

# Joint development plan, objective 1.1: Member States are engaged in geodesy governance

The New Zealand example

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Information New  
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# What we will cover

- Geodesy Supply Chain in New Zealand
- Governance structure
- Current challenges and path forward, the PNT Advisory Committee example
- Operational model , the GNSS infrastructure example
- How New Zealand is contributing to the Joint Development Plan



# New Zealand Global Geodetic Reference Frame governance



**MINISTRY OF BUSINESS,  
INNOVATION & EMPLOYMENT**  
HĪKINA WHAKATUTUKI

## New Zealand Government

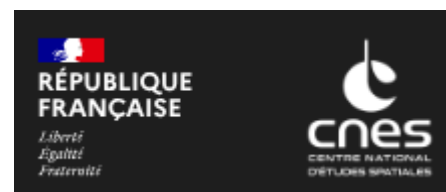
- Ministry of Business, Innovation and Employment, sets strategic direction for Economy, Science and Technology.
- New Zealand Space Agency sits within MBIE



**Toitū Te Whenua**  
**Land Information**  
**New Zealand**

## Land Information New Zealand

- government's lead agency for location information and property
- maintain geodetic and cadastral survey systems and standards
- administer legislation that relate to NZ land and seabed
- Coordinates and procure geodetic services
- Operate centralized geodetic data sharing facility

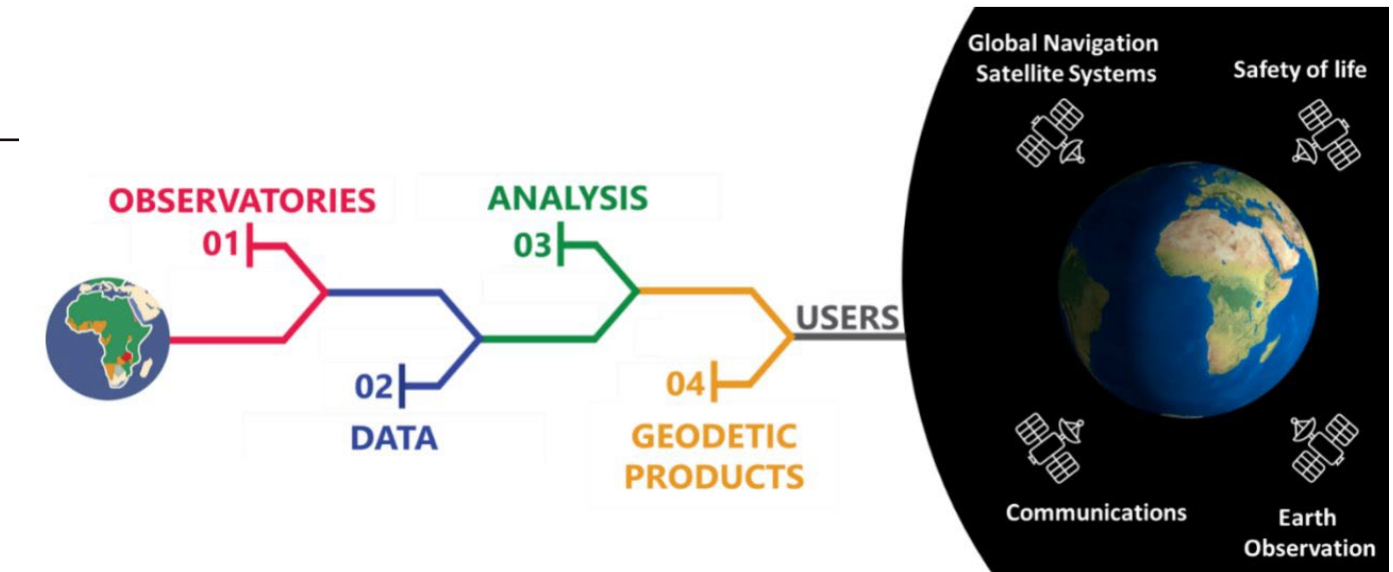


## Science organisations

- GNS Science undertake Earth Science research for the government and is responsible for the country-level geohazards monitoring
- Operate ground infrastructure: GNSS: GNS Science and Otago University, DORIS: CNES (Fr), VLBI (formerly Auckland University of Technology)
- science to delivery, contribute to international geodetic community and datum updates
- Educate workforce



# How Aotearoa New Zealand contributes to the Global Geodetic Reference Frame through LINZ and GNS Science



01



Warkworth **geodetic observatory** : operated on behalf of LINZ by GNS Science (**GNSS**) and SpaceOps (**VLBI**)

01



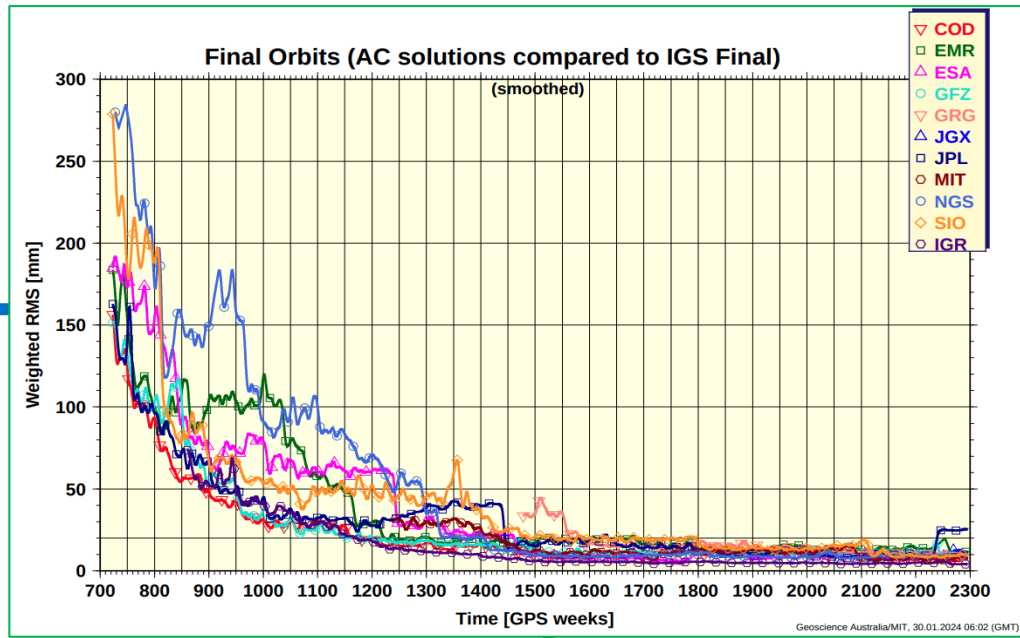
Continuous **GNSS network** is operated by GeoNet (partnership between LINZ and GNS). 6 GNSS stations contributes to the global geodetic datum definition.

02

3.05	OBSERVATION DATA - M (MIXED)	RINEX VERSION / TYPE
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gfrnx-2.1.9	FILE MERGE	20241120 000644 UTC COMMENT
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WARK00NZL	MARKER NAME	
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GeoNet	GNS	OBSERVER / AGENCY
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E 15 C1X CSX C6X C7X CBX L1X L5X L6X L7X L8X S1X S5X S6X		SYS / # / OBS TYPES
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G 9 C1C C2M CSX L1C L2M L5X S1C S2M S5X		SYS / # / OBS TYPES
J 15 C1C C1X C1Z C2X CSX L1C L1X L1Z L2X L5X S1X S1Z		SYS / # / OBS TYPES
S2X S5X		SYS / # / OBS TYPES
R 12 C1C C1P C2C C2P L1C L1P L2C L2P S1C S1P S2C S2P		SYS / # / OBS TYPES
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24 R01 1 R02 -4 R03 5 R04 6 R05 1 R06 -4 R07 5 R08		6 GLONASS SLOT / FRQ #
R09 -2 R10 -7 R11 0 R12 -1 R13 -2 R14 -7 R15 0 R16 -1		GLONASS SLOT / FRQ #
R17 4 R18 -3 R19 3 R20 2 R21 4 R22 -3 R23 3 R24 2		GLONASS SLOT / FRQ #
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R L1P 0.25000		SYS / PHASE SHIFT
R L2C -0.25000		SYS / PHASE SHIFT
	COMMENT	
This station is part of the LINZ and GeoNet cGNSS networks.		COMMENT
These networks are operated in partnership between Land		COMMENT
Information New Zealand and GNS Science.		COMMENT
This data is licensed for re-use under the Creative Commons		COMMENT
Attribution 4.0 International licence. For more detail		COMMENT
please refer to <a href="https://www.linz.govt.nz/linz-copyright">https://www.linz.govt.nz/linz-copyright</a>		COMMENT

GNSS **data** from reference stations are continuously generated following international standards and sent to International GNSS Service (IGS) data centers

03

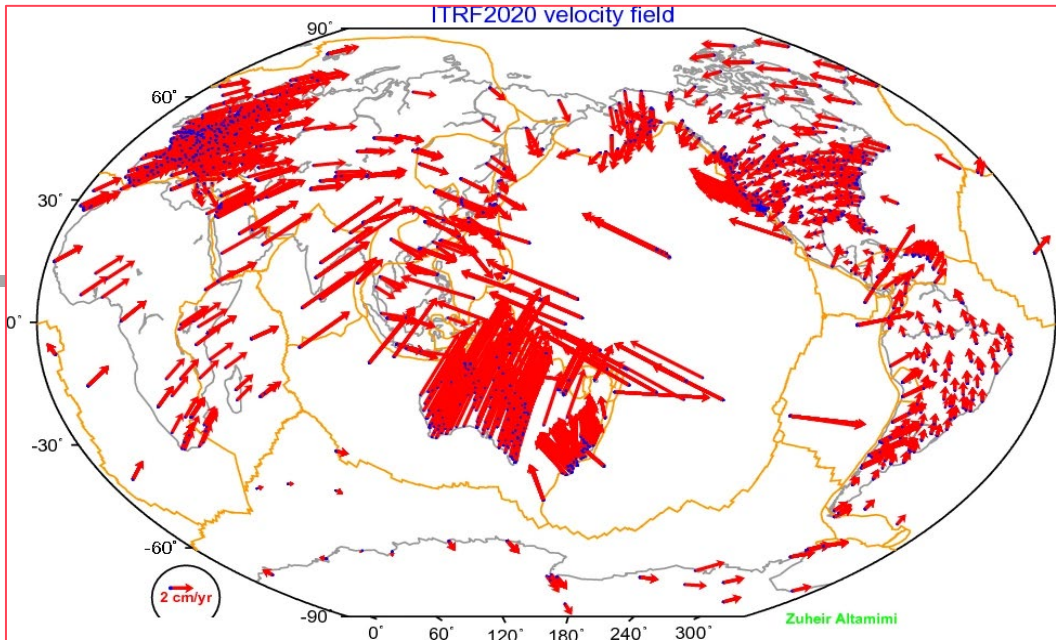


IGS **analysis centers** process GNSS data from reference stations and combine them to generate GNSS geodetic products such as satellites orbits [source: IGS Technical report, Dach et al., 2024]



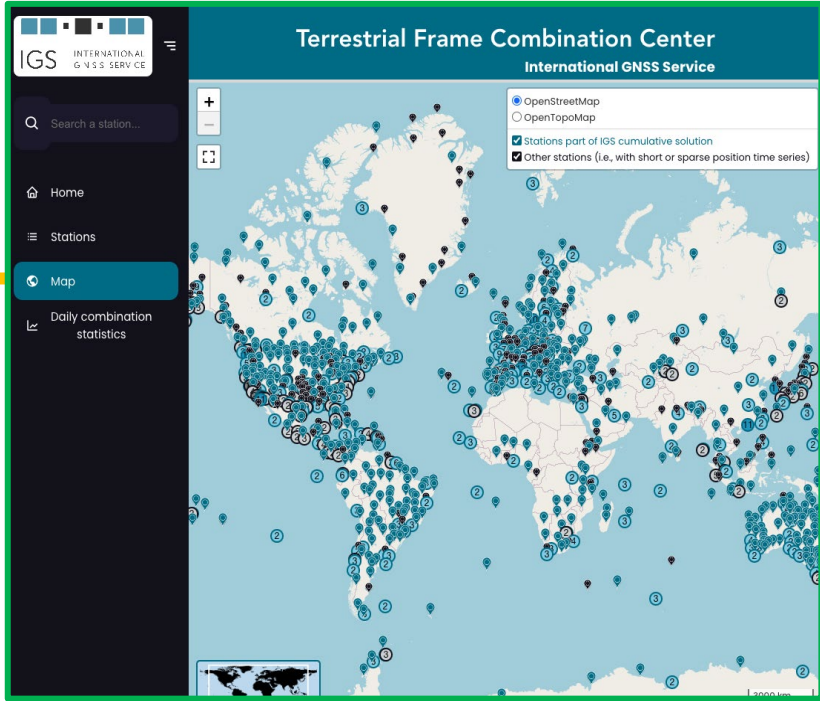
The Global Geodetic Reference Datum is based on ITRF, and is the fundamental building block of any geospatial **users'** application

04



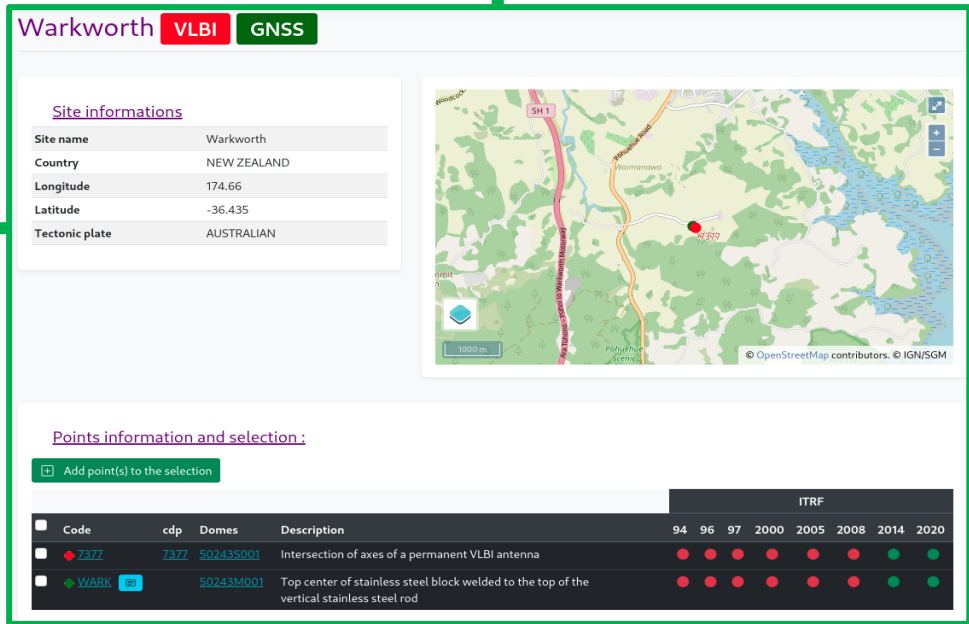
GNSS, VLBI, DORIS and SRL outputs are then combined to generate **products** such as the International Terrestrial Reference Frame (ITRF) from which the global tectonic plate velocity model is derived [source: Altamimi et al., 2023].

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GNSS products are combined with results from other geodetic techniques such as VLBI by the International Earth Rotation and Reference Systems Service (IERS) **analysis centers** [source: ITRF website, ]

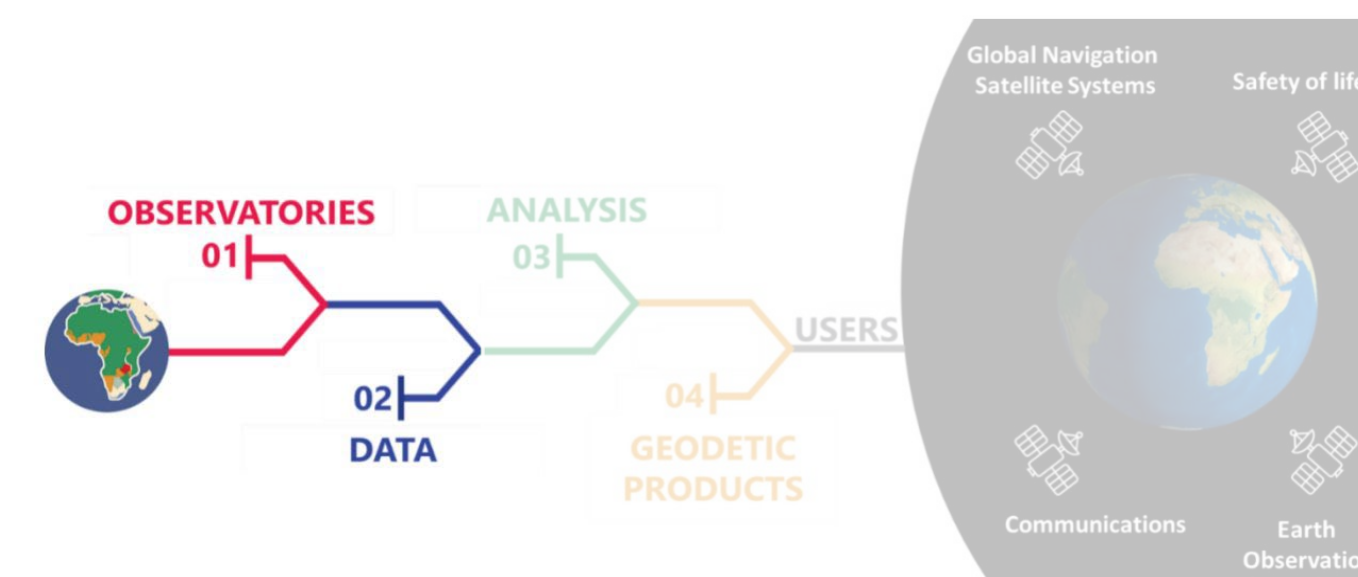
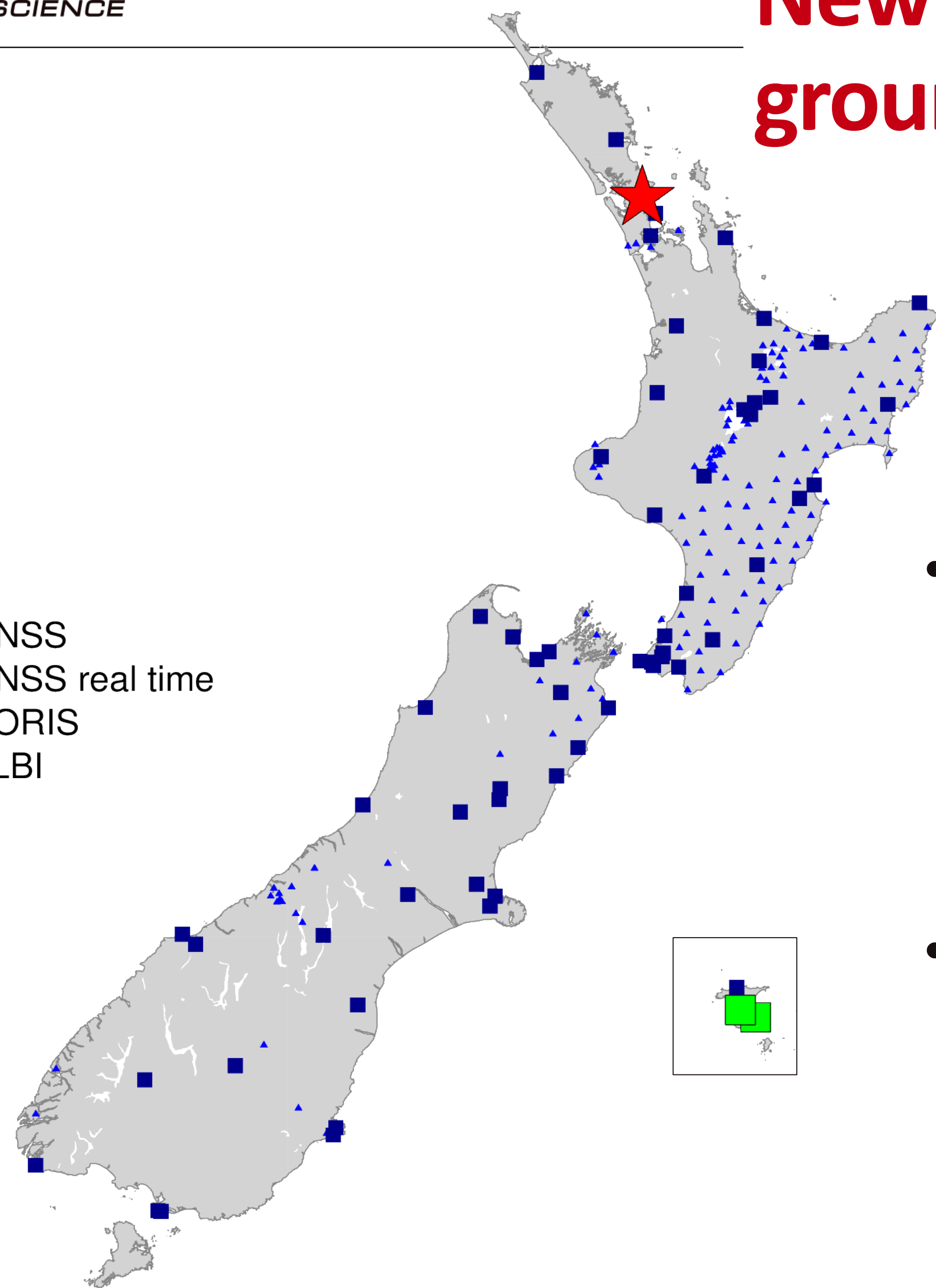
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# New Zealand geodesy supply chain: ground infrastructure and data centres

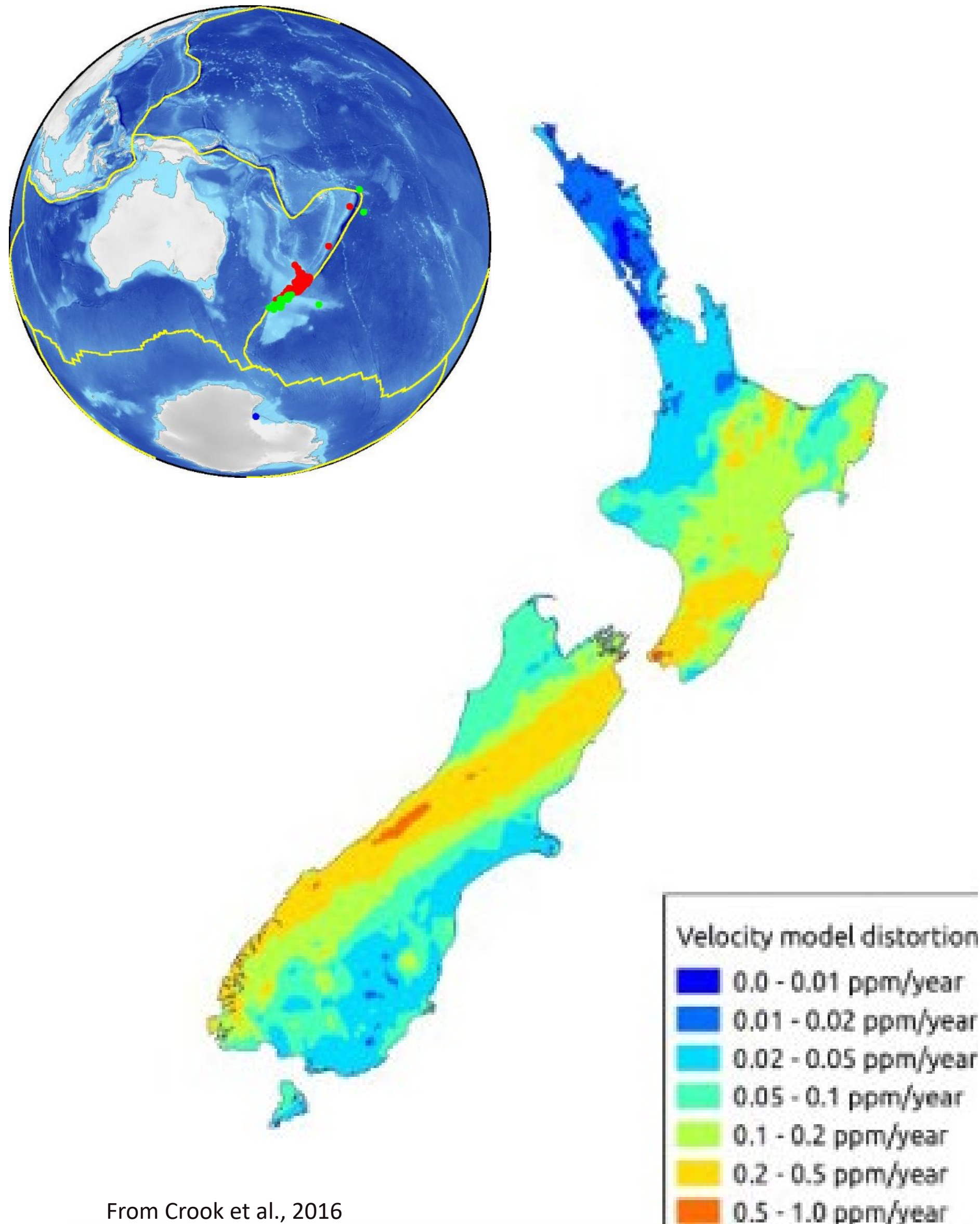
- ▲ GNSS
- GNSS real time
- DORIS
- ★ VLBI



- Ground infrastructure extends from Raoul Island to Antarctica
  - 200+ GNSS CORS, ~30% real time
  - 2 DORIS
  - 1 VLBI
- National geodetic data archive curated by LINZ (mapping agency), with GNS Science operating the GNSS infrastructure. DORIS is operated by CNES (Fr) and supported by GNS and LINZ.

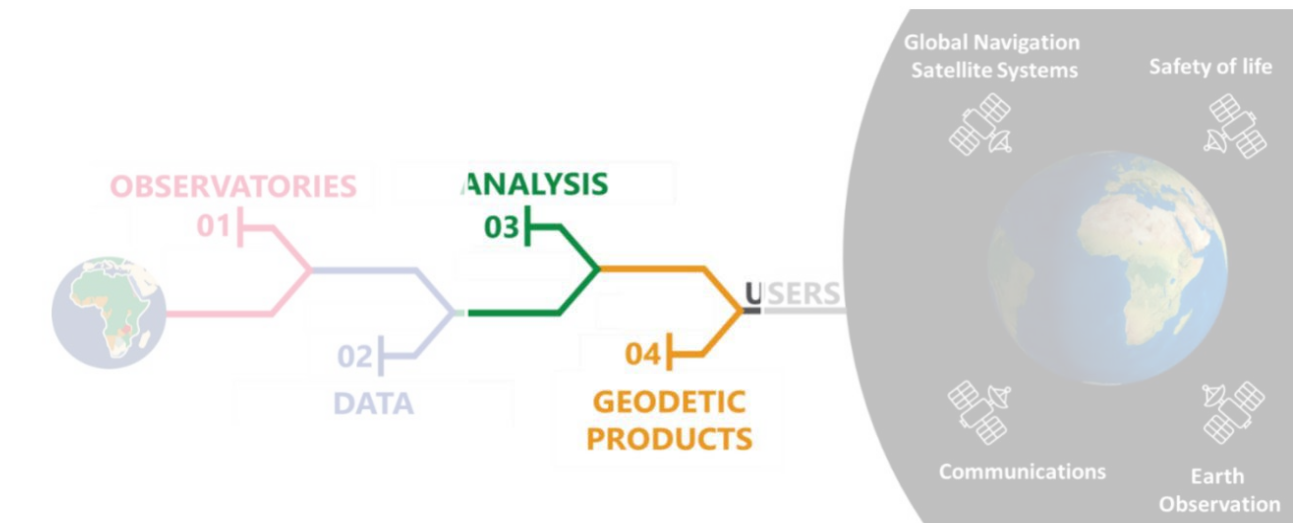


# New Zealand geodesy supply chain: analysis centers and geodetic products



From Crook et al., 2016

<https://doi.org/10.1080/00288306.2015.1100641>



New Zealand sits on an active plate boundary, crucial to have a well-maintained datum

First country to implement a semi-dynamic datum

- New Zealand Geodetic Datum (NZGD2000): linear deformation model + significant deformation events
- New Zealand Vertical Datum 2016 (NZVD2016)
- Link to Global Geodetic Reference Frame through active international partnership and collaborations



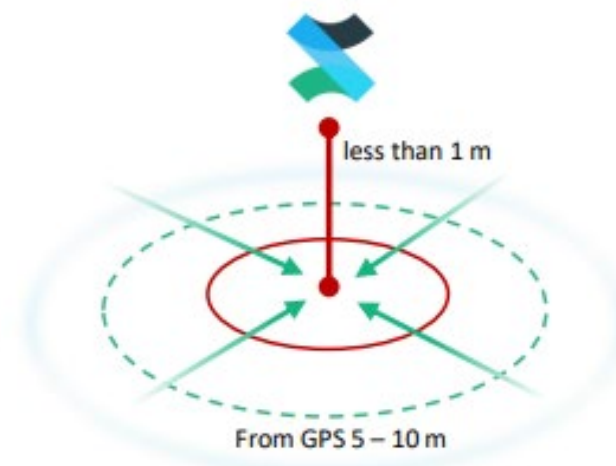
# New Zealand geodesy supply chain: user segment

25 MARCH 2025



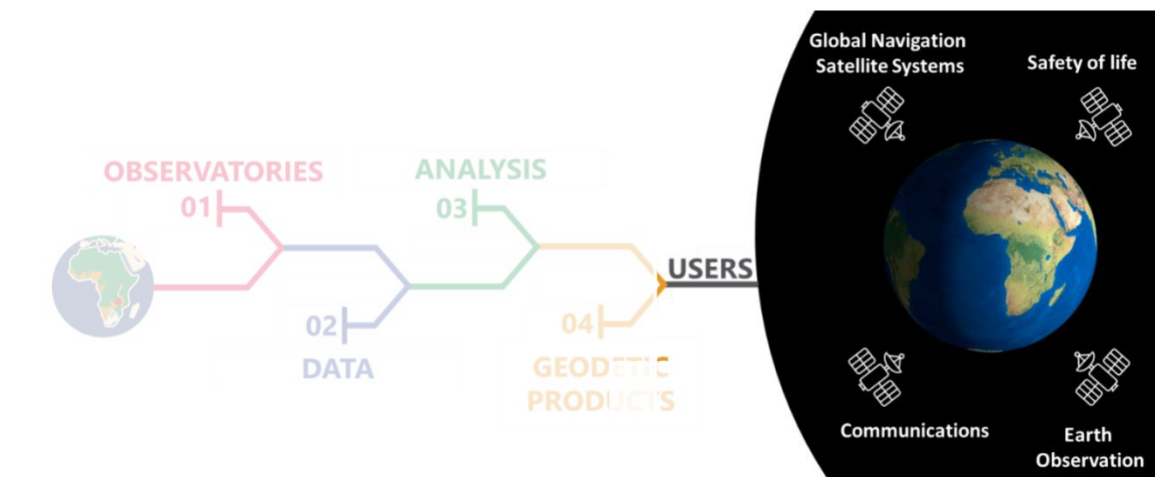
## What is SouthPAN?

The Southern Positioning Augmentation Network (SouthPAN) is a freely available, open access positioning system that improves the accuracy, reliability and availability of Global Navigation Satellite Systems (GNSS), such as GPS, from 5-10 metres down to less than a metre, and in some cases as little as 10cm, across New Zealand and Australia.



## What is the benefit?

SouthPAN's free and open access to less than a metre accuracy gives businesses across a wide range of industries such as agriculture, forestry, maritime, transport and aviation that use standard GPS, the opportunity to benefit from improved accuracy and positioning to enhance and optimise their operations.



- User segment range from cadastral surveyors to agriculture industries
- Success and importance of positioning and timing service demonstrated with launch of SouthPAN in 2023, with NZ funding totaling to \$NZD781 million over 19 years

16 SEPTEMBER 2022

## NZ/AU partnership to bring world-class satellite positioning services

Hon Damien O'Connor

Land Information

Land Information Minister Damien O'Connor today announced a joint Trans-Tasman partnership which will provide Australasia with world-leading satellite positioning services that are up to 50 times more accurate, boosting future economic productivity, sustainability and safety.

New Zealand and Australia have partnered to deliver the Southern Positioning Augmentation Network (SouthPAN), with the first services available in the next few weeks.



**Beehive.govt.nz**

The official website of the New Zealand Government



# LINZ exemplar of stepping up to avoid further degradation of the geodesy supply chain



# Challenge: Warkworth VLBI observatory



- Warkworth VLBI was traditionally operated by Auckland University of Technology
- Due to decrease in funding to the University, AUT stepped down and decided to decommission the VLBI operations in 2021-22
- This southern hemisphere station has a vital role for the global VLBI network, and its operations require sustainable, long-term funding



# Challenge: The gap in governance

- The Surveyor-General is required to maintain a national geodetic system (eg coordinate systems and transformations) and a national survey control system (eg a network of physical control marks), by the Cadastral Survey Act 2002
- Until recently, there were no governance arrangements for Positioning, Navigation and Timing (PNT)
- This lack of governance was particularly apparent when the Warkworth VLBI station closure was proposed. The impacts of closure would have been profound, but impacts were not primarily in the applications of cadastral surveying or hazard monitoring (ie it was largely out of scope for the existing governance structures)



# New Zealand Senior Space Leadership Group

- An existing group of “Tier 2” (eg Deputy Chief Executive) leaders from across the NZ Government
- Provides strategic leadership, guidance and coordination relating to New Zealand’s interests in space
- SSLG recognised that governance arrangements and cross-government coordination for PNT was lacking
- Requested that LINZ set up a Positioning, Navigation and Timing Advisory Committee (PNTAC) to address this gap, reporting to SSLG



# Position, Navigation and Timing Advisory Committee

- Currently in the establishment phase, focussed on building awareness and coordinating activity across government
- Have made extensive use of material developed by the UN-GGCE in discussions with numerous parties, including to Ministers
- Strong connections to key government and industry bodies (eg Lifelines Council, Critical Infrastructure Advisory Group)
- Membership currently limited to central government agencies during the establishment phase, but is likely to expand
- Chaired by LINZ, representatives from NZ Defence Force, Ministry of Defence, NZ Space Agency, Ministry of Business, Innovation and Employment etc.

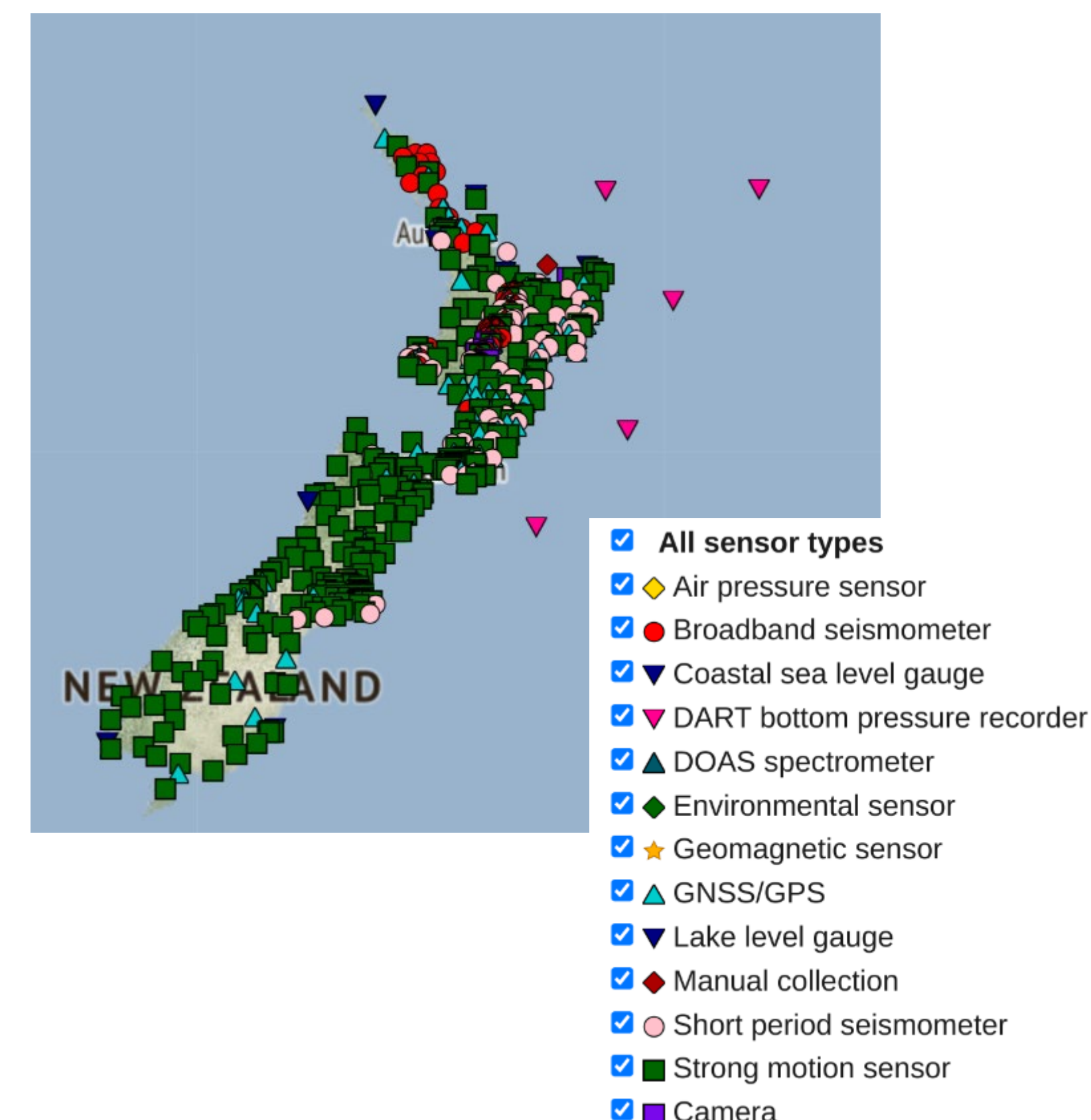


# GNS Science and LINZ, a partnership to sustain the geodesy supply chain through the GeoNet programme



# New Zealand GNSS infrastructure

- The New Zealand national GNSS infrastructure is operated by GNS Science through the GeoNet programme
- GeoNet is New Zealand's national land and geohazards data and monitoring system, and operate a multidisciplinary data pipeline (from the ground infrastructure to value-added products dissemination and 24/7 geohazards monitoring)
- The programme is run by GNS Science and funded by LINZ, NHC (Natural Hazard Commission, government insurance cover against natural hazards), MBIE (Ministry of Business, Innovation and Economy) and NEMA (National Emergency Management Agency)





# GeoNet programme governance model

The governance structure represent all funding stakeholders and GNS, to advise on decisions and advocate for the programme at different levels.

## GNS Science board

- Accountable for the provision of GeoNet products and services

## Advisory Panel

- tier 2 executive of funding partners
- Contracting, funding, sustainability of the programme

## Steering Group

- tier 3 executives of funding partners
- Strategic direction, workplan approval

## Programme Management team

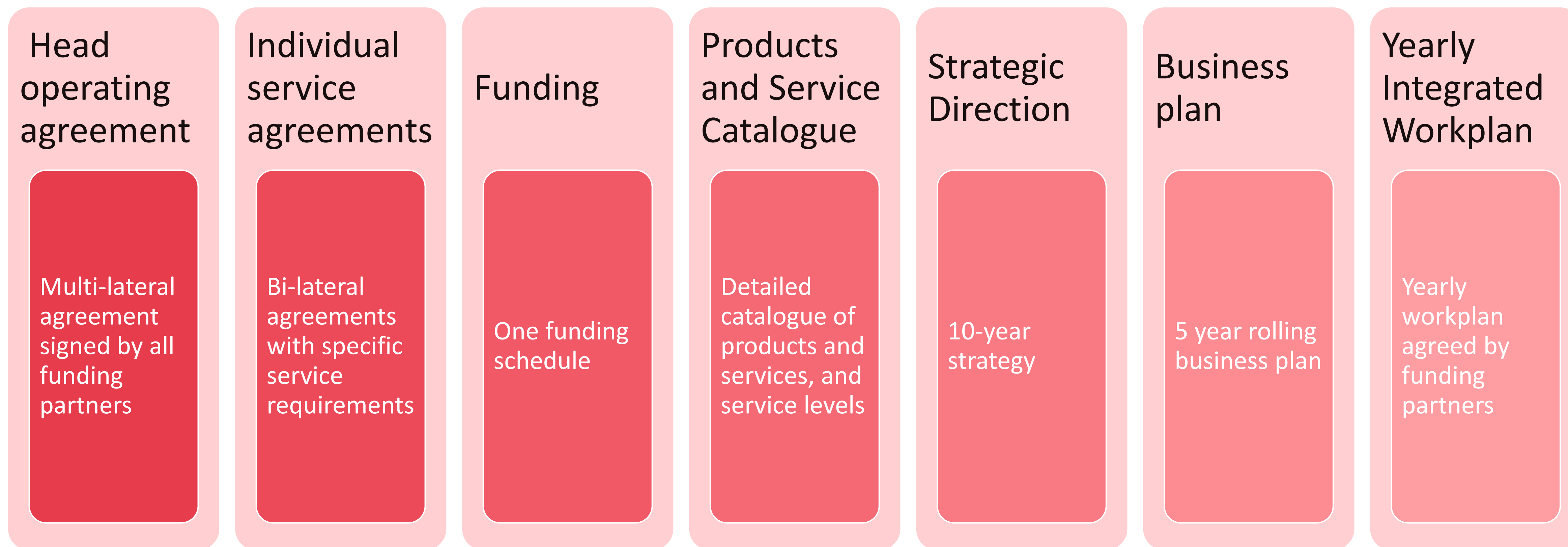
- programme leader and core functions leaders
- Workplan development, stakeholder relations, products and services management

## Staff

- Daily operations, workplan implementation



# GeoNet programme, contracting and operations





# Key messages

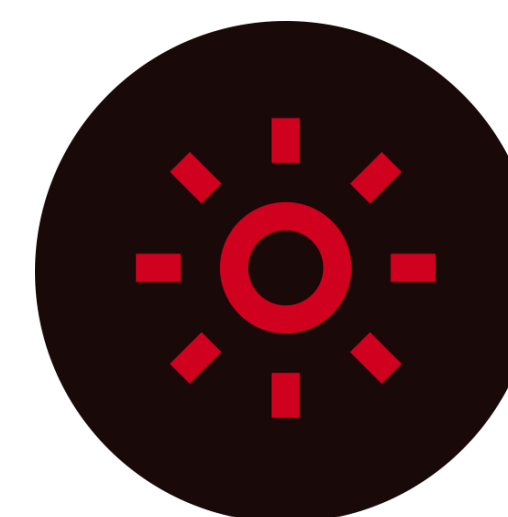
New Zealand has a privileged position: economy reasonably wealthy, open data policies and government endorsement to science, technology and innovation. But funding are limited, and it still lack of a good model to operate and sustain geodetic infrastructure, products and services. Hard to accommodate expansion and innovation.



- Join forces: success story of GeoNet programme, that gain efficiency by integrating ground infrastructure for multi-purpose (geodetic datum and hazard monitoring)



- Engaged lead agency (LINZ) actively connecting the small geodetic community and coordinating between different sectors



- Part of the success story thanks to government level Open Data Policy (NZGOAL)



# Summary: New Zealand progress towards objective 1.1 (geodesy governance)

Joint Development Plan, objective 1.1 outcomes	Status
1.1.1 improved governance arrangements to manage strategic, operational, and technical geodetic risks	NZ is establishing a country level Advisory Committee on Position, Navigation and Timing
1.1.2 Governments, science organizations, industry, and universities understand their roles in the global geodesy supply chain	Through LINZ coordination, science organizations such as GNS contribute to the geodesy supply chain LINZ and GNS actively contribute to IAG
1.1.3 Member States understand their dependency, contribution and impact of loss of the global geodesy supply chain.	LINZ and GNS will be signatories of the UN-GGCE MMOU LINZ and GNS starting to work together on a "geodesy" story tailored to NZ, for funders and policy makers
1.1.4 Risks associated with weaknesses in the global geodesy supply chain are beginning to be mitigated	LINZ working on mitigating risk of losing Warkworth VLBI station GNS working on securing sustainable funds for the GNSS infrastructure and data and products pipeline





# Thank you!

**Joint development plan, objective 1.1: Member States are engaged in geodesy governance  
the New Zealand example**

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