New Zealand Reference Frame Case Study

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Land Information New Zealand

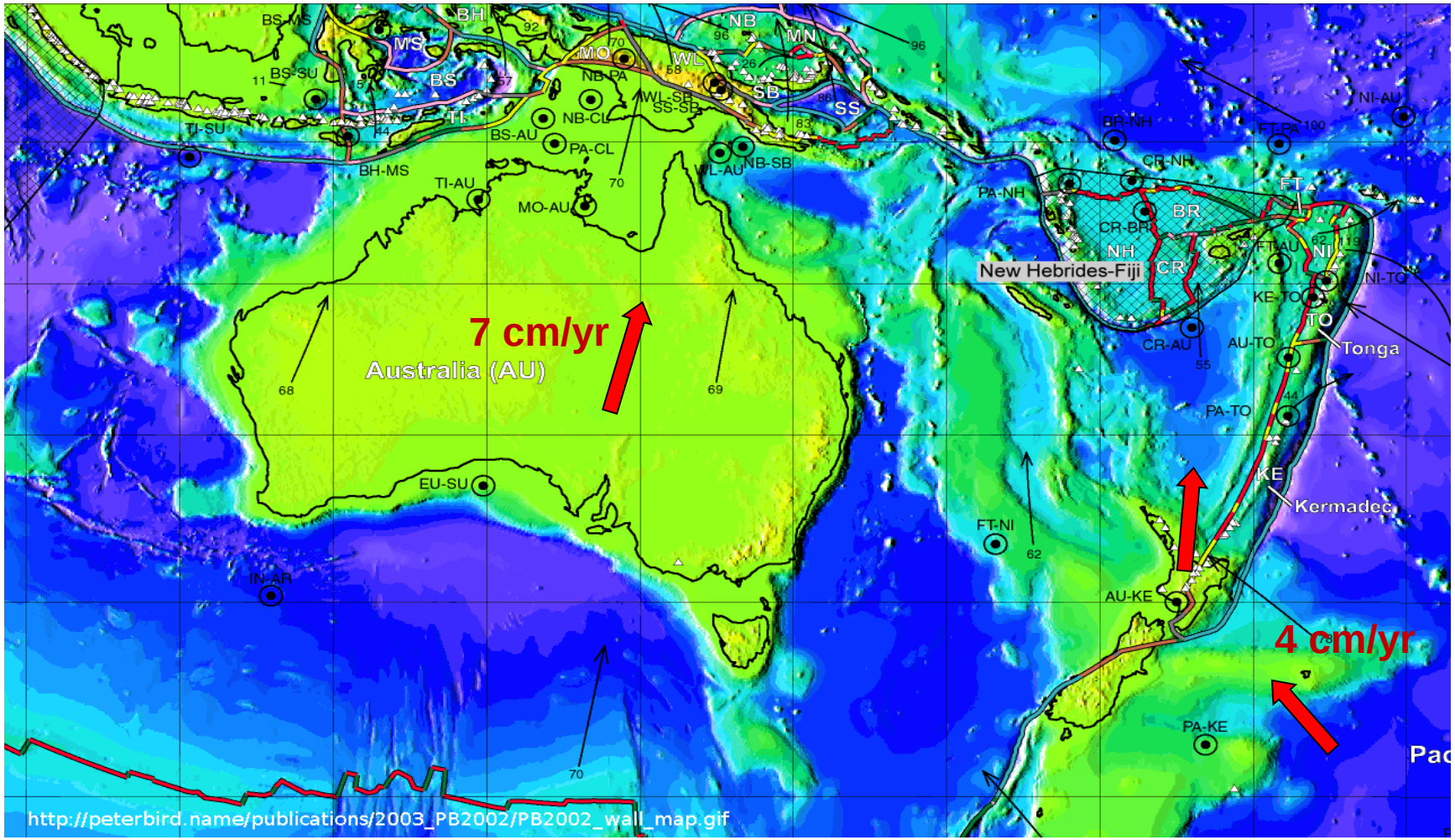
Fundamental role of the reference frame

Requirements of a National Reference System

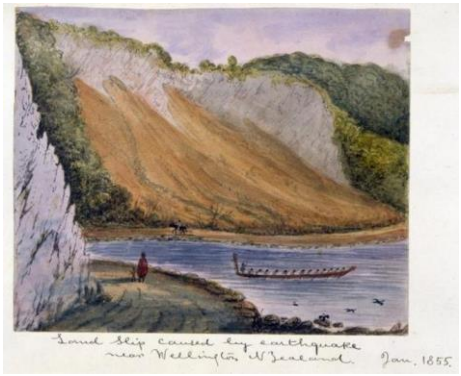
- A coordinate framework that is **accurate, stable, reliable and accessible**
- Direct **linkage** to International Reference Frames
- **Simple** for users to connect to and use
- **Physical infrastructure** may include GNSS CORS and traditional geodetic survey marks
- Systems and tools to allow connection to the coordinate reference system and **transformation** of legacy data to the current reference system

- **Tectonic setting**
- **Geodetic datum**
  - NZGD2000
  - PositioNZ
  - Deformation models
- **Vertical datum**
  - NZVD2016

Tectonic setting of New Zealand



Significant historic earthquakes



West Wairarapa 1855

Napier 1931

Edgecumbe 1987

Murchison 1929

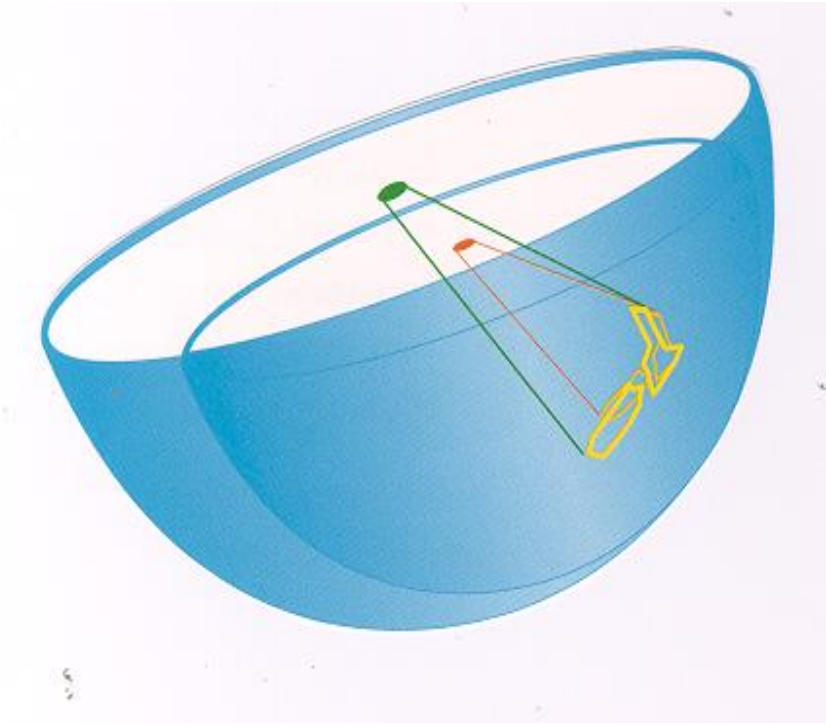
Inangahua 1968

Christchurch 2011

Introduction of NZGD2000

1998 – NZ introduced NZGD2000 (ref epoch 1 Jan 2000)

- geocentric origin
- aligned with the ITRS
- ITRF96 with epoch 2000.0 coordinates



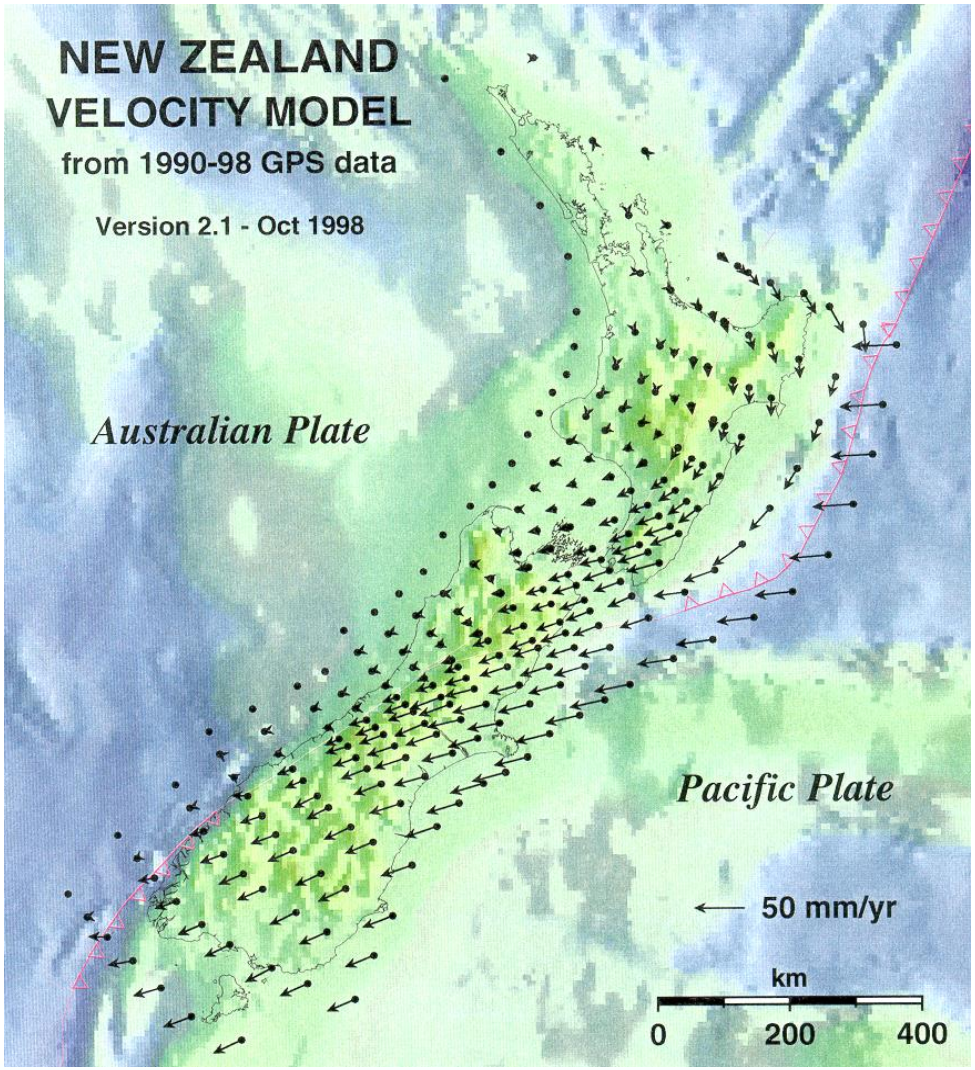
NZGD2000 - semi-dynamic datum

- generalised motion of points modelled using a deformation model

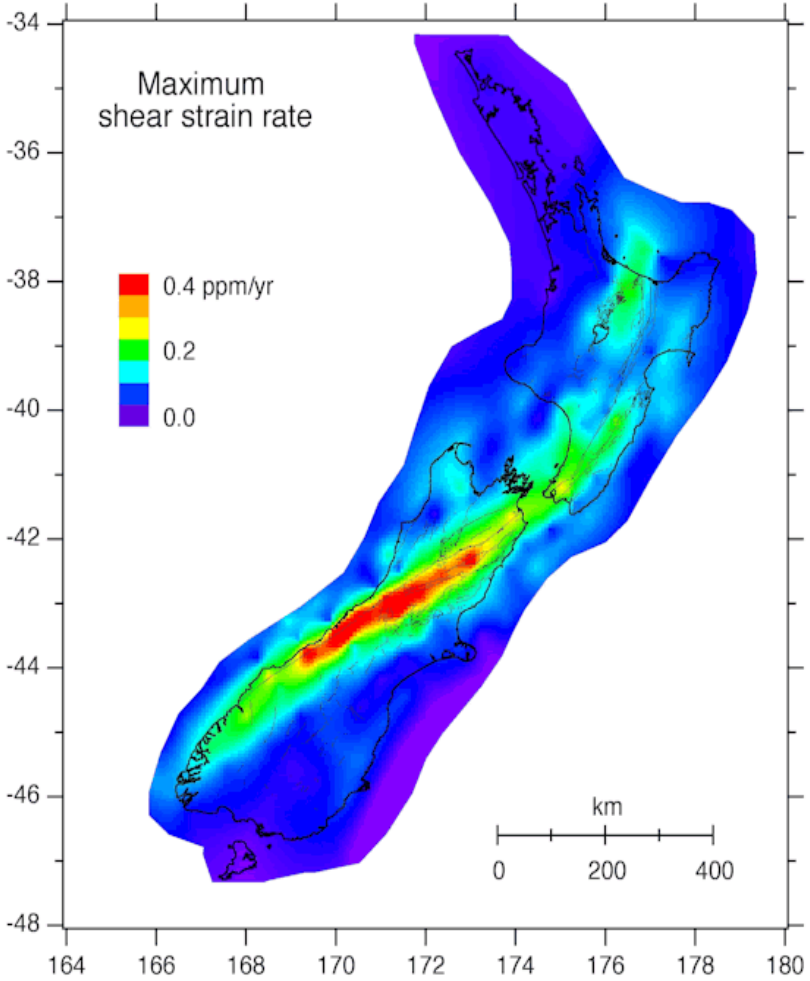
Introduction of NZGD2000

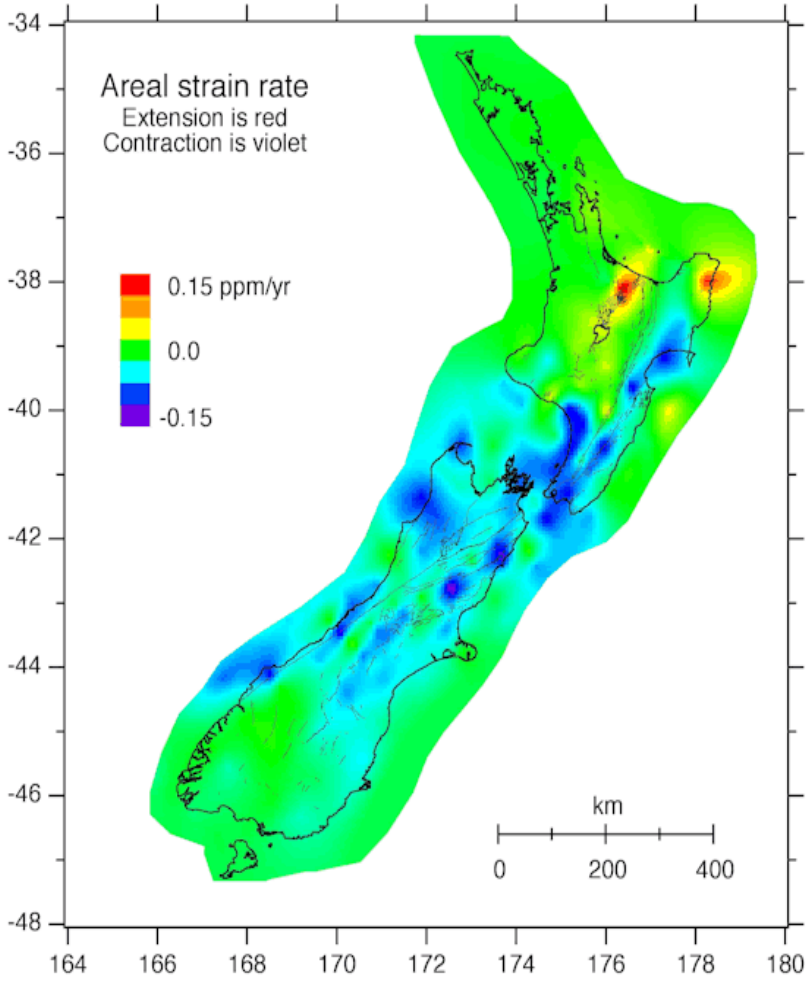
Semi-dynamic datum

- current deformation model has horizontal constant velocities only
- initially generated using repeat surveys between 1992 and 1998
- enables propagation of coordinates and observations between reference epoch and observation epoch
- for many uses has the **appearance of a static datum**

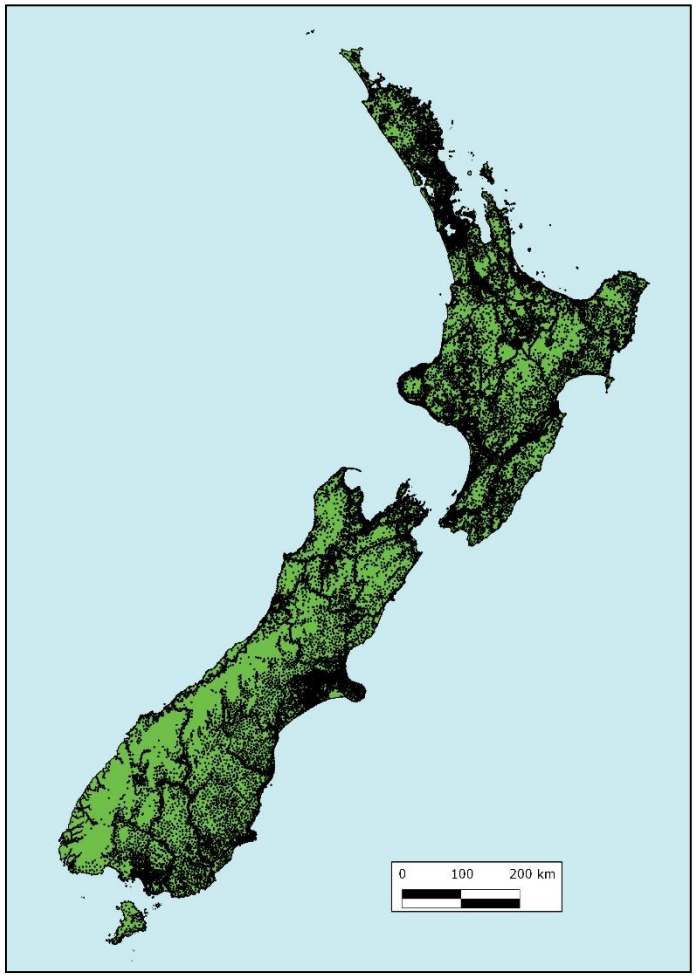


Measuring deformation - strain



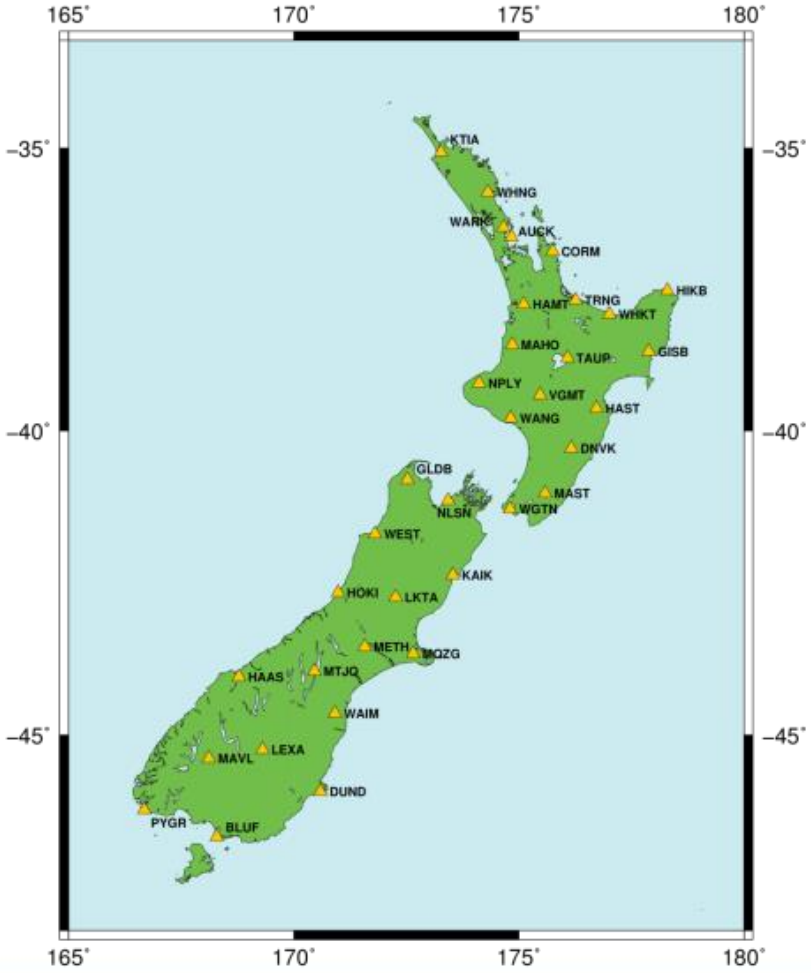


Connecting to the datum



100,000+ control marks

Connecting to the datum



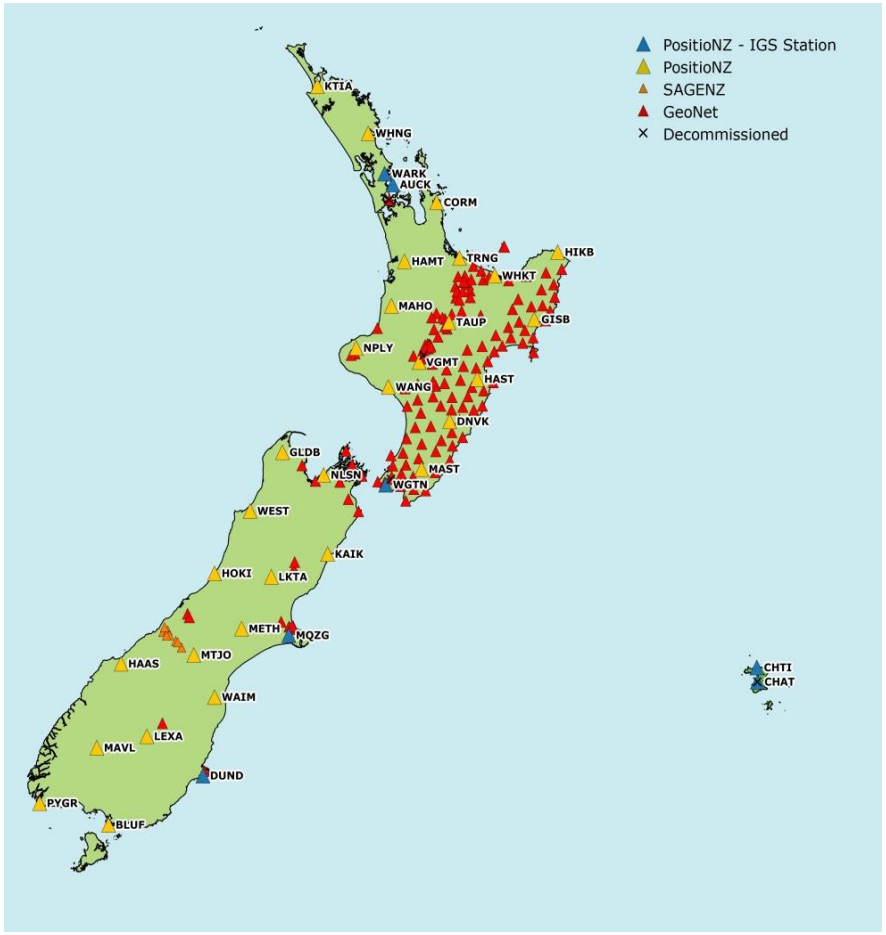
PositioNZ Network

35 on the mainland of NZ

1 on the Chatham Islands

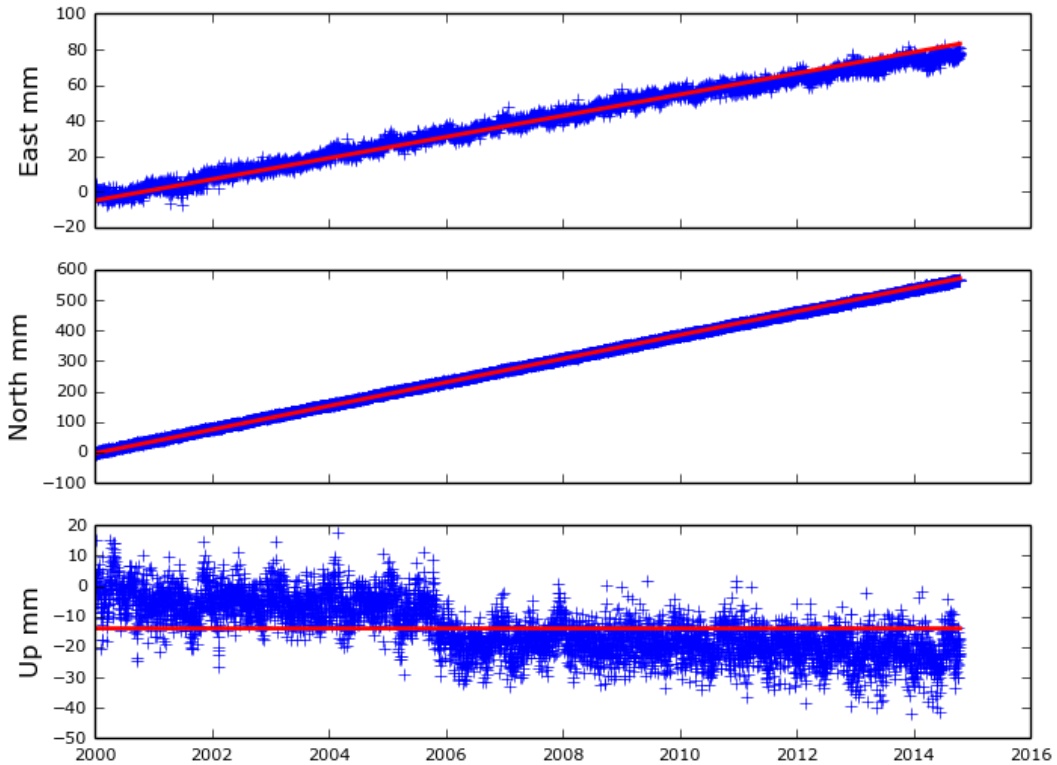
3 in Antarctica

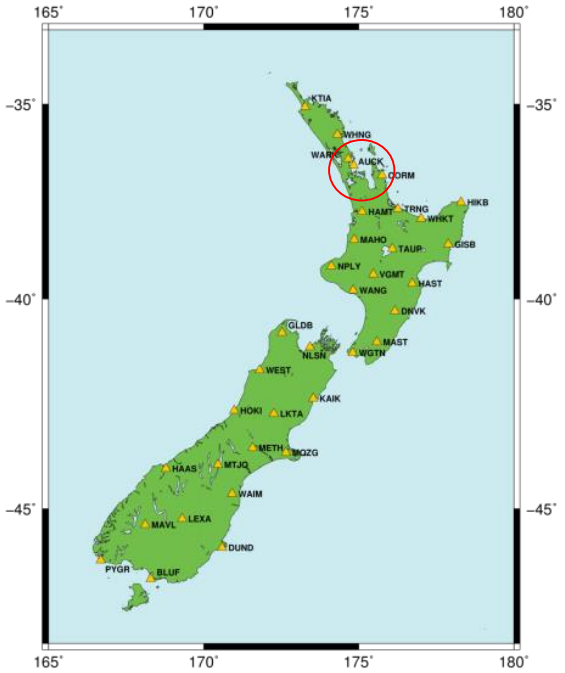
GEONET


PositioNZ - IGS Station
PositioNZ
SAGENZ
GeoNet
Decommissioned
KTIA
WHNG
WARK
AUCK
CORM
HAMT
TRNG
HIKB
WHKT
MAHO
TAUP
GISB
NPLY
VGMT
HAST
WANG
DNVK
GLDB
NLSN
MAST
WGTN
WEST
KAIK
HOKI
LKTA
METH
MQZG
MTJO
HAAS
WAIM
LEXA
MAVL
DUND
PYGR
BLUF
CHTI
CHAT

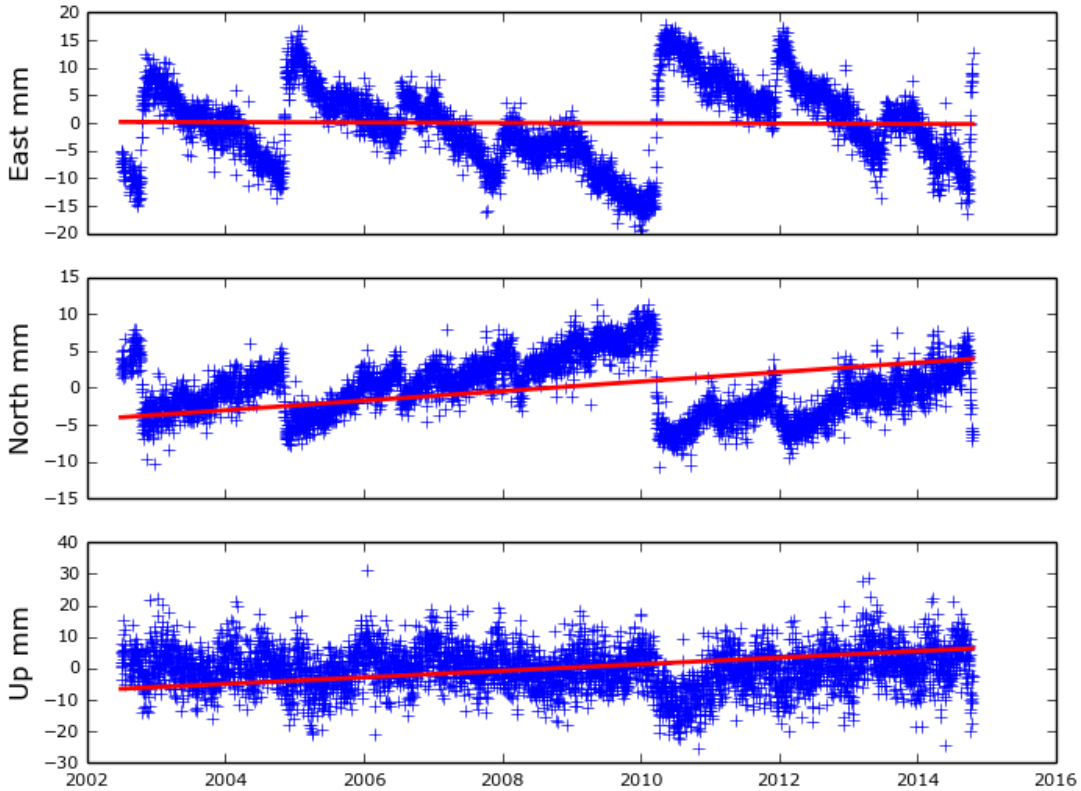

PositioNZ
GeoNet

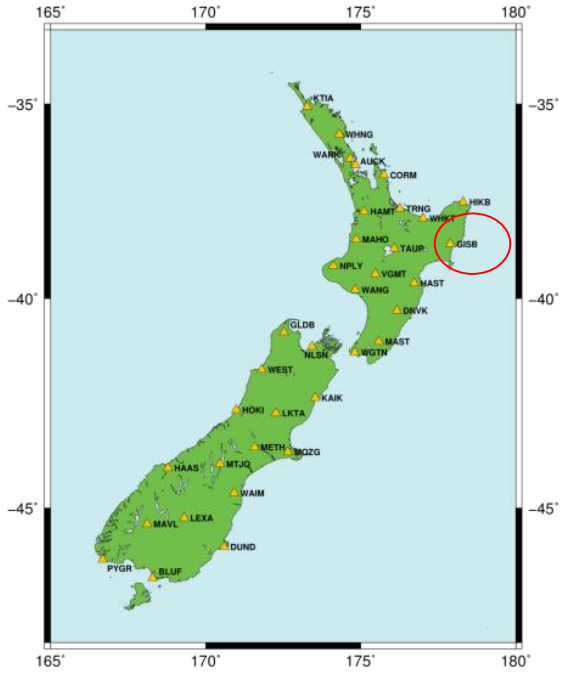
Auckland - stable



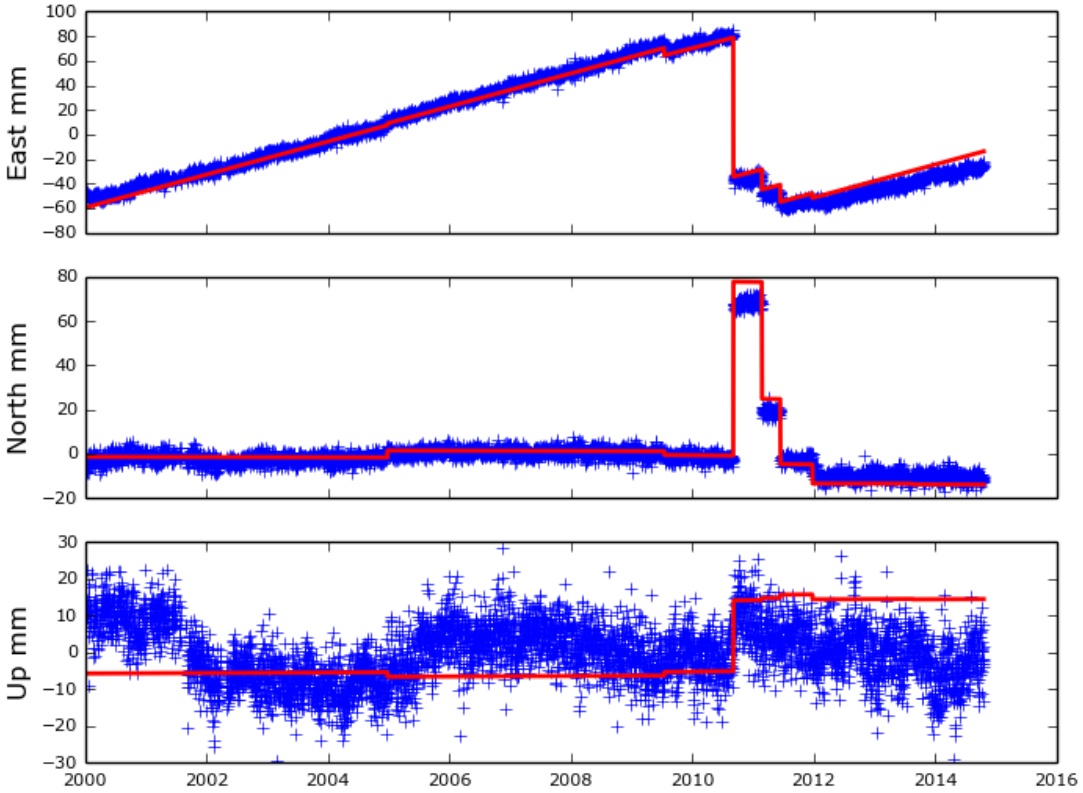


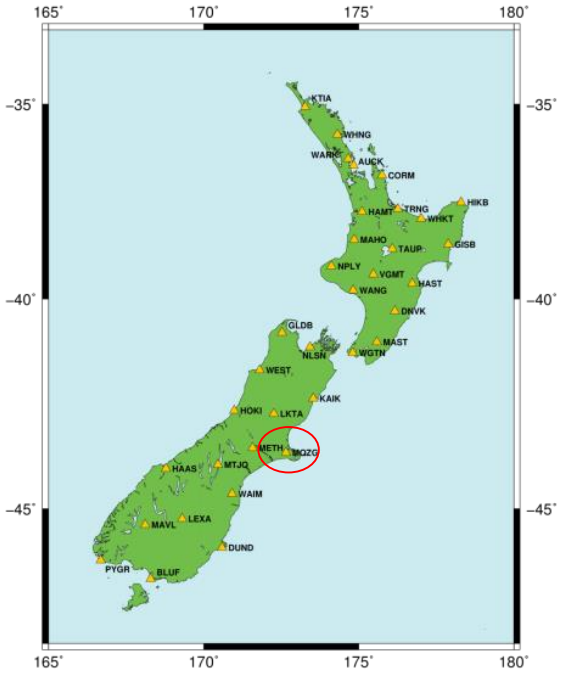
Gisborne – slow earthquakes



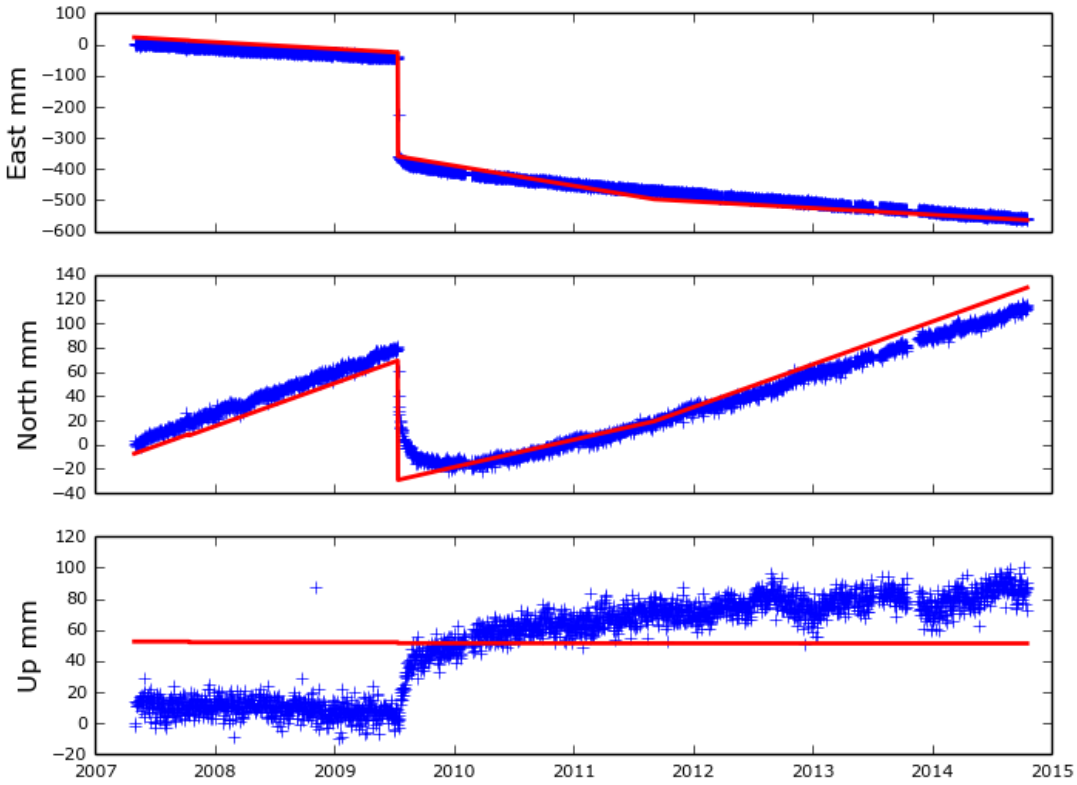


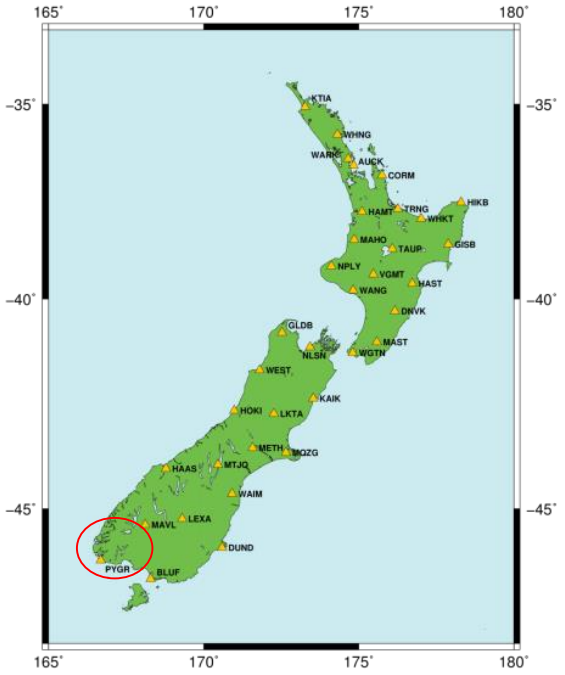
Christchurch – Canterbury earthquakes





Fiordland postseismic recovery



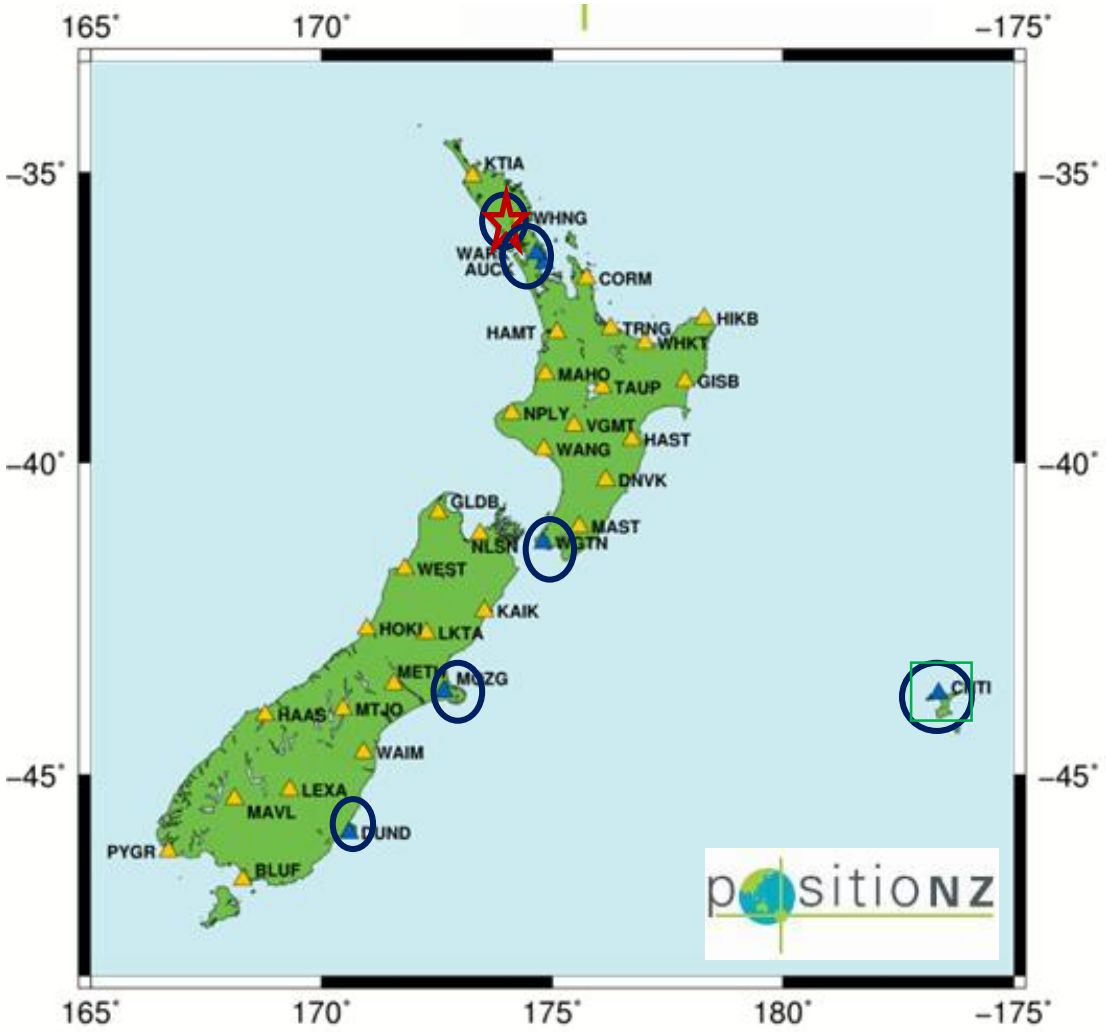


Contribution to ITRF

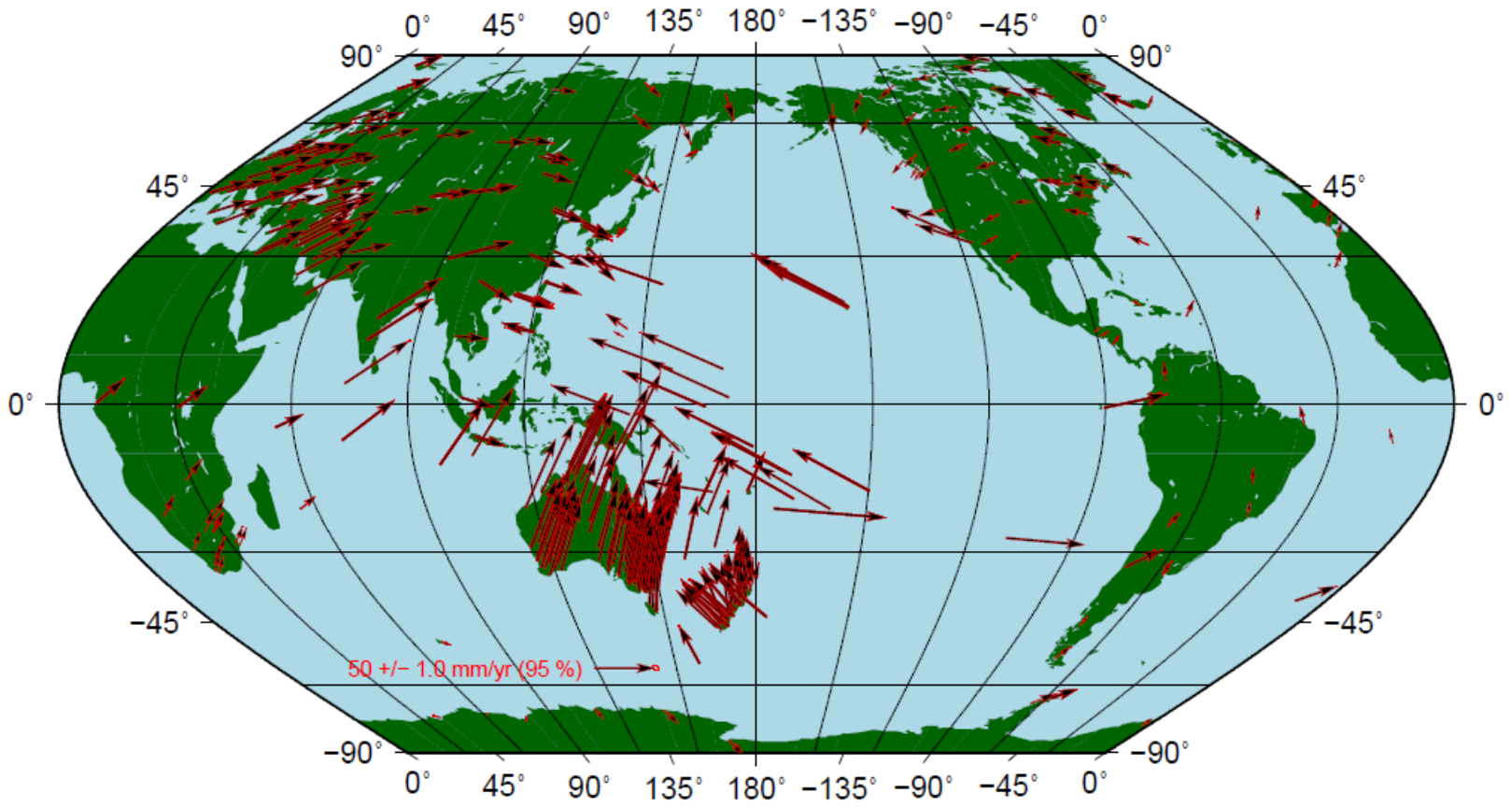
CORS

VLBI

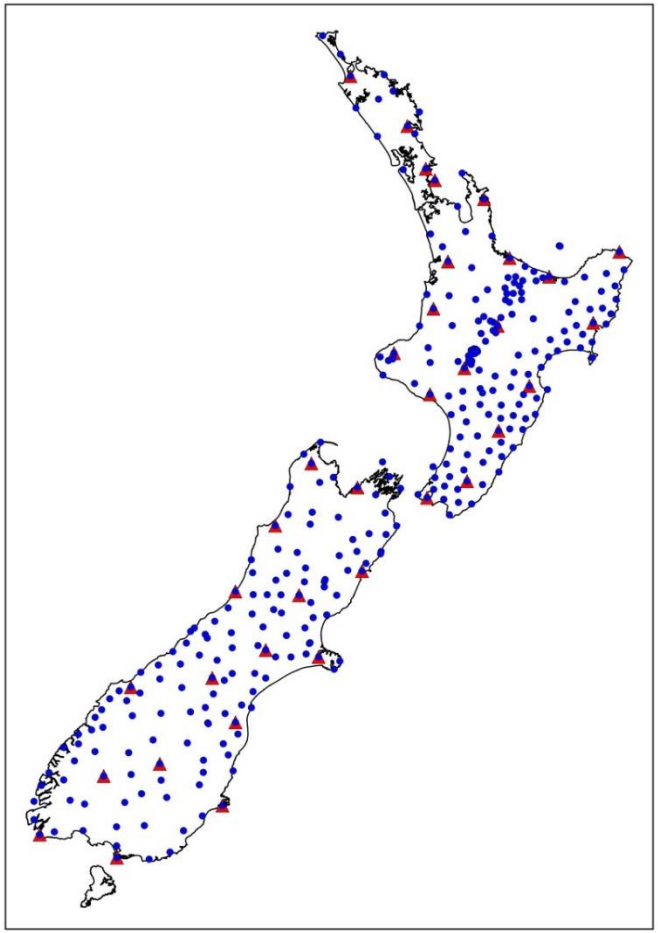
DORIS



Contribution to Asia Pacific Reference Frame (APREF)

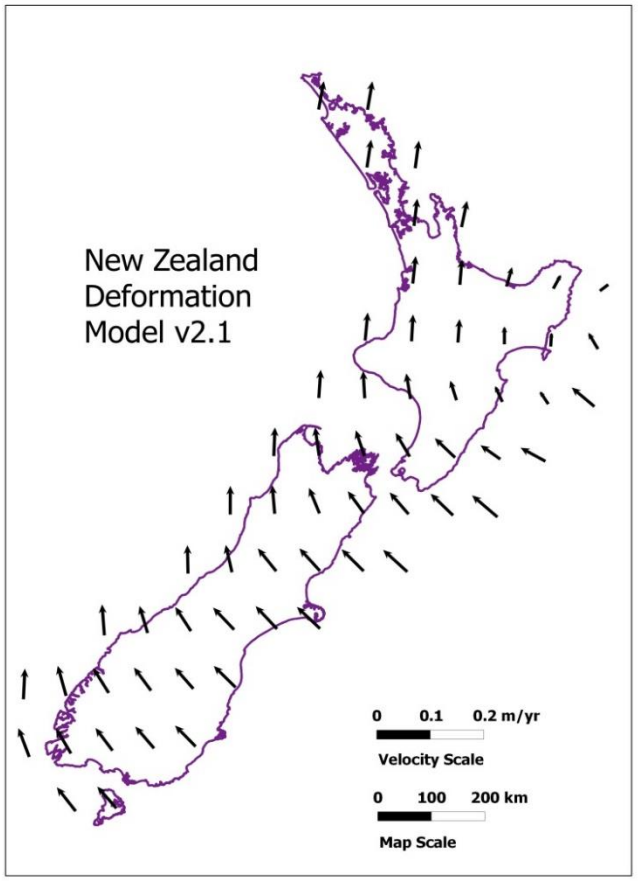


National deformation monitoring network



National Deformation Monitoring Network (NDMN),
- campaign stations measured every 8 years.

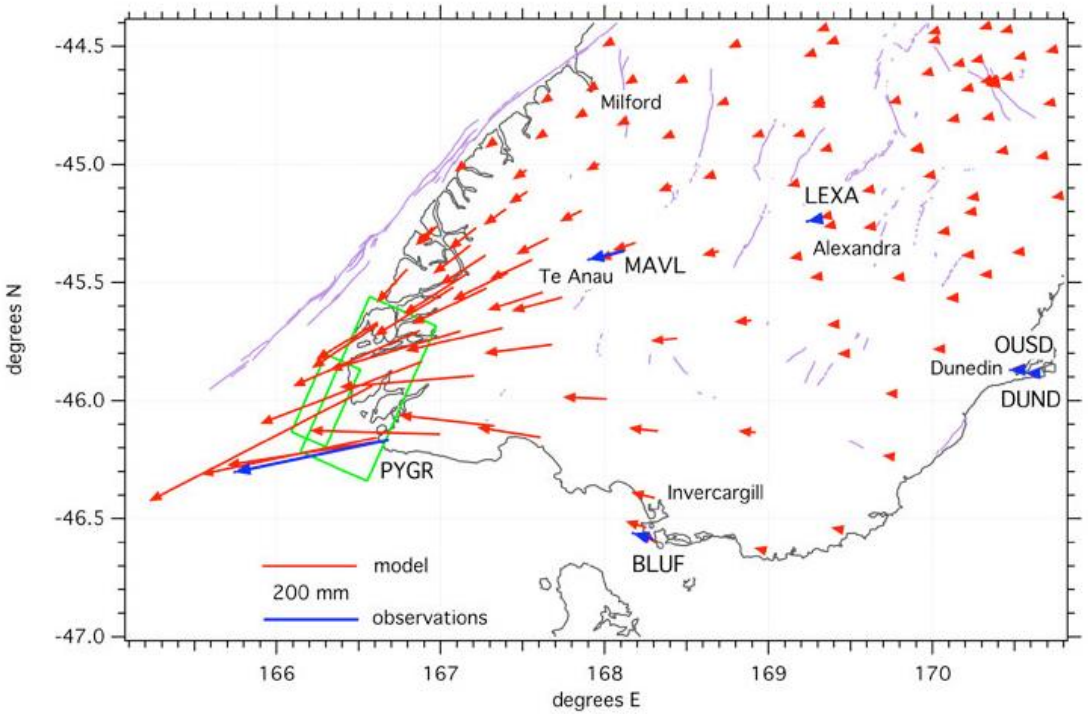
Enhancing the Deformation Model

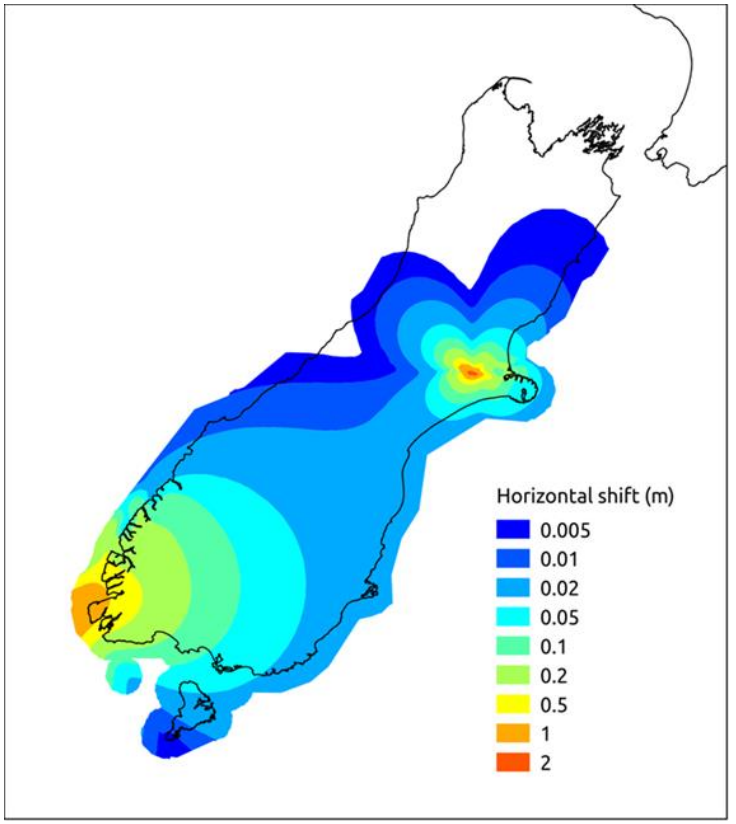


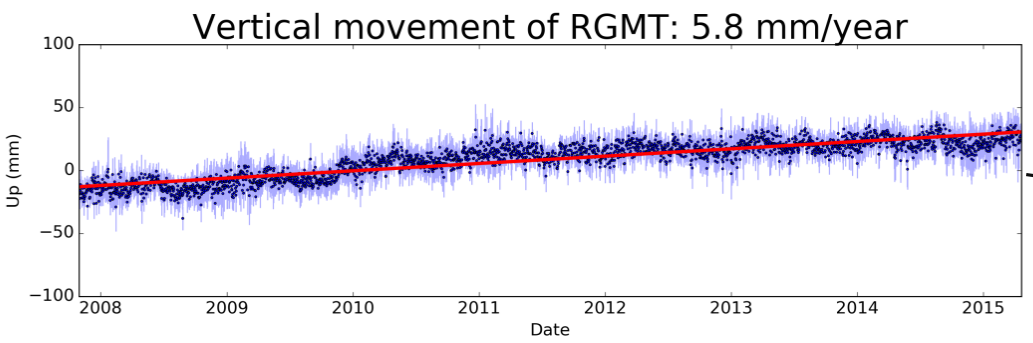
Horizontal model only

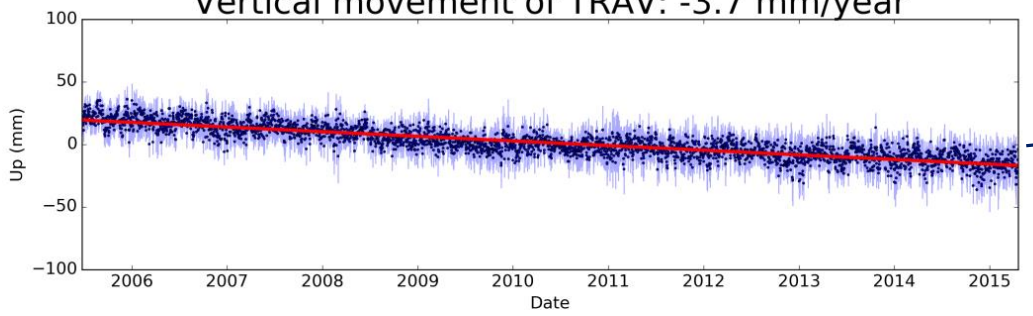
Continuously updated and refining

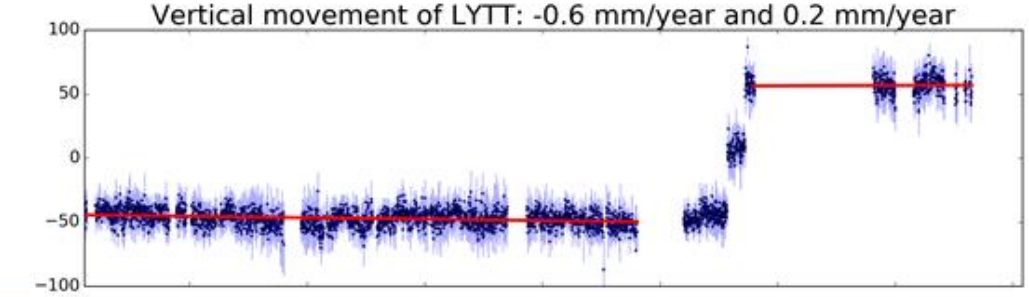
Adding patches

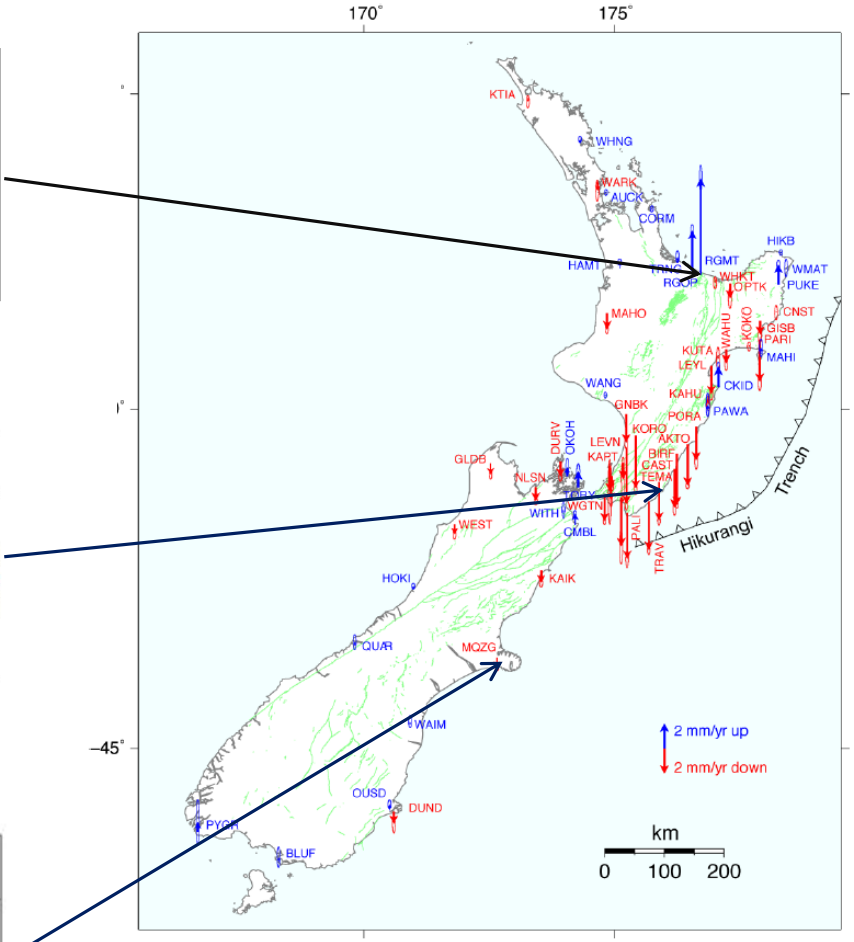












Beavan, R.J.; Litchfield, N.J. 2012. Vertical land movement around the New Zealand coastline: implications for sea-level rise, *GNS Science Report* 2012/29

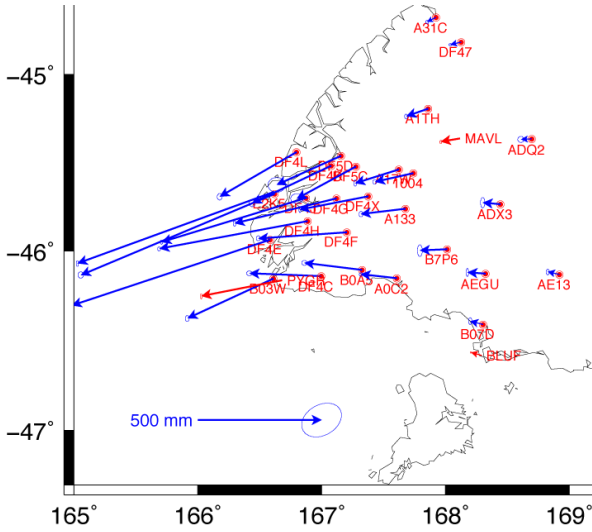
Where are we at

What has gone well

- Good user acceptance
- The incorporation of a deformation model in NZGD2000 has enabled the life of the datum to be lengthened and new observations to be integrated with old observations
- Accuracy of datum has been maintained
- Alignment of new and old geodetic data through a single national adjustment

Issues

- Managing the deformation model
- Accuracy of deformation model versus CORS real time positions
- Managing the spatial alignment of the cadastral system



New Zealand Vertical Datum 2016

- Published in June 2016
- Based on NZGeoid2016
- 3 cm nominal accuracy
- Transformation surfaces to local datums