

Zero Base-length Data Processing

Post-Processing Kinematic (PPK) for High-Accuracy Position Data

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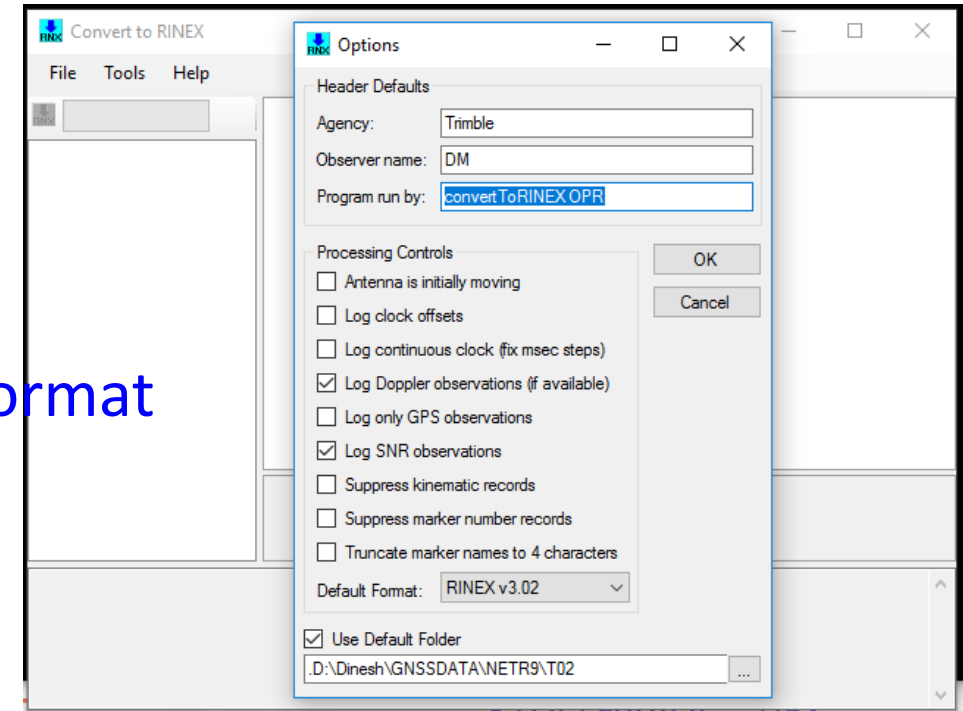
Observation Data

- Base Station Data

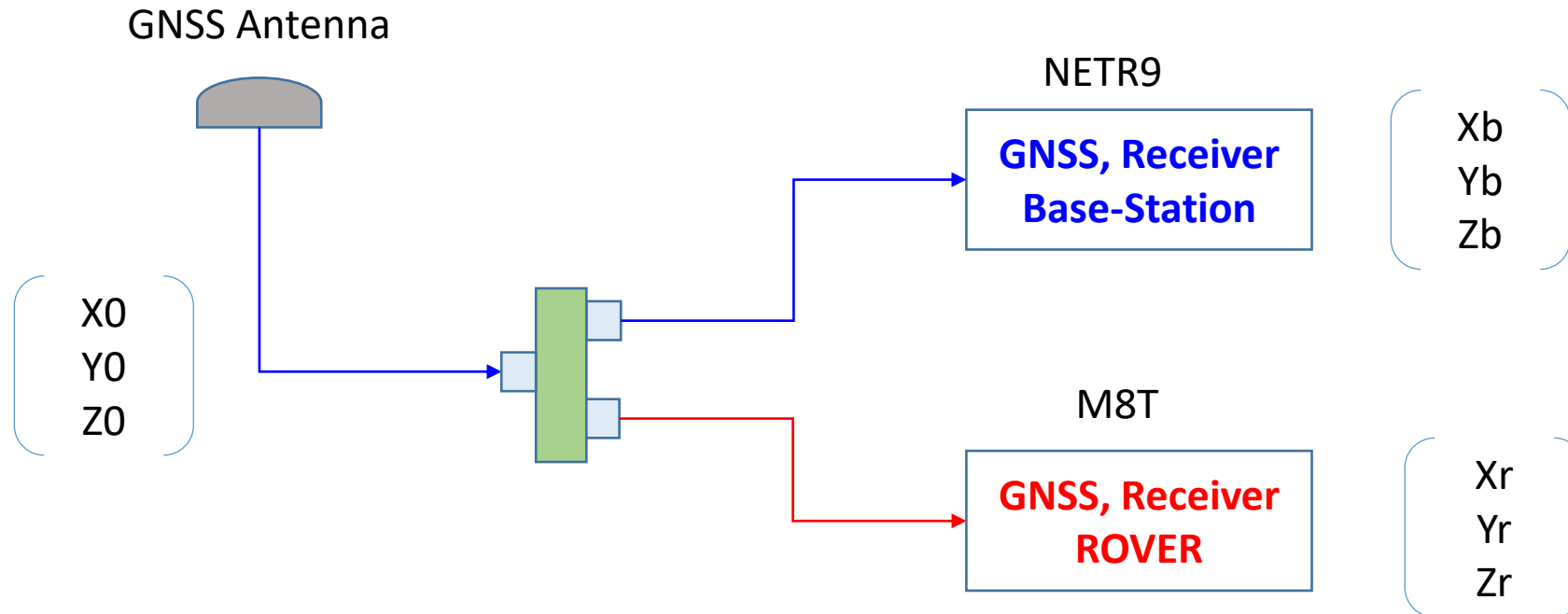
- Receiver : Trimble NetR9
Multi-frequency, Multi System
- Data Format : T02 Trimble format
- Data Conversion : Convert to RINEX Format
- Antenna : Zephyr 2

- Rover Data

- Receiver : U-Blox M8T
- Data Format : UBX
- Data Conversion : Convert to RINEX Format using RTKLIB



Zero Base-Length PPK



Zero Base-Length = Distance between Base and Rove is Zero

Both receivers are sharing the same antenna with a splitter

Thus, $\{X_0\}$, $\{X_b\}$ and $\{X_r\}$ must be the same.

However, due to various errors and signal processing techniques inside the receivers, the position data fro $\{X_b\}$ and $\{X_r\}$ might be different.

A good test to see receiver performance

PPK → RTK in Post-Processing Mode

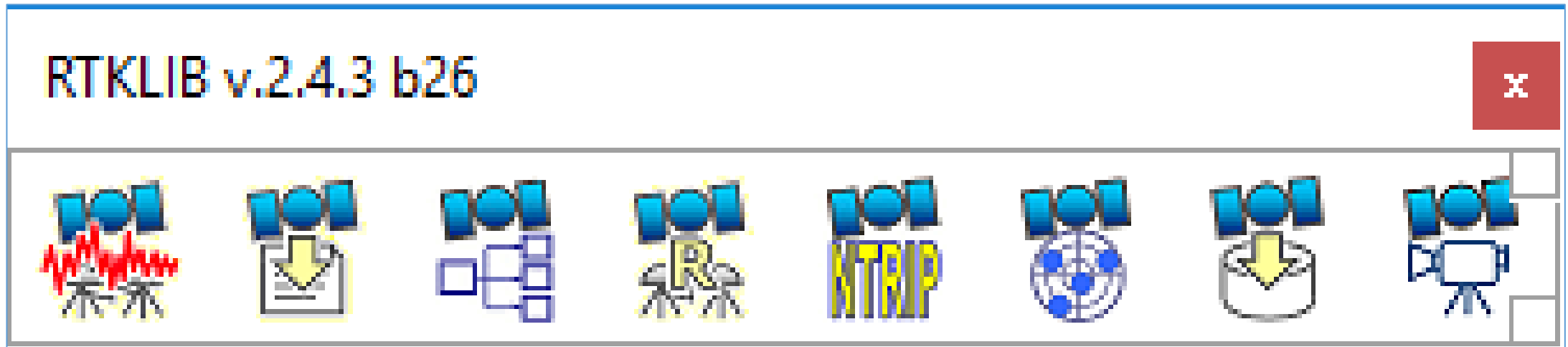
Zero Base-Length PPK Results

$$\begin{pmatrix} X_0 \\ Y_0 \\ Z_0 \end{pmatrix} = \begin{pmatrix} X_b \\ Y_b \\ Z_b \end{pmatrix} = \begin{pmatrix} X_r \\ Y_r \\ Z_r \end{pmatrix} \quad \text{Check the results of } X_0, X_b \text{ and } X_r$$
$$\begin{pmatrix} X_0 \\ Y_0 \\ Z_0 \end{pmatrix} = \begin{pmatrix} X_b \\ Y_b \\ Z_b \end{pmatrix} \neq \begin{pmatrix} X_r \\ Y_r \\ Z_r \end{pmatrix}$$

Compute Base Station Antenna Coordinate

- Observer Data for 24 hour
- Convert to RINEX 2.12 Format
- Use Online PPP Service
- Use Software provided by maker (If available) for PPP
- Use RTKLIB for PPP
- Use RTK Processing with the nearest base-station

Post-processing using RTKLIB



RTKLIB

Select Rover and
Base Files

RTKPOST ver.2.4.3 b26

Time Start (GPST) ? Time End (GPST) ? Interval Unit

2016/03/12 00:30:00 2016/03/06 01:00:00 0 s 24 H

RINEX OBS: Rover ?

D:\Dinesh\GNSSDATA\M8T\20191019\20191019.obs

RINEX OBS: Base Station

D:\Dinesh\GNSSDATA\NETR9\R211\01022920B.19o

RINEX NAV/CLK, SP3, FCB, IONEX, SBS/EMS or RTCM

D:\Dinesh\GNSSDATA\NETR9\R211\01022920B.19n

Solution Dir D:\GNSS_Training\Data\RTK\1h_static

D:\Dinesh\GNSSDATA\M8T\20191019\20191019.nmea

?

Plot... View... KML/GPX... Options... Execute Exit

RTKLIB

Setting 1 Menu

Options



Setting1

Setting2

Output

Statistics

Positions

Files

Misc

Positioning Mode

Static



Frequencies / Filter Type

L1+L2



Forward



Elevation Mask (°) / SNR Mask (dBHz)

15



...

Rec Dynamics / Earth Tides Correction

OFF



OFF



Ionosphere Correction

Broadcast



Troposphere Correction

Saastamoinen



Satellite Ephemeris/Clock

Broadcast



Sat PCV Rec PCV PhWU Rej Ed RAIM FDE DBCorr

Excluded Satellites (+PRN: Included)

GPS GLO Galileo QZSS SBAS BeiDou IRNSS

Load...

Save...

OK

Cancel

Setting 1 Menu Processing Options

The screenshot shows the 'Options' dialog box in RTKLIB, with the 'Setting1' tab selected. The 'Positioning Mode' dropdown menu is open, showing various options. The 'Setting1' tab contains the following options:

- Positioning Mode: Static (selected in the dropdown)
- Frequencies / Filter Type
- Elevation Mask (°) / SNR Mask (dBHz)
- Rec Dynamics / Earth Tides Correction
- Ionosphere Correction
- Troposphere Correction
- Satellite Ephemeris/Clock
- Sat PCV Rec PCV PhWU Rej Ed RAIM FDE DBCorr
- Excluded Satellites (+PRN: Included) [Empty text box]
- GPS GLO Galileo QZSS SBAS BeiDou IRNSS

At the bottom of the dialog are four buttons: 'Load...', 'Save...', 'OK', and 'Cancel'.

RTKLIB

Setting 2 Menu

Options



Setting1	Setting2	Output	Statistics	Positions	Files	Misc
Integer Ambiguity Res (GPS/GLO/BDS)	Fix and I	OFF	ON			
Min Ratio to Fix Ambiguity	3					
Min Confidence / Max FCB to Fix Amb	0.9999	0.25				
Min Lock / Elevation (°) to Fix Amb	0	0				
Min Fix / Elevation (°) to Hold Amb	10	0				
Outage to Reset Amb/Slip Thres (m)	5	0.050				
Max Age of Diff (s) / Sync Solution	30.0	ON				
Reject Threshold of GDOP/Innov (m)	30.0	30.0				
Max # of AR Iter/# of Filter Iter	1	1				
<input type="checkbox"/> Baseline Length Constraint (m)	0.000	0.000				

Load...
Save...
OK
Cancel

RTKLIB

Output Menu

Options



Setting1	Setting2	Output	Statistics	Positions	Files	Misc
Solution Format		NMEA0183		v		
Output Header / Output Processing Options		OFF		v OFF v		
Time Format / # of Decimals		hh:mm:ss GPST		v 3		
Latitude Longitude Format / Field Separator		ddd.dddddd		v		
Output Single if Sol Outage / Max Sol Std (m)		OFF		v 0		
Datum / Height		WGS84		v Ellipsoidal v		
Geoid Model		Internal		v		
Solution for Static Mode		All		v		
NMEA Interval (s) RMC/GGA, GSA/GSV		0		0		
Output Solution Status / Output Debug Trace		OFF		v OFF v		
Load...		Save...		OK		Cancel

Positions Menu

Options



Setting1

Setting2

Output

Statistics

Positions

Files

Misc

Rover

RINEX Header Position



90.000000000

0.000000000

-6335367.6285

Antenna Type (*: Auto)

Delta-E/N/U (m)

0.0000

0.0000

0.0000

Base Station

X/Y/Z-ECEF (m)



-3958757.045

3328944.101

3719537.389

Antenna Type (*: Auto)

Delta-E/N/U (m)

0.0000

0.0000

0.0000

Station Position File



Load...

Save...

OK

Cancel

RTKLIB

Processing Running

RTKPOST ver.2.4.3 b26

Time Start (GPST) ? Time End (GPST) ? Interval Unit

2016/03/12 00:30:00 2016/03/06 01:00:00 0 s 24 H

RINEX OBS: Rover ?

D:\Dinesh\GNSSDATA\M8T\20191019\20191019.obs

RINEX OBS: Base Station

D:\Dinesh\GNSSDATA\NETR9\R211\01022920B.19o

RINEX NAV/CLK, SP3, FCB, IONEX, SBS/EMS or RTCM

D:\Dinesh\GNSSDATA\NETR9\R211\01022920B.19n

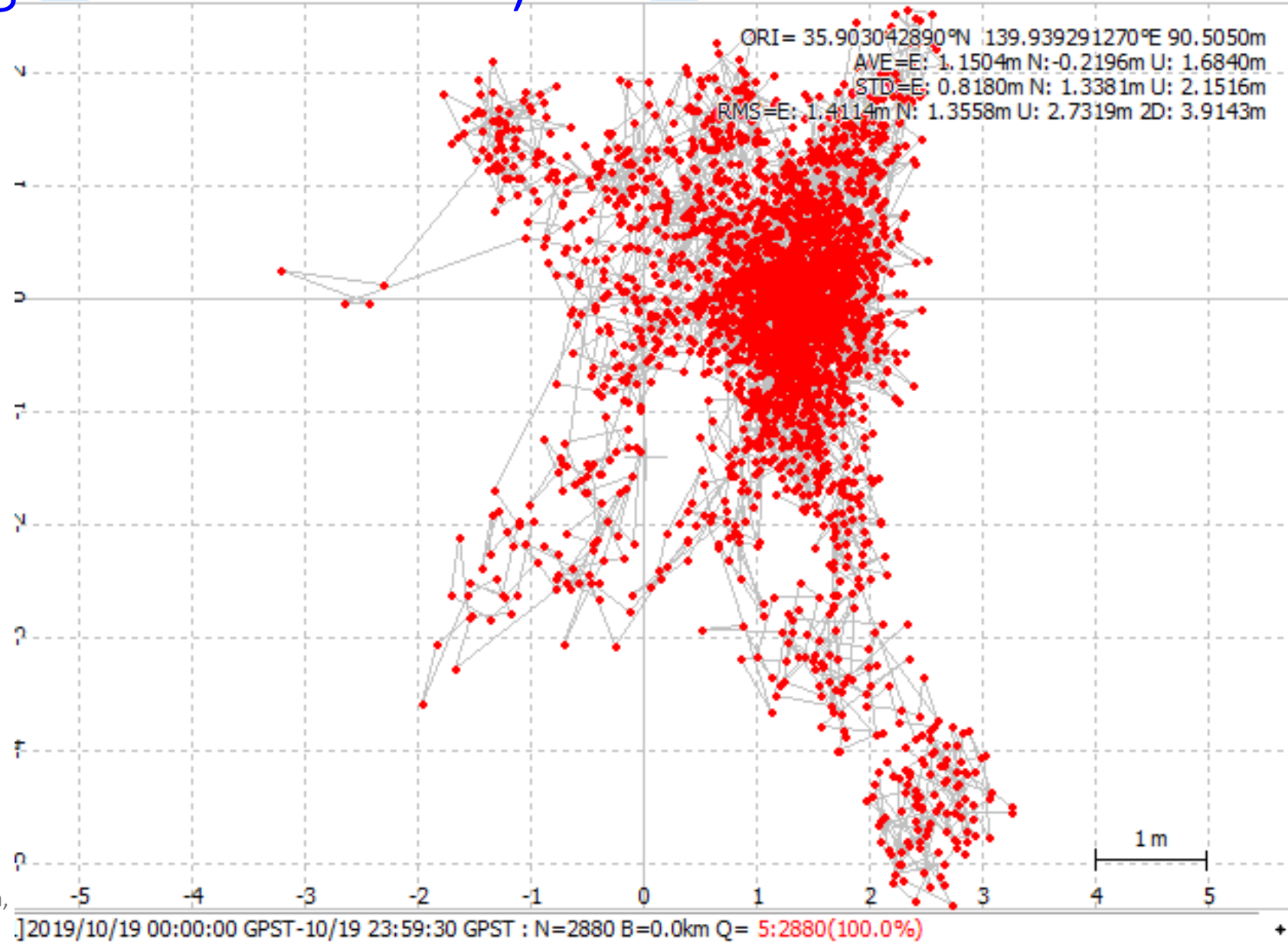
Solution Dir D:\Dinesh\GNSSDATA\M8T\20191019\TEST

D:\Dinesh\GNSSDATA\M8T\20191019\TEST\20191019.nmea

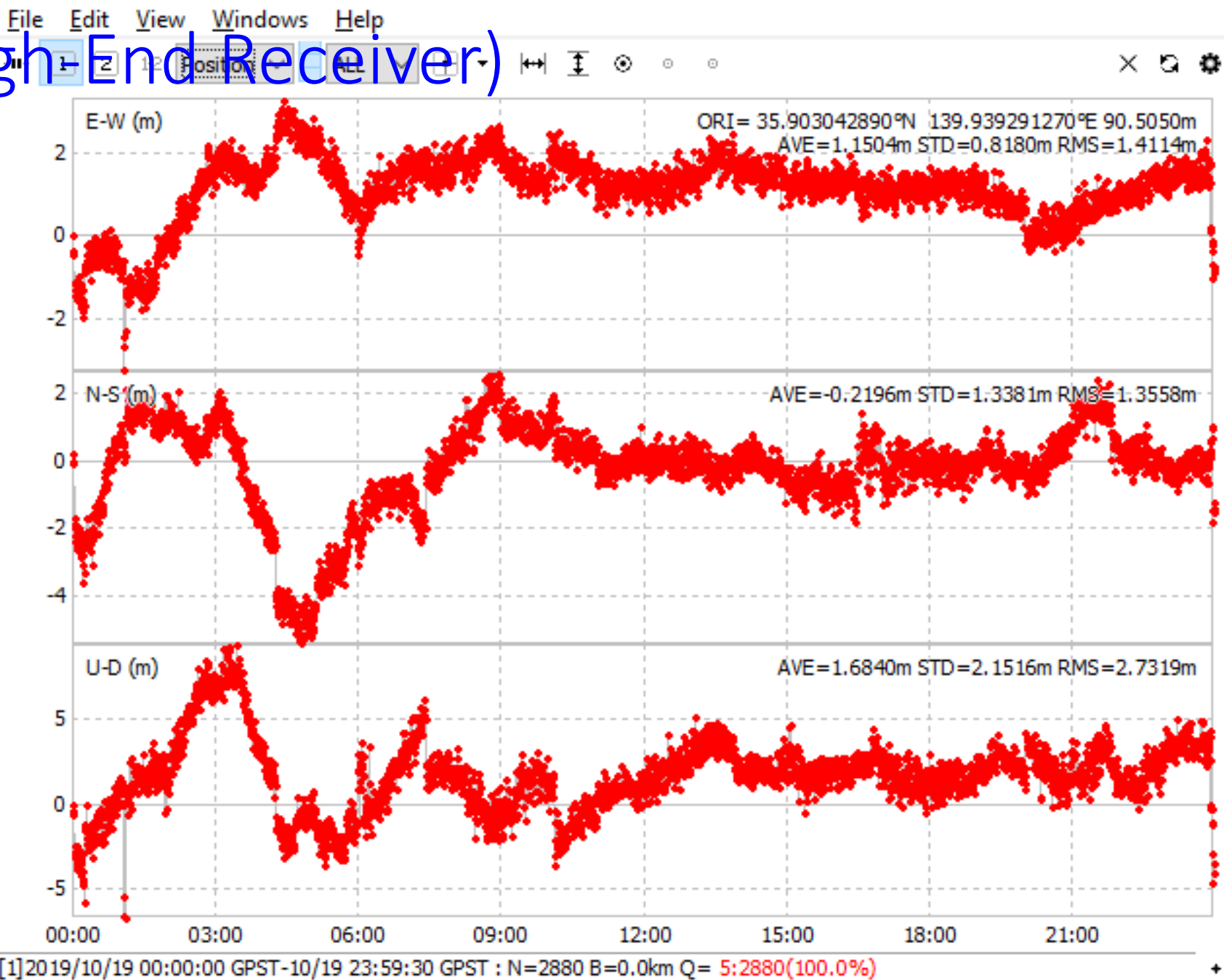
processing : 2019/10/19 01:12:56 Q=1 ?

Plot... View... KML/GPX... Options... Abort Exit

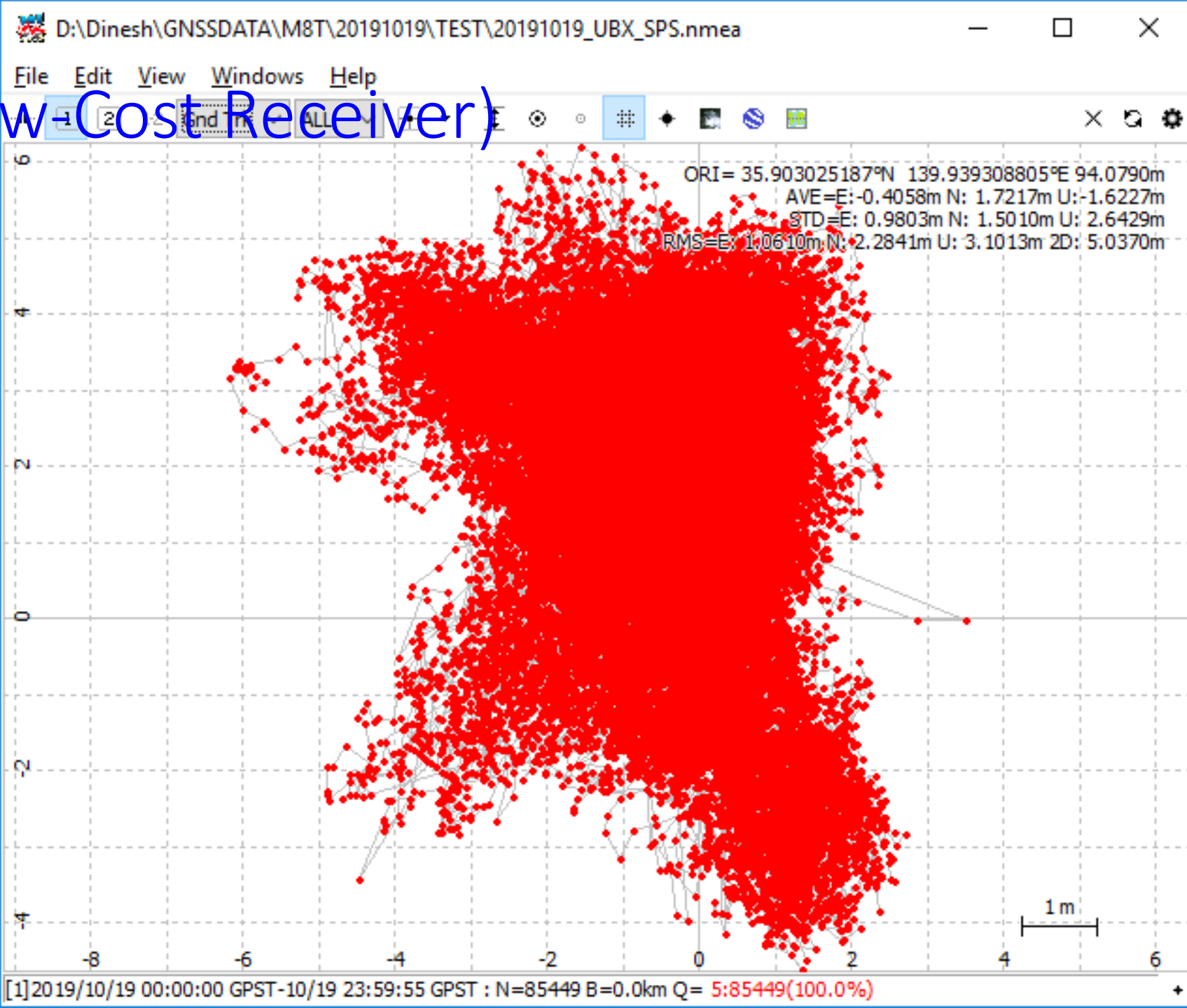
SPP : NetR9 (High-End Receiver)



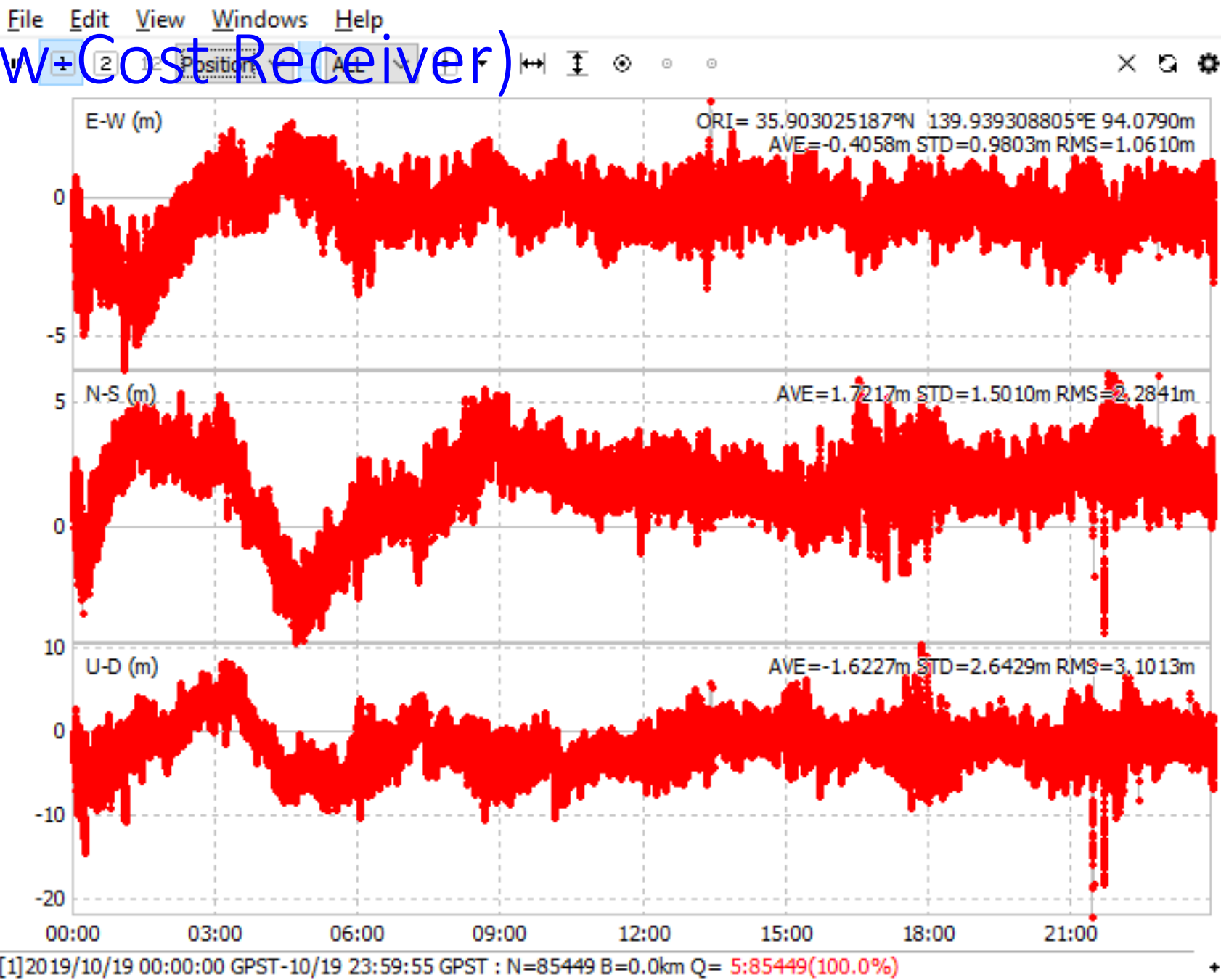
SPP : NetR9 (High-End Receiver)



SPP : U-blox (Low-Cost Receiver)



SPP : U-blox (Low Cost Receiver)

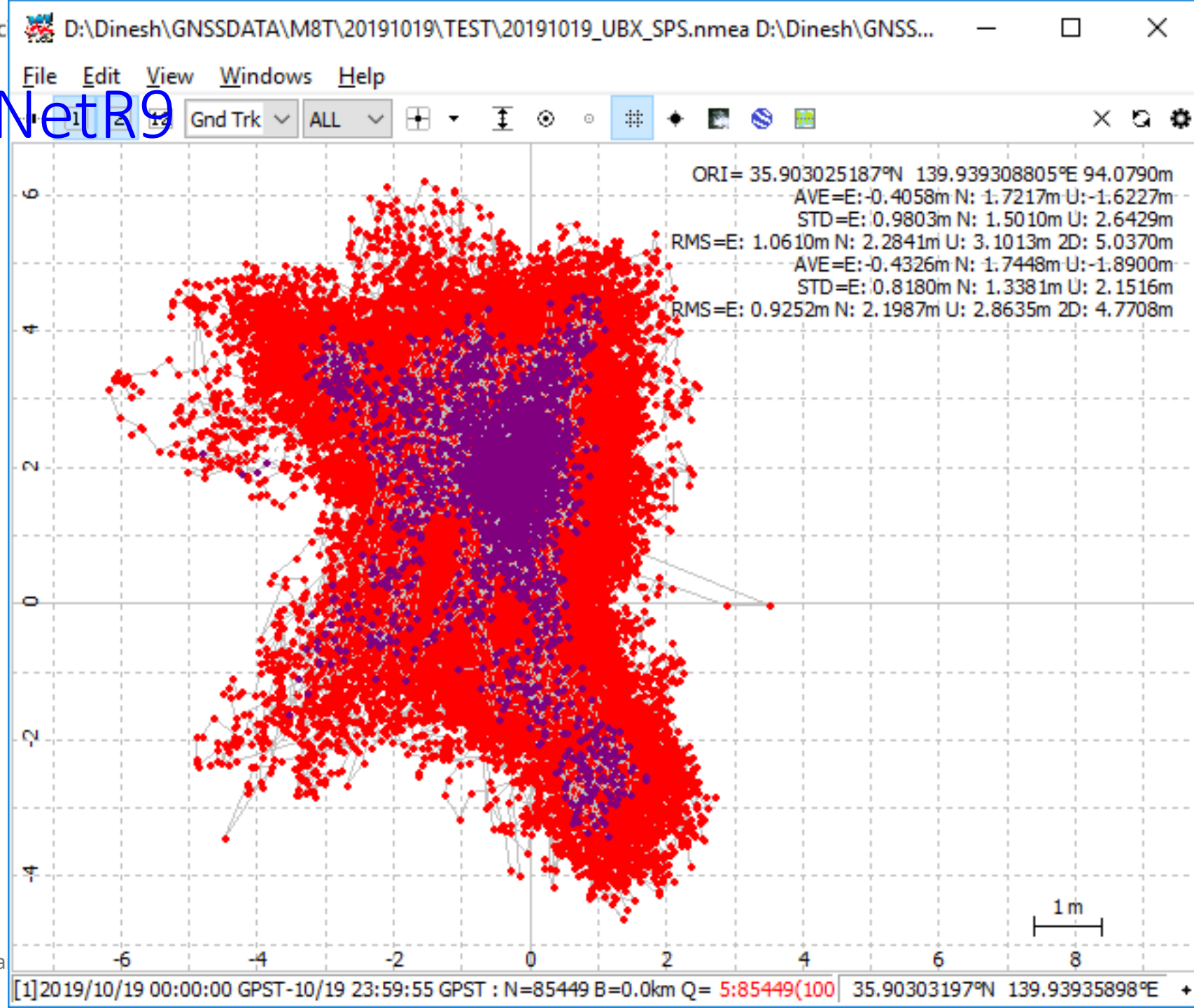


SPP : u-blox vs NetR9

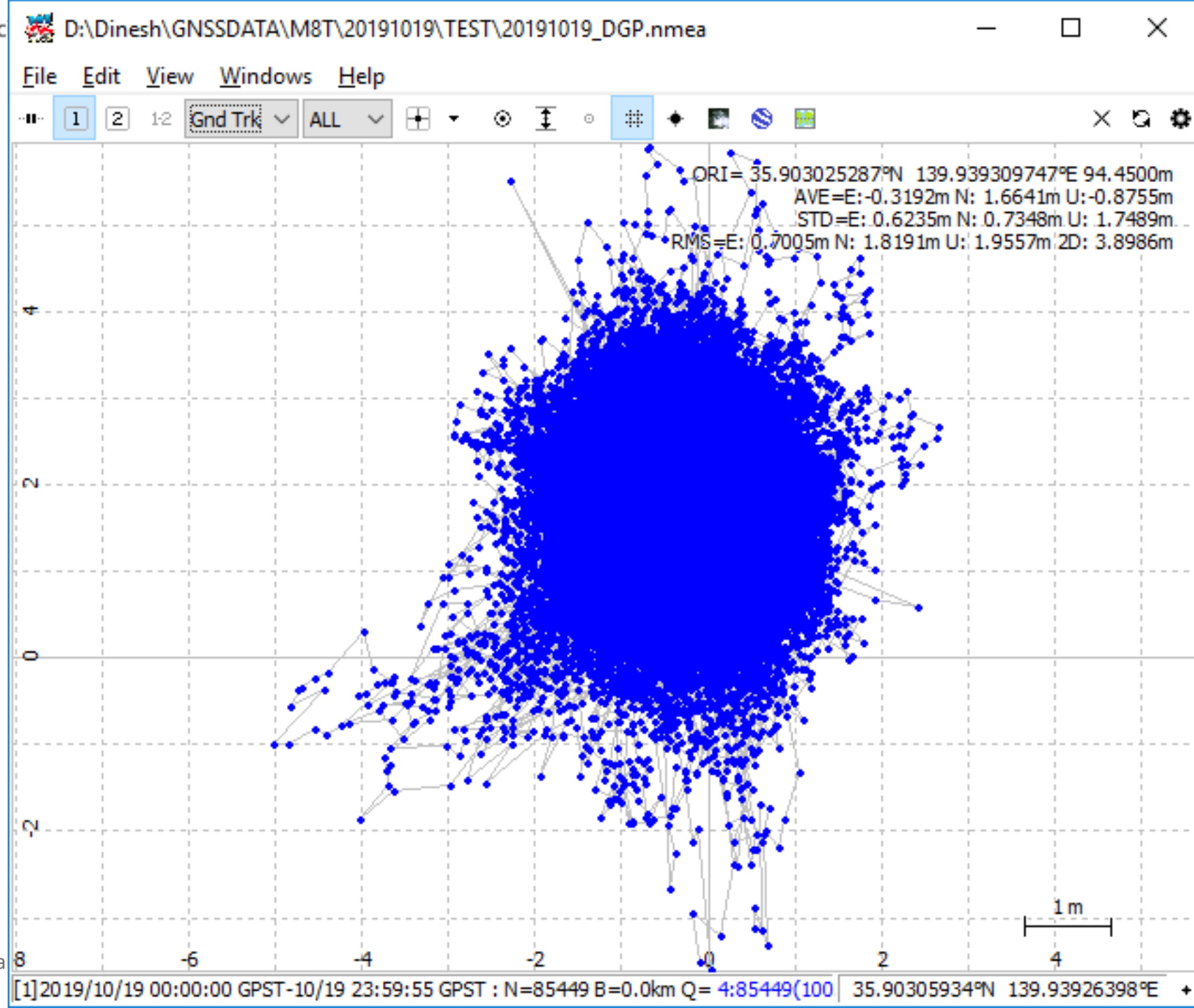
SPP Output

Red: u-blox (Low-Cost)

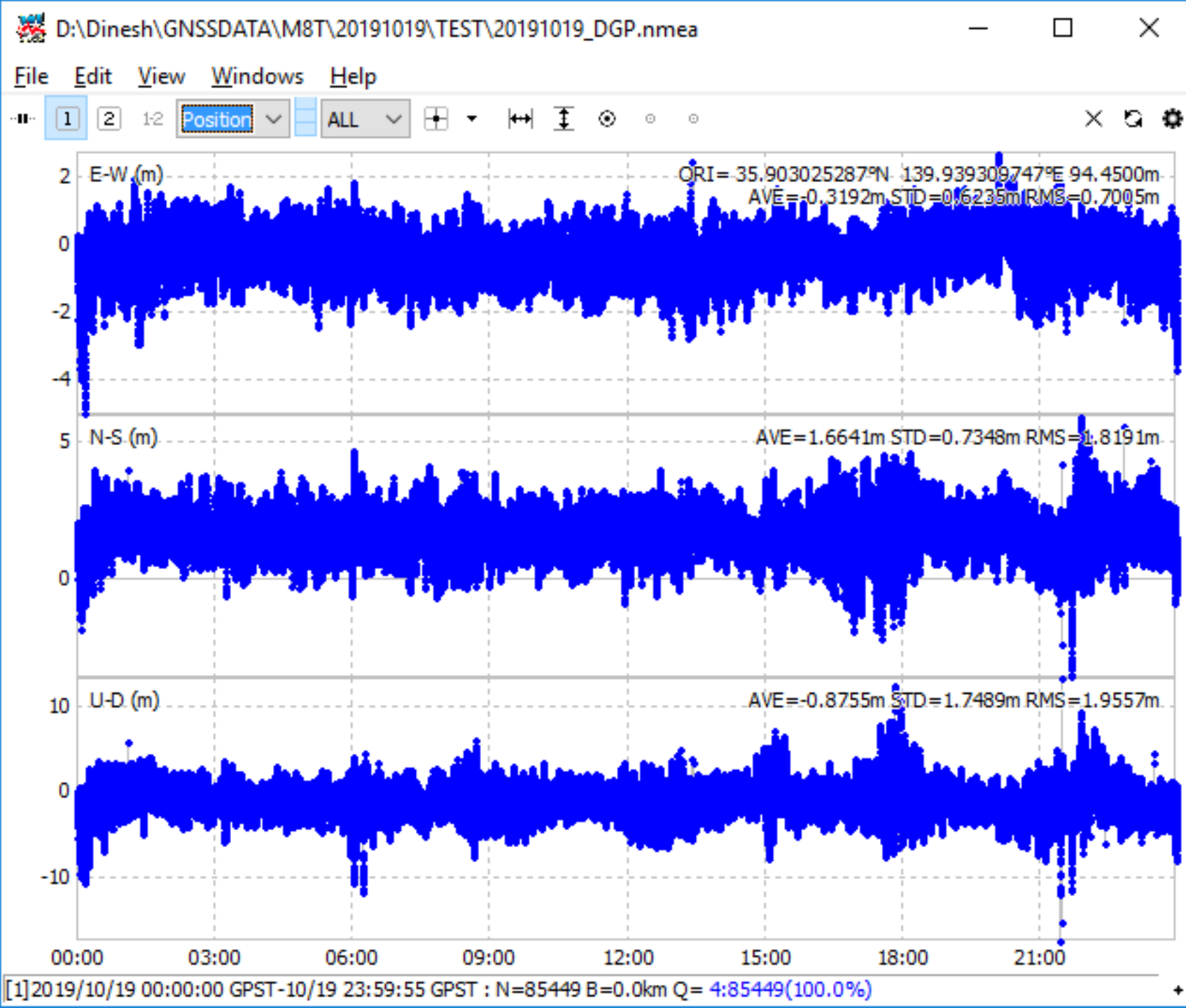
Violet: NetR9 (High-End)

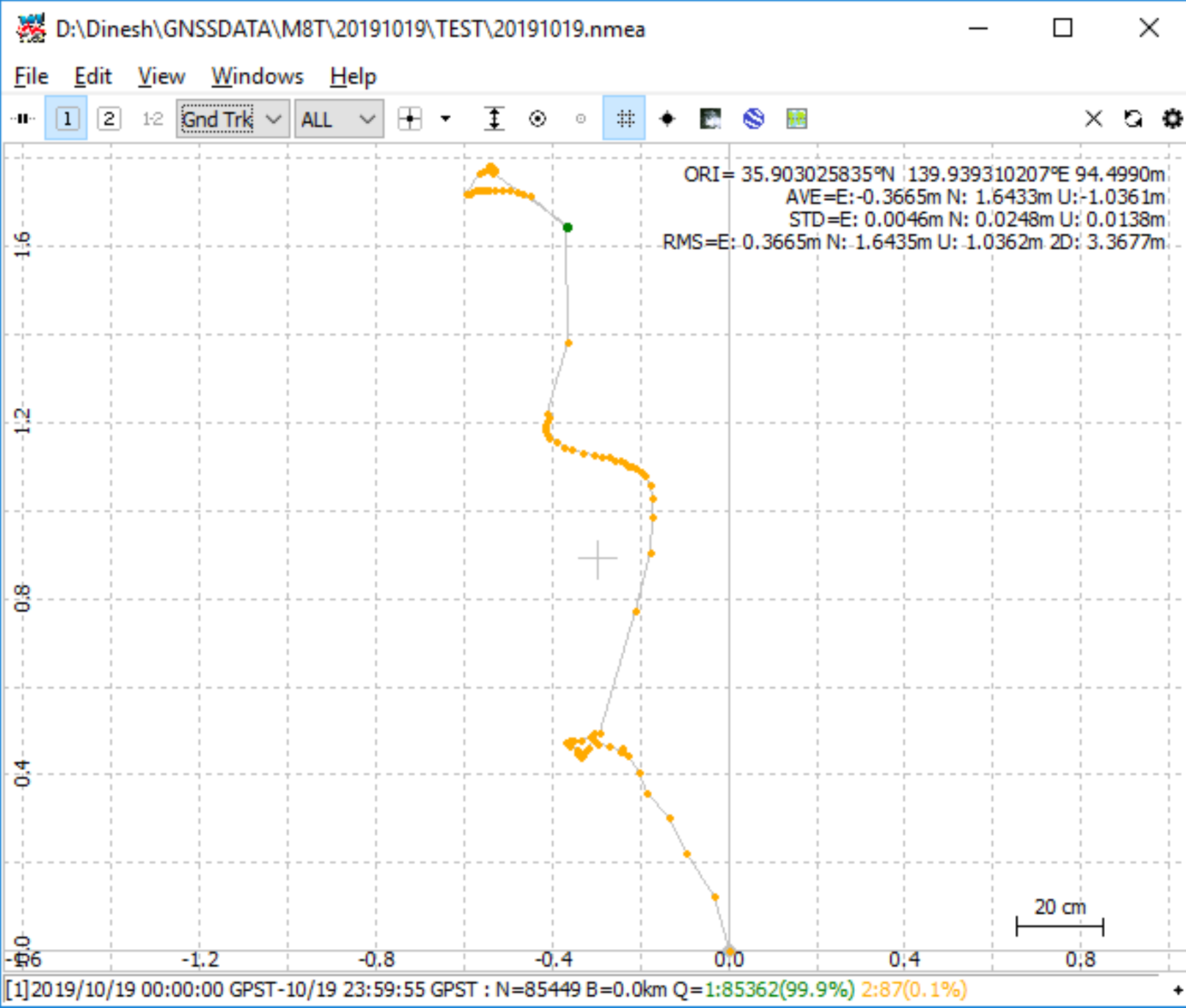


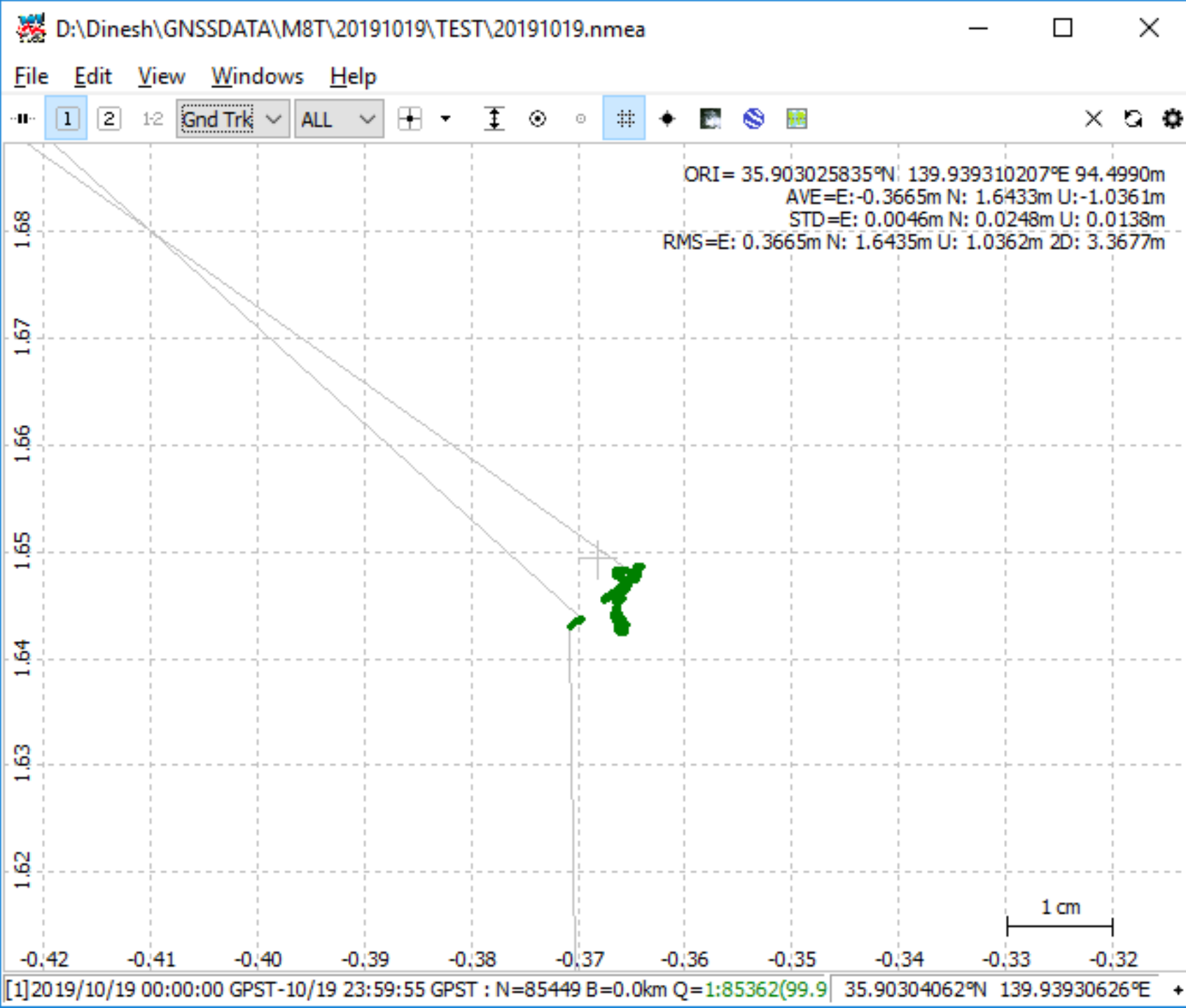
DGPS

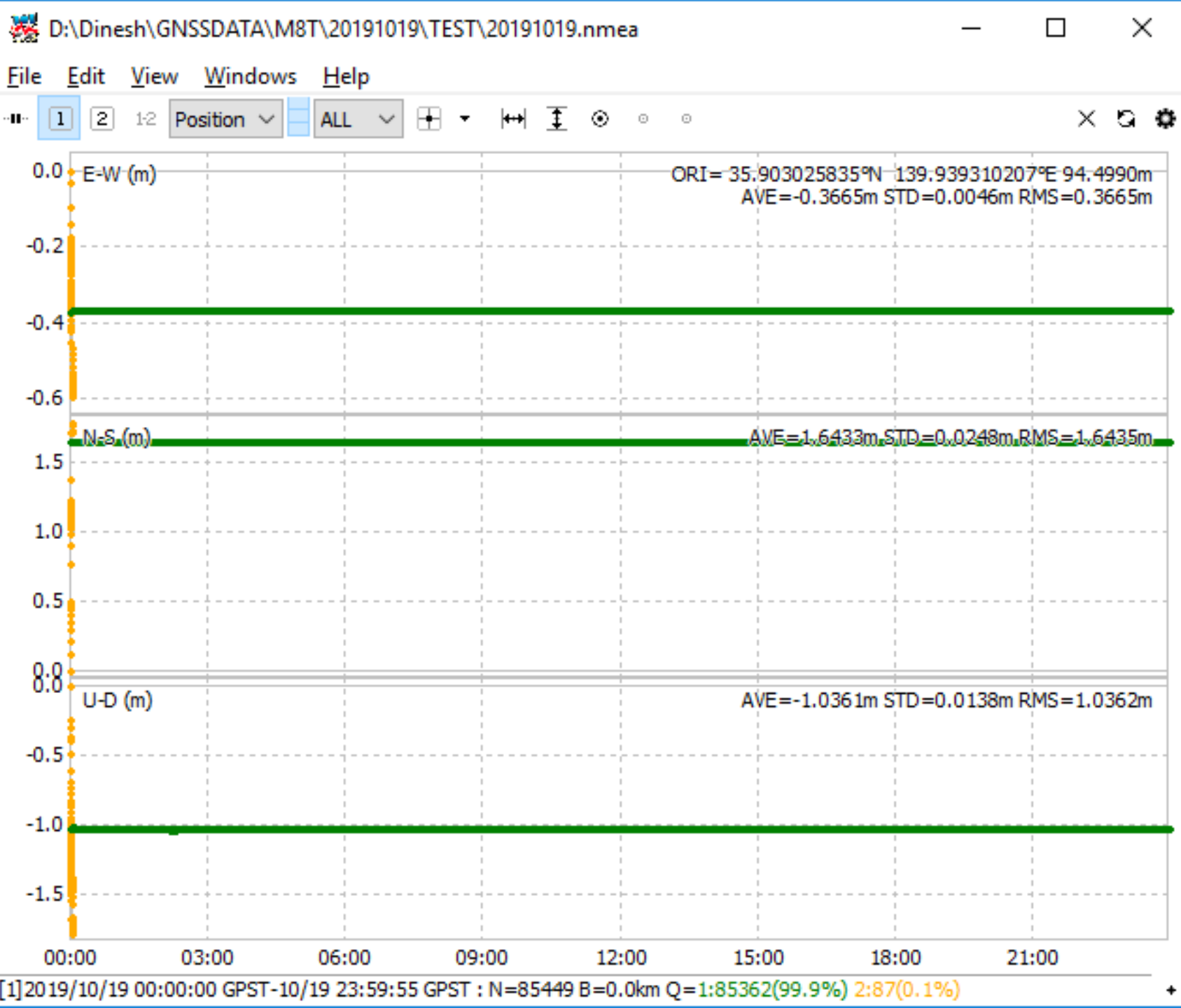


DGPS

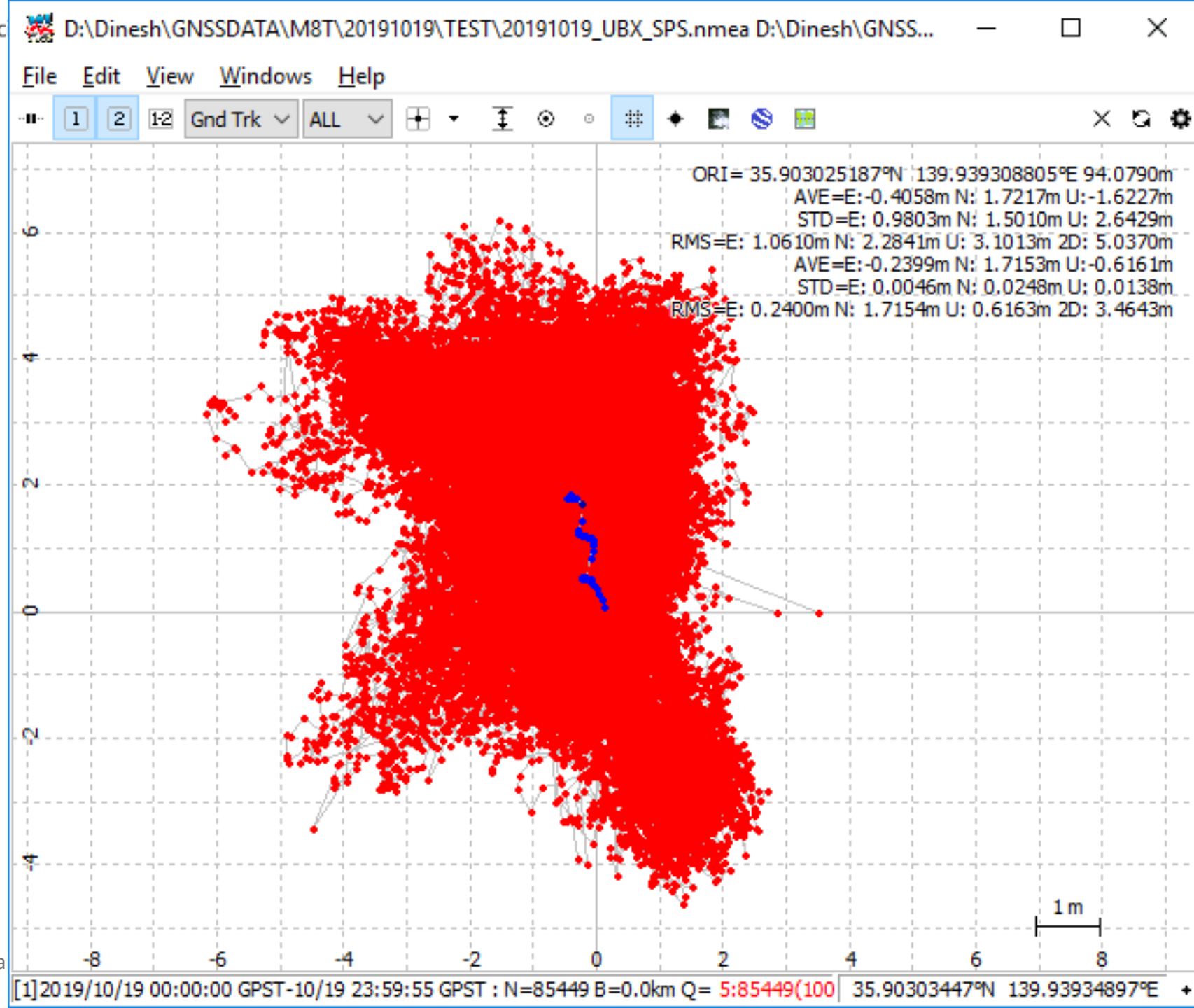




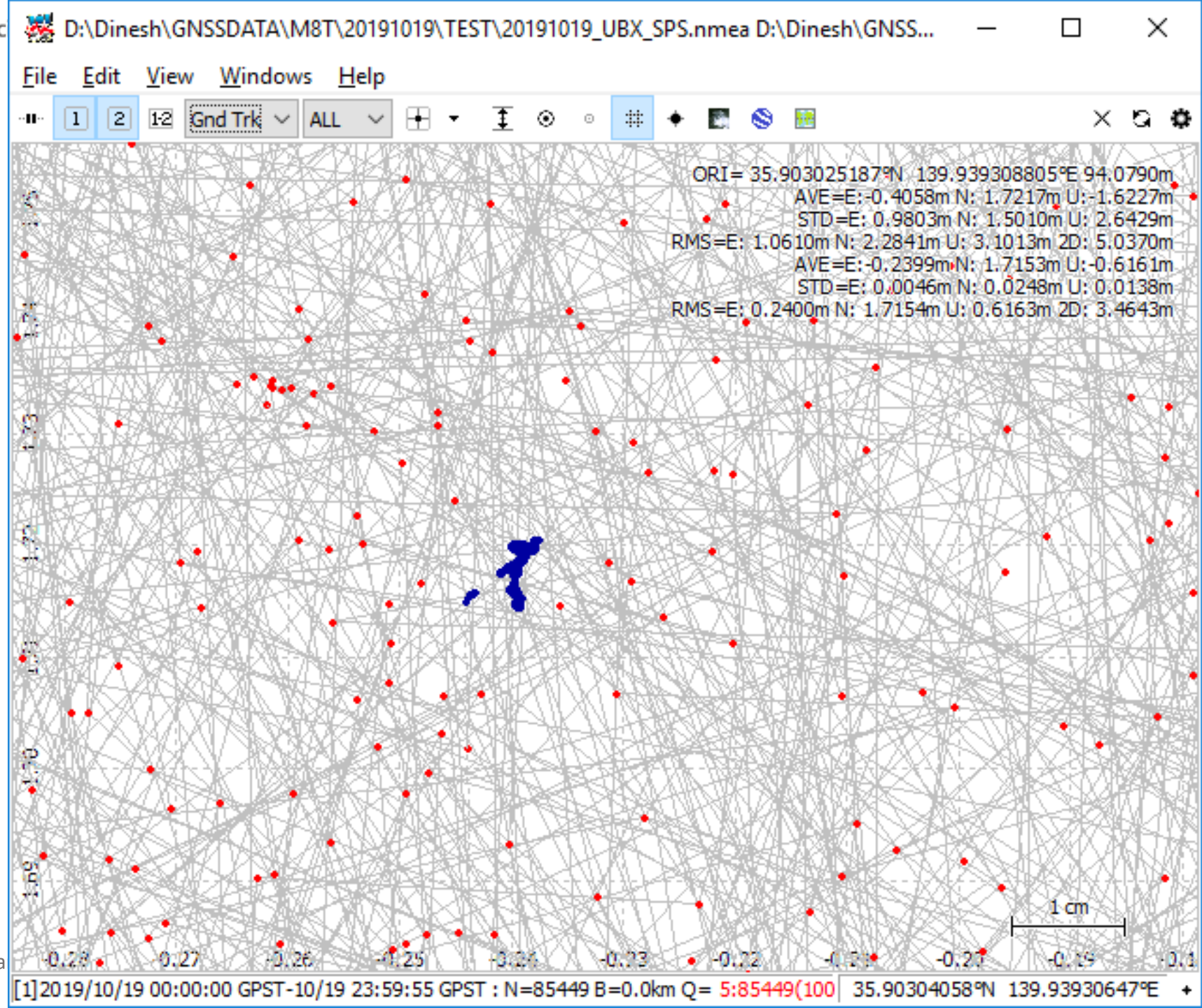




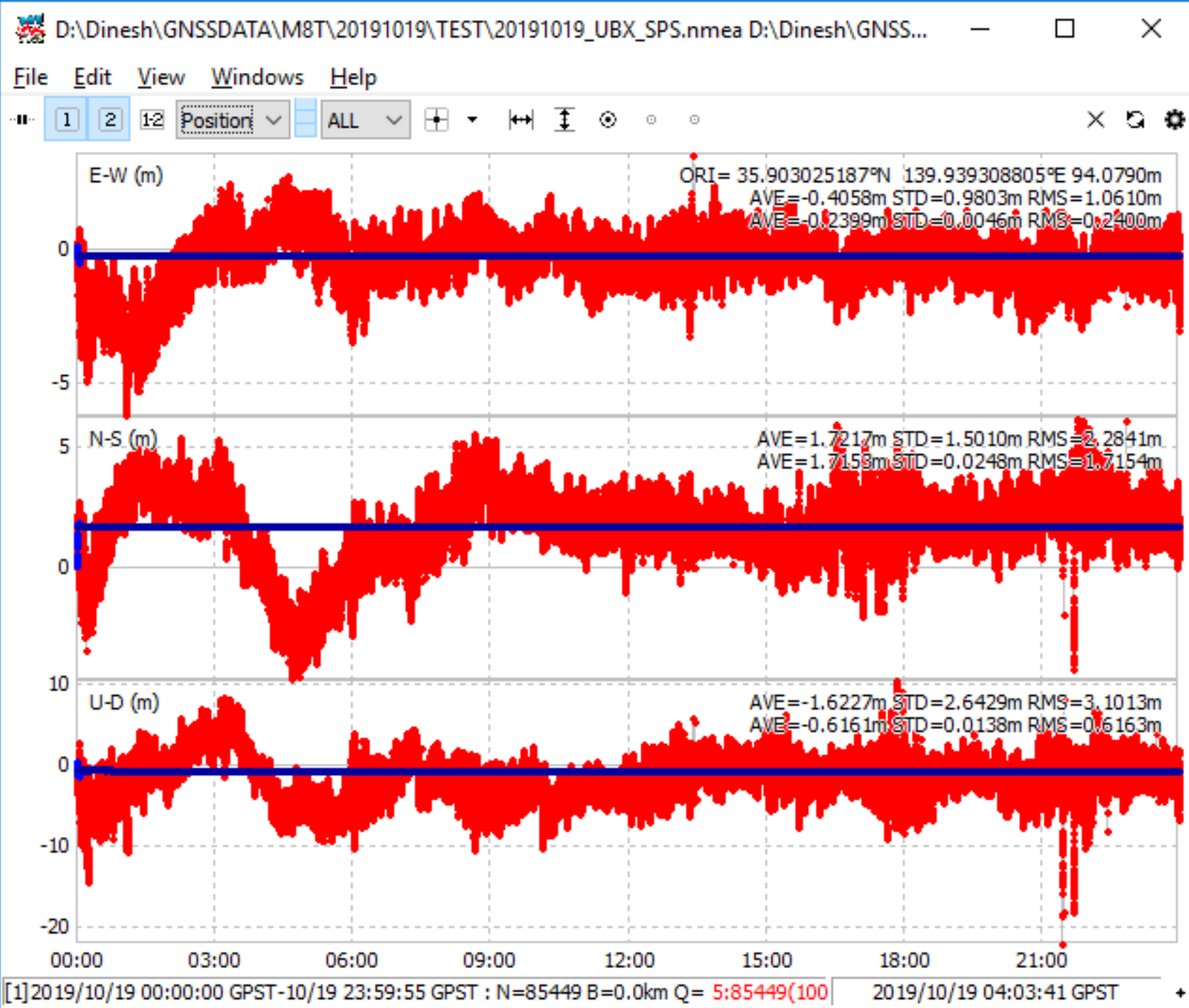
SPP vs RTK



SPP vs RTK



SPP vs RTK



Output Data from SPP and PPK

- Compute CEP for SPP
- Compute CEP for PPK

RTK Exercise

