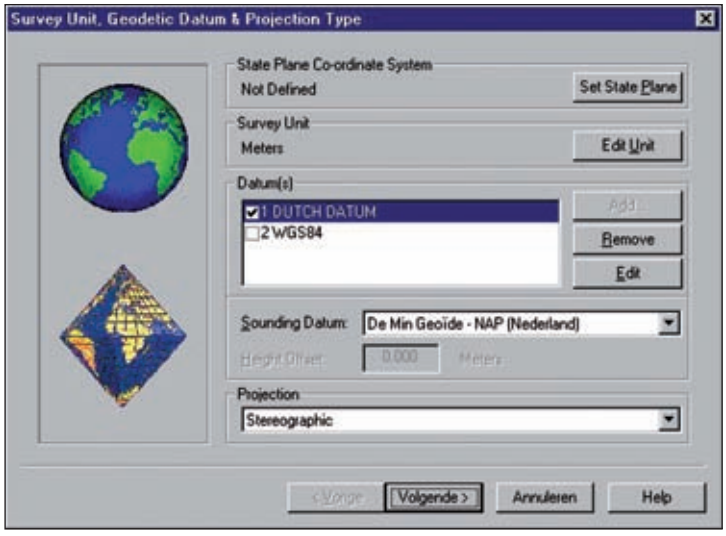
Part 6: Software Set-up

Practical Geodesy

Every GIS program or GPS system needs at some point to have a few parameters set. The background of most settings was discussed in the previous articles, but which parameters are truly necessary and which settings should be made? In this final article an overview of the various settings is given.

By Huibert-Jan Lekkerkerk



Settings for the Dutch horizontal and vertical datum when using GPS with QINSy hydrographic software.

With most hardware and software the following settings have to be made by the user:

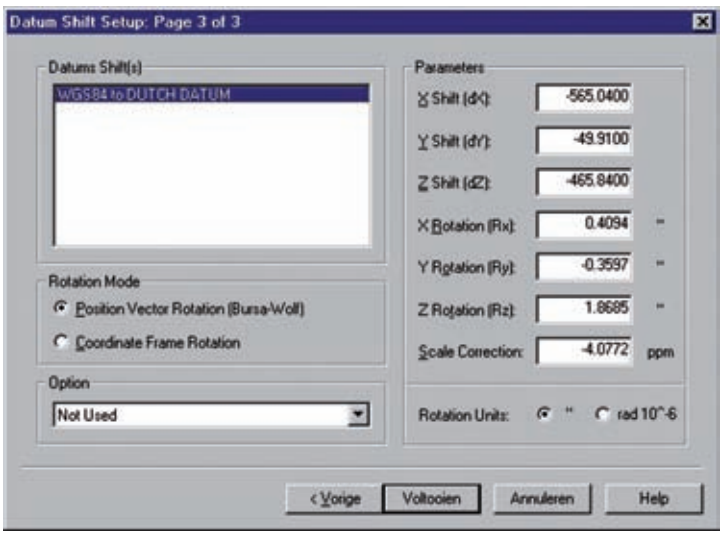
- Selection of the horizontal datum used for the measurement
- Selection of the horizontal datum used for projection
- Definition of the datum transformation between the two datums
- Selection of the vertical datum to be used
- Selection of the projection in which all data has to be displayed

In some cases a few of these items will be coupled, such as with the State Plane Coordinate System or the Dutch RDNAP-TransTM. In these cases steps 2 to/or 5 are usually bundled in the method.

Selection of the horizontal datum

When working with GPS all measurements are, by default, in the WGS84 datum. In software this is not a common setting and therefore one has to select the datum on which the data was collected and the datum onto which it will be projected/presented.

Usually a great number of horizontal datums are defined within the software. When the correct datum is unavailable (check the exact parameters!), it needs to be added by the user. Most software uses either the semi-major and semi-minor axes or the semi-major axis and the flattening.



Datum transformation settings for the Netherlands in QINSy.

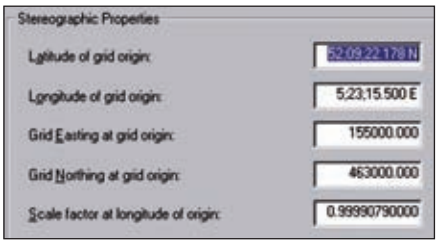
Datum transformation

Since the datum used to portray the data is usually different from that used to collect the data, some sort of transformation between the two is needed. For very small areas (a few square kilometers) or for projects not requiring much accuracy, one can simply shift the coordinates between the two datums (translation or 2/3 parameter datum transformation).

If greater accuracy is required or if the area is larger, some mathematics are needed. In this case the coordinates are first transformed from geographic to Cartesian (X,Y,Z) coordinates. These coordinates, also called ECEF (Earth Centred Earth Fixed) coordinates, are determined relative to the centre of a spheroid.

The ECEF coordinates are now transformed using a three-dimensional rotation, translation and scaling to ECEF coordinates in the new datum. Depending on the software, a three, seven or nine parameter datum shift is used. Most common is the seven parameter shift using a three axis rotation and translation and a single scale factor. Because the scaling is not three dimensional, the parameters are only valid over a certain area (e.g. a complete state).

A common mistake with datum transformations is the use of a seven parameter shift when only three parameters have been given (leaving the other four parameters at zero). This may result in errors as large as a few dozen to a few hundred meters.



Projection settings for the Netherlands in QINSy.

Selecting a vertical datum

As a rule, measurements are performed referenced to orthometric heights such as mean sea level. When converting the ellipsoid height from the GPS receiver, a correction grid or formula is needed.

Without a correction grid we will only find heights relative to the ellipsoid. When working within a (very) small area, a fixed correction value can be determined using GPS measurement of a benchmark. The result will, however, always be less than with an accurate correction value.

Projection

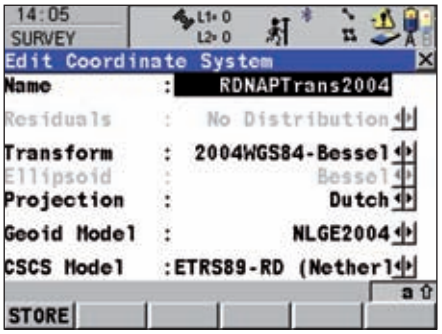
The final step is the selection of a projection on which to display the measured coordinates. Most systems will have a number of pre-defined projections built into them. As a rule, these are general projections and users need to input their own specific parameters.

Which parameters need to be set will depend on the projection selected. If UTM is used it is usually enough to select the correct central meridian. Based on that information the software sets all the other parameters. But if, for example, a stereographic projection is selected, as is the case for the Netherlands, then all sorts of parameters such as point of origin, scale factor and false easting/northing need to be defined.

Check

Good survey practice dictates a check of the geodetic parameter entered. When working with GPS this is best done by placing the receiver over a control point, the coordinates of which have been calculated in both WGS84 and in projection coordinates. With the receiver set correctly, the results should be within the measurement precision of the receiver.

When working with software, a check can be achieved using a small test file with a few coordinates. In this case the exact position should be displayed in the software after inputting and converting the file.



Selecting geodetic settings in Leica SmartworX software.

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This article is the last in this series and represents his own opinions.