

FIG "From the wisdom of the ages
to the challenges of modern world"

The Practical Limitations of a Semi-Dynamic Datum – Is There a Better Solution

FIG WORKING WEEK 2015 17–21 MAY SOFIA BULGARIA

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'The power of where'

The Practical Limitations of a Semi-Dynamic Datum – Is There a Better Solution

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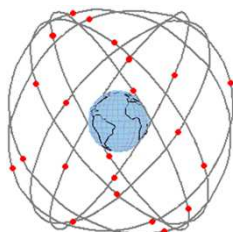


- The role of a national geodetic datum
- Handling tectonic movement in NZGD2000
- Accuracy limitations
- The future for NZGD2000
 - Is there a better solution? or
 - Will it satisfy spatial user needs into the future?

The role of a national geodetic datum – has it changed?

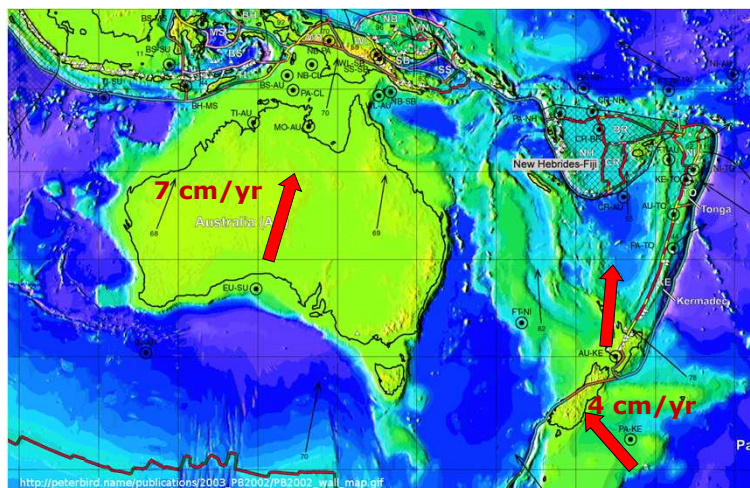


The National Geodetic Datum is dead!



Long live the National Spatial Reference System

Everything is moving!



NZGD2000 – semi dynamic datum?



NZ Geodetic Datum 2000 (NZGD2000)?

or is it

NZ Reference Frame 2000 (NZRF2000)

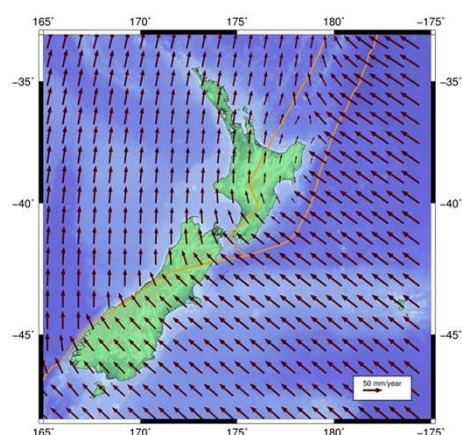
- Plate fixed local coordinate system
- Defined in relationship to ITRF1996
- Includes a time dependent deformation model
 - Enables the transformation to and from other reference frames (eg ITRF, WGS84)
- Can be considered as a series of datums as the deformation model changes
- Provides a convenient means of defining coordinates of physical spatial features that are **independent of epoch**

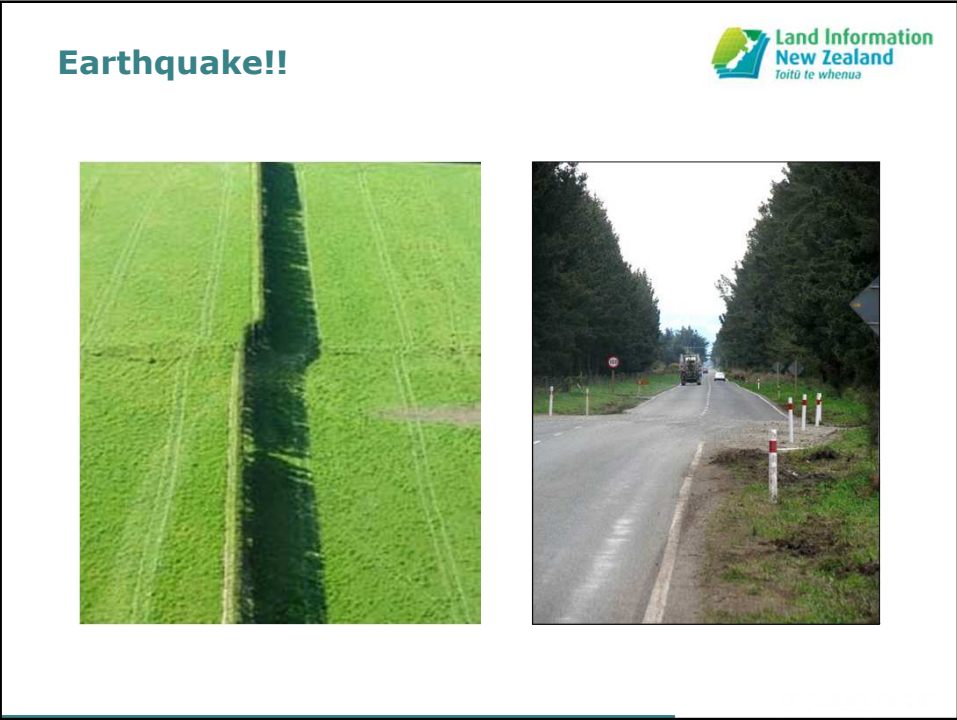
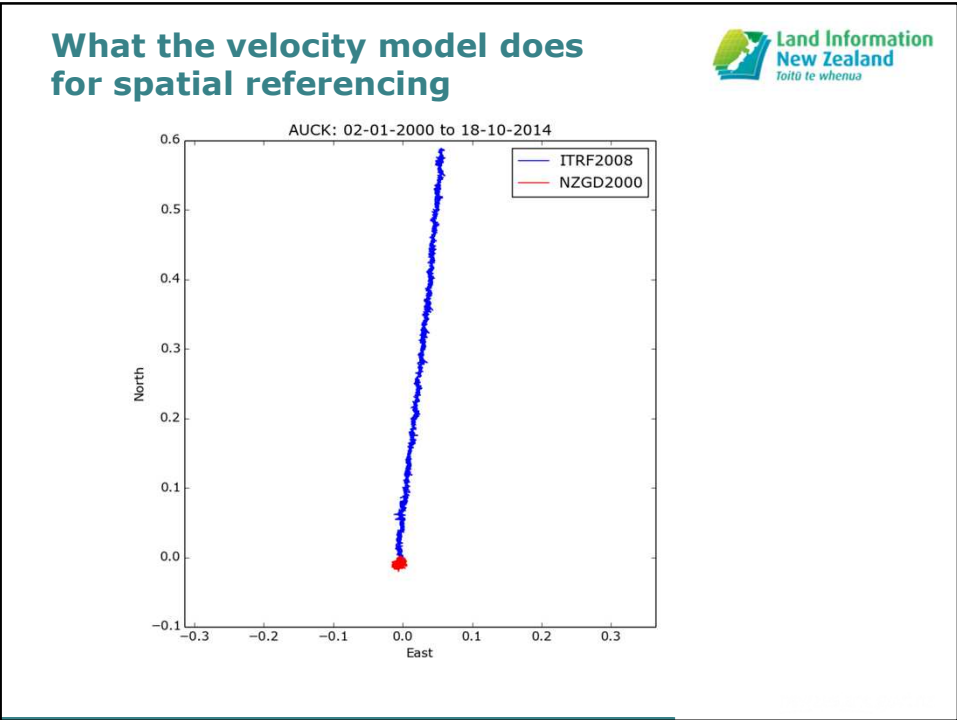
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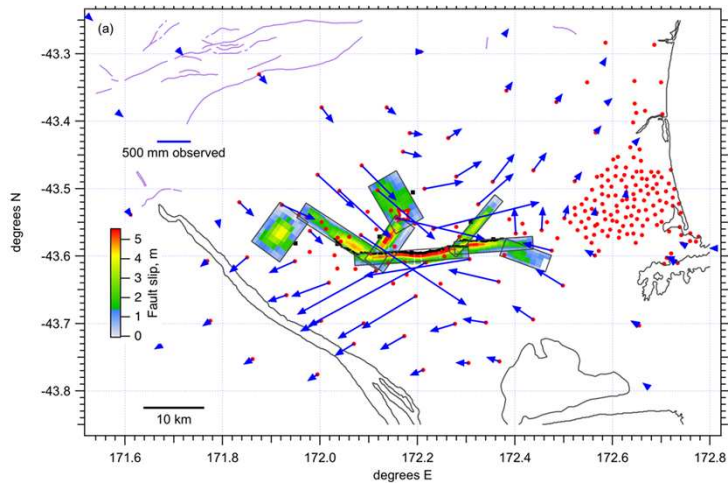
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The secular velocity model

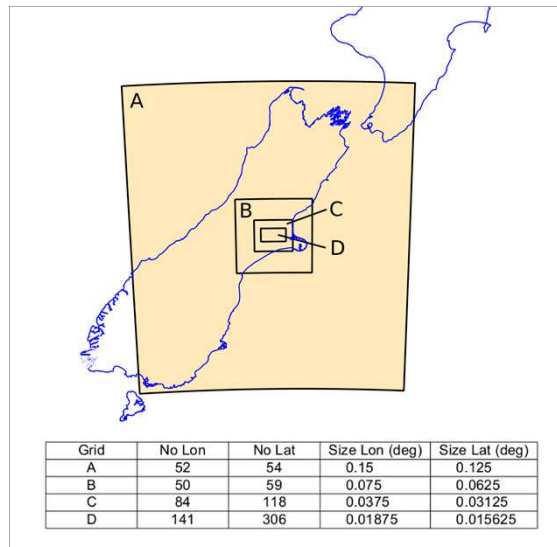




Deformation due to earthquake



Deformation model patch



Events effecting the South Island of New Zealand since 2000



Name	Date	Magnitude	Max H	Max V
Secretary Island (Fiordland)	22 Aug 2003	7.2	0.27	0.72
Macquarie Island	24 Dec 2004	8.1	0.02	0.01
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	17 Jul 2013	6.5	0.08	0.02
Lake Grassmere	16 Aug 2013	6.6	0.34	0.26

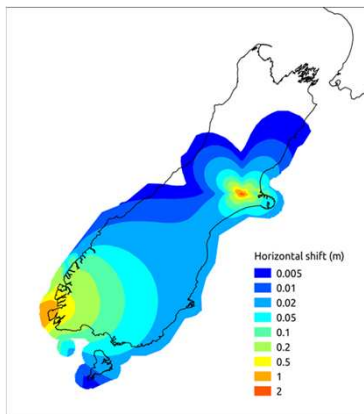
Max H and Max V are maximum horizontal and vertical displacements across the land area of New Zealand in metres.

Two options for patching

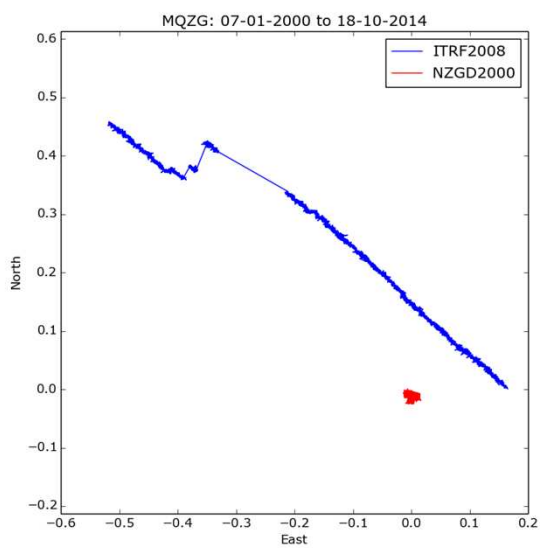


"Forward" patch	"Reverse" patch
Coordinates unchanged	Coordinates changed to reflect deformation due to earthquake
Need to apply patch to convert current coordinates ITRF ⇄ NZGD2000	Only need to apply patch to convert coordinate for dates before the earthquake
Local relative accuracy degraded (for current coordinates)	Relative local accuracy maintained
Simple to implement – only changes deformation model, most users unaffected	Costly to implement – coordinate change applies to all databases of NZGD2000 coordinates in affected area

Reverse patch coordinate update



What patches do for spatial referencing

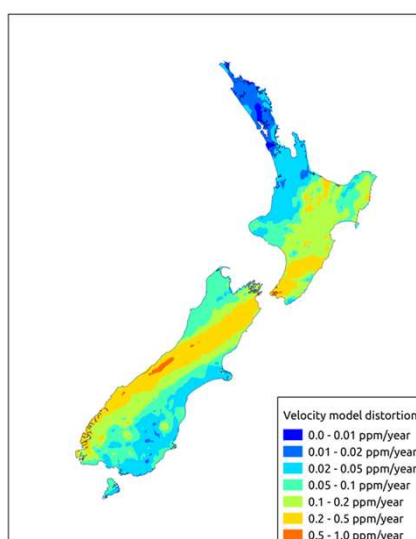


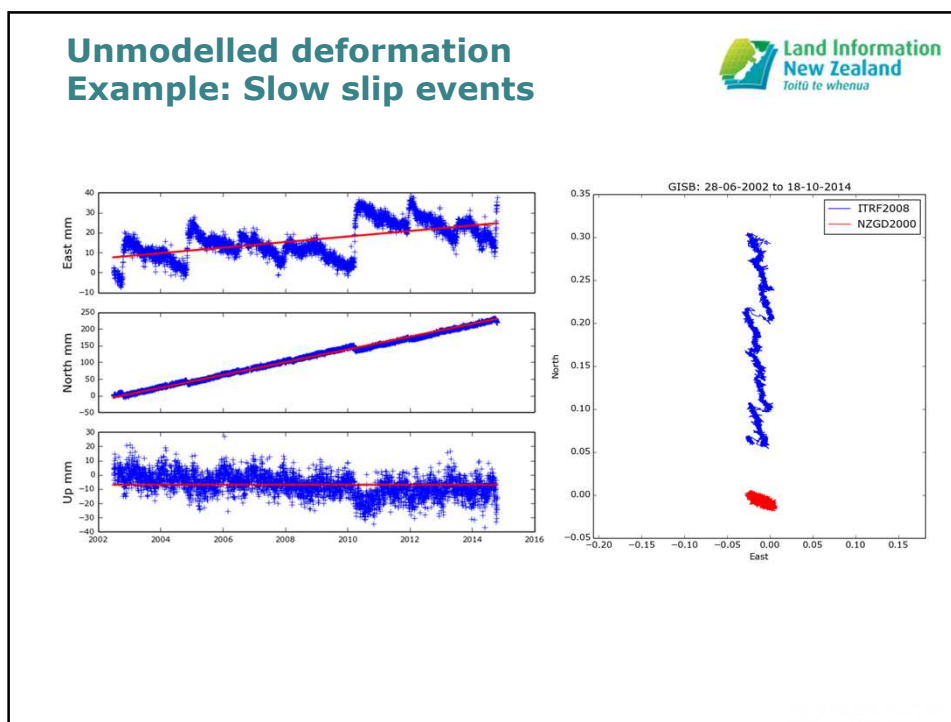
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Distortion of reference system





Latency



Deformation model is not available immediately after event such as earthquake.

May wait until frequency of events has tailed off, or immediate post-seismic movement has subsided

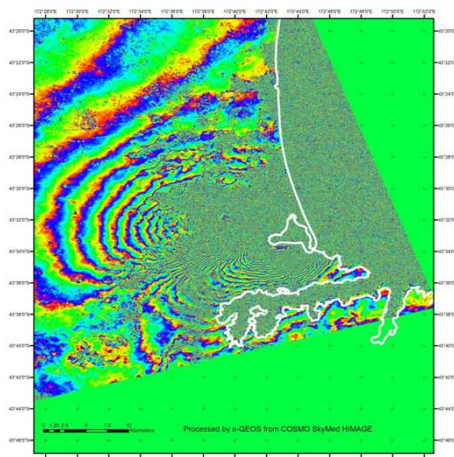
Delayed by acquisition of post event data and time for analysis and implementation

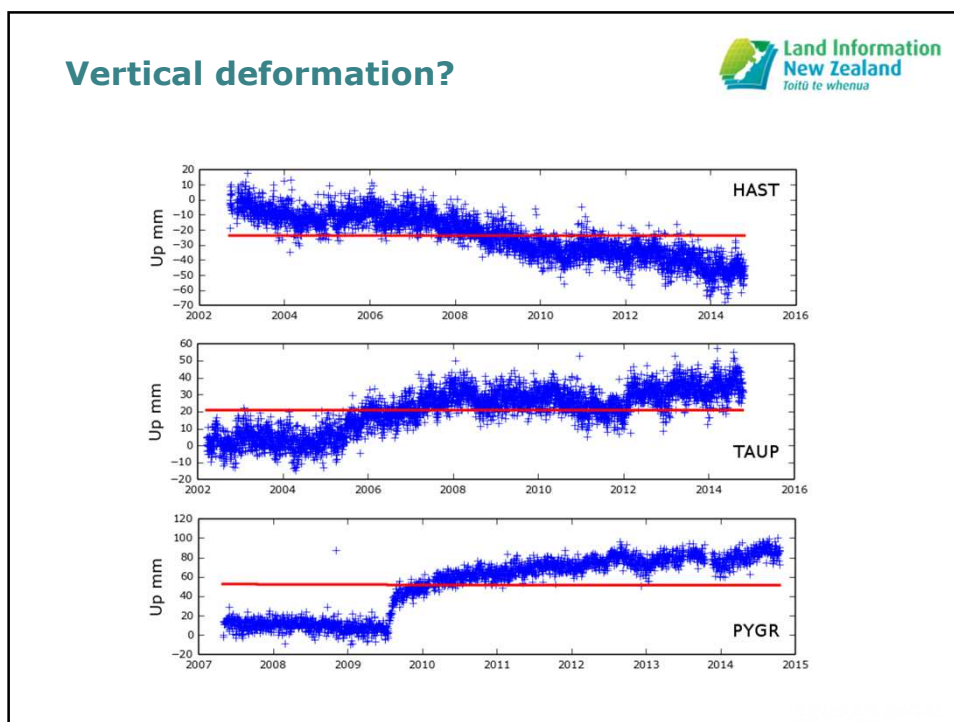
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Other sources of data – direct measurement of deformation





Take home messages

- For high accuracy scientific applications ITRFxx will be used
- NZGD2000 will remain a very useful **spatial reference frame** focused on providing a geospatial infrastructure for New Zealand geospatial community rather than a scientific geodetic datum
- NZGD2000 will continue to meet the needs of this community for the foreseeable future
 - It will be simpler to convert real time positions in terms of ITRFxx or WGS84 to NZGD2000 than to continually update geospatial datasets to track realisations of the ITRF and WGS84
 - It will be simpler to make the corrections at the positioning data source and transform them to the geospatial reference frame – NZRF2000
- Transformation of GNSS derived coordinates in terms of global reference frames (ITRF, WGS84) to NZRF2000 is time dependent and is precisely defined by the deformation model
- Future earthquakes will be addressed in NZGD2000 datum by new versions of the deformation model
- Good time/datum metadata on spatial information is essential if sub-metre spatial accuracy is a concern.
- **NZRF2000 will continue to meet the spatial community needs into the future**

