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# NLS GNSS SOFAMESA

GNSS Measurement Accuracy Analysis Software of the National Land Survey of Finland  
Beta Version 1.10  
2019-05-27

## Measurement Report of the File:

20190524-A-99M5040-METHOD2-4



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Thank you for the help: Topi Rikkinen, Marko Ollikainen, Antti Laaksonen, Hannu Koivula, and Ari Huvinen.

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## Statistics Behind the Figures

Parameter	Value
Total Number of Measurements	12148.0
Number of All Satellites Mean (No Outliers or Float Solutions Removed)	32.0
Number of All Satellites Min and Max (No Outliers or Float Solutions Removed)	Min: 24 and Max: 36
Number of GPS Satellites Mean (No Outliers or Float Solutions Removed)	10.5
Number of GLONASS Satellites Mean (No Outliers or Float Solutions Removed)	7.5
Number of GALILEO Satellites Mean (No Outliers or Float Solutions Removed)	6.1
Number of BEIDOU Satellites Mean (No Outliers or Float Solutions Removed)	7.9
Mean of HDOP Values (No Outliers or Float Solutions Removed)	0.5
Mean of VDOP Values (No Outliers or Float Solutions Removed)	1.0
Mean of PDOP Values (No Outliers or Float Solutions Removed)	0.9
Mean of TDOP Values (No Outliers or Float Solutions Removed)	nan
Mean of GDOP Values (No Outliers or Float Solutions Removed)	1.1
User-Defined Tolerance Values	North and East 0.1m, Height 0.2m
Number of Measurements Above the Set Tolerance Values	30
Above Tolerance Values Percentage	0.25%
Number of All Satellites Mean (Outliers Removed)	32.0
Number of Satellites Min and Max (Outliers Removed)	Min: 24 and Max: 35
Number of GPS Satellites Mean (Outliers Removed)	10.5
Number of GLONASS Satellites Mean (Outliers Removed)	7.5
Number of GALILEO Satellites Mean (Outliers Removed)	6.1
Number of BEIDOU Satellites Mean (Outliers Removed)	7.9
Mean of HDOP Values (Outliers Removed)	0.5
Mean of VDOP Values (Outliers Removed)	1.0
Mean of PDOP Values (Outliers Removed)	0.9
Mean of TDOP Values (Outliers Removed)	nan
Mean of GDOP Values (Outliers Removed)	1.1

<b>Parameter</b>	<b>Precision (m)*</b>	<b>Accuracy (m)**</b>
<b>Horizontal RMSE***</b>	0.012	0.014
<b>Vertical RMSE****</b>	0.023	0.071
<b>Horizontal 2dRMSE***</b>	0.025	0.028
<b>Vertical 2dRMSE****</b>	0.047	0.141
<b>North Coordinate Standard Deviation</b>	0.0097	
<b>East Coordinate Standard Deviation</b>	0.0077	
<b>Height Standard Deviation</b>	0.0234	
<b>North Coordinate Mean</b>	6687768.3882	
<b>East Coordinate Mean</b>	394444.8216	
<b>Height Mean</b>	25.1966	
<b>North Coordinate Median</b>	6687768.387	
<b>East Coordinate Median</b>	394444.822	
<b>Height Median</b>	25.1958	

\* The precision of the measurements = inner accuracy.

\*\* The accuracy of the measurements = outer accuracy.

\*\*\* Horizontal RMSE is 63-68% of the measurements and it depends on the shape of the distribution. Horizontal 2dRMSE is 95-98% of the measurements and it also depends on the shape of the distribution.

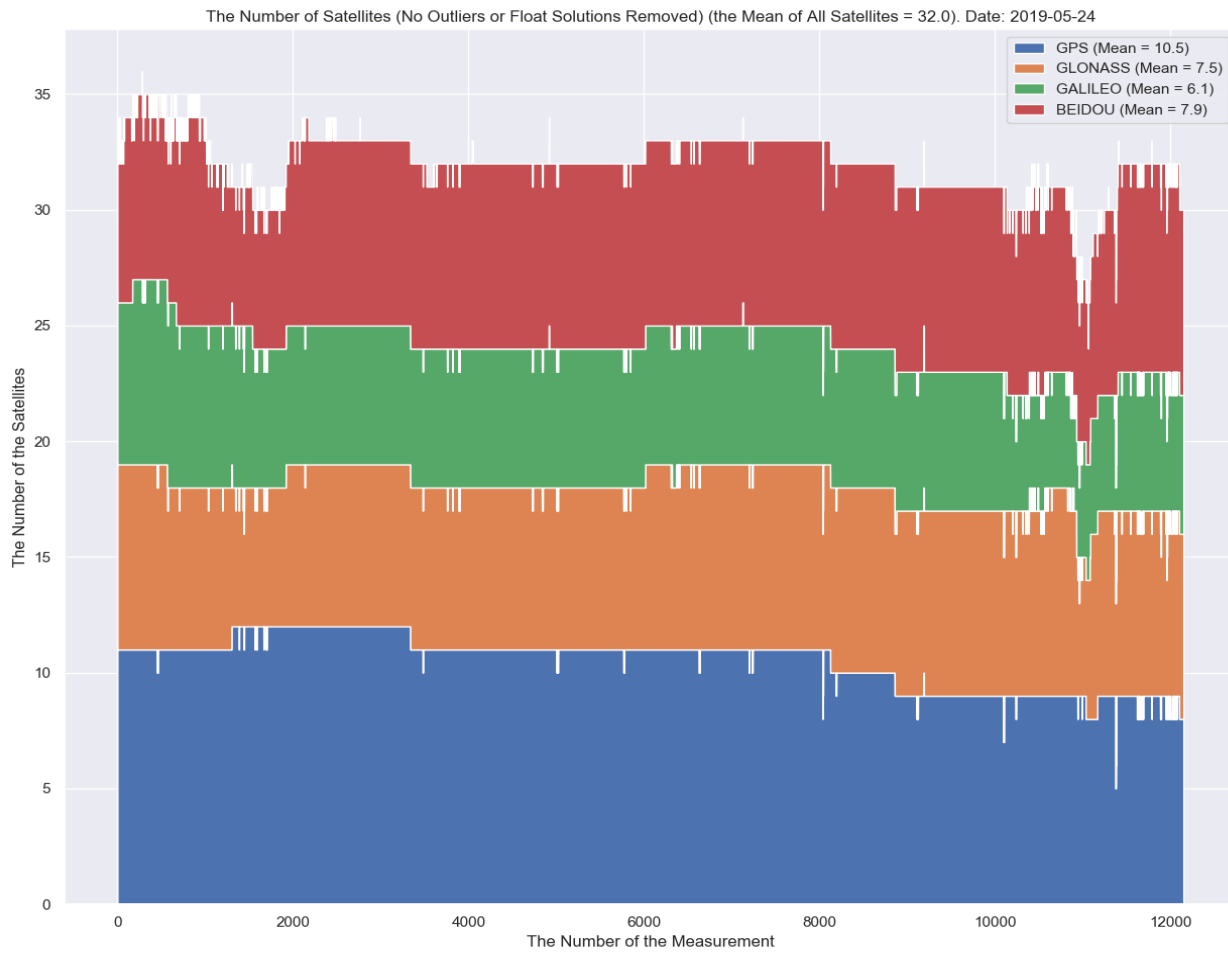
\*\*\*\* Vertical RMSE is 63-68% of the measurements and it depends on the shape of the distribution. Vertical 2dRMSE is 95-98% of the measurements and it also depends on the shape of the distribution.

## Figures

Please find the figures, which NLS GNSS SOFAMESA produces, on the upcoming pages.

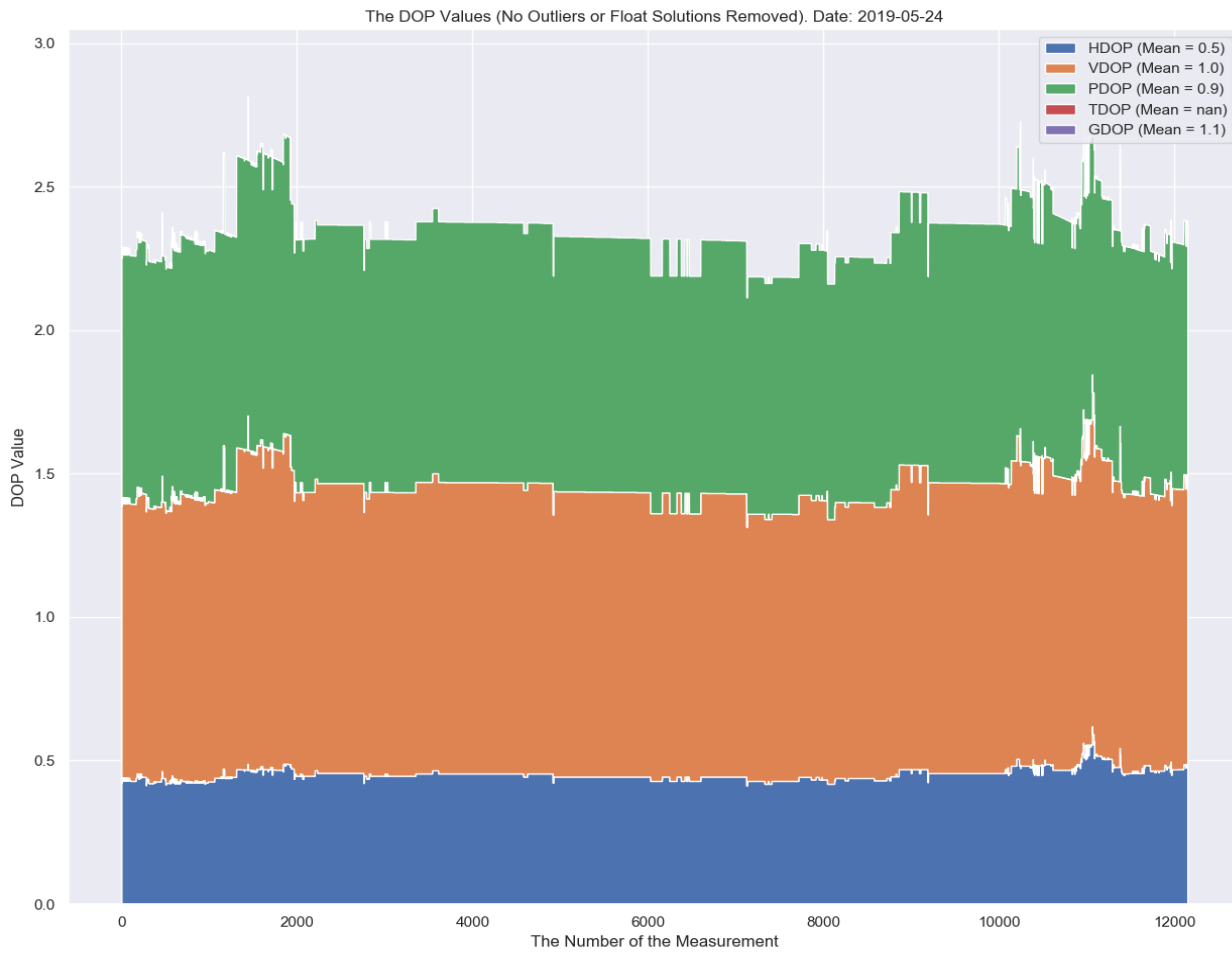
# The Number of Satellites (No Outliers or Float Solutions Removed)

## METHOD2



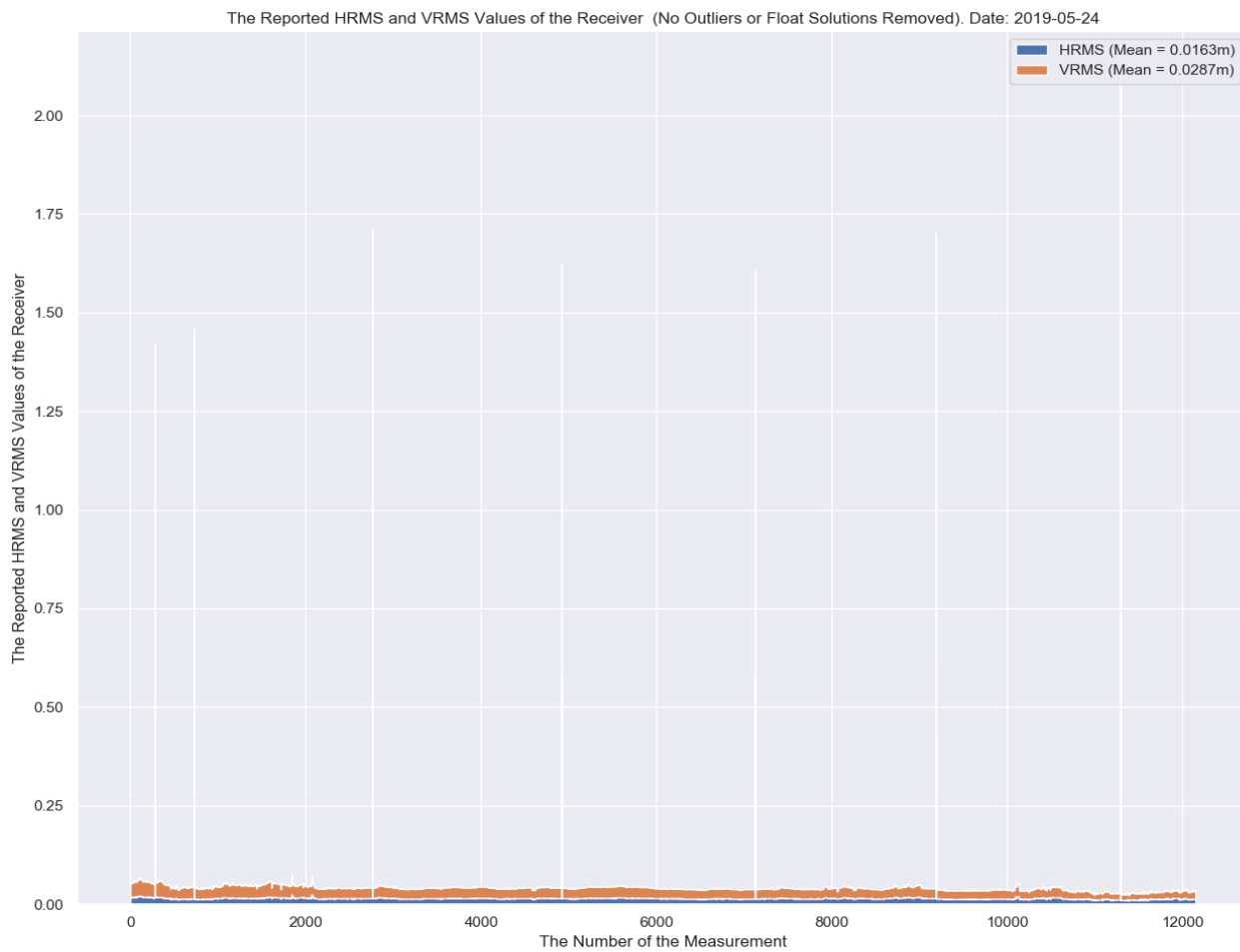
# The DOP Values (No Outliers or Float Solutions Removed)

## METHOD2



## The Reported HRMS and VRMS Values of the Receiver (No Outliers or Float Solutions Removed)

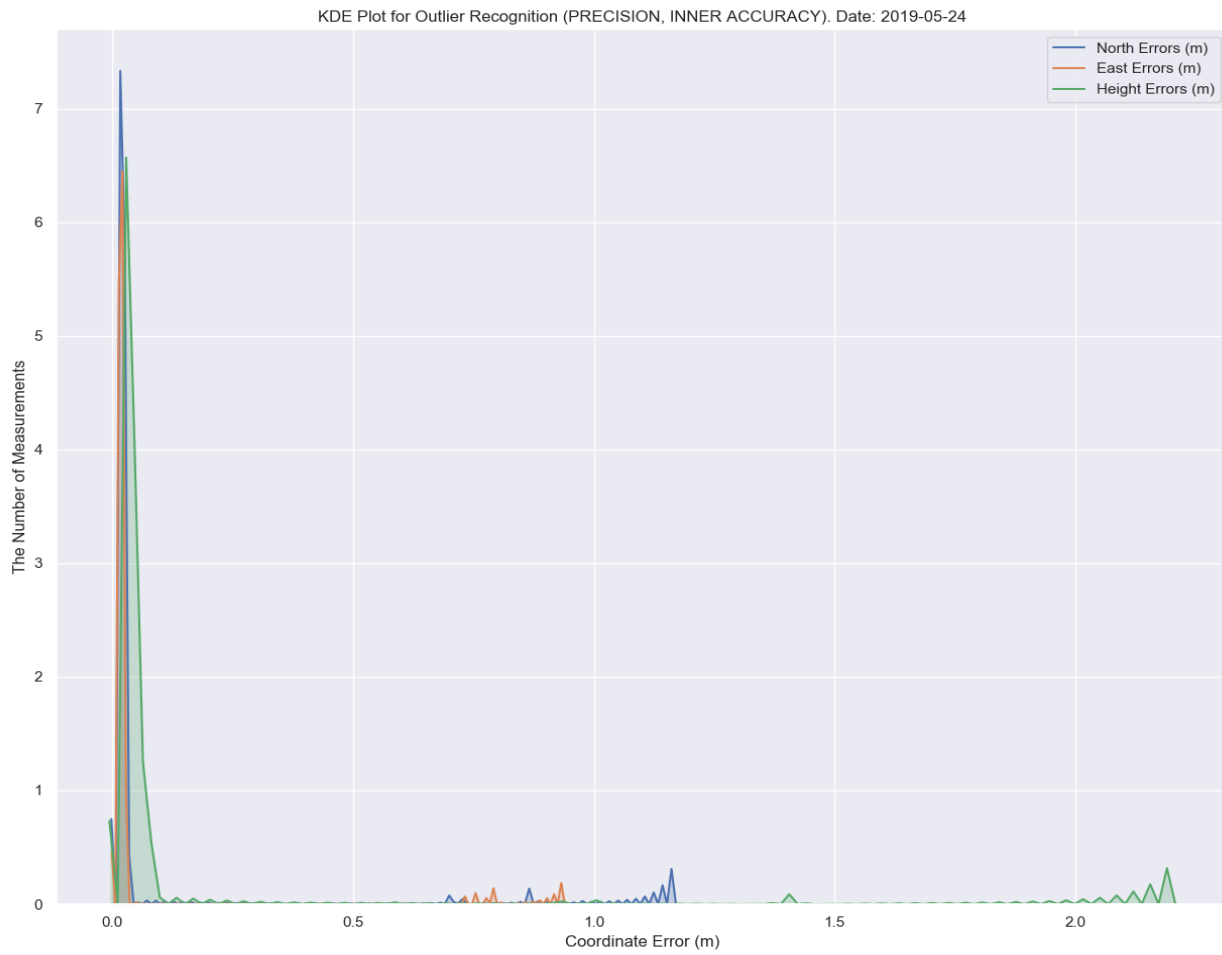
### METHOD2





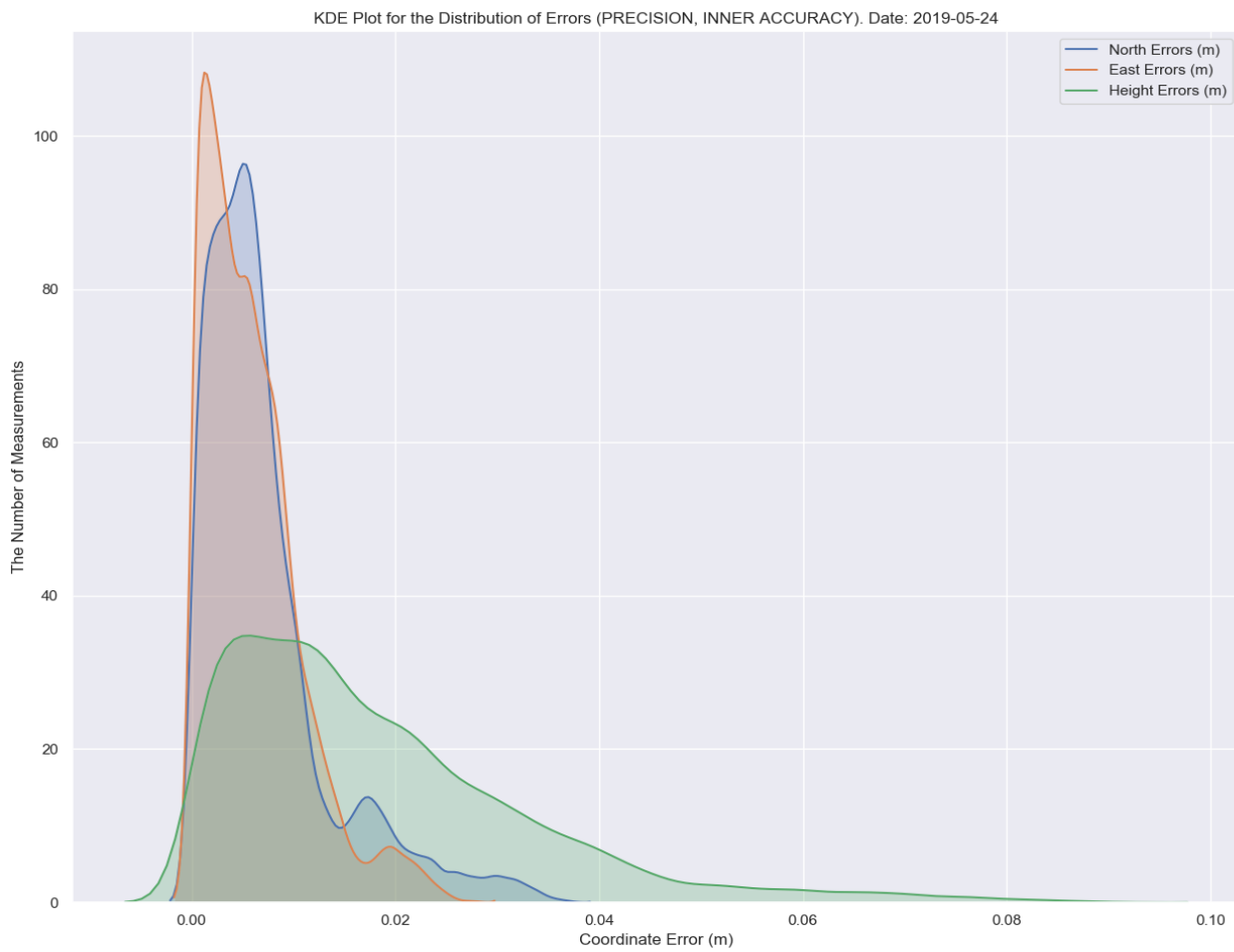
# KDE Plot for Outlier Recognition (PRECISION, INNER ACCURACY)

## METHOD2



# KDE Plot for the Distribution of Errors (PRECISION, INNER ACCURACY)

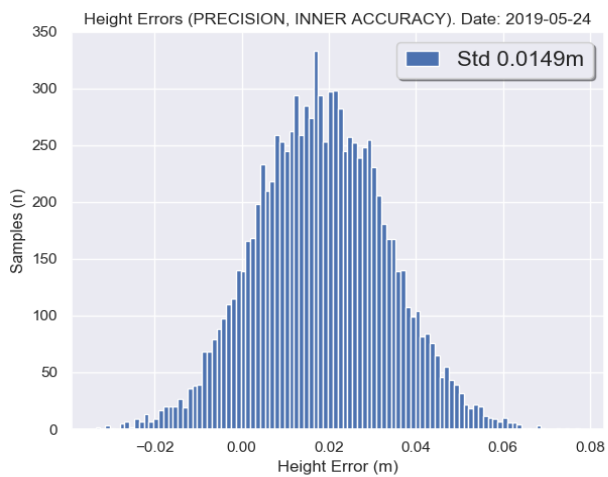
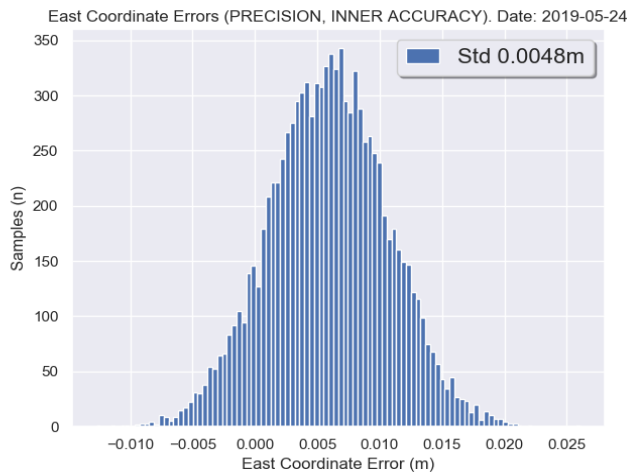
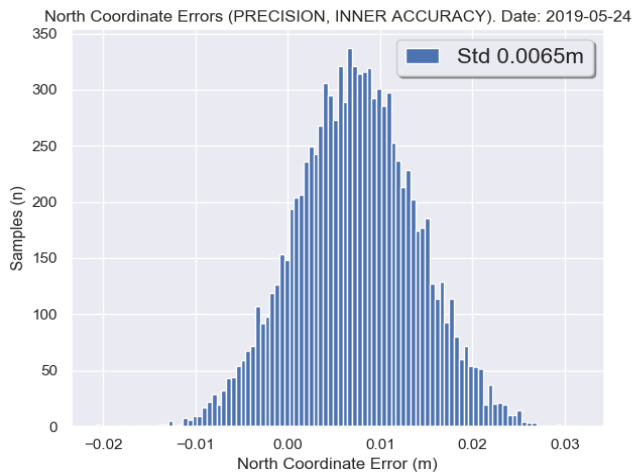
## METHOD2



# Gaussian Distribution Models for the Distributions of Errors (PRECISION, INNER ACCURACY)

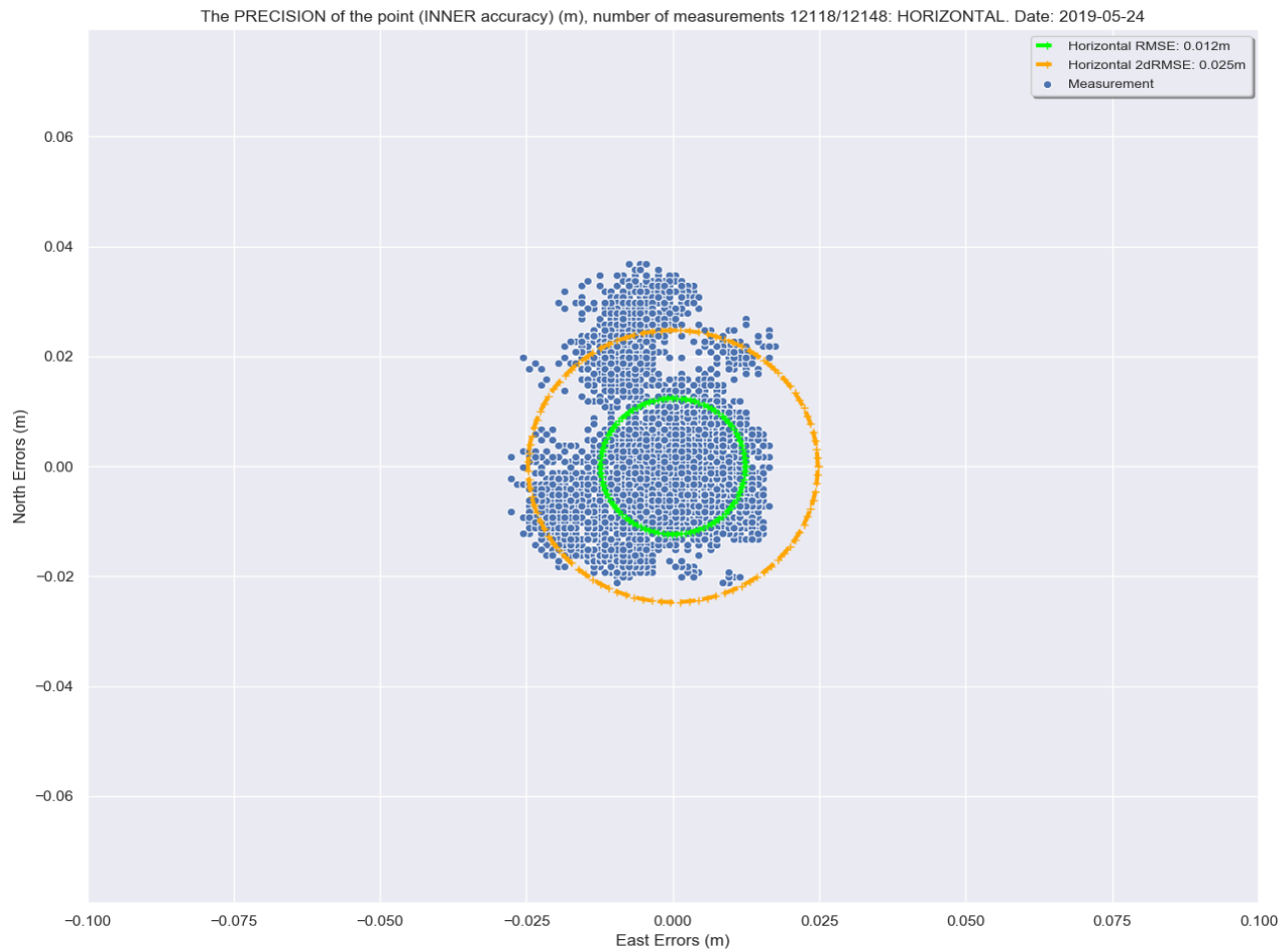
## METHOD2

Gaussian Distribution Models for North and East Coordinate Errors, and Height Errors. Precision (Inner Accuracy):  
User-Defined Sample Size (n): 10000



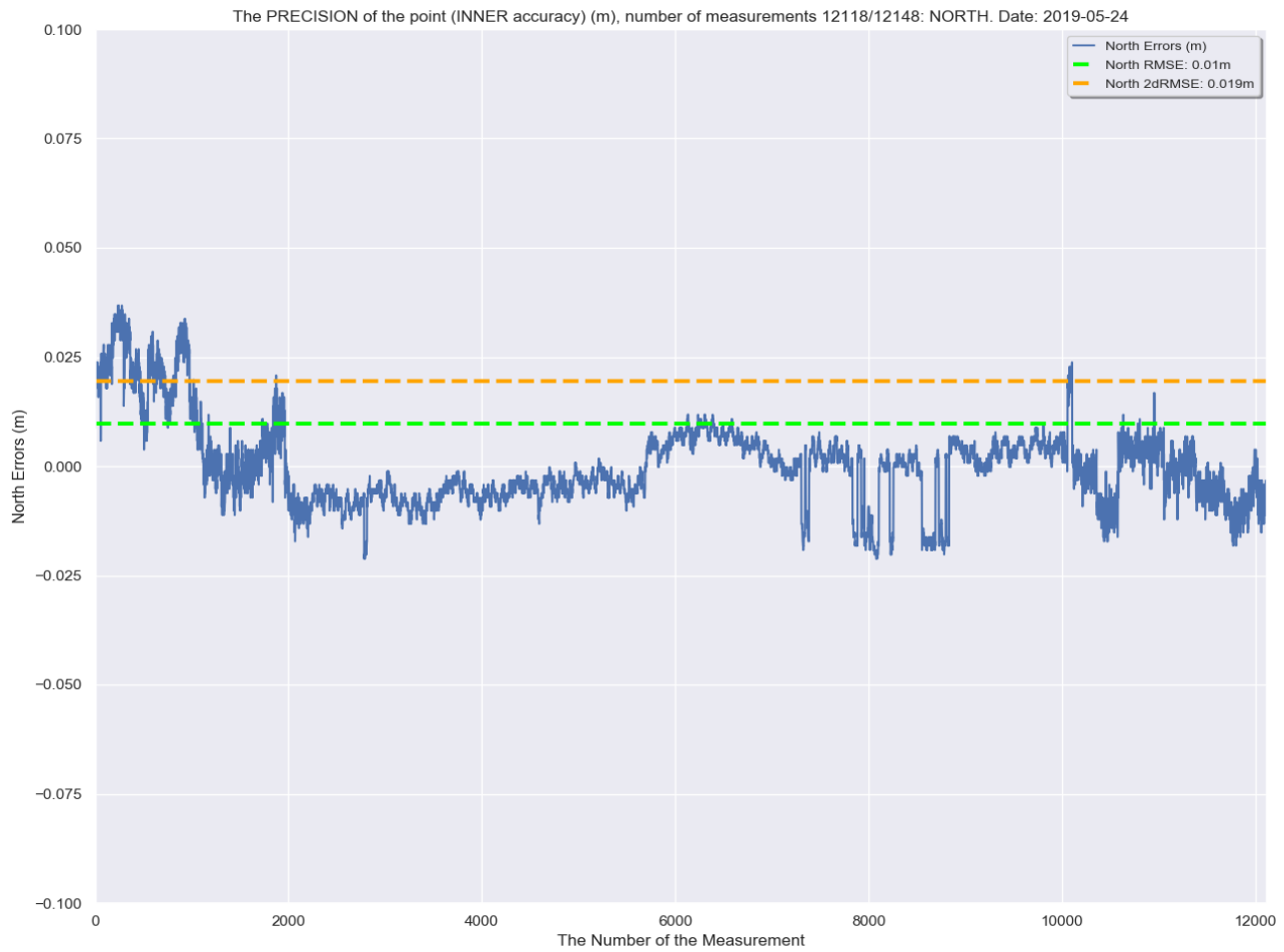
# The PRECISION of the point (INNER accuracy) (m) HORIZONTAL

## METHOD2



# The PRECISION of the point (INNER accuracy) (m) NORTH

## METHOD2



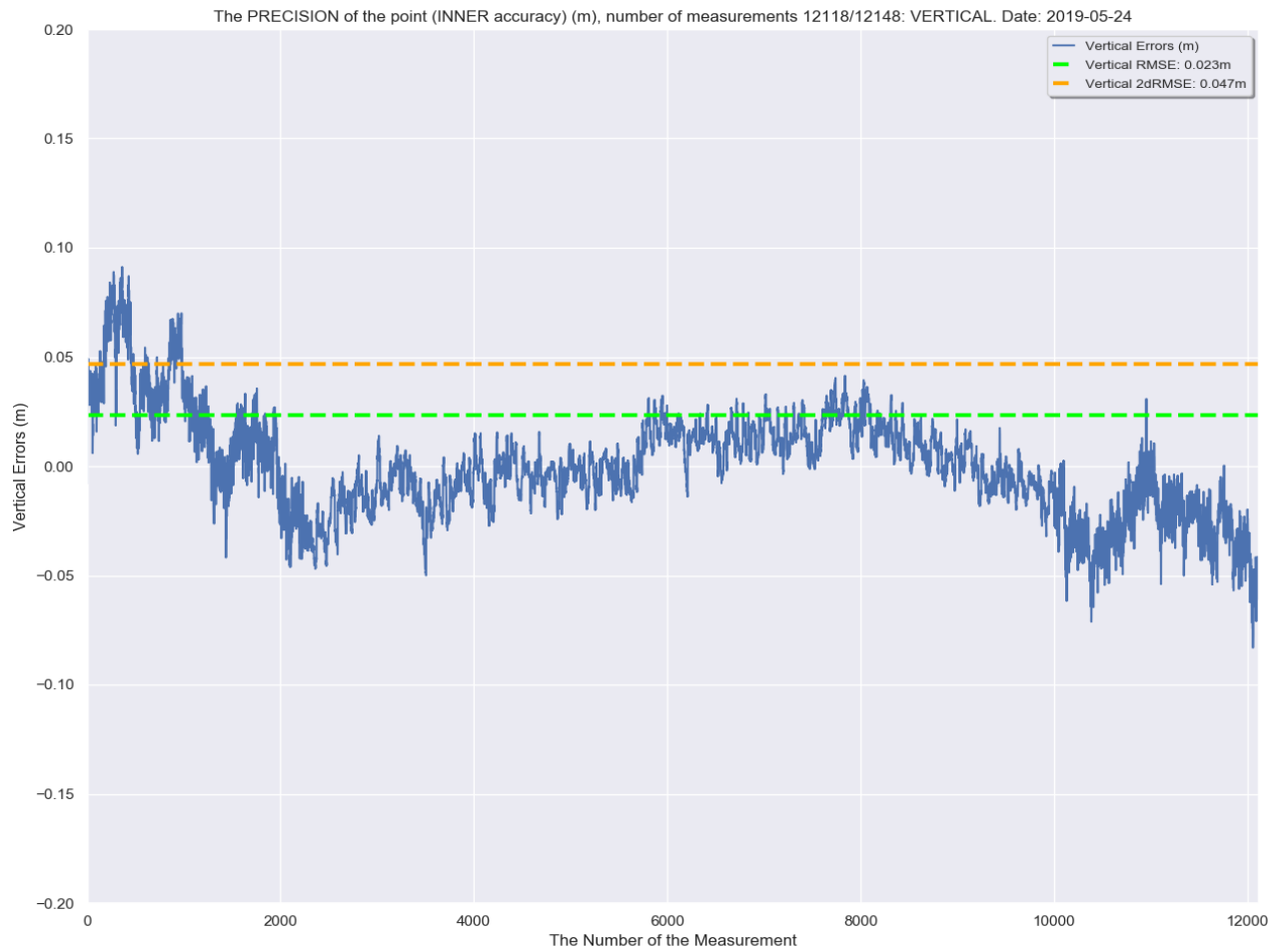
# The PRECISION of the point (INNER accuracy) (m) EAST

## METHOD2



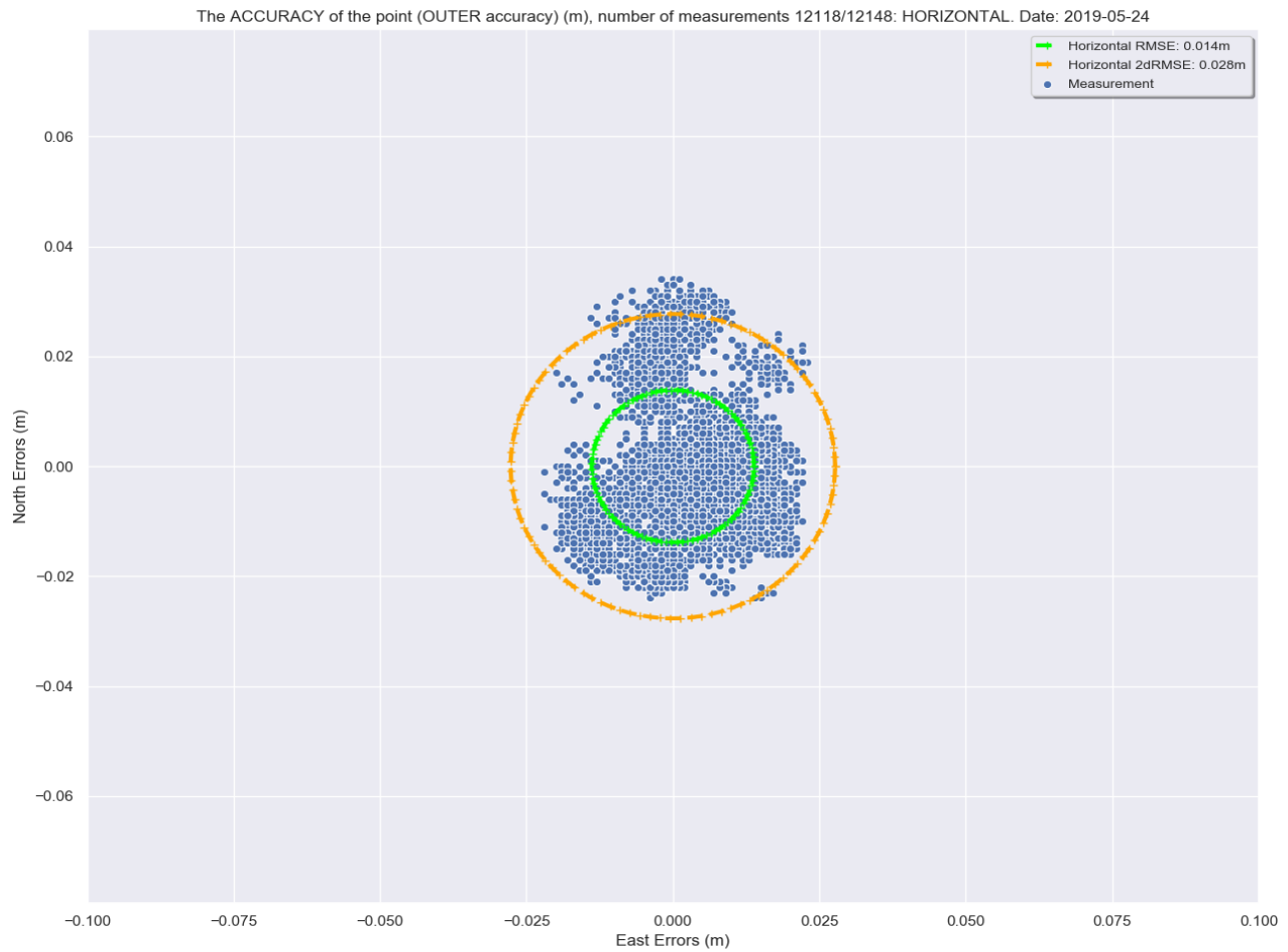
# The PRECISION of the point (INNER accuracy) (m) VERTICAL

## METHOD2



# The ACCURACY of the point (OUTER accuracy) (m) HORIZONTAL

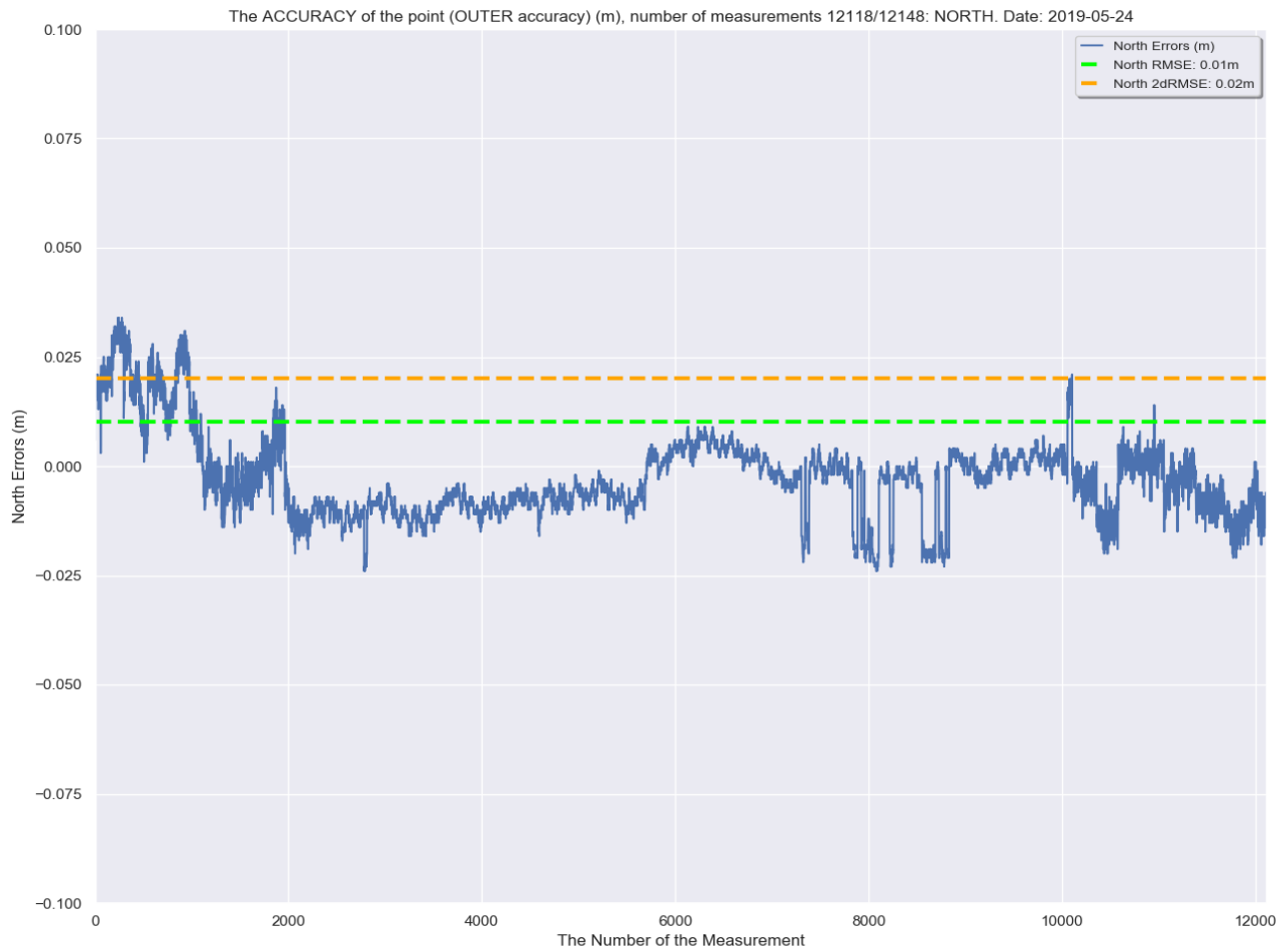
## METHOD2





# The ACCURACY of the point (OUTER accuracy) (m) NORTH

## METHOD2



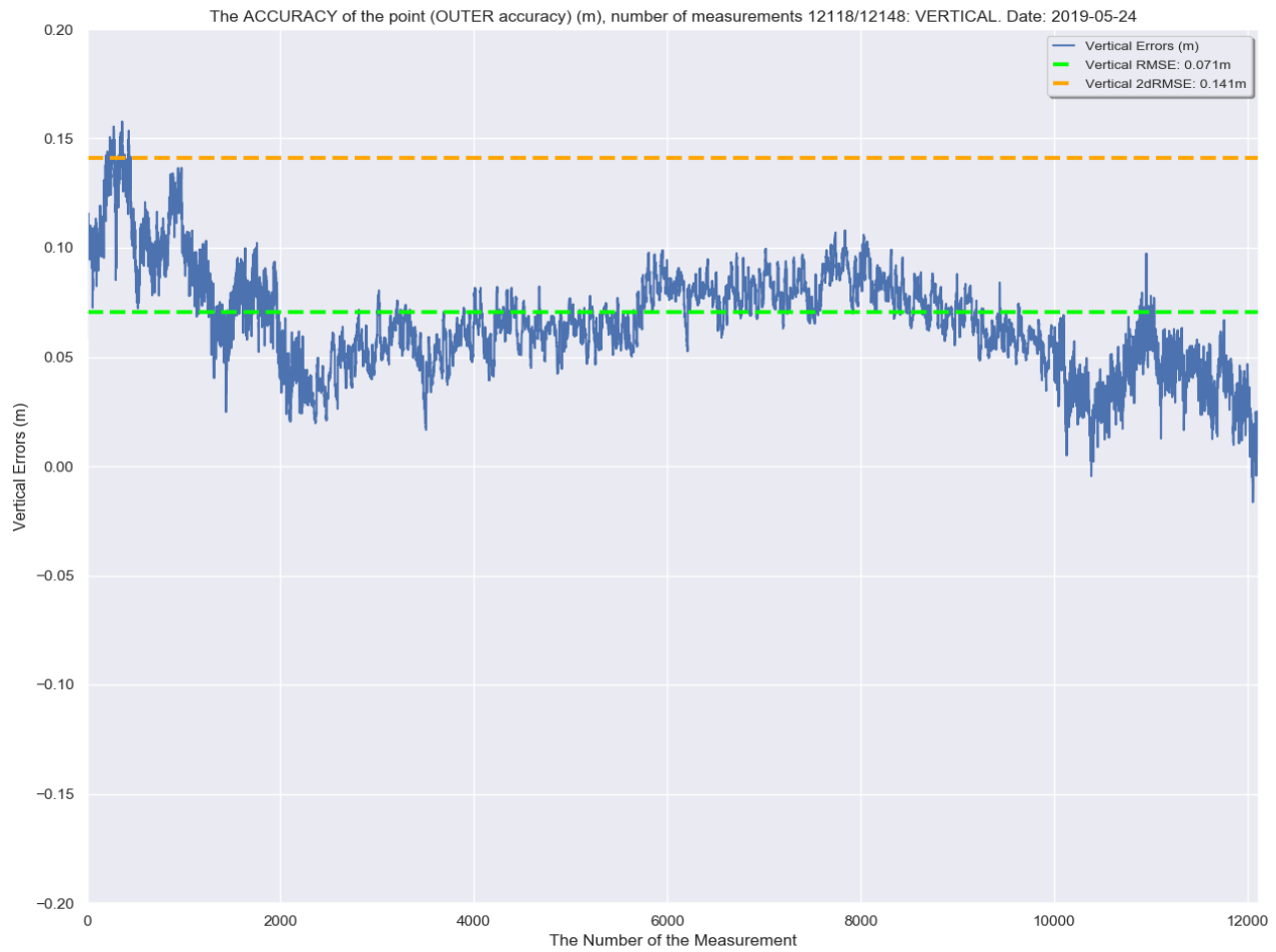
# The ACCURACY of the point (OUTER accuracy) (m) EAST

## METHOD2



# The ACCURACY of the point (OUTER accuracy) (m) VERTICAL

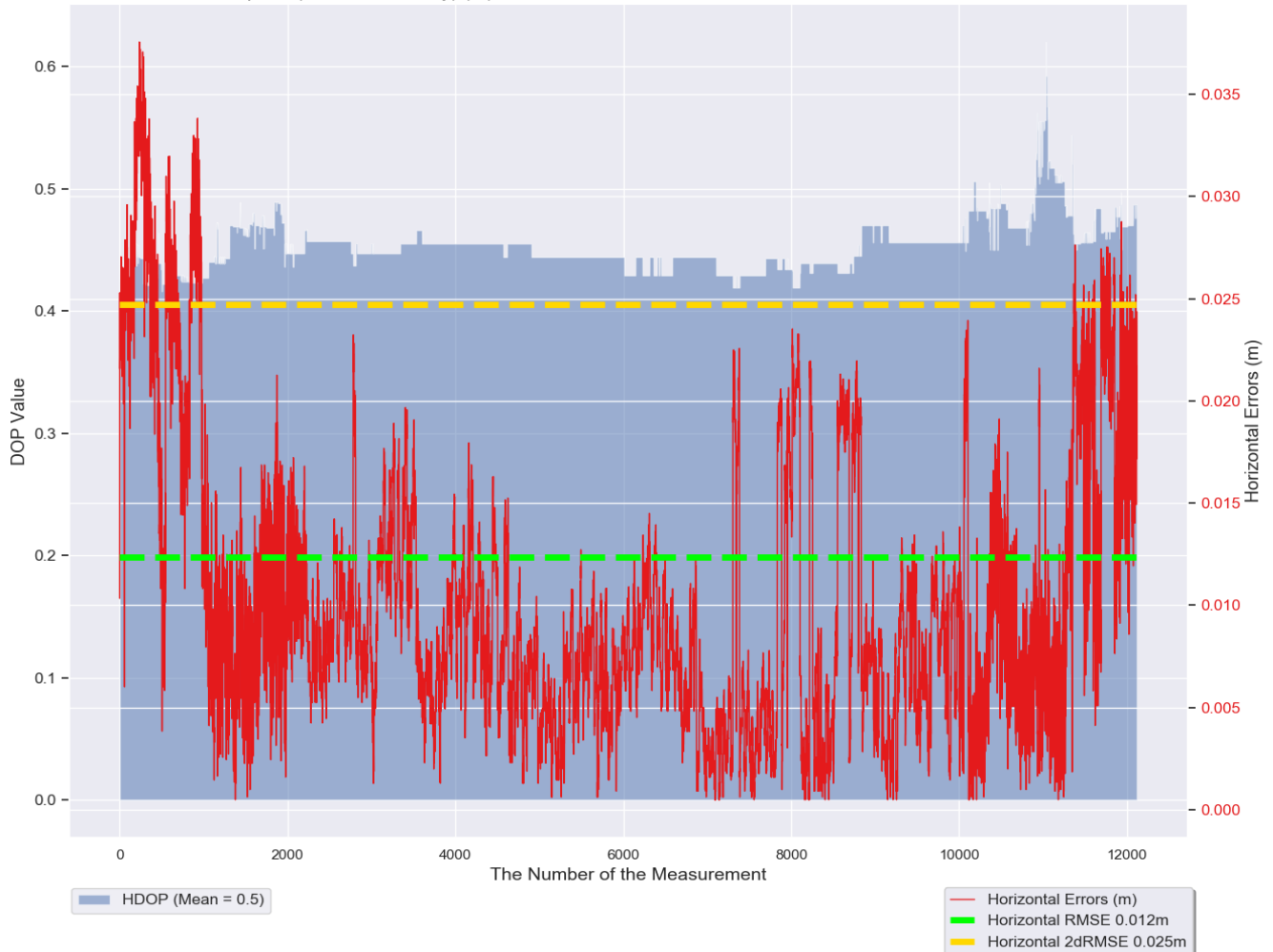
## METHOD2



# The Horizontal PRECISION of the point (INNER accuracy) (m) with DOP values

## METHOD2

The Horizontal PRECISION of the point (INNER accuracy) (m) with DOP values, number of measurements 12118/12148: HORIZONTAL. Date: 2019-05-24



# The 3D PRECISION of the point (INNER accuracy) (m) with DOP values

## METHOD2

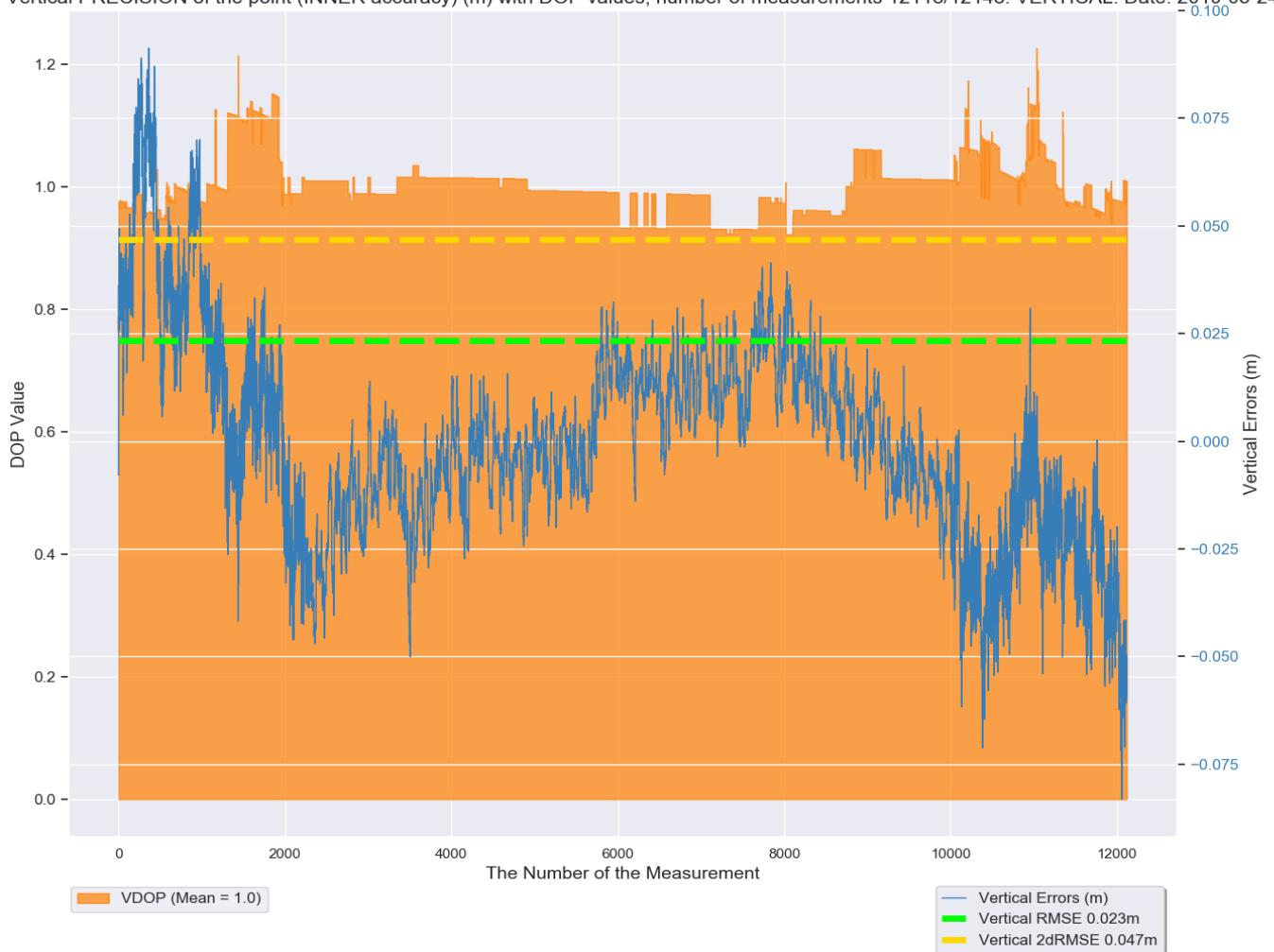
The 3D PRECISION of the point (INNER accuracy) (m) with DOP values, number of measurements 12118/12148: 3D. Date: 2019-05-24



# The Vertical PRECISION of the point (INNER accuracy) (m) with DOP values

## METHOD2

The Vertical PRECISION of the point (INNER accuracy) (m) with DOP values, number of measurements 12118/12148: VERTICAL. Date: 2019-05-24



## Conclusions

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