Dynamic Datum Transformations in Australia and New Zealand

Nic Donnelly, Land Information New Zealand and University of NSW

Chris Crook, Land Information New Zealand

Joel Haasdyk, Land and Property Information and University of NSW

Craig Harrison, Geoscience Australia

Chris Rizos, University of NSW

Craig Roberts, University of NSW

Richard Stanaway, University of NSW

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Dynamic Datums

- Origin, orientation of axes are fixed and mean tectonic plate motion is zero

- Coordinates are time-dependent: Require velocities and sometimes other information (such as coseismic offsets) to track position through time
- No fixed coordinates. Coordinates change to reflect rigid plate motion and (possibly) other deformations

ITRF and WGS84

- ITRF2008
  - Secular, global reference frame (linear velocities)
  - Reference coordinates and linear velocities
  - Open, accessible and traceable for high-precision positioning

- WGS84(G1674)
  - Epoch reference fra[illegible]user
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  - [illegible]n positioning not available to general users

GDA94

- Geocentric Datum of Australia 1994
- Aligned to ITRF92 at epoch 1994.0
- Static datum
- Assumed to be on rigid plate – negligible deformation

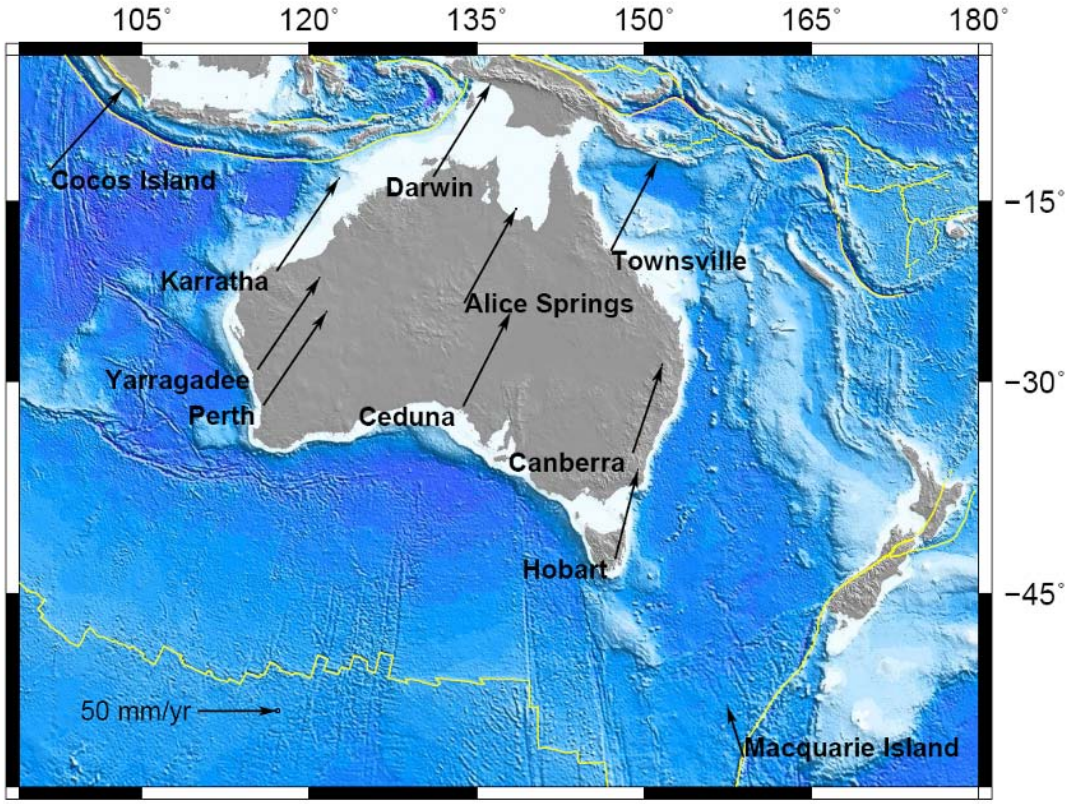
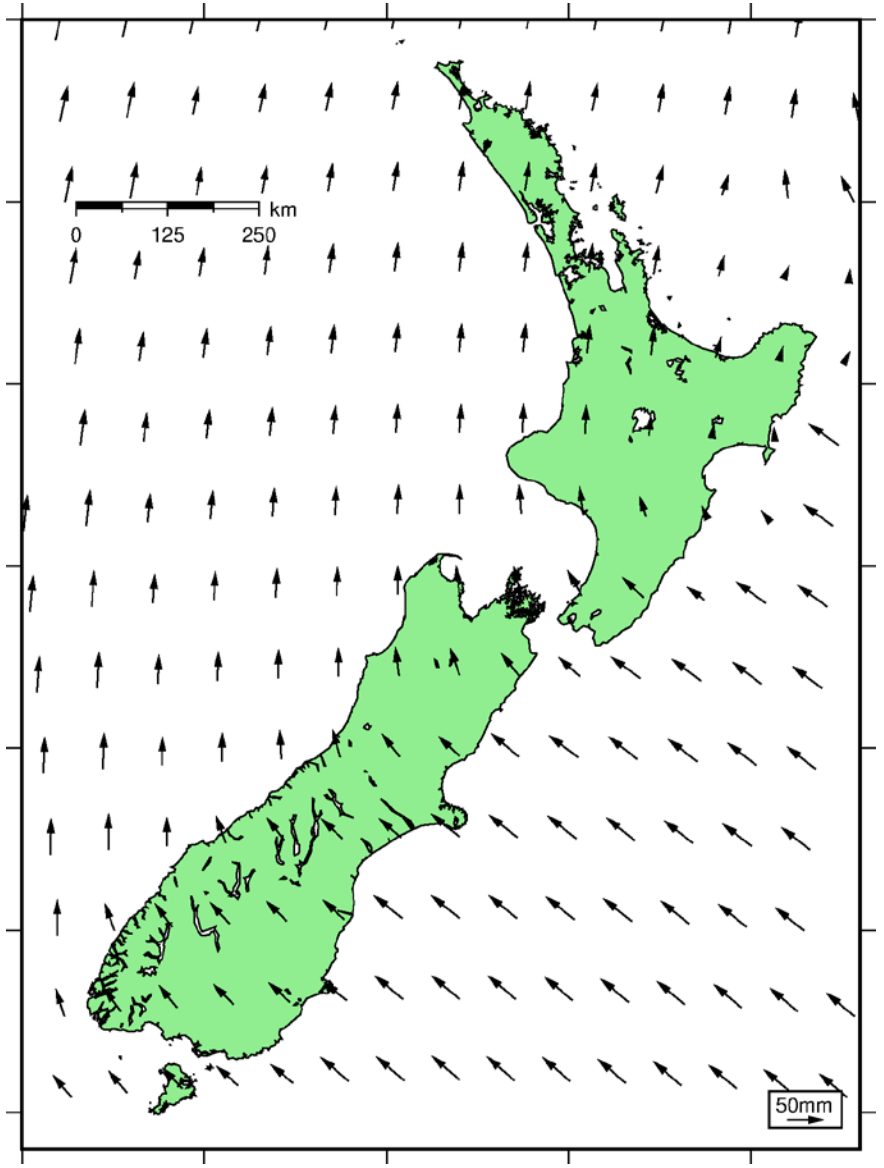


Diagram courtesy of John Dawson, Geoscience Australia / ICSM

NZGD2000

- Geocentric, aligned to ITRF96 at epoch 2000.0
- Semi-dynamic datum
- Looks static, because deformation model is used to propagate coordinates to the reference epoch



New Zealand Deformation Environment

- Significant over relatively short distances for many applications
- Across the city of Wellington: 20 km from airport (south) to Tawa (north)
- 0.08m relative movement between airport and Tawa

Australia Deformation Environment

- Most stable populated continent
- Limited deformation associated with great earthquakes
- Impacts on highest-precision applications

9mm rotation on a 30km baseline after 26 years

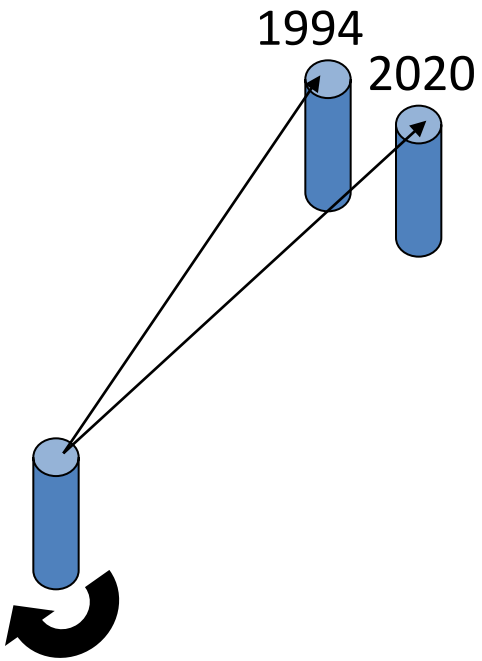


Diagram courtesy of John Dawson, Geoscience Australia / ICSM

Transformation Approaches

Australia

Reference Frame Transformation

Plate Motion Propagation

GDA-specific 14-parameter transformation, including plate motion

rate	T_x $\dot{T}_x$	T_y $\dot{T}_y$	T_z $\dot{T}_z$	S $\dot{S}$	R_x $\dot{R}_x$	R_y $\dot{R}_y$	R_z $\dot{R}_z$

New Zealand

Reference Frame Transformation

Global IERS/IGS 14-parameter transformation

rate	T_x $\dot{T}_x$	T_y $\dot{T}_y$	T_z $\dot{T}_z$	S $\dot{S}$	R_x $\dot{R}_x$	R_y $\dot{R}_y$	R_z $\dot{R}_z$

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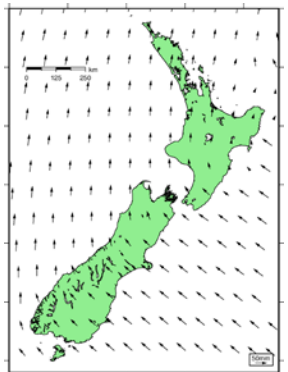


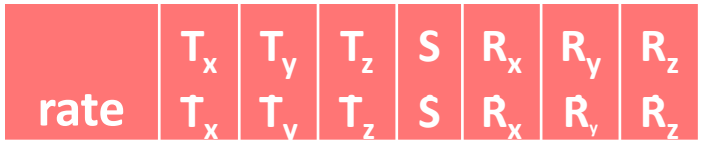
Deformation Model Propagation

Local NZGD2000 Deformation Model

Improving Transformations in Australia

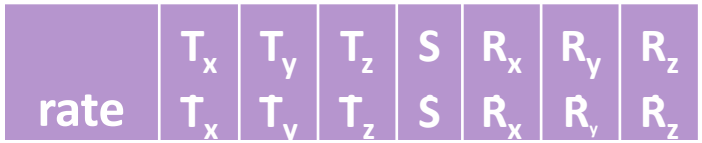
- One option: supplement a GDA-specific 14-parameter transformation with a deformation model

14-parameter reference frame transformation



3-parameter rigid plate rotation model

Combined 14-parameter transformation



Coseismic, postseismic and interseismic deformation

Gridded deformation model

Summary

- Global positioning methodologies (such as GPS) use global dynamic datums
- Need to transform to national datum
- Current 14-parameter transformation for Australia doesn't meet needs of highest-precision applications
- Deformation model, perhaps combined with 14-parameter transformation is one option that would meet this need