Assessing the Impact of not Using a Deformation Model

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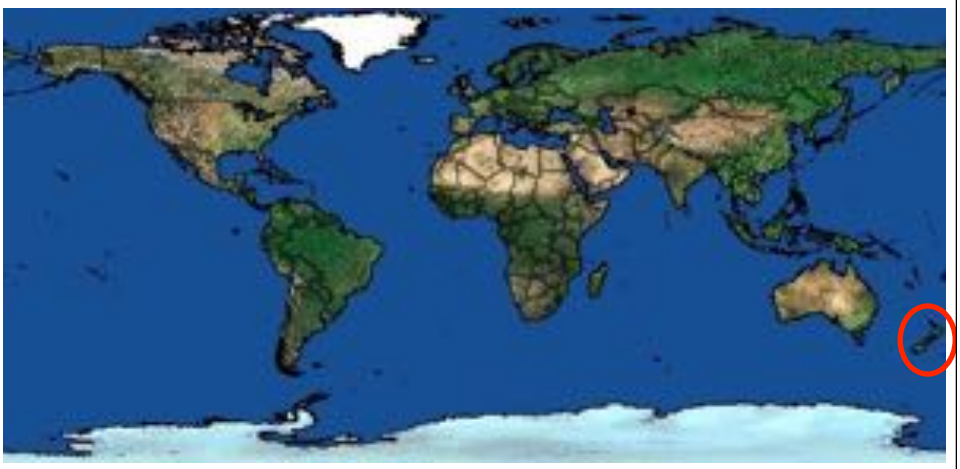
Outline

NZGD2000 Deformation Model

Case Study: Wellington

NZGD2000 Deformation Model

New Zealand



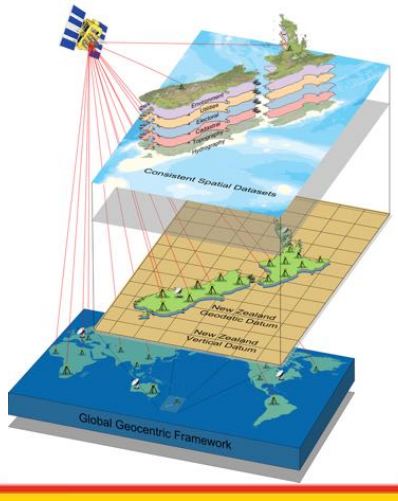
New Zealand Geodetic Datum 2000 (NZGD2000)

- Official local reference frame widely used in New Zealand (compulsory for some applications)
- Aligned to ITRF96, nominally at epoch 2000.0
- Relationship to global frame (ITRF) managed by official 14-parameter transformation and deformation model with secular and non-secular submodels

Role of NZGD2000

Consistent spatial references to facilitate data integration

Provide coordinates that are static over time



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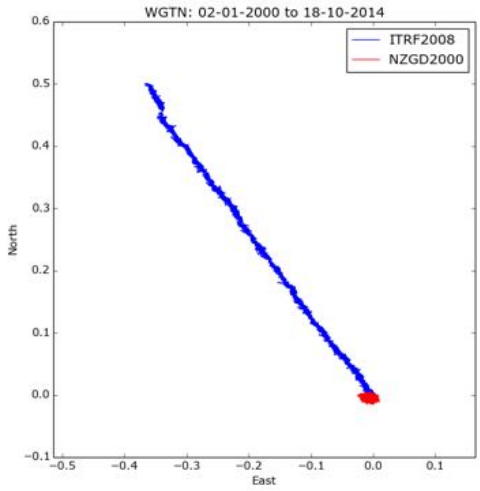
ITRF vs NZGD2000

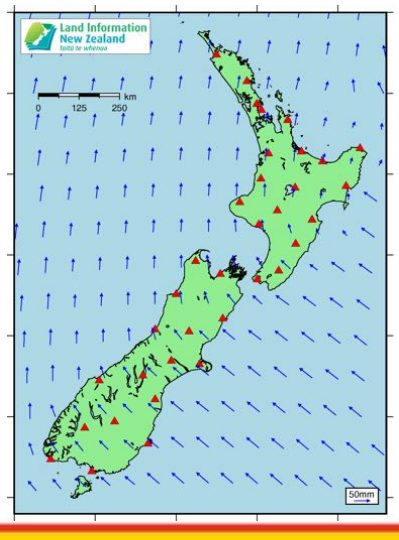


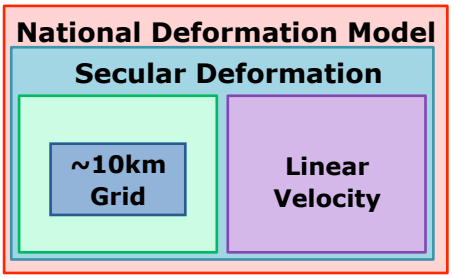
New Zealand's Active Faults

No simple way to provide static coordinates in this environment

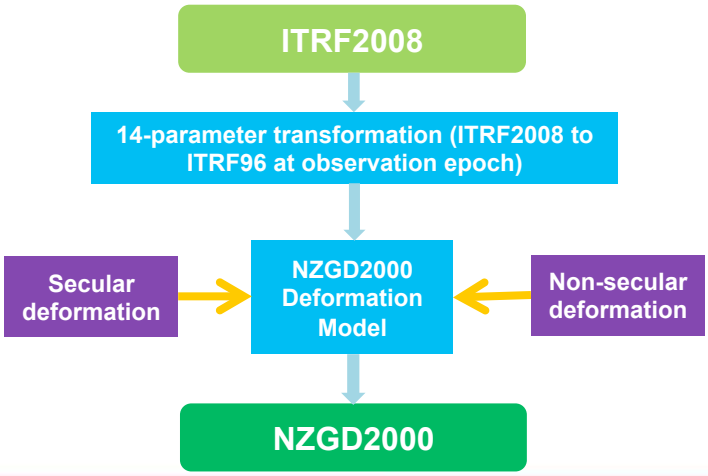
Source: GNS Science

Secular Deformation Model





Obtaining NZGD2000 coordinates from GNSS (rigorous)



Obtaining NZGD2000 coordinates from GNSS (the reality)

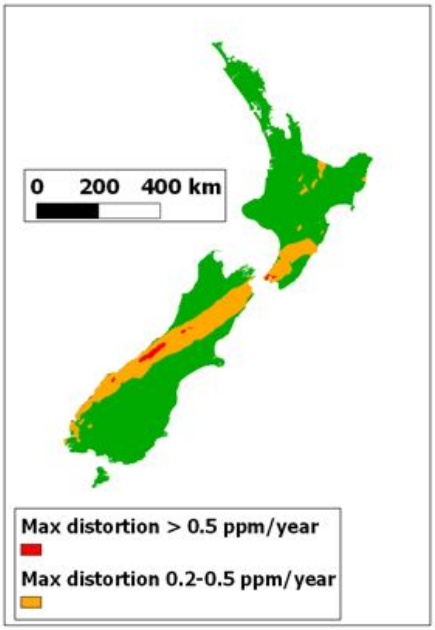
Connect to a nearby NZGD2000 mark and forget about the reference frame transformation and the deformation model

Because it is said that...

Over small areas, (relative) deformation is negligible for practical purposes, in the absence of earthquakes and other local deformation events

Neglecting the Deformation Model

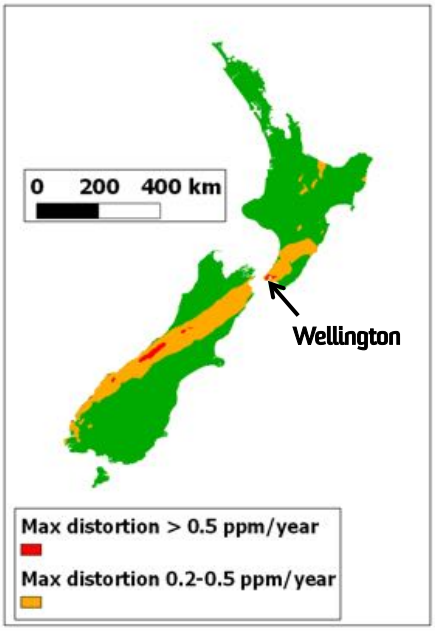
Is it always valid to assume that the secular deformation model is not required?



Case Study: Wellington

Wellington Case Study

- Largest relative movement of any urban area
- Want to calculate positions across the city with an accuracy better than 5cm and 50ppm (95% CI) as efficiently as possible



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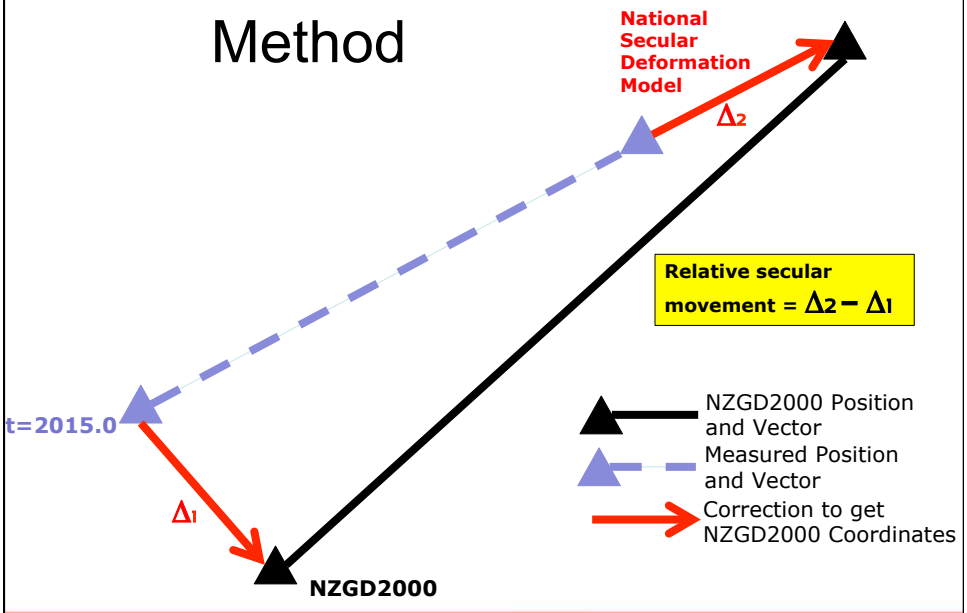
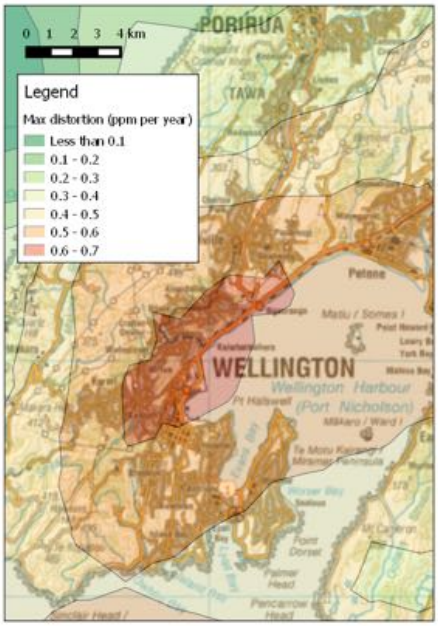
Method



Relative accuracy

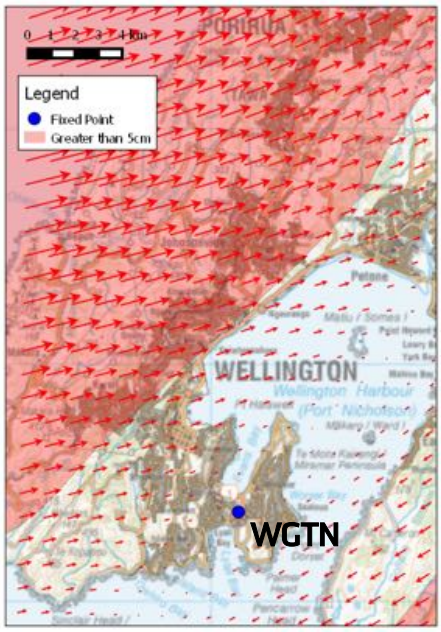
- Maximum relative movement about 0.6ppm per year

Easily complies with the relative accuracy specification



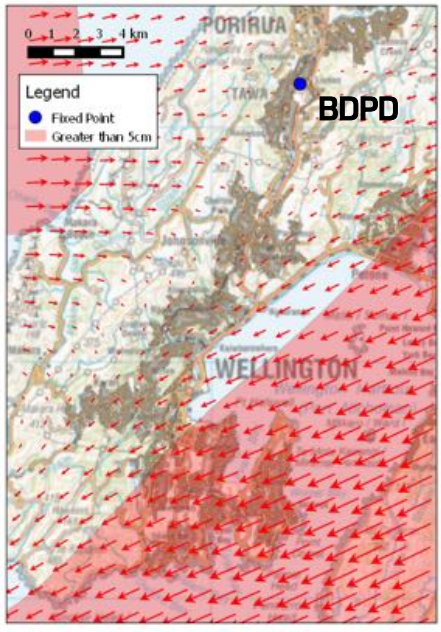
Absolute Accuracy 1

- Heavily influenced by network design
- If positioning off WGTN (streaming free real-time data), northern half of city has residual deformation that exceeds specifications



Absolute Accuracy 2

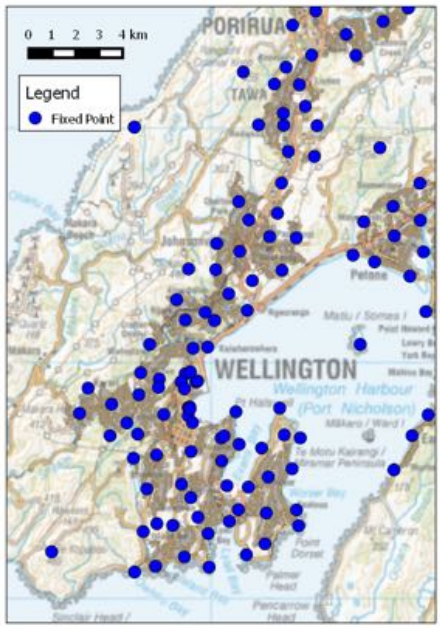
- Similar pattern if positioning off mark to the north (BDPD)
- Southern half of city has residual deformation that exceeds specifications



Absolute Accuracy 3

- Can mitigate impact by calibrating to nearby control
- But even then, high residuals will remain in the network

Need to use the deformation model



Summary

- The deformation model is a critical component of NZGD2000, but its use is often neglected
- In areas of high strain, such as Wellington, neglecting the model can lead to significant coordinate errors, depending on the extent and methodology of the survey
- The magnitude of the error increases with increasing distance to the nearest fixed control