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Should Active control Networks Replace Passive Control Networks?

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- Introduction
- Active Control Networks
- Passive Control Networks
- The Importance of Passive Control
- Case Study: Passive Control for Earthquake Recovery
- The Future of Passive Control
- Conclusion

Fundamental Role of Reference Frame

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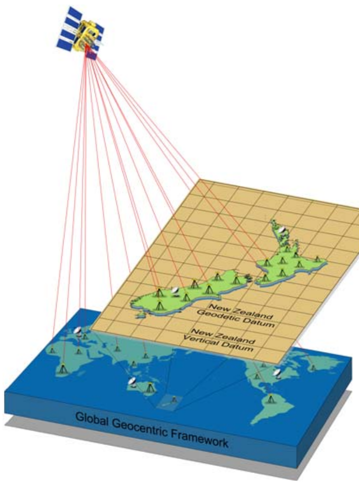

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Fundamental Role of Reference Frame

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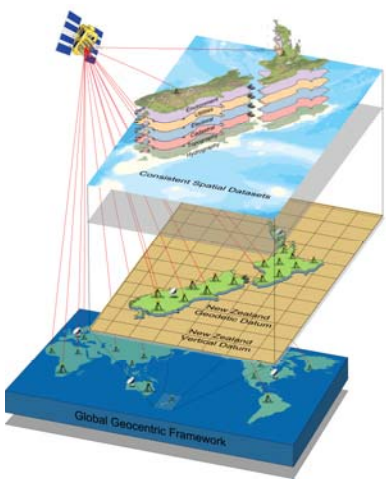

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Fundamental Role of Reference Frame

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Requirements

- 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

NZ Geodetic System

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- Datum aligned to ITRF96
- Semi-dynamic
- Reference epoch 2000.0
- Realised through
  - 35 CORS (PositioNZ)
  - 100,000 control marks
- Datum features
  - Widely adopted by users
  - Appearance of static datum
  - Good relative accuracy

Active Control Networks

PositioNZ – 40 stations, GeoNet – 122 stations, others 20+

Role in Survey Control Networks (8 defined in NZ)

- National Reference Frame
- National Deformation Monitoring Network
- Regional Deformation Monitoring Network

Advantages of Active Control Network

- Continuous monitoring of deformation
- Ability to separate modes of deformation
- Ability to calculate updated coordinates almost immediately
- Contribution in near real-time to hazard monitoring
- Contribution to international reference frame realisation
- Unlikely to be accidentally destroyed
- GNSS users need only one receiver to obtain a cm-accurate position
- Relatively easy to connect to for non-surveyors

Passive Control Networks

Comprise 99% geodetic marks in NZ - increasing by about 2000/yr

Role in Survey Control Networks

- Local Deformation Monitoring Network
- Cadastral Horizontal Network
- Cadastral Vertical Network
- Basic Geospatial Network
- National Height Network

Advantages of Passive Control Network

- Numerous marks already exist, some with a long history
- Often directly connected to important national datasets, such as the cadastre
- Cheap to install
- Placed where needed
- Few or no ongoing costs
- Can have structures placed over them control purposes
- Suitable for occupation by non-GNSS techniques

The Importance of Passive Control

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Many countries are stopping or reducing their passive survey control programmes

However, NZ has increased the numbers of marks surveyed in recent years

- **to support the accurate positioning of the digital representation of the cadastre,**
- **reflects the desire for passive control marks near to any survey job.**

The Passive Control network enables:

- Datum access
- Detailed deformation monitoring
- Localised transformations in deforming regions
- Realising Survey-Accurate digital cadastre
- Control for projects such as imagery

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Case Study: Passive Control for Earthquake Recovery

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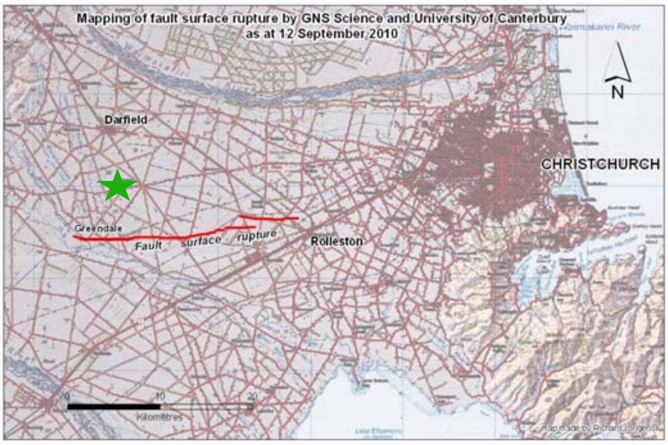
Darfield Earthquake – Sept 4 2010,
40 km W of Christchurch, Mw 7.1, Depth 10 km



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Darfield Earthquake

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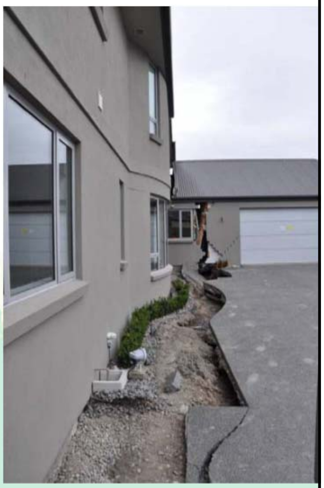

Geodetic resurveys - regional

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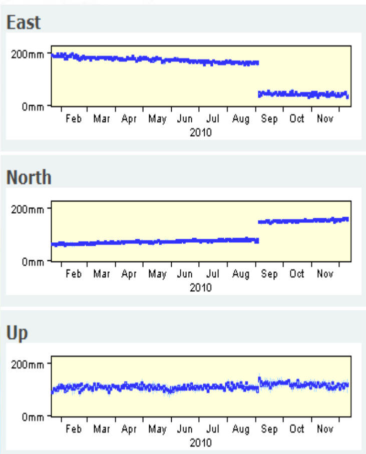
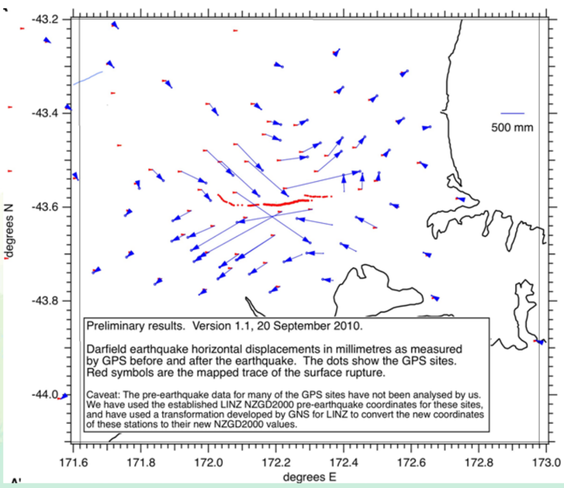
Active Control



Passive Control



Geodetic resurveys - Christchurch

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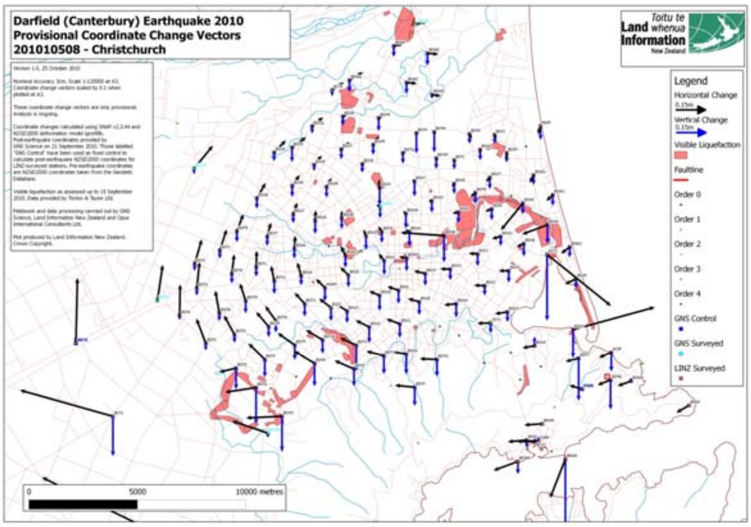

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Observed and modeled displacements

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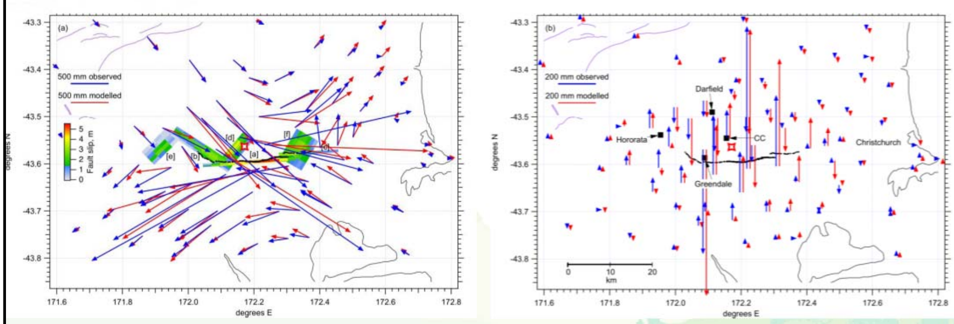

The model consists of slip on the Greendale Fault plus three thrust segments on NE-oriented planes

Form Beavan et al. THE DARFIELD (CANTERBURY) EARTHQUAKE: GEODETIC OBSERVATIONS AND PRELIMINARY SOURCE MODEL

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Impact on geodetic control

Range is based on the distance from the centre of the fault rupture.

Maximum Range (km)	Geodetic marks (order 5 or better)	Cadastral control (order 6 or better)	Total marks
0-20	223	4816	56835
20-40	1269	49538	565892
40-60	3176	28632	387606
60-80	673	3681	143593
80-100	487	2182	103995
Total	**5828**	**88849**	**1257921**

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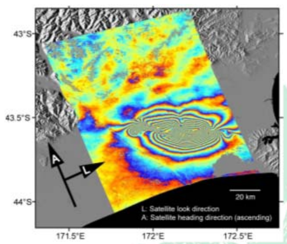
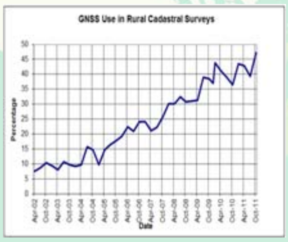
The Future of Passive Control

Despite current value the role of passive control in the geodetic system may decrease significantly in the future





Reasons

- New Technologies – InSAR and LiDAR for deformation monitoring and increased GNSS
- Changing focus in NZ – will complete installation of passive control such that in rural areas every point will be within 200m of a passive control point and in rural areas 2000m
- Increase in use of GNSS for cadastral surveys, particularly in rural areas

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Conclusion

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- For geodetic datum to be useful it needs to be easily accessible – active control can provide this and its use will increase.
- As more datum users become GNSS enabled more resources will need to be diverted into active control
- Active control can only provide accurate positioning over long distances where:
  - relative deformation is minimal; or
  - a deformation model is used
- Passive control can be provided close to where it is needed hence deformation can be ignored
- CORS is still costly so need to supplement with passive control
- Computing an accurate deformation model in areas of complex deformation requires denser network of marks than CORS

Active control networks will NOT replace passive control networks in NZ at the moment.

They might eventually but they are likely to be decades away rather than years in the future.

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