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Analysis of The Effect of Data Intervals on the GNSS Processing

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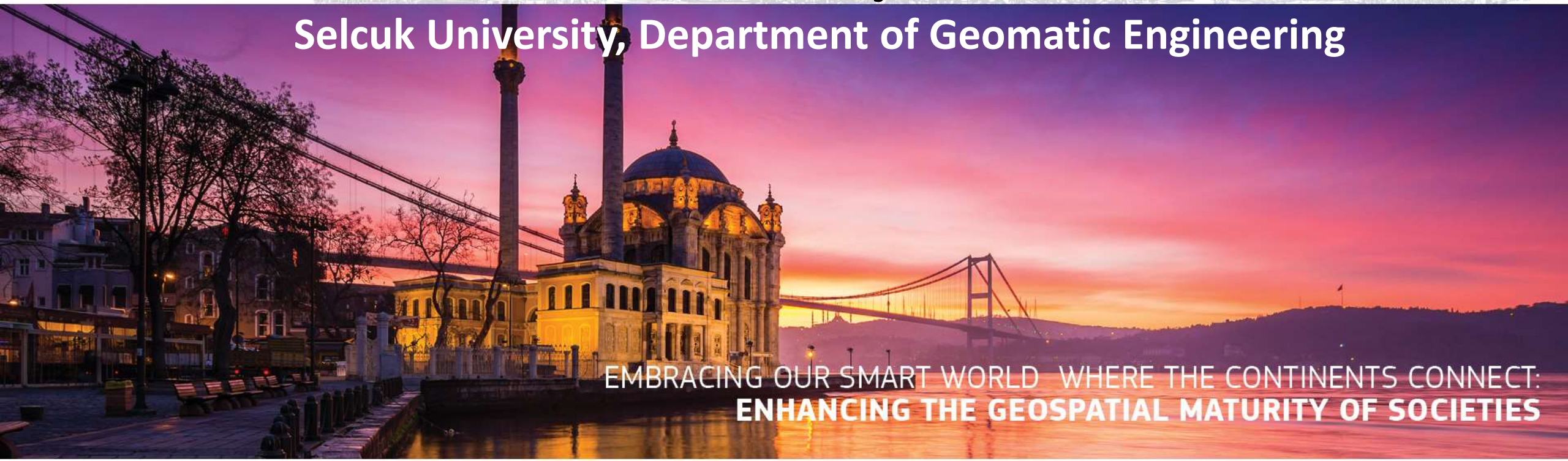

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1. Introduction

Today, with the rapid development and changes in space geodesy and satellite techniques, opportunities for choosing and using GNSS have increased, and many satellite systems are available and ready to use.

GNSS applications have been one of the most important areas of work in measurement techniques and Geodetic Science. In order to analyze the effect of data intervals of GNSS processing results with data intervals of 1, 5, 10, 15, 30 seconds, satellite systems (GPS, GLONASS) observation duration 5, 20, 120 minutes investigated how much of which effect has been interpreted.

2. Material and method

In this study, data of two GNSS networks, namely, national CORS-TR and the newly established local network were used. For this purpose, a local network consisting of 28 points was established in the project area. 25 of them were newly established (J1 - J25), and the other point is the existing point of the conventional TNFGN (Turkey National Fundamental GPS Network - L29-G002) and two others are points of the Konya Greater Municipality local geodetic network (M2920010 and M2910003). Processing was performed in ITRF96 datum and 2005.0 epoch. In this study the following observation plan was applied: 3 reference points (L29-G002, M2920010 and M2910003) were observed for two

hours with a 1 second data interval in order to cover the 25 newly established points in the observation span. The locally established 25 new points were observed for 20 minutes statically with a 1 second data interval. The cut-off elevation angle of 10° was applied. Base lengths between all points vary between 400 m and 5 km. The 20 minute duration were divided into 5 minute periods in order to compare the results obtained from 20 minute solutions to shorter (i.e. 5 minutes) time spans. Information about baseline lengths and time intervals are provided in Table 1 , base solutions geometry by LGO and local geodetic network in figure 1 and figure 2. During the observations, dual frequency geodetic GNSS receivers (JAVAD TRIUMPH-1) were used, belonging to the Selcuk University.

Table 1: Baseline lengths and time table

From	To	Base Lengths (m)	Duration (20 Minutes)			
			Session Time	Session Time	Session Time	Session Time
J21	L29-G002	2015.302	0-5	5-10	10-15	15-20
J21	M2910003	2867.12	0-5	5-10	10-15	15-20
J21	J1	1267.695	0-5	5-10	10-15	15-20
J21	J10	1000.92	0-5	5-10	10-15	15-20
J21	J20	324.498	0-5	5-10	10-15	15-20
J21	J9	977.334	0-5	5-10	10-15	15-20
J21	J11	649.629	0-5	5-10	10-15	15-20
J21	J12	670.805	0-5	5-10	10-15	15-20

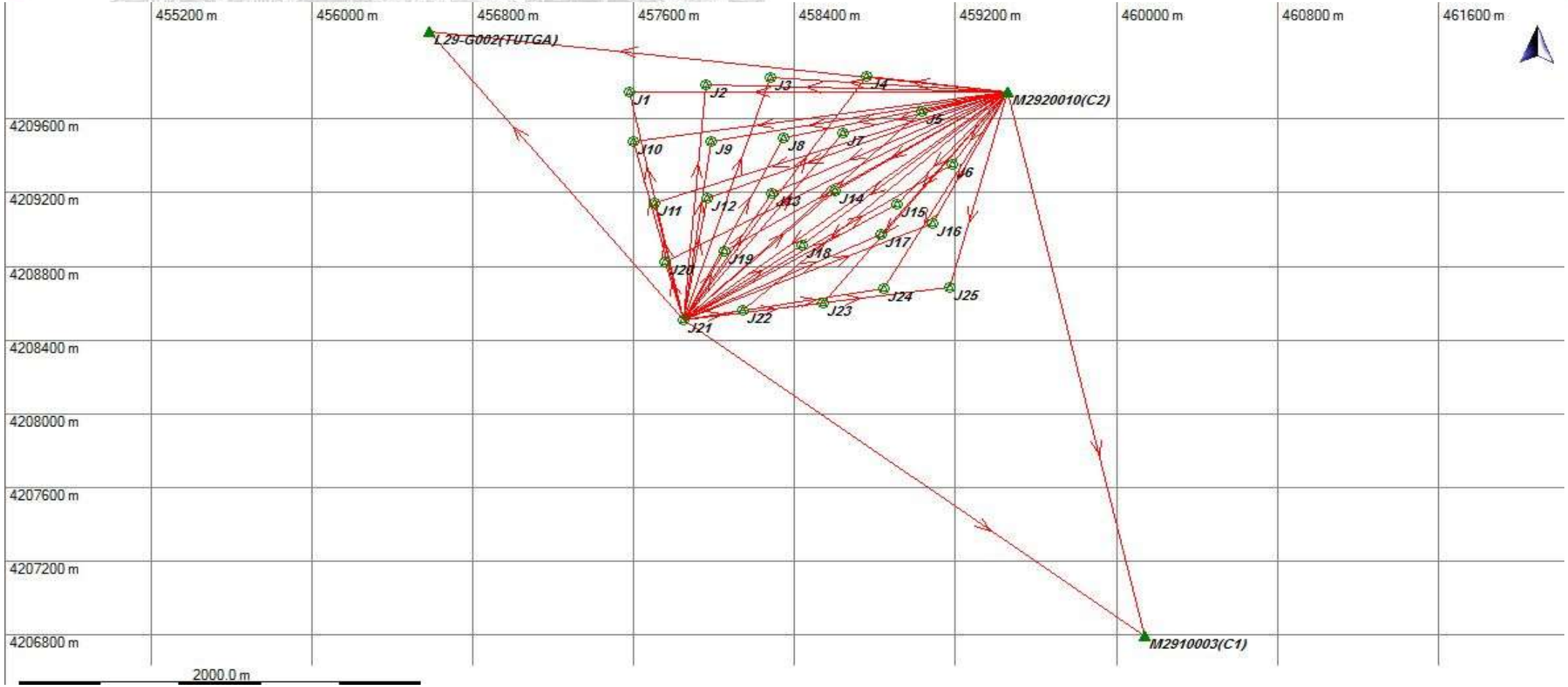

Figure 1: base solutions Geometry by LGO

Figure 2 : Local Geodetic Network points by google earth

Data of CORS - TR stations (AKHISAR, KONYA, CIHANBEYLI, KARAPINAR, YUNAK, and KARAMAN) used in this study were downloaded from its web-site. The same baselines were processed in different data intervals with different observation periods. Baseline lengths between CORS-TR points had ranges up to 120 km. All computations were performed using LGO GNSS processing software Information about baseline lengths and time intervals are provided in Table 2. Collected data were converted into RINEX format in order to provide solutions using LGO software. All processing parameters are provided in Table 3 ,base solutions geometry by LGO and CORS-TR geodetic network as shown in figure 3 and figure 4.

Table 2:Baseline lengths and time table

From	To	Base Lengths (m)	Duration times (24 Hourly)			
			Session	Session	Session	Session
AKHR	CIHA	133888.239	0-2	2-4	4-6	6-8
AKHR	KAMN	204745.318	0-2	2-4	4-6	6-8
AKHR	KAP1	198042.317	0-2	2-4	4-6	6-8
AKHR	KNY1	107840.583	0-2	2-4	4-6	6-8
AKHR	YUN1	56163.895	0-2	2-4	4-6	6-8
CIHA	KAMN	163844.059	0-2	2-4	4-6	6-8

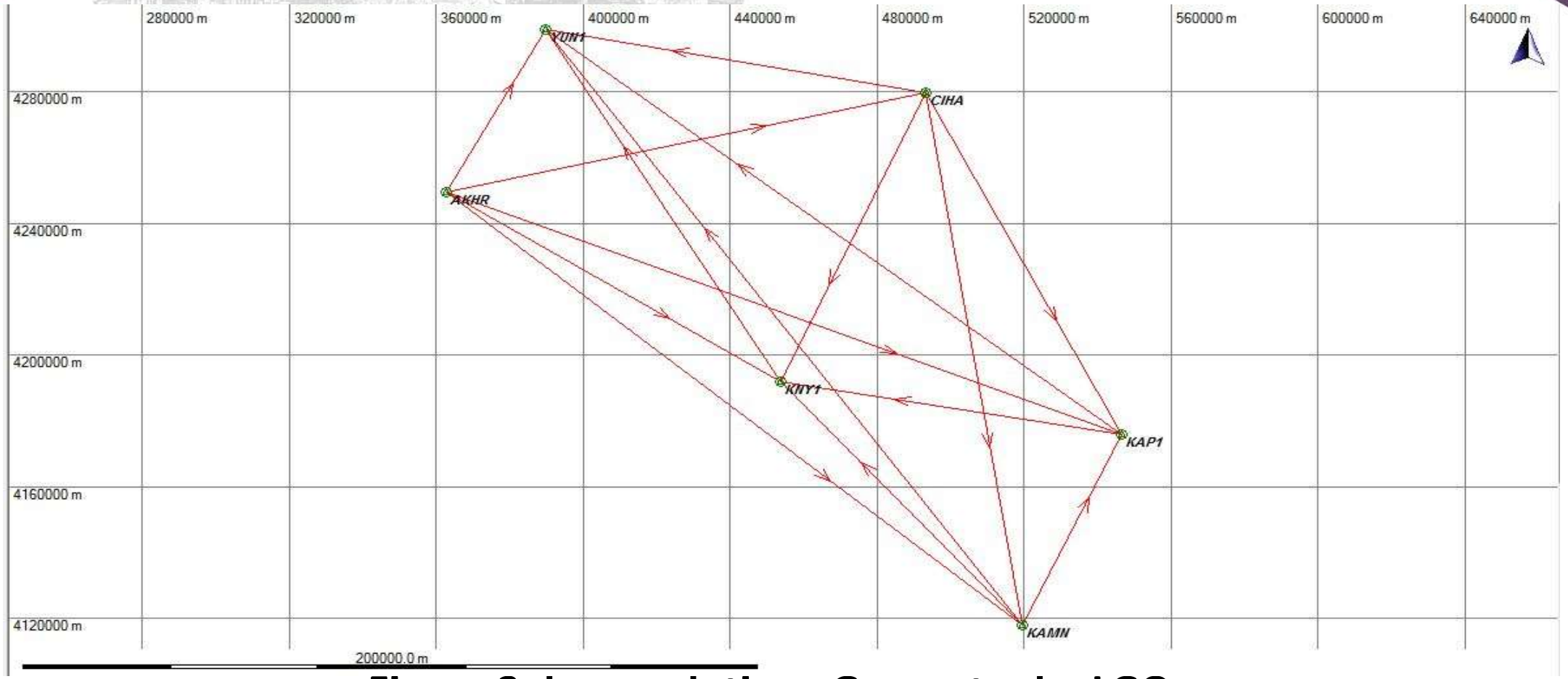

Figure 3: base solutions Geometry by LGO

Figure 4 : CORS-TR Geodetic Network points by google earth

Table 3: Processing parameters are available in local and CORS-TR geodetic Network

Parameters	Selected
Cut-off angle:	10°
Ephemeris type:	Broadcast (CORS-TR data with precise eph)
Solution observable:	Phase
GNSS type:	GPS, GPS+GLONASS, GLONASS
Solution Method	Baseline
Frequency:	Automatic (L1, L2, L1+L2, Iono free fixed)
Fix ambiguities up to:	500 km
Min. duration for float solution (static):	300 Sec
Sampling rate:	(1,5,10,15,30) sec
Tropospheric model:	Hopfield
Ionospheric model:	Automatic

3.Processing Results : for each solution explained in Tables 1 and 2 as shown in down tables

3.1. Local Geodetic Network

Table 1: Differences between 1 second and 5 , 10 second data intervals using GPS-only , GLONASS only satellites. Data and observation time is 20 minutes.

	ΔX (m)	ΔY (m)	ΔZ (m)
Minimum	-0.001	-0.001	-0.001
Maximum	-0.001	-0.001	-0.001
Average	-0.001	-0.001	-0.001
Standard deviations	-0.001	-0.001	-0.001

Table 2 : Differences between 1 second and 15 second data intervals using GPS-only satellites. Data and observation time is 20 minutes.

	ΔX (m)	ΔY (m)	ΔZ (m)
Minimum	-0.001	-0.001	-0.001
Maximum	0.002	0.002	0.002
Average	0.000	0.000	0.000
Standard deviations	0.001	0.001	0.001

Table 3 : Differences between 1 second and 30 second data intervals using GPS-only satellites. Data and observation time is 20 minutes.

	ΔX (m)	ΔY (m)	ΔZ (m)
Minimum	-0.001	-0.001	-0.001
Maximum	0.003	0.003	0.003
Average	0.000	0.000	0.000
Standard deviations	0.001	0.001	0.001

Table 4 : Differences between 1 second and 15 second data intervals using GLONASS-only satellites. Data and observation time is 20 minutes.

	ΔX (m)	ΔY (m)	ΔZ (m)
Minimum	-0.001	-0.001	-0.001
Maximum	0.001	0.001	0.001
Average	0.000	0.000	0.000
Standard deviations	0.001	0.000	0.001

Table 5 : Differences between 1 second and 30 second data intervals using GLONASS-only satellites. Data and observation time is 20 minutes.

	ΔX (m)	ΔY (m)	ΔZ (m)
Minimum	-0.001	-0.001	-0.001
Maximum	0.002	0.001	0.002
Average	0.000	0.000	0.000
Standard deviations	0.001	0.001	0.001

Table 6 : Differences between 1 second and 5 second data intervals using GPS+GLONASS satellites. Data and observation time is 20 minutes.

	ΔX (m)	ΔY (m)	ΔZ (m)
Minimum	-0.001	-0.001	-0.001
Maximum	0.001	0.001	0.001
Average	0.000	0.000	0.000
Standard deviations	0.000	0.000	0.000

Table 7 : Differences between 1 second and 10 second data intervals using GPS+GLONASS satellites. Data and observation time is 20 minutes.

	ΔX (m)	ΔY (m)	ΔZ (m)
Minimum	-0.004	-0.002	-0.003
Maximum	0.001	0.002	0.002
Average	0.000	0.000	0.000
Standard deviations	0.001	0.001	0.001

Table 8 : Differences between 1 second and 15 second data intervals using GPS+GLONASS satellites. Data and observation time is 20 minutes.

	ΔX (m)	ΔY (m)	ΔZ (m)
Minimum	-0.003	-0.001	-0.003
Maximum	0.002	0.003	0.001
Average	0.000	0.000	0.000
Standard deviations	0.001	0.001	0.001

Table 9 : Differences between 1 second and 30 second data intervals using GPS+GLONASS-only satellites. Data and observation time is 20 minutes.

	ΔX (m)	ΔY (m)	ΔZ (m)
Minimum	-0.001	-0.001	-0.001
Maximum	0.003	0.002	0.002
Average	0.000	0.000	0.000
Standard deviations	0.001	0.001	0.001

Table 10 : Differences between 1 second and 5 , 10 , 15 , 30 second data intervals using GPS only , GLONASS only , GPS+GLONASS-only satellites. Data and observation time is 5 minutes.

	ΔX (m)	ΔY (m)	ΔZ (m)
Minimum	-0.004	-0.002	0.005
Maximum	0.005	0.002	0.005
Average	0.000	0.000	0.000
Standard deviations	0.002	0.001	0.001

3.2. CORS-TR points results

Table 11 : Differences between 1 second and 5 , 10 , 15 , 30 second data intervals using GPS only , GLONASS only , GPS+GLONASS-only satellites. Data and observation time is 2 hours.

	ΔX (m)	ΔY (m)	ΔZ (m)
Minimum	-0.001	-0.001	0.000
Maximum	0.001	0.001	0.001
Average	0.000	0.000	0.000
Standard deviations	0.001	0.000	0.000

4. Conclusions

According to comparison results on these tables, the differences between GPS-only, GLONASS-only and GPS+GLONASS data are a maximum of 5 mm and standard deviations are on the order of 1 mm in local geodetic network and a maximum of 1 mm and standard deviations are on the order of 1 mm in CORS –TR. According to the processing results, shorter data intervals such as 1, 5 and 10 seconds do not change the results significantly when compared to processing results obtained using 15 or 30 second data intervals. Consequently, it can be said that data collected in the field with 15 or 30 second data intervals will be sufficient to obtain satisfactory results in static GNSS data observation and processing.

It should be remembered that 5 mm differences on the local network is valid only for two baselines. Also, consideration should be noted that the processing period varies between 5-20 minutes.

Thanks for your attention …