



How To
Measurements on floating objects
Version 4.0.2



Bovendonk 29, P.O. Box 1747, 4700 BS Roosendaal, The Netherlands
Telephone +31-165-575859; Telefax +31-165-561368
E-mail MOVE3@Grontmij.nl
<http://www.MOVE3.com>

Contents

1.	Introduction	3
2.	New MOVE3 Project	3
3.	Options	4
4.	Default standard deviations	5
5.	Import TPS measurements	6
6.	Adding known points	7
7.	Deflections of the vertical for Total Station setups	9
8.	Adjustment in Phases	10
9.	A different approach: Objects on land	12

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 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.

General options

Project | Geometry | Adjustment | MOVE3 output selection | Units

Network name : FloatingObjects

Terrestrial :

- Observations
- Coordinates

Feature code

None

GPS :

- Observations
- Coordinates

Geoid model :

Automatic

Terr -> Local (stereographic)

OK Cancel Help

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).

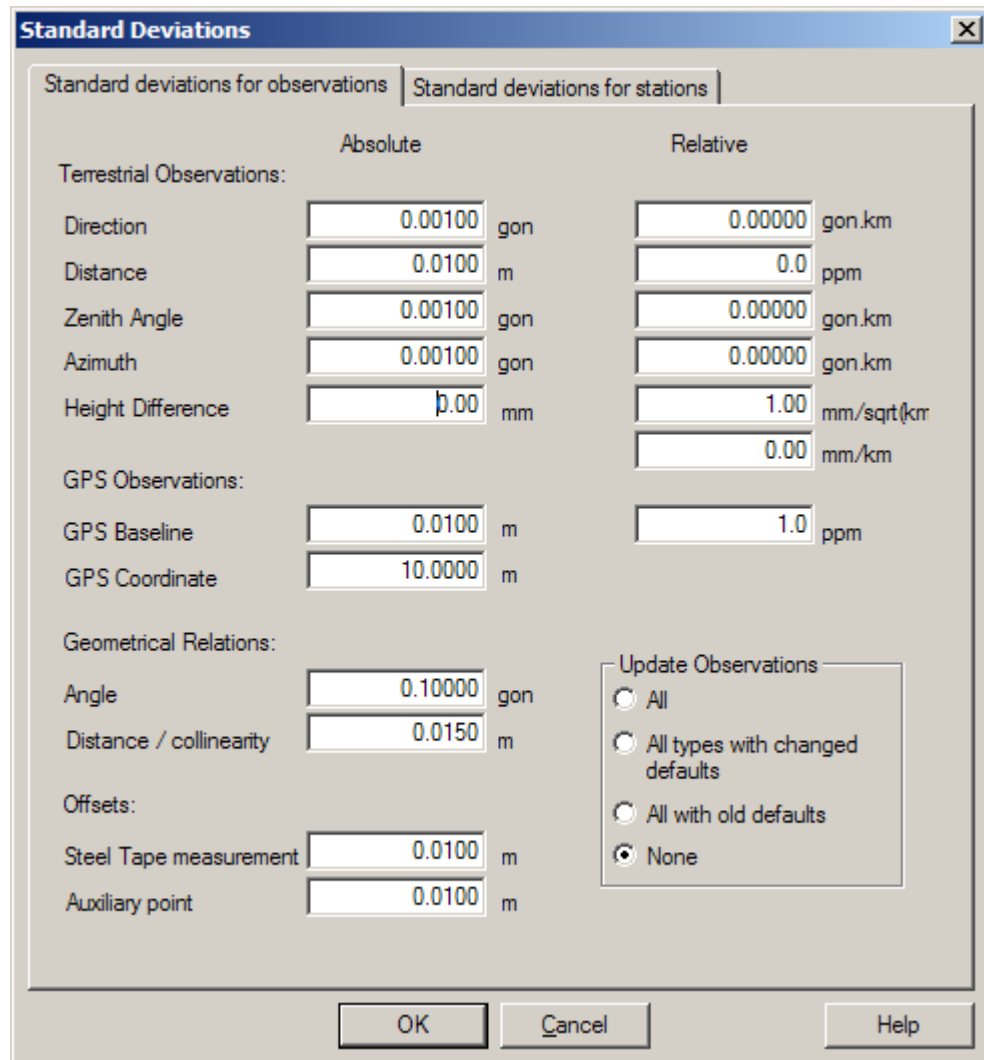
The screenshot shows the 'General options' dialog box with the 'Geometry' tab selected. The settings are as follows:

Parameter	Value	Unit
Dimension	3D	
Projection	Local (stereographic)	
Longitude of origin/CM	0 00 00.00000	
Latitude of origin	0 00 00.00000	
Standard parallel 1		
Standard parallel 2		
Scalefactor	1.000000000	
False Easting	0.0000	m
False Northing	0.0000	m
Ellipsoid	Bessel 1841	
Semi major axis	6377397.1550	m
Inverse flattening	299.152812800	
Transformation	None	
GPS coordinate type	XYZ	

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. The default values are added to each imported observation.



The 'Standard Deviations' dialog box is divided into two tabs: 'Standard deviations for observations' (active) and 'Standard deviations for stations'. It is further organized into 'Absolute' and 'Relative' columns.

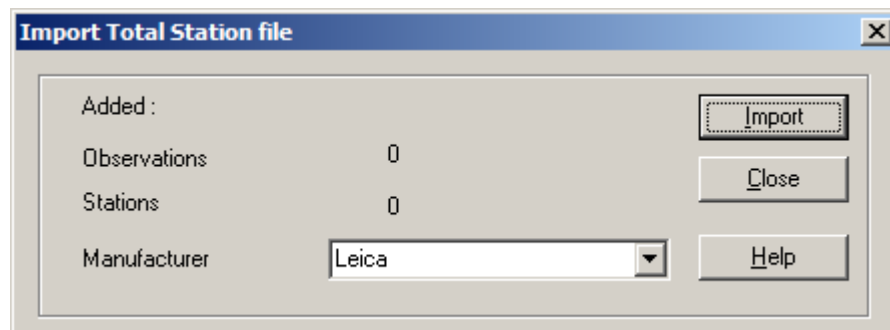
Category	Parameter	Absolute Value	Unit	Relative Value	Relative Unit
Terrestrial Observations:	Direction	0.00100	gon	0.00000	gon.km
	Distance	0.0100	m	0.0	ppm
	Zenith Angle	0.00100	gon	0.00000	gon.km
	Azimuth	0.00100	gon	0.00000	gon.km
	Height Difference	0.00	mm	1.00	mm/sqrt(km)
GPS Observations:	GPS Baseline	0.0100	m	1.0	ppm
	GPS Coordinate	10.0000	m	0.00	mm/km
Geometrical Relations:	Angle	0.10000	gon		
	Distance / collinearity	0.0150	m		
Offsets:	Steel Tape measurement	0.0100	m		
	Auxiliary point	0.0100	m		

An 'Update Observations' sub-dialog is also present, with radio buttons for: All, All types with changed defaults, All with old defaults, and None (selected).

Standard Deviations.

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).



The 'Import Total Station file' dialog box shows the following information:

Category	Value
Added :	
Observations	0
Stations	0
Manufacturer	Leica

Buttons: Import, Close, Help.

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	0.00000	1.13000	RO	394.94200	S0	33.6620	Z0	118.62900	3D
2	s1	13	0.00000	0.25000	RO	197.40500	S0	62.6290	Z0	108.21700	3D
3	s1	3	0.00000	0.12500	RO	0.00000	S0	36.0410	Z0	114.76300	3D
4	s1	4	0.00000	2.32000	RO	10.03700	S0	34.1170	Z0	115.03600	3D
5	s1	6	0.00000	1.53000	RO	13.48200	S0	29.1620	Z0	115.25100	3D
6	s1	7	0.00000	0.08500	RO	386.12700	S0	21.2340	Z0	122.25100	3D
7	s1	8	0.00000	0.25000	RO	119.86400	S0	10.8880	Z0	106.54600	3D
8	s1	9	0.00000	0.25000	RO	237.94800	S0	5.5430	Z0	111.54300	3D
9	s1	10	0.00000	0.08500	RO	163.98500	S0	7.0580	Z0	110.75300	3D
10	s1	12	0.00000	0.25000	RO	184.77200	S0	63.3090	Z0	108.26500	3D
11	s1	14	0.00000	0.25000	RO	189.71000	S0	73.5850	Z0	105.34500	3D
12	s1	15	0.00000	0.25000	RO	193.39900	S0	73.3000	Z0	105.32200	3D
13	s1	16	0.00000	1.88000	RO	192.78200	S0	36.6470	Z0	108.22700	3D
14	s1	17	0.00000	1.88000	RO	184.84100	S0	36.9590	Z0	108.20300	3D
15	s1	20	0.00000	2.14000	RO	197.08300	S0	32.9520	Z0	109.43100	3D
16	s1	21	0.00000	2.14000	RO	179.26700	S0	33.5400	Z0	109.37000	3D
17	s2	2	0.00000	1.53000	RO	378.08100	S0	10.9590	Z0	113.02800	3D
18	s2	8	0.00000	1.53000	RO	220.34300	S0	29.6070	Z0	84.22400	3D
19	s2	9	0.00000	1.53000	RO	249.10200	S0	31.5500	Z0	85.01400	3D
20	s2	6	0.00000	1.53000	RO	43.70400	S0	2.8090	Z0	95.75100	3D
21	s2	7	0.00000	0.08500	RO	298.51800	S0	11.1700	Z0	101.04000	3D
22	s2	1	0.00000	1.53000	RO	11.80800	S0	8.3910	Z0	117.58400	3D
23	s2	3	0.00000	0.12500	RO	0.00000	S0	11.5400	Z0	106.57800	3D
24	s2	4	0.00000	1.53000	RO	29.69300	S0	8.0090	Z0	113.36000	3D
25	s2	5	0.00000	1.53000	RO	369.92900	S0	12.4090	Z0	107.99800	3D
26	s2	22	0.00000	-0.08500	RO	227.25850	S0	32.3650	Z0	57.29000	3D
27	s2	22a	0.00000	-0.17200	RO	227.25850	S0	32.3650	Z0	57.29000	3D
28	s3	10	0.00000	1.33000	RO	394.90600	S0	45.8840	Z0	91.68700	3D
29	s3	14	0.00000	0.08500	RO	196.22600	S0	21.4950	Z0	101.73000	3D
30	s3	15	0.00000	0.08500	RO	208.72500	S0	21.7570	Z0	101.61700	3D
31	s3	12	0.00000	1.83000	RO	171.64400	S0	11.3620	Z0	104.61900	3D
32	s3	13	0.00000	1.83000	RO	238.82800	S0	13.0850	Z0	103.61100	3D
33	s3	17	0.00000	1.63000	RO	388.47300	S0	15.4230	Z0	86.42800	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.

Edit station	
TER	GEO
Station	1
Station name	1
X East	-2.7810 m
Y North	-0.0034 m
Height	-2.9182 m
Known	
Standard Deviations	
X East	<input checked="" type="checkbox"/> 0.0000 m
Y North	<input checked="" type="checkbox"/> 0.0000 m
Height	<input checked="" type="checkbox"/> 0.0000 m
Precision of idealisation XY	0.0000 m
Precision of idealisation height	0.0000 m
Deselection	<input type="checkbox"/>
Add GPS	Apply
Apply all	Help
OK	Cancel

Adding Known Points

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

Import Coordinate file

Added :
 Observations 0
 Stations 0

Import

Close

Add as: Known station

Update existing only

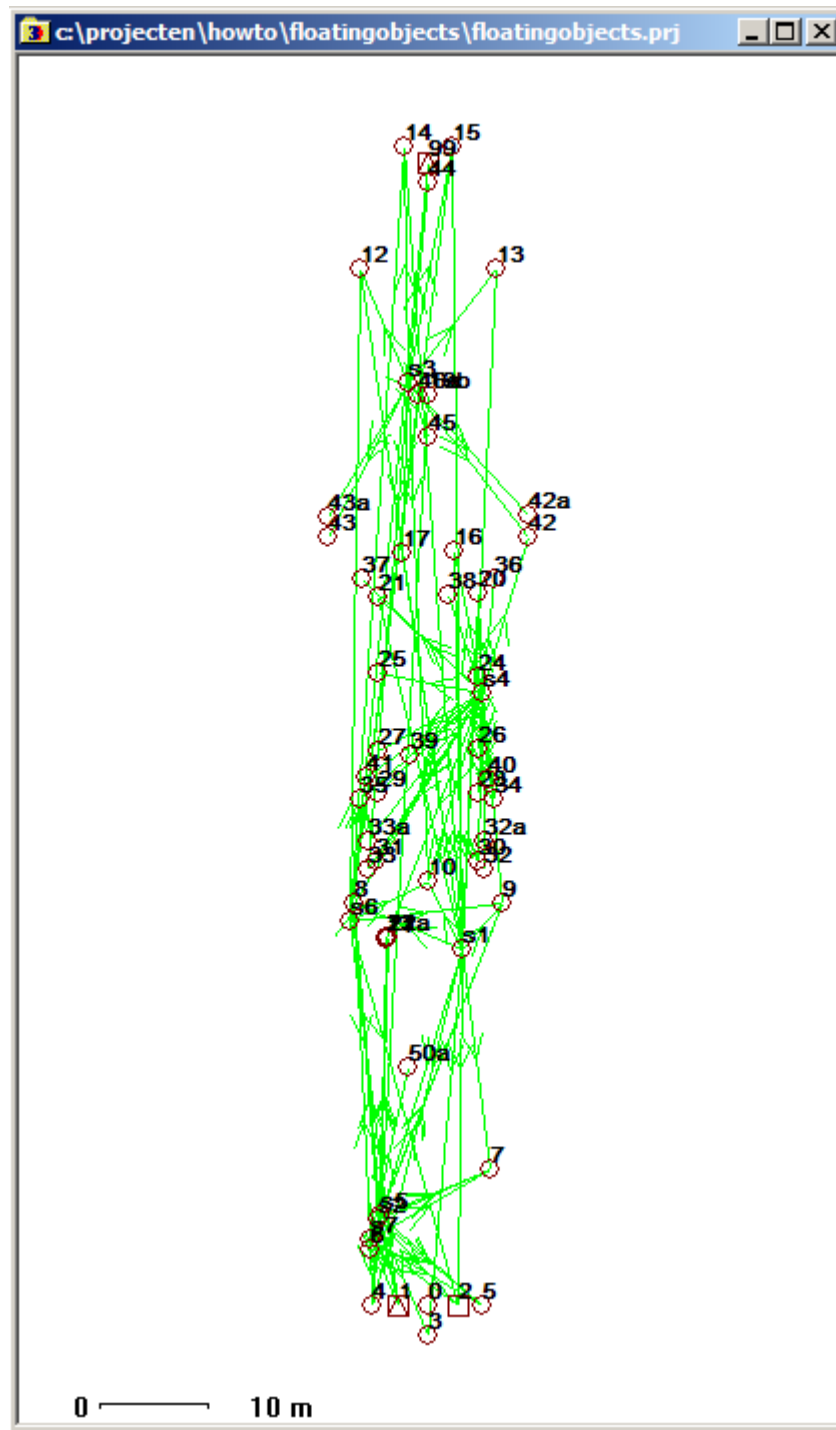
Format: Separator Space

	Begin	Length	Field
Station name	0	0	1
X East	0	0	2
Y North	0	0	3
Height	0	0	4
St dev X East	0	0	0
St dev Y North	0	0	0
St dev Height	0	0	0

Help

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. Un-check the deflection of the vertical fixed check box. 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.

The 'Edit station' dialog box has two tabs: 'TER' and 'GEO'. The 'GEO' tab is active. A dropdown menu at the top shows 'S4'. Below it, the 'Geoid Height' section contains a text box with '0.0000'. The 'Deflections of the vertical' section contains three text boxes: 'East' with '0.000"', 'North' with '0.000"', and 'Fixed' with an unchecked checkbox. At the bottom, there are six buttons: 'Add GPS', 'Apply', 'Apply all', 'OK', 'Cancel', and 'Help'.

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.

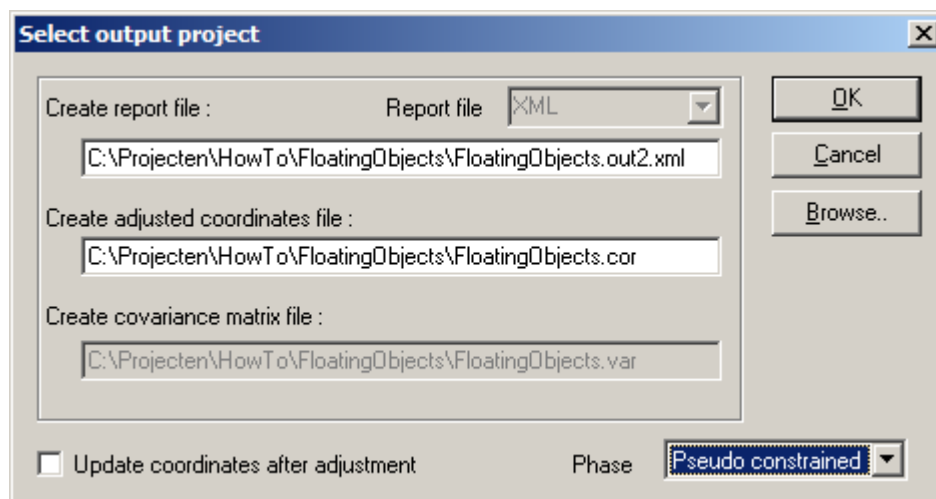
The 'Select output project' dialog box has three text input fields: 'Create report file' (with 'Report file' dropdown set to 'XML' and path 'C:\Projecten\HowTo\FloatingObjects\FloatingObjects.out1.xml'), 'Create adjusted coordinates file' (path 'C:\Projecten\HowTo\FloatingObjects\FloatingObjects.cor'), and 'Create covariance matrix file' (path 'C:\Projecten\HowTo\FloatingObjects\FloatingObjects.var'). At the bottom left, there is an unchecked checkbox 'Update coordinates after adjustment' and a 'Phase' dropdown set to 'Free network'. On the right side, there are three buttons: 'OK', 'Cancel', and 'Browse..'.

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.

	Begin	Length	Field
Stations name	0	0	1
X East	0	0	2
Y North	0	0	3
Height	0	0	4
St dev X East	0	0	5
St dev Y North	0	0	6
St dev Height	0	0	7
Feature code	0	0	8
Ext Rel X East	0	0	9
Ext Rel Y North	0	0	10
Ext Rel Height	0	0	11
St Ellipse A	0	0	12
St Ellipse B	0	0	13
St Ellipse Phi	0	0	14

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.

The image shows a software dialog box titled "Additional parameters" with a close button (X) in the top right corner. The dialog is divided into two main sections: "GPS transformation parameters" and "Other Parameters".

At the top, there are three tabs: "Scale factor", "Vert refractioncoeff", and "Azimuth offset". The "Other Parameters" tab is currently selected.

Under the "Other Parameters" section, there are two sub-sections:

- Local Transformation Parameters:** Contains a "Transformation type" dropdown menu with "None" selected.
- Additional Transformation Parameters:** Contains a "Rotations" dropdown menu with "Always add" selected.

At the bottom of the dialog, there are three buttons: "OK", "Cancel", and "Help".

Additional parameters Other tab sheet