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New Zealand and IGS: Three Decades of Collaboration and Looking into the Future

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Introduction

The Aotearoa New Zealand GNSS network was established more than 20 years ago, when GNS Science Te Pū Ao and Toitū Te Whenua Land Information New Zealand (LINZ) established a partnership to develop a national positioning and hazard monitoring infrastructure. The continuous GNSS network captures many geophysical phenomena over a wide range of spatial and temporal scales.

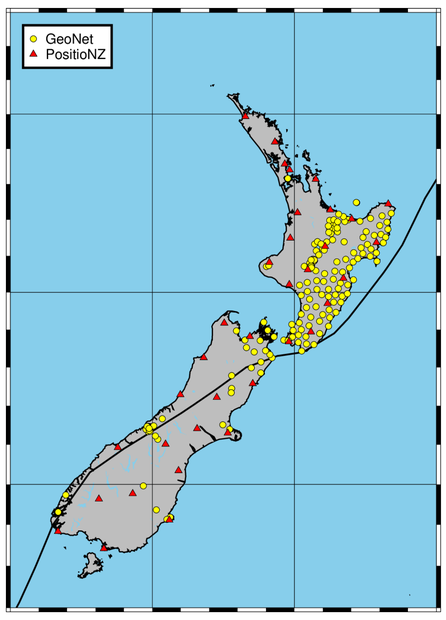


Fig 1. New Zealand GNSS network (without Antarctica, Raoul and Chatham Islands)

The **PositioNZ** network the backbone of the New Zealand Geodetic Datum 2000 (NZGD2000). NZGD2000 is a semi-dynamic datum, with coordinates aligned to the International Terrestrial Reference Frame 1996 (ITRF96), at the reference date of 1 January 2000 (epoch 2000.0). This means that the tectonic motions and the regional deformations are considered when determining station coordinates. NZGD2000 is assumed to be a plate-fixed datum [1].

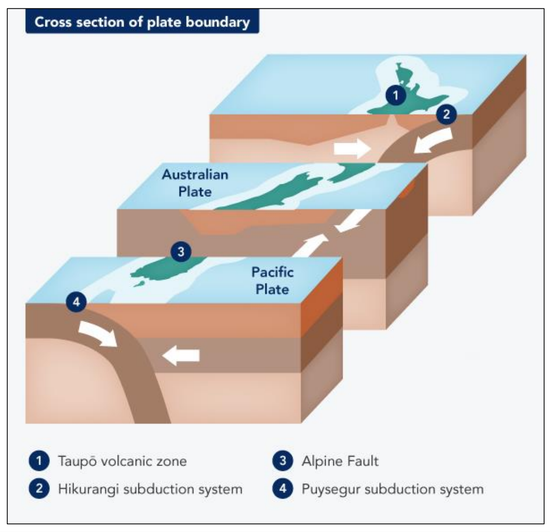


Fig 2. Cross Section of New Zealand's Plate Boundary [3]

Considering New Zealand's unique position on the active Pacific-Australian plate boundary, its GNSS network plays a significant role in understanding processes that control natural hazards. The **GeoNet** is a densified GNSS network in areas of active deformation, such as the Hikurangi subduction zone, the Taupo Volcanic Zone or the north part of the Alpine Fault [2, 3].

International contribution

New Zealand contributes to **IGS** with 7 GNSS stations. AUCK and CHAT were established in 1995, DUND, MQZG, WGTN and CHTI in the 2000's. In 2009, to support **IERS** WARK was established and co-located with two New Zealand's VLBI radio telescopes which are part of the International VLBI service (IVS). New Zealand also supports overseas stations in the SW Pacific (FALE, NIUM, now operated by Australia) and Antarctic (SCTB) regions.

Fig 3. IGS stations supported by New Zealand

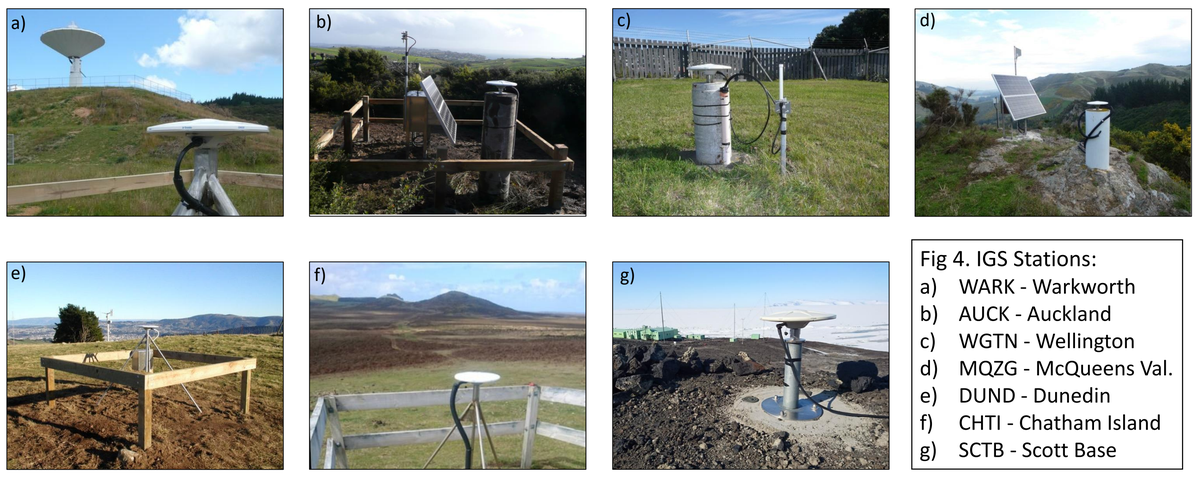


Fig 4. IGS Stations:
a) WARK - Warkworth
b) AUCK - Auckland
c) WGTN - Wellington
d) MQZG - McQueens Val.
e) DUND - Dunedin
f) CHTI - Chatham Island
g) SCTB - Scott Base

Key international activities:

- Contribution as network operator to the IGS network and Real-Time Service;
- Participation to IGS governance, working groups, committees and pilot projects;
- Collaboration with Japan Aerospace Exploration Agency (JAXA) during testing phase of the Quasi-Zenith Satellite System (QZSS);
- Participation to the United Nations Global Geodetic Center of Excellence and Committee of Experts on Global Geospatial Information Management.

Future Plans

New Zealand is currently exploring opportunities to use real-time GNSS to support monitoring of earthquakes and tsunami in New Zealand and the Southwest Pacific [2, 3]. GNSS real time will be used to:

- Rapid characterization of large local earthquakes;
- Rapid characterization of the impact of tsunami on the Hikurangi subduction zone.

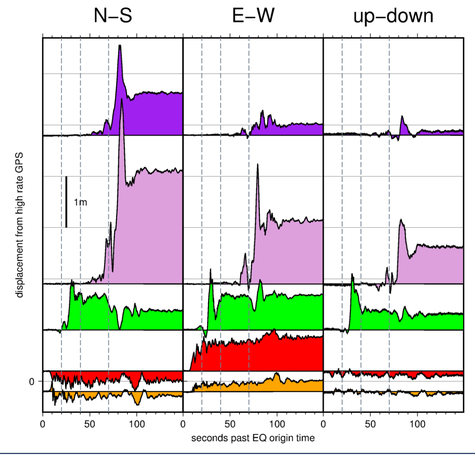
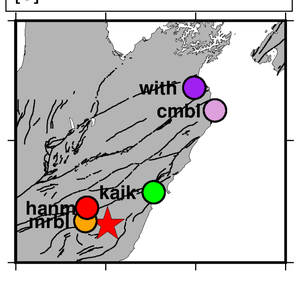


Fig 5. Dynamic ground displacement during the M7.8 Kaikoura earthquake [6]



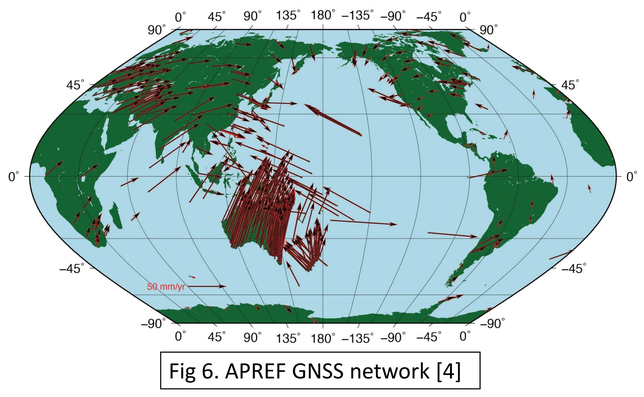


Fig 6. APREF GNSS network [4]

New Zealand currently contributes to the Asia Pacific Reference Frame (**APREF**) with all PositioNZ network data. There is a plan to extend this and contribute with the entire GeoNet network. In coming years, there is a strong intention for New Zealand to join the APREF project as a local analysis center and contribute to the development of an accurate geodetic infrastructure that will support the needs of science, public and industries in the Asia-Pacific region.

The Southern Positioning Augmentation Network (**SouthPAN**) is a satellite-based augmentation system that provides positioning and navigation services for users in Australia and New Zealand [5].

SouthPAN includes:

- a network of ground reference stations
- 2 industry-owned satellites with SBAS payloads
- 2 computation centres with dual satellite uplinks

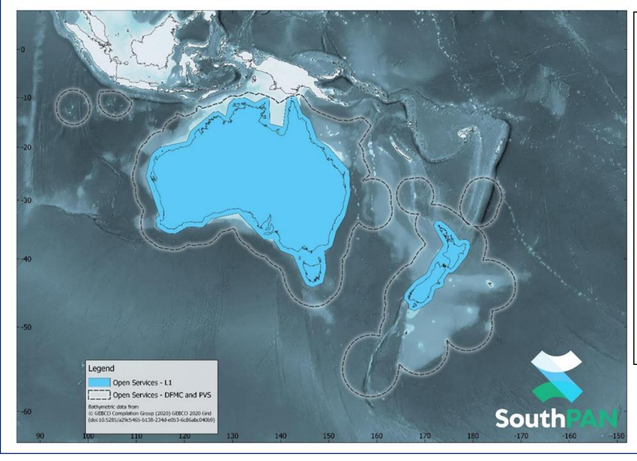


Fig 7. A map of SouthPAN's Open Service coverage area [5]:
blue – L1 SBAS;
dashed – Dual Frequency Multi-Constellation SBAS (DFMC) and PPP via SouthPAN (PVS);

Acknowledgments

Numerous geodesists, scientists and technicians have contributed in the years to the development of the GeoNet and PositioNZ networks. We would like to acknowledge the contribution of J. Beavan, M. Amos, N. Balfour, L. Bland, G. Blick, C. Burton, D. Collett, H. Cowan, P. Denys, A. Douglas, S. Edwards, K. Fenaughty, N. Fournier, P. Gentle, K. Gledhill, D. Whitaker, L. Wallace, S. Hreinsdottir, B. Hodge, A. Jordan, D. Matheson, C. Miller, N. Palmer, S. Taylor-Offord, H. Woodard, R. Winefield, S. King, M. Madley, J. Simonsen and all the operational teams that worked for the GeoNet Project since 2001.

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