FIG WORKING WEEK 2017

Helsinki Finland

29 May - 2 June 2017

Re-establishing the geodetic system after the 14 November 2016 Kaikoura earthquake

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Surveying the world of tomorrow -
From digitalisation to augmented reality

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Key points

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- Rapidly assess earthquake impact on geodetic system
- Fast re-establishment of base level of horizontal and vertical control
- Empower surveyors to generate their own control where and when they need it

New Zealand's tectonic setting

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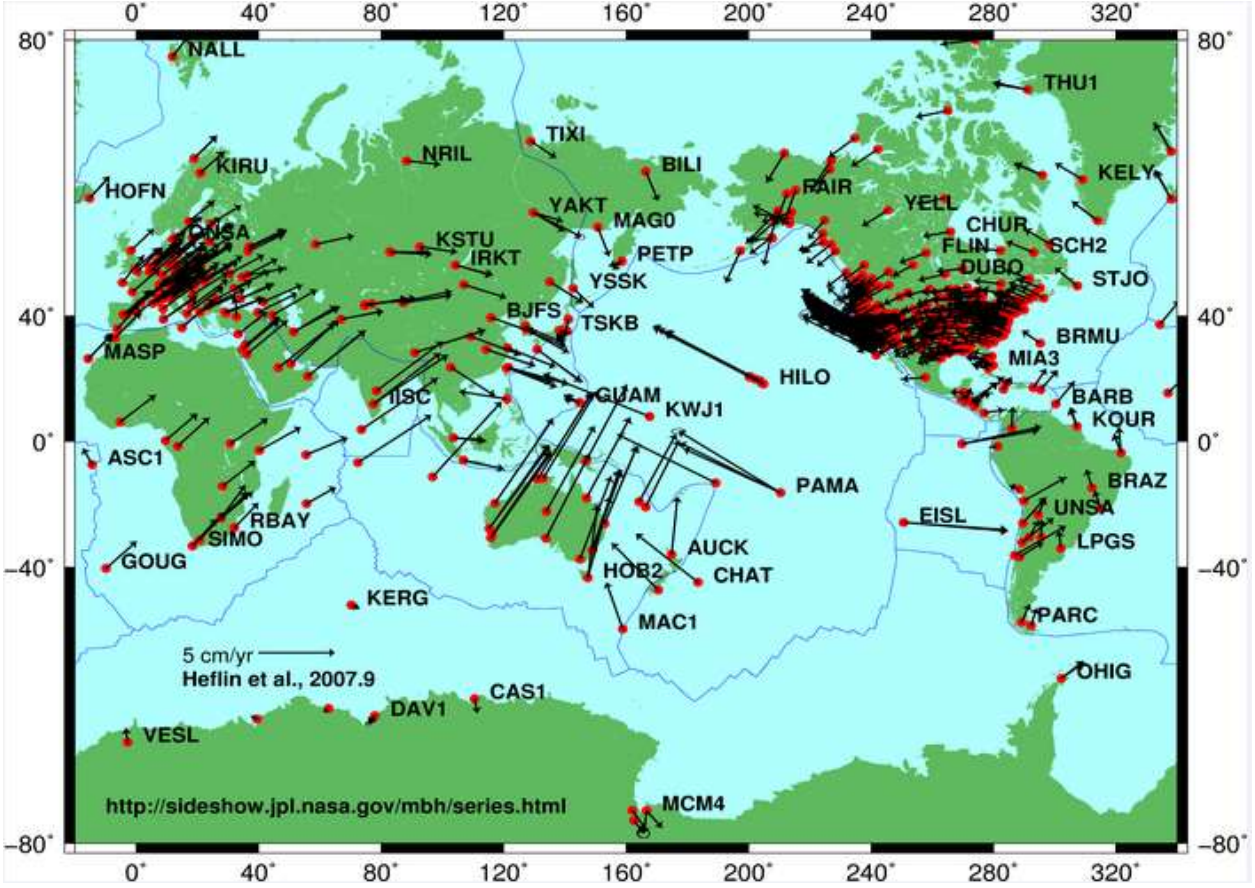

New Zealand Geodetic Datum 2000

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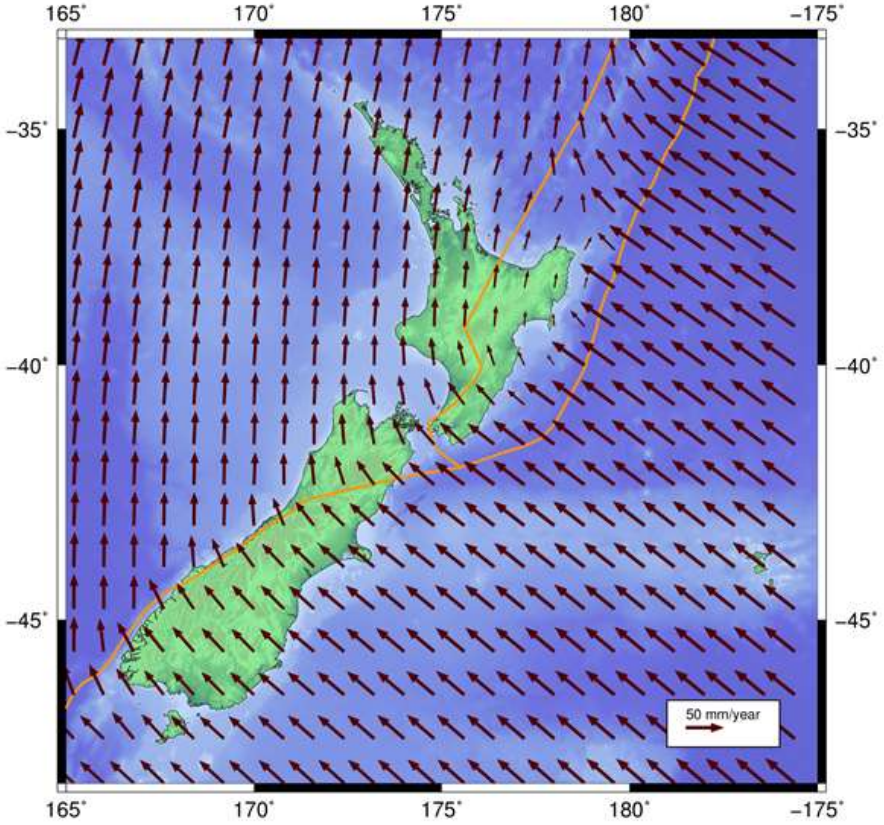
- Coordinates are fixed, except after an earthquake
- Deformation model manages tectonic movements
- New versions of deformation model published after earthquakes or when new data is available



New Zealand Vertical Datum 2016

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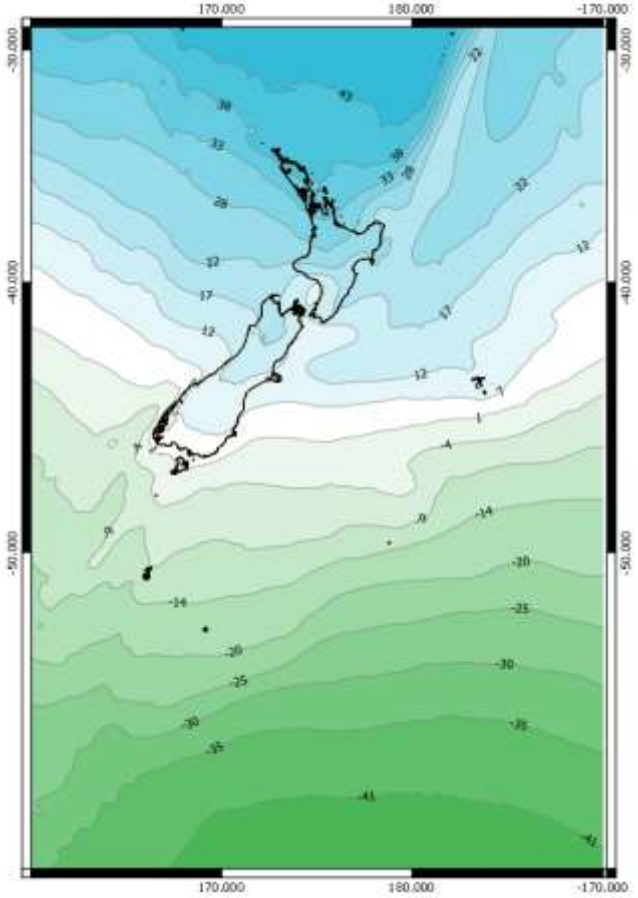
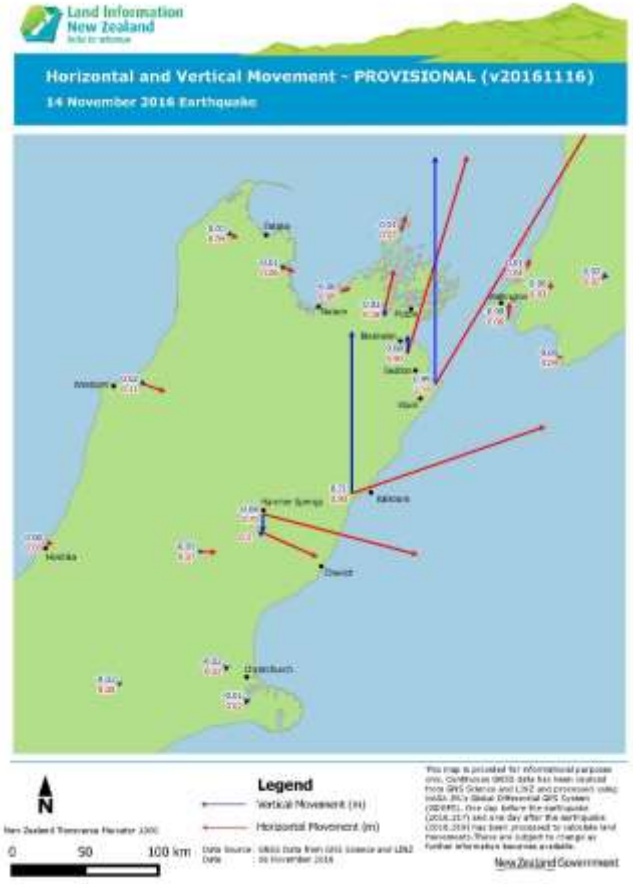
- Heights referenced to the quasigeoid
- Model provides offsets between ellipsoid and quasigeoid
- Users primarily access the datum via GNSS ellipsoidal heights

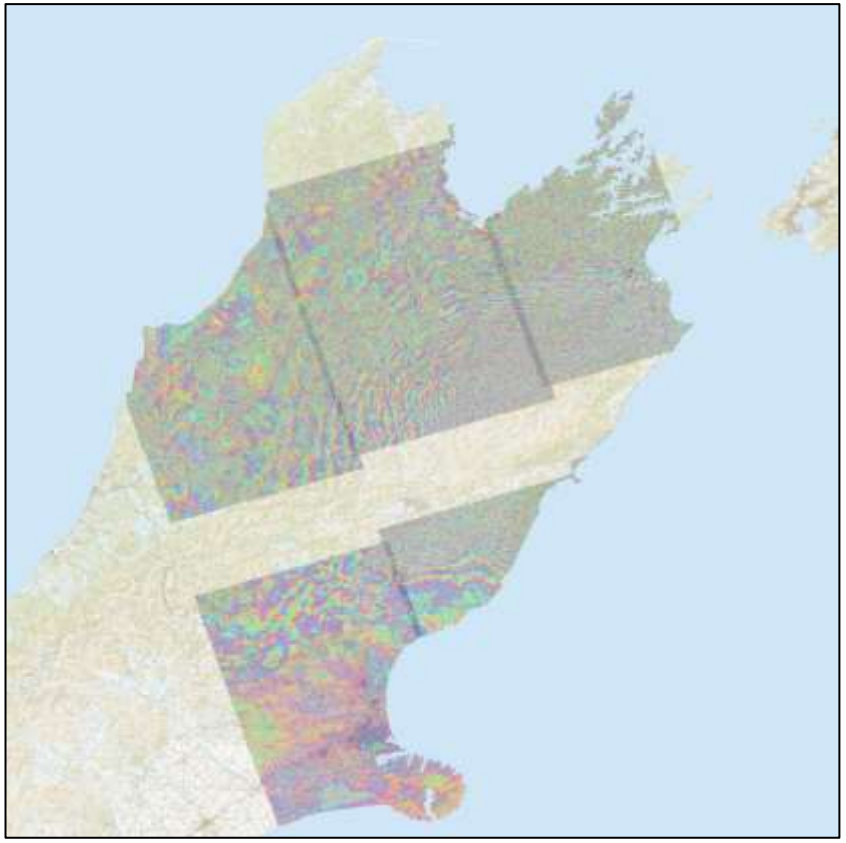


Kaikoura earthquake

- Magnitude 7.8, 14 November 2016
- Multiple faults ruptured
- Displacements exceeding 5m (horizontal and vertical)
- Serious property and infrastructure damage

Determining approximate size and extent – GNSS and InSAR





Surveying post-earthquake geodetic control

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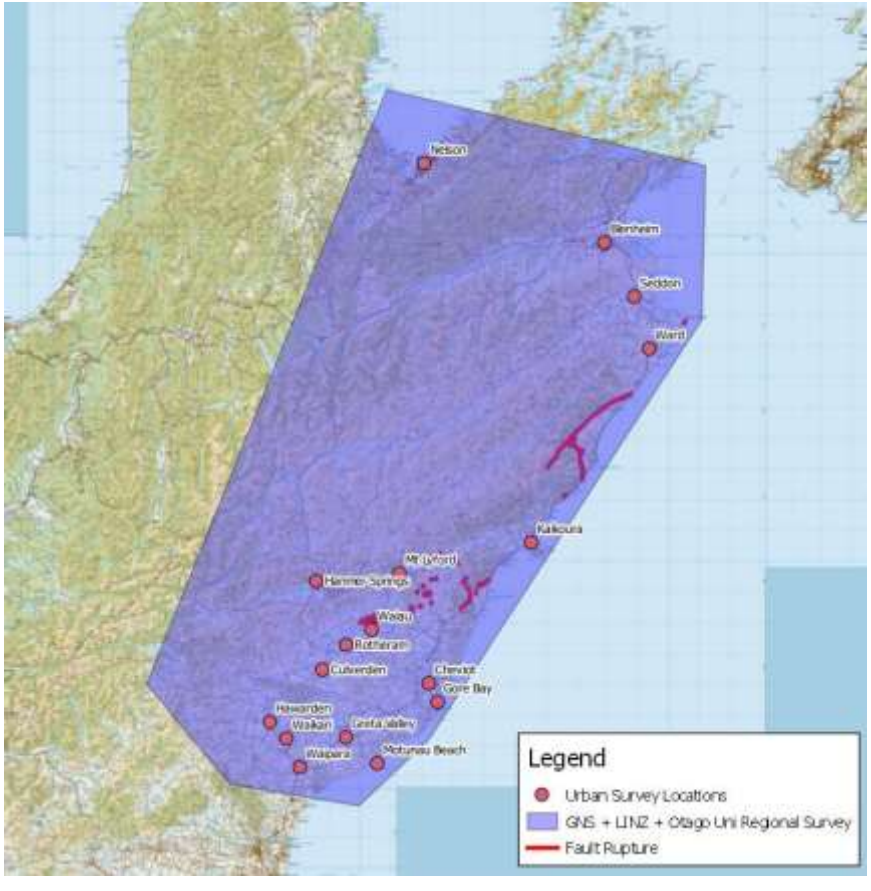
- Initial focus on existing geodetic marks in urban areas
- Objective to survey as many marks as possible in a short timeframe
- 4-hour plus 1-hour GNSS occupations at base station in each locality
- Other marks surveyed with RTK



Data processing and displacement estimates

- High-precision base station coordinates from PositioNZ-PP online processing service
- Other coordinates from RTK or fast static processing
- Displacements calculated using the SNAP least squares software

http://www.linz.govt.nz/positionzpp

Publishing post-earthquake data

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NZ Kaikoura Earthquake (14 Nov 2016) Geodetic Marks

LINZ / National Geodetic Office

Licence 354 15 Updated 25 Jan 2017

nod_id	36766080
code	APKE
mark_name	SS 388 (HENDERSON STREET)
geo_db_link	http://apps.linz.govt.nz/gdb/index.aspx?code=APKE
datum	NZGD2000
datum_version	v20160701
coord_epoch	2016-11-23 00:00:00
lat_dd	-41.504382393
lon_dd	173.972682545
lat_dms	41°30'15.77661"S
lon_dms	173°58'21.65716"E

Rev.	Published (UTC)	Features	Add	Mod.	Del.
5	25 January 2017 02:14	158	1	0	0
4	11 January 2017 21:55	157	0	0	0
3	22 December 2016 21:45	154	104	40	0
2	21 December 2016 18:02	50	0	0	0
1	8 December 2016 00:34	50	50	0	0

https://data.linz.govt.nz/layer/3527

Guidance to surveyors generating their own control in affected areas

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- Webpage set up covering:
  - Post-earthquake control survey methodologies
  - How to reference coordinates
  - Land movement maps

East and north accuracy (95% confidence level) (m)		Height accuracy (95% confidence level) (m)		Minimum distance between control marks (m)	Minimum time for each occupation (2 occupations for each mark required) (hours)	Order	
Local (vector between control marks)	*Network (coordinate in terms of PositioNZ stations)*	*Local (height change between control marks)*	*Network (height in terms of PositioNZ stations)*			*NZGD2000*	*NZVD2016*
0.010	0.005	0.015	0.010	4000	16	3	1V
0.010	0.005	0.015	0.010	1500	16	4	2V
0.020	0.015	0.030	0.020	3000	4	4	2V
0.020	0.015	0.030	0.020	300	4	5	3V
0.030	0.020	0.050	0.040	700	3	5	3V
0.040	0.030	0.060	0.050	1500	2	5	3V

Importance of metadata when the land is still moving

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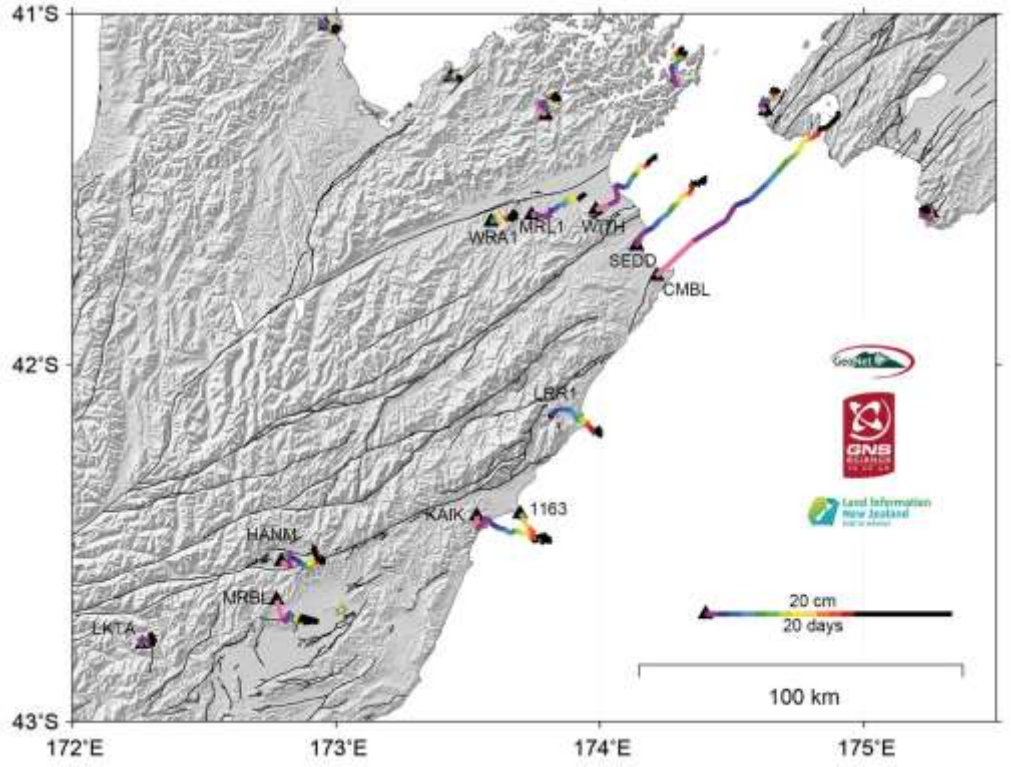
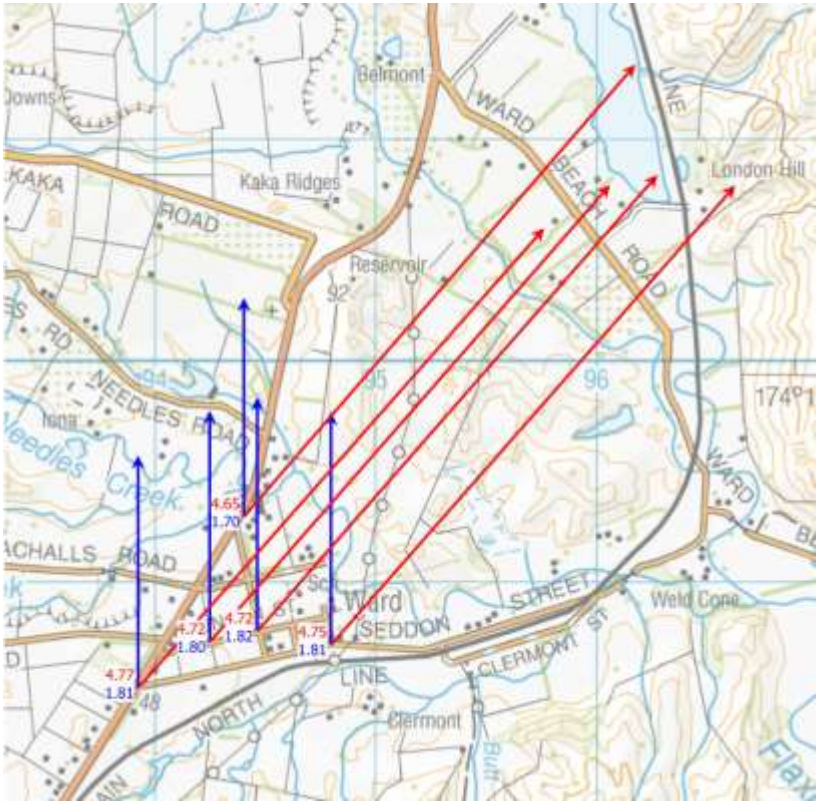
- Record the coordinate epoch (date) and datum version
  - NZGD2000 may be updated several times due to ongoing movement.
  - Coordinate epoch is important as there is significant ongoing movement – coordinates will change



Next steps – deformation modelling and coordinate updates

- Geophysical model provided by GNS Science (New Zealand's geoscience research agency)
- LINZ incorporating model into datum and assessing impact on coordinates, which will flow to other geospatial data
- Surveys and possibly deformation model updates will be ongoing



Summary

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- Rapidly assess impact on geodetic system
- Fast re-establishment of base level of horizontal and vertical control
- Empower surveyors to generate their own control where and when they need it

the power of where drives NZ's success

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Questions?