

How To Adjust Deformation networks Version 4.6



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1. Introduction

This document describes how the networks of 2 (or more) measurement epochs can be adjusted together to test for deformations.

The first step is always an adjustment of the measurements for each individual epoch to remove the measurement errors. To achieve this a free network adjustment would be sufficient, but of course one could also compute a constrained adjustment to check if the measurements will fit on the control points.

For more information on the adjustment of networks please refer to the How To: Combined TPS and GPS adjustment and How To: Levelling.

Please note that this is a sample. The actual settings may differ depending on your requirements.



2. Combined MOVE3 Project

Open the project with the first epoch. Save this project under a new name. Then label the stations by adding a suffix, for example :1, to the all station names.

•	Stations							
Cle	ise Edit	Tools						
	No.	Name		Туре	X East		Y North	Height
	1	VAL		TER	106066.0579 *	458	832.9495 *	18.5907
	2	557	Change Dee		100150.0000	450	710.0000	4 45504
	3	650	Change Pro	percies				~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
	4	1003	Known terr	estrial coordinate	es		- Change Statu	s
	5	1002	□ × Fast	/ Y North	0.0050	m	From 📃	to 🔳
	6	1004	Height	1110101	0.0000	m	From	to 🕅
	7	556	E Hoight		0.0000			
	8	553	Known GN	SS/GPS coordir	nates			
	9	552	XYZ		0.0100	m	From	to 📃
	10	551						
Ľ	11	651	Precision o	t idealisation			Prefix	
	12	555	Precisio	nXY	0.0000	m	Suffix	:1
	13	652	Precisio	n Height	0.0000	m	Feature code	
Ы	15	653						
	16	559	Save a	s defaults			Update statio	ins
	17	117		Gordano			II (
	18	11					Selection	
	19	127		ж	Cancel He	elp		
	20	12		- En	100050.0000		750.0000	4.2000
	21	10		TER	106030.0000	458	730.0000	1.9999
	22	9		TER	106030.0000	458	730.0000	2.0016
	23	8		TER	106041.0000	458	721.0000	2.0857
	24	601		TER	106040.0000	458	720.0000	2.0824

Then import the second epoch into this project using Import|MOVE3 project. The second epoch stations can be labelled by adding a suffix, for example :2.

No.	Name	Туре	X East	Y North	Height	
] 67	5	TER 1	06040.0000	458710.0000	2.3959	
68	HI_12	Change Properties	00000 0000	450700.0000		
69	HI_13	enongerropentes				
70		Known terrestrial coordinates		Change Status		
71	9	East / Y North	0.0050 m	From	to 🗖	
72	HI_14	Theight	0.0000 m	From	to 🗖	
73	HI_ 10					
74	0	Known GNSS/GPS coordinates				
		XYZ	0.0100 m	From	to 🔳	
77		Precision of idealisation		Prefix		
78			0.0000		2	
79	2A	Precision XY	0.0000 11	Sumx .		
		Precision Height	U.UUUU m	Feature code		
				- Undate station		
82	DP1	Save as defaults				
83	DP2			Colorian		
84	DP3			 Selection 		
	DP10	UK Car	ncel Help			
	DP11		00200.0000	400000.0000	1.2735	
87	DP12		06150.0000	458670.0000	3.5404	
88	HI_17		06050.0000	458710.0000	5.5722	



3. Options Adjustment

In the General Options Adjustment tab the Level of Significance for the Shift Vector can be set separately from the Level of Significance of the other observations.

General options		— X—
Project Geometry Adjustment	MOVE3 output selection	Units Datasnooping
Adjust / design	Adjustment 🔹	Filter
Phase	Free network 🔹	Inner Constraint
Max number of iterations	3	
Iteration criterion	0.0001 m	
Level of significance		
General	0.001 🔹	
Shift Vector	0.317 🔹	
Power	0.80 -	
Confidence level 1D	Standard 💌	
Confidence level 2D	Standard 💌	
C0 criterion	0.0000 cm2	
C1 criterion	1.0000 cm2/km	
Additional Output	None	•
ОК	<u>C</u> ancel	Help

Adjustment tab sheet.

For an early warning the Level of significance can be set to for example 0.317, this will test the Shift Vectors at a 1 sigma level.



4. Options Datasnooping

In the General Options Datasnooping tab Automated Datasnooping can be activated.

General options									
Project Geometry Adjustment	MOVE3 output	t selection Units	Datasnooping						
Warning: Automated datasnooping should sufficient number of redundant o	only be activate bservations.	d for networks with	a						
Automated Datasnooping									
F-Test maximum value	2.000								
F-Test minimum value	0.250								
Maximum number of removals	25								
Minimum Redundancy	51	%							
OK	<u>C</u> ancel		Help						

Datasnooping tab sheet.

With the automated datasnooping on the rejected Shift Vectors will automatically be removed from the adjustment in a one by one process, largest rejected Shift Vector first. Especially in deformation analysis it is important to release Shift Vectors that are rejected, since keeping them constrained would influence the final result.

5. Default standard deviations

Before Adding the Shift Vectors it is important to properly set the defaults for the standard deviations of the shift vectors. The default values are added to each added shift vector.

Standard Deviations					- ×
Standard deviations for obse	ervations Standar	d deviat	ions for	stations	
Terrestrial Observations:					
Direction	0.00010	gon		0.00002	gon.km
Distance	0.0010	m		1.0	ppm
Zenith Angle	0.00010	gon		0.00002	gon.km
Azimuth	0.00030	gon		0.00030	gon.km
Height Difference	0 15	mm		0.80	mm/sart(km)
	0.10			0.00	mm/km
Shift Vector EN	0.0010	m	Н	0.0010	m
Local Coordinate EN	0.0100	m	Н	0.0100	m
GNSS/GPS Observations					
GNSS/GPS Baseline	0.0020	m		0.2	ppm
GNSS/GPS Coordinate	10.0000	m			
Geometrical Relations:			⊢U	pdate Observations	,
Angle	0.10000	gon	\odot	All	
Distance / collinearity	0.0150	m	0	All types with char defaults	nged
Offsets:			0	All with old default	s
Steel Tape measurement	0.0030	m	۲	None	
Auxiliary point	0.0030	m			
	ОК	<u> </u>	ancel		Help

Standard Deviations.

6. Adding Shift vectors

The shift vectors can be added via the View|Observations menu item Edit|Shift vectors. Use the station name to add the shift vectors.

Shift vectors							x			
		Entered tex	Entered text will be ignored while comparing							
V Station Name	From	:1		То	:2					
Distance		0.1000	m	3D 🔻						
Add as		3D 🔻								
				C	OK	Cancel				
				L	UN	Cancer				

In the example above :1 and :2 will be ignored when comparing station names. If the station names match then a 3D Shift Vector will be added. The value for the shift will be 0.

1	Observati	ons										
<u>C</u> l	ose <u>E</u> dit	Tools									Help	p
	No.	From	То	Instr Hgt	Target	Reading		Reading		Reading	Source	^
	300	553:2	HI_18:2		DH	1.37838	SH	10.492				
	301	HI_18:2	11A:2		DH	-1.40895	SH	9.018				
	302	HI_18:2	12A:2		DH	-1.40817	SH	8.098				
	303	HI_18:2	556:2		DH	-1.37344	SH	9.696				
	304	HI_18:2	10:2		DH	-3.66683	SH	11.741				
	305	HI_18:2	9:2		DH	-3.66364	SH	12.543				
	306	HI_18:2	559:2		DH	-0.80563	SH	29.659				
	307	VAL:1	VAL:2		DE	0.0000	DN	0.0000	DH	0.0000		
	308	557:1	557:2		DE	0.0000	DN	0.0000	DH	0.0000		
	309	1003:1	1003:2		DE	0.0000	DN	0.0000	DH	0.0000		
	310	1002:1	1002:2		DE	0.0000	DN	0.0000	DH	0.0000		
	311	1004:1	1004:2		DE	0.0000	DN	0.0000	DH	0.0000		
	312	556:1	556:2		DE	0.0000	DN	0.0000	DH	0.0000		
	313	553:1	553:2		DE	0.0000	DN	0.0000	DH	0.0000		
	314	552:1	552:2		DE	0.0000	DN	0.0000	DH	0.0000		
	315	551:1	551:2		DE	0.0000	DN	0.0000	DH	0.0000		
	316	555:1	555:2		DE	0.0000	DN	0.0000	DH	0.0000		
	317	554:1	554:2		DE	0.0000	DN	0.0000	DH	0.0000		
	318	559:1	559:2		DE	0.0000	DN	0.0000	DH	0.0000		
	319	10:1	10:2		DE	0.0000	DN	0.0000	DH	0.0000		
	320	9:1	9:2		DE	0.0000	DN	0.0000	DH	0.0000		
	321	8:1	8:2		DE	0.0000	DN	0.0000	DH	0.0000		
	322	6:1	6:2		DE	0.0000	DN	0.0000	DH	0.0000		
	323	603:1	603:2		DE	0.0000	DN	0.0000	DH	0.0000		
	324	2:1	2:2		DE	0.0000	DN	0.0000	DH	0.0000		
	325	1:1	1:2		DE	0.0000	DN	0.0000	DH	0.0000		
	326	558:1	558:2		DE	0.0000	DN	0.0000	DH	0.0000		
	327	1001:1	1001:2		DE	0.0000	DN	0.0000	DH	0.0000	-	-
												ļ
•											•	
-												



/	Observation	15										
Clo	se <u>E</u> dit	Tools										<u>H</u> elp
	No.	From	То	Instr Hgt	Target		Reading		Reading		Reading	Source
	295	HI_17:2	555:2			DH	-3.45383	SH	28.791			
	296	HI_17:2	8:2			DH	-3.48018	SH	29.134			
	297	HI_17:2	555B:2			DH	-3.45135	SH	29.119			
	298	HI_17:2	553:2			DH	-1.27947	SH	47.900			
	299	HI_17:2	553:2			DH	-1.27934	SH	47.903			
	300	553:2	HI_18:2			DH	1.37838	SH	10.492			
	301	HI_18:2	11A:2			DH	-1.40895	SH	9.018			
	302	HI_18:2	12A:2			DH	-1.40817	SH	8.098			
	303	HI_18:2	556:2			DH	-1.37344	SH	9.696			
	304	HI_18:2	10:2			DH	-3.66683	SH	11.741			
	305	HI_18:2	9:2			DH	-3.66364	SH	12.543			
	306	HI_18:2	559:2			DH	-0.80563	SH	29.659			
	307	VAL:1	VAL:2			DE	0.0000	DN	0.0000			
	308	557:1	557:2							DH	0.0000	
	309	556:1	556:2							DH	0.0000	
	310	553:1	553:2							DH	0.0000	
	311	552:1	552:2							DH	0.0000	
	312	551:1	551:2							DH	0.0000	
	313	555:1	555:2							DH	0.0000	
	314	554:1	554:2							DH	0.0000	
	315	559:1	559:2							DH	0.0000	
	316	10:1	10:2			DE	0.0000	DN	0.0000			
	317	9:1	9:2			DE	0.0000	DN	0.0000			
	318	8:1	8:2			DE	0.0000	DN	0.0000			
	319	6:1	6:2			DE	0.0000	DN	0.0000			
	320	2:1	2:2			DE	0.0000	DN	0.0000			
	321	1:1	1:2			DE	0.0000	DN	0.0000			
	322	558:1	558:2							DH	0.0000	=
•												•

Here some of the points need to checked for deformation in height, while others are to be checked for deformation in position. This requires manual changes to the individual records.

7. Free network adjustment

This network can be adjusted as a free network or as an inner constraint network if you select to use the inner constraint adjustment in the Adjustment tab

General options			×		
Project Geometry Adjustment	MOVE3 output selection	Units	Datasnooping		
Adjust / design	Adjustment 🔹	Filte	er		
Phase	Free network 🔹	🔳 Inn	Inner Constraint		
Max number of iterations	9				
Iteration criterion	0.0001 m				
Level of significance					
General	0.001 🔹				
Shift Vector	0.317 🔹				
Power	0.80 🔻				
Confidence level 1D	Standard 🔻				
Confidence level 2D	Standard 👻				
C0 criterion	0.000 cm2				
C1 criterion	1.000 cm2/km				
Additional Output	None	•			
ОК	<u>C</u> ancel		Help		

General options Geometry tab

Then go to Compute | MOVE3 and adjust the free network to find errors in the observations.

Select output project				×
Create report file :	Report file	HTML	•	OK
C:\Projecten\HowTo\	Deformation\Epoch1	and2.out1.html		<u>C</u> ancel
Create adjusted coordinate	<u>B</u> rowse			
C:\Projecten\HowTo\				
Create covariance matrix fil	e:			
C:\Projecten\HowTo\	Deformation\Epoch1	and2.var		
 Update coordinates after Overwrite files 	adjustment	Phase	Free net	work 👻



Compute Free network

The MOVE3 report will give the testing results of the adjustment, allowing to identify the points that have been affected by deformation. If the correction is bigger than what is expected based on the standard deviation this case the shift vectors will be rejected.

First we will show the results with automated datasnooping off.

. C:	\Projecten\How	To\Deformation\Ep	och1and2.out1.ht	ml					• ×	
<u>F</u> ile	<u>E</u> dit									
	Max coord co	rrection in last ite	ration	0.0000 m					-	
	TESTING								.=	1
	Alfa (multi din	nensional)		0.6312						
	Alfa 0 (one di	mensional)		0.0010						
	Alfa 0 (Shift v	ector)		0.3170						
	Beta			0.80						
	Critical value	W-test		3.29						
	Critical value	T-test (3 dimensio	nal)	4.24						
	Critical value	T-test (2 dimensio	nal)	5.91						
	Critical value	W-test (Shift vect	or)	1.00						
	Critical value	T-test (3 dimensio	nal) (Shift vector) 0.90						
	Critical value	T-test (2 dimensio	nal) (Shift vector) 0.98						
	Critical value	F-test		0.98						
	F-test			0 454 Accer	nted					
				0.4047.0000	, cou					
	Chi-Square Te	– est (99.9%)								
	Lower Bound	()		0 811						
	Upper Bound			1 213						
	Chi-Square Te	est		0 454 < Low	er Bound					
	on oquaro n			0.101 - 201						
	TEST SUMM	ARY		-						
	Record		Station	Target	Tes	st Factor	Red	Est err		
	308	DH(shift)	557:1	557:2	W-tes	st 4.8	80	0.0054 m		
	317	DH(shift)	9:1	9:2	W-tes	st 1.1	78	-0.0013 m		
	320	DH(shift)	2:1	2:2	VV-tes	st 1.1	81	-0.0012 m		
	318	DH(shift)	8:1	8:2	VV-tes	st 1.0	82	-0.0011 m		
	VARIANCE C	OMPONENT ANA	LYSIS							
						Variance		Redundancy		
	Terrestrial					0.405		493.6		
	GNSS/GPS					1.005		44.4		
	Directions					0.373		133.2		
	Distances					0.286		139.8		
	Zenith angles					0.287		148.4		
	Height differer	nces				0.861		51.1		
	GNISS/GPS o	nordinata differen	-00			1 005		AA A		1

The Test Summary shows 4 rejected height shifts, the biggest is related to point 557. This is the most suspect one.

After activating the automated datasnooping we get following results.



FOIL								
Max coord	d correction in last	iteration	0.000 r	n				
TESTING								
Alfo (multi	i dimonoional)		0 6211					
Alla (mulu	dimensional)		0.0010					
Alla 0 (Olle	e dimensional)		0.0010					
Alla U (Shi Data	iit vector)		0.3170					
Deta			0.00					
Critical val	lue vv-test	-:D	3.29					
Critical val	lue T-test (3 dimen:	sional)	4.24					
Critical val	iue i-test (2 almen:	sional)	5.91					
Critical val	iue vv-test (Snift Ve	clur)	1.00					
Critical val	lue T-test (3 dimen:	sional) (Shift vec	tor) 0.90					
Critical val	lue 1-test (2 almen:	sional) (Shift Vec	tor) 0.98					
Critical val	lue F-test		0.98					
F-test			0.4127	Accepted				
Chi-Square	e Test (99.9%)							
Lower Bou	und		0.811					
Upper Bou	und		1 213					
00000000	una		1.215					
Chi-Square	re Test		0.412 <	< Lower Bou	ind			
Chi-Squar	e Test		0.412 <	< Lower Bou	Ind			
Chi-Square	e Test	Y	0.412	< Lower Bou	ind			
Chi-Square DATASNO Record	ooping summar	Y Station	0.412 <	< Lower Bou Test	Ind Factor	Red	Est err	F-test
Chi-Square DATASNO Record 308	DOPING SUMMAR	Y Station 557:1	0.412 < Target 557:2	< Lower Bou Test W-test	Factor 4.8	Red 80	Est err 0.0054 m	F-test 0.454
Chi-Square DATASNO Record 308 VARIANCE	DOPING SUMMAR DOPING SUMMAR DH(shift)	Y Station 557:1 NALYSIS	0.412 < Target 557:2	< Lower Bou Test W-test	Factor 4.8	Red 80	Est err 0.0054 m	F-test 0.454
Chi-Square DATASNO Record 308 VARIANCE Terrestrial	DOPING SUMMAR DOPING SUMMAR DH(shift) E COMPONENT AI	Y Station 557:1 NALYSIS	0.412 < Target 557:2	< Lower Bou Test W-test	Factor 4.8 Va	Red 80 riance 0.358	Est err 0.0054 m Re	F-test 0.454 dundancy 492.6
Chi-Square DATASNO Record 308 VARIANCE Terrestrial GNSS/GP	DOPING SUMMAR DOPING SUMMAR DH(shift) E COMPONENT AI	Y Station 557:1 NALYSIS	0.412 < Target 557:2	< Lower Bou Test W-test	Factor 4.8 Va	Red 80 riance 0.358 1.005	Est err 0.0054 m Re	F-test 0.454 dundancy 492.6 44.4
Chi-Square DATASNO Record 308 VARIANCE Terrestrial GNSS/GP Directions	DOPING SUMMAR DH(shift) E COMPONENT AI	Y Station 557:1 NALYSIS	0.412 < Target 557:2	< Lower Bou Test W-test	Factor 4.8 Va	Red 80 riance 0.358 1.005 0.373	Est err 0.0054 m Re	F-test 0.454 dundancy 492.6 44.4 133.2
Chi-Square DATASNO Record 308 VARIANCE Terrestrial GNSS/GP Directions Distances	DOPING SUMMAR DH(shift) E COMPONENT AI	Y Station 557:1 NALYSIS	0.412 < Target 557:2	< Lower Bou Test W-test	Factor 4.8 Va	Red 80 riance 0.358 1.005 0.373	Est err 0.0054 m Re	F-test 0.454 dundancy 492.6 44.4 133.2 139.8
Chi-Square DATASNO Record 308 VARIANCE Terrestrial GNSS/GP Directions Distances Zenith ang	DOPING SUMMAR DH(shift) E COMPONENT AI	Y Station 557:1 NALYSIS	Target 557:2	< Lower Bou Test W-test	Factor 4.8 Va	Red 80 riance 0.358 1.005 0.373 0.286 0.282	Est err 0.0054 m Re	F-test 0.454 dundancy 492.6 44.4 133.2 139.8 148.4
Chi-Square Chi-Square DATASNO Record 308 VARIANCE Terrestrial GNSS/GP Directions Distances Zenith ang Height diffe	DOPING SUMMAR DH(shift) E COMPONENT AI	Y Station 557:1 NALYSIS	1.213 0.412 Target 557:2	< Lower Bou Test W-test	Factor 4.8 Va	Red 80 riance 0.358 1.005 0.373 0.286 0.282 0.845	Est err 0.0054 m Re	F-test 0.454 dundancy 492.6 44.4 133.2 139.8 148.4 51.1
Chi-Square Chi-Square	DOPING SUMMAR DH(shift) E COMPONENT AI PS gles erences PS coordinate differe	Y Station 557:1 NALYSIS	1.213 0.412 Target 557:2	< Lower Bou Test W-test	Factor 4.8 Va	Red 80 riance 0.358 1.005 0.373 0.286 0.282 0.845 1.005	Est err 0.0054 m Re	F-test 0.454 dundancy 492.6 44.4 133.2 139.8 148.4 51.1 44.4

MOVE3 adjustment report

In the report the Datasnooping Summary shows all rejected and removed observations (in this case just one). To access the observation tab open the Datasnooping items view from the Results menu. This view shows the observations listed in the Datasnooping Summary.

💷 Datasno	ooping Summary							×
<u>V</u> iew <u>D</u> e	select <u>C</u> lose							<u>H</u> elp
Record	Туре	From	То	Test	Factor	Redundancy	F-Test	
308	DHeight	557:1	557:2	W-test	4.8	80%	0.454	

Datasnooping Summary



Click the first item in the list to open the observation tab of the removed observation. This observation can be deselected permanently (use CTRL-A and click Deselect to deselect all the observations that were removed during automated datasnooping).

8. Exporting results

After the adjustment the adjusted coordinates and computed shift vectors can be exported in a csv file

Export Shift Vectors		—
Format:	Separator 💌 Comma 💌	<u>Export</u>
		Close
Length	15	<u>H</u> elp

Export Adjusted Coordinates tab sheet

	Α	В	С	D	E	F	G	Н	Ι	J	К	L	М	N
1	VAL:1	106066.1	458832.9		VAL:2	106066.1	458832.9		0.0024		-0.0043			
2	557:01:00			4.1556	557:02:00			4.1501				-	0.0055	** #
3	556:01:00	106021	458730.3		556:02:00	106021	458730.3		0.0014		0.0045			
4	553:01:00	106018.1	458723		553:02:00	106018.1	458723		-0.0026		0.0029			
5	552:01:00	106035.4	458717.4		552:02:00	106035.4	458717.4		0.0009		0.0003			
6	551:01:00	106057.3	458707.8		551:02:00	106057.3	458707.8		-0.0012		0.0015			
7	555:01:00	106038.5	458724.3		555:02:00	106038.5	458724.3		0.0002		0.0011			
8	554:01:00	106060.2	458715		554:02:00	106060.2	458715		-0.0006		0.0006			
9	559:01:00	105982.2	458736.2		559:02:00	105982.2	458736.2		0.0032		-0.0019			
10	10:01			1.9999	10:02			1.9994				-	0.0005	
11	9:01			2.0017	9:02			2.002					0.0004	
12	8:01			2.0858	8:02			2.086					0.0002	
13	6:01			2.0765	6:02			2.0765					0	
14	2:01			4.1477	2:02			4.1479					0.0002	
15	1:01			4.1412	1:02			4.1409				-	0.0003	
16	558:01:00	106092.3	458693.1		558:02:00	106092.3	458693.1		-0.0036		-0.0047			

Exported Shift Vectors in Excel

The ** identifies the rejected shift vectors, the # indicates that the shift vectors have been deselected, either manually or via automated datasnooping (**#).

Note that using suffix :1 etc combined with numeric point names may confuse Excel, assuming that these are hours and minutes.

9. Constrained adjustment

If you have stable control points you can also use a constrained adjustment to check for deformations. In this example there is just one control point in height, 557. Here a problem is detected in this control point.



Edit								
	dimensional)		0.0010					
Alfa U (one	dimensional)		0.0010					
Alfa U (Shiπ	vector)		0.3170					
Deta	- 10/ 11		0.80					
Critical valu	e vv-test		3.29					
Critical valu	e 1-test (3 dimen	isional)	4.24					
Critical valu	e 1-test (2 dimen	isional)	5.91					
Critical valu	e vv-test (Shift ve	ector)	1.00					
Critical valu	e 1-test (3 dimen	isional) (Shift vec	tor) 0.90					
Critical valu	e 1-test (2 dimen	isional) (Shift vec	tor) 0.98					
Critical valu	e ⊢-test		0.98					
F-test			0.411	Accepted				
	Test (99.9%)							
Cni-Square								
Cni-Square Lower Boun	d		0.812					
Chi-Square Lower Boun Upper Boun Chi-Square	d d Test		0.812 1.213 0.411 <	< Lower Bou	ınd			
Chi-Square Lower Boun Opper Boun Chi-Square DATASNOC Record	d d Test PPING SUMMAR	Y (2) Station	0.812 1.213 0.411 • Target	< Lower Bou Test	ind Factor	Red	Est err	F-test
Chi-Square Lower Boun Opper Boun Chi-Square DATASNOC Record 308	d d Test PPING SUMMAR	Y (2) Station 557:1	0.812 1.213 0.411 - Target 557:2	< Lower Bou Test W-test	Ind Factor 3.9	Red 83	Est err 0.0043 m	F-test
Chi-Square Lower Boun Opper Boun Chi-Square DATASNOC Record 308 59	d d Test PPING SUMMAR DH(shift) Height	Y (2) Station 557:1 557:2	0.812 1.213 0.411 Target 557:2	< Lower Bou Test W-test W-test	Ind Factor 3.9 1.5	Red 83 80	Est err 0.0043 m 0.0054 m	F-test 0.481 0.453
Chi-Square Lower Boun Upper Boun Chi-Square DATASNOC Record 308 59 VARIANCE	d d Test DPING SUMMAR DH(shift) Height COMPONENT A	Y (2) Station 557:1 557:2 NALYSIS	0.812 1.213 0.411 - Target 557:2	< Lower Bou Test W-test W-test	Factor 3.9 1.5	Red 83 80	Est err 0.0043 m 0.0054 m	F-test 0.481 0.453 edundancy
Chi-Square Lower Boun Opper Boun Chi-Square DATASNOC Record 308 59 VARIANCE Terrestrial GNSS/GPS	d d Test DPING SUMMAR DH(shift) Height COMPONENT A	Y (2) Station 557:1 557:2 NALYSIS	0.812 1.213 0.411 Target 557:2	< Lower Bou Test W-test W-test	Factor 3.9 1.5 Va	Red 83 80 mriance 0.358 1.003	Est err 0.0043 m 0.0054 m	Edundancy 493.0 44 5
Chi-Square Lower Boun Chi-Square DATASNOC Record 308 59 VARIANCE Terrestrial GNSS/GPS Directions	d d Test DPING SUMMAR DH(shift) Height COMPONENT A	Y (2) Station 557:1 557:2 NALYSIS	0.812 1.213 0.411 • Target 557:2	< Lower Bou Test W-test W-test	Factor 3.9 1.5 Va	Red 83 80 0.358 1.003 0.373	Est err 0.0043 m 0.0054 m	edundancy 493.0 44.5
Chi-Square Lower Boun Chi-Square DATASNOC Record 308 59 VARIANCE Terrestrial GNSS/GPS Directions Distances	d d Test DPING SUMMAR DH(shift) Height COMPONENT A	Y (2) Station 557:1 557:2 NALYSIS	0.812 1.213 0.411 • Target 557:2	< Lower Bou Test W-test W-test	Factor 3.9 1.5 Va	Red 83 80 0.358 1.003 0.373 0.287	Est err 0.0043 m 0.0054 m	edundancy 493.0 44.5 133.2 139.8
Chi-Square Lower Bour Upper Bour Chi-Square DATASNOC Record 308 59 VARIANCE Terrestrial GNSS/GPS Directions Distances Zenith ande	d d Test DPING SUMMAR DH(shift) Height COMPONENT A	Y (2) Station 557:1 557:2 NALYSIS	0.812 1.213 0.411 • Target 557:2	< Lower Bou Test W-test W-test	Factor 3.9 1.5	Red 83 80 0.358 1.003 0.373 0.287 0.282	Est err 0.0043 m 0.0054 m	edundancy 493.0 44.5 133.2 139.8 148.4
Chi-Square Lower Bour Upper Bour Chi-Square DATASNOC Record 308 59 VARIANCE Terrestrial GNSS/GPS Directions Distances Zenith angle Height differ	d d Test DPING SUMMAR DH(shift) Height COMPONENT A	Y (2) Station 557:1 557:2 NALYSIS	0.812 1.213 0.411 • Target 557:2	< Lower Bou Test W-test W-test	Factor 3.9 1.5	Red 83 80 0.358 1.003 0.373 0.287 0.282 0.845	Est err 0.0043 m 0.0054 m	edundancy 493.0 44.5 133.2 139.8 148.4 51.1
Chi-Square Lower Boun Upper Boun Chi-Square DATASNOC Record 308 59 VARIANCE Terrestrial GNSS/GPS Directions Distances Zenith angle Height differ GNSS/GPS	d d Test DPING SUMMAR DH(shift) Height COMPONENT A component A	Y (2) Station 557:1 557:2 NALYSIS ences	0.812 1.213 0.411 • Target 557:2	< Lower Bou W-test W-test	Factor 3.9 1.5 Va	Red 83 80 ariance 0.358 1.003 0.373 0.287 0.282 0.845 1.003	Est err 0.0043 m 0.0054 m	edundancy 493.0 44.5 133.2 139.8 148.4 51.1 44.5
Chi-Square Lower Boun Upper Boun Chi-Square DATASNOC Record 308 59 VARIANCE Terrestrial GNSS/GPS Directions Distances Zenith angle Height differ GNSS/GPS Known coor	d d Test DPING SUMMAR DH(shift) Height COMPONENT A component A s ences coordinate differ dinates	Y (2) Station 557:1 557:2 NALYSIS ences	0.812 1.213 0.411 • 557:2	< Lower Bou	Factor 3.9 1.5 Va	Red 83 80 ariance 0.358 1.003 0.373 0.287 0.282 0.845 1.003 0.188	Est err 0.0043 m 0.0054 m	edundancy 493.0 44.5 133.2 139.8 148.4 51.1 44.5 1.5

It is most likely that in in the second epoch the adaptor (6 mm) was not used at point 557. When just comparing the results of the adjusted heights based on the control point 557 may conclude that all points levelled may have been shifted up for 6 mm, where the problem is in the control height.