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# Progress Towards A Nationwide Adjustment of New Zealand's Geodetic Data

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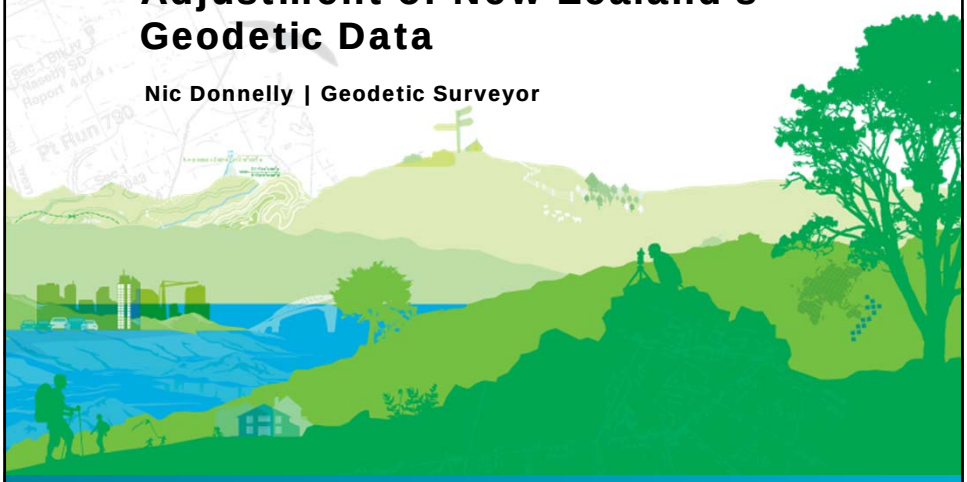
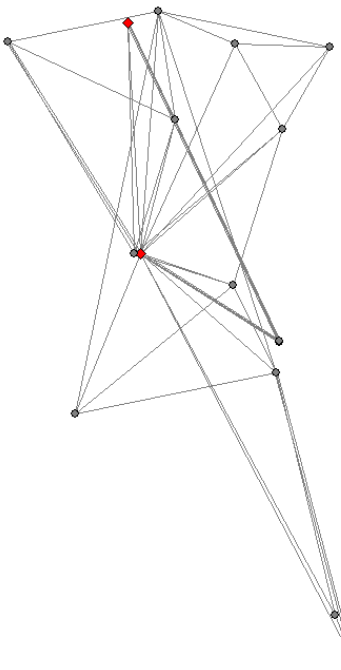




## Overview

- Current status of New Zealand geodetic adjustments
- Drivers for a nationwide adjustment
- The nationwide Geodetic Adjustment of New Zealand
- Special Features
  - Deformation Model
  - Calculation of local accuracy



## New Zealand Geodetic Datum 2000 – NZGD2000

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- The official datum is New Zealand Geodetic Datum 2000 (NZGD2000)
- Defined as ITRF96 at epoch 2000.0
- New Zealand is at the boundary of the Australian and Pacific plates
- Even over small distances, marks can be moving at different velocities. Cannot assume a static Earth
- Includes a deformation model which can be used to generate coordinates at other epochs


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## Current Adjustments

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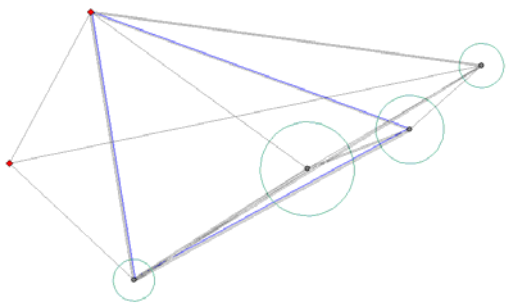
- Hierarchical series of networks
- Weighting
  - Pre-2005: Mainly based on standards to which survey was carried out – enabled easy testing against standards
  - Post-2005: Mainly based on expected accuracy of observations
- Adjustment management
  - Hundreds of individual campaigns
  - Consistency maintained through strong connections to higher accuracy control



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## Drivers for a Nationwide Adjustment

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- Geodetic standards
  - Require testing of local accuracy against all other marks of the same or better accuracy within a given radius
- CORS/passive control conflicts
- Accurate normal orthometric height determination
  - Calculate normal orthometric heights from GNSS data and an accurate geoid model
  - Refine datum offsets to enable conversions to levelling datums
- Deformation model enhancements
  - Improved secular model, inclusion of earthquake patches

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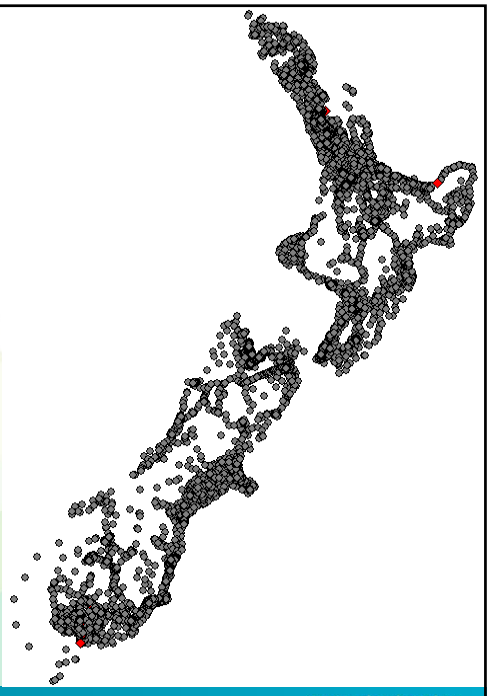
## The Nationwide Adjustment

- 400000 observations (130000 GNSS baselines – X, Y, Z)
- 70000 parameters (23000 coordinates)
- Uses existing processed baselines
- Terrestrial observations may be included in the future



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## The Nationwide Adjustment 2

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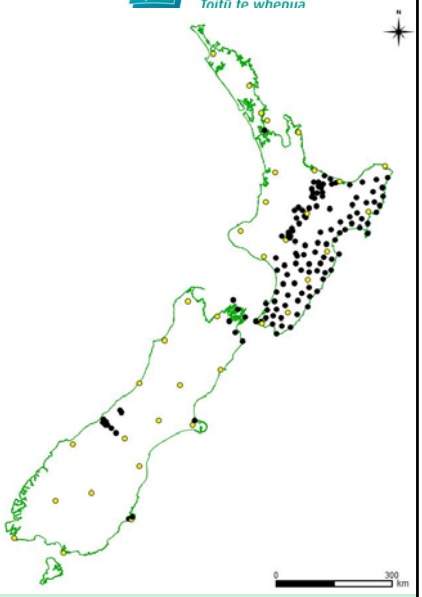
- Constrained to CORS
- Weighted initially based on expected accuracy, refined for each campaign based on RMS values
- Identification and resolution of outliers



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## Data Management and Analysis

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- Authoritative observations in official Landonline database
- Observations and coordinates transferred to PostgreSQL database
- LINZ SNAP software used for least squares adjustment
- Appropriate updates

made to Landonline database



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## Deformation Model Application

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- Observations from different epochs can be included in a common adjustment
- Each observation is compared in the adjustment software against coordinates calculated based on coordinate at the reference epoch plus the deformation between the reference epoch and time of observation

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## Deformation Model 2

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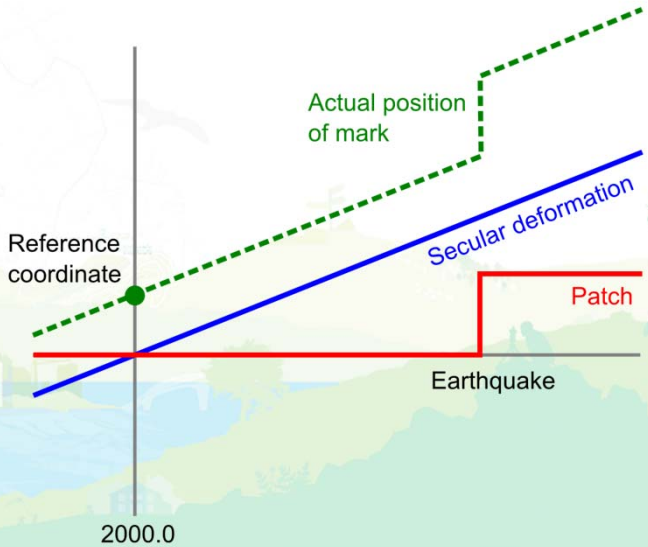


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## Local Accuracy Calculation

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- Inverting a large normal matrix is time consuming
- There are various approaches to make this more efficient:
  - Helmert blocking (eg United States National Geodetic Survey)
  - Phased least squares (eg Australia)



## Local Accuracy Calculation 2

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- Another approach: We don't need the full covariance matrix, as we are only interested in local accuracy between "nearby" stations, between which a surveyor is likely to make measurements
- Therefore output the Choleski decomposition of the normal equations – no inversion necessary
- Covariances calculated as required from decomposition matrix, to assess local accuracy between marks separated by a given distance

## Summary

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- A nationwide adjustment of GNSS data has been compiled and error analysis is underway
- Driven by both regulatory and customer requirements – passive marks are still important in New Zealand
- Will ensure coordinate consistency across the country, at a level suitable for surveying from CORS

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