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Madrid, Spain

Warkworth geodetic station as a potential GGOS core site in New Zealand

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New Zealand

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Contents

- Recent activities of AUT
  - *IVS, 30m antenna, SKA, Geodetic experiments*
- Contribution of Warkworth
  - *New Zealand geodesy*
  - *GGOS project*
- Improving the estimation of the ocean tide loading displacement at Warkworth

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Recent activities of AUT 1/4

WARK12M

- Ww 12m radio telescope
  - Launched on October, 2008
  - Participate in the global IVS sessions regularly since the beginning of 2011

http://www.hat-lab.com/, http://www.haystack.mit.edu/
http://www.symmetricom.com/

We appreciate IVS and the related institute's cooperation

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Recent activities of AUT 2/4

- 30m Antenna
  - November 2010, Telecom NZ handed over a 30m antenna to AUT
  - Manufactured in 1984 by NEC
  - Located 200m north of WARK12M
  - Conversion to Radio Telescope: Installation of drive and RF systems

for Astronomy and Geodesy

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Recent activities of AUT 3/4

- Big Step Forward for the SKA

5,500 km

http://www.ska.gov.au/

July 2011
Successful demonstration of real time eVLBI between WARK12M and Australian telescopes

Sustained data rates of **520Gb/s**

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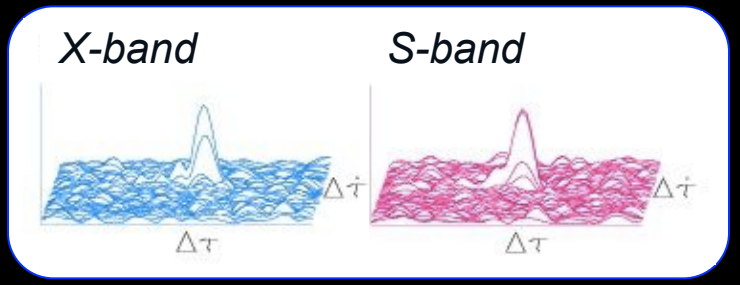
Recent activities of AUT 4/4

- Establishment of the geodetic experiment environment
  - Ultra-rapid EOP measurement



Correlation processing
Bandwidth synthesizing
Data analysis

Baseline length
Ww-Ts 8,105 km
Ww-K1 8,075 km

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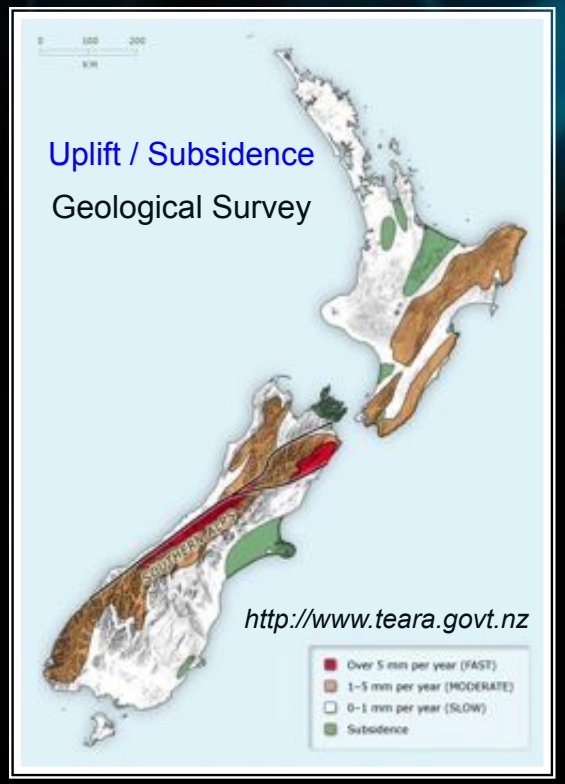
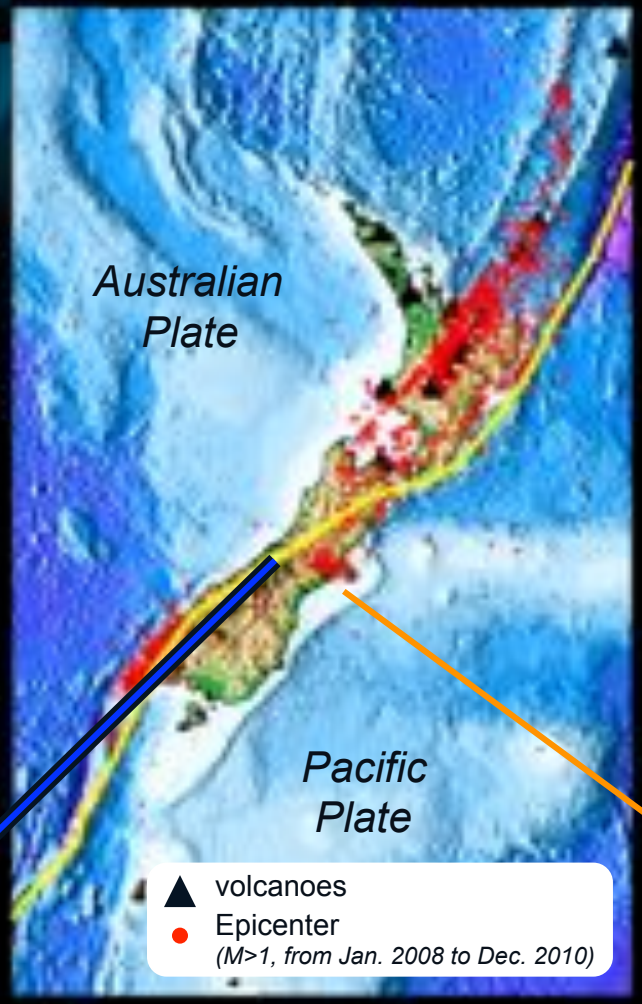
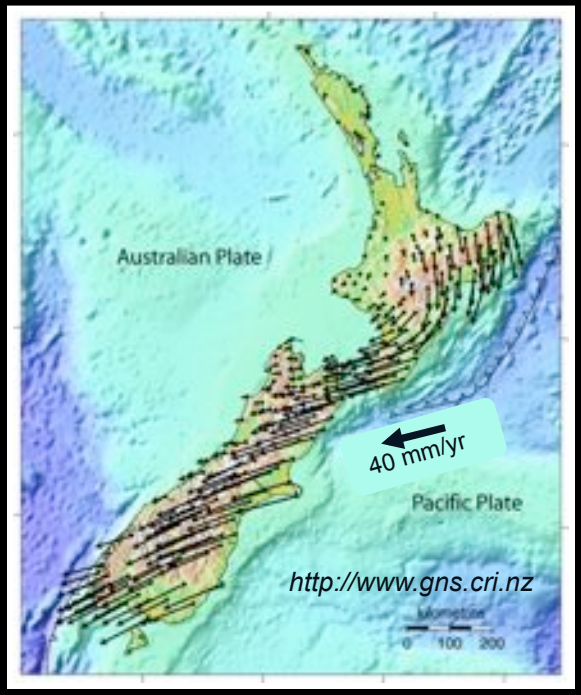
Crustal deformation in NZ



Uplift @Southern Alps
5 ±0.6 mm/year



Tectonic plate motion
30 – 50 ±0.4 mm/year



22 Feb, 2011
Canterbury earthquake

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Space geodesy @ NZ

- before launch of VLBI
  - only GNSS

- **PositioNZ** by *LINZ (Land Information New Zealand)*
  - about 30 (2:Chatham Islands, 3: Antarctica)
  - Geodetic system, NZGD2000, surveying, mapping

Land Information New Zealand
Toitū te whenua

- **GeoNet** by *Earthquake Commission & GNS Science*
  - to monitor earthquakes, volcanic unrest, land deformation, geothermal activity and tsunami
  - seismometer, accelerometer, tide gauge, sea level pressure
  - GPS : active volcanic zone, over 100

GNS SCIENCE TE PŪ AO

Synergy of VLBI and GNSS

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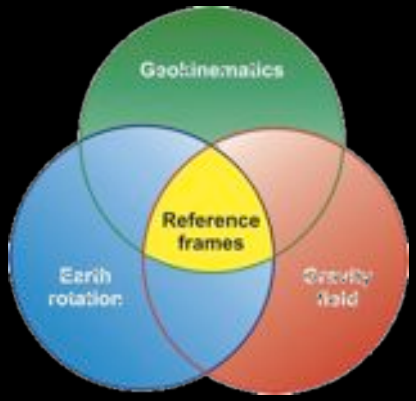
Global Geodetic Observing System

- GGOS aims:
  1) accuracy of < **1 mm** for position
  2) accuracy of < **0.1 mm/yr** for velocity
  - by using and integrating advanced geodetic observing techniques



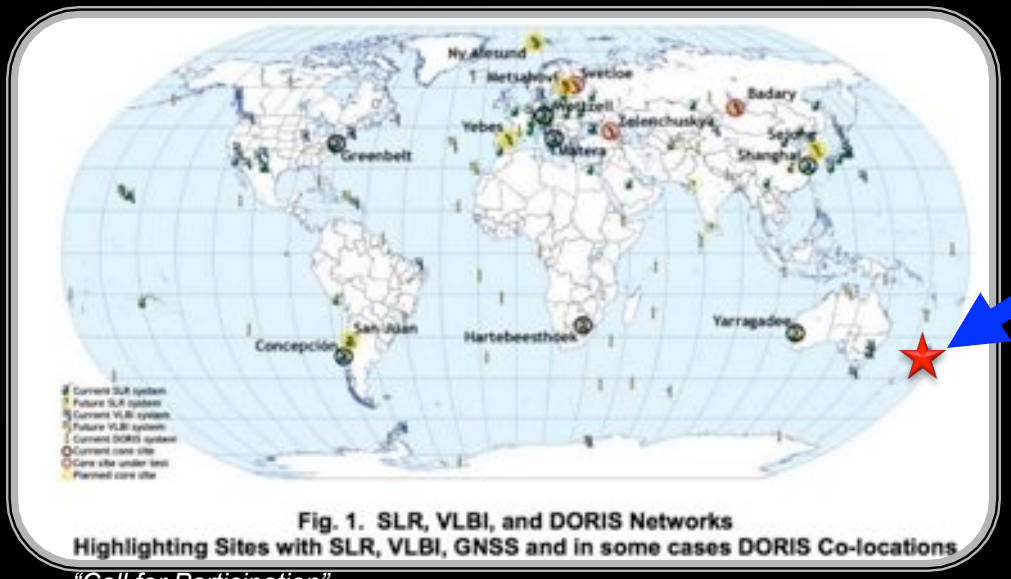


Fig. 1. SLR, VLBI, and DORIS Networks
Highlighting Sites with SLR, VLBI, GNSS and in some cases DORIS Co-locations

"Call for Participation"

Warkworth

has capability to became a core site

Important contribution to geometrical distribution

Ww contribute to NZ geodesy
⟷ Ww become a core site

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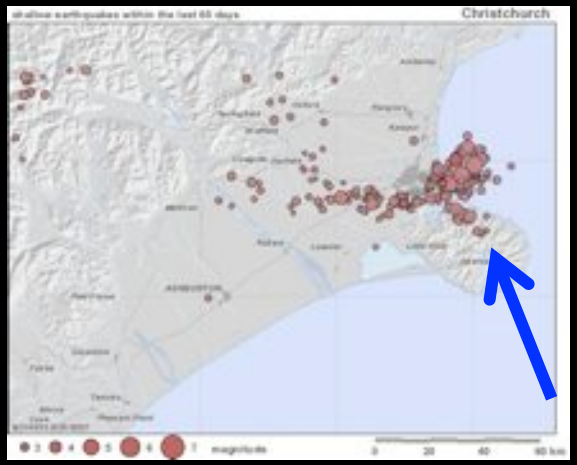
Gravity measurement in NZ

- There are no **Absolute Gravimeters** or **Superconducting Gravimeters**
  - Observation
    - Christchurch
    - Southern Alps



http://www.gns.cri.nz/

only South Island
the gravity value should change

Absolute gravity base station
must be in **North Island**
- monitoring : volcano, uplift, etc.
- continuous measurement
- co-located
  multiple geodetic techniques

http://www.microglacoste.com/

http://www.gwrinstruments.com/

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dream

A plan about contribution of Ww

- Fundamental geodetic station
  - Ww has 2 of the 4 space geodetic techniques
  - Local Survey Ground Monuments

2nd GNSS at Ww

SLR station

Gravity base station
AG or SG

2nd VLBI station
with GNSS
in the South Island

ⓘ *This is not a plan with the guarantees of the budgets yet.*

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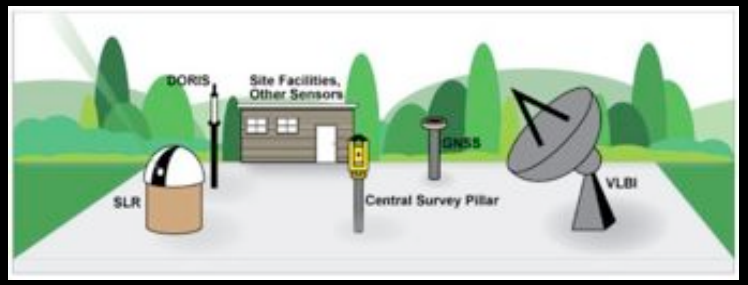
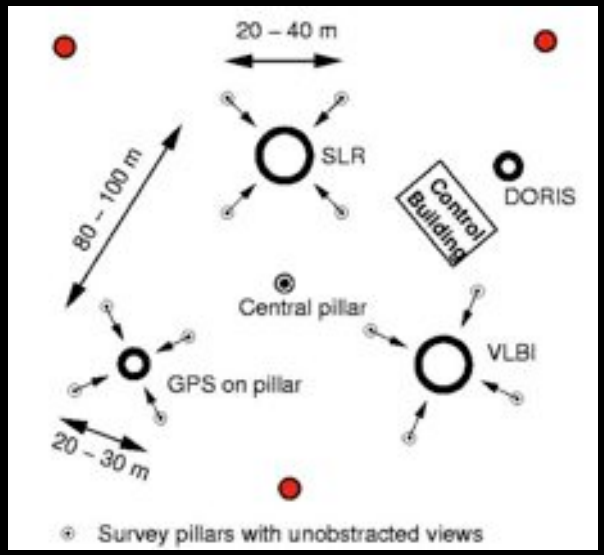
To make a core site

- Stable results
  - Make an appropriate model
    - atmospheric delay
    - *Ocean Tide Loading*
    - environmental loads, etc
  - assistance observation
    - Groundwater,
      Soil moisture, etc.
  - Cooperation with other institutes
    - periodical local survey
      - to realize the local tie between VLBI and GPS
      - LINZ and GNS Science





"Site Requirements for GGOS Core Sites"

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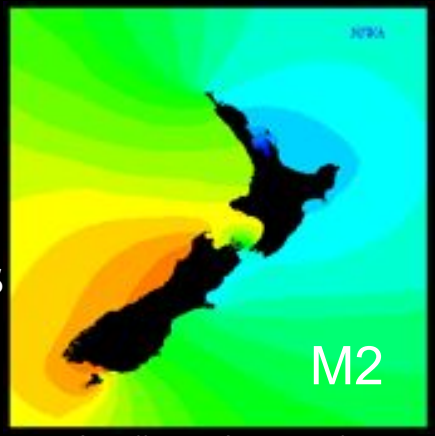
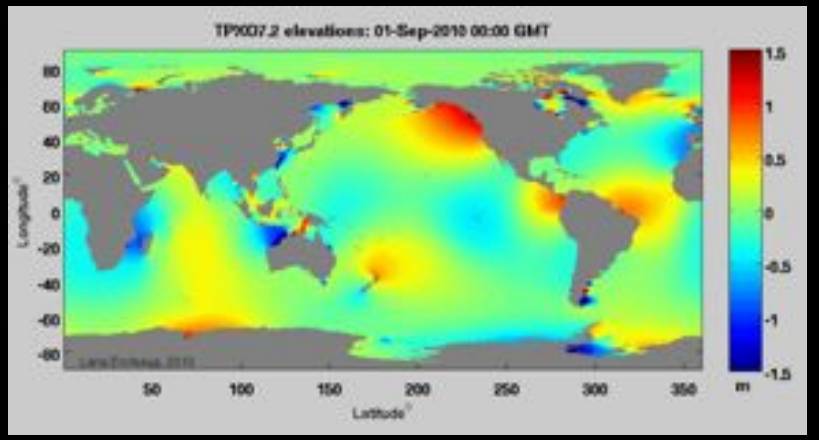
Ocean tide loading displacement

- To compute the OTL displacement
  - given *site-dependent tidal coefficients*
  - 342/141 constituent tides
    - spline interpolation based on 11 main tides
- To calculate site-dependent tidal coefficients
  1. global OTL model
  2. Green's function
  3. *land-sea grid*
  4. Convolution [Farrell, 1972]



http://www.niwa.co.nz/



http://volkov.oce.orst.edu/

Onsala Space Observatory
- Ocean Tide Loading provider

http://froste.oso.chalmers.se/loading//index.html

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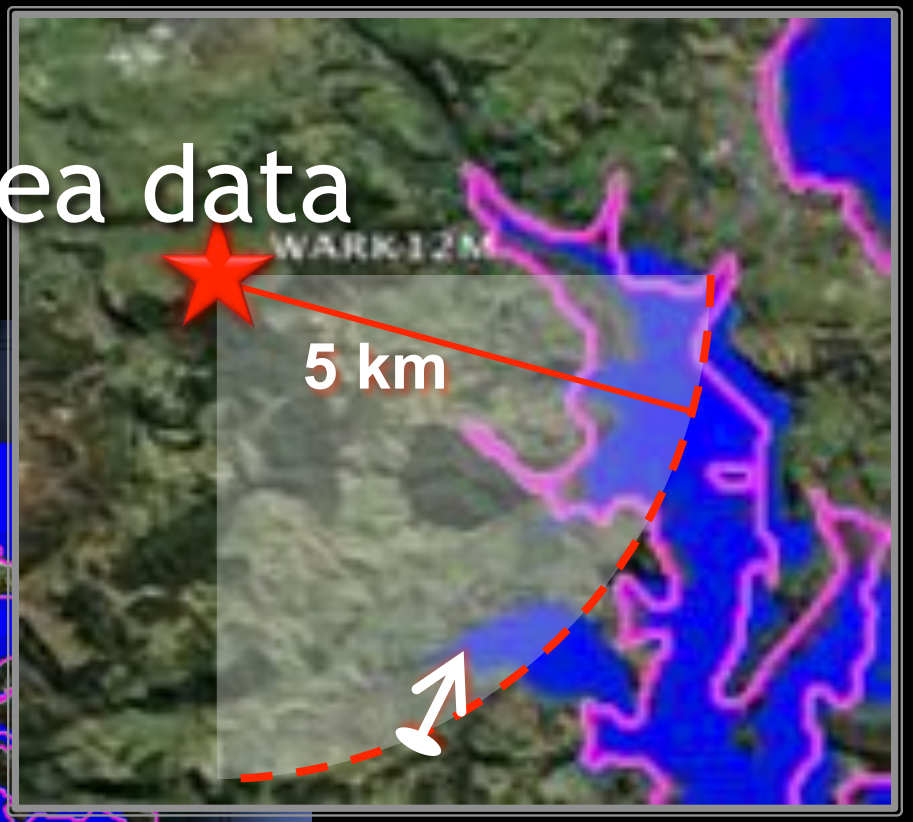
Land-sea data



Shuttle Radar Topography Mission
The Mission to Map the World

Version 2 : SRTM3
World 3 arc-seconds
(90m)

full resolution coastline of GMT package

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Calculate OTL displacement

- site-dependent tidal coefficients of 11 main tides @Warkworth

software	OTL provider	GOTIC2
OT model	NAO99b	
Earth model	Gutenberg-Bullen	
Land-sea grid	600m	90m

- Calculate OTL displacement
  - c5++ software
  - 1 year (2011) every 12h
  - NS, EW , UP

c5++

the new space geodetic analysis software developed at NICT, Hitotsubashi Univ., JAXA and **AUT**

http://www3.nict.go.jp/w/w114/stsi/c5++/

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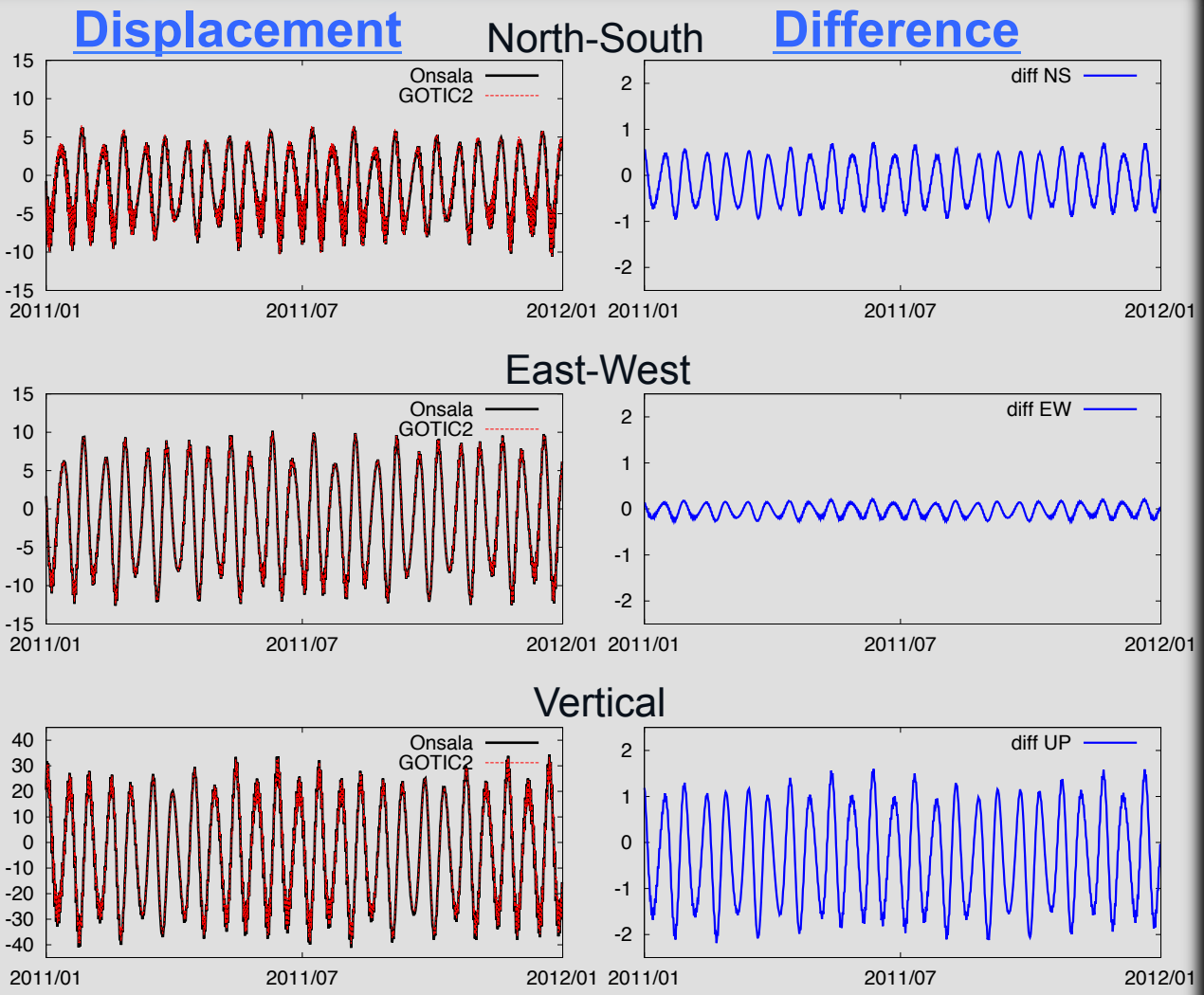
Results : OTL displacement @Ww



- OTL provider
  - this study
    - IERS Conv. 2003
- NS : ± 1 mm
- EW: ±0.3mm
- Vertical : ± 2 mm

Not small for 1mm accuracy !

Unit: mm

We need to take care when analyzing geodetic data

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Conclusion

- AUT radio telescope is ready to contribute to New Zealand and global geodetic research

- AUT started discussing with related institutes in New Zealand to establish a fundamental geodetic station at Warkworth

→ ***get a budget***

- Calculated and compared OTL displacements @Ww
  - difference of grid data
    - not small
      compared to *1mm accuracy*.

→
- ✓ apply to geodetic analysis
- ✓ evaluate the effect

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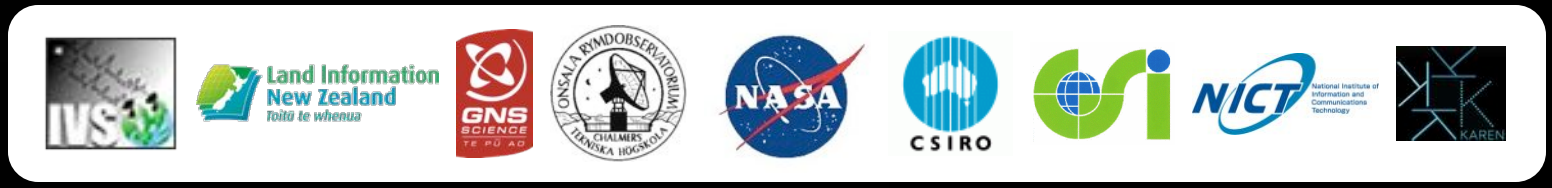
Thank you very much for your attention.

Thanks to Neville Palmer, Dave Collett, Oleg Titov, Hans-Georg Scherneck,
GOTIC2 and c5++ developer
and



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