How To
Measurements on floating objects
Version 4.6

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Contents

1. Introduction

This document describes how measurement taken on floating objects can be adjusted. The last paragraph explains how to deal with object that are on stable ground, but have their own local coordinate frame, with a height direction that is not parallel to the direction of the gravity.

For measurements on floating object the compensator should be disabled since the total station should not compensate for the movements of the object.

When using multiple setups a sufficient number of overlapping points is required to solve for the additional unknown deflection of the vertical.

The Terrestrial Positioning System (= TPS) measurements taken on floating objects can be imported from Leica GSI/DBX (Leica 1200), Topcon, Sokkia SDR33 and Trimble DC/JobXML format.

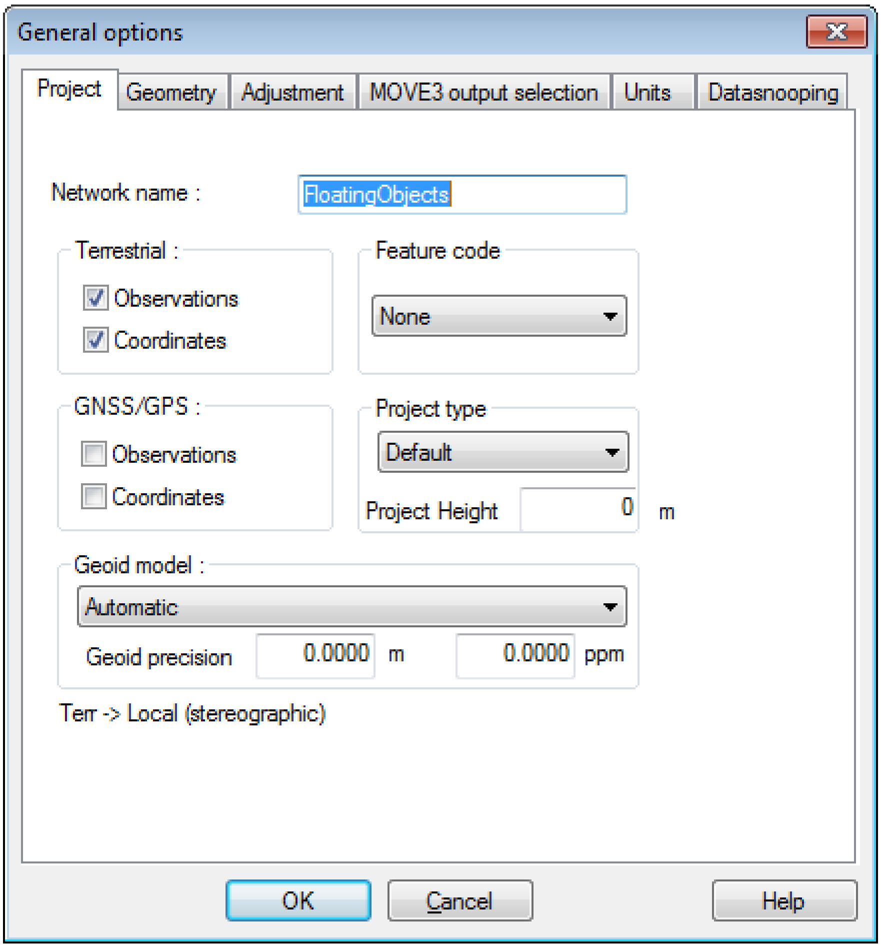
Please note that this is a sample. The actual settings may differ depending on your local requirements.

2. New MOVE3 Project

Create a new MOVE3 project by specifying the project name. A template project (option file) can be selected to use previously defined project settings.

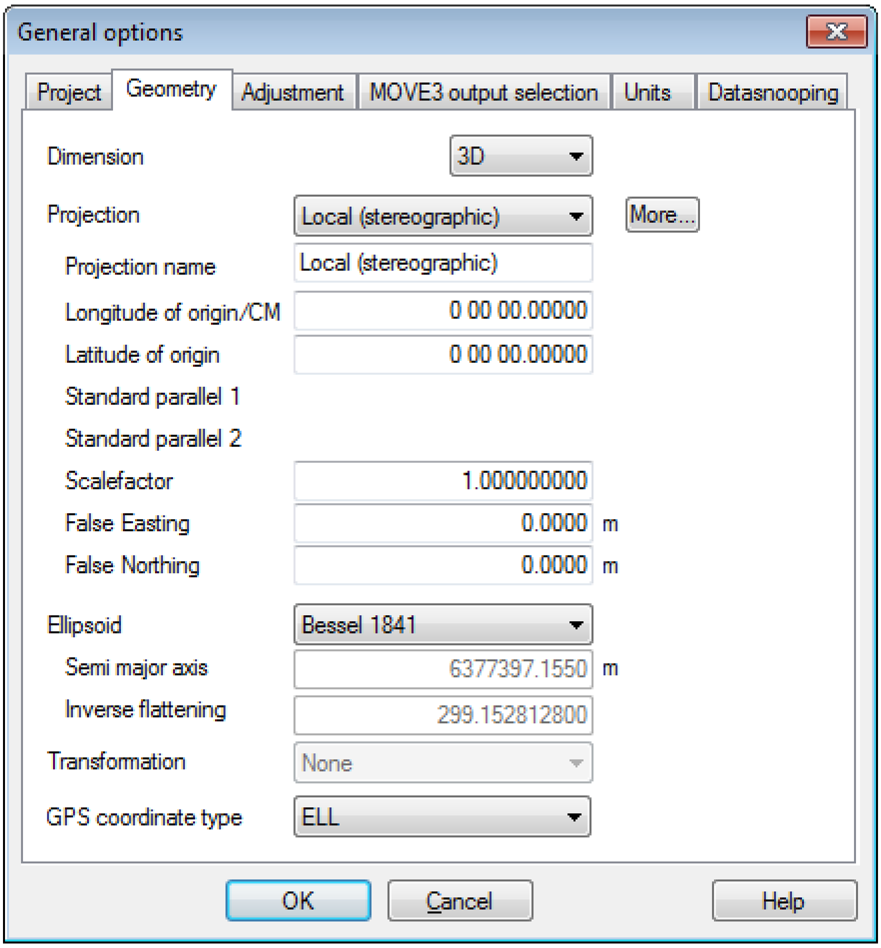
3. Options

Starting a new project without using a template will set all options to the MOVE3 defaults. In this case you must set at least some of the options to meet the adjustment requirements. Set the *Project* options to terrestrial only and set the Geoid model to Automatic. In this case the Geoid model will not be used to correct orthometric heights to ellipsoidal heights, but to introduce additional deflection of the vertical unknowns to the adjustment for each setup point.



Project tab sheet.

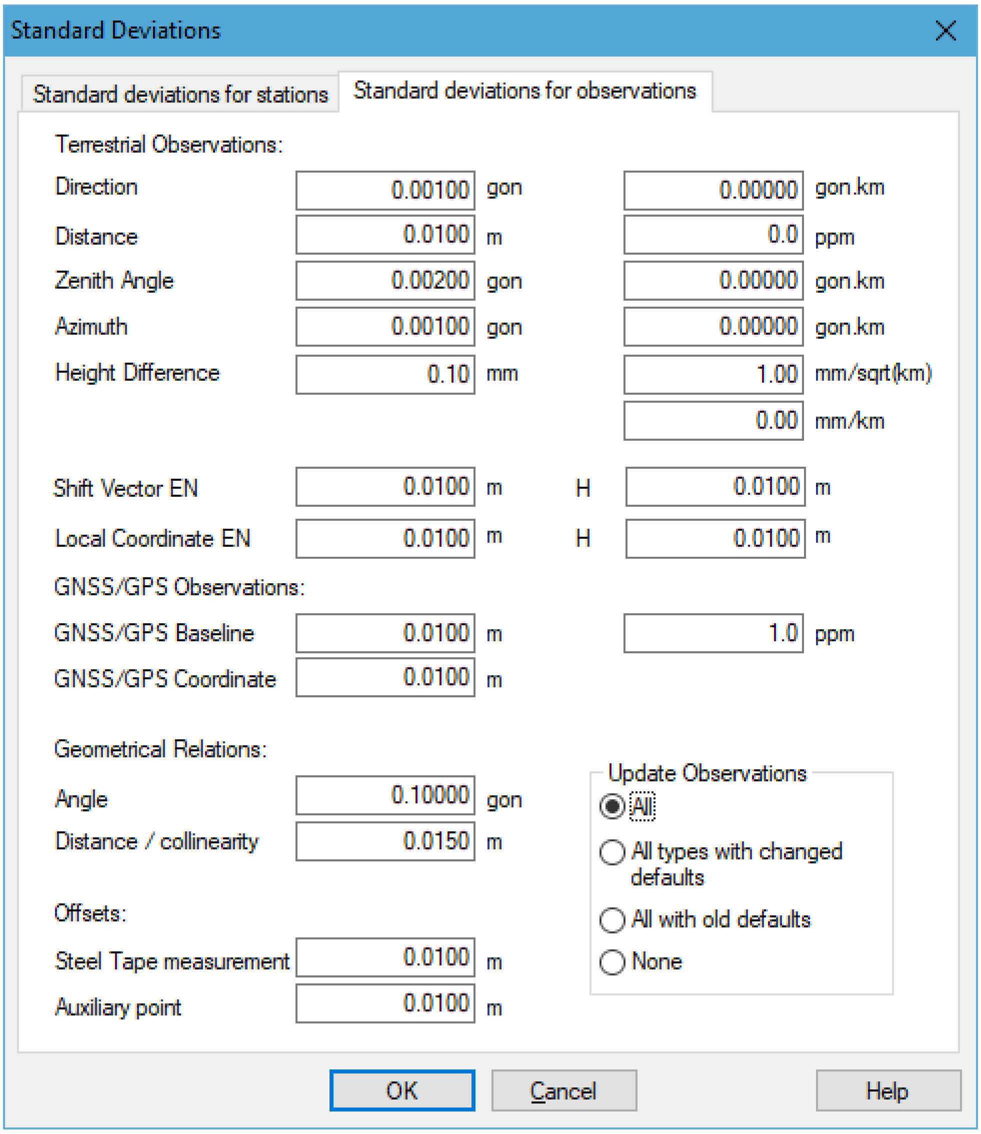
In the *Geometry* tab the Dimension must be set to 3D. In most cases these specific measurements will be attached to a local defined coordinate system, so the Local (Stereographic) projection can be used. Use a proper setting for False Easting and False Northing to make sure that the scale distortion is minimal. Typically the False Easting and False Northing could be set to the coordinates of the centre of the network. Due to the limited extends of this type of network the setting of the (shape of the) ellipsoid is not important, nor is the exact location of the network (Latitude of origin and Longitude of origin).



Geometry tab sheet.

4. Default standard deviations

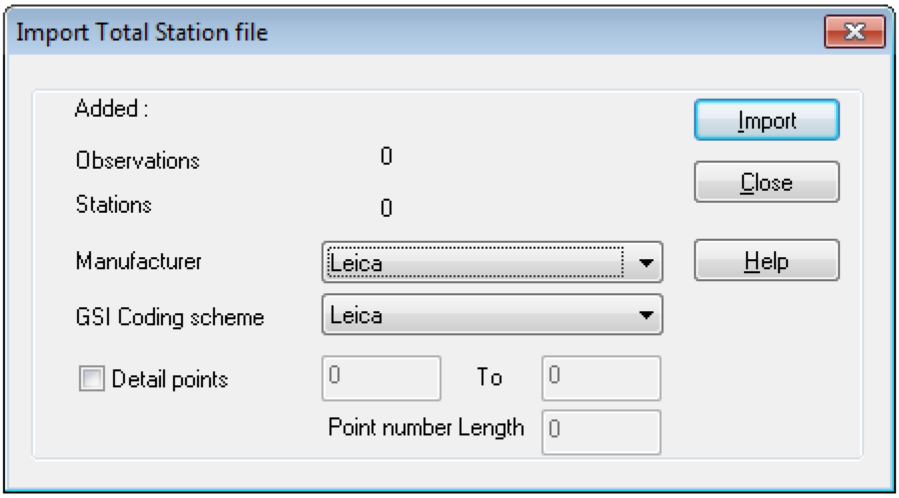
Before importing the data it is important to properly set the defaults for the standard deviations of the TPS observations direction, distance and zenith angle. The standard deviations have an absolute part and a relative. These values are added as defaults to each imported observation.



Standard deviations for observations tab sheet.

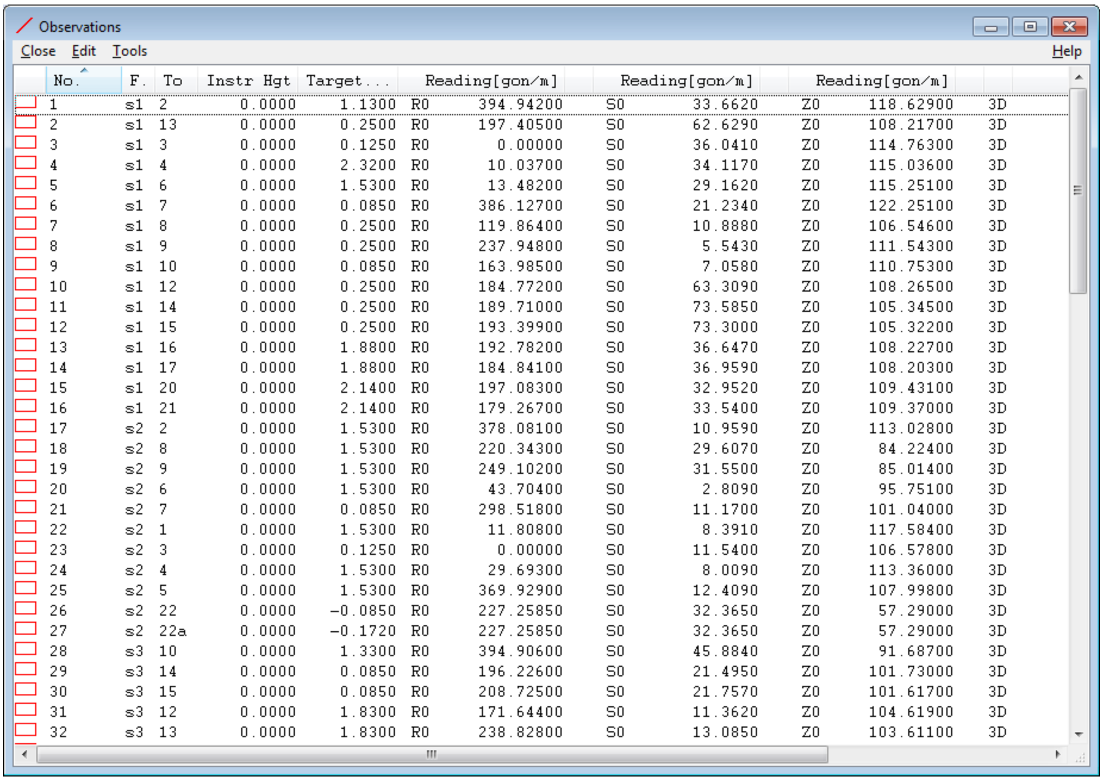
5. Import TPS measurements

Select the menu option Import/export | Total Station and specify the manufacturer. Then click Import and select the raw data file(s).



Import Total Station dialog.

The imported data will be shown in the observation list that can be opened under View | Observations.

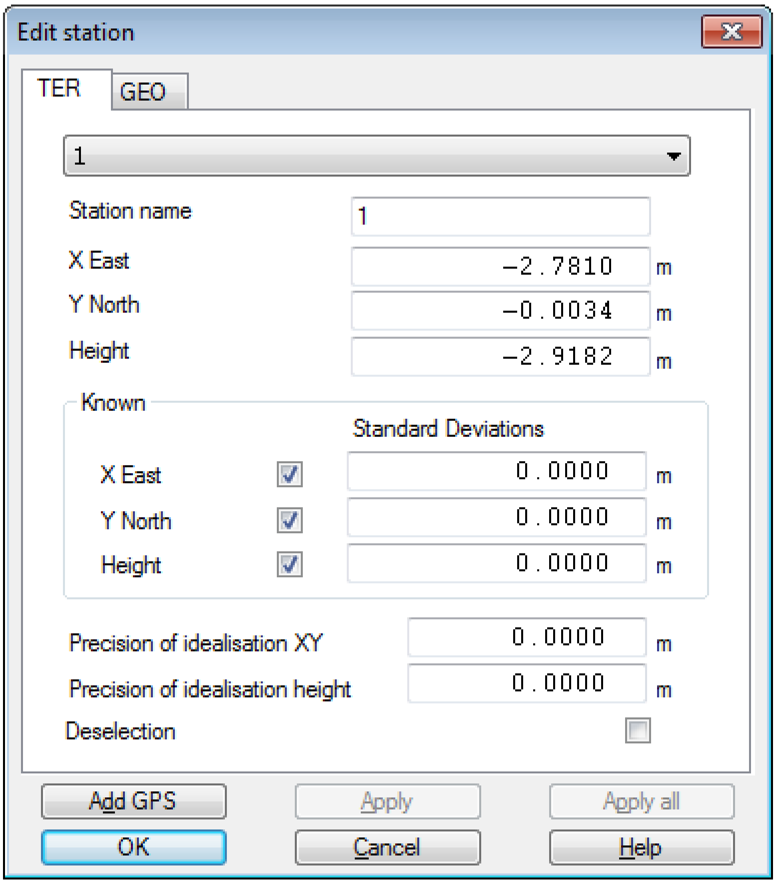


No.	F.	To	Instr Hgt	Target...		Reading[gon/m]		Reading[gon/m]		Reading[gon/m]	
1	s1	2	0.0000	1.1300	R0	394.94200	S0	33.6620	Z0	118.62900	3D
2	s1	13	0.0000	0.2500	R0	197.40500	S0	62.6290	Z0	108.21700	3D
3	s1	3	0.0000	0.1250	R0	0.00000	S0	36.0410	Z0	114.76300	3D
4	s1	4	0.0000	2.3200	R0	10.03700	S0	34.1170	Z0	115.03600	3D
5	s1	6	0.0000	1.5300	R0	13.48200	S0	29.1620	Z0	115.25100	3D
6	s1	7	0.0000	0.0850	R0	386.12700	S0	21.2340	Z0	122.25100	3D
7	s1	8	0.0000	0.2500	R0	119.86400	S0	10.8880	Z0	106.54600	3D
8	s1	9	0.0000	0.2500	R0	237.94800	S0	5.5430	Z0	111.54300	3D
9	s1	10	0.0000	0.0850	R0	163.98500	S0	7.0580	Z0	110.75300	3D
10	s1	12	0.0000	0.2500	R0	184.77200	S0	63.3090	Z0	108.26500	3D
11	s1	14	0.0000	0.2500	R0	189.71000	S0	73.5850	Z0	105.34500	3D
12	s1	15	0.0000	0.2500	R0	193.39900	S0	73.3000	Z0	105.32200	3D
13	s1	16	0.0000	1.8800	R0	192.78200	S0	36.6470	Z0	108.22700	3D
14	s1	17	0.0000	1.8800	R0	184.84100	S0	36.9590	Z0	108.20300	3D
15	s1	20	0.0000	2.1400	R0	197.08300	S0	32.9520	Z0	109.43100	3D
16	s1	21	0.0000	2.1400	R0	179.26700	S0	33.5400	Z0	109.37000	3D
17	s2	2	0.0000	1.5300	R0	378.08100	S0	10.9590	Z0	113.02800	3D
18	s2	8	0.0000	1.5300	R0	220.34300	S0	29.6070	Z0	84.22400	3D
19	s2	9	0.0000	1.5300	R0	249.10200	S0	31.5500	Z0	85.01400	3D
20	s2	6	0.0000	1.5300	R0	43.70400	S0	2.8090	Z0	95.75100	3D
21	s2	7	0.0000	0.0850	R0	298.51800	S0	11.1700	Z0	101.04000	3D
22	s2	1	0.0000	1.5300	R0	11.80800	S0	8.3910	Z0	117.58400	3D
23	s2	3	0.0000	0.1250	R0	0.00000	S0	11.5400	Z0	106.57800	3D
24	s2	4	0.0000	1.5300	R0	29.69300	S0	8.0090	Z0	113.36000	3D
25	s2	5	0.0000	1.5300	R0	369.92900	S0	12.4090	Z0	107.99800	3D
26	s2	22	0.0000	-0.0850	R0	227.25850	S0	32.3650	Z0	57.29000	3D
27	s2	22a	0.0000	-0.1720	R0	227.25850	S0	32.3650	Z0	57.29000	3D
28	s3	10	0.0000	1.3300	R0	394.90600	S0	45.8840	Z0	91.68700	3D
29	s3	14	0.0000	0.0850	R0	196.22600	S0	21.4950	Z0	101.73000	3D
30	s3	15	0.0000	0.0850	R0	208.72500	S0	21.7570	Z0	101.61700	3D
31	s3	12	0.0000	1.8300	R0	171.64400	S0	11.3620	Z0	104.61900	3D
32	s3	13	0.0000	1.8300	R0	238.82800	S0	13.0850	Z0	103.61100	3D

Observation dialog

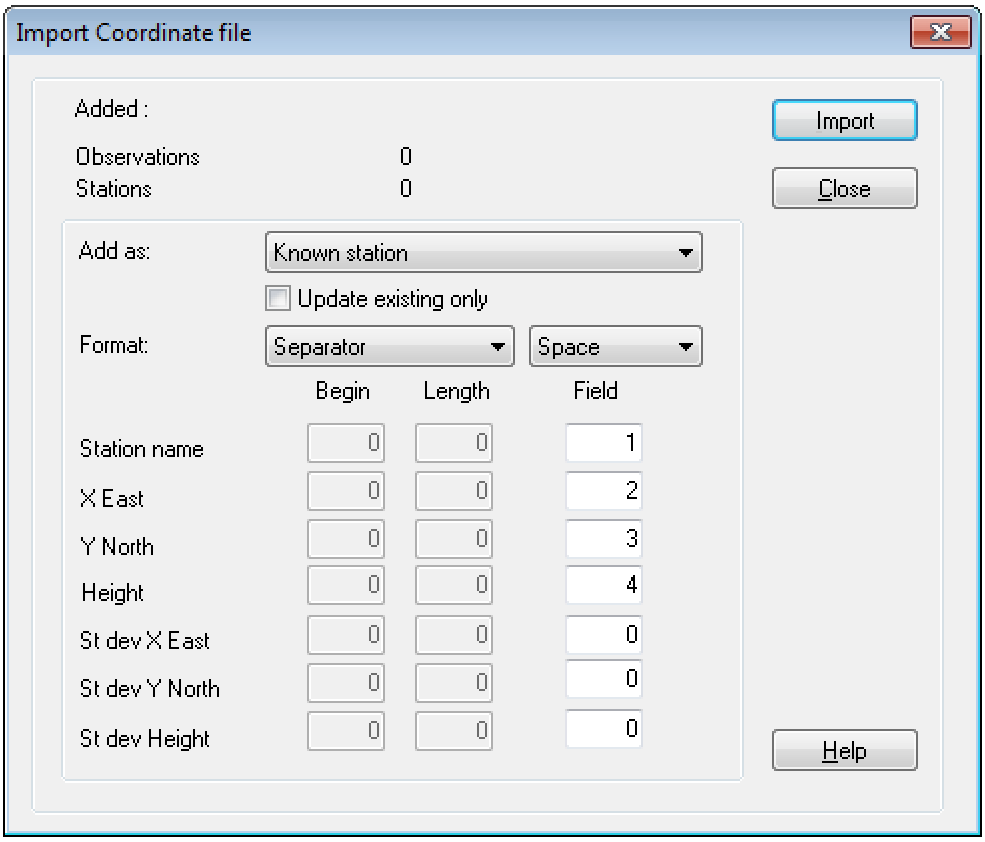
6. Adding known points

A proper adjustment requires that all control points are added as known stations. Go to the View | Station and edit the control stations. Enter the proper station coordinates and check the Known check boxes.



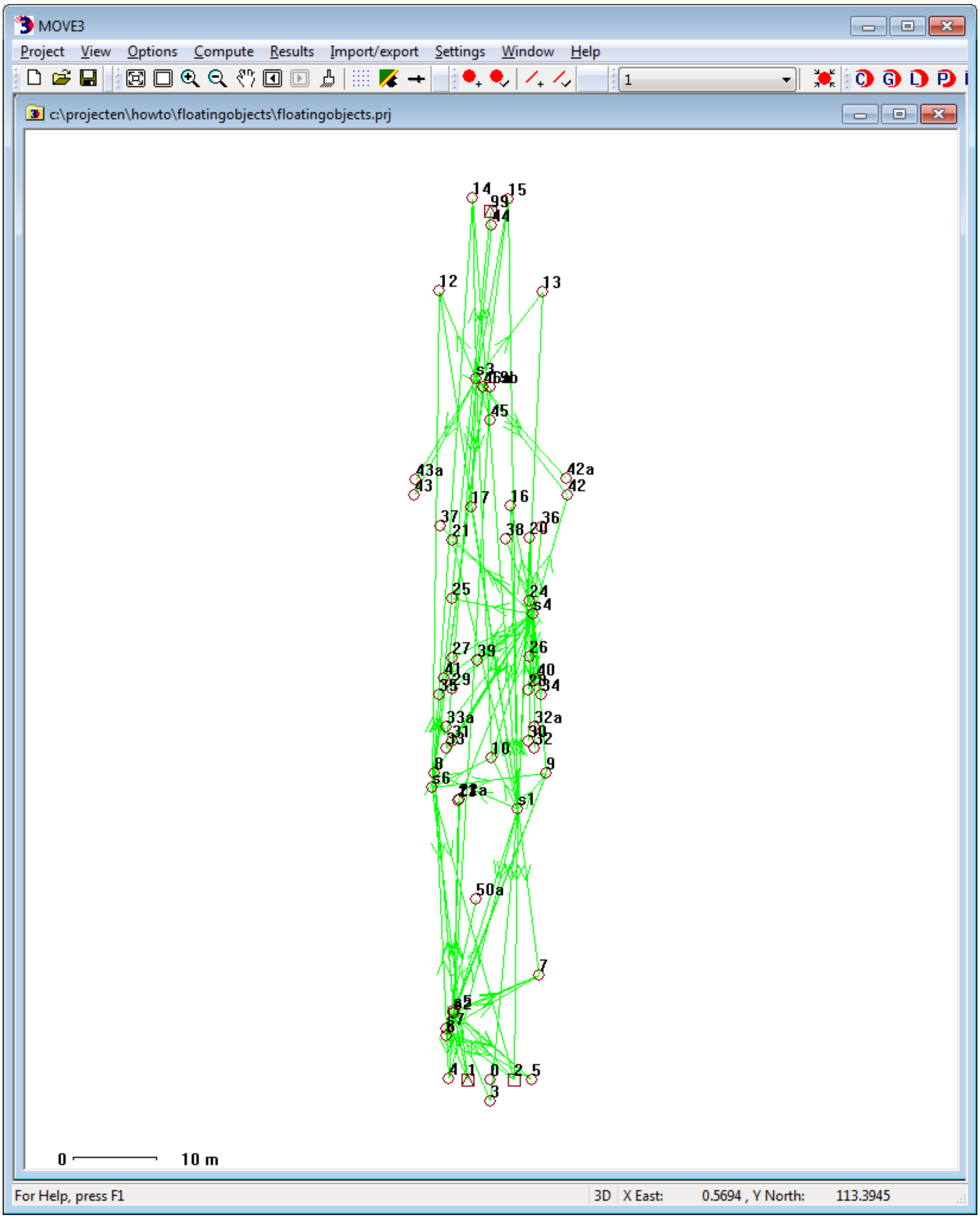
Adding Known Points

Alternatively known points can also be added via the Import/export menu option Coordinate file.



Import Known Points

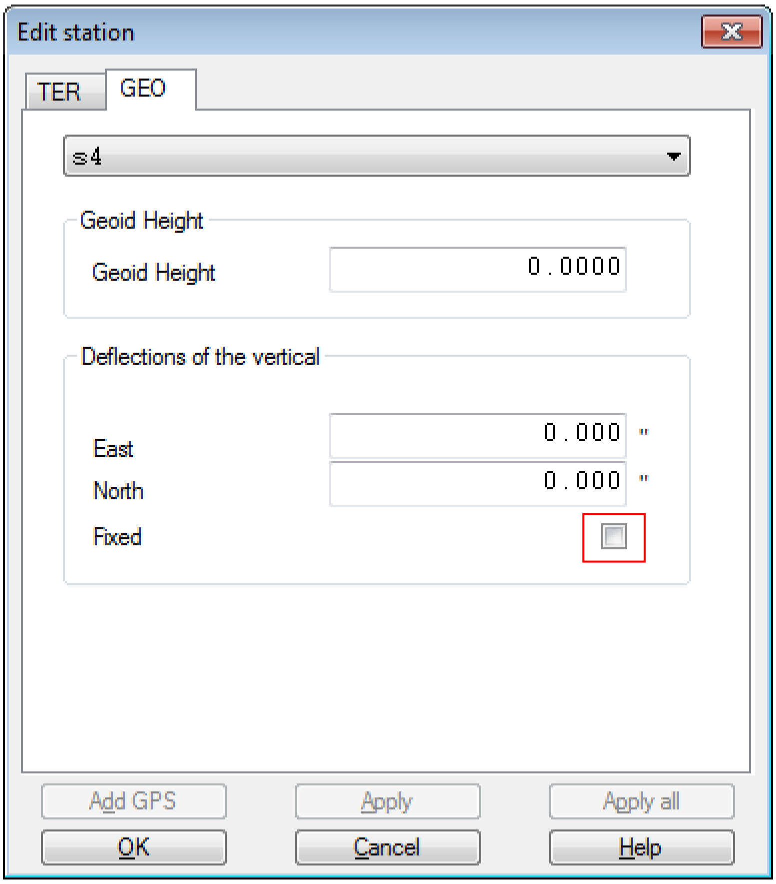
Once the known points have been added the approximate coordinates can be computed using the COGO3 option from the compute menu. The graphics view now shows the layout of the network.



7. Deflections of the vertical for Total Station setups

Open the Edit station dialog, for the points with a total station setup and go to the GEO tab. Note that this tab is only visible to the user in case the geoid model has been configured different than none, which is our case here.

Un-check the deflection of the vertical checkbox named “Fixed” for all setup points. Now 2 additional unknown deflections of the vertical will be added to the adjustment thus solving for the tilt of the total station with respect to the object. Any possible movement introduced during TPS measurements on the floating object is being adjusted. Corrections are being distributed in a least-squares manner over all observations.



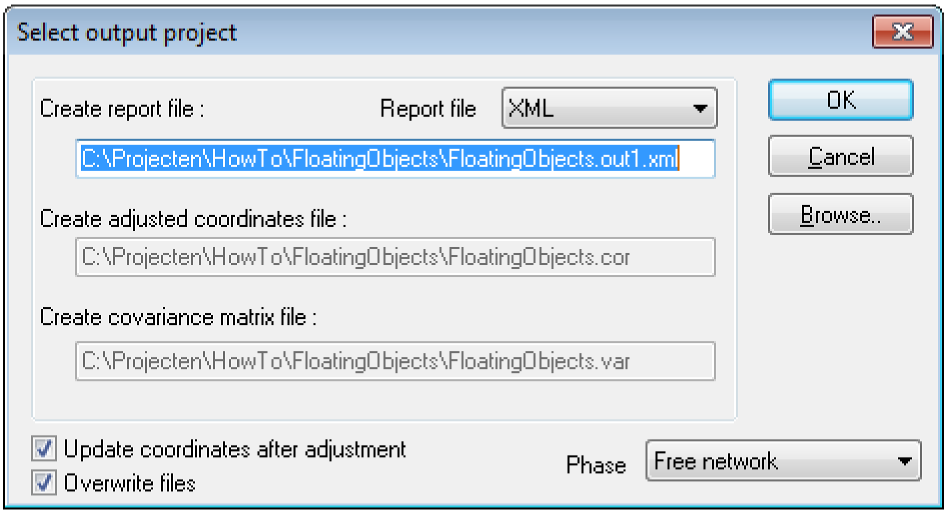
Edit station GEO tab

It does no harm when the deflections of the vertical are activated for a target only points, since the deflections of the vertical unknowns will only be added to observations that are measured from the setup point.

If the deflections of the vertical are kept fixed for a setup point numerous observations may be rejected. This is not caused by observation errors, but by ignoring the deflections of the vertical in the model.

8. Adjustment in Phases

You're now ready to adjust the network. It is best to do a free network first to test the observations for outliers. Go to Compute| MOVE3 and set the phase to Free network.

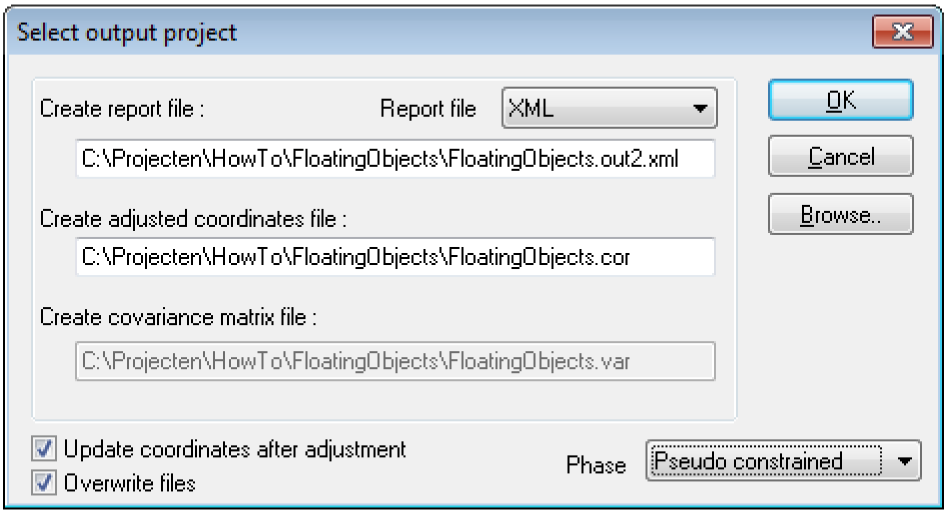


Compute Free network

The MOVE3 report will give the testing results of the adjustment, allowing to identify errors when sufficient redundancy is available.

In case one does not meet the predefined quality of the observations the global F-test will be rejected. This may be caused by either a too optimistic set of standard deviations of the observations or by observation errors. Usually a rejection is caused by errors in the observations. To identify the observation errors one can use the W-test. The observation with the largest W-test is the most suspect observation. One should try to solve the cause of the error, maybe there was a problem during import of the raw observations that can be corrected. The estimated error can be used for this purpose because it gives an estimate of the size of the observational error. If the error cannot be repaired, the observation can be deselected (not used in the adjustment). This will however affect the reliability of the network. In some cases rejected observations may have to be re-measured to maintain proper reliability.

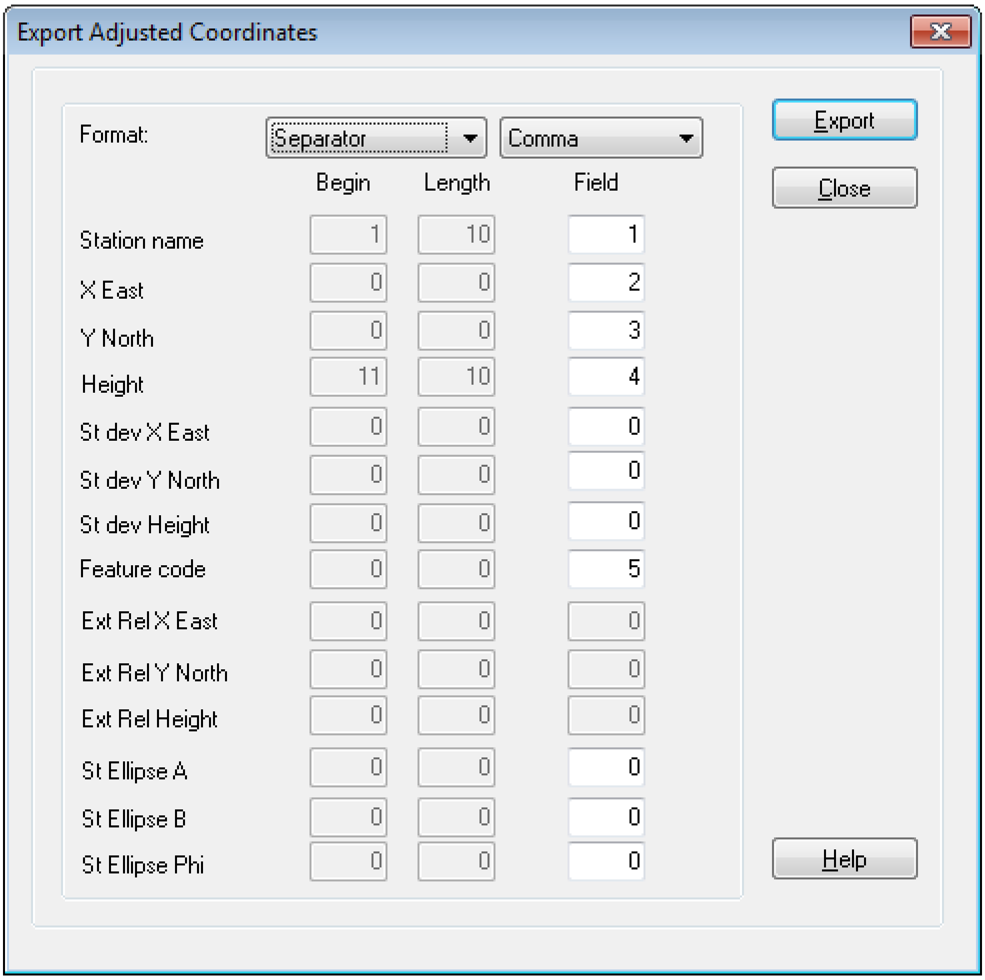
After an acceptable Free network adjustment the combined network can be constrained to all available control points in the Absolute constrained adjustment. This phase will result in testing of the available control heights and the final adjusted coordinate computation.



Compute Absolute constrained network

The quality of the control points (the standard deviation of the known coordinates) is taken into account for testing. If the combined network does not fit to the control points there may be rejected points. If the F-test is rejected, the largest W-test value can be used to identify the errors. If a control point is rejected this may have been caused by a mistake in entering the known points coordinates or by entering a wrong control point. It is best to check this out first. There may be a deformation in the control points as well, causing the error. If the problem cannot be solved the control point can be removed as a control point for the adjustment. The point will then be re-adjusted, getting new adjusted coordinates.

The final results are stored in the MOVE3 report file, but they are also written to the MOVE3 COR file. The adjusted coordinates can also be exported using the Import/export menu option Adjusted Coordinates. Specify the format and the fields you want to export and write the data to an ASCII file.

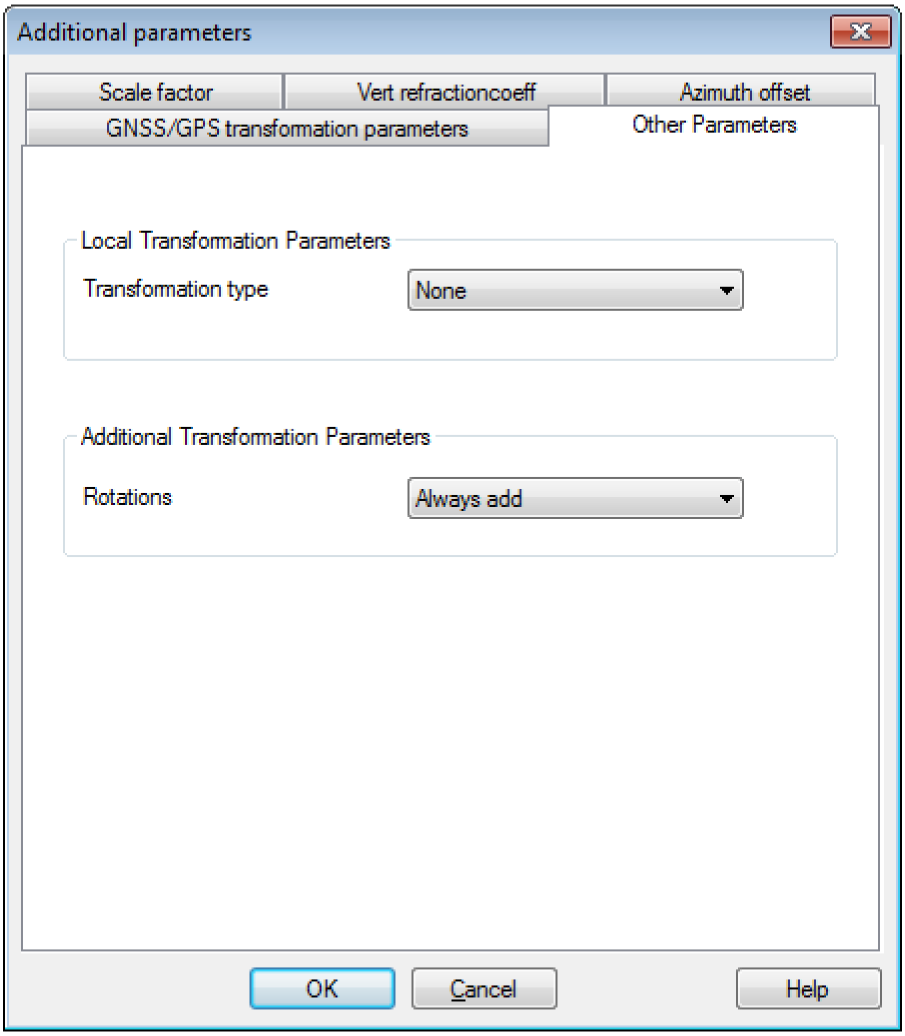


Export Adjusted Coordinates tab sheet

9. A different approach: Objects on land

If the object is located on land the total station setups may be properly levelled, but the objects height system may not be lined up with the direction of the gravity. For this case the Geoid model is set to None and the Additional Transformation Parameters setting is set to Always add.

Now one set of deflection of the vertical parameters is solved to cater for tilt between the total station setups and the height system of the object.



Additional parameters Other tab sheet