

## The Twostep Transformation

Please refer back to Newsletters Vol. 01, No.9 and No.10 which explained the **Classical 3D** and the **Onestep** Transformations.

With the new v3.0 Sensor Firmware and v2.1 SKI-Pro there is now another transformation type available - the **Twostep** transformation.

This Newsletter explains how it works and why we have introduced this.

## Why Another Transformation?

Remember that the **Classical 3D** transformation is the most rigorous transformation type. It is a similarity transformation, which keeps the full geometrical information. Knowledge of the **ellipsoid** and the **map projection** is required and all common points have to be known in **position and height**.

The **Onestep** transformation does not need the knowledge of the map projection of the local points, and also does not need position and height information for the common points, as it treats **position and height separately**.

As for the position transformation of a Onestep, the WGS84 geodetic co-ordinates are projected onto a preliminary grid using a temporary Transverse Mercator projection. Onestep transformations are limited to areas of about 10km square.

The new **Twostep** transformation combines the advantages of the two approaches. It allows treating position and height separately, but is not restricted to smaller areas.

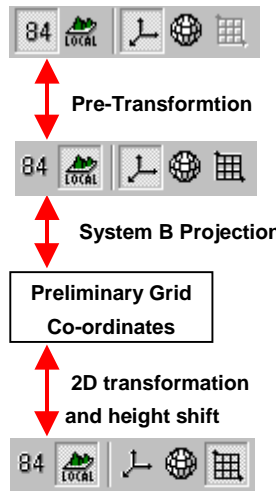
## How Does It Work?

In the first step, the WGS84 co-ordinates of the common points are shifted closely to

the local datum using a given **Classical 3D Pre-Transformation**.

In the second step, the co-ordinates are projected onto a **preliminary grid**, but this time using the true map projection of the local points.

The final part of the positional transformation is a **2D transformation**, exactly as with the Onestep transformation.



Compared to the Onestep transformation the first step avoids any distortions due to the fact that the preliminary grid co-ordinates are built on a different ellipsoid than the local points. And even more importantly, the second step makes sure that the influence of the scale factor of the map projection is equally taken into account before the final 2D transformation is done.

For these reasons the transformation will fit much better over larger areas than a Onestep transformation. The height part is independent of the position transformation and is identical to the approach taken for the Onestep.

## Which Pre-Transformation To Use?

Any Classical 3D transformation can be used as the **Pre-Transformation** of the first step. This will typically be a

rough transformation valid for your country.

If no such pre-transformation is available, you can enter and then select a zero transformation (zero shifts and rotations) and still make use of the benefits from the second step!

## The Operation

Twostep transformations can be calculated in **SKI-Pro** and on the **Sensor**. In Datum&Map, the type and the Pre-Transformation can be selected on the Configuration page accessible in the Match tabbed view.

On the Sensor the Pre-Transformation is selected in the **COORDSYS\ Type Selection** screen together with the ellipsoid and projection of the local points.

## Any Disadvantage?

The map projection has to be known otherwise the distortions of the projection could not be modelled. This would of course restrict the area over which the transformation can be applied.

Also, the same restriction for heights applies as for the Onestep. Geoid models can of course be used with the Twostep transformation.

## Remember...

- Applying Twostep transformations is not limited to smaller areas.
- Common points can be given in **position and height**, in **position only** or even in **height only**.
- As with Classical 3D transformations, the **Ellipsoid** and the **Projection** have to be known to calculate a Twostep transformation. A **Pre-transformation** also has to be selected.