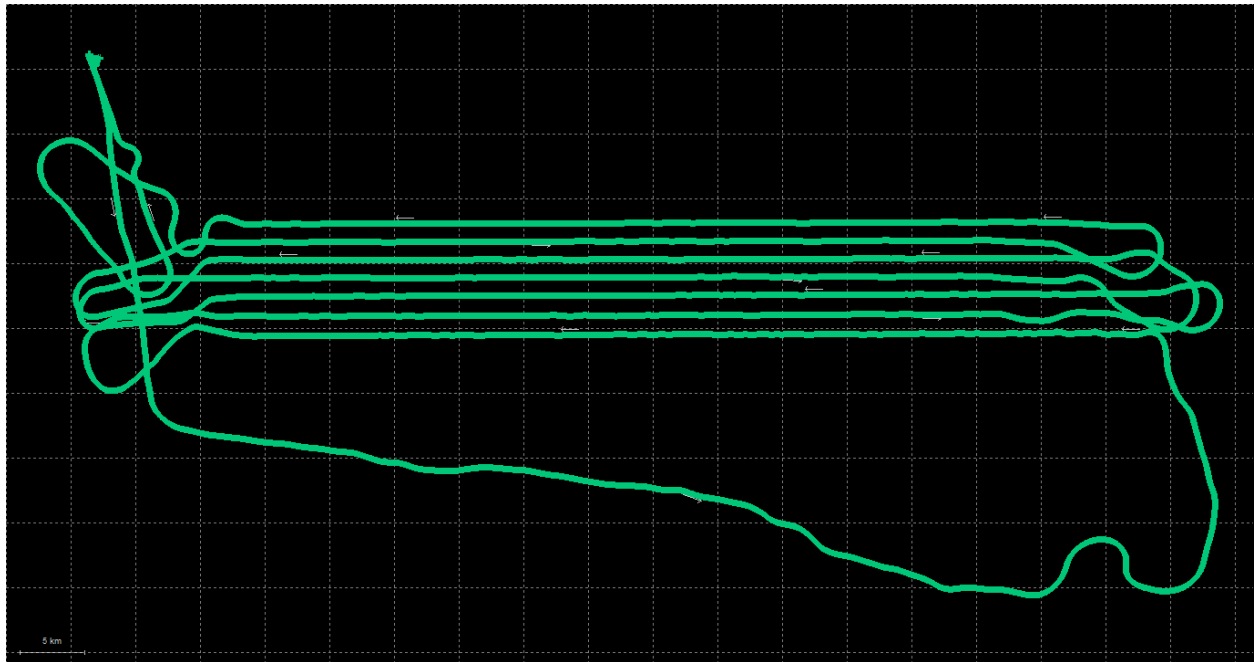


Process 20210916A_GnssImu by Unknown on 9/20/2021 at 12:34:05

Output Results for 20210916A_GnssImu

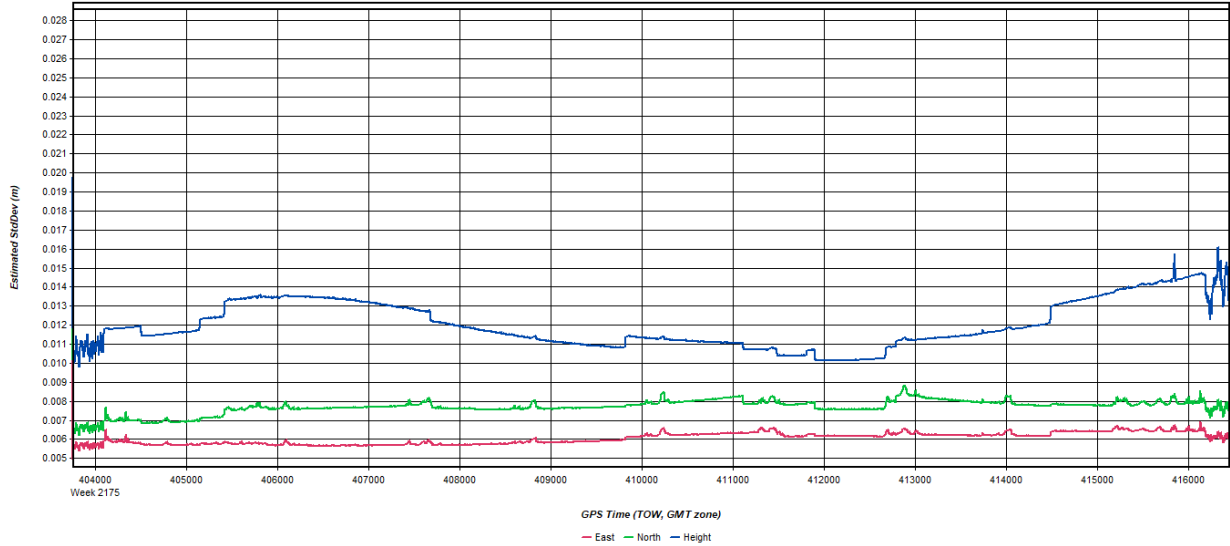
Inertial Explorer Version 8.90.2124
09/20/2021

Figure 1: Smoothed TC Combined - Map



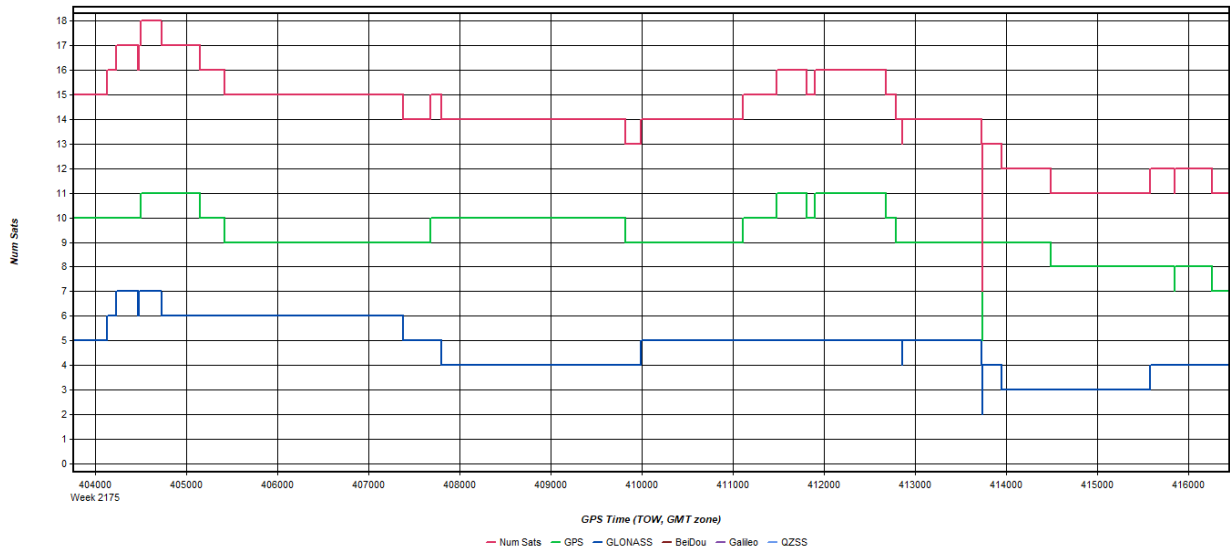
Process	20210916A_GnssImu	by Unknown	on 9/20/2021	at 13:11:16
---------	-------------------	------------	--------------	-------------

Figure 2: 20210916A_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



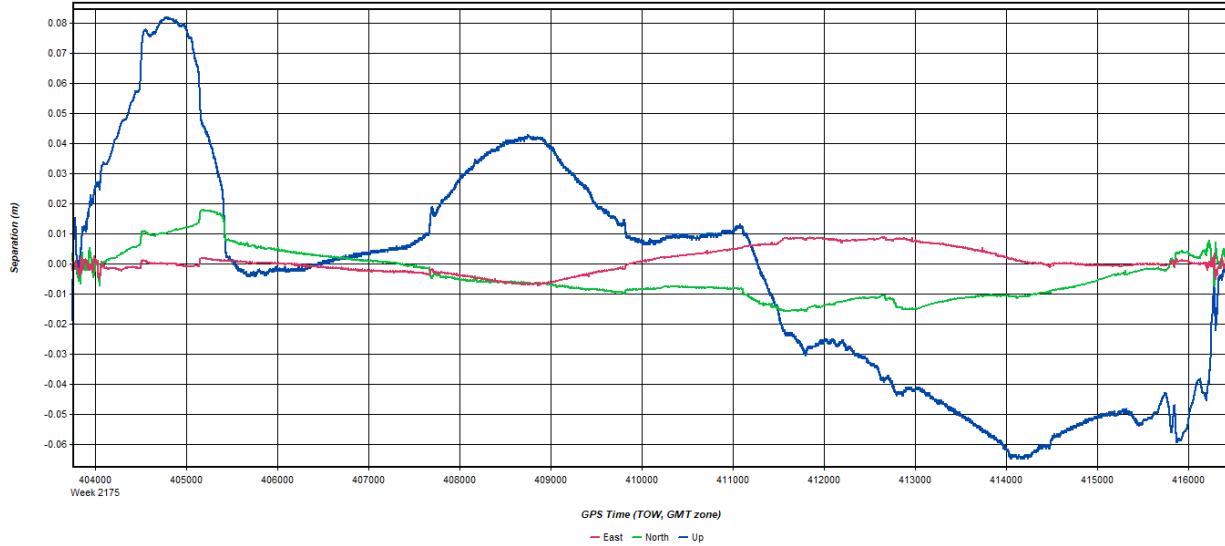
Process 20210916A_GnssImu by Unknown on 9/20/2021 at 13:11:16

Figure 3: 20210916A_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



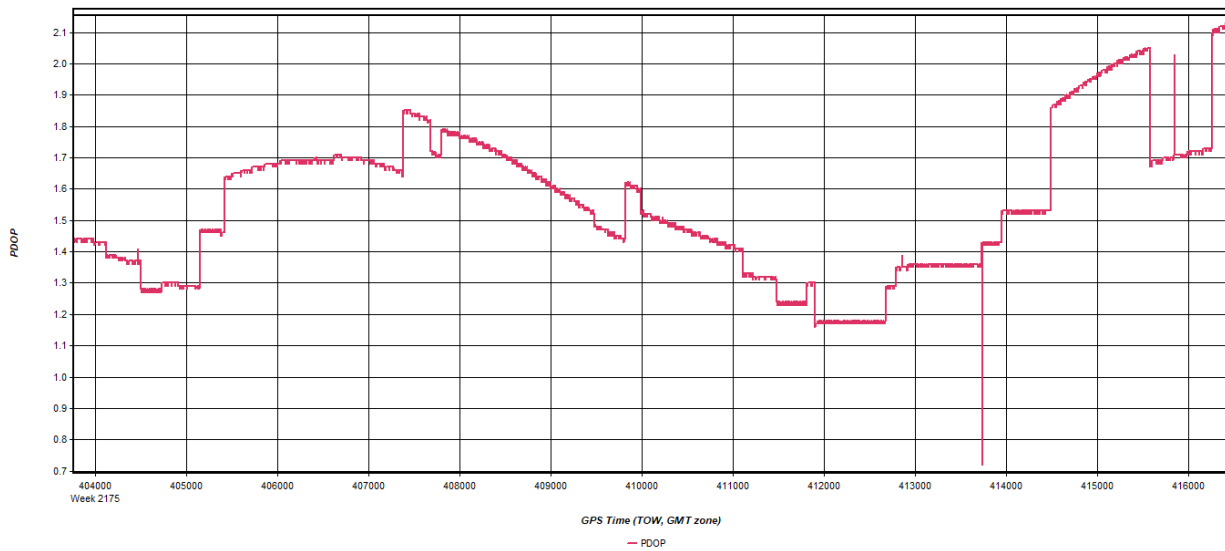
Process 20210916A_GnssImu by Unknown on 9/20/2021 at 13:11:16

Figure 4: 20210916A_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210916A_GnssImu by Unknown on 9/20/2021 at 13:11:16

Figure 5: 20210916A_GnssImu [Smoothed TC Combined] - PDOP Plot

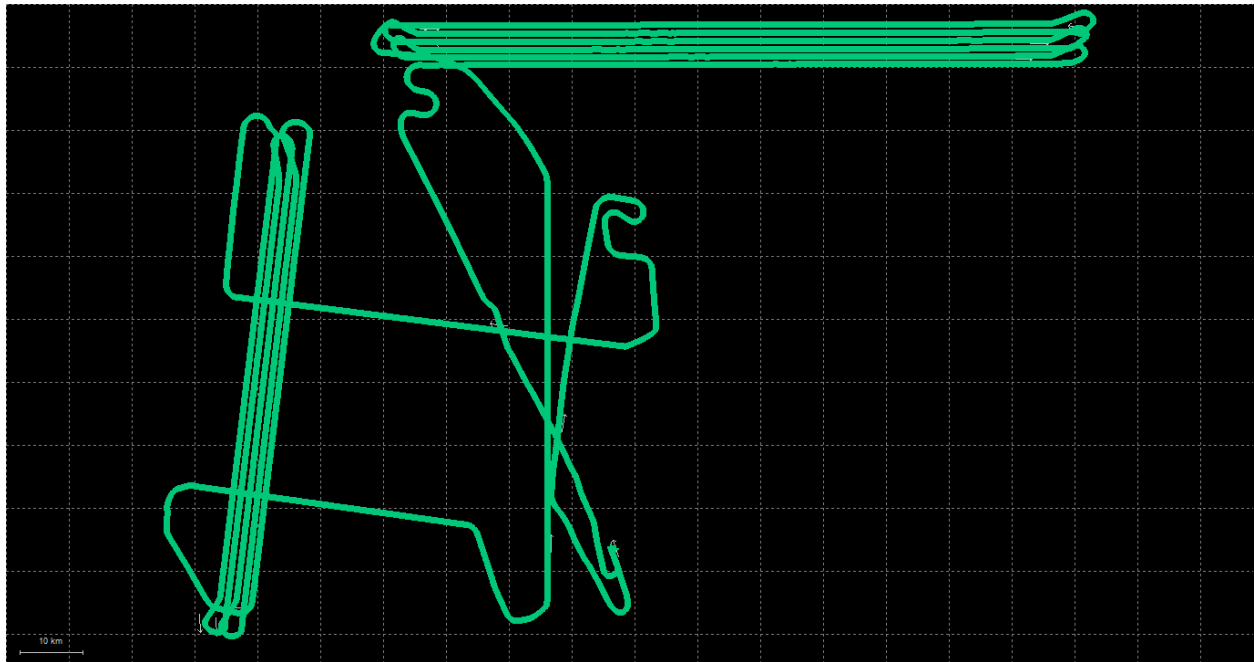


Process 20210916A_GnssImu by Unknown on 9/20/2021 at 13:11:16

Output Results for 20210917A_GnssImu

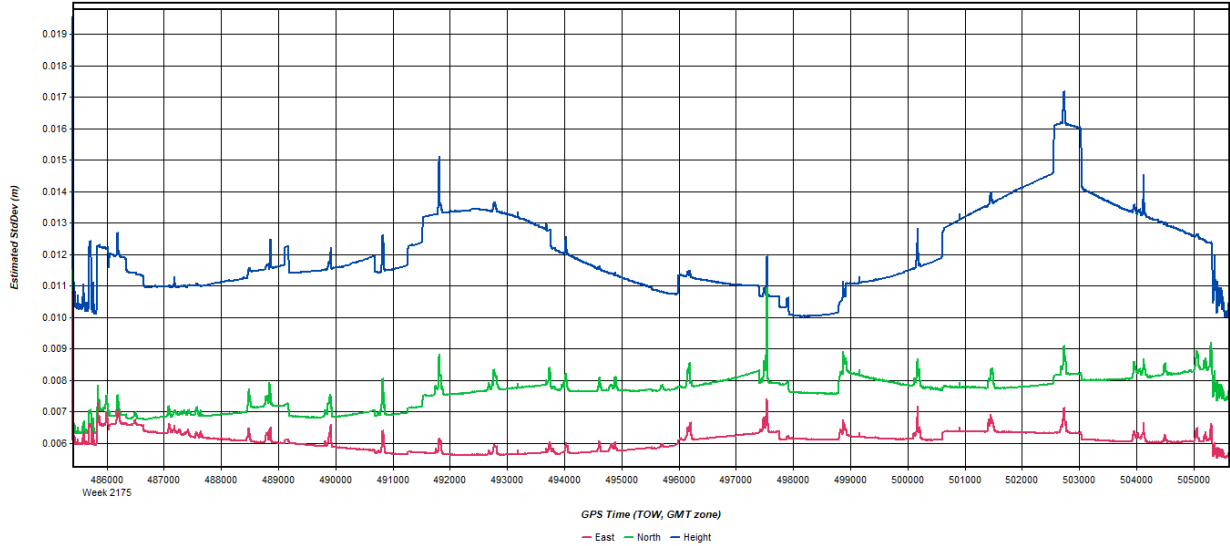
Inertial Explorer Version 8.90.2124
09/21/2021

Figure 1: Smoothed TC Combined - Map



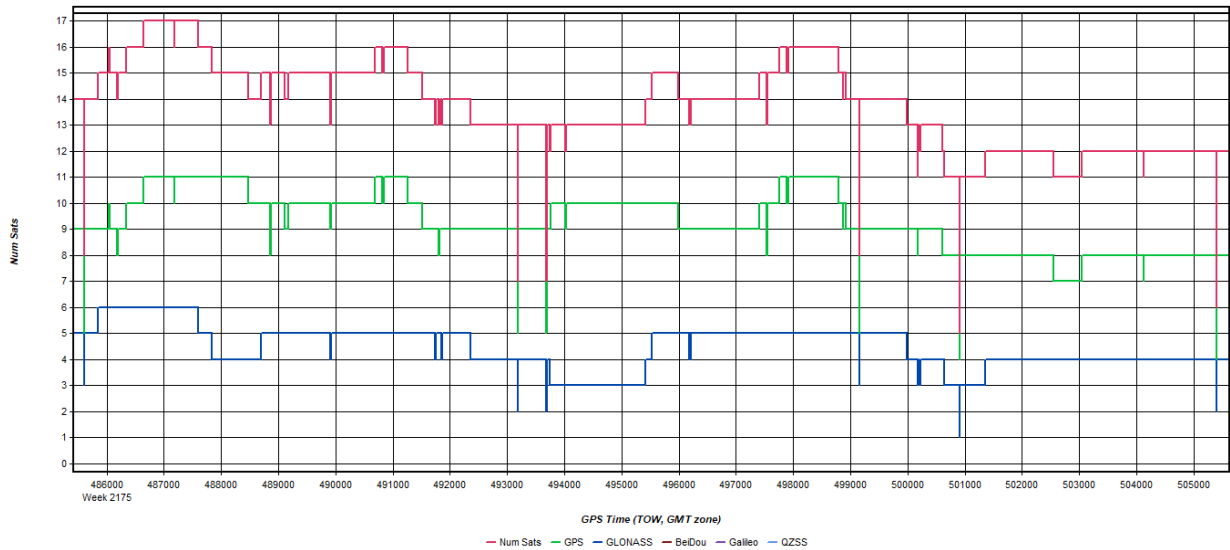
Process	20210917A_GnssImu	by Unknown	on 9/21/2021	at 12:15:32
---------	-------------------	------------	--------------	-------------

Figure 2: 20210917A_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



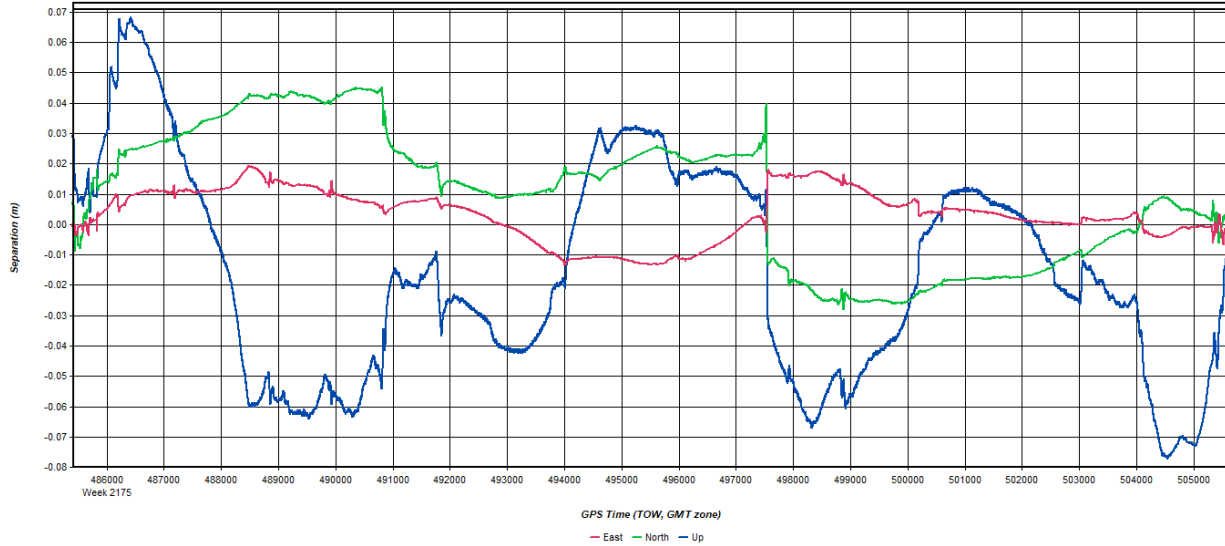
Process 20210917A_GnssImu by Unknown on 9/21/2021 at 12:15:32

Figure 3: 20210917A_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



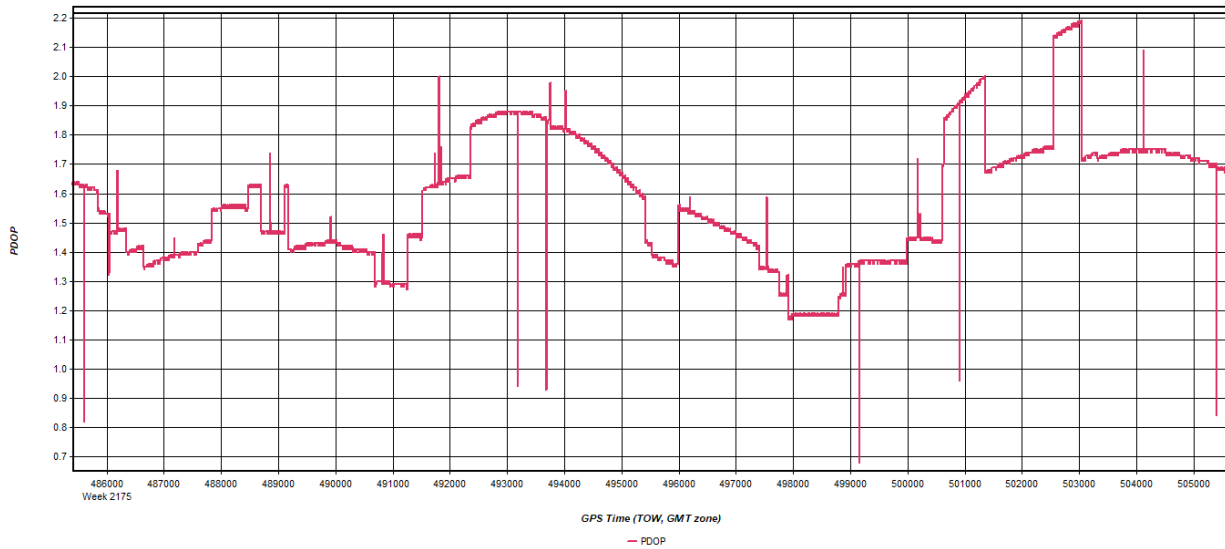
Process 20210917A_GnssImu by Unknown on 9/21/2021 at 12:15:32

Figure 4: 20210917A_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210917A_GnssImu by Unknown on 9/21/2021 at 12:15:32

Figure 5: 20210917A_GnssImu [Smoothed TC Combined] - PDOP Plot

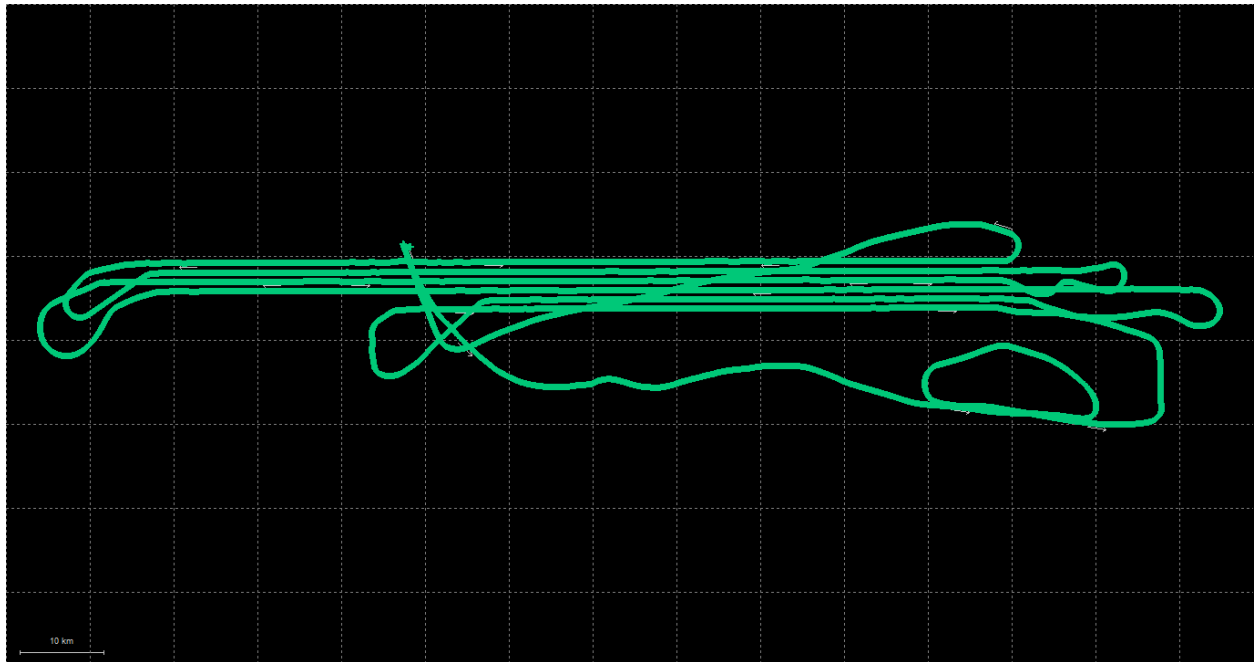


Process 20210917A_GnssImu by Unknown on 9/21/2021 at 12:15:32

Output Results for 20210920B_GnssImu

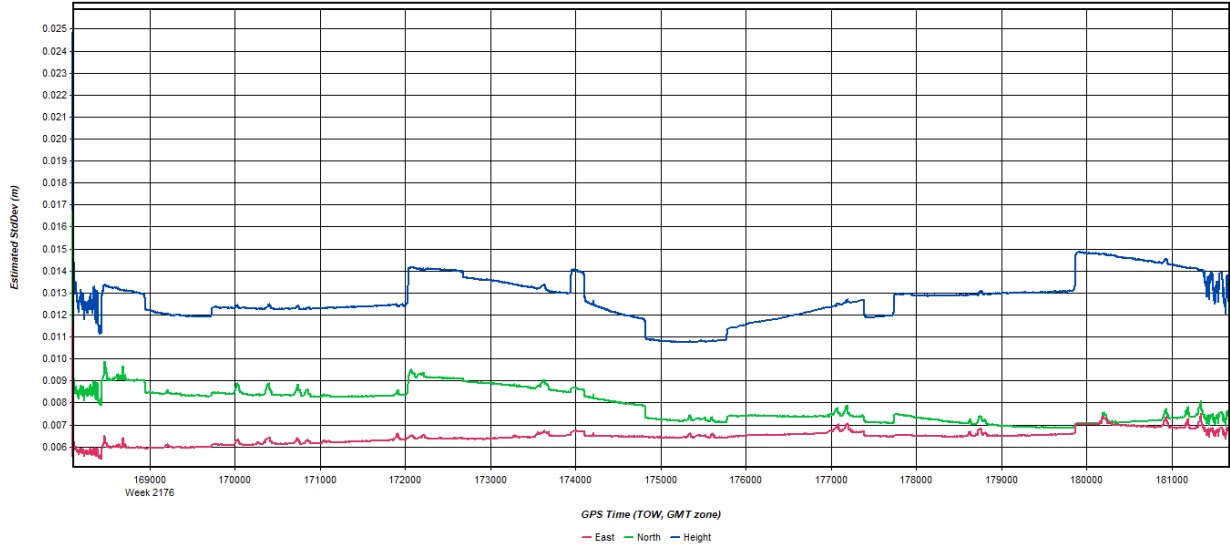
Inertial Explorer Version 8.90.2124
09/22/2021

Figure 1: Smoothed TC Combined - Map



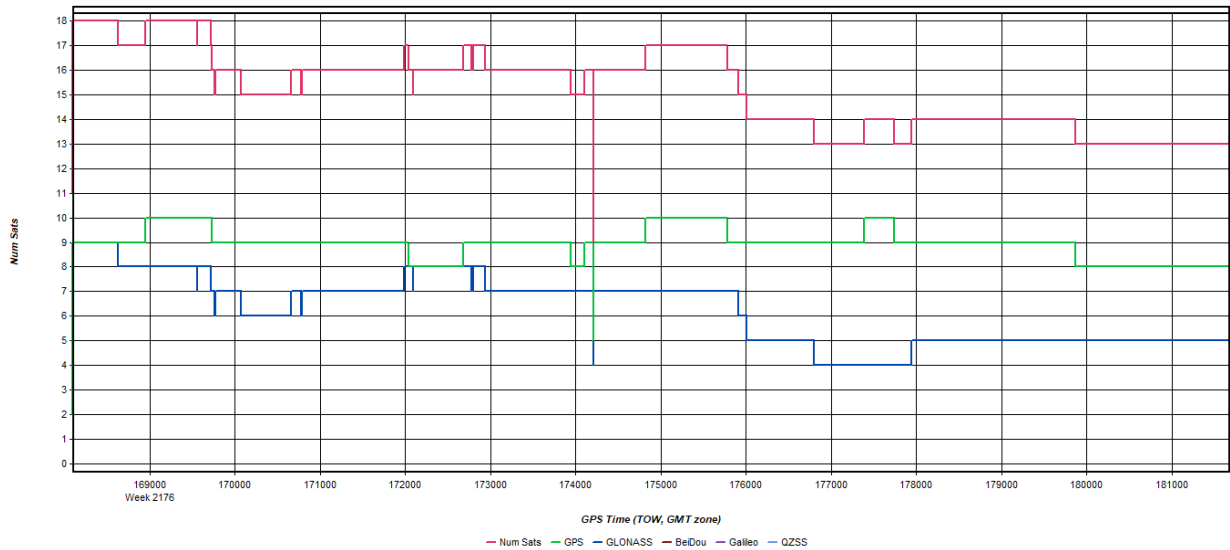
Process	20210920B_GnssImu	by Unknown	on 9/22/2021	at 13:09:47
---------	-------------------	------------	--------------	-------------

Figure 2: 20210920B_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



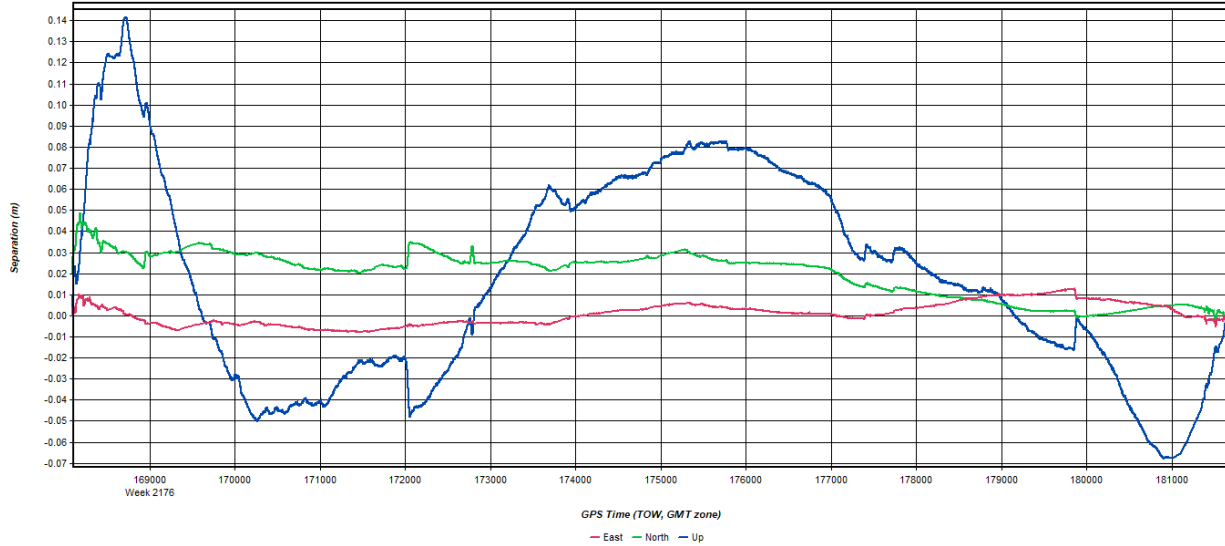
Process 20210920B_GnssImu by Unknown on 9/22/2021 at 13:09:47

Figure 3: 20210920B_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



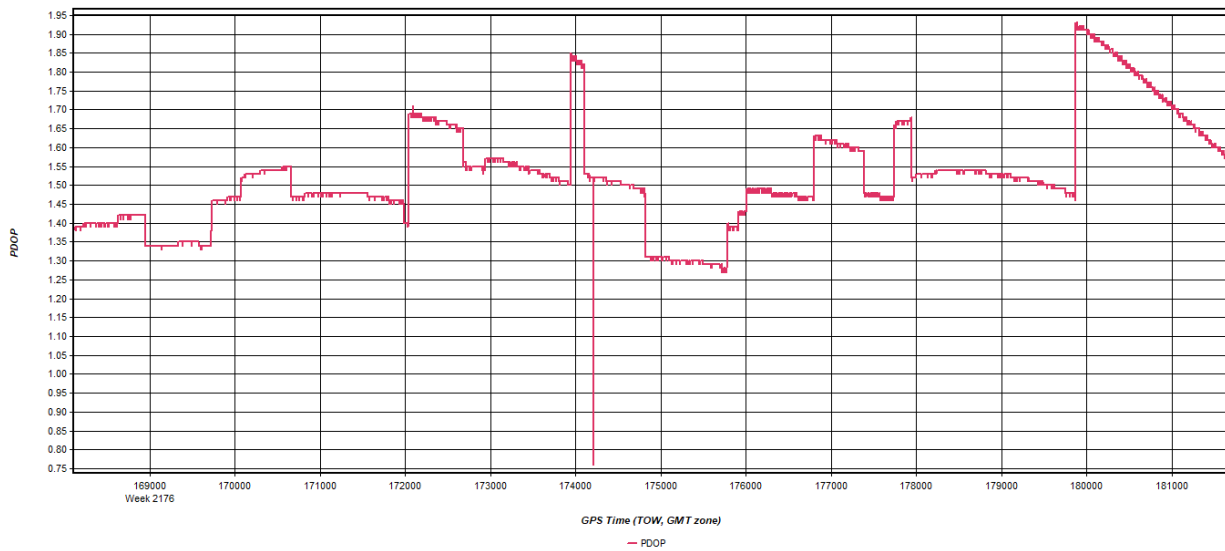
Process 20210920B_GnssImu by Unknown on 9/22/2021 at 13:09:47

Figure 4: 20210920B_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210920B_GnssImu by Unknown on 9/22/2021 at 13:09:47

Figure 5: 20210920B_GnssImu [Smoothed TC Combined] - PDOP Plot

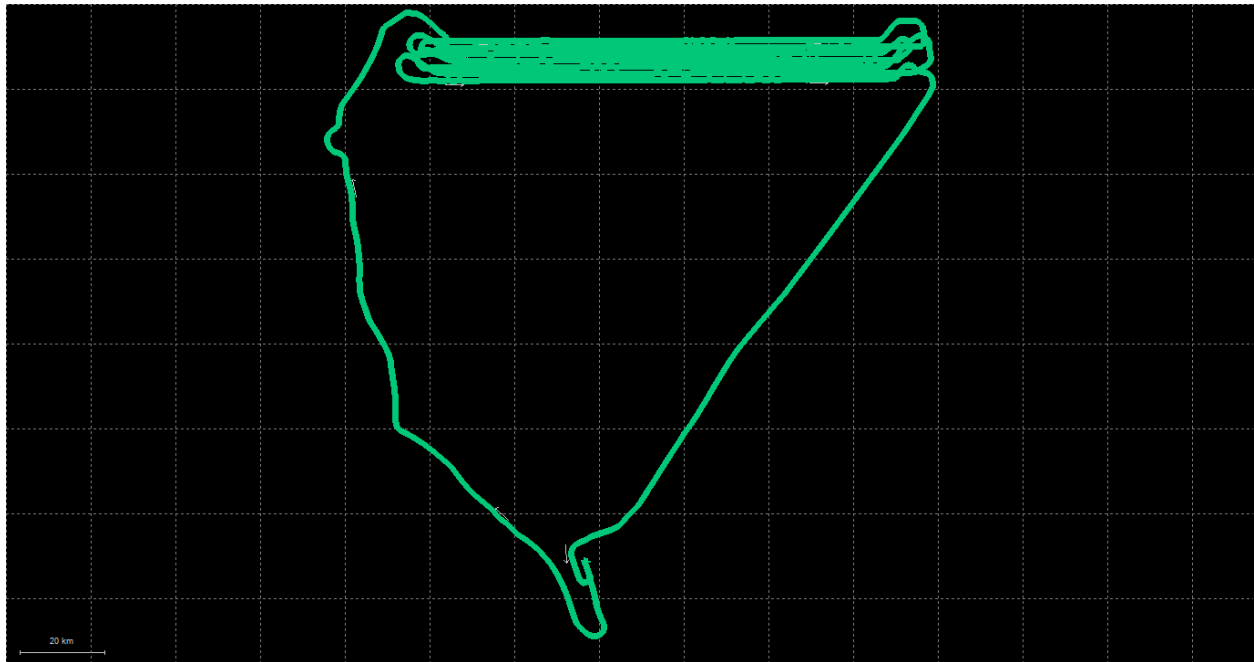


Process 20210920B_GnssImu by Unknown on 9/22/2021 at 13:09:47

Output Results for 20210921A_GnssImu

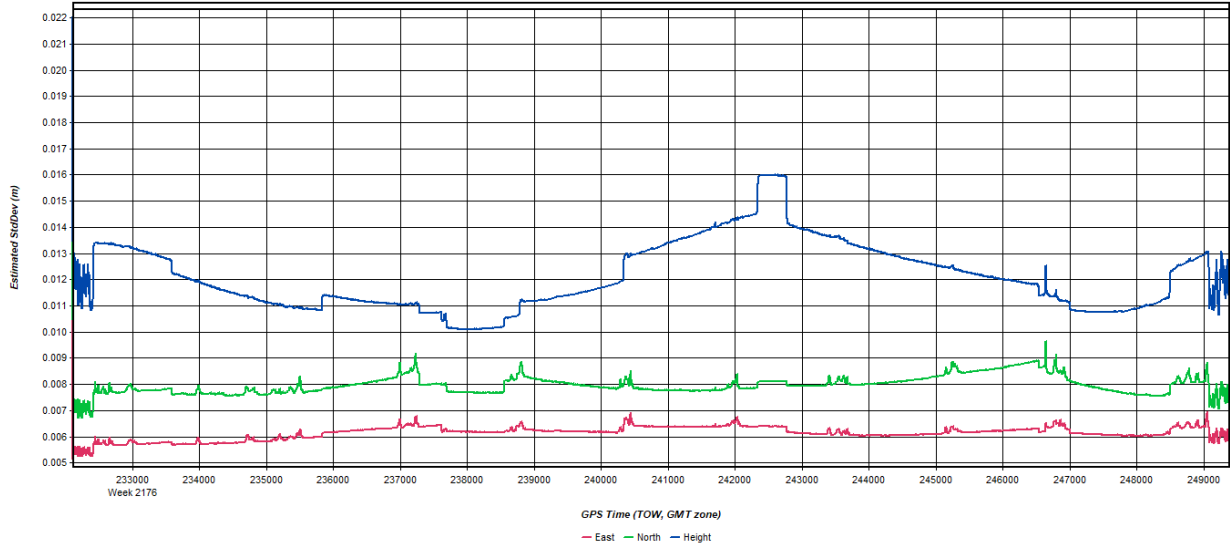
Inertial Explorer Version 8.90.2124
09/23/2021

Figure 1: Smoothed TC Combined - Map



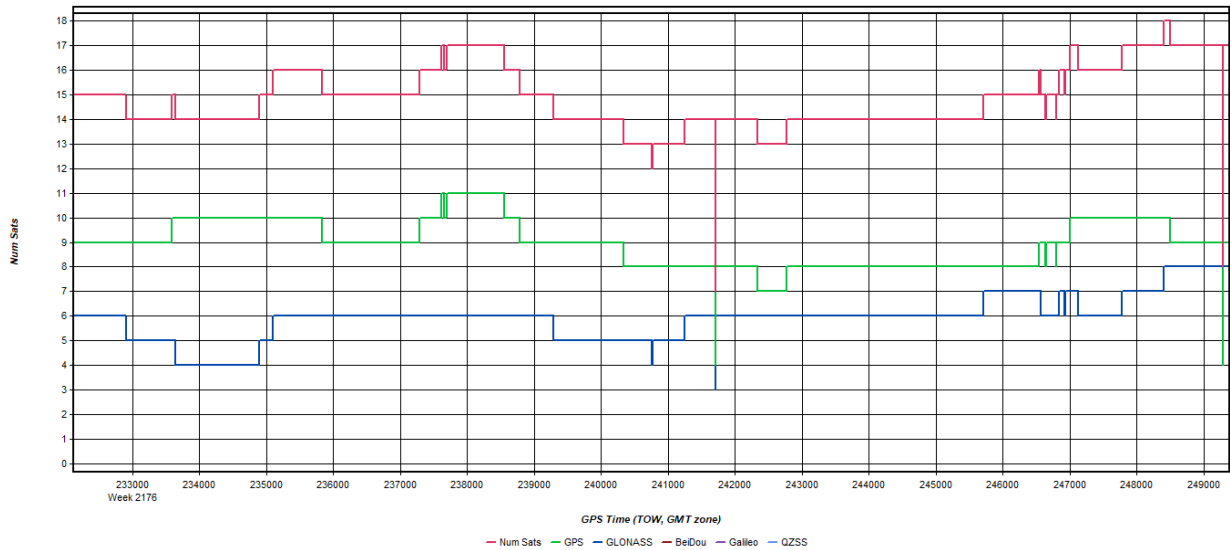
Process	20210921A_GnssImu	by Unknown	on 9/23/2021	at 12:33:48
---------	-------------------	------------	--------------	-------------

Figure 2: 20210921A_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



Process 20210921A_GnssImu by Unknown on 9/23/2021 at 12:33:48

Figure 3: 20210921A_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



Process 20210921A_GnssImu by Unknown on 9/23/2021 at 12:33:48

Figure 4: 20210921A_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210921A_GnssImu by Unknown on 9/23/2021 at 12:33:48

Figure 5: 20210921A_GnssImu [Smoothed TC Combined] - PDOP Plot

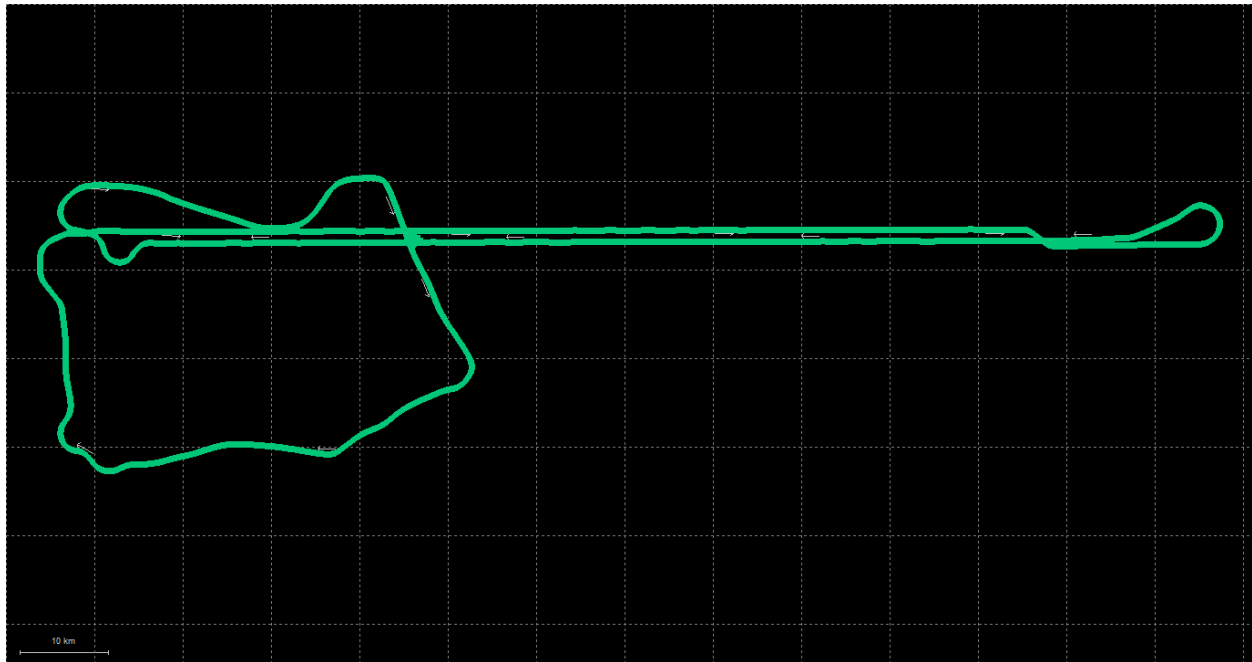


Process 20210921A_GnssImu by Unknown on 9/23/2021 at 12:33:48

Output Results for 20210921_GnssImu

Inertial Explorer Version 8.90.2124
09/23/2021

Figure 1: Smoothed TC Combined - Map



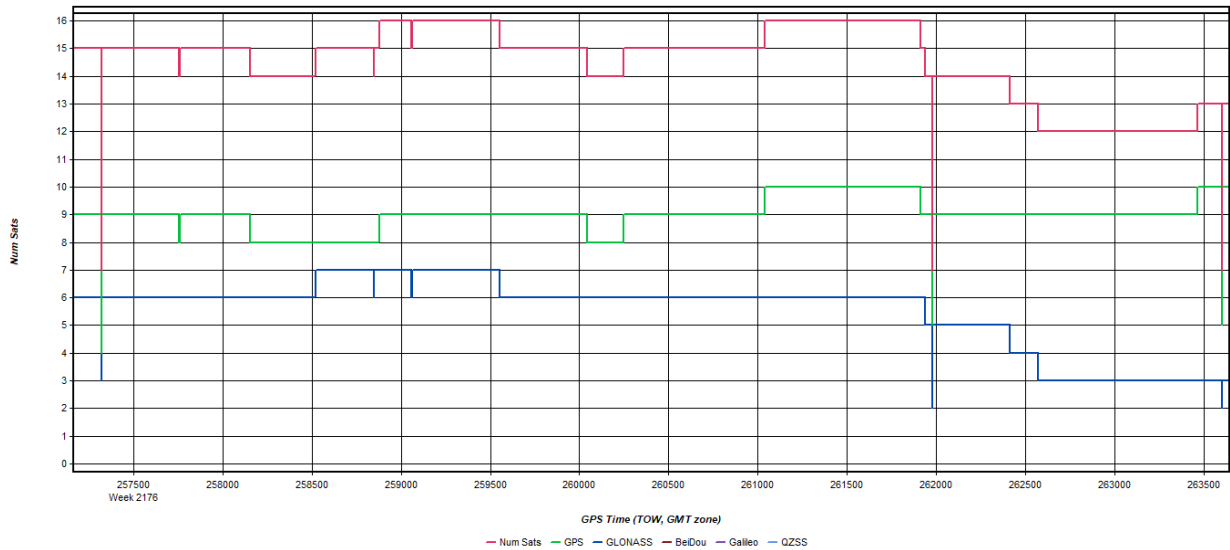
Process	20210921_GnssImu	by Unknown	on 9/23/2021	at 12:21:53
---------	------------------	------------	--------------	-------------

Figure 2: 20210921_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



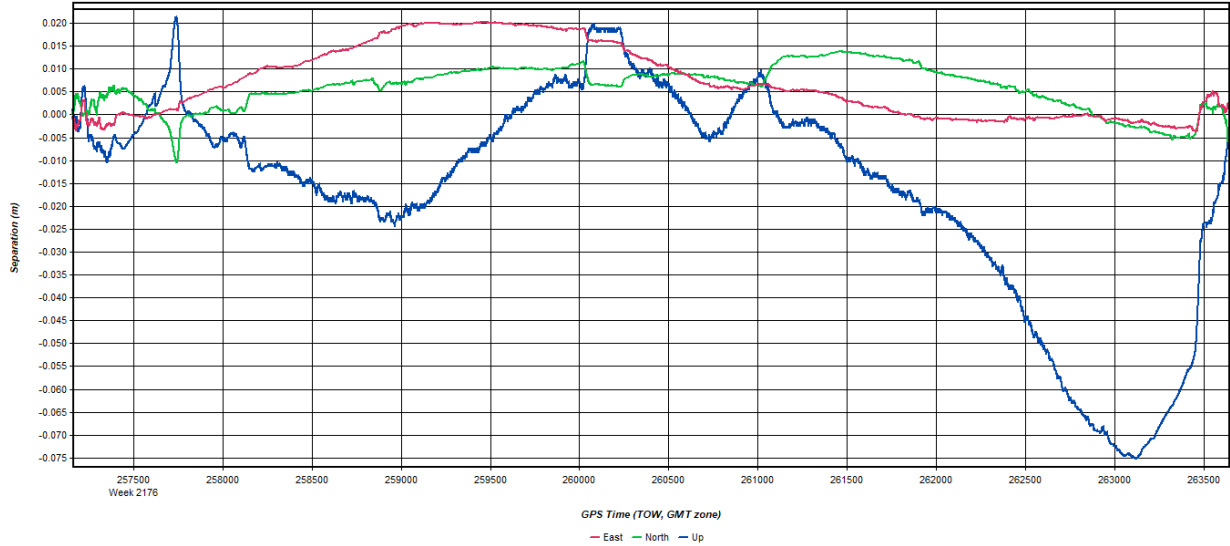
Process 20210921_GnssImu by Unknown on 9/23/2021 at 12:21:53

Figure 3: 20210921_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



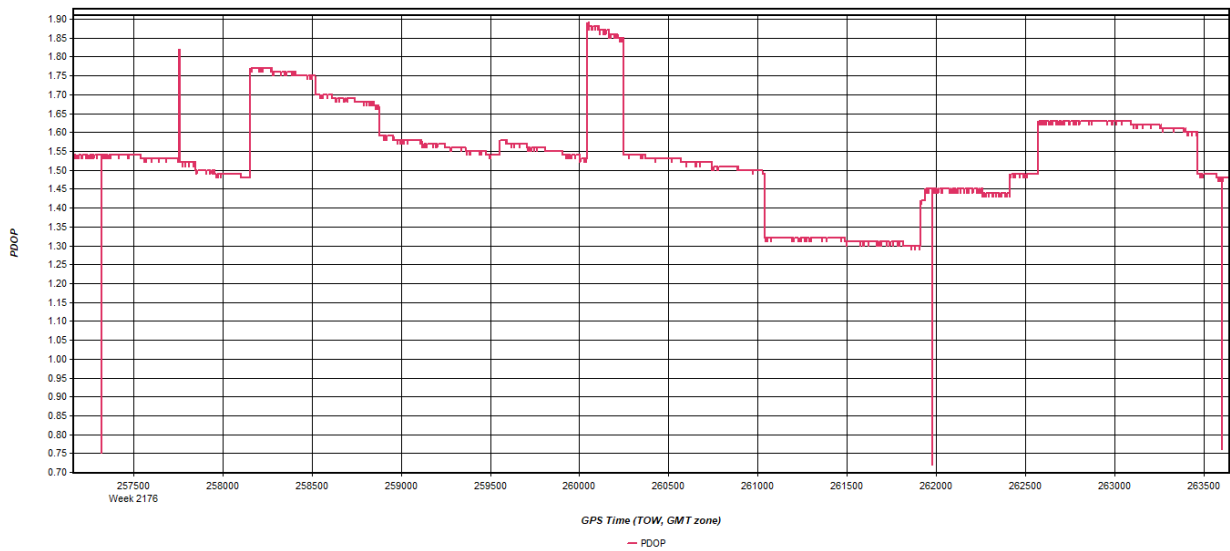
Process 20210921_GnssImu by Unknown on 9/23/2021 at 12:21:53

Figure 4: 20210921_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210921_GnssImu by Unknown on 9/23/2021 at 12:21:53

Figure 5: 20210921_GnssImu [Smoothed TC Combined] - PDOP Plot

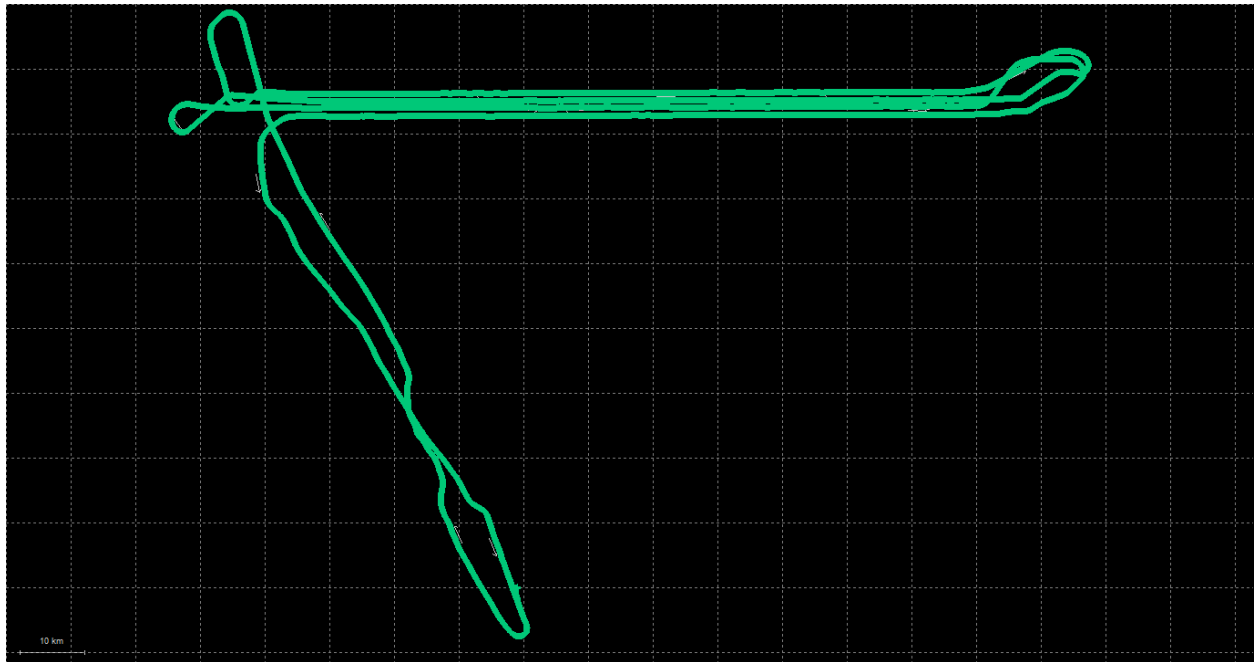


Process 20210921_GnssImu by Unknown on 9/23/2021 at 12:21:53

Output Results for 20210922A_Gnsslmu

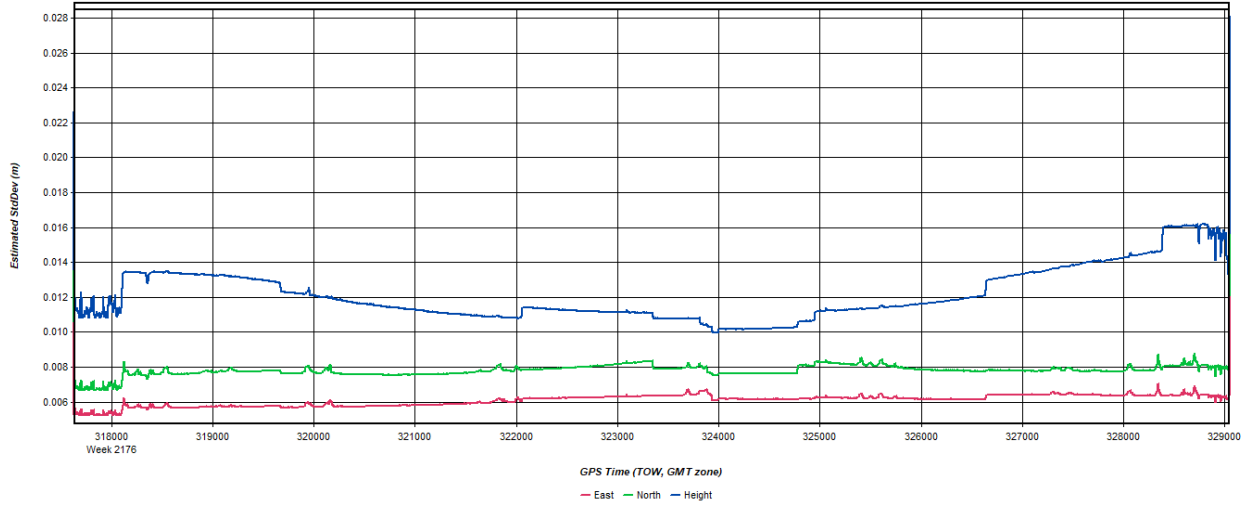
Inertial Explorer Version 8.90.2124
09/12/2022

Figure 1: Smoothed TC Combined - Map



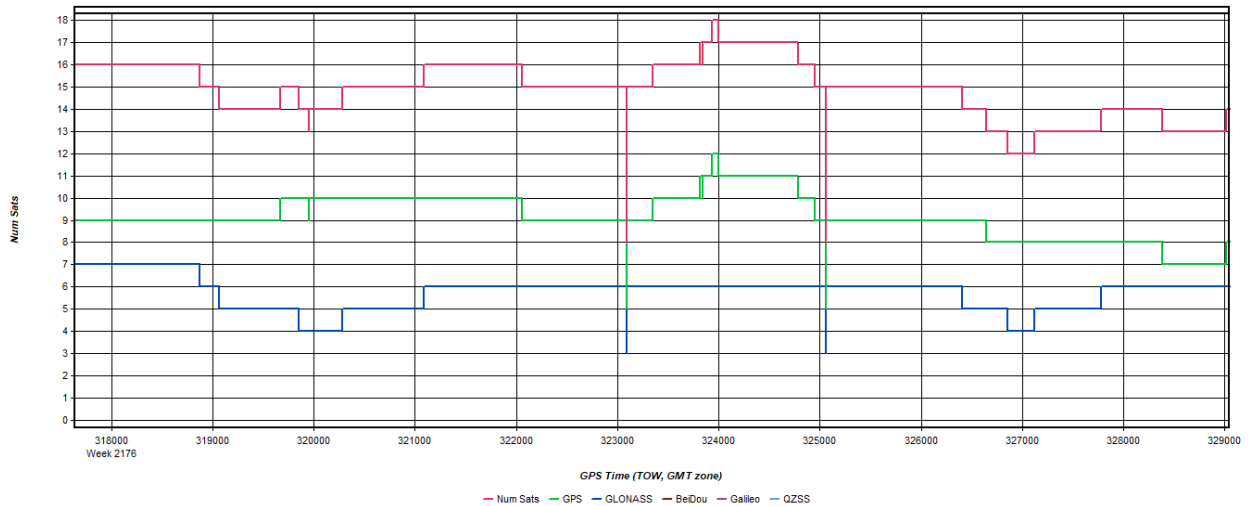
Process	20210922A_Gnsslmu	by Unknown	on 9/30/2021	at 07:04:43
---------	-------------------	------------	--------------	-------------

Figure 2: 20210922A_Gnsslm [Smoothed TC Combined] - Estimated Position Accuracy Plot



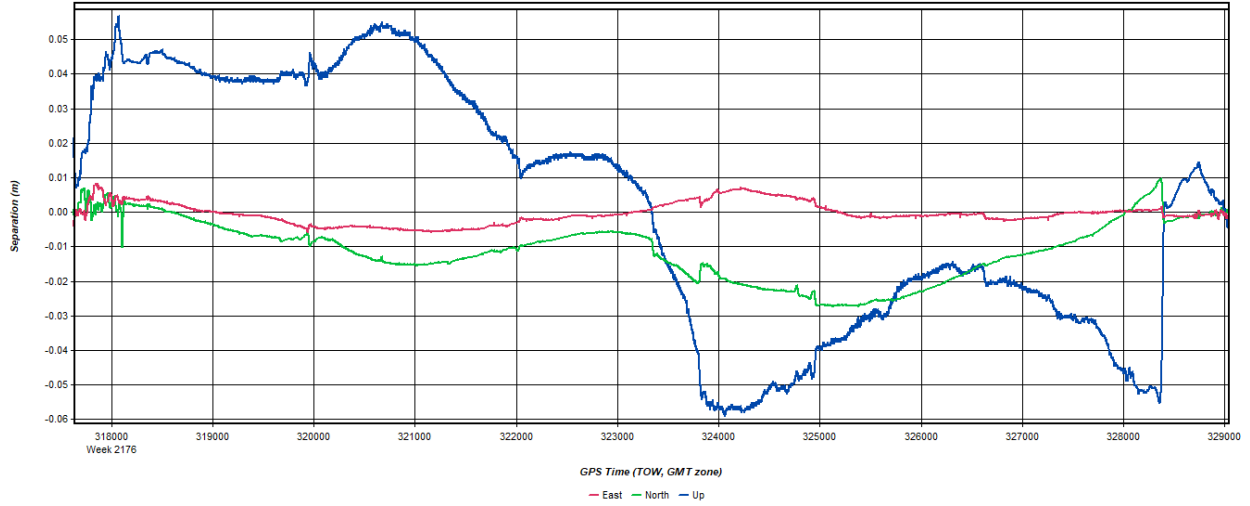
Process 20210922A_Gnsslm by Unknown on 9/30/2021 at 07:04:43

Figure 3: 20210922A_Gnsslm [Smoothed TC Combined] - Number of Satellites Line Plot



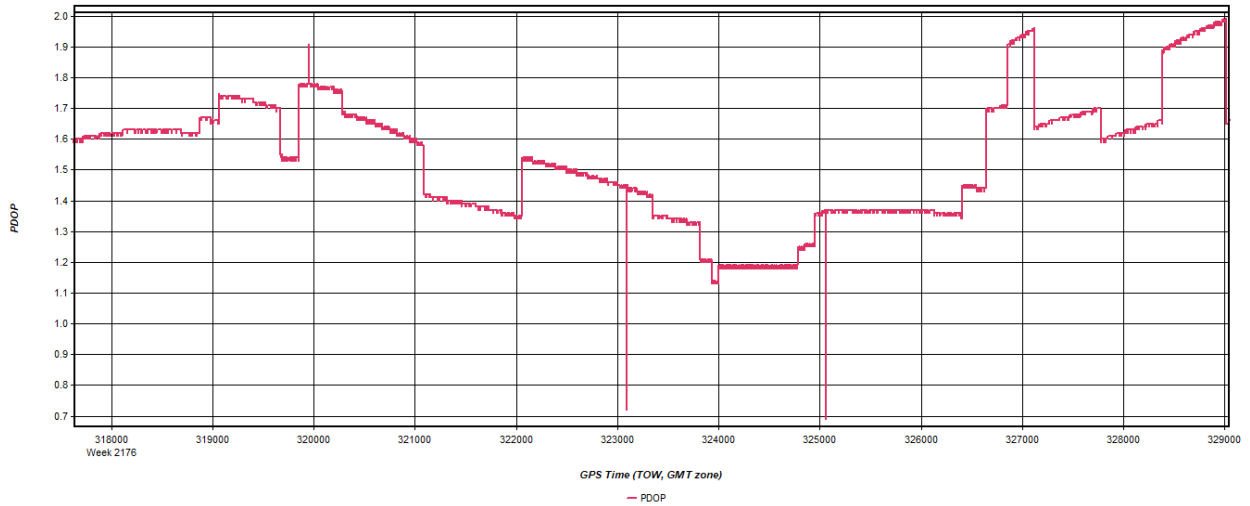
Process 20210922A_Gnsslm by Unknown on 9/30/2021 at 07:04:43

Figure 4: 20210922A_Gnsslm [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210922A_Gnsslm by Unknown on 9/30/2021 at 07:04:43

Figure 5: 20210922A_Gnsslm [Smoothed TC Combined] - PDOP Plot

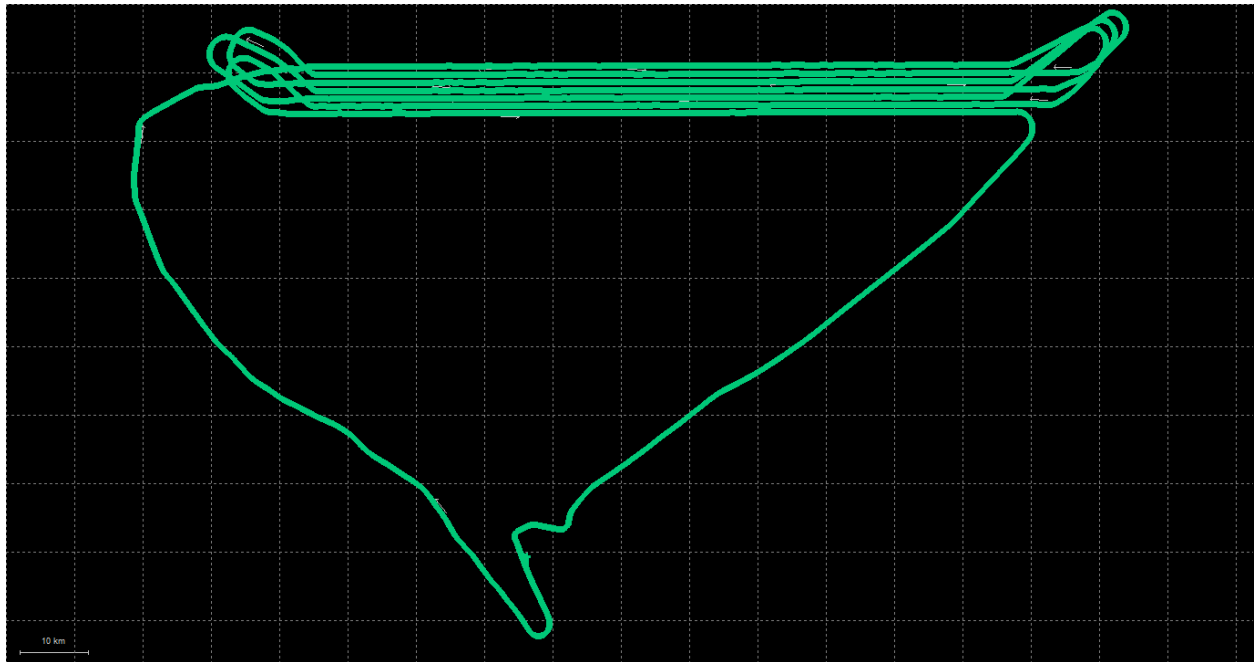


Process 20210922A_Gnsslm by Unknown on 9/30/2021 at 07:04:43

Output Results for 20210923A_Gnsslmu

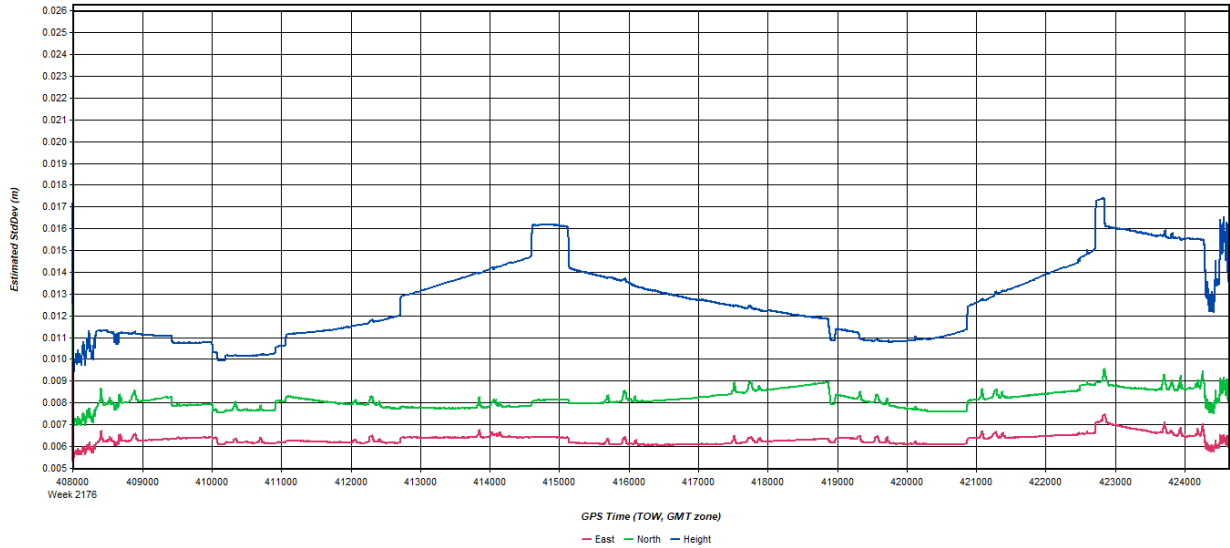
Inertial Explorer Version 8.90.2124
09/29/2021

Figure 1: Smoothed TC Combined - Map



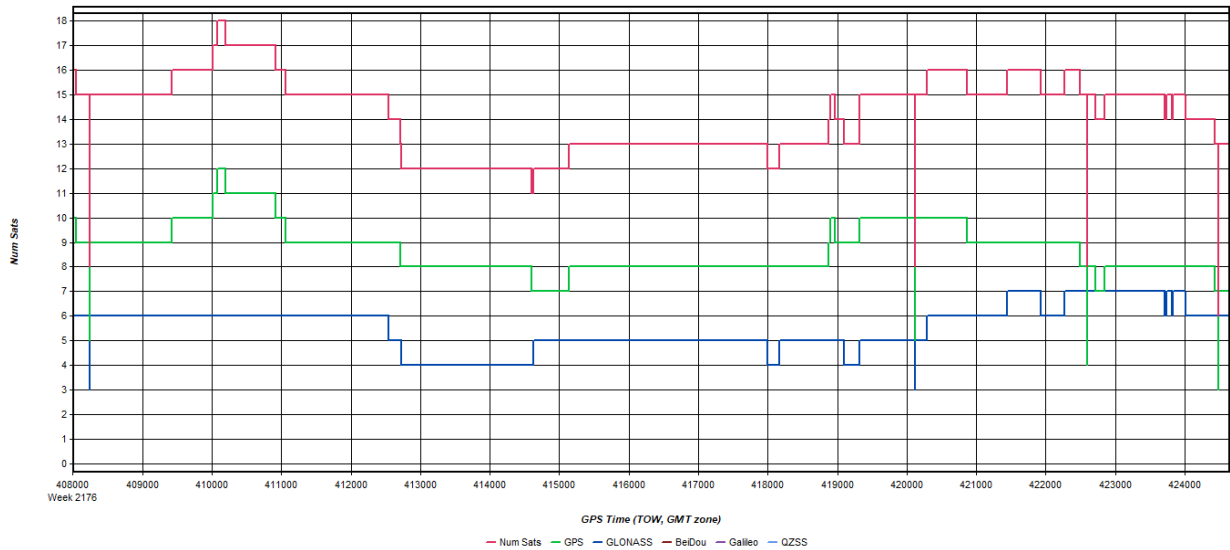
Process	20210923A_Gnsslmu	by Unknown	on 9/29/2021	at 07:05:21
---------	-------------------	------------	--------------	-------------

Figure 2: 20210923A_Gnsslm [Smoothed TC Combined] - Estimated Position Accuracy Plot



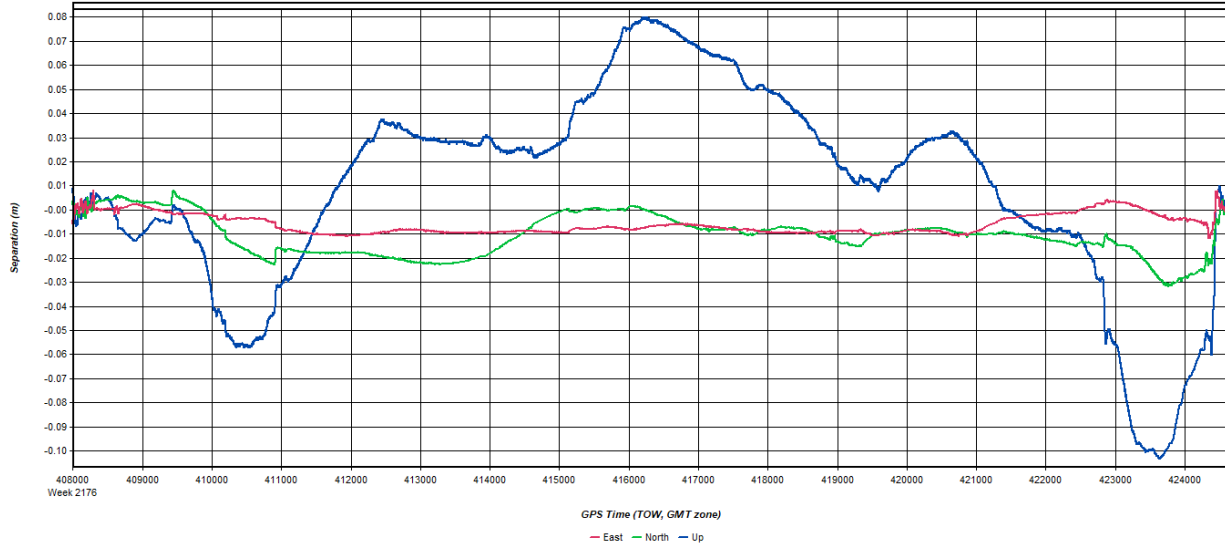
Process 20210923A_Gnsslm by Unknown on 9/29/2021 at 07:05:21

Figure 3: 20210923A_Gnsslm [Smoothed TC Combined] - Number of Satellites Line Plot



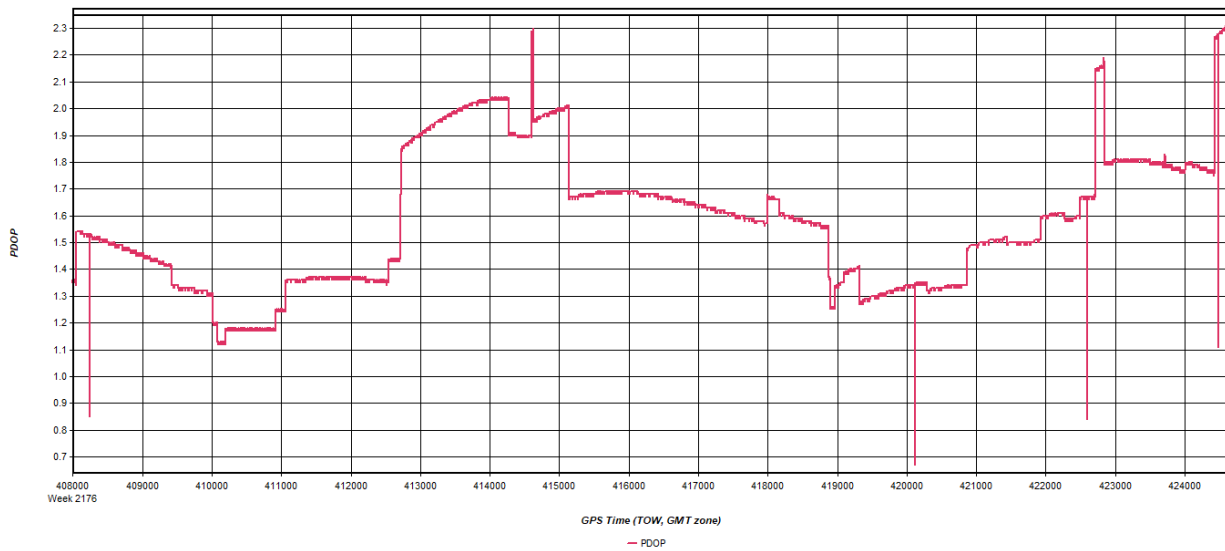
Process 20210923A_Gnsslm by Unknown on 9/29/2021 at 07:05:21

Figure 4: 20210923A_Gnsslm [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210923A_Gnsslm by Unknown on 9/29/2021 at 07:05:21

Figure 5: 20210923A_Gnsslm [Smoothed TC Combined] - PDOP Plot

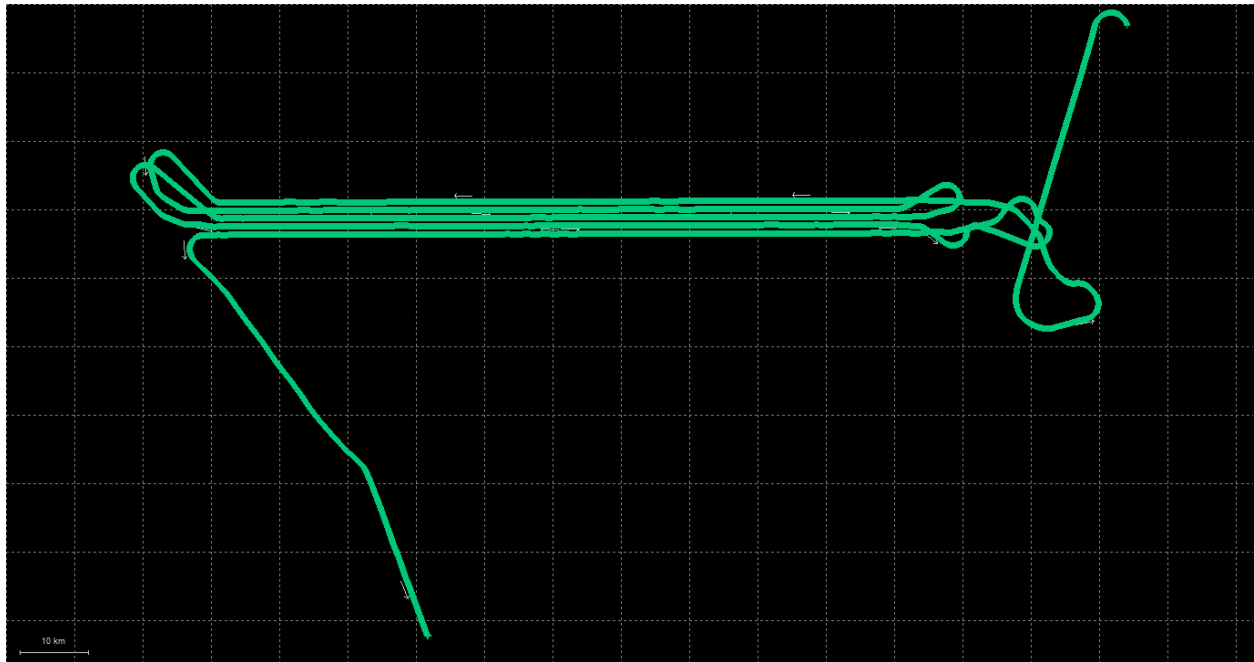


Process 20210923A_Gnsslm by Unknown on 9/29/2021 at 07:05:21

Output Results for 20210924A_GnssImu

Inertial Explorer Version 8.90.2124
10/04/2021

Figure 1: Smoothed TC Combined - Map



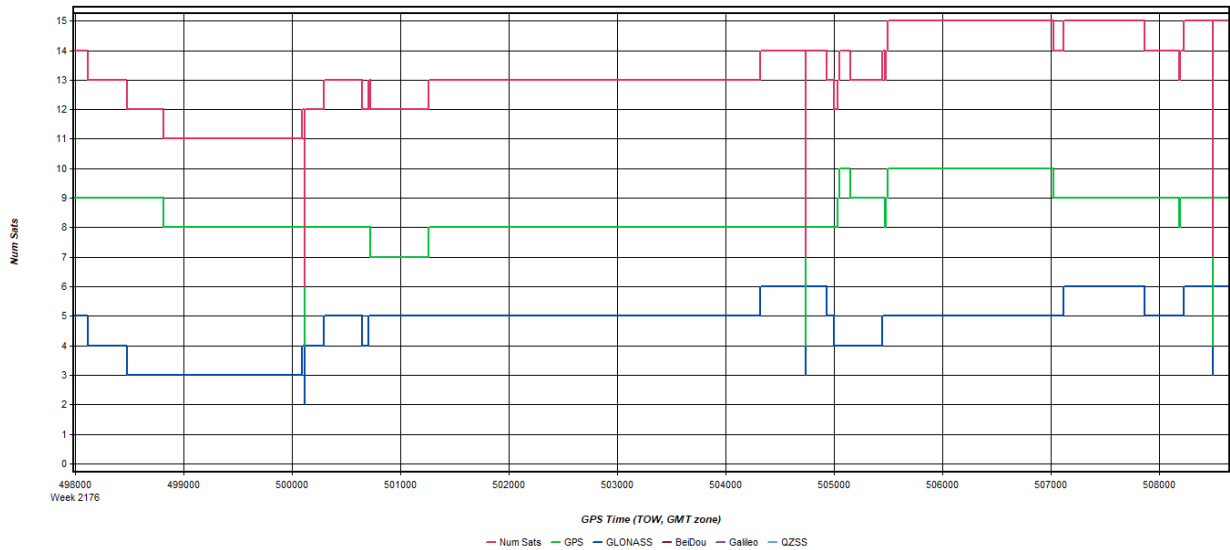
Process	20210924A_GnssImu	by Unknown	on 10/4/2021	at 12:25:01
---------	-------------------	------------	--------------	-------------

Figure 2: 20210924A_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



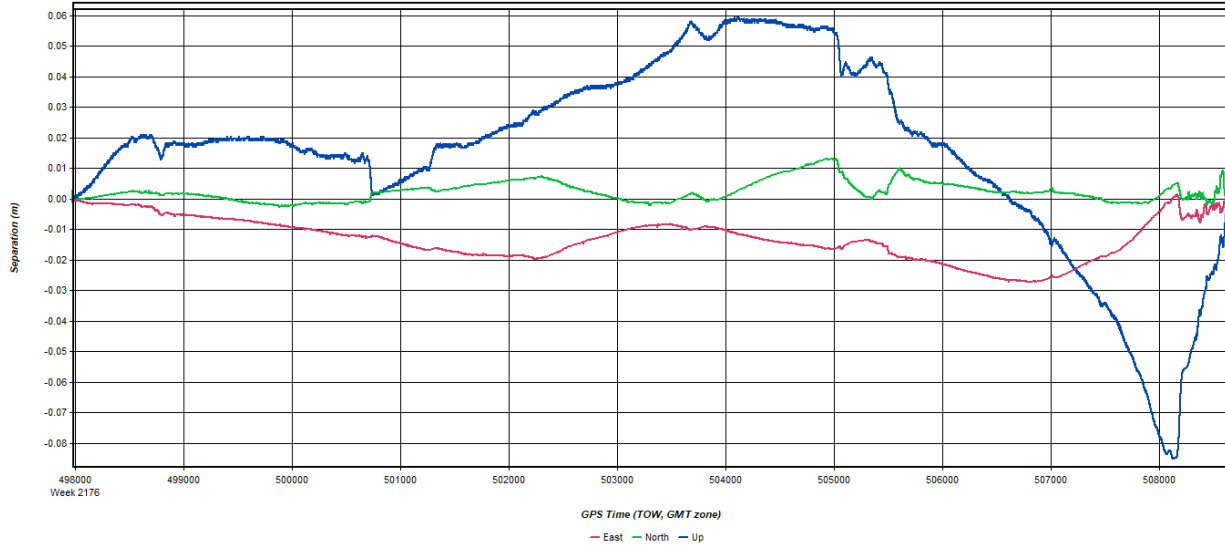
Process 20210924A_GnssImu by Unknown on 10/4/2021 at 12:25:01

Figure 3: 20210924A_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



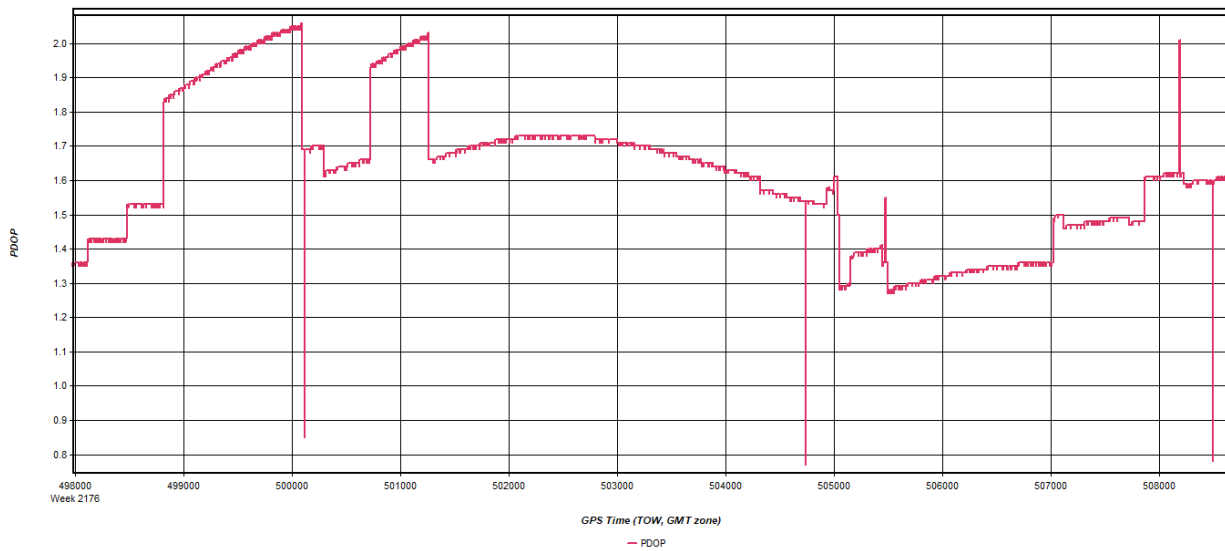
Process 20210924A_GnssImu by Unknown on 10/4/2021 at 12:25:01

Figure 4: 20210924A_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210924A_GnssImu by Unknown on 10/4/2021 at 12:25:01

Figure 5: 20210924A_GnssImu [Smoothed TC Combined] - PDOP Plot

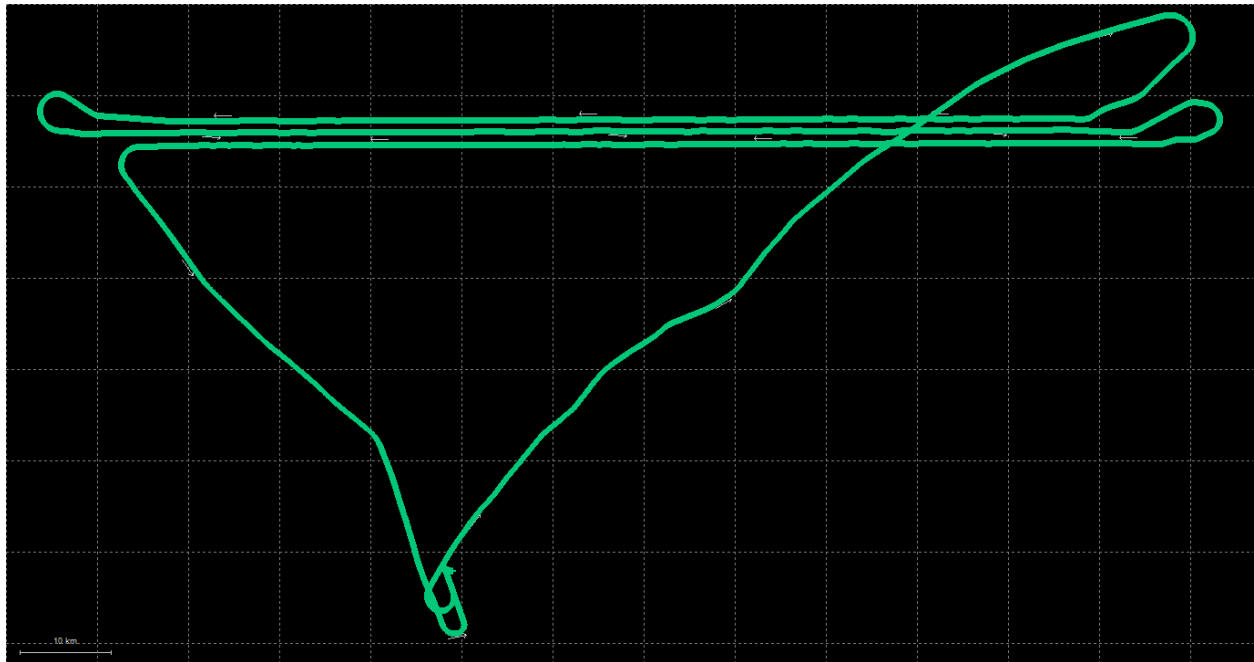


Process 20210924A_GnssImu by Unknown on 10/4/2021 at 12:25:01

Output Results for 20210924C_GnssImu

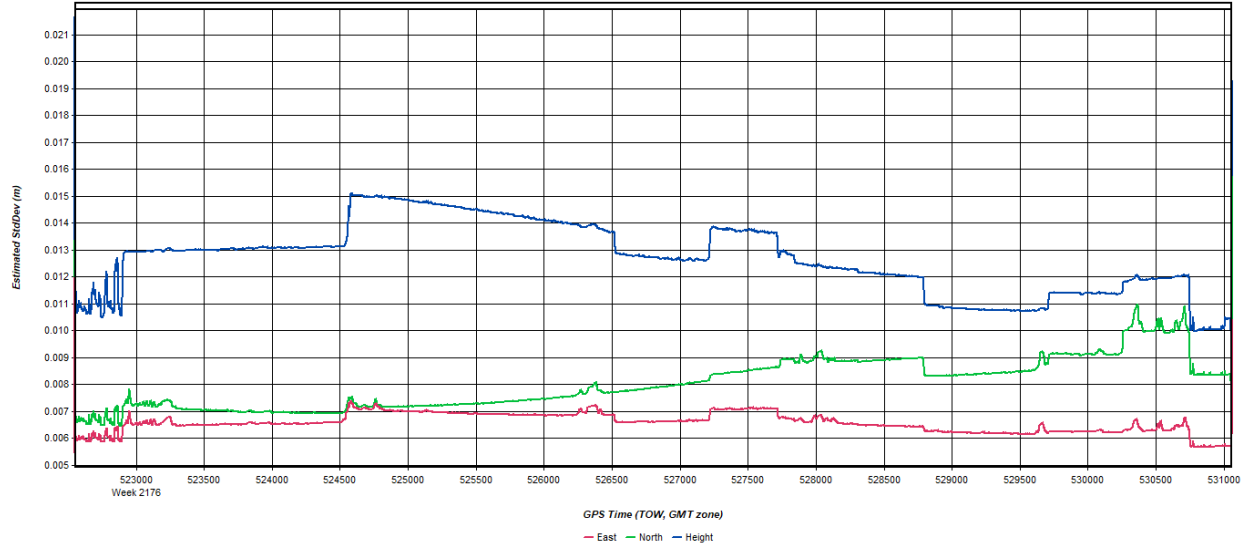
Inertial Explorer Version 8.90.2124
10/04/2021

Figure 1: Smoothed TC Combined - Map



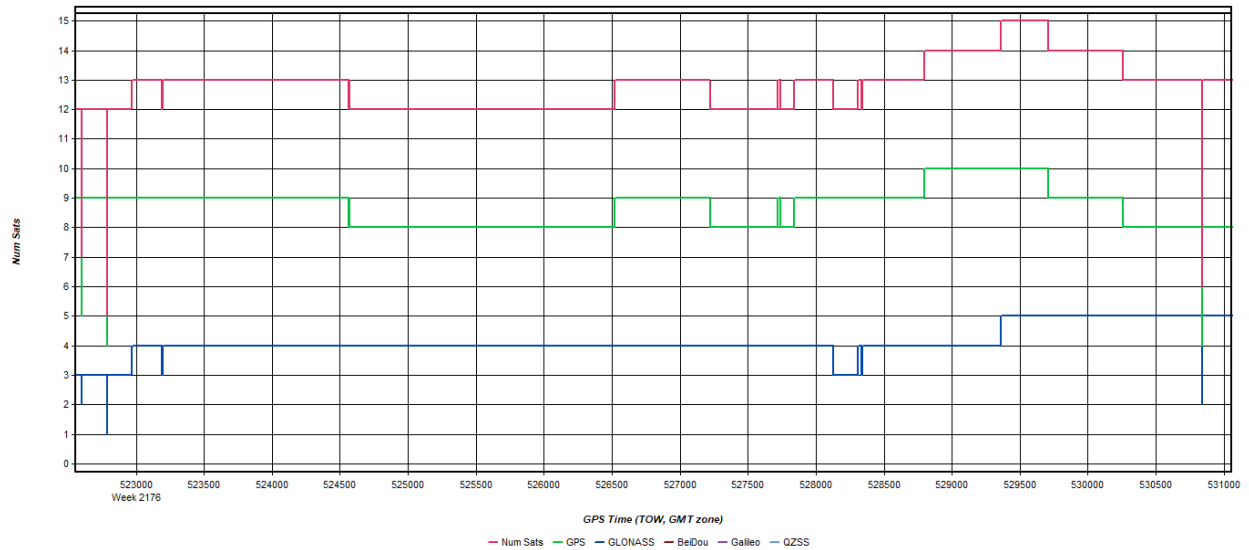
Process	20210924C_GnssImu	by Unknown	on 10/4/2021	at 12:40:27
---------	-------------------	------------	--------------	-------------

Figure 2: 20210924C_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



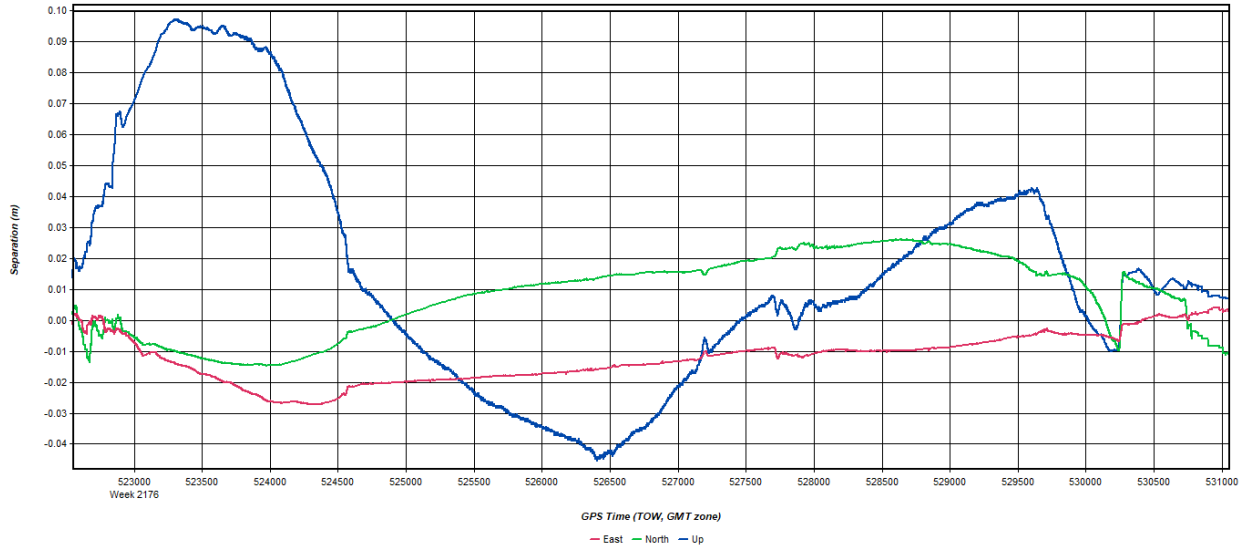
Process 20210924C_GnssImu by Unknown on 10/4/2021 at 12:40:27

Figure 3: 20210924C_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



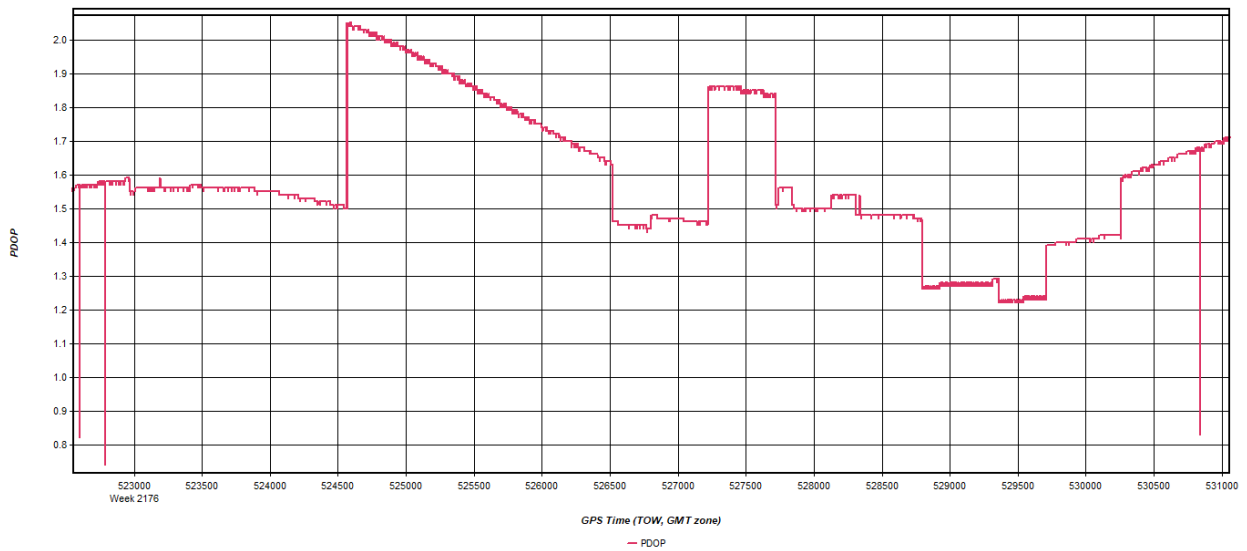
Process 20210924C_GnssImu by Unknown on 10/4/2021 at 12:40:27

Figure 4: 20210924C_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210924C_GnssImu by Unknown on 10/4/2021 at 12:40:27

Figure 5: 20210924C_GnssImu [Smoothed TC Combined] - PDOP Plot

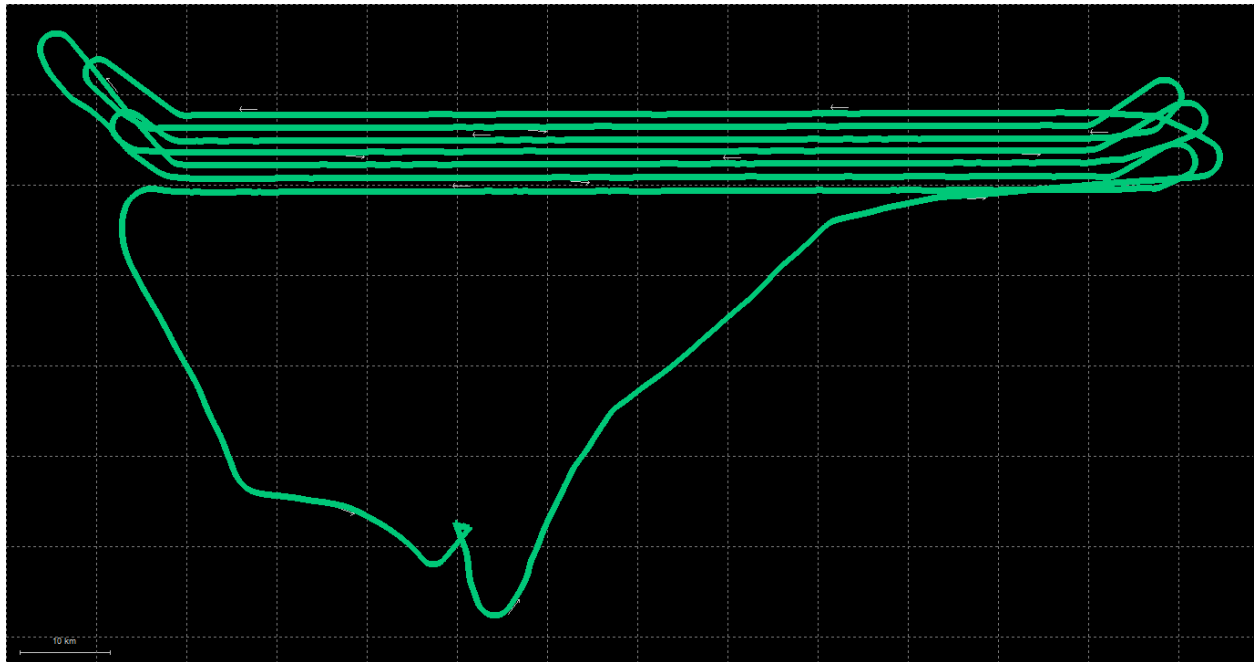


Process 20210924C_GnssImu by Unknown on 10/4/2021 at 12:40:27

Output Results for 20210925A_GnssImu

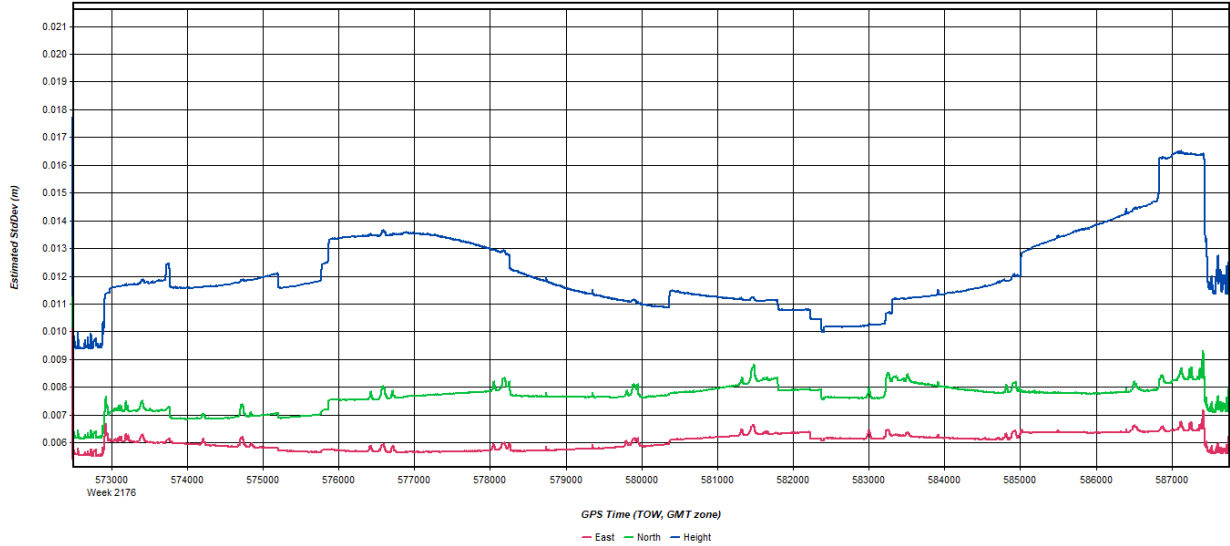
Inertial Explorer Version 8.90.2124
10/04/2021

Figure 1: Smoothed TC Combined - Map



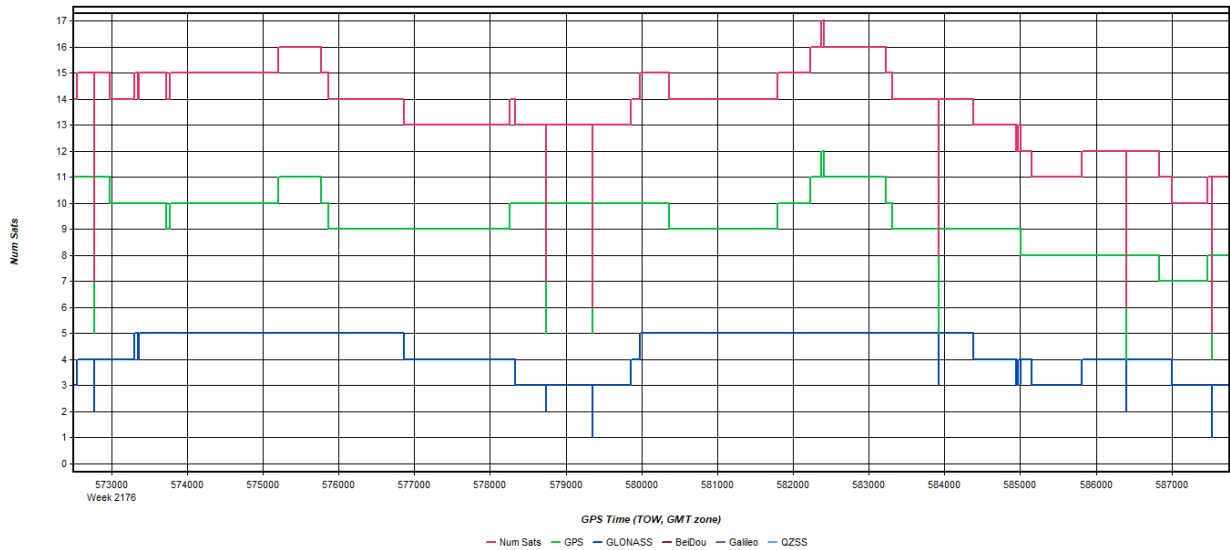
Process	20210925A_GnssImu	by Unknown	on 10/4/2021	at 13:00:44
---------	-------------------	------------	--------------	-------------

Figure 2: 20210925A_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



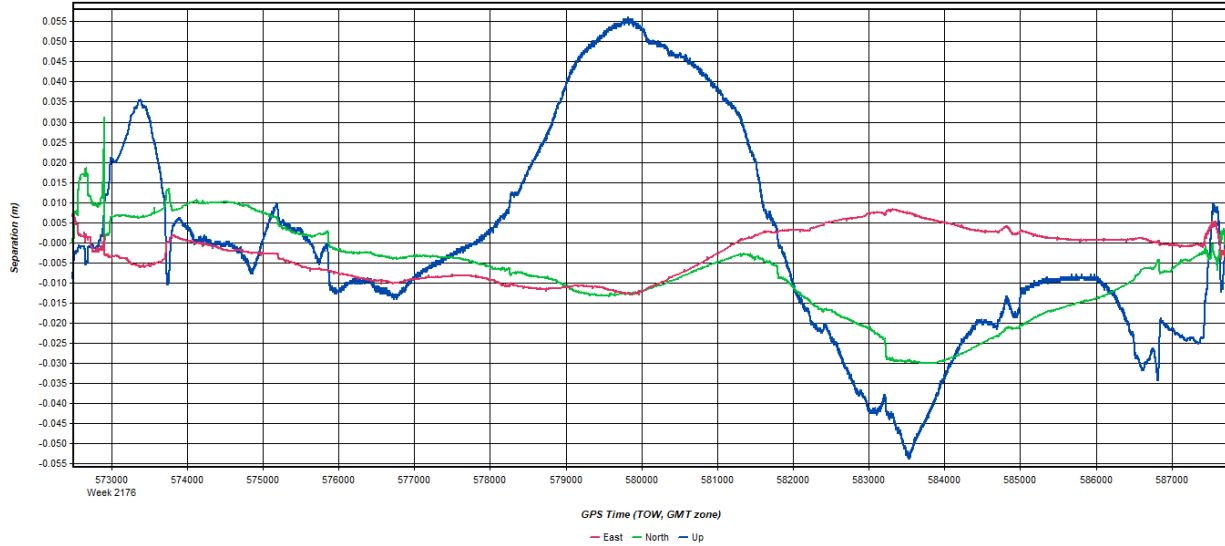
Process 20210925A_GnssImu by Unknown on 10/4/2021 at 13:00:44

Figure 3: 20210925A_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



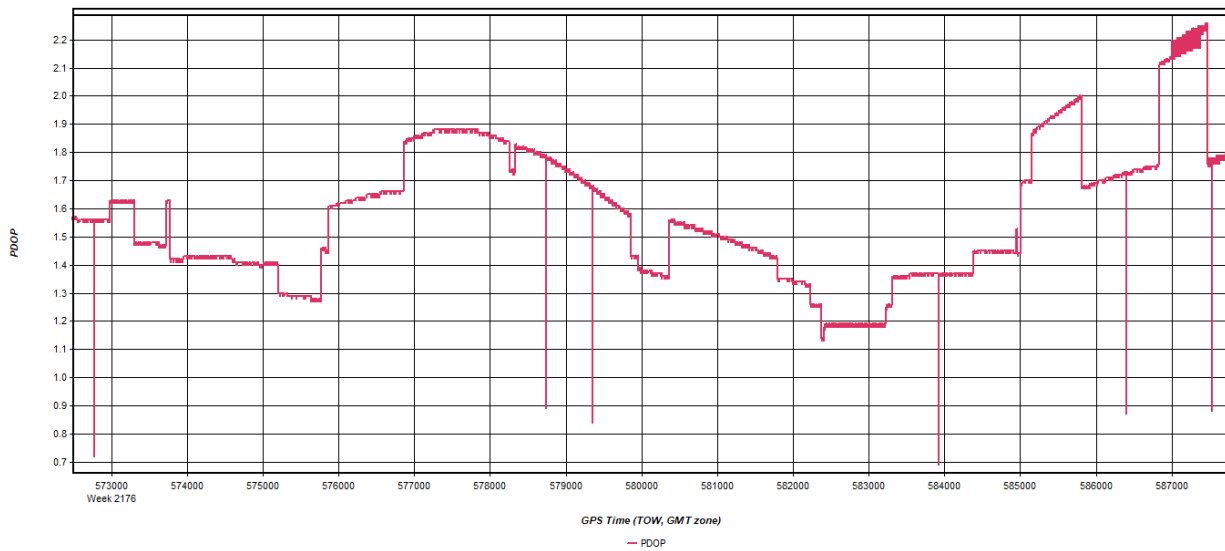
Process 20210925A_GnssImu by Unknown on 10/4/2021 at 13:00:44

Figure 4: 20210925A_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210925A_GnssImu by Unknown on 10/4/2021 at 13:00:44

Figure 5: 20210925A_GnssImu [Smoothed TC Combined] - PDOP Plot

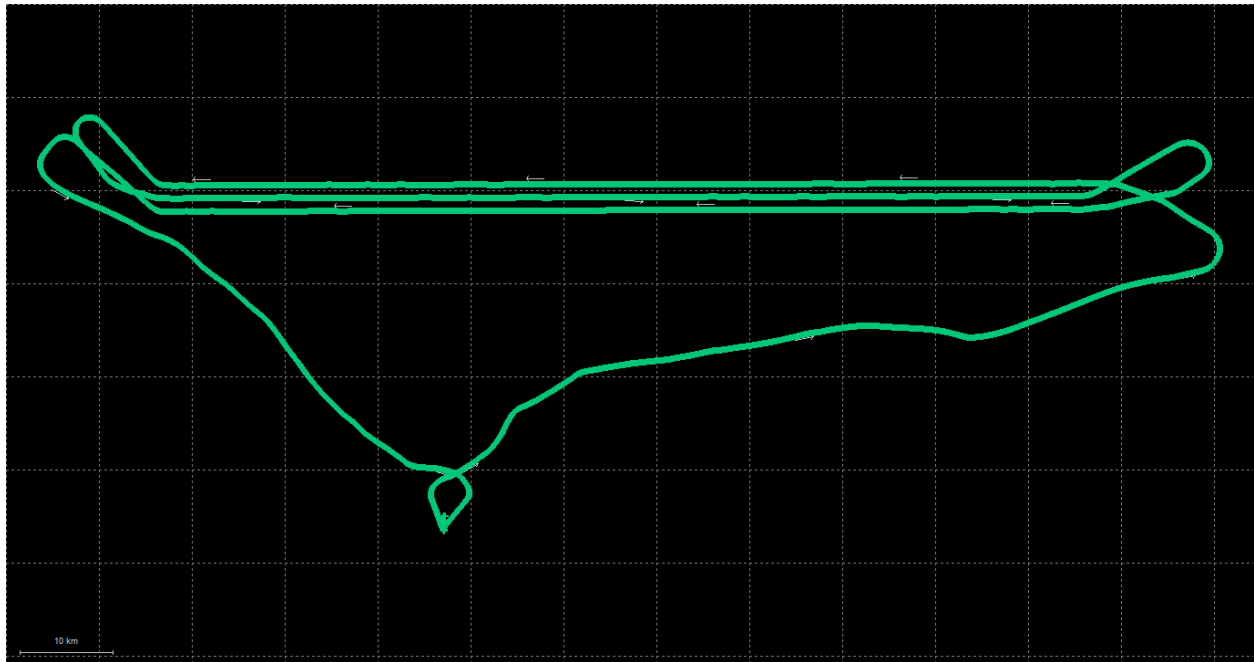


Process 20210925A_GnssImu by Unknown on 10/4/2021 at 13:00:44

Output Results for 20210925B_GnssImu

Inertial Explorer Version 8.90.2124
10/04/2021

Figure 1: Smoothed TC Combined - Map



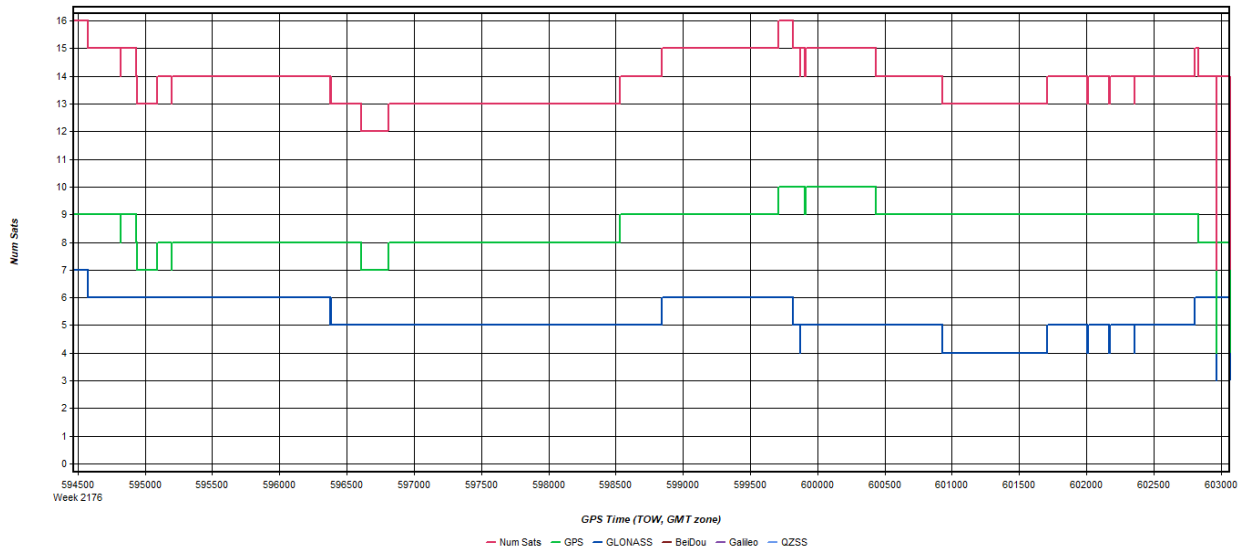
Process	20210925B_GnssImu	by Unknown	on 10/4/2021	at 13:04:45
---------	-------------------	------------	--------------	-------------

Figure 2: 20210925B_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



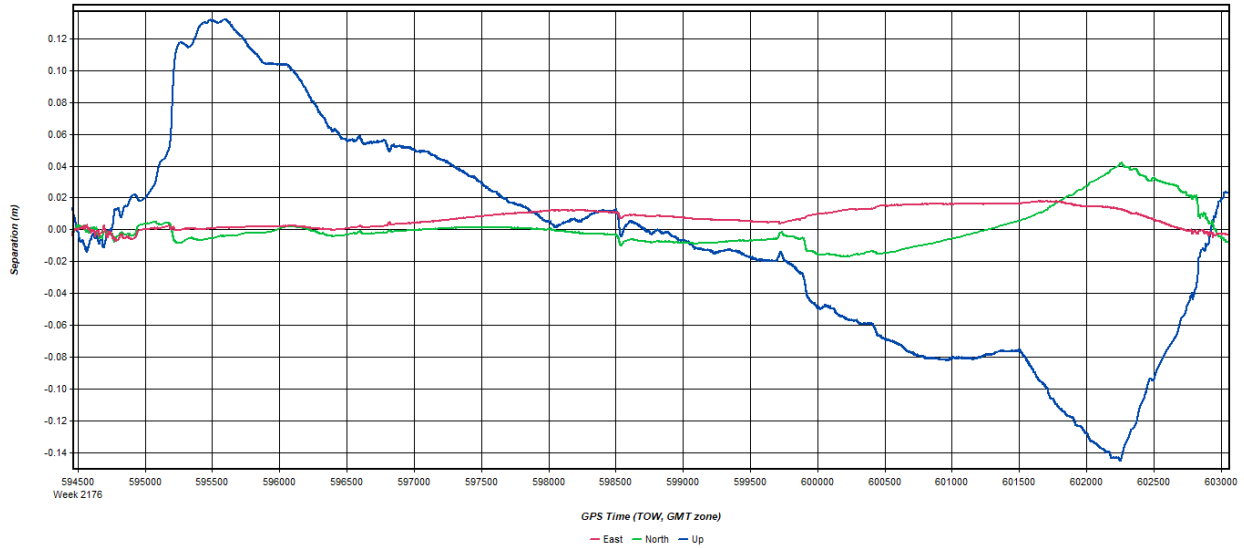
Process 20210925B_GnssImu by Unknown on 10/4/2021 at 13:04:45

Figure 3: 20210925B_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



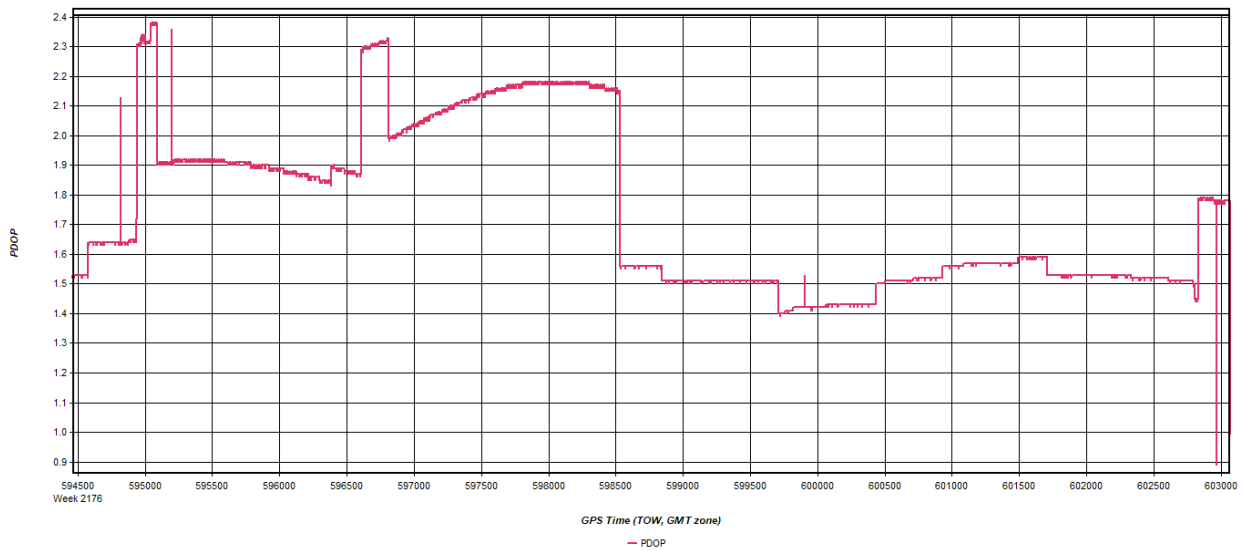
Process 20210925B_GnssImu by Unknown on 10/4/2021 at 13:04:45

Figure 4: 20210925B_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210925B_GnssImu by Unknown on 10/4/2021 at 13:04:45

Figure 5: 20210925B_GnssImu [Smoothed TC Combined] - PDOP Plot

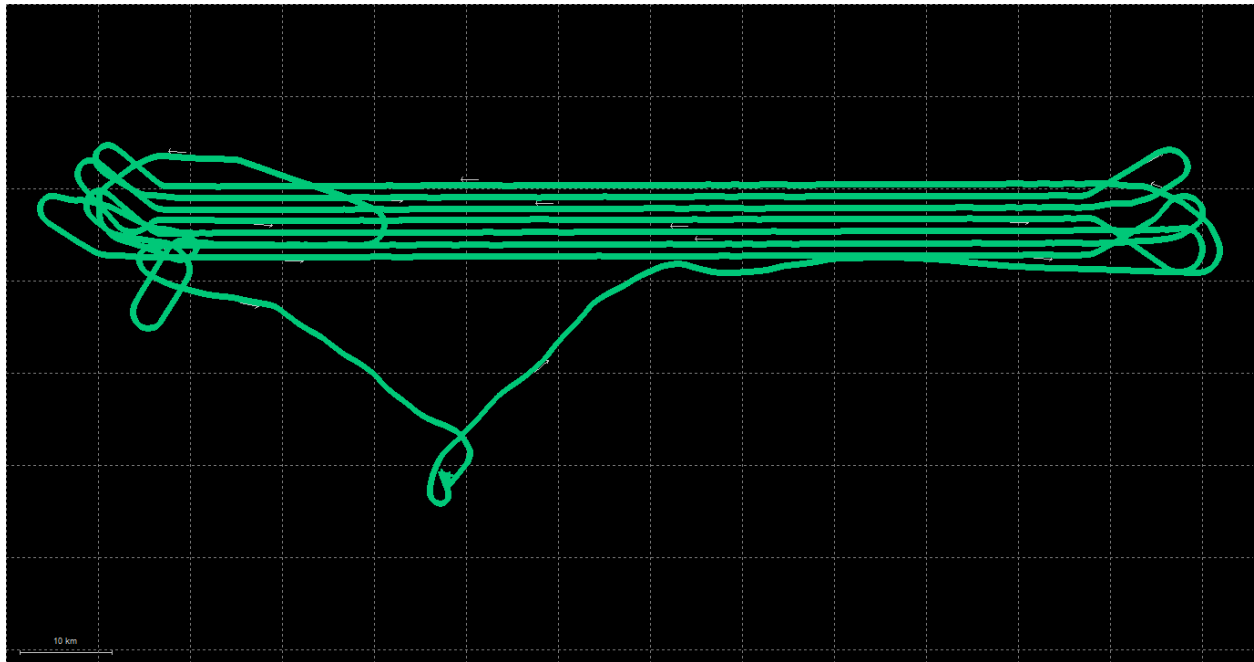


Process 20210925B_GnssImu by Unknown on 10/4/2021 at 13:04:45

Output Results for 20210926A_GnssImu

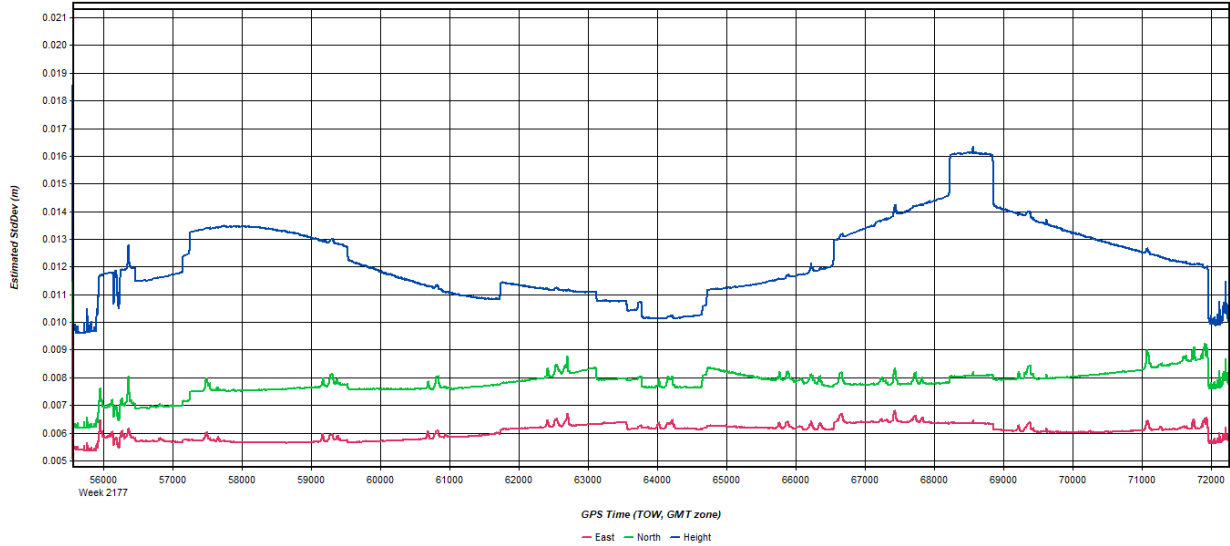
Inertial Explorer Version 8.90.2124
10/04/2021

Figure 1: Smoothed TC Combined - Map



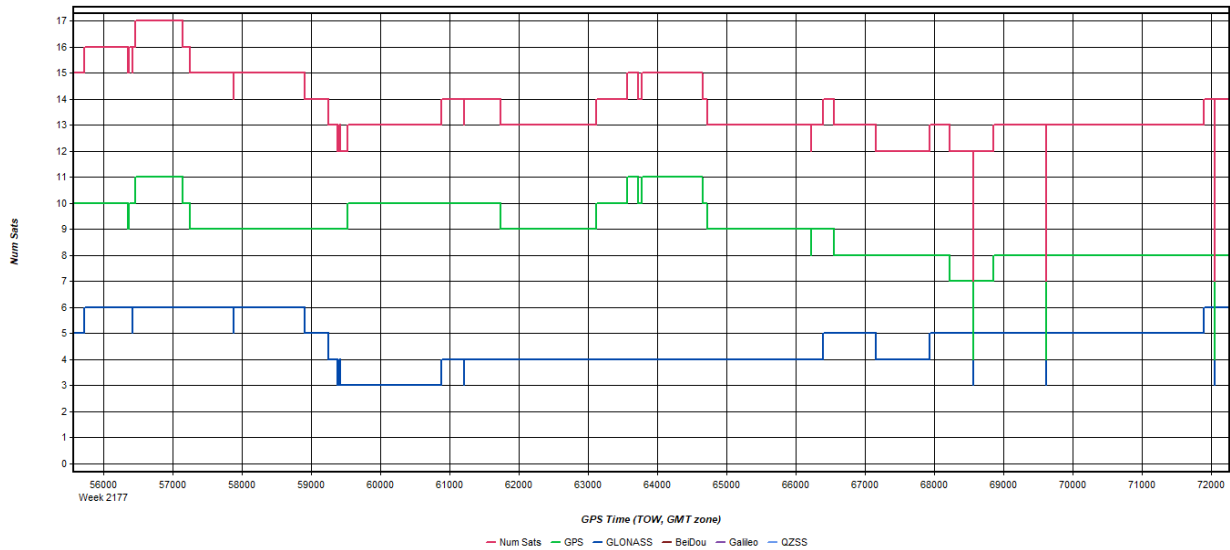
Process	20210926A_GnssImu	by Unknown	on 10/4/2021	at 13:42:09
---------	-------------------	------------	--------------	-------------

Figure 2: 20210926A_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



Process 20210926A_GnssImu by Unknown on 10/4/2021 at 13:42:09

Figure 3: 20210926A_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



Process 20210926A_GnssImu by Unknown on 10/4/2021 at 13:42:09

Figure 4: 20210926A_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210926A_GnssImu by Unknown on 10/4/2021 at 13:42:09

Figure 5: 20210926A_GnssImu [Smoothed TC Combined] - PDOP Plot

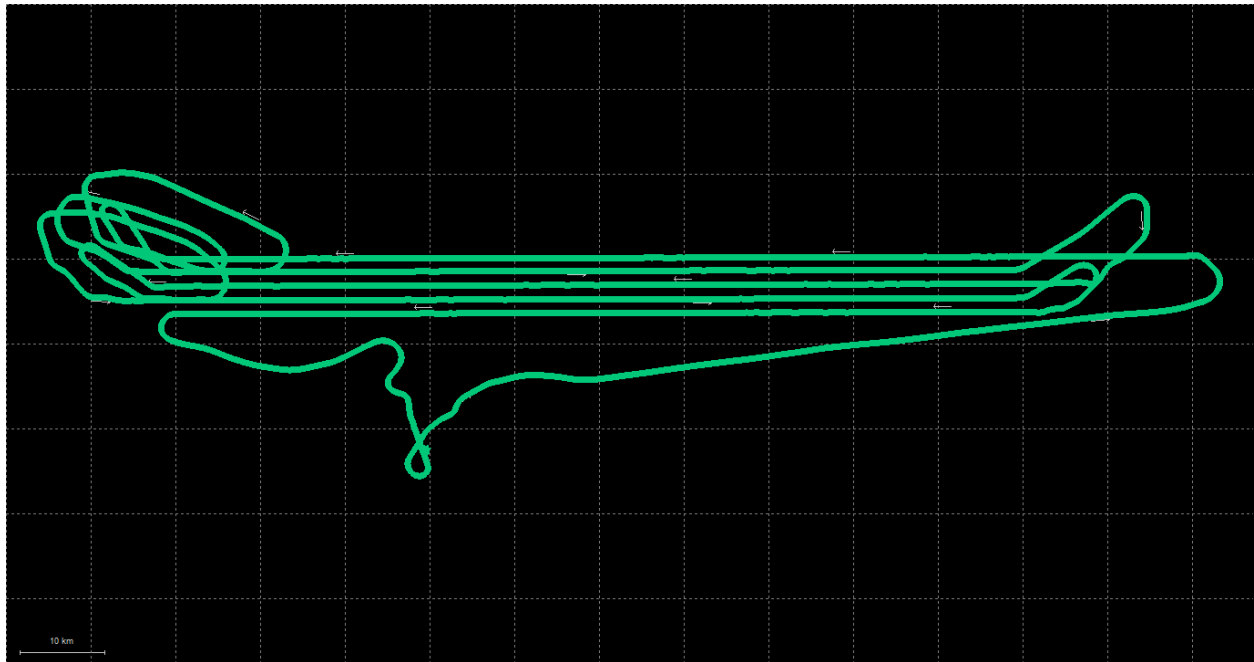


Process 20210926A_GnssImu by Unknown on 10/4/2021 at 13:42:09

Output Results for 20210927A_GnssImu

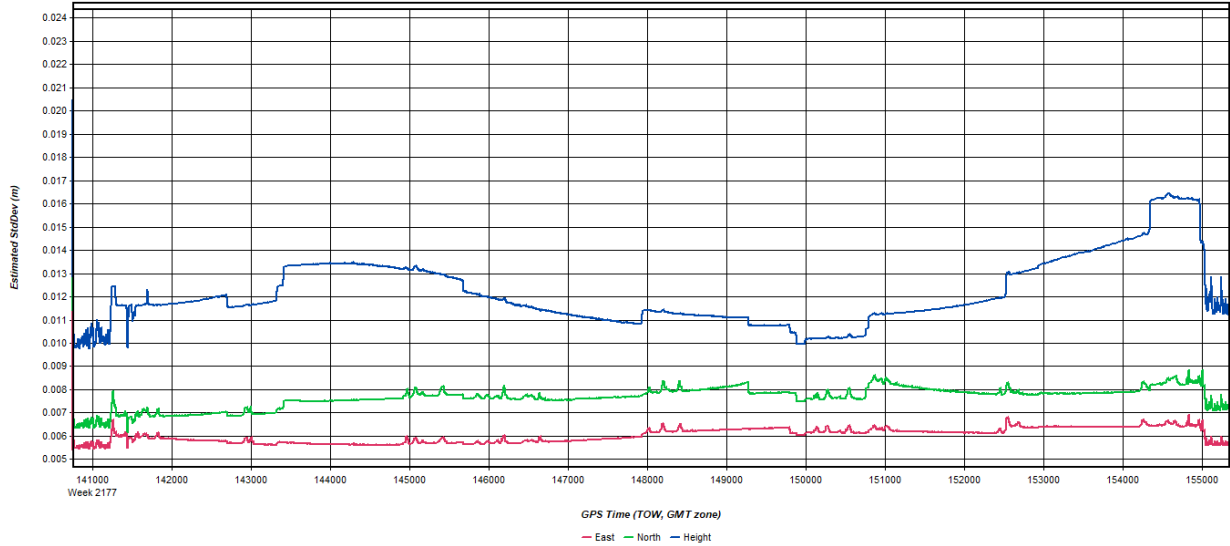
Inertial Explorer Version 8.90.2124
10/04/2021

Figure 1: Smoothed TC Combined - Map



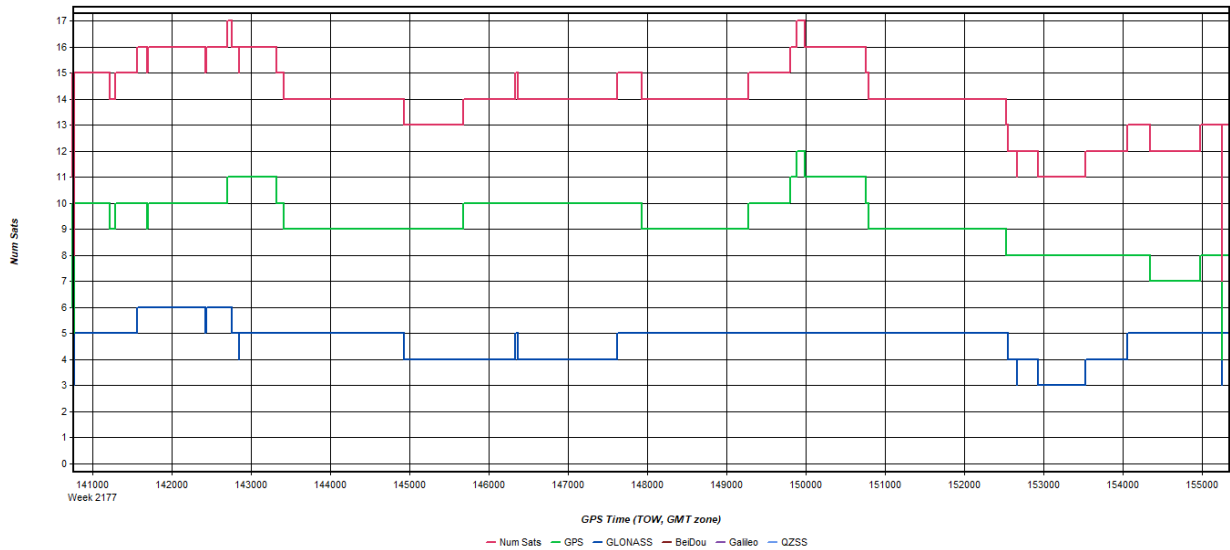
Process	20210927A_GnssImu	by Unknown	on 10/4/2021	at 16:20:53
---------	-------------------	------------	--------------	-------------

Figure 2: 20210927A_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



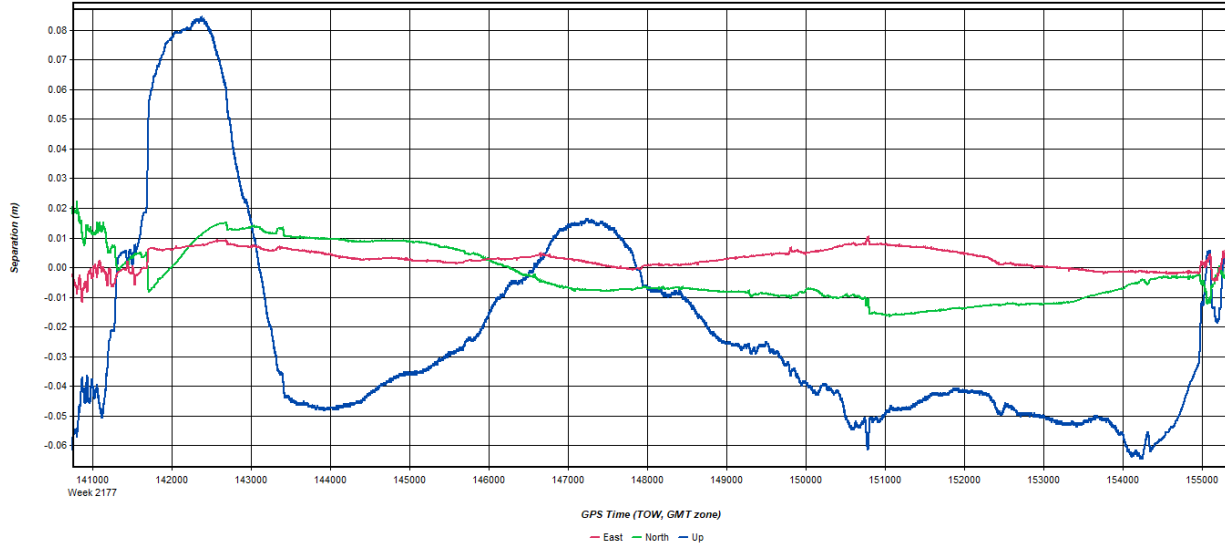
Process 20210927A_GnssImu by Unknown on 10/4/2021 at 16:20:53

Figure 3: 20210927A_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



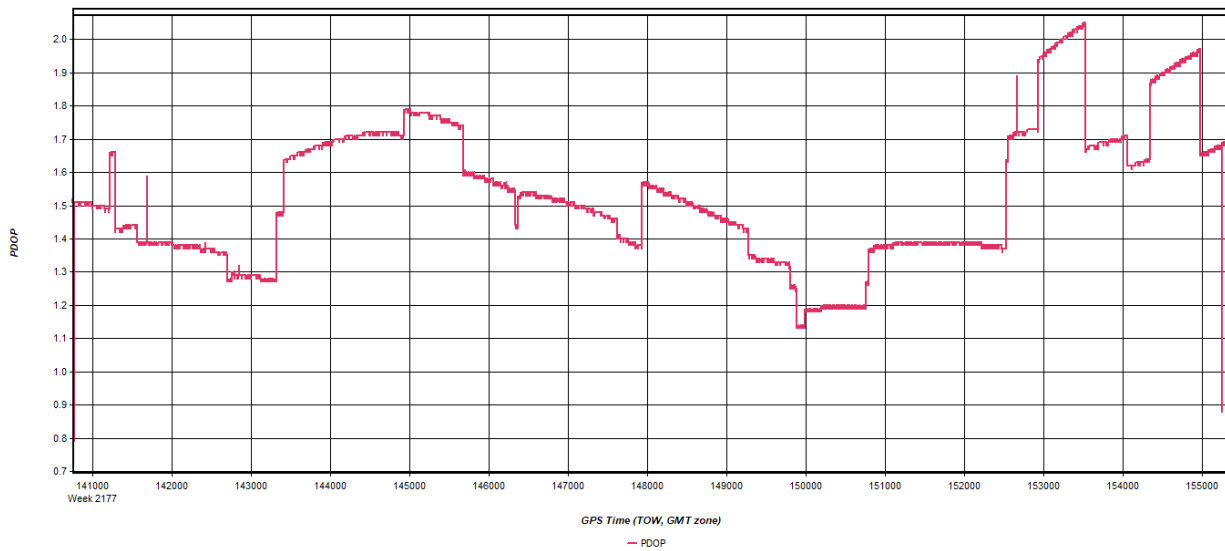
Process 20210927A_GnssImu by Unknown on 10/4/2021 at 16:20:53

Figure 4: 20210927A_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210927A_GnssImu by Unknown on 10/4/2021 at 16:20:53

Figure 5: 20210927A_GnssImu [Smoothed TC Combined] - PDOP Plot

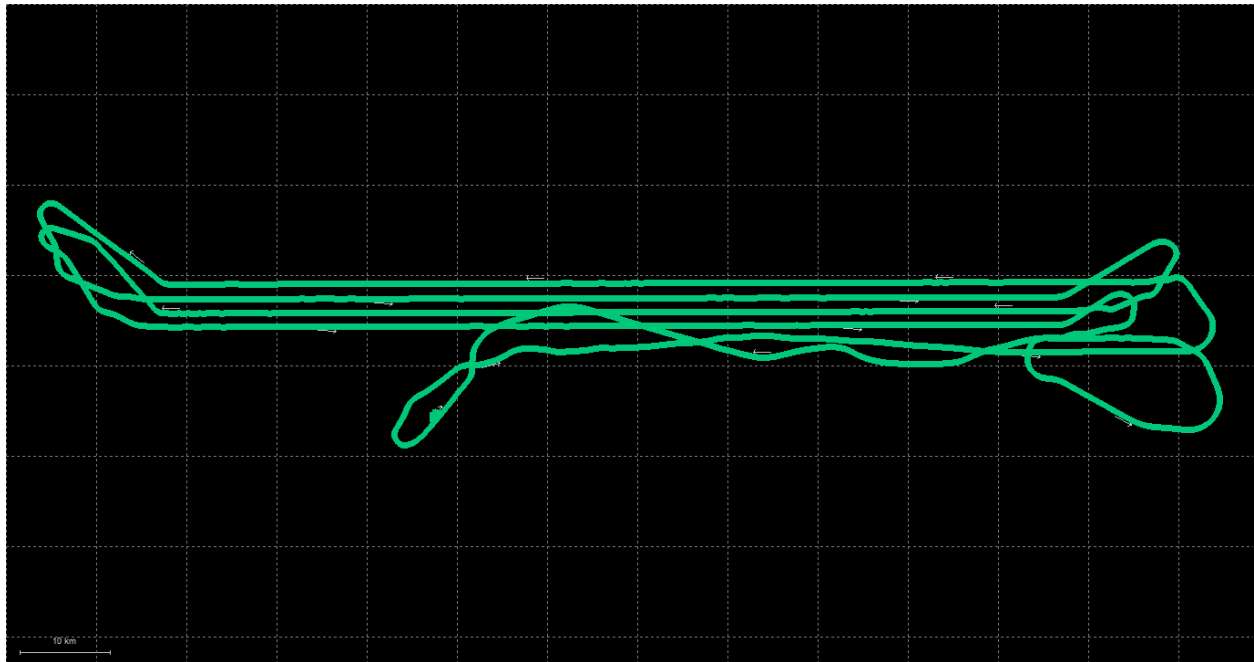


Process 20210927A_GnssImu by Unknown on 10/4/2021 at 16:20:53

Output Results for 20210927B_GnssImu

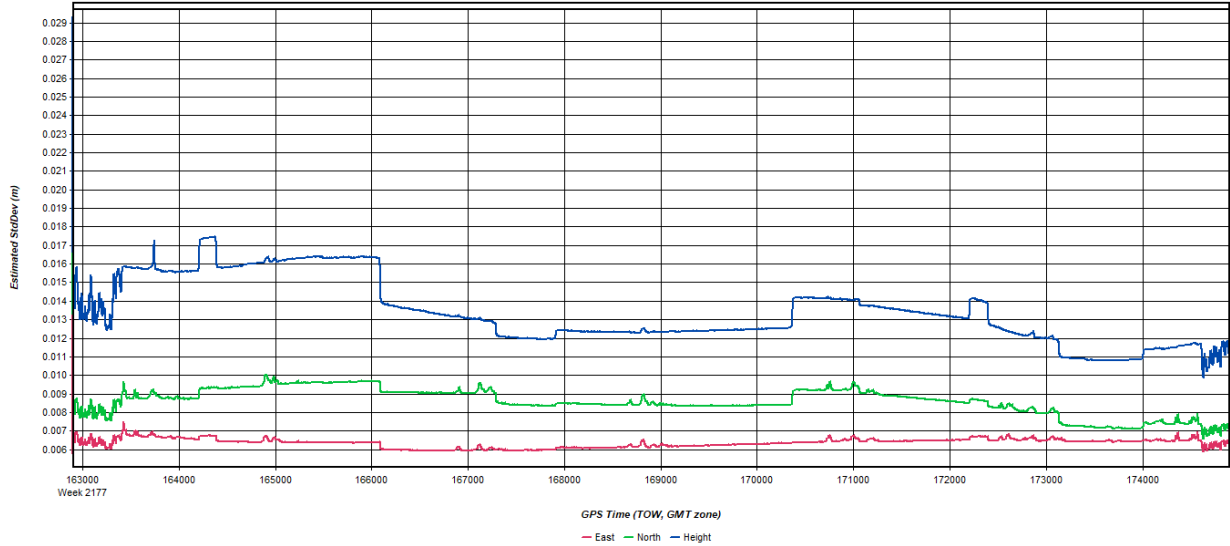
Inertial Explorer Version 8.90.2124
10/04/2021

Figure 1: Smoothed TC Combined - Map



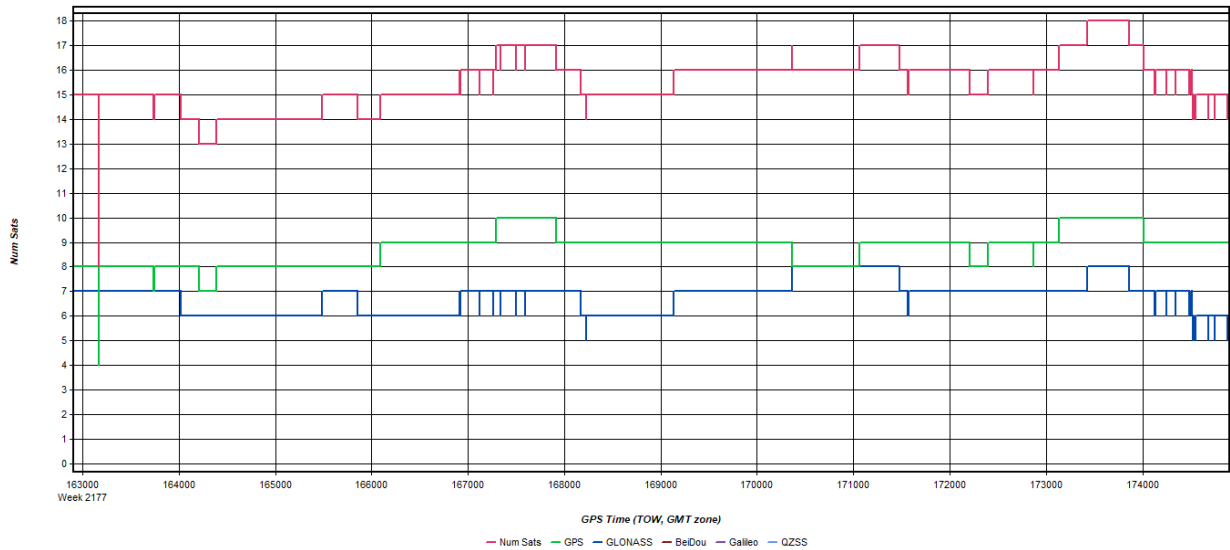
Process	20210927B_GnssImu	by Unknown	on 10/4/2021	at 16:22:02
---------	-------------------	------------	--------------	-------------

Figure 2: 20210927B_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



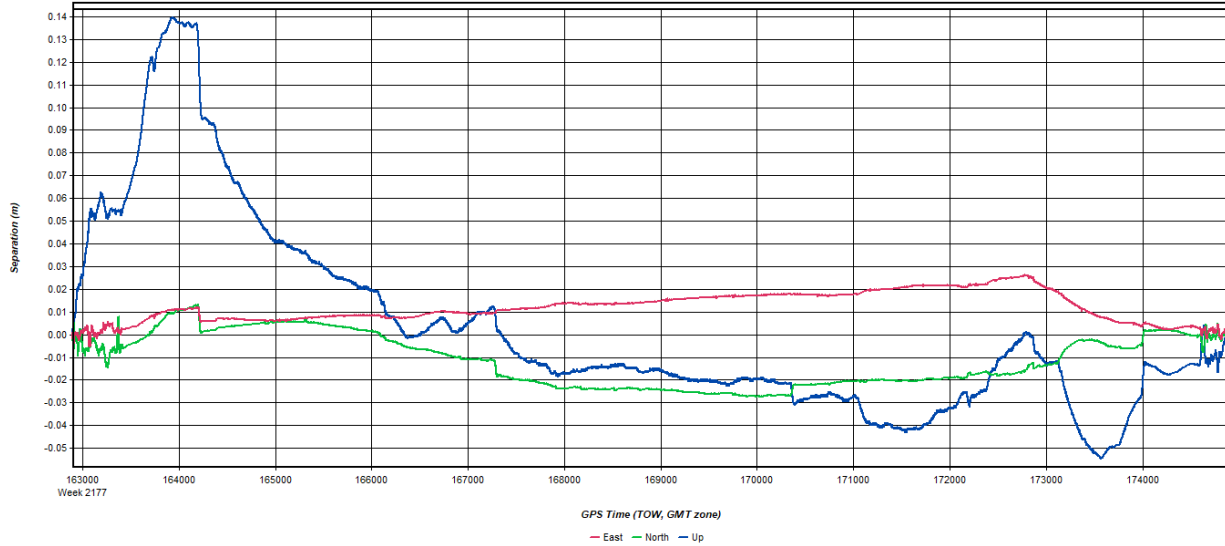
Process 20210927B_GnssImu by Unknown on 10/4/2021 at 16:22:02

Figure 3: 20210927B_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



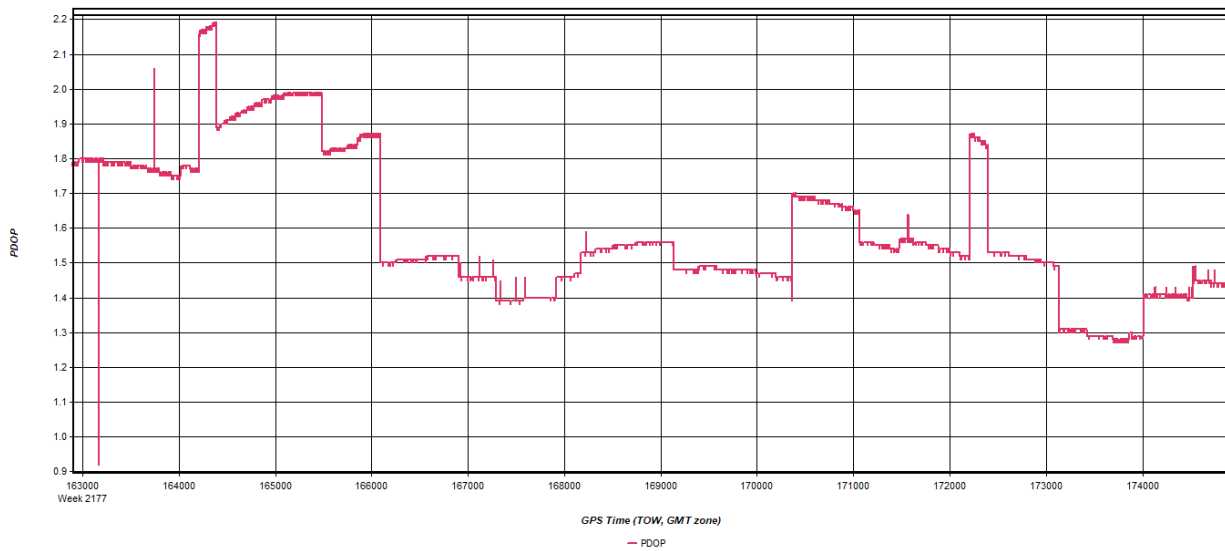
Process 20210927B_GnssImu by Unknown on 10/4/2021 at 16:22:02

Figure 4: 20210927B_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210927B_GnssImu by Unknown on 10/4/2021 at 16:22:02

Figure 5: 20210927B_GnssImu [Smoothed TC Combined] - PDOP Plot

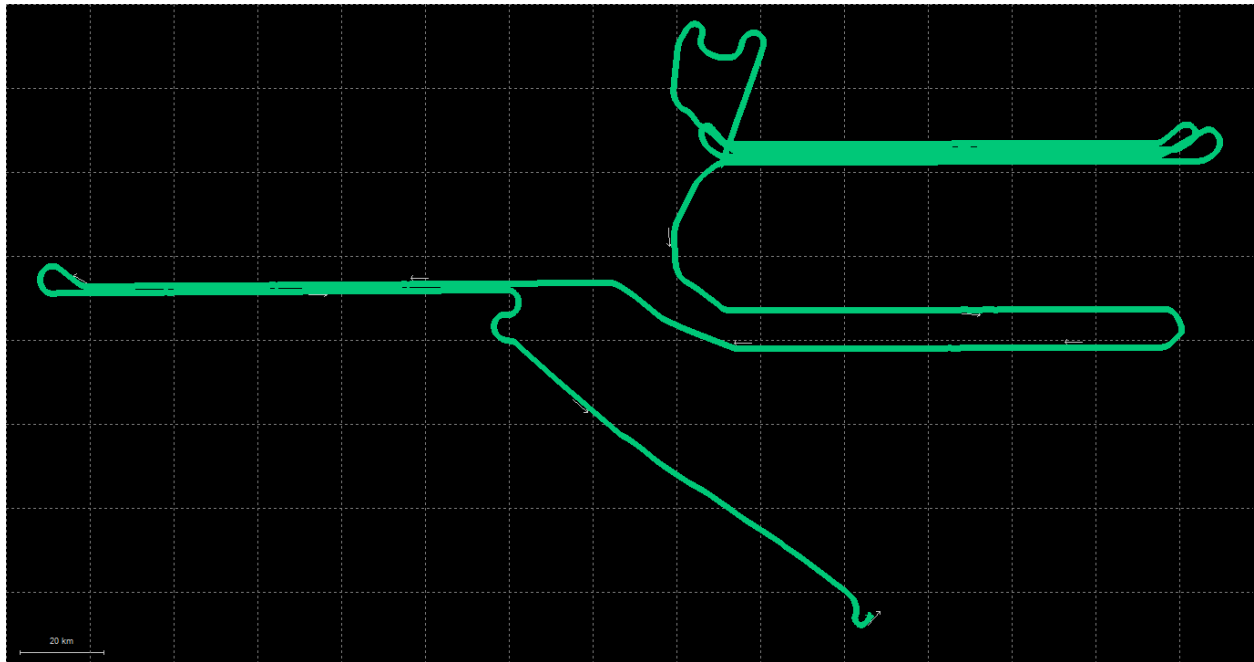


Process 20210927B_GnssImu by Unknown on 10/4/2021 at 16:22:02

Output Results for 20210929A_GnssImu

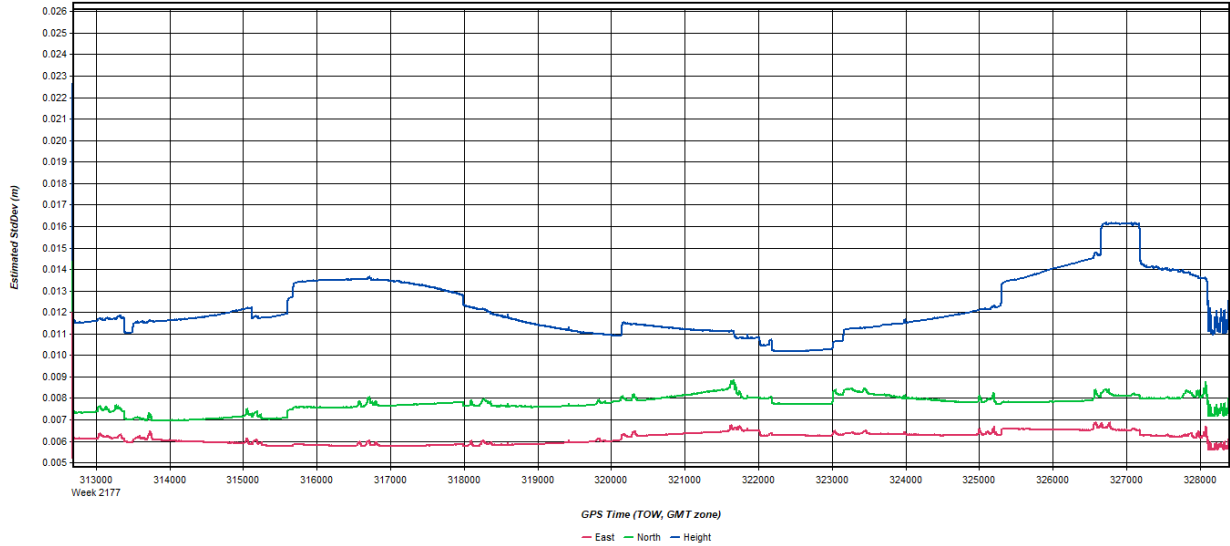
Inertial Explorer Version 8.90.2124
10/04/2021

Figure 1: Smoothed TC Combined - Map



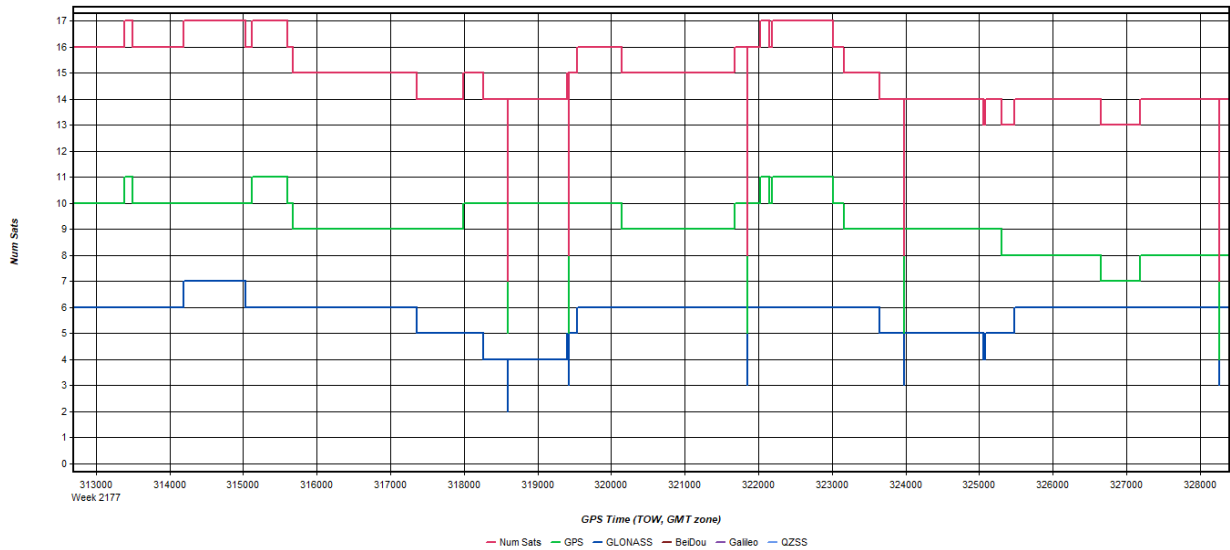
Process	20210929A_GnssImu	by Unknown	on 10/4/2021	at 14:25:10
---------	-------------------	------------	--------------	-------------

Figure 2: 20210929A_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



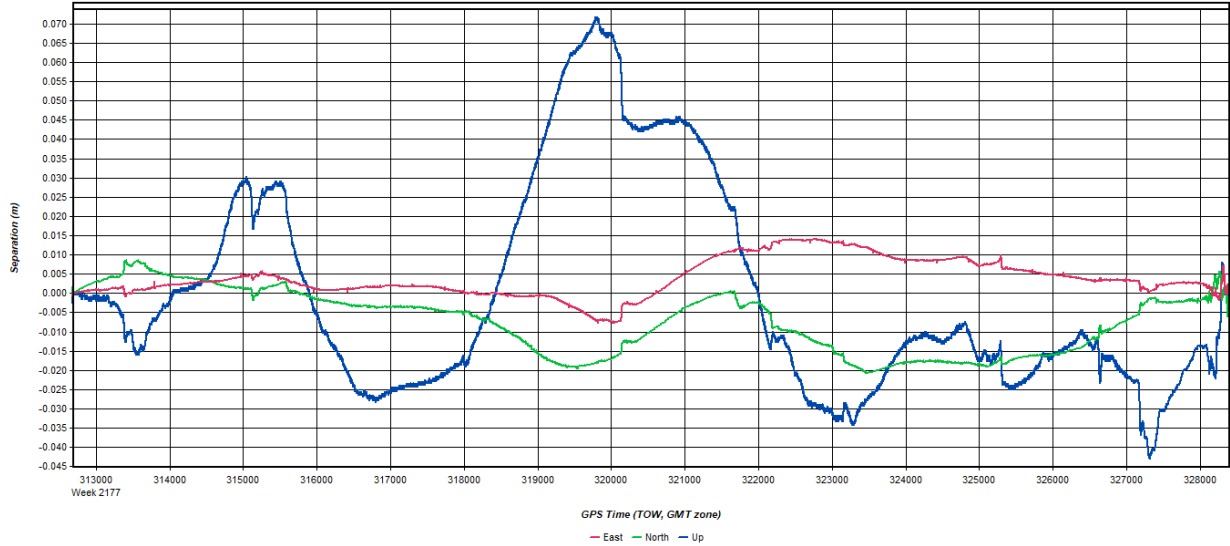
Process 20210929A_GnssImu by Unknown on 10/4/2021 at 14:25:10

Figure 3: 20210929A_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



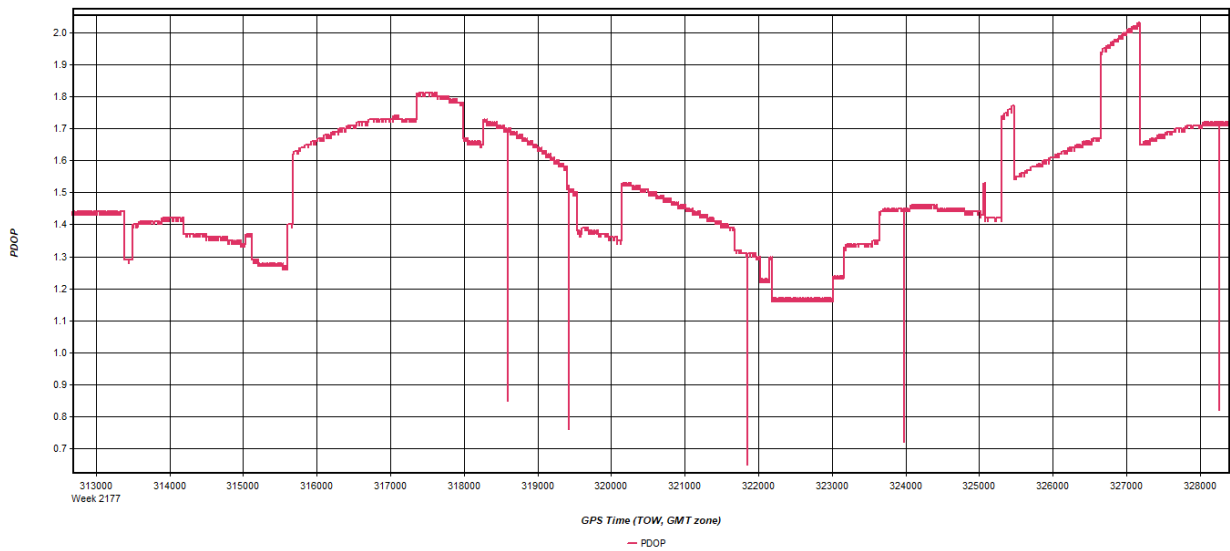
Process 20210929A_GnssImu by Unknown on 10/4/2021 at 14:25:10

Figure 4: 20210929A_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210929A_GnssImu by Unknown on 10/4/2021 at 14:25:10

Figure 5: 20210929A_GnssImu [Smoothed TC Combined] - PDOP Plot

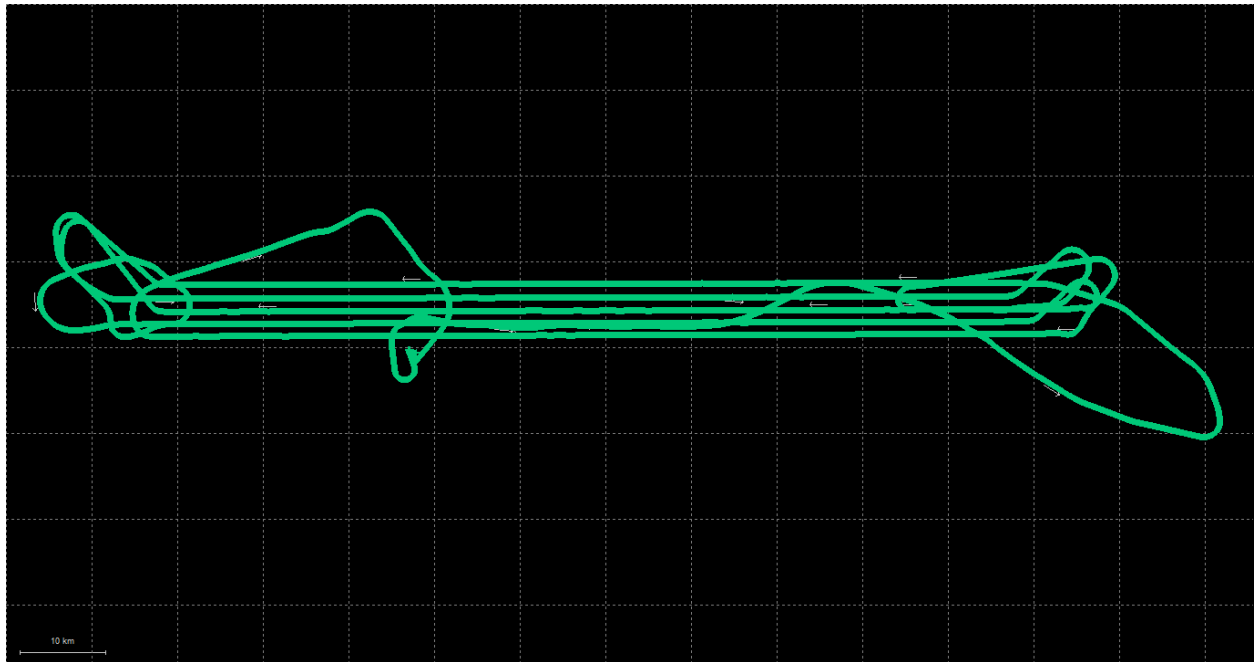


Process 20210929A_GnssImu by Unknown on 10/4/2021 at 14:25:10

Output Results for 20210929A_GnssImu

Inertial Explorer Version 8.90.2124
10/04/2021

Figure 1: Smoothed TC Combined - Map



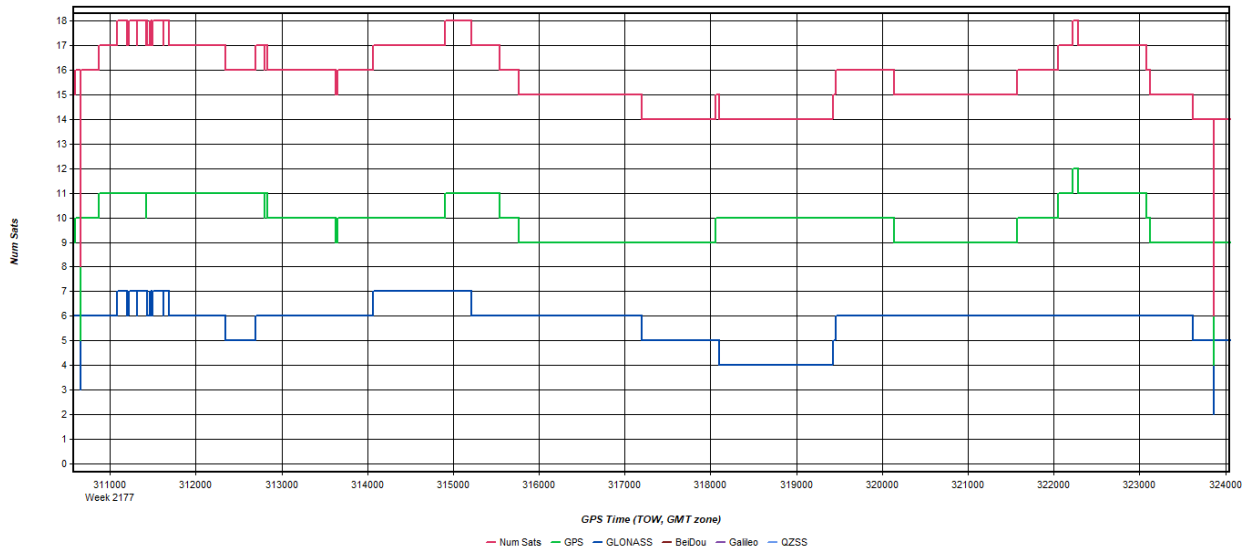
Process	20210929A_GnssImu	by Unknown	on 10/4/2021	at 17:10:01
---------	-------------------	------------	--------------	-------------

Figure 2: 20210929A_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



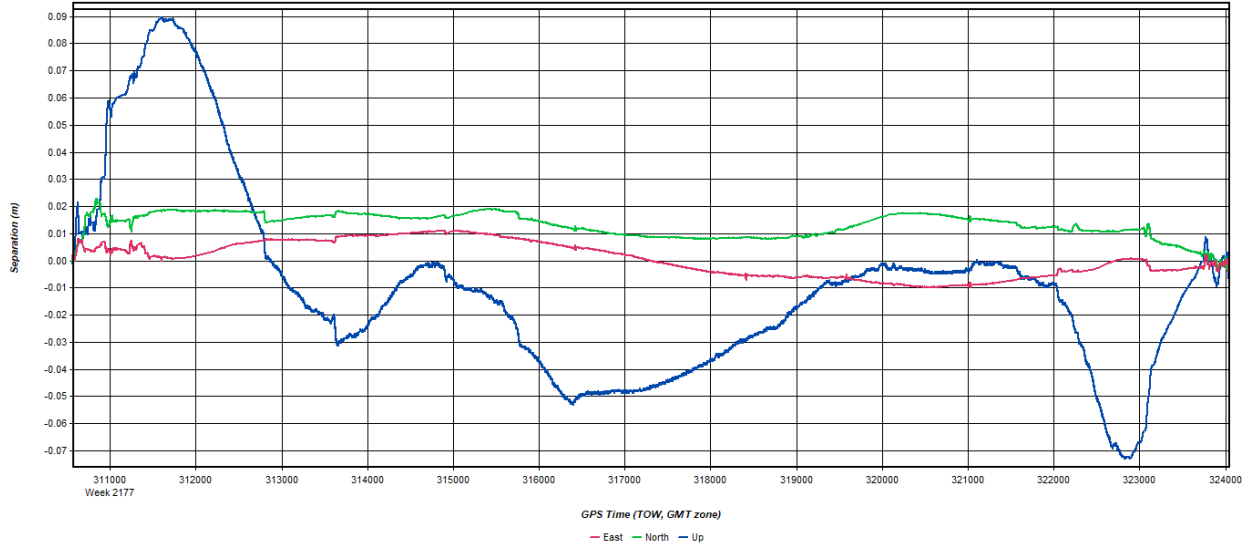
Process 20210929A_GnssImu by Unknown on 10/4/2021 at 17:10:01

Figure 3: 20210929A_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



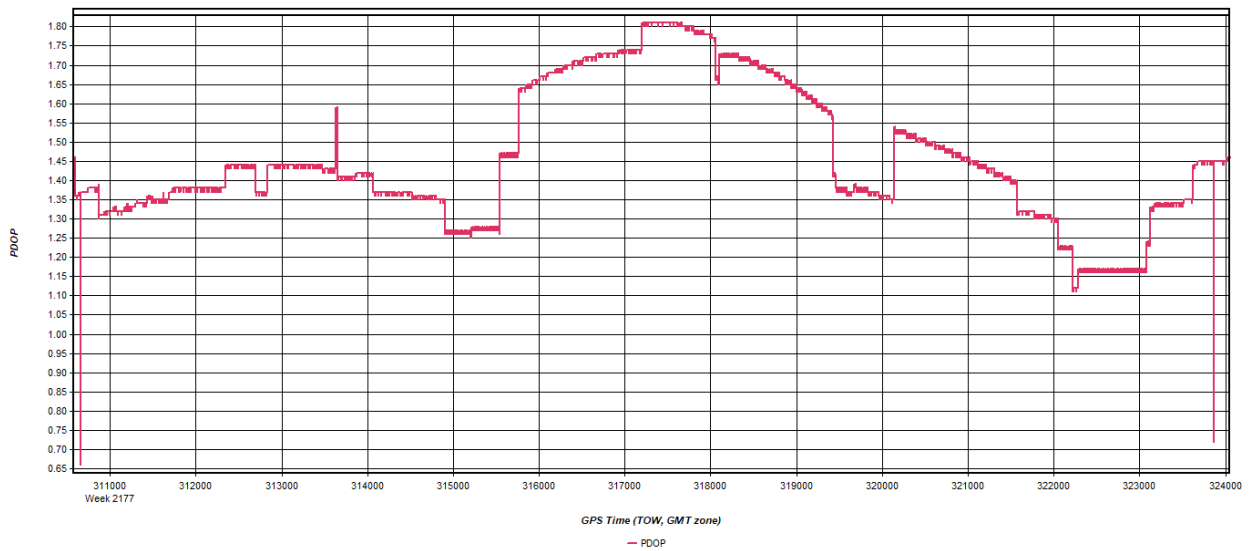
Process 20210929A_GnssImu by Unknown on 10/4/2021 at 17:10:01

Figure 4: 20210929A_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210929A_GnssImu by Unknown on 10/4/2021 at 17:10:01

Figure 5: 20210929A_GnssImu [Smoothed TC Combined] - PDOP Plot

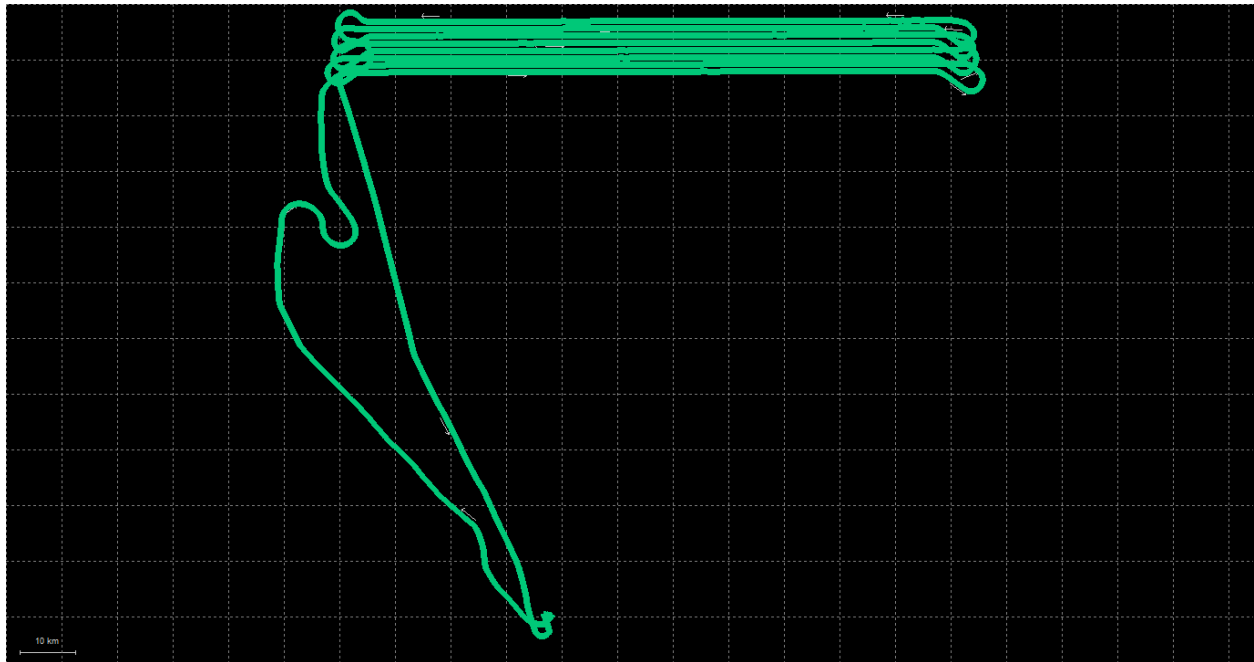


Process 20210929A_GnssImu by Unknown on 10/4/2021 at 17:10:01

Output Results for 20210929B_GnssImu

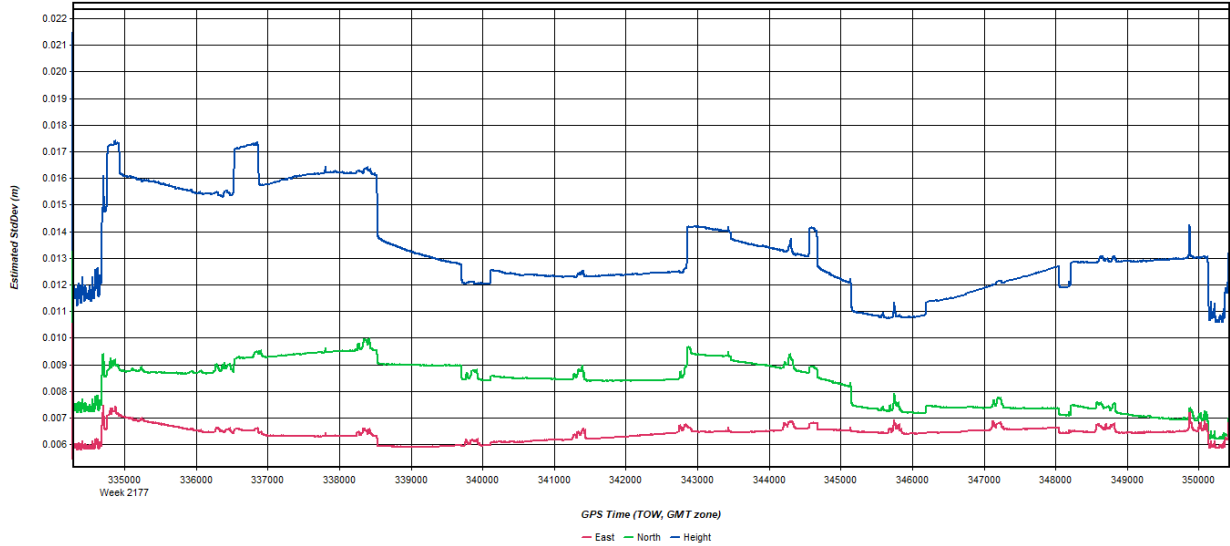
Inertial Explorer Version 8.90.2124
10/04/2021

Figure 1: Smoothed TC Combined - Map



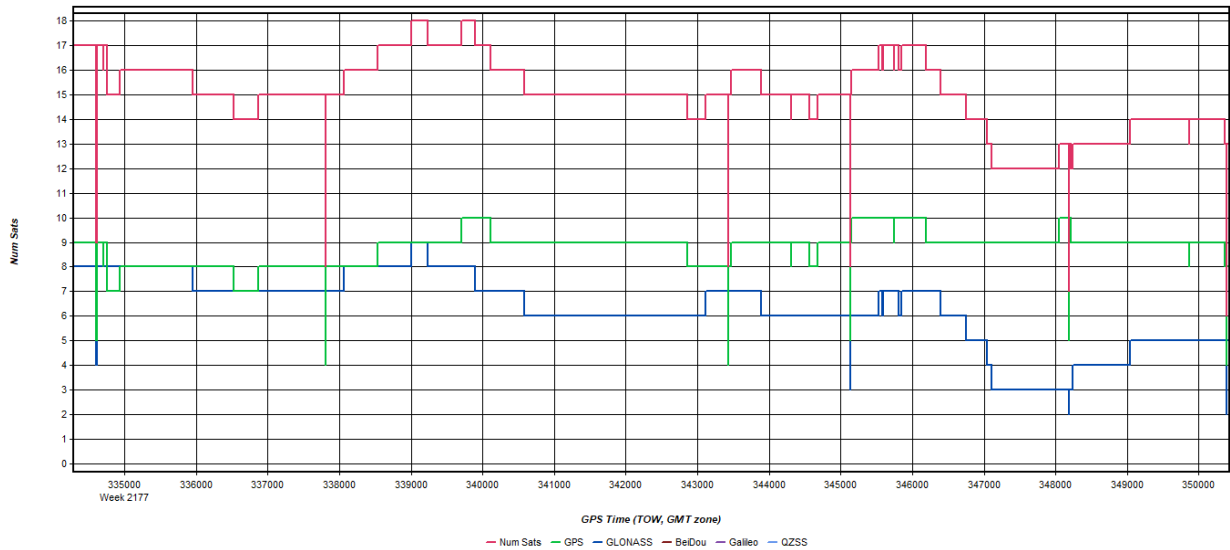
Process	20210929B_GnssImu	by Unknown	on 10/4/2021	at 14:34:56
---------	-------------------	------------	--------------	-------------

Figure 2: 20210929B_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



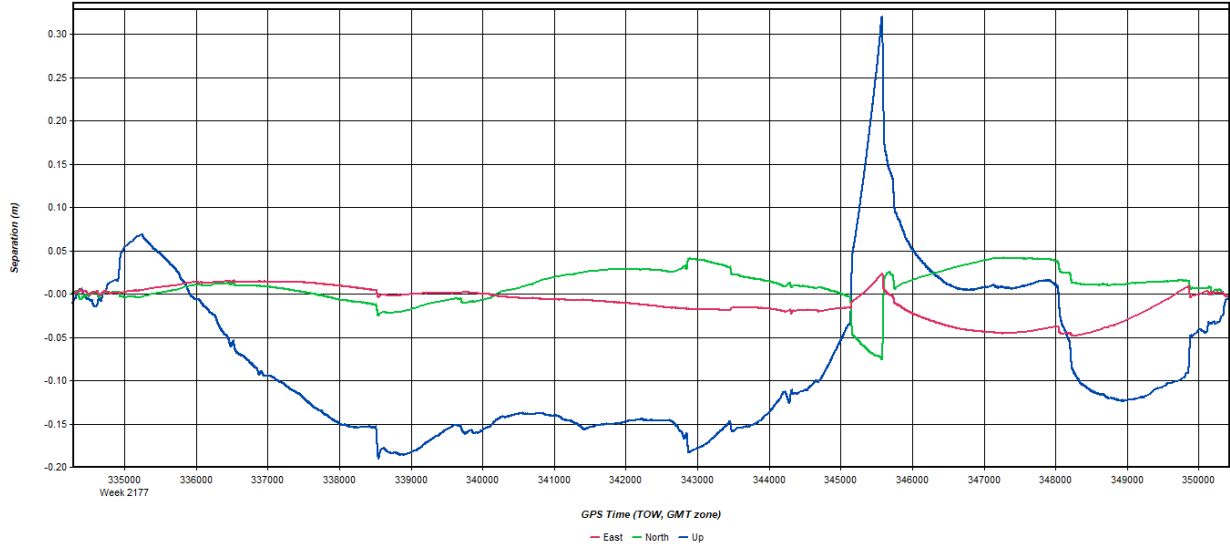
Process 20210929B_GnssImu by Unknown on 10/4/2021 at 14:34:56

Figure 3: 20210929B_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



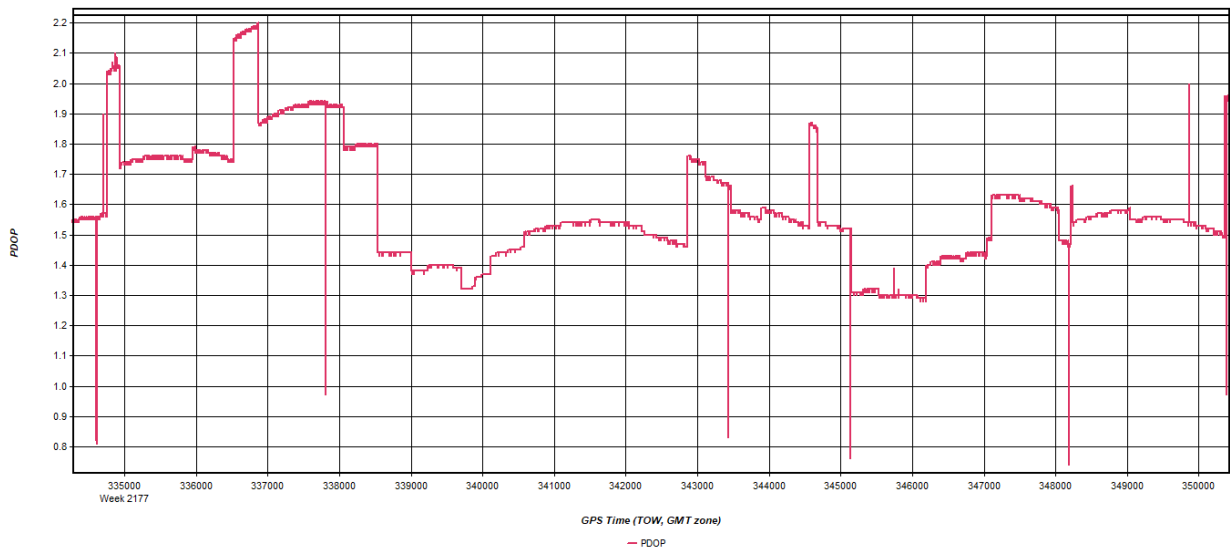
Process 20210929B_GnssImu by Unknown on 10/4/2021 at 14:34:56

Figure 4: 20210929B_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210929B_GnssImu by Unknown on 10/4/2021 at 14:34:56

Figure 5: 20210929B_GnssImu [Smoothed TC Combined] - PDOP Plot

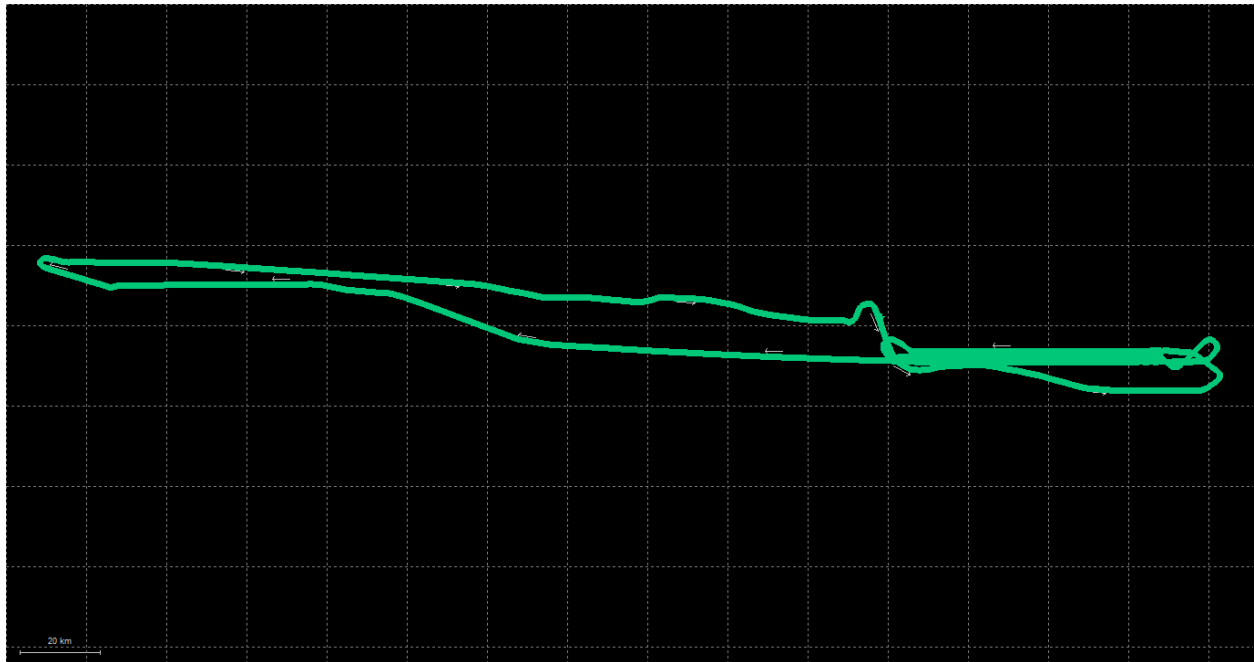


Process 20210929B_GnssImu by Unknown on 10/4/2021 at 14:34:56

Output Results for 20210929B_GnssImu

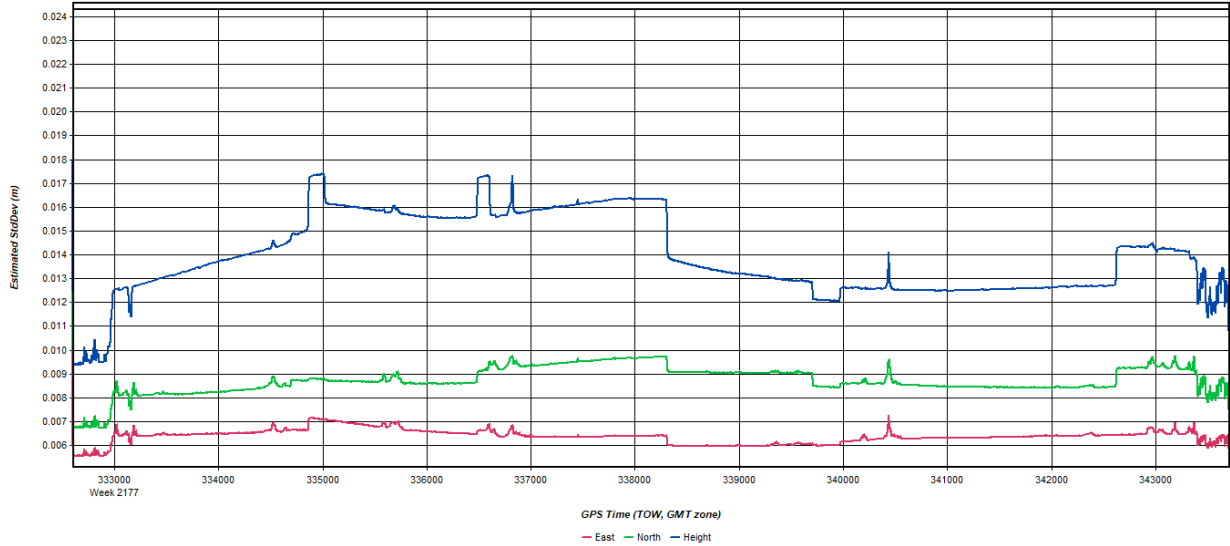
Inertial Explorer Version 8.90.2124
10/04/2021

Figure 1: Smoothed TC Combined - Map



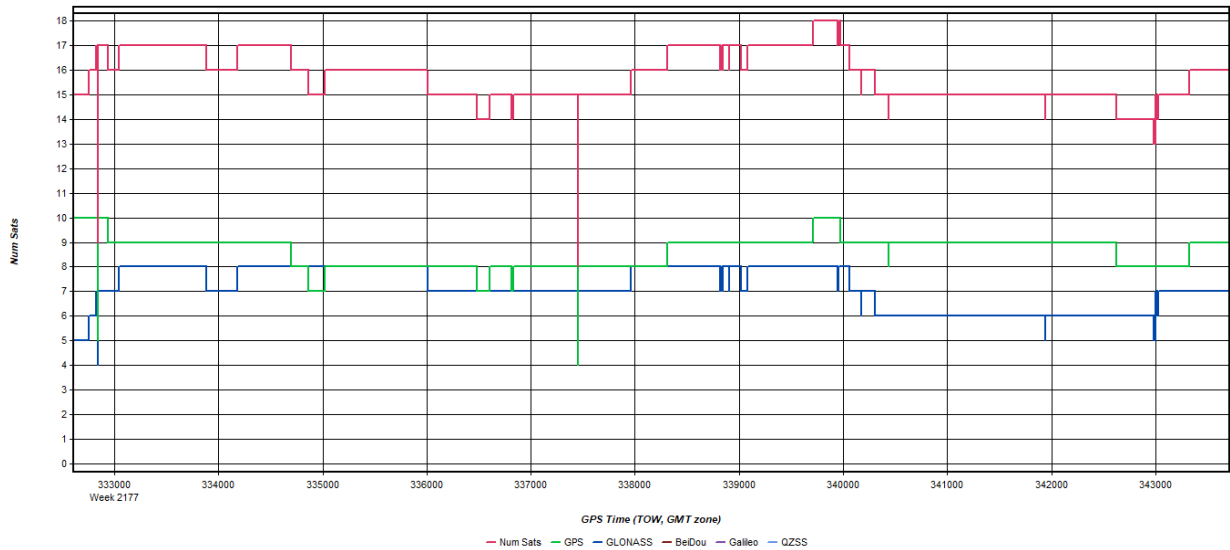
Process	20210929B_GnssImu	by Unknown	on 10/4/2021	at 17:13:07
---------	-------------------	------------	--------------	-------------

Figure 2: 20210929B_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



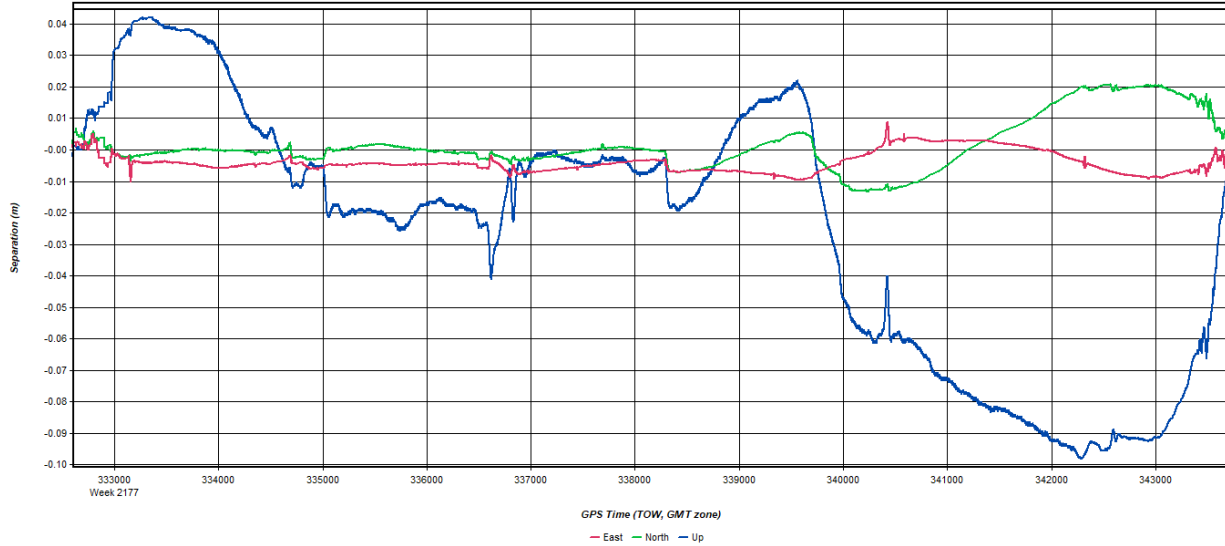
Process 20210929B_GnssImu by Unknown on 10/4/2021 at 17:13:07

Figure 3: 20210929B_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



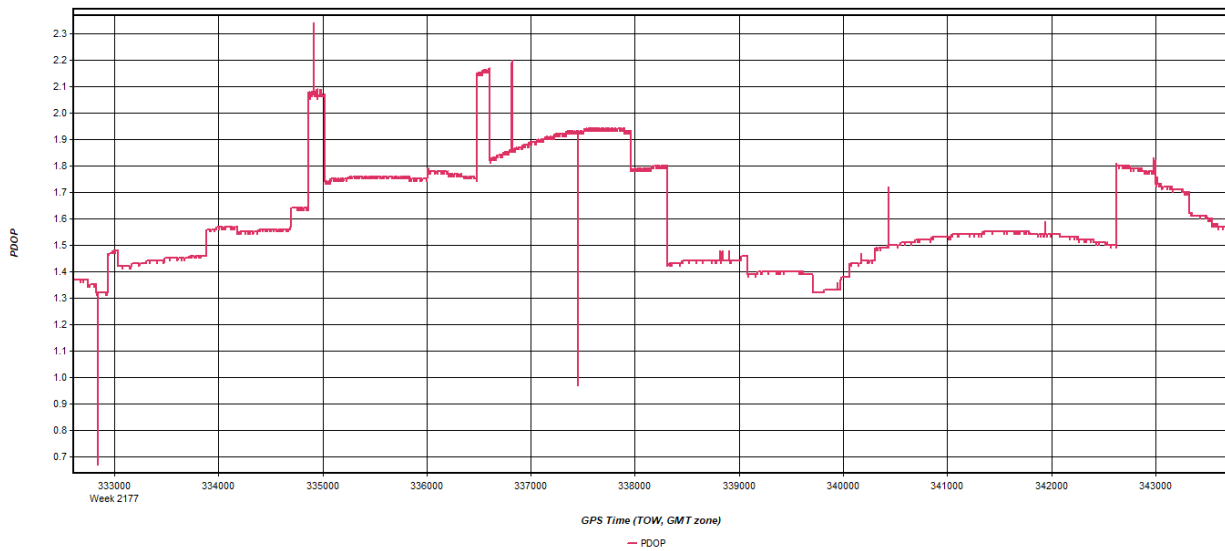
Process 20210929B_GnssImu by Unknown on 10/4/2021 at 17:13:07

Figure 4: 20210929B_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20210929B_GnssImu by Unknown on 10/4/2021 at 17:13:07

Figure 5: 20210929B_GnssImu [Smoothed TC Combined] - PDOP Plot



Process 20210929B_GnssImu by Unknown on 10/4/2021 at 17:13:07

Output Results for 20211010A_GnssImu

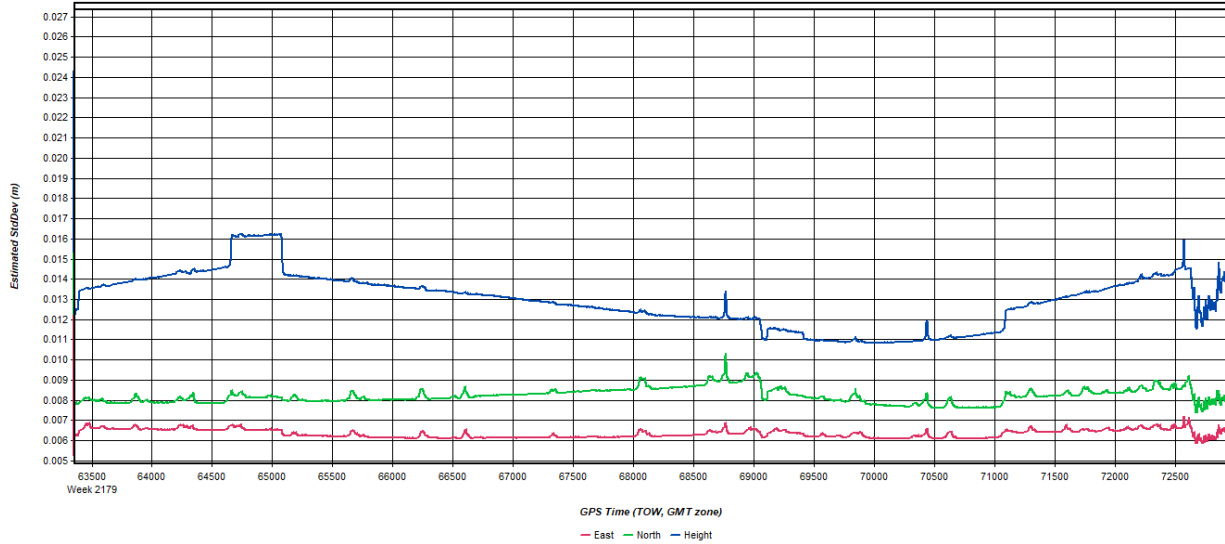
Inertial Explorer Version 8.90.2124
10/12/2021

Figure 1: Smoothed TC Combined - Map



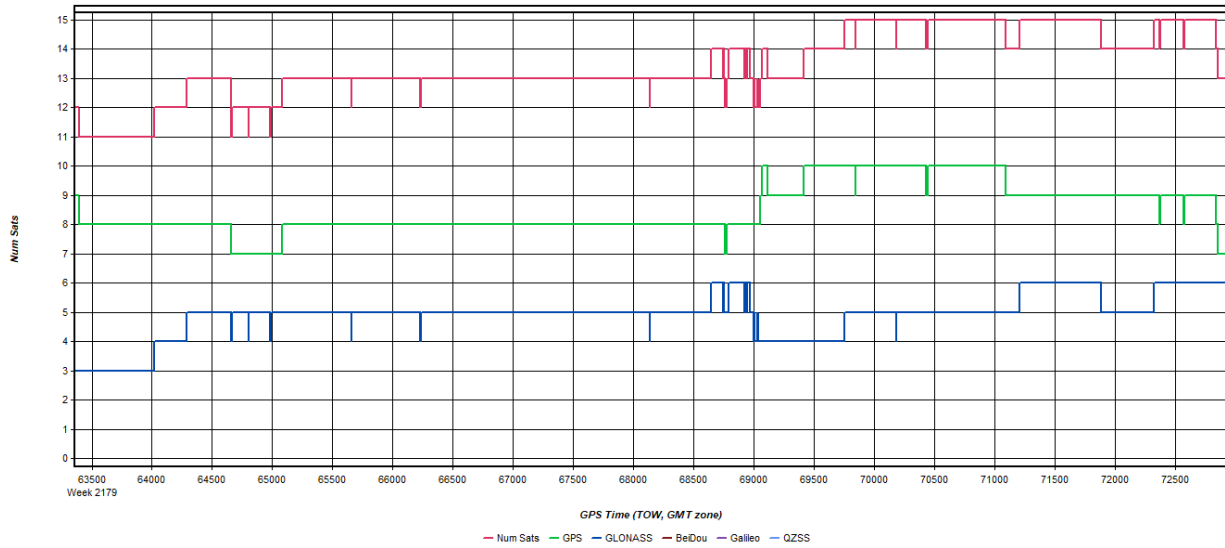
Process	20211010A_GnssImu	by Unknown	on 10/12/2021	at 14:18:05
---------	-------------------	------------	---------------	-------------

Figure 2: 20211010A_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



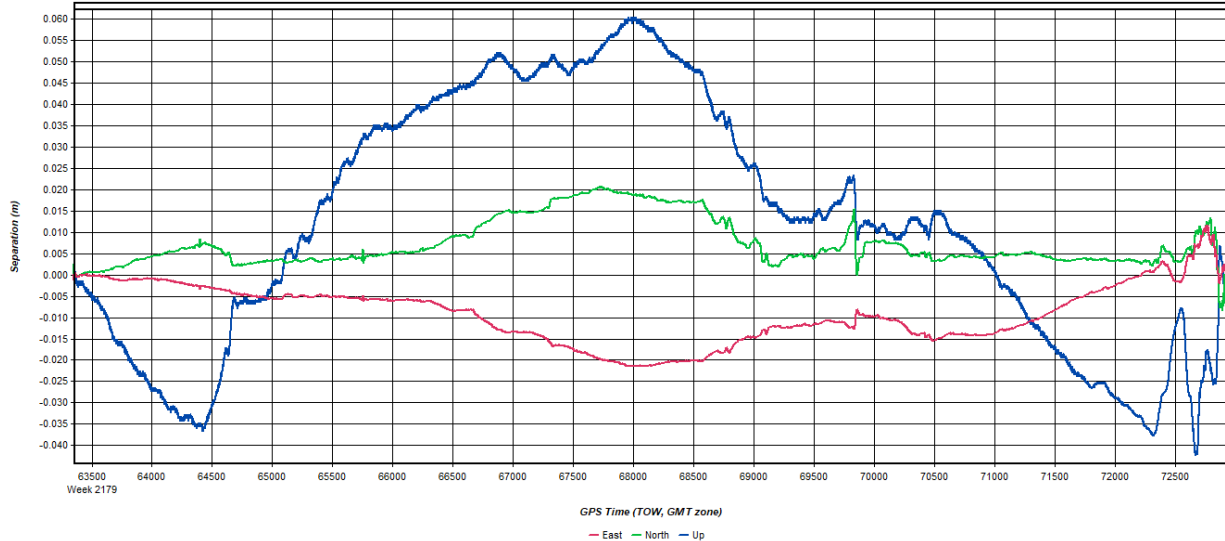
Process 20211010A_GnssImu by Unknown on 10/12/2021 at 14:18:05

Figure 3: 20211010A_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



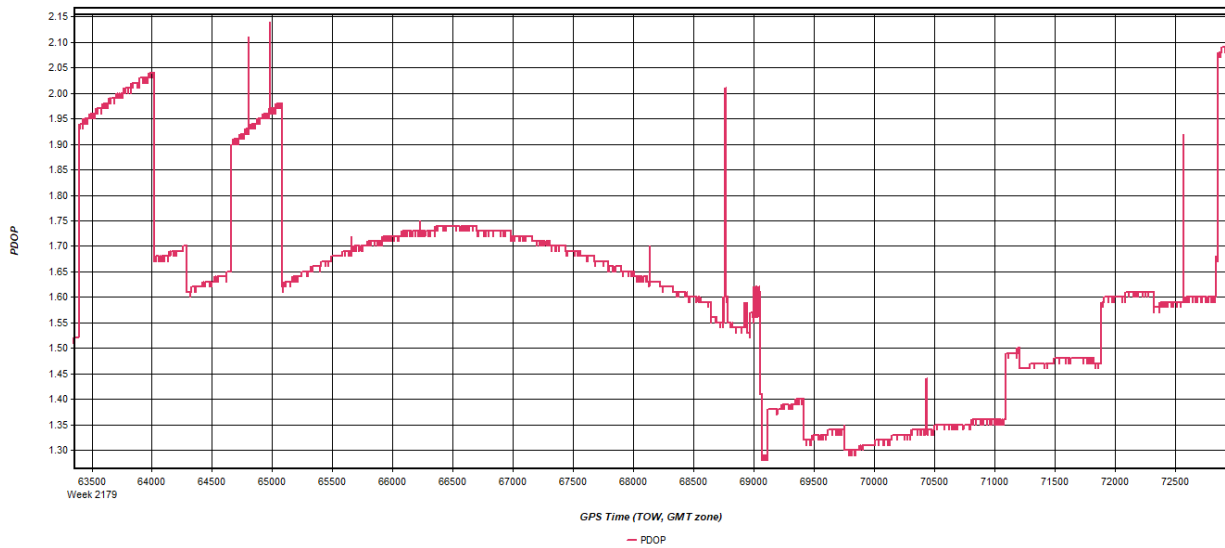
Process 20211010A_GnssImu by Unknown on 10/12/2021 at 14:18:05

Figure 4: 20211010A_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20211010A_GnssImu by Unknown on 10/12/2021 at 14:18:05

Figure 5: 20211010A_GnssImu [Smoothed TC Combined] - PDOP Plot

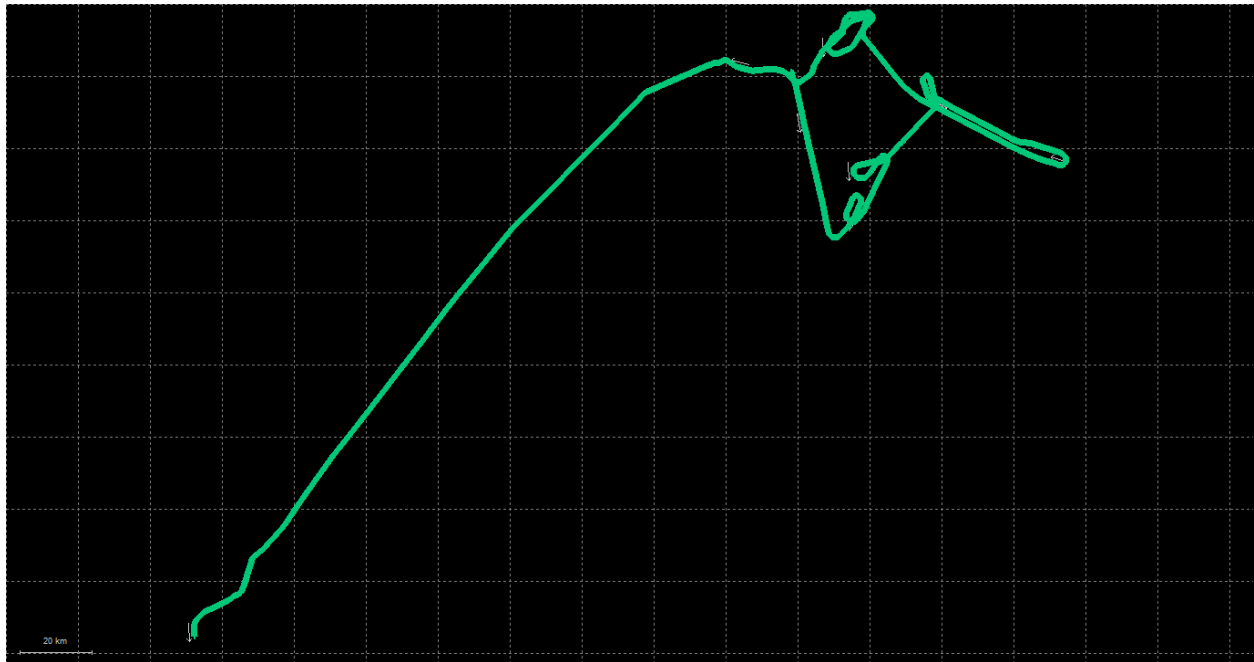


Process 20211010A_GnssImu by Unknown on 10/12/2021 at 14:18:05

Output Results for 20211010B_GnssImu

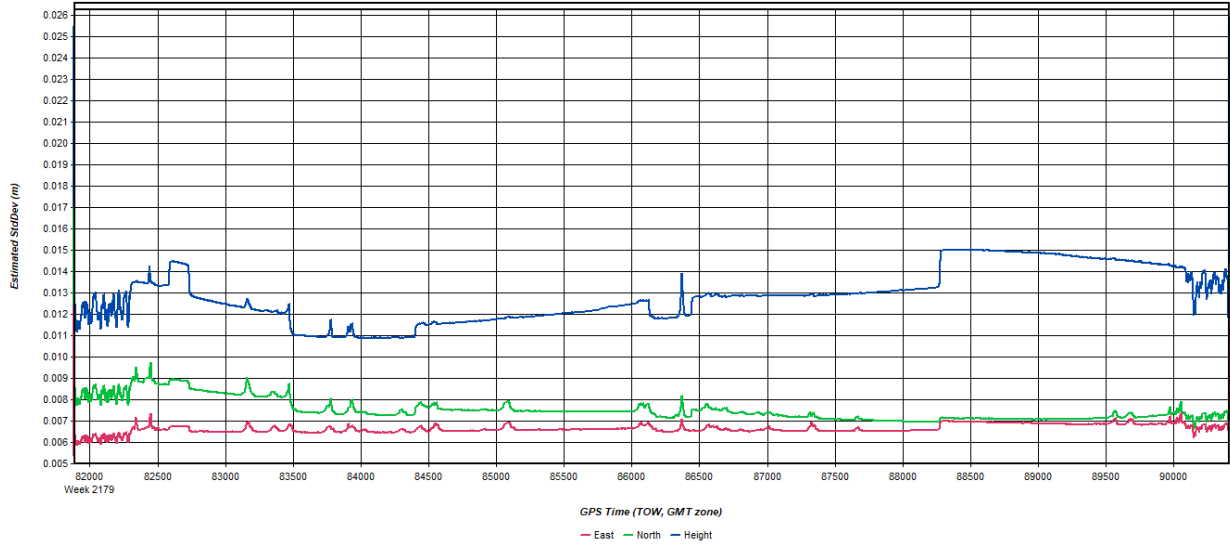
Inertial Explorer Version 8.90.2124
10/12/2021

Figure 1: Smoothed TC Combined - Map



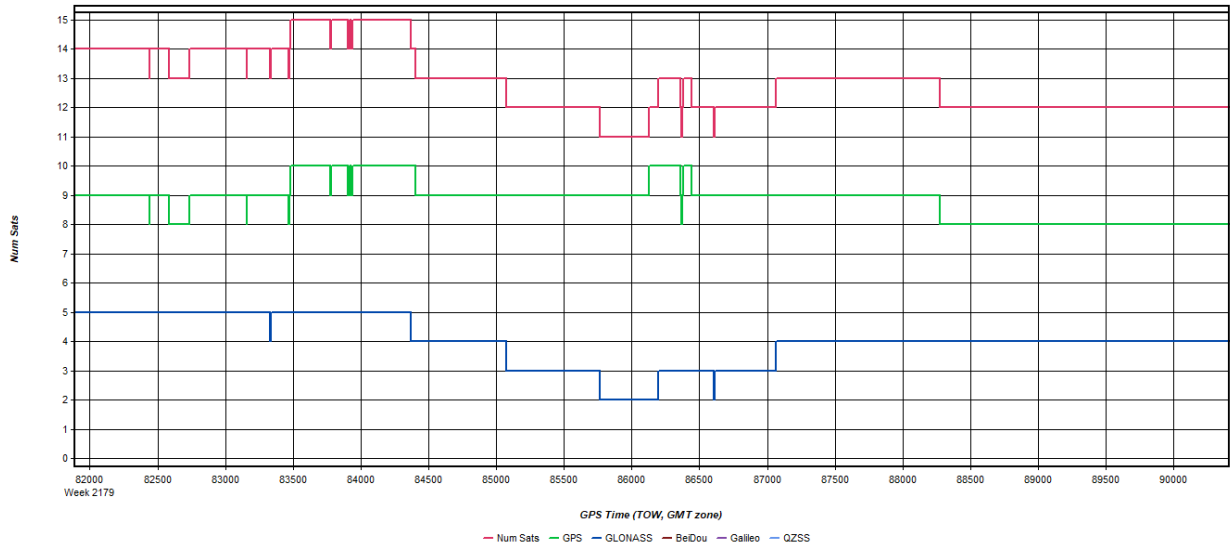
Process	20211010B_GnssImu	by Unknown	on 10/12/2021	at 14:43:28
---------	-------------------	------------	---------------	-------------

Figure 2: 20211010B_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



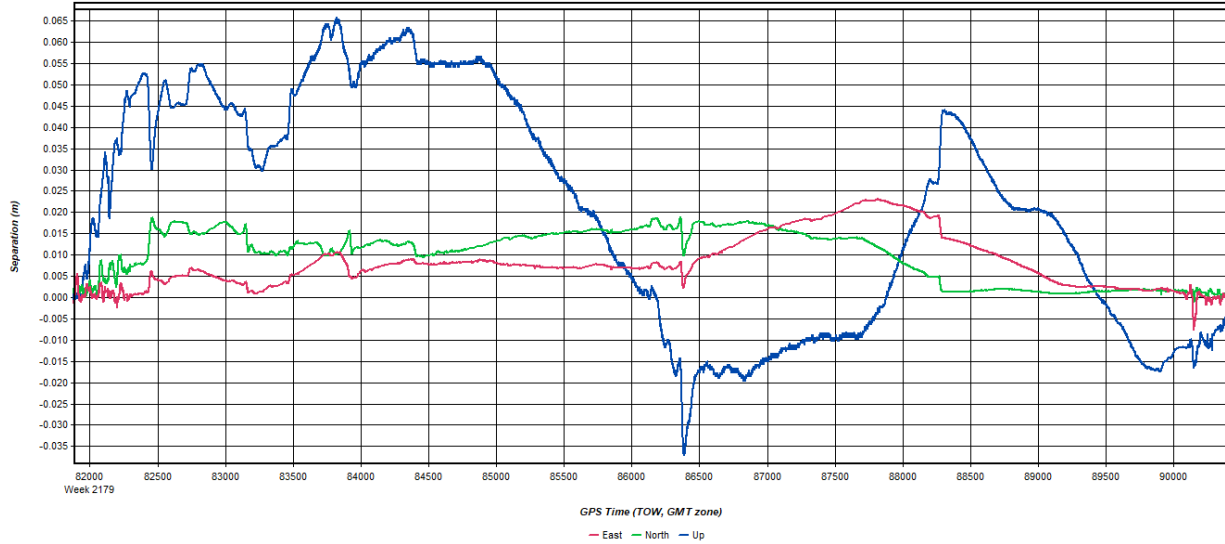
Process 20211010B_GnssImu by Unknown on 10/12/2021 at 14:43:28

Figure 3: 20211010B_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



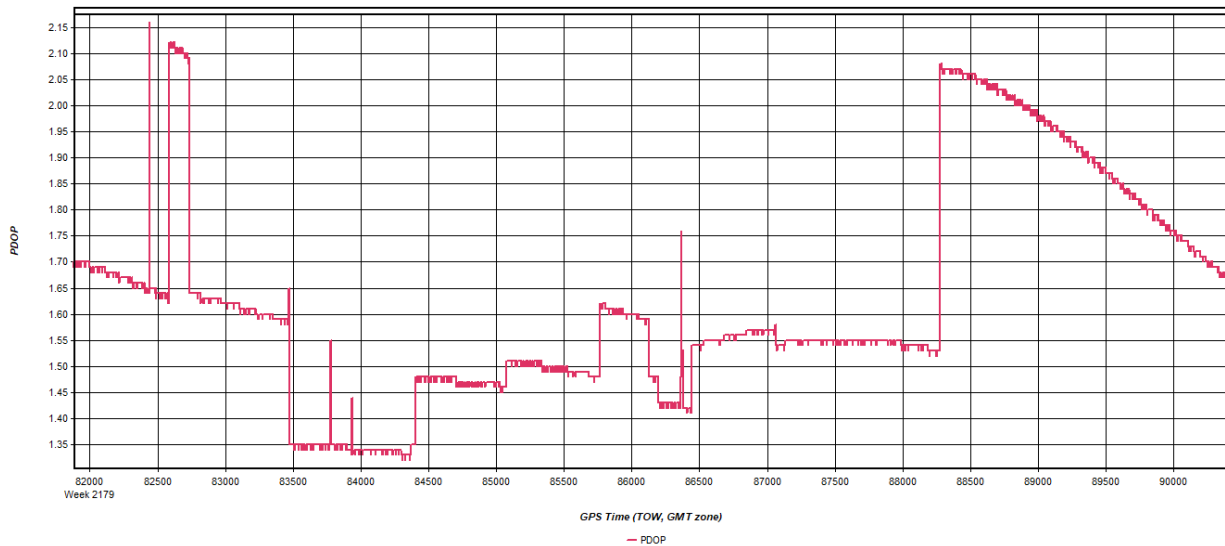
Process 20211010B_GnssImu by Unknown on 10/12/2021 at 14:43:28

Figure 4: 20211010B_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20211010B_GnssImu by Unknown on 10/12/2021 at 14:43:28

Figure 5: 20211010B_GnssImu [Smoothed TC Combined] - PDOP Plot

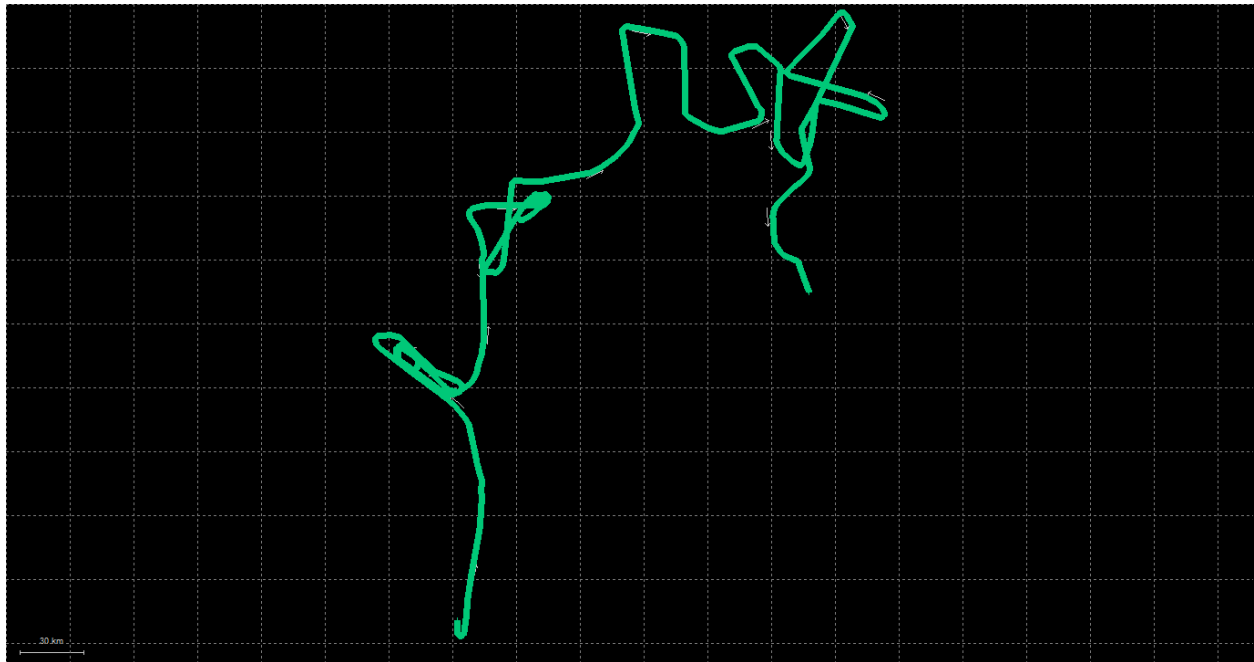


Process 20211010B_GnssImu by Unknown on 10/12/2021 at 14:43:28

Output Results for 20211015A_GnssImu

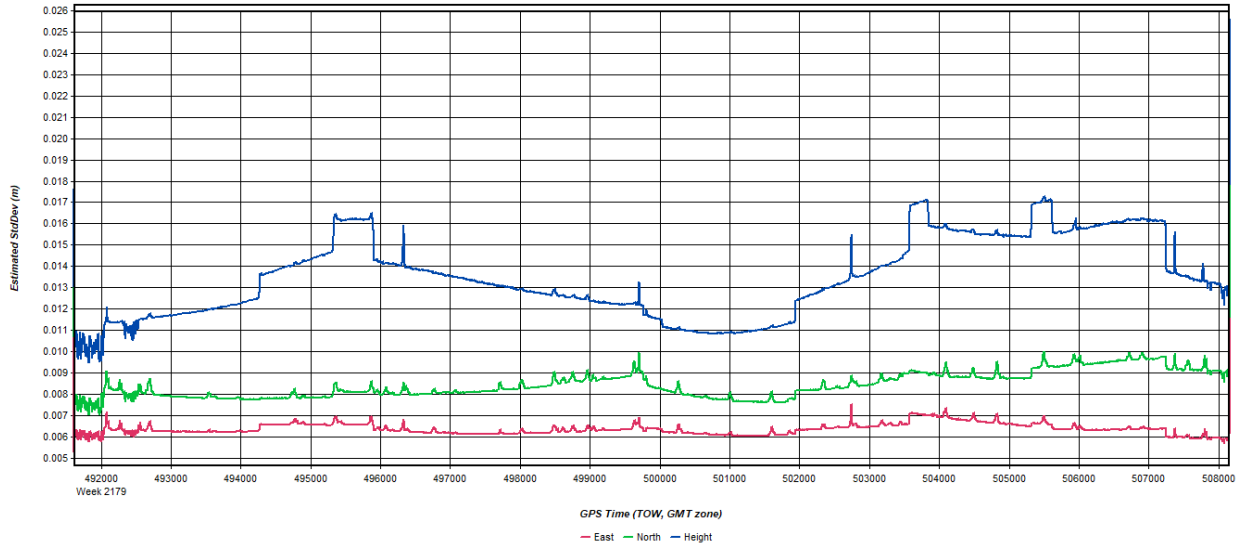
Inertial Explorer Version 8.90.2124
10/18/2021

Figure 1: Smoothed TC Combined - Map



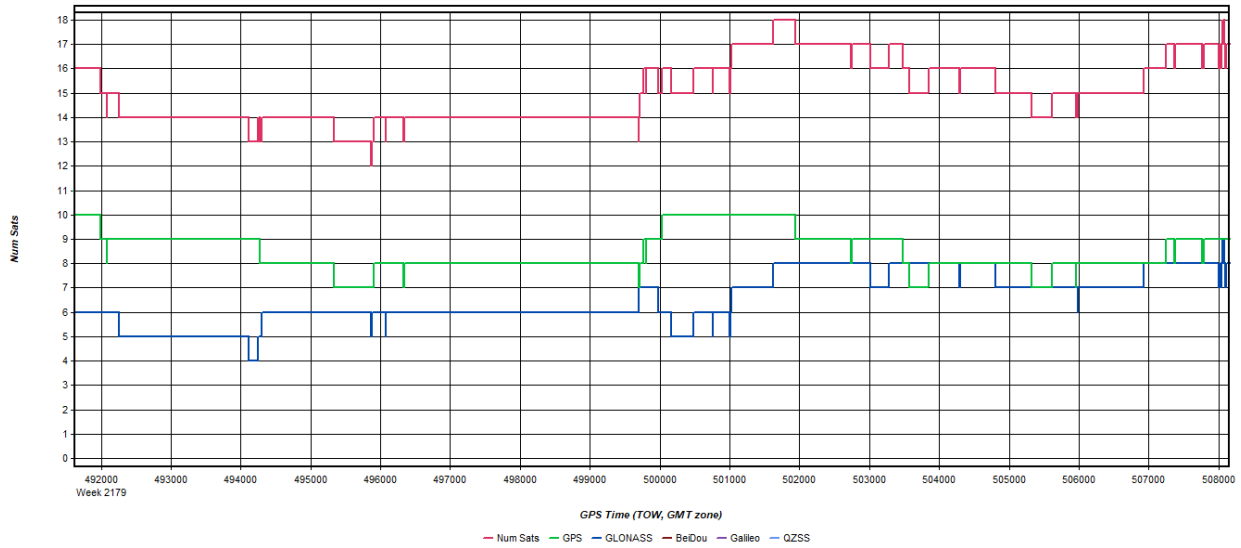
Process	20211015A_GnssImu	by Unknown	on 10/18/2021	at 14:17:50
---------	-------------------	------------	---------------	-------------

Figure 2: 20211015A_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



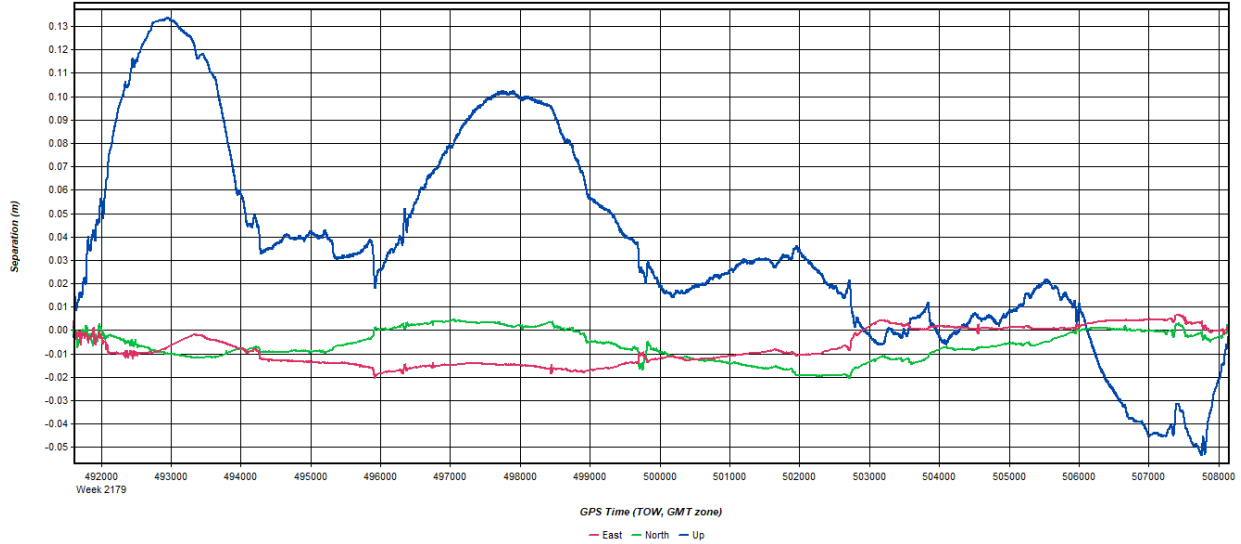
Process 20211015A_GnssImu by Unknown on 10/18/2021 at 14:17:50

Figure 3: 20211015A_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



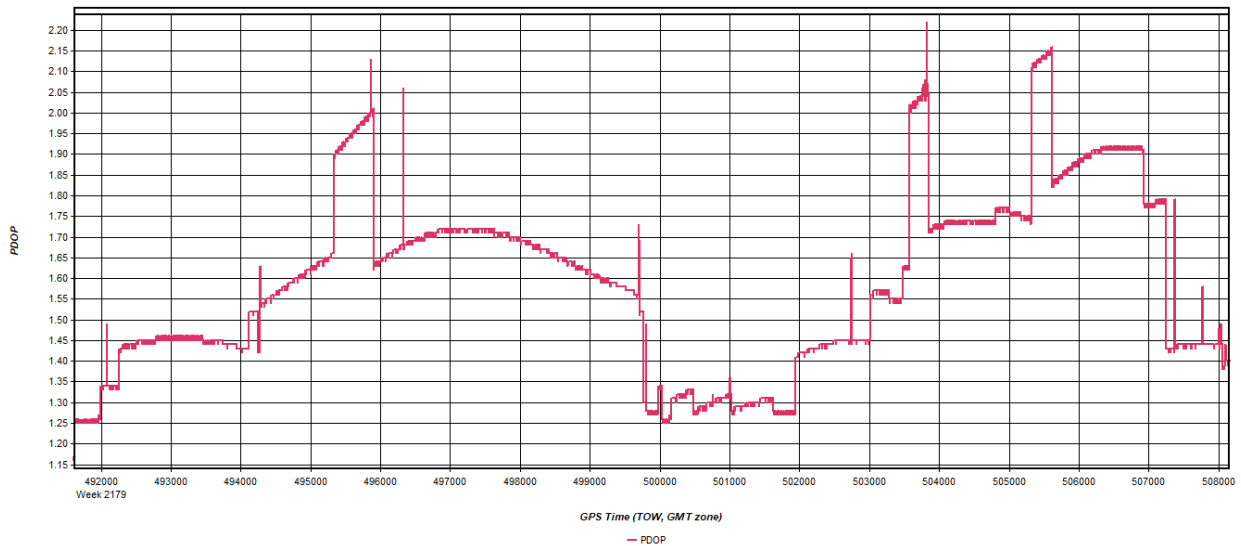
Process 20211015A_GnssImu by Unknown on 10/18/2021 at 14:17:50

Figure 4: 20211015A_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20211015A_GnssImu by Unknown on 10/18/2021 at 14:17:50

Figure 5: 20211015A_GnssImu [Smoothed TC Combined] - PDOP Plot



Process 20211015A_GnssImu by Unknown on 10/18/2021 at 14:17:50

Output Results for 20211015A_GnssImu

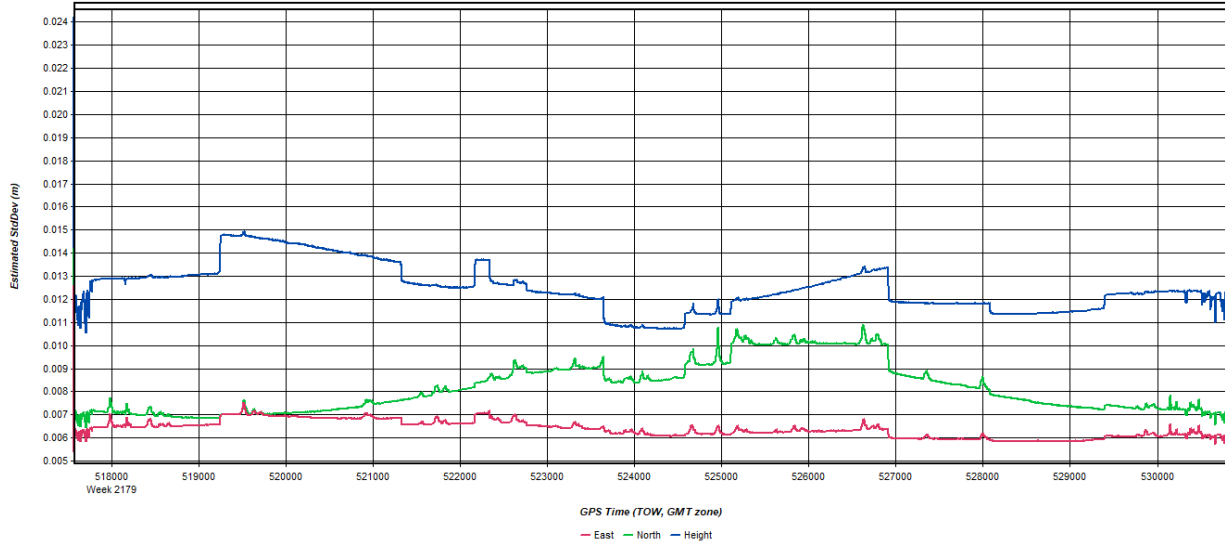
Inertial Explorer Version 8.90.2124
10/18/2021

Figure 1: Smoothed TC Combined - Map



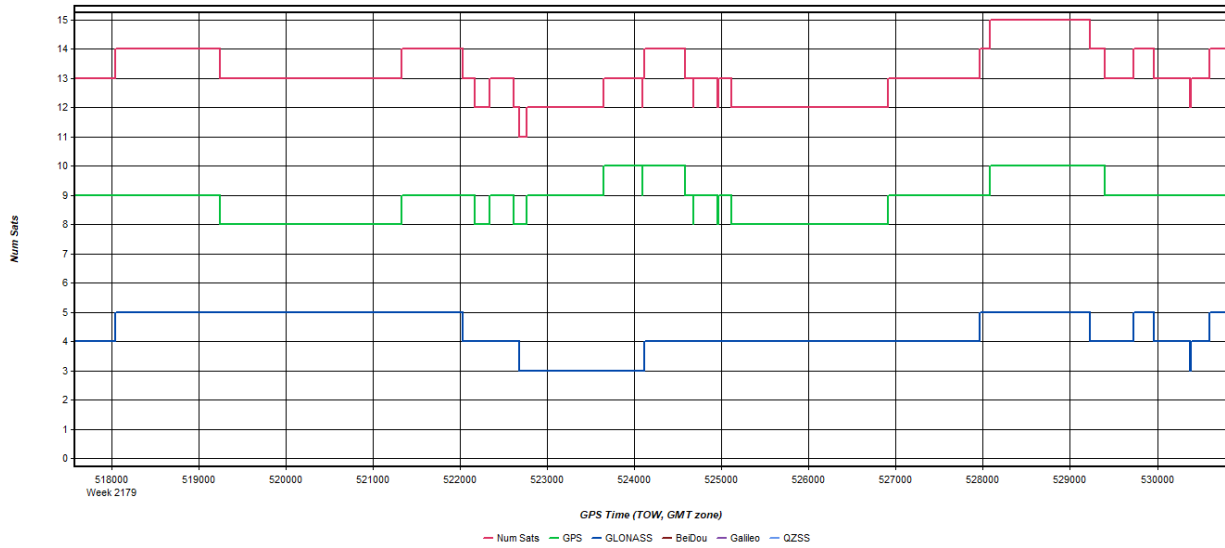
Process	20211015A_GnssImu	by Unknown	on 10/18/2021	at 15:04:35
---------	-------------------	------------	---------------	-------------

Figure 2: 20211015A_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



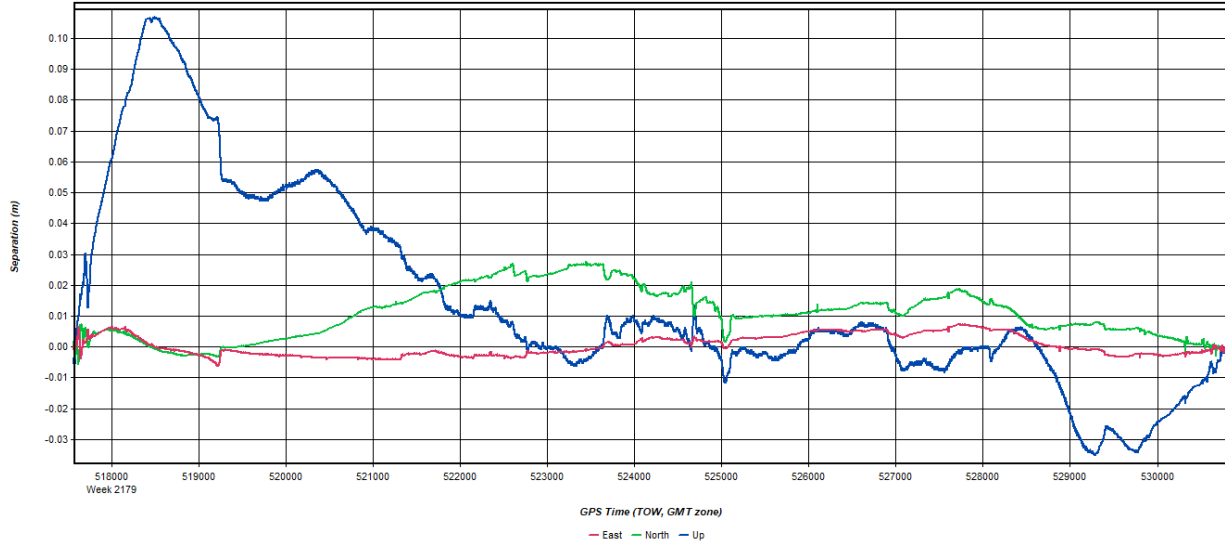
Process 20211015A_GnssImu by Unknown on 10/18/2021 at 15:04:35

Figure 3: 20211015A_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



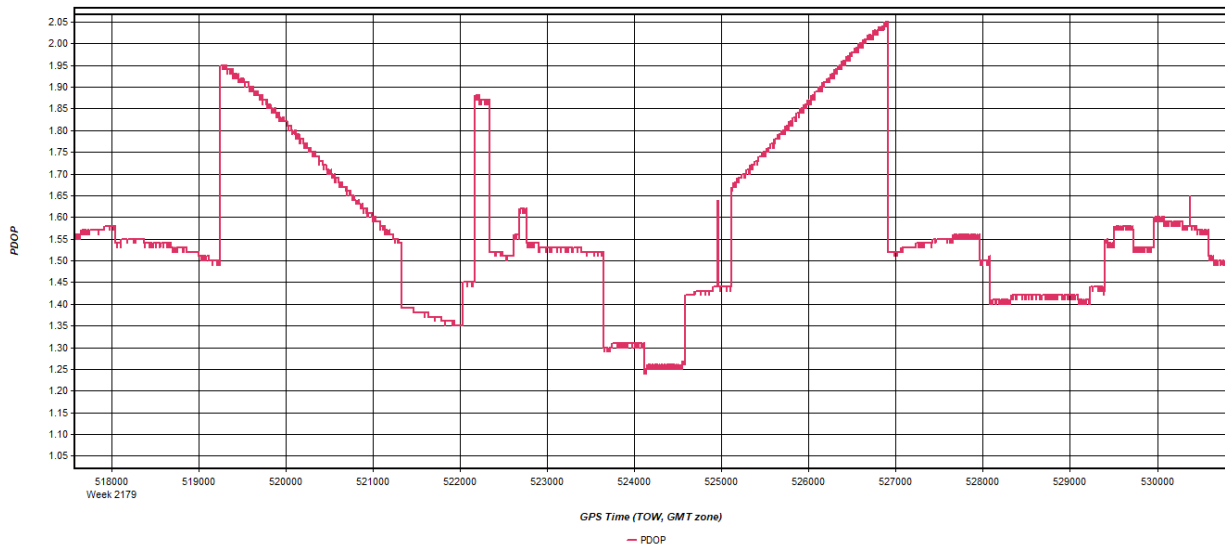
Process 20211015A_GnssImu by Unknown on 10/18/2021 at 15:04:35

Figure 4: 20211015A_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20211015A_GnssImu by Unknown on 10/18/2021 at 15:04:35

Figure 5: 20211015A_GnssImu [Smoothed TC Combined] - PDOP Plot

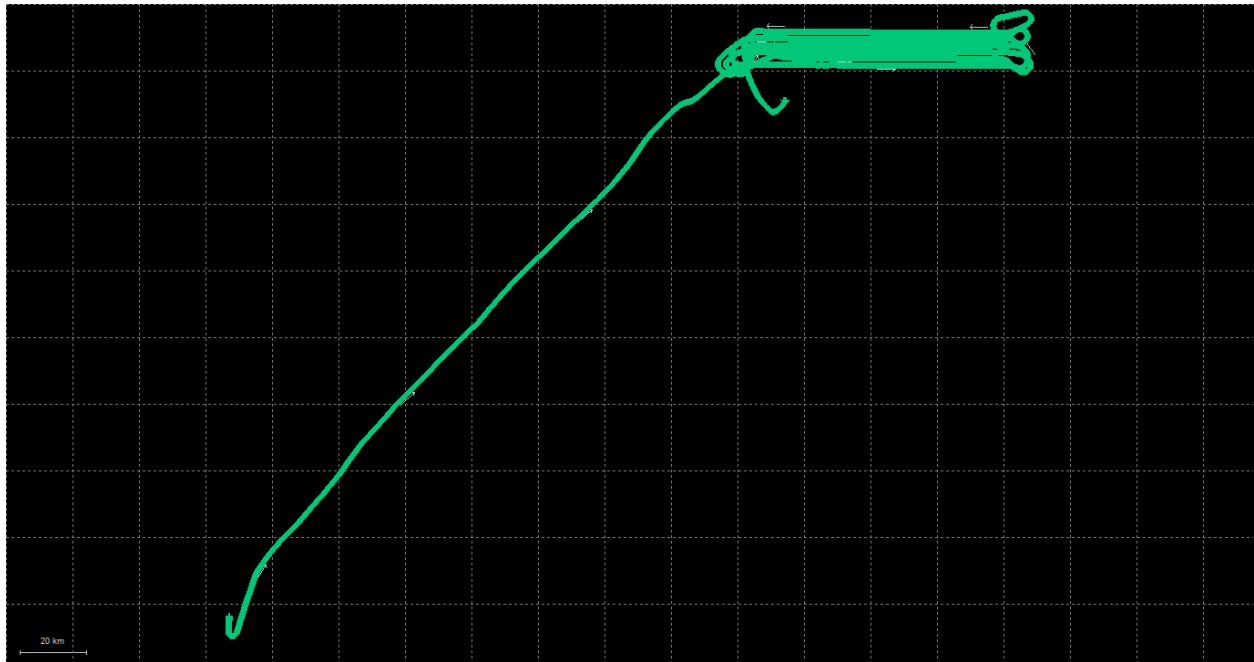


Process 20211015A_GnssImu by Unknown on 10/18/2021 at 15:04:35

Output Results for 20211016A_GnssImu

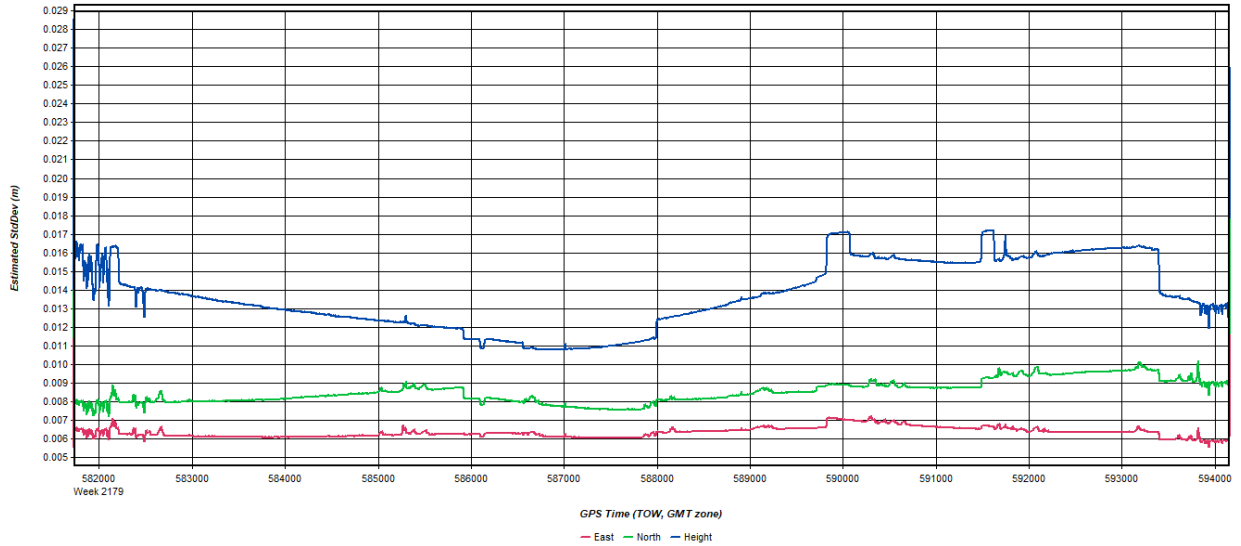
Inertial Explorer Version 8.90.2124
10/18/2021

Figure 1: Smoothed TC Combined - Map



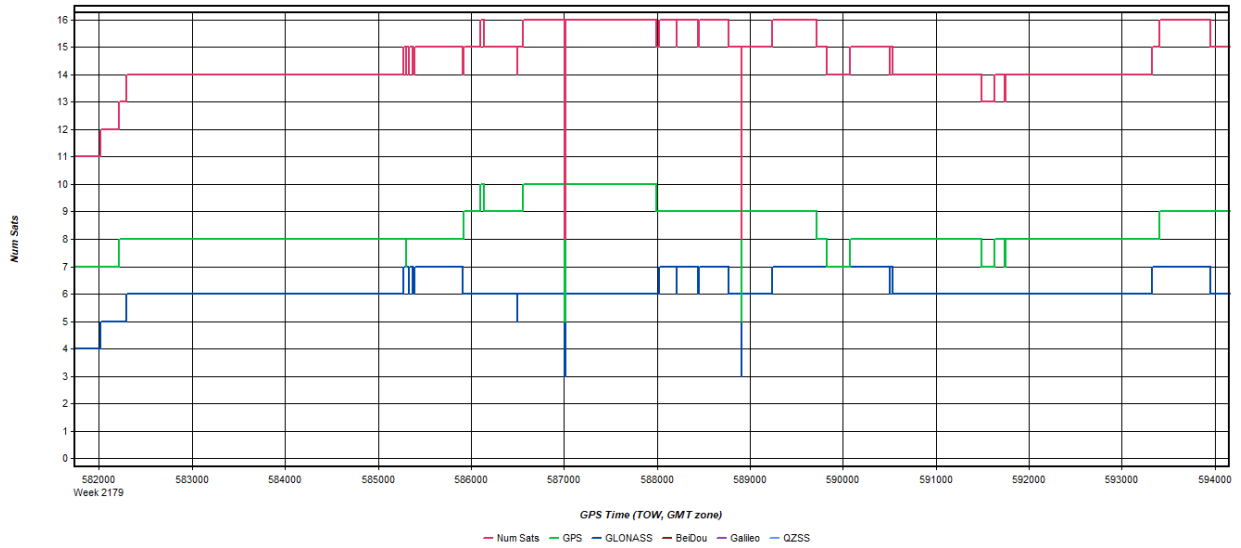
Process	20211016A_GnssImu	by Unknown	on 10/18/2021	at 15:36:39
---------	-------------------	------------	---------------	-------------

Figure 2: 20211016A_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



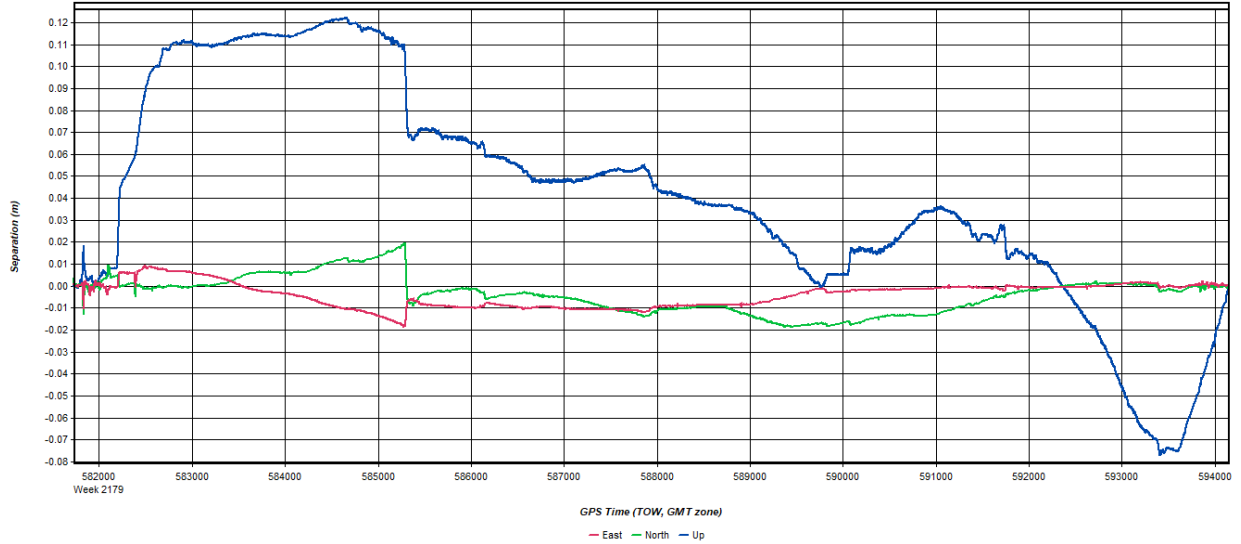
Process 20211016A_GnssImu by Unknown on 10/18/2021 at 15:36:39

Figure 3: 20211016A_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



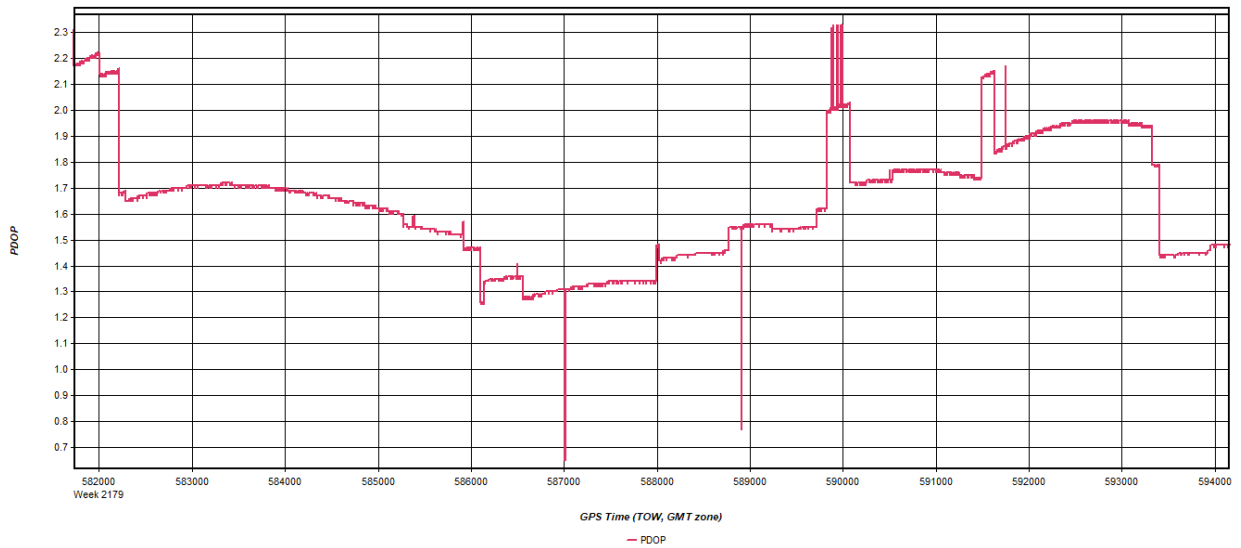
Process 20211016A_GnssImu by Unknown on 10/18/2021 at 15:36:39

Figure 4: 20211016A_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20211016A_GnssImu by Unknown on 10/18/2021 at 15:36:39

Figure 5: 20211016A_GnssImu [Smoothed TC Combined] - PDOP Plot

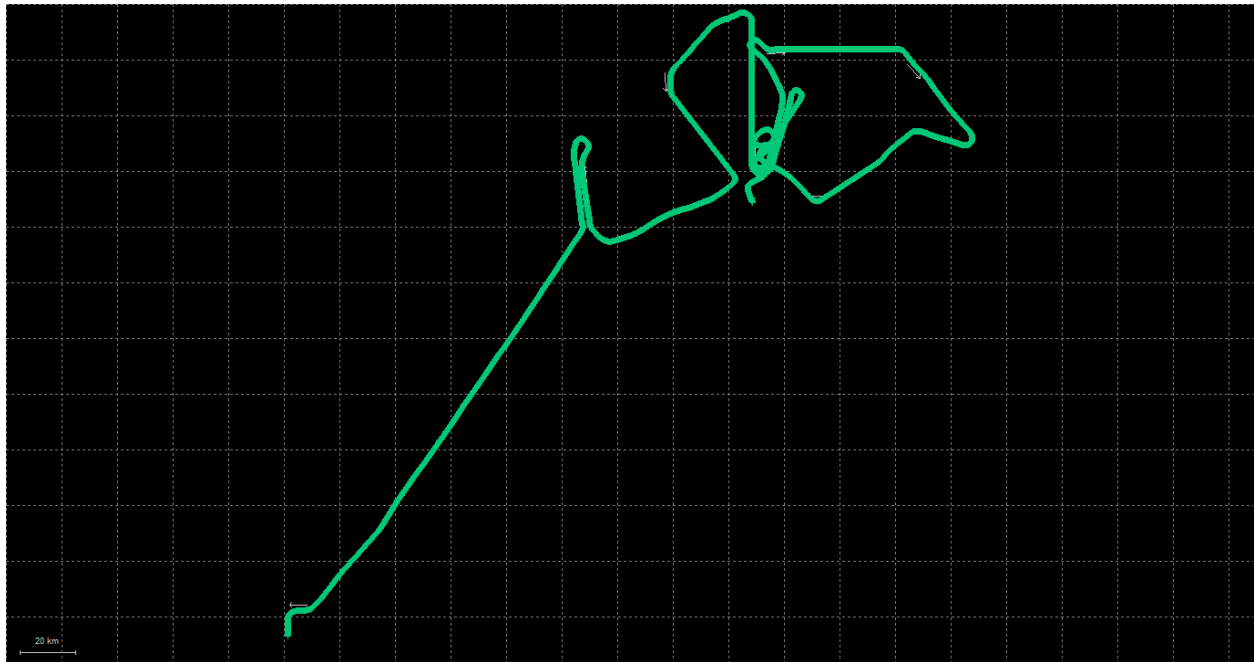


Process 20211016A_GnssImu by Unknown on 10/18/2021 at 15:36:39

Output Results for 20211016B_GnssImu

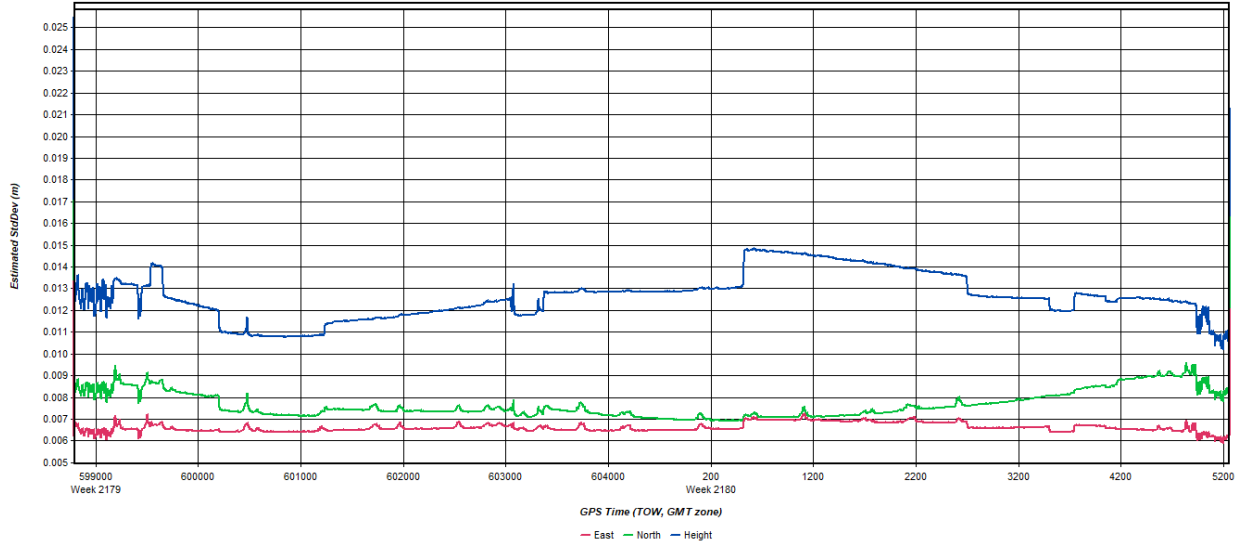
Inertial Explorer Version 8.90.2124
10/18/2021

Figure 1: Smoothed TC Combined - Map



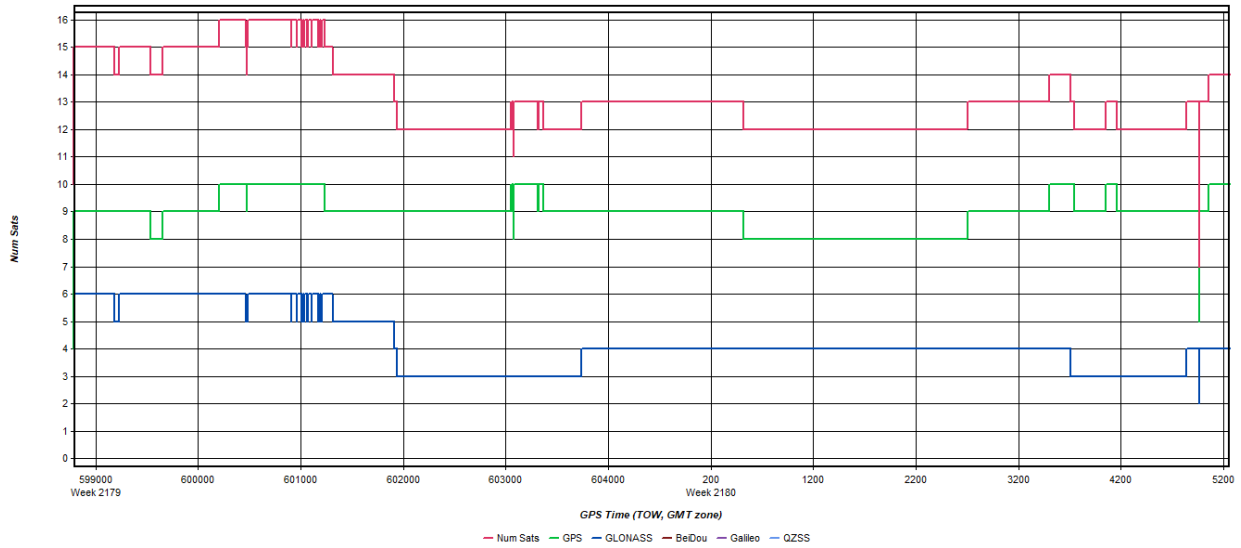
Process	20211016B_GnssImu	by Unknown	on 10/18/2021	at 16:03:22
---------	-------------------	------------	---------------	-------------

Figure 2: 20211016B_GnssImu [Smoothed TC Combined] - Estimated Position Accuracy Plot



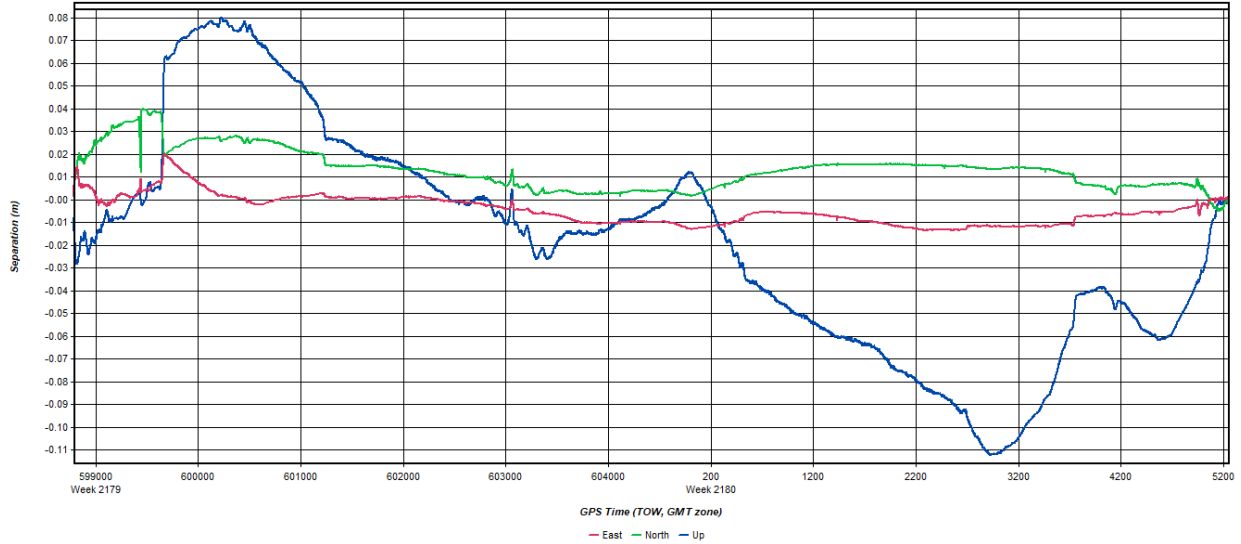
Process 20211016B_GnssImu by Unknown on 10/18/2021 at 16:03:22

Figure 3: 20211016B_GnssImu [Smoothed TC Combined] - Number of Satellites Line Plot



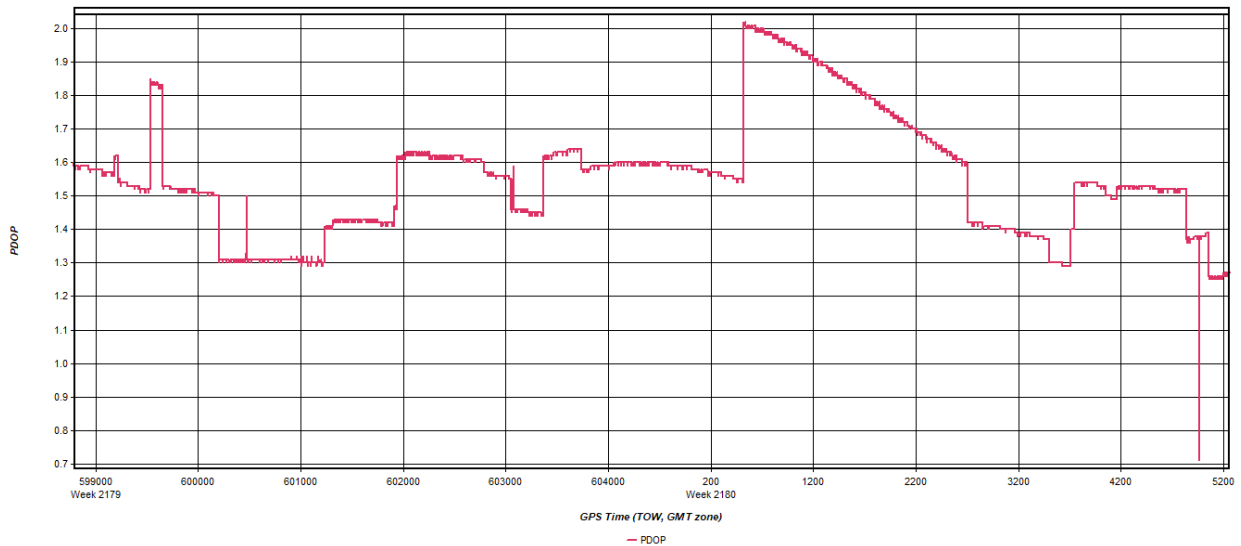
Process 20211016B_GnssImu by Unknown on 10/18/2021 at 16:03:22

Figure 4: 20211016B_GnssImu [Smoothed TC Combined] - Forward/Reverse or Combined Separation Plot



Process 20211016B_GnssImu by Unknown on 10/18/2021 at 16:03:22

Figure 5: 20211016B_GnssImu [Smoothed TC Combined] - PDOP Plot



Process 20211016B_GnssImu by Unknown on 10/18/2021 at 16:03:22