Report on GNSS Training

Course ID: T151-40

`Team No: 6

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1.1 Executive Summary

The project activities involved GNSS data collection and processing through multiple techniques and the analysis of the results obtained so forth. The different processing techniques that were performed were DGNSS, SBAS, RTK and PPP. They offered different accuracies even with the same equipment and setup.

The report covers most of the topics regarding GNSS data processing and how it can be done by RTKLIB software. The zero-baseline data is used in order to explain different types of positioning modes and settings. Since the antenna of both rover and base stations are connected to one antenna, we call it the zero-baseline data. The GNSS data used for post processing whose results are shown in the figure below is logged in for 24 hours.

Beside GNSS data processing, we carried out RTK (real time kinematic) using different types of applications like SW-Maps and RTKdroid. The main objective of this activity during the training is to understand how the data logged in low cost and high cost receivers differ from each other and how the processing of same data in different processing modes in RTKLIB brings about difference in their accuracy.

1.2 Team Members

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1.3 Introduction

The report covers most of the topics regarding GNSS data processing and how it can be done by RTKLIB software. The zero-baseline data is used in order to explain different types of positioning modes and settings. Since the antenna of both rover and base stations are connected to one antenna, we call it the zero-baseline data. The GNSS data used for post processing whose results are shown in the figure below is logged in for 24 hours.

An SBAS system only requires an SBAS capable receiver and a GNSS antenna. A DGNSS system requires a base station receiver and antenna, a rover receiver and antenna and a communication link between the base station and rover. Also, the DGNSS system requires base station to be in a known location.

An SBAS system and a PPP system are similar in that both systems receive corrections from satellites. However, a PPP system is significantly more accurate than an SBAS system. Part of the accuracy advantage is the correction method. PPP systems use the carrier phase method and SBAS systems use the code method. The other part of the accuracy advantage is that the private corrections services typically used by PPP systems provide higher quality corrections and are multi-frequency, multi-constellation.

The advantage of SBAS systems is that the corrections services are free for everyone to use. While the private corrections services provide higher quality corrections and are available worldwide, a paid subscription is required to access the signals. Also, since SBAS is a code-based method, there are no ambiguities to resolve and full SBAS accuracy is available almost immediately. PPP systems require time to converge (resolve ambiguities) before full accuracy is available.

An RTK system offers higher accuracy and quick initialization, but is more complex to setup and more expensive. The RTK system requires at least two RTK capable receivers (one base station and one or more rovers), a GNSS antenna for each receiver and a communication link between the receivers. Also, to achieve the high level of accuracy, the base station must be very precisely set up at a known location.

A PPP system has a simpler configuration; a single PPP compatible receiver, an antenna capable of receiving GNSS and L-Band frequencies and a subscription to a corrections service provider. However, PPP has a somewhat lower accuracy and longer initial convergence time.

The baseline length also creates the difference. The distance between base station and rover (baseline length) on an RTK system directly impacts system accuracy. At short baseline lengths, a few kilometers, RTK is very accurate. However, as the baseline length increases, the accuracy and availability of a solution decreases. At long baseline lengths RTK can no longer be used. Since PPP does not use a base station, it is not affected by baseline length and can provide full accuracy anywhere in the world.

1.4 SUMMARY

RESULT OF PROCESSING H-4

ZERO BASELINE PROCESSING

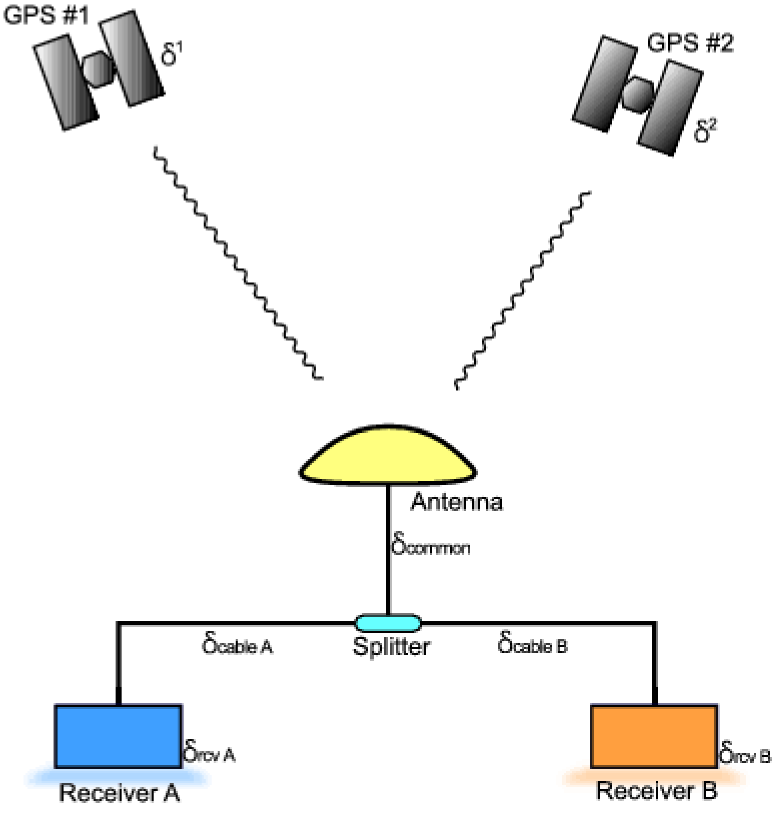

Figure 1: Zero Baseline Receiver and Antenna Setup

Data used : **Sample Data For Zero Baseline**
Receiver Type : **U-Blox M8T and Trimble NetR9**
True XYZ Coordinate : **-3958757.0450, 3328944.1010, 3719537.3890**

1. Zero Baseline for Static Data using RTKLib --> SPP

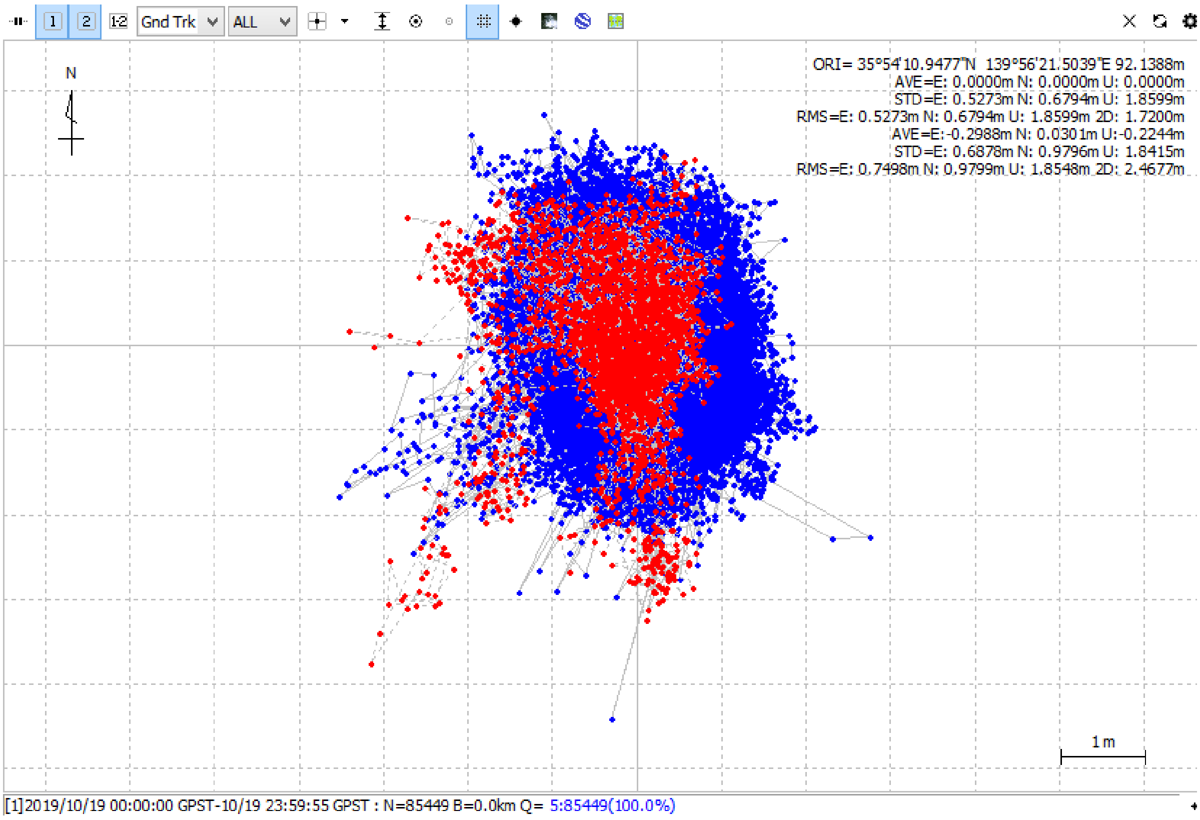

Figure 2: Ground Track of SPP (single point positioning) Data

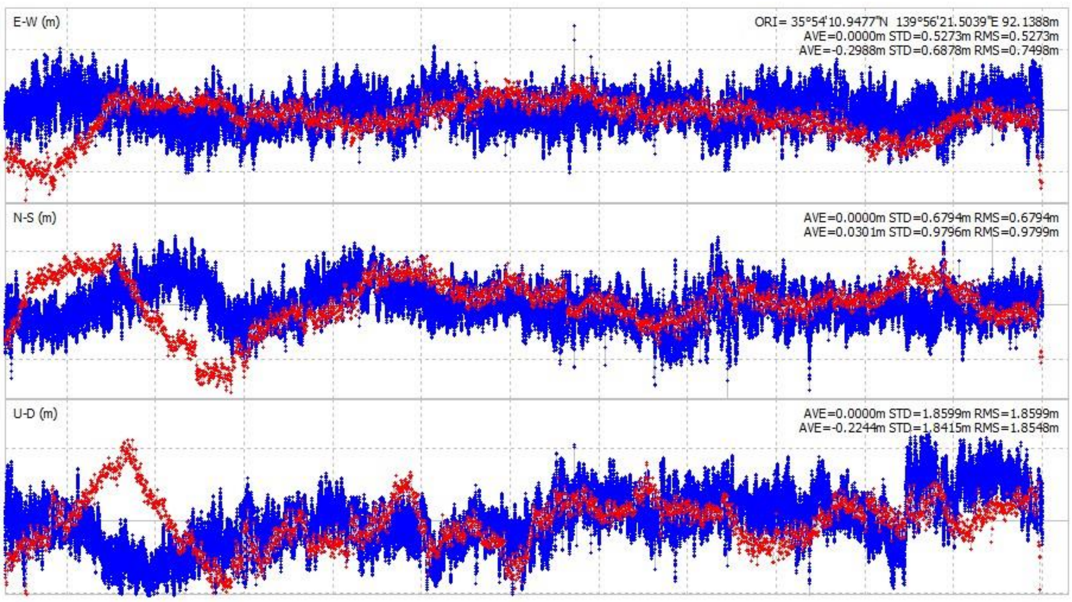

Figure 3: Output of position SPP (single point positioning) data

2. Zero Baseline for Static Data using RTKLib --> DGNSS

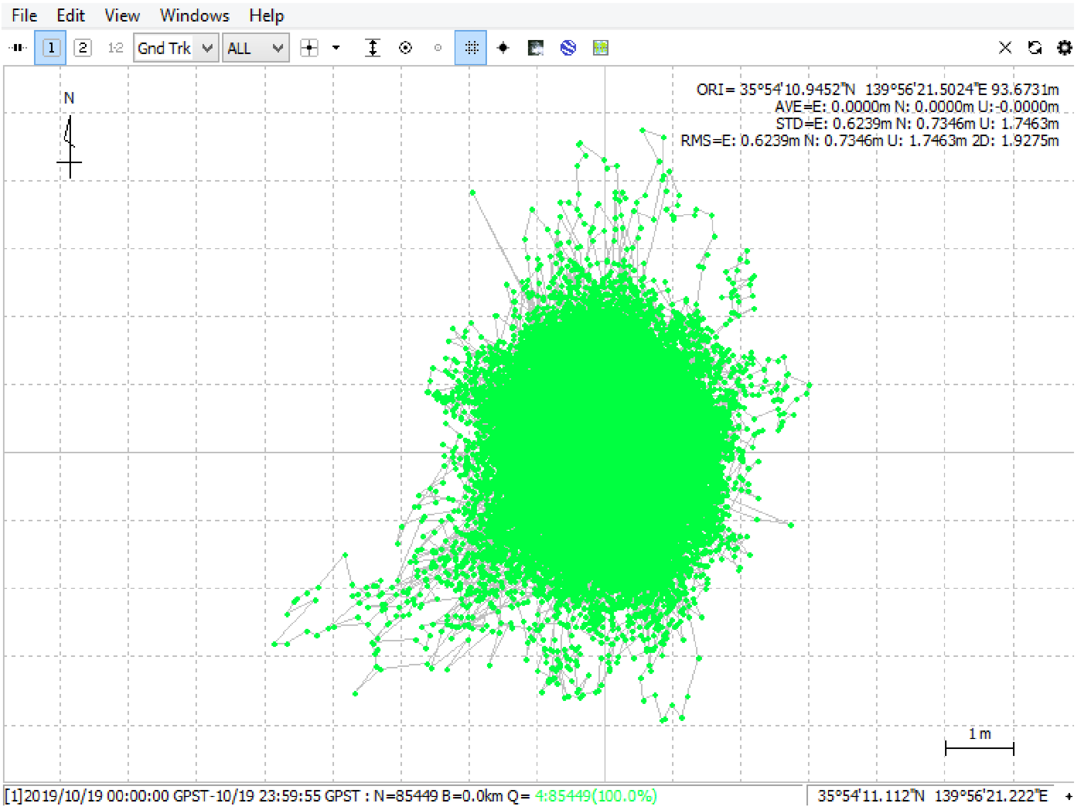

Figure 4: Ground track of DGNSS (Differential Global navigation systems) data

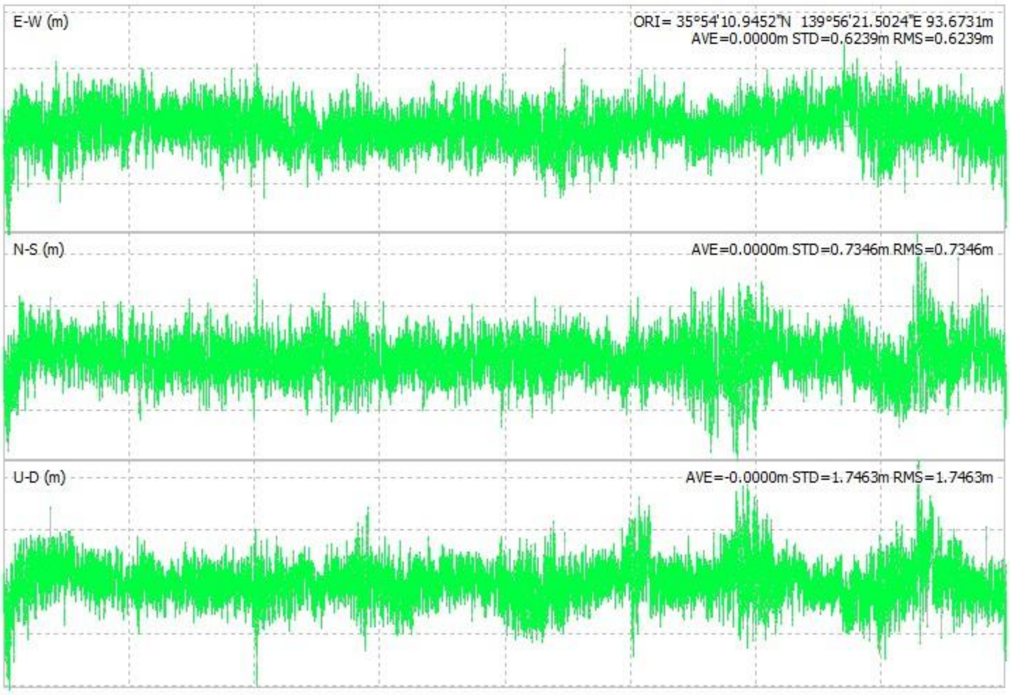

Figure 5: Output of position DGNSS (Differential Global navigation systems)

3. Zero Baseline for Static Data using RTKLib --> Static/ Continuous

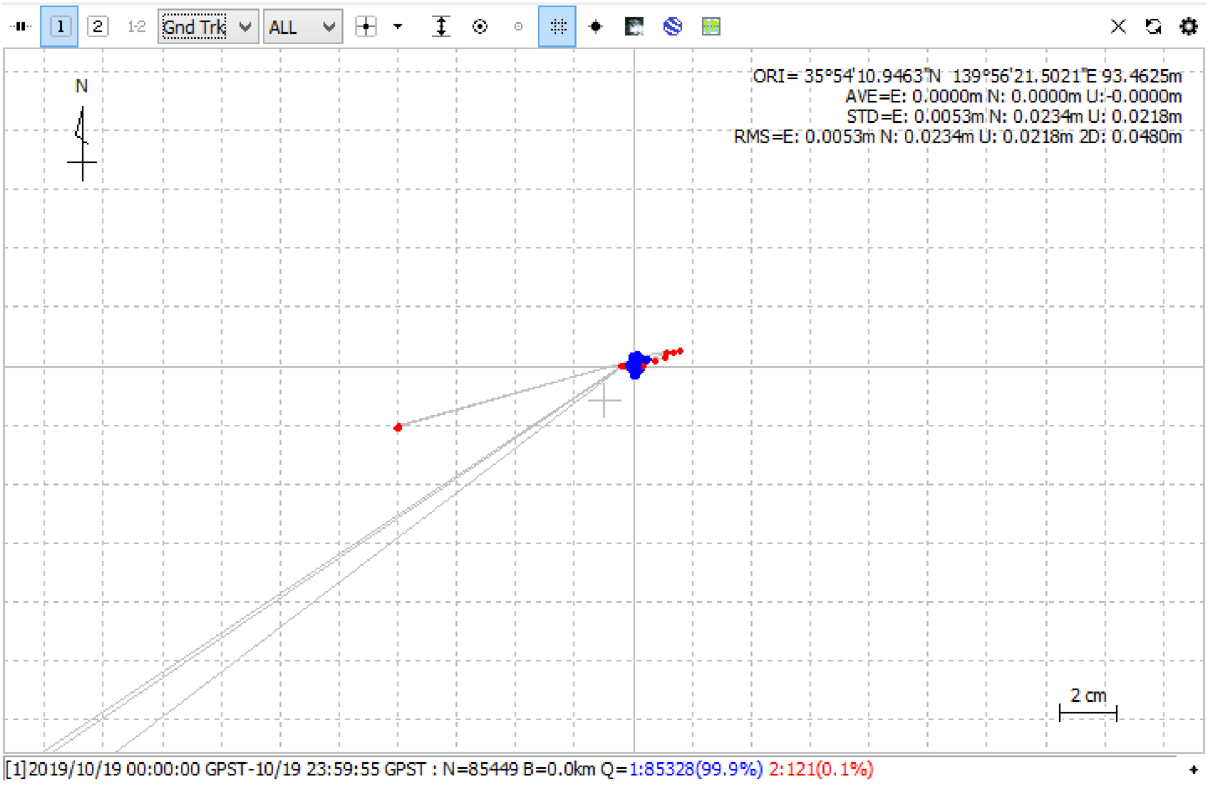

Figure 6: Ground track of static data

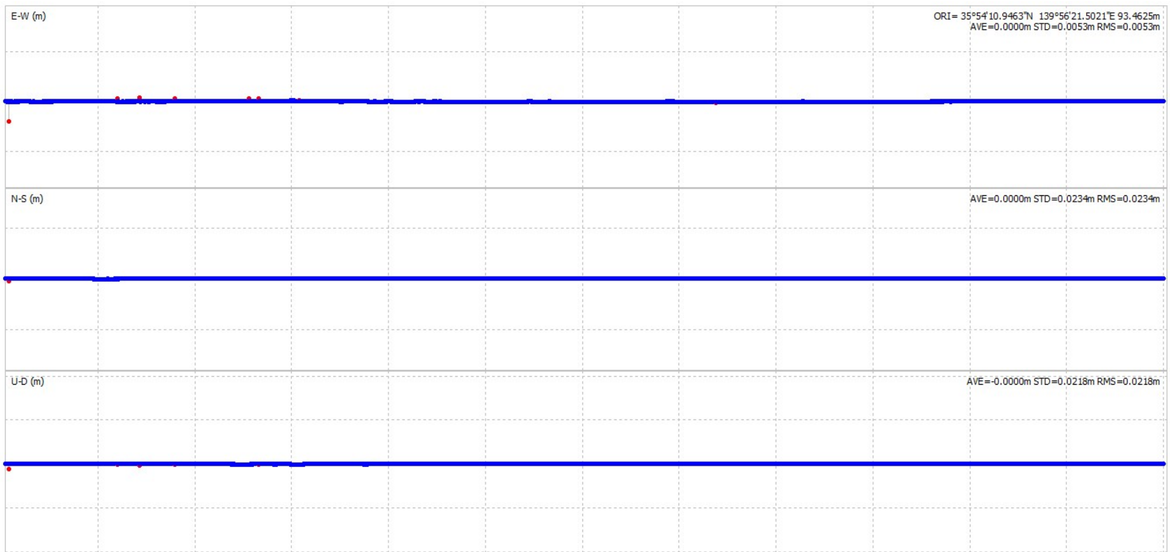

Figure 7: Ground track of static data

4. Zero Baseline for Static Data using RTKLib --> Static/ Instantaneous

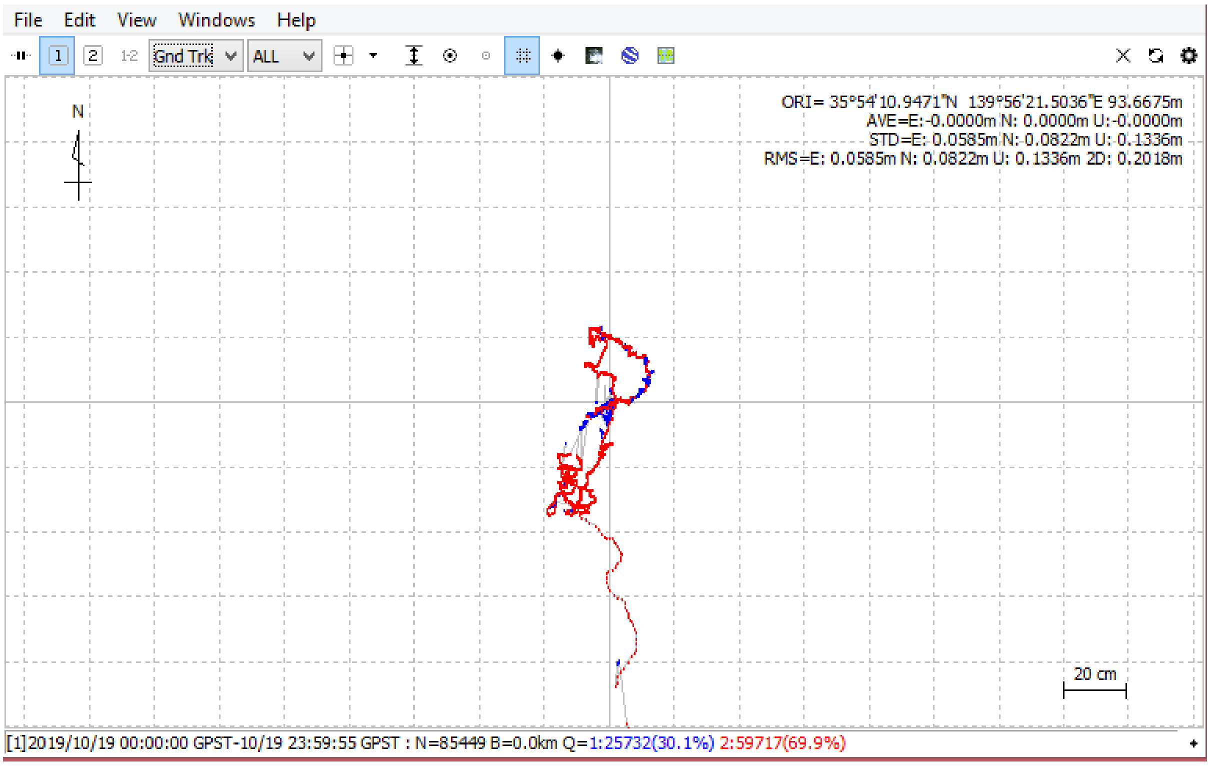

Figure 8: Ground track of static data

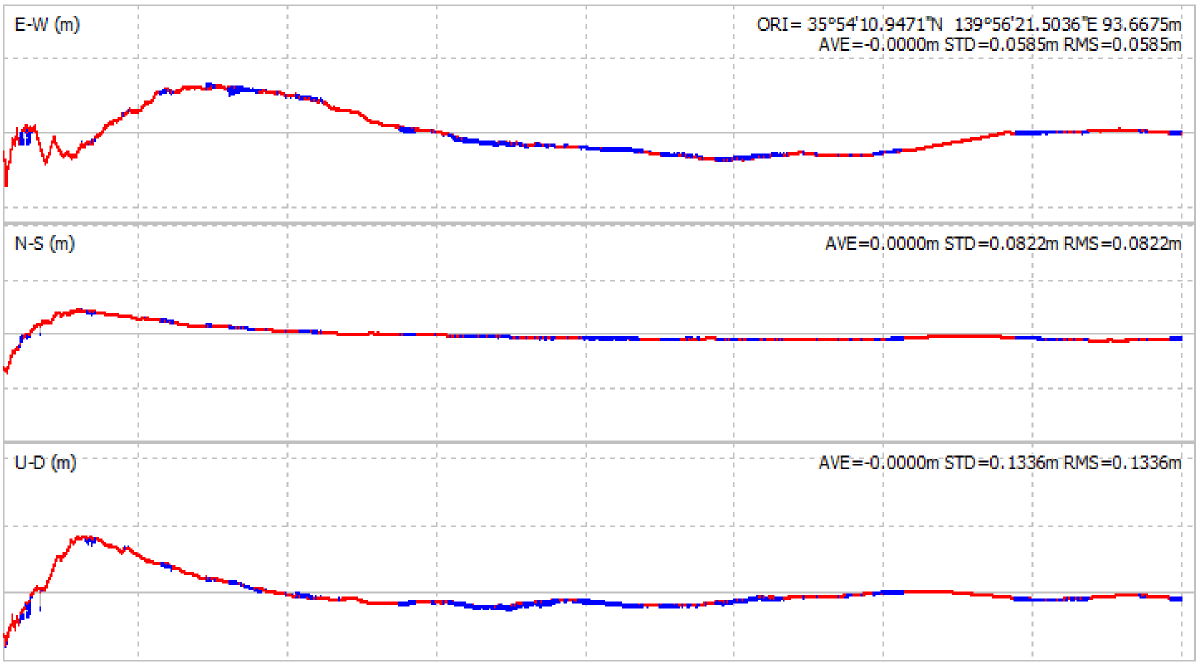

Figure 9: Output of static position

5. Zero Baseline for Static Data using RTKLib --> Static/ Fix hold

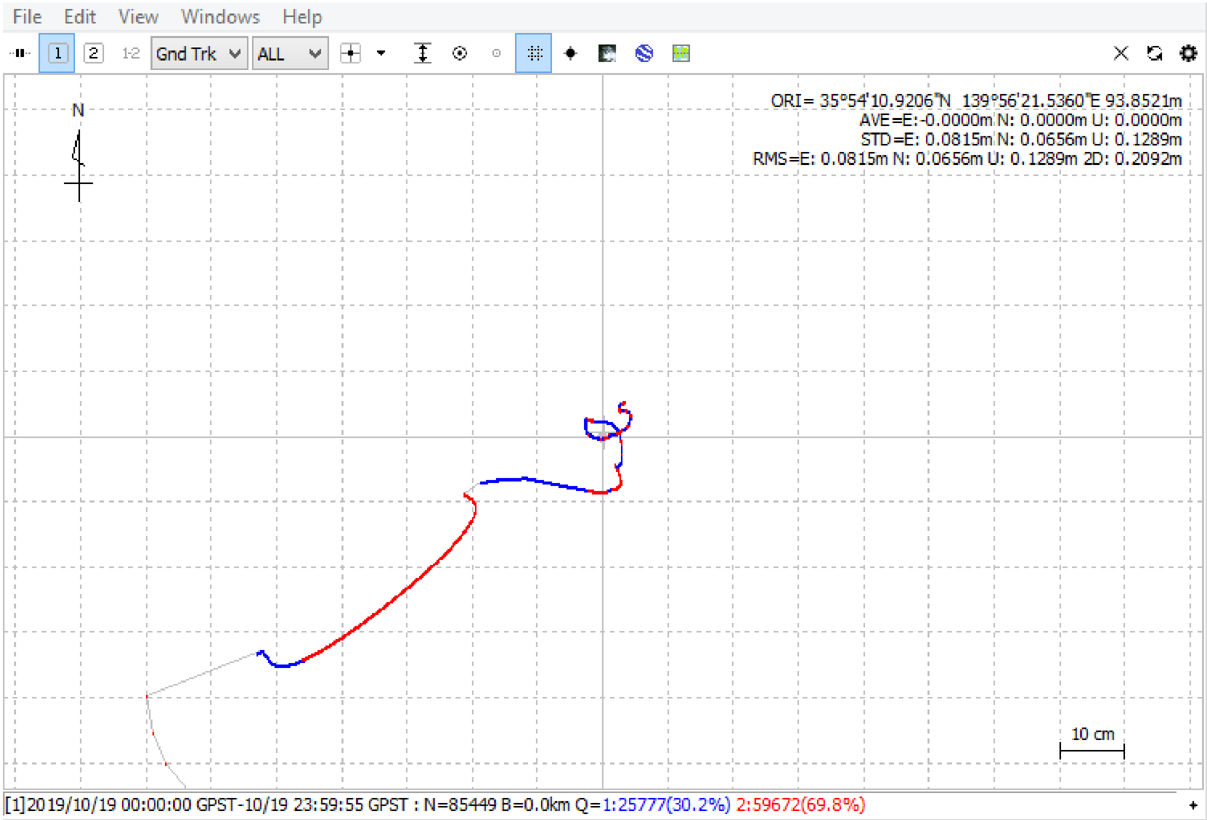

Figure 10: Ground track of static data

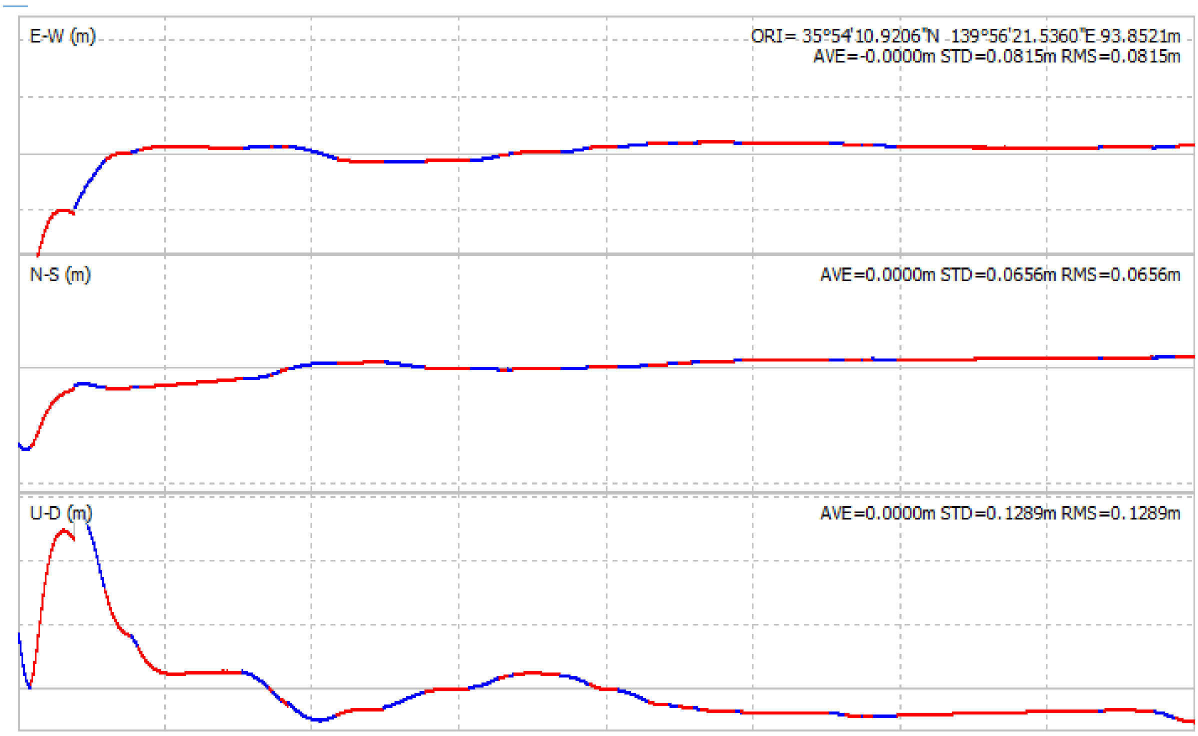

Figure 11: Output of static position

6. Zero Baseline for Static Data using RTKLib --> Kinematic/ Continuous

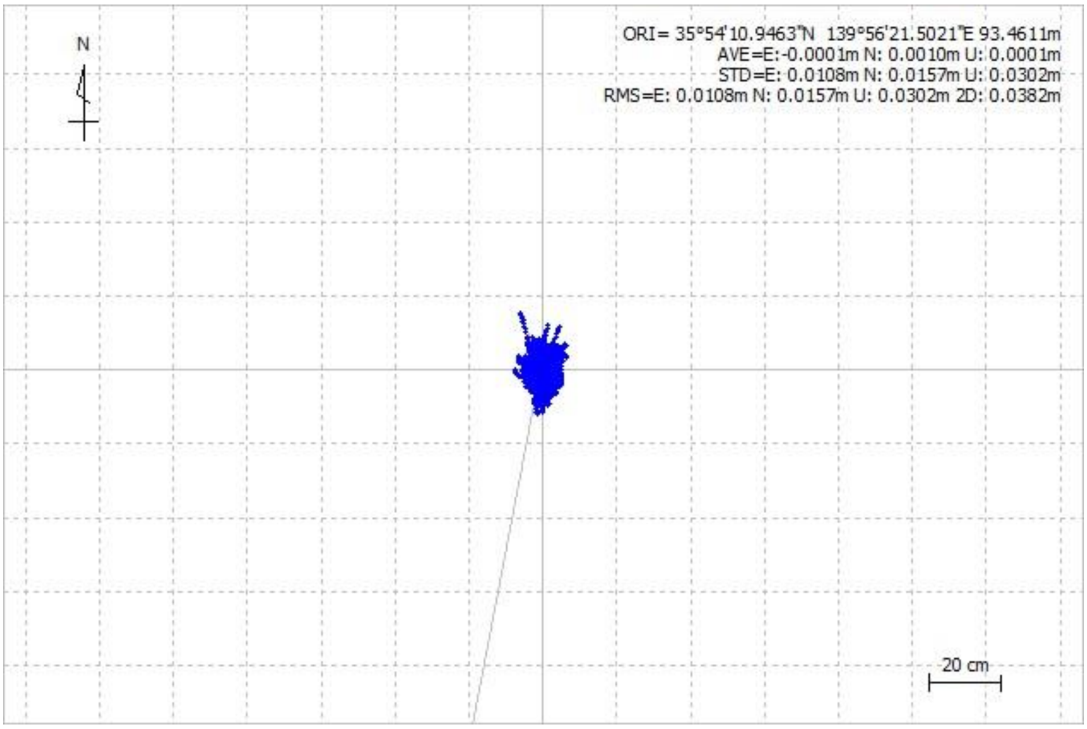

Figure 12: Ground track of Kinematic data

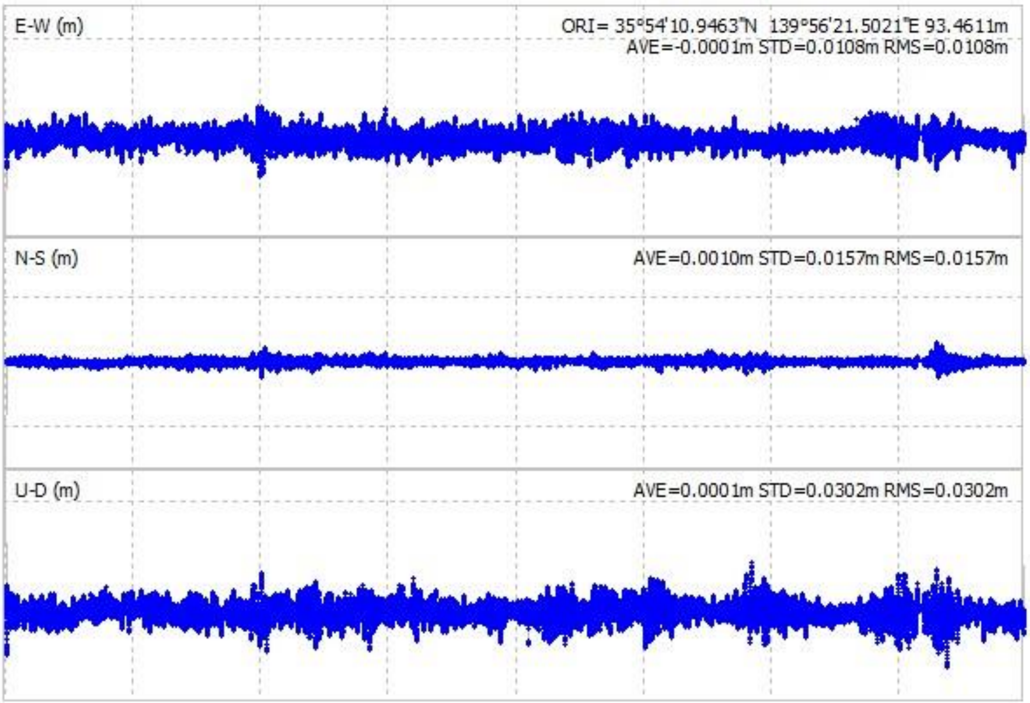

Figure 13: Output of Kinematic position

7. Zero Baseline for Static Data using RTKLib --> Kinematic/ Instantaneous

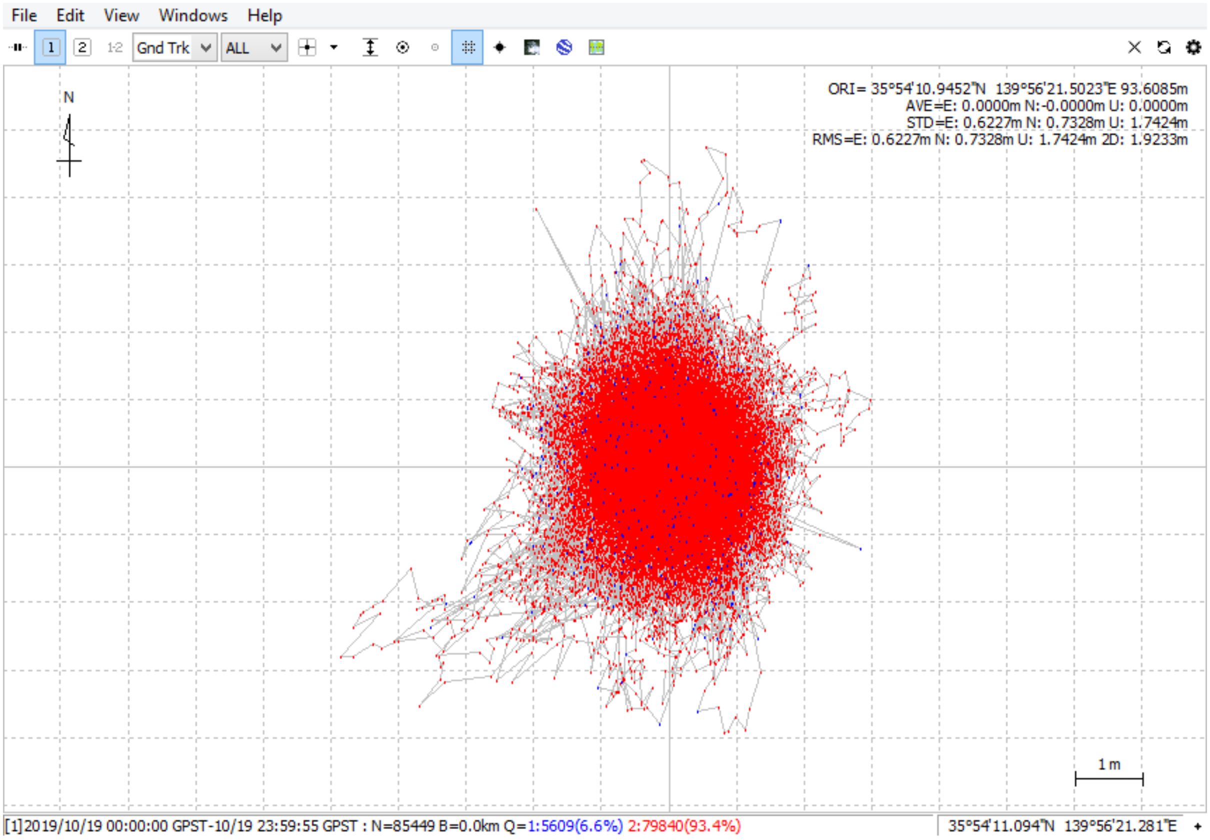

Figure 14: Ground track of Kinematic data

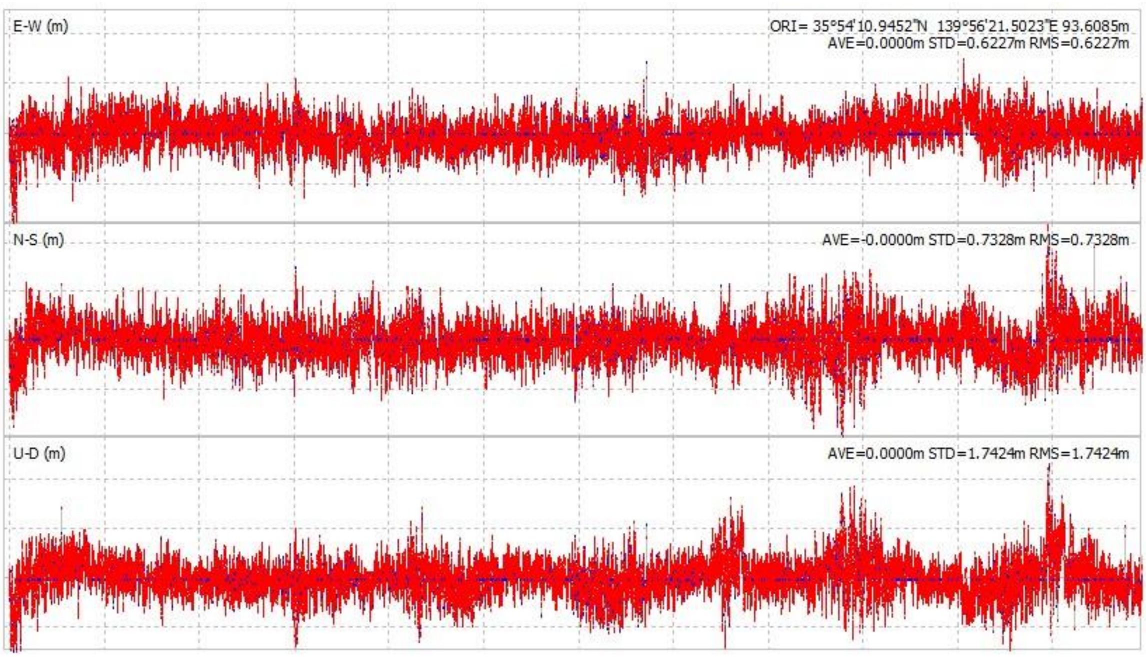

Figure 15: Output of Kinematic position

8. Zero Baseline for Static Data using RTKLib --> Kinematic/ Fix Hold

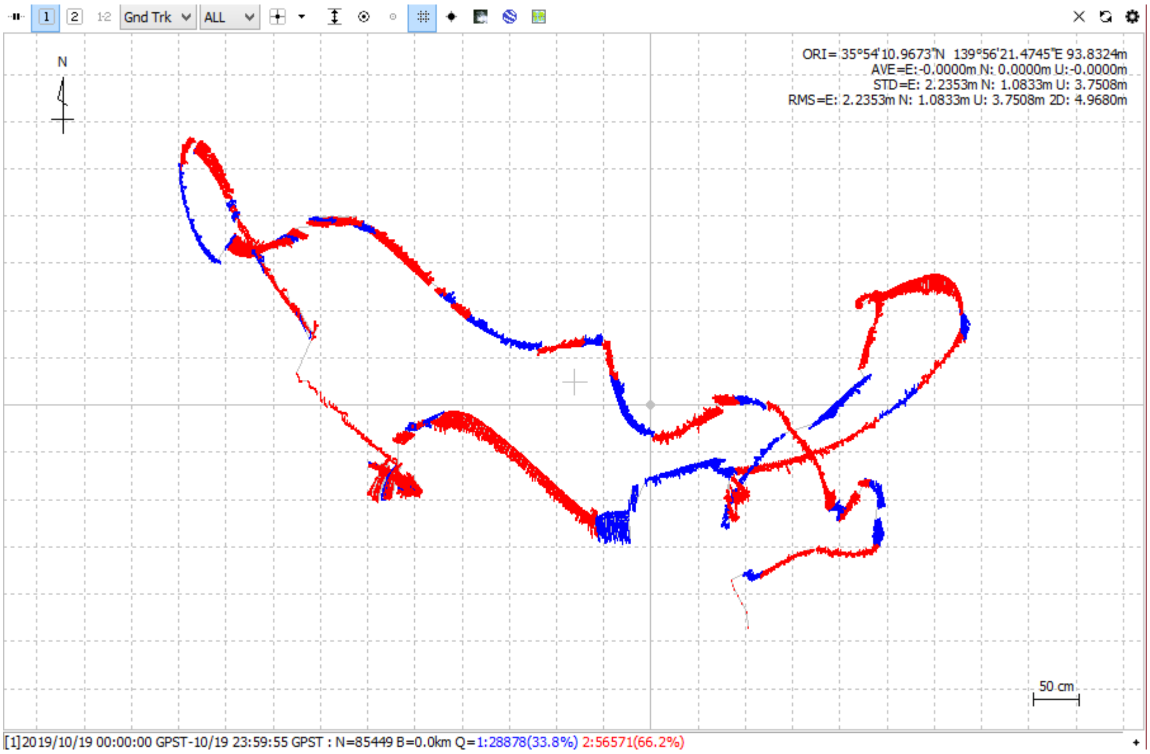

Figure 16: Ground track of Kinematic data

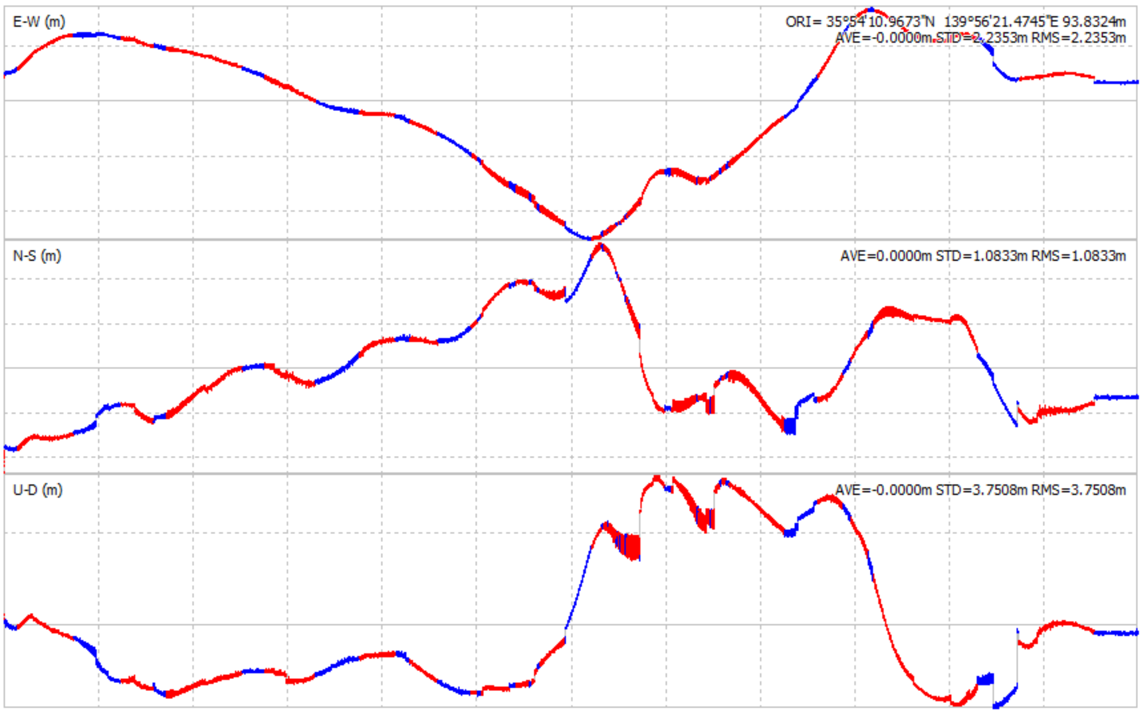

Figure 17: Output of Kinematic position

Table 1: Data Error Analysis via Different Processing and Integer Ambiguity Methods

No	Method	STD			Status of Quality (100%)					
		E(m)	N(m)	U(m)	Q1	Q2	Q3	Q4	Q5	Q6
1	**SPP**	**0.6878**	**0.9796**	**1.8415**					**100**	
2	**DGNSS**	**0.6239**	**0.7346**	**1.7463**				**100**		
3	**Static-cont**	**0.0053**	**0.0234**	**0.0218**	**99.1**	**0.1**				
4	**Static-instant**	**0.0585**	**0.0822**	**0.1336**	**30.1**	**69.9**				
5	**Static-fix hold**	**0.0815**	**0.0656**	**0.1289**	**30.2**	**69.8**				
6	**Kinematic-cont**	**0.0108**	**0.0157**	**0.0302**						
7	**Kinematic-instantaneous**	**0.6227**	**0.7328**	**1.7424**	**6.6**	**93.4**				
8	**Kinematic-fix hold**	**2.2353**	**1.0833**	**3.7508**	**33.8**	**66.2**				

1.5 Conclusion and Recommendation

The objective of this training being GNSS data collection and processing, we fulfilled it by carrying out the task and analyzing the result followed by the optimization of the result choosing the best settings while data processing. In addition to it, we also learned the do's and don'ts while carrying out the data collection so as to get the precise location to the best possible limit.