Using a Deformation Model to Calculate Coordinates in a Local Reference Frame

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SUMMARY

Many countries have incorporated deformation models into their national geospatial referencing systems over the last 15 years, a trend set to continue due to increasing requirements to align datasets accurately with global reference frames. However, it is often not clear how these models should be used by spatial professionals to calculate coordinates in the local reference frame. This paper demonstrates how a deformation model can be used in practice to calculate a single set of coordinates from observations made at different times.

Least squares estimation is the most common procedure used to calculate coordinates for geodetic data. By making a simple modification to the observation equations, the deformation present in each observation (relative to the reference epoch) can be accounted for in the least squares process. This then enables the usual error detection and observation reweighting processes to take place, before generating final coordinates.

The process is illustrated using GNSS baseline data collected in Christchurch before and after one of the major earthquakes of the 2010 and 2011 sequence. By applying the deformation model within the least squares adjustment, a full set of local reference frame coordinates is generated, even for marks where it has not been possible to observe data after the earthquakes.

This approach can be generalised to all types of deformation and spatial data. While the computations would typically be carried out in a software package, an understanding of the principles behind use of a deformation model will help spatial professionals make informed decisions about its impact on their data and assist with the interpretation of results in regions of significant deformation.