A Two-Frame Spatial Referencing System Accounting for Geodynamics

Nic Donnelly[1,2], Chris Crook[1], Richard Stanaway[2], Craig Roberts[2], Joel Haasdyk[2,3], Chris Rizos[2]

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[1] Land Information New Zealand, Wellington, New Zealand
[2] Civil and Environmental Engineering, University of NSW, Sydney, Australia
[3] New South Wales Land and Property Information, Bathurst, Australia

Outline

- The Changing Role of National Reference Frames
- The Two-Frame System
- Case Study: New Zealand

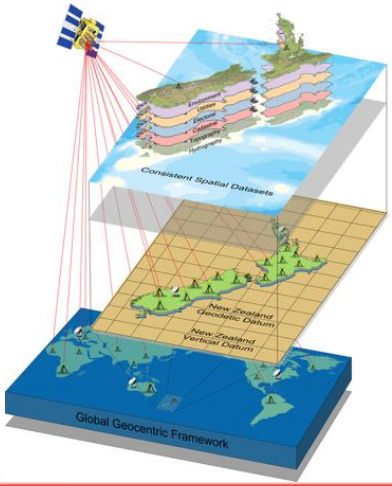
The Changing Role of National Reference Frames

The Two-Frame System

Case Study: New Zealand

Current Role of the National Reference Frame

Consistent spatial references to facilitate data integration



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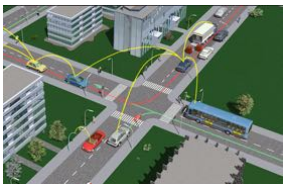
Near-Future of Positioning

Unmanned Aerial Vehicles

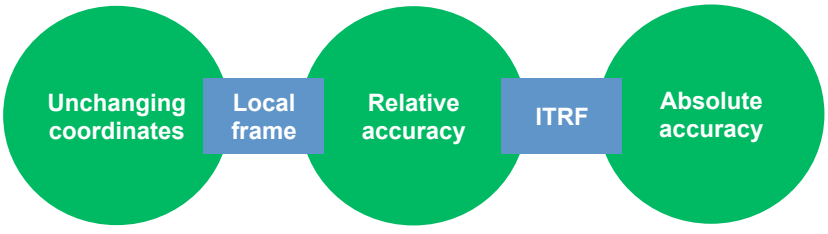


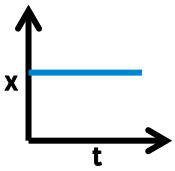
Intelligent Transportation Systems

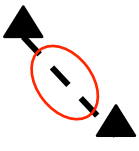
Consumer "Smart" Devices

10cm positioning in terms of ITRF at current epoch

User Requirements of a National Reference Frame







The Changing Role of National Reference Frames

The Two-Frame System

Case Study: New Zealand

Global vs Local Frame

Global	Local
Driven by geodetic requirements	Flexibility to account for local user requirements
Time-varying coordinates	Time-invariant coordinates
Plate motion and/or deformation models to propagate coordinates between epochs	Plate motion and/or deformation models to generate reference coordinates
Native system for modern positioning techniques (GNSS) and non-specialist users	Modern positioning techniques (GNSS) require transformation to the local frame

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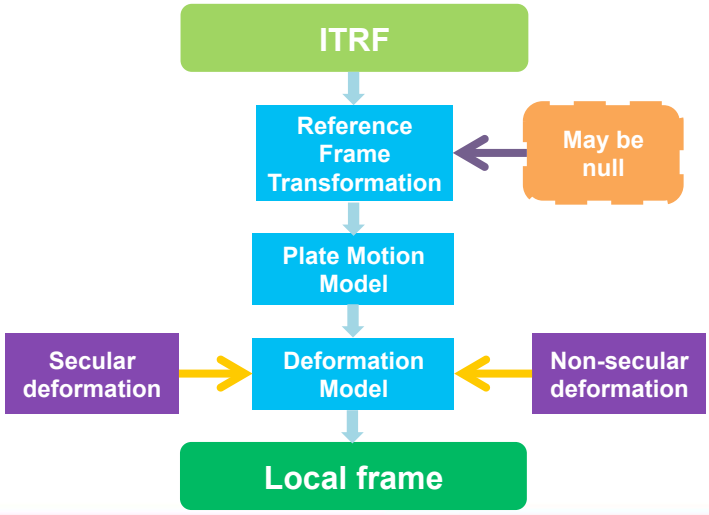
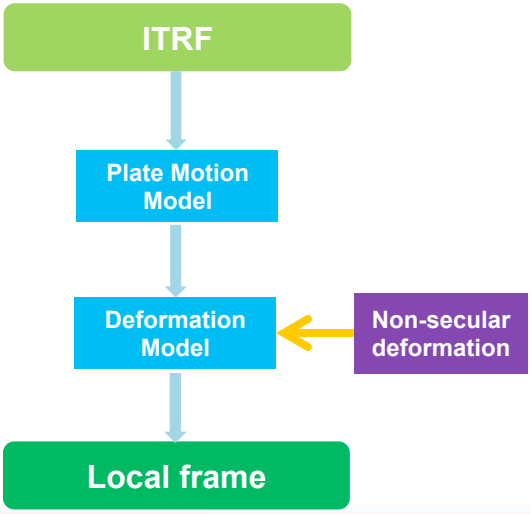
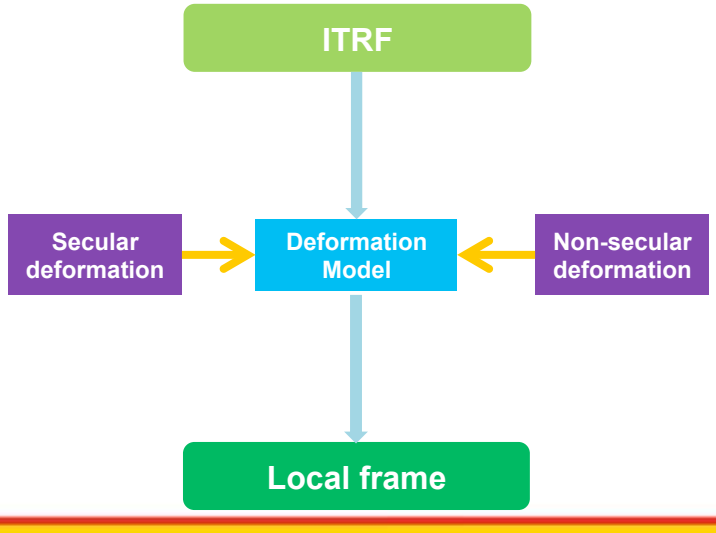
Two-Frame Referencing System



Non-Deforming Region



Deforming Region



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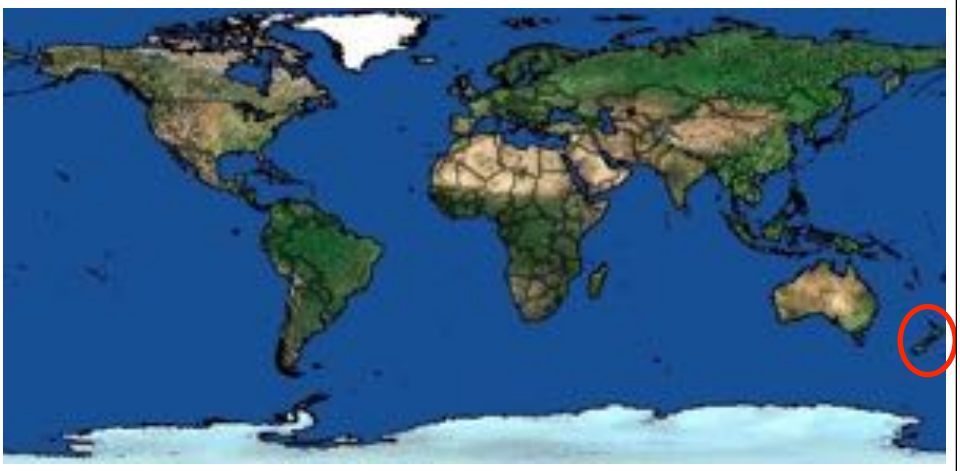
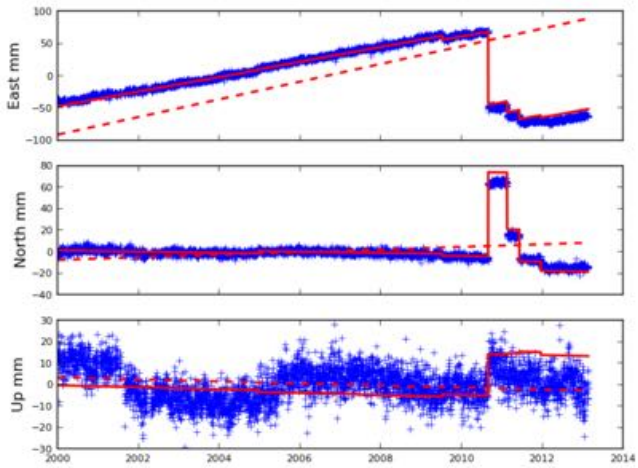
New Zealand



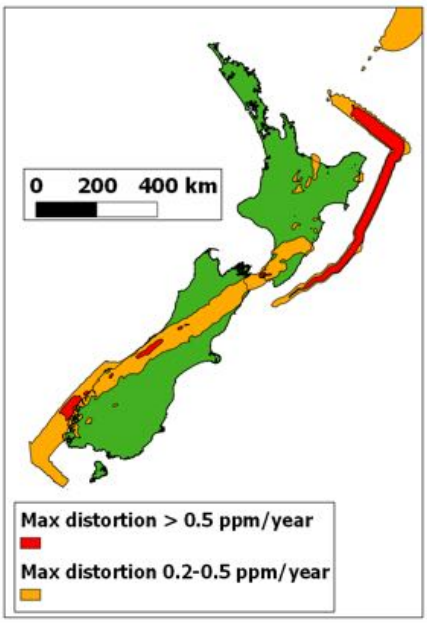
New Zealand Active Faults

Source: GNS Science

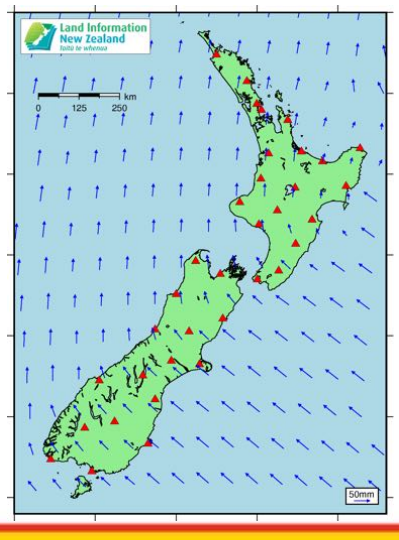
Deformation Model for ITRF Coordinate Propagation



Secular Deformation Distortion



Secular Deformation



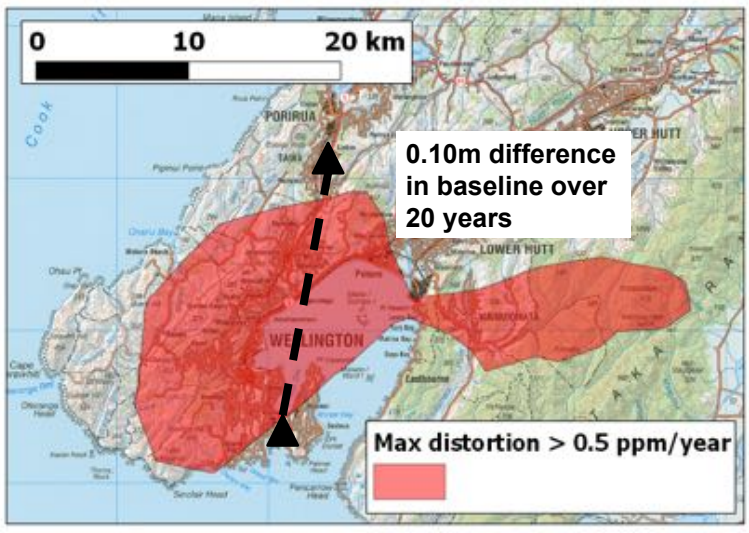
National Deformation Model

Secular Deformation

~10km Grid

Linear Velocity

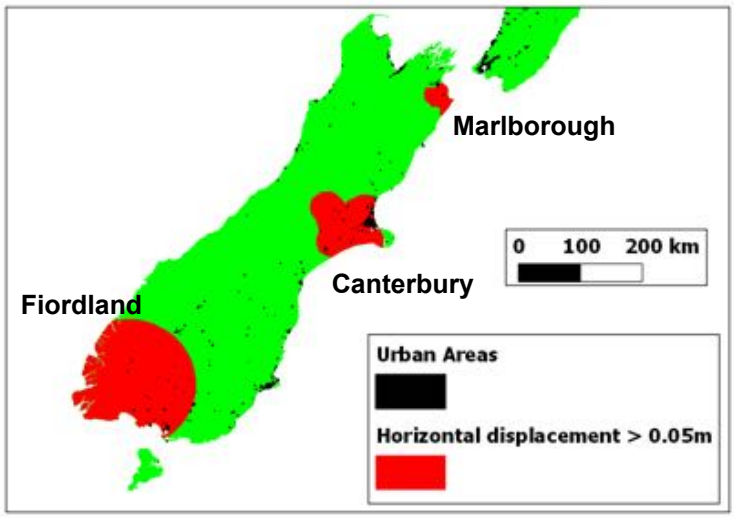
Secular Deformation Distortion



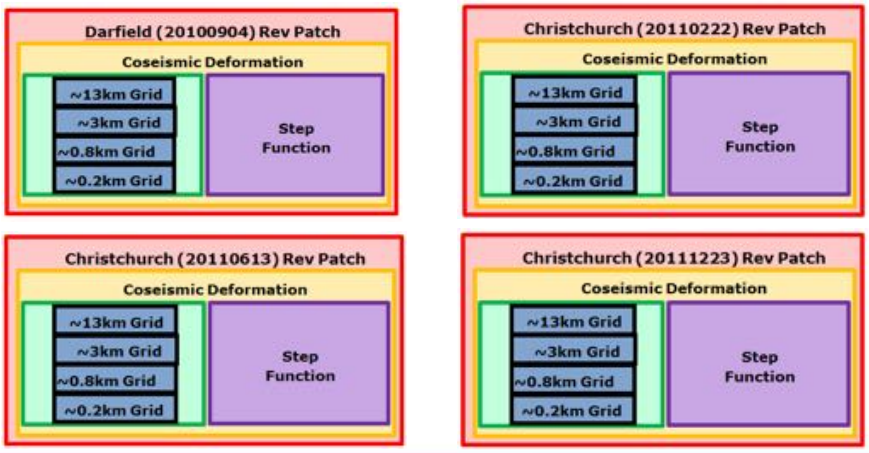
Significant Earthquakes 2000-2013

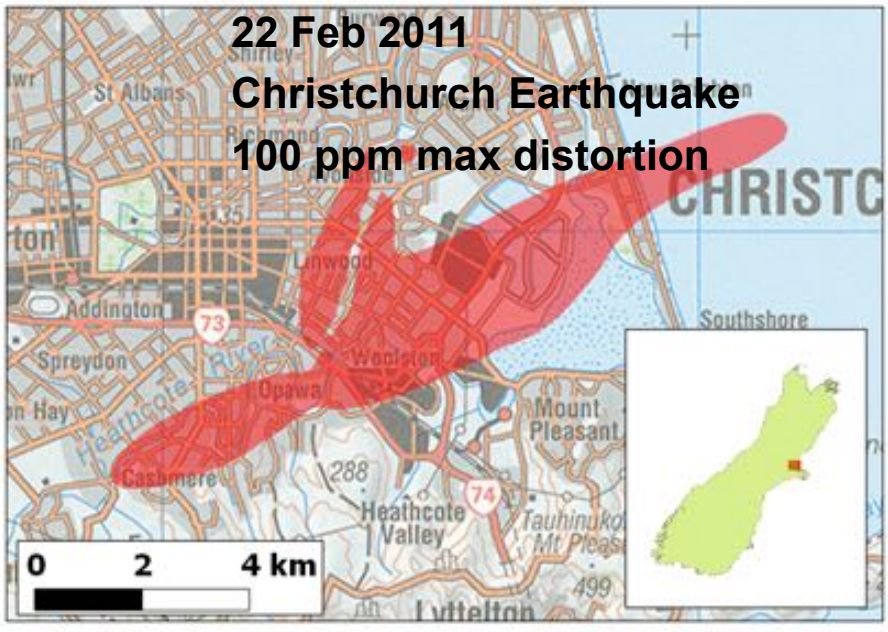
Name	Date	Magnitude	Max Hz (m)	Max Vt (m)
Secretary Island (Fiordland)	22 Aug 2003	7.2	0.27	0.72
Macquarie Island	24 Dec 2004	8.1	0.015	0.005
George Sound (Fiordland)	16 Oct 2007	6.7	0.13	0.27
Dusky Sound	15 Jul 2009	7.8	1.74	0.39
Darfield	4 Sep 2010	7.1	3.20	1.75
Christchurch	22 Feb 2011	6.3	0.31	0.48
Christchurch	13 Jun 2011	6.3	0.22	0.13
Christchurch	23 Dec 2011	6.0	0.25	0.36
Cook Strait	21 Jul 2013	6.0	0.082	0.024
Lake Grassmere	16 Aug 2013	6.6	0.34	0.26

Significant Earthquakes 2000-2013



Canterbury Earthquakes Submodels





Summary

- The spatial/mapping community is not yet ready for kinematic coordinates, but positioning is increasingly ITRF-based
- A two-frame system formalises existing practice, provides a transition to ITRF and supports multiple communities
- Deformation models accounting for geodynamics are critical for both frames, but the use may be slightly different

Thank-you

- Acknowledgement: Deformation model for New Zealand developed from source models developed by John Beavan and Ian Hamling of GNS Science

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