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# Joining New Zealand Land and Sea Vertical Datums (JLAS)

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# Mapping NZ 2025

## What is the problem

## Background – Vertical Datums in NZ

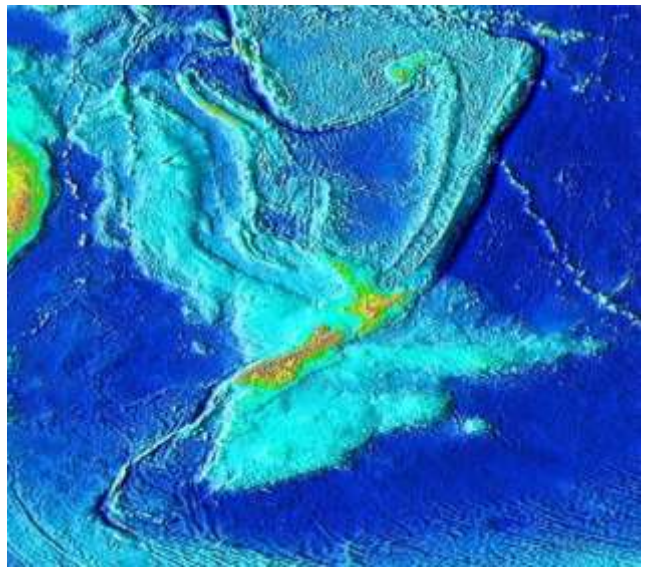
## LINZ's JLAS project

## Data Inputs

## Proposed Solution

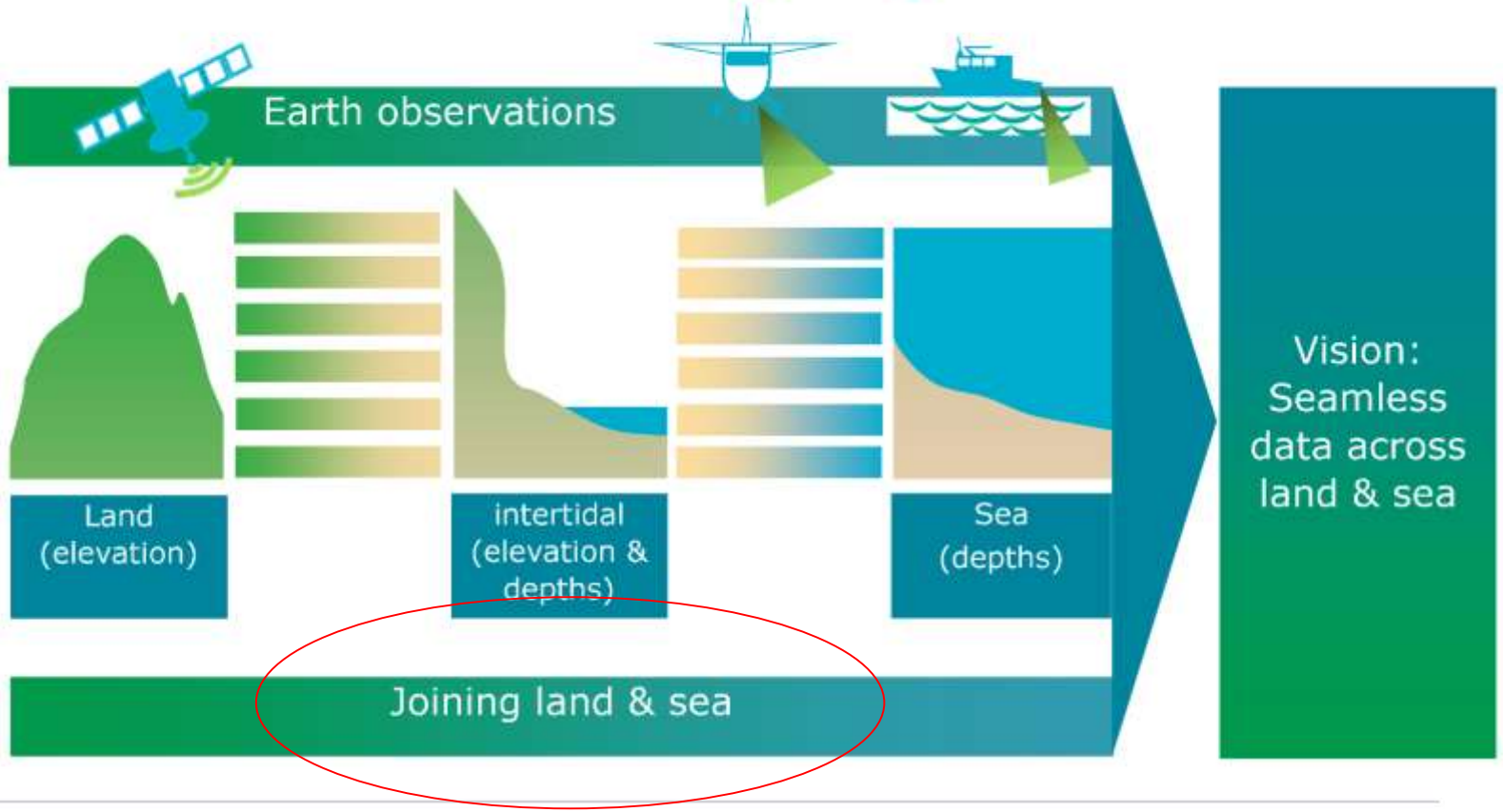
# Mapping New Zealand 2025

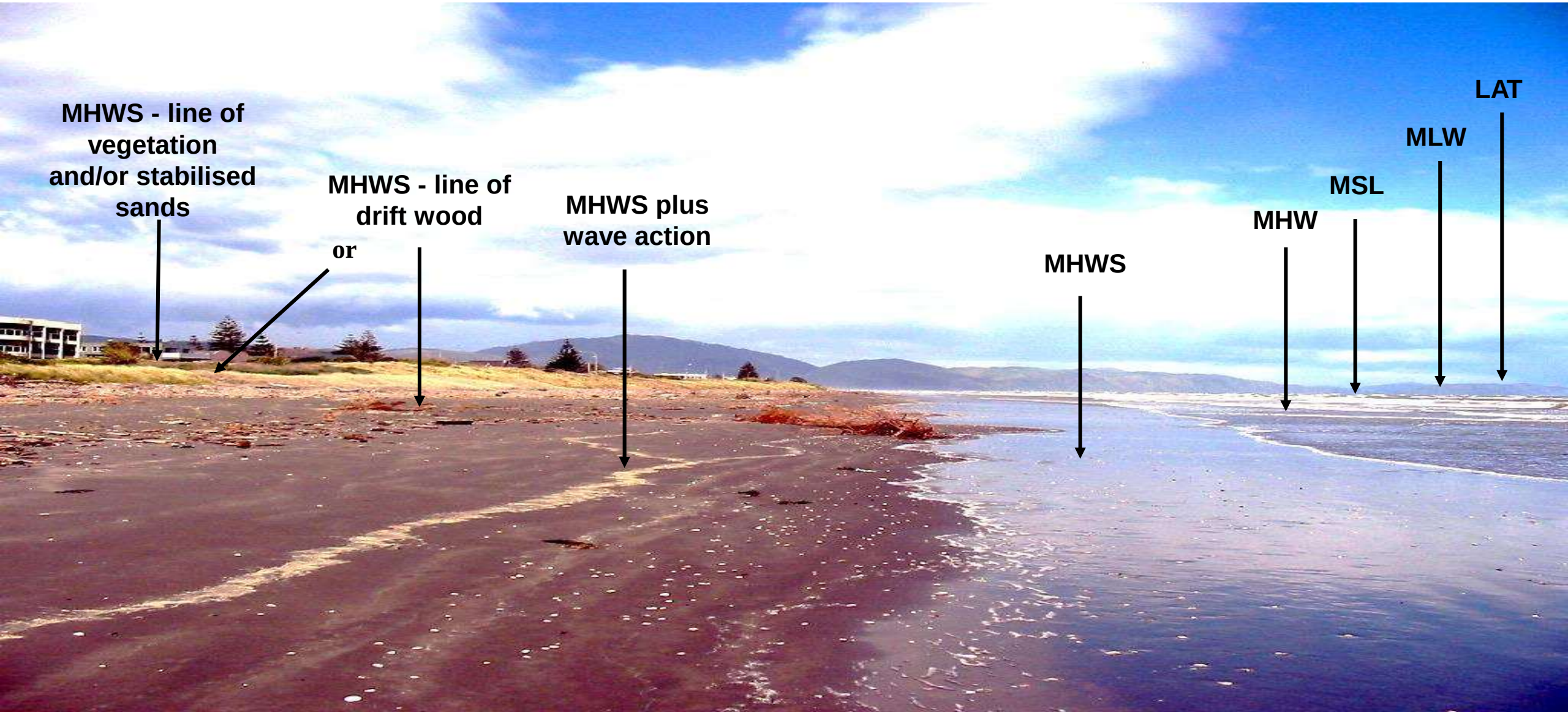
Seamless terrain mapping from the top of Mt Cook to the outer extent of the continental shelf



# Mapping NZ 2025

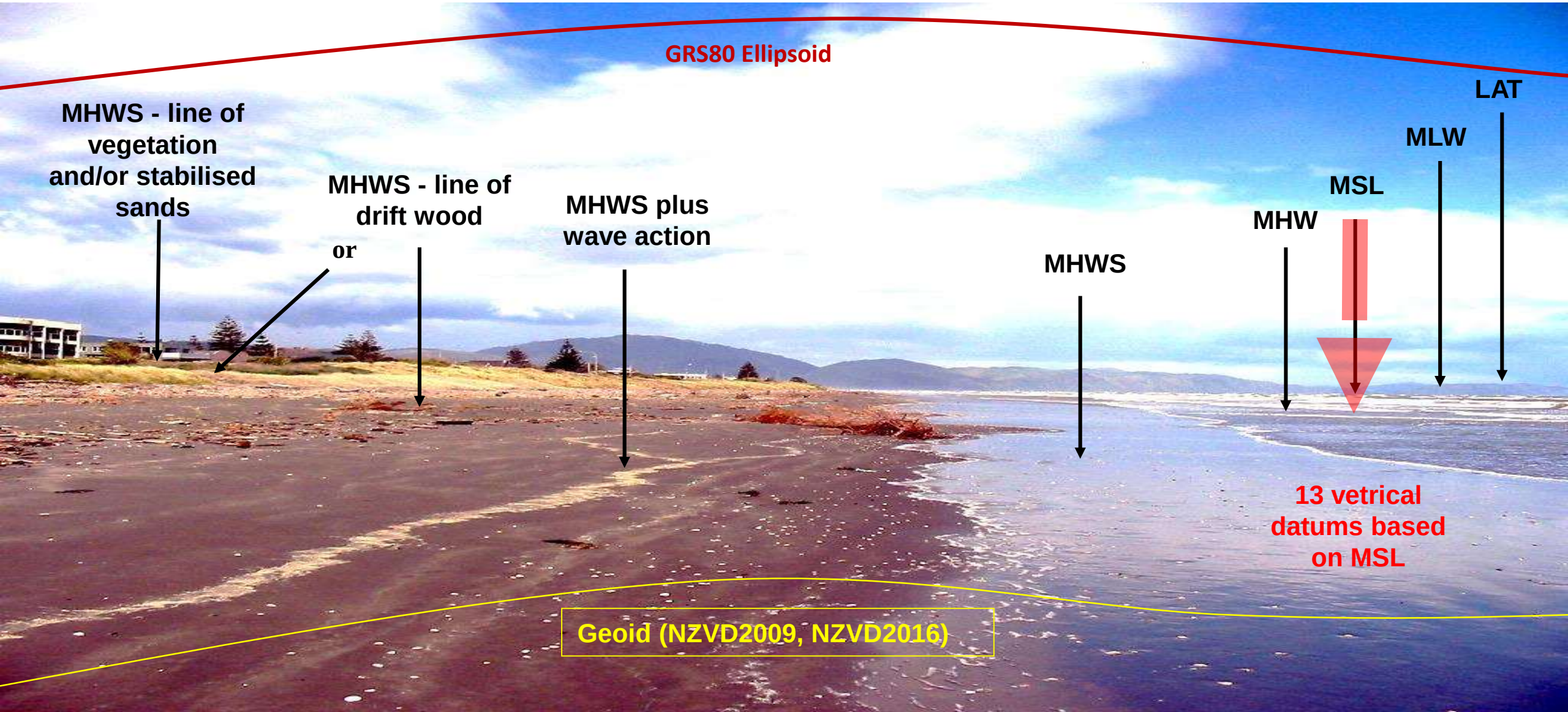
The 'Joining Land and Sea' projects aims to develop transformations between the land and marine datums using NZVD2016 as a common reference surface thereby enable the integration of land and sea spatial datasets.




MHWS - line of vegetation and/or stabilised sands
MHWS - line of drift wood
or
MHWS plus wave action
MHWS
MHW
MSL
MLW
LAT

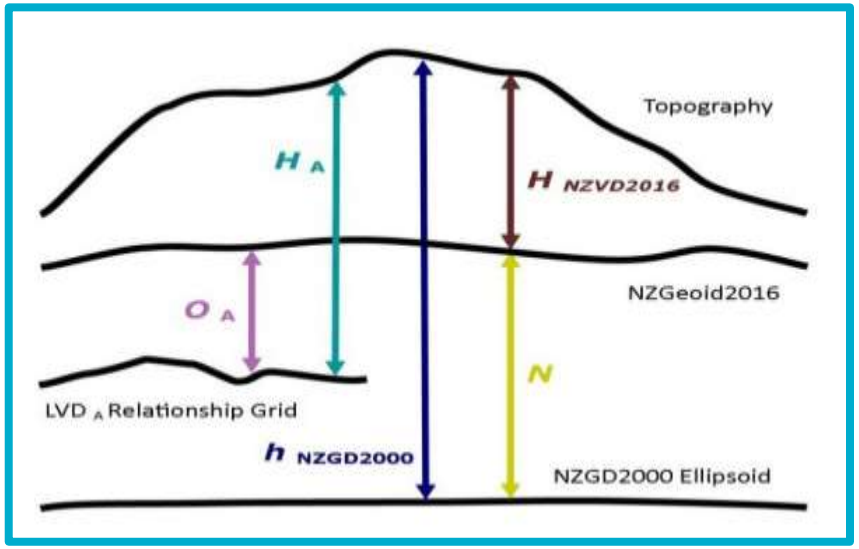
## Working with NIWA to enable linking boundaries in the littoral zone and seamless data:

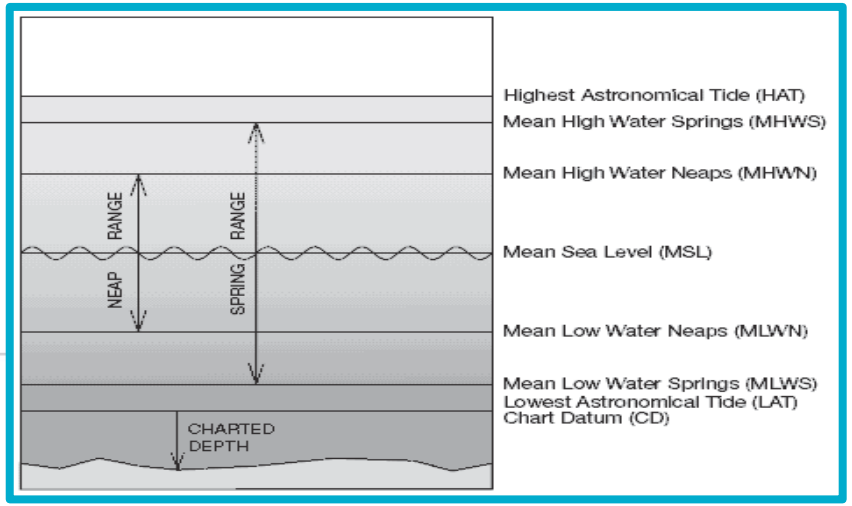
- tool for transforming data between datums
- improved NZ tidal model



# Vertical datums in New Zealand

- All elevation/depth data is referenced to a vertical datum:
    - 13 Local vertical datums
    - NZGD2000 (=ellipsoid)
    - NZVD2009 (=geoid)
    - NZVD2016 (=geoid)
    - Tidal datums – eg MHWS
- For elevation datasets to be blended together, they must be referenced to the same vertical datum

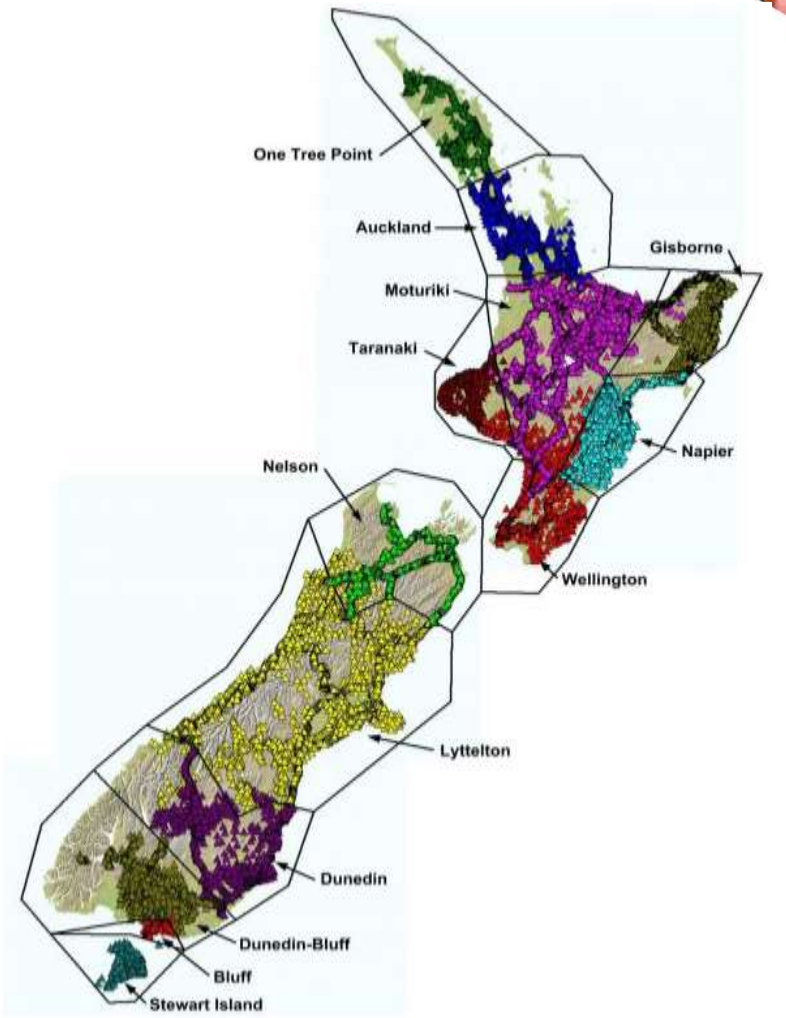


# Sea-level datums

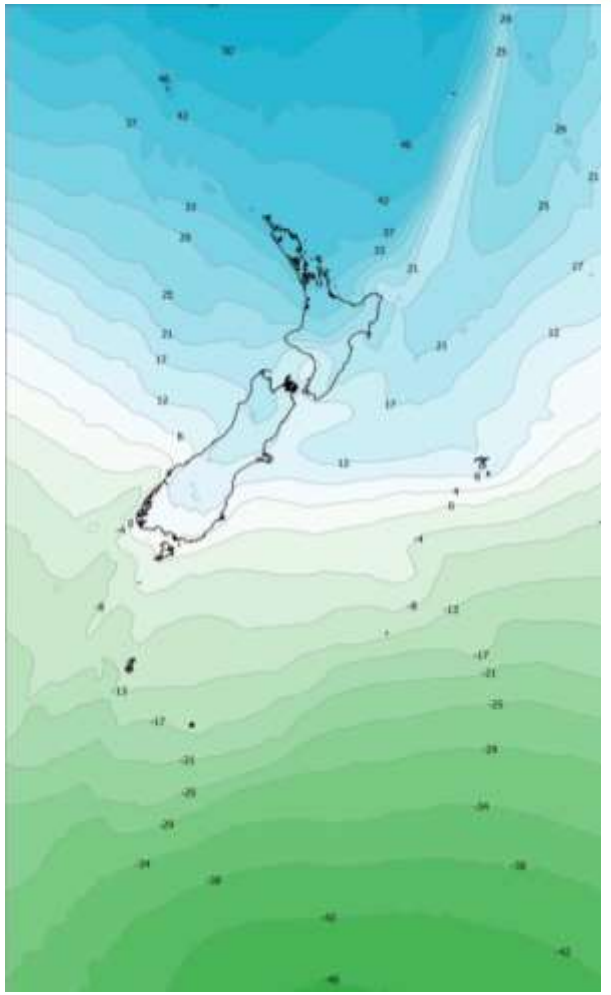
No national sea level datum

- 13 local datums based on MSL at a single tide gauge



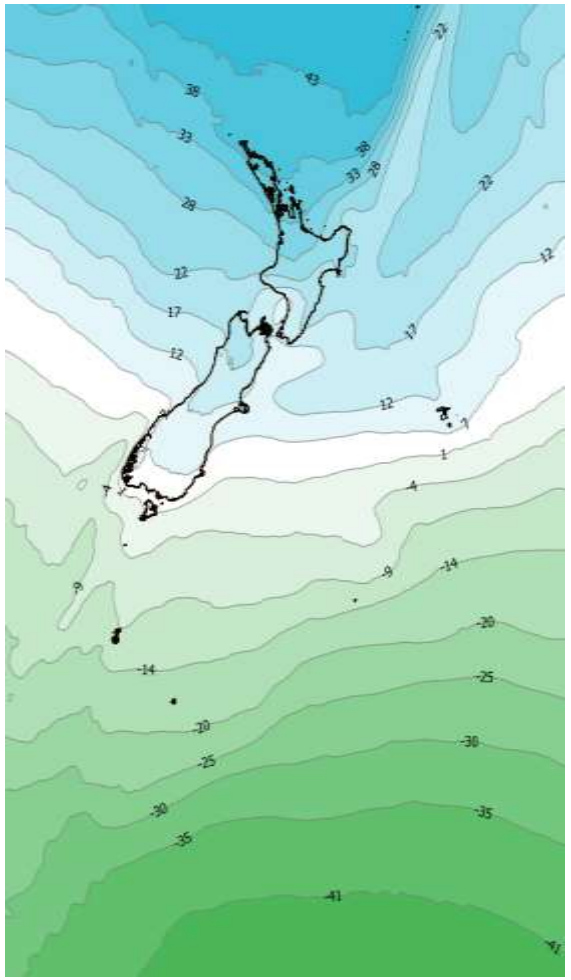
# New Zealand Vertical Datum 2009

- **NZ one of the first countries to adopt a geoid based vertical datum**
- Provided nationally consistent vertical datum within the NZ continental shelf
- Enabled normal-orthometric heights from GNSS
- **Included offsets to 13 LVD**
- **Nominal accuracy ±0.06m**



# New Zealand Vertical Datum 2016

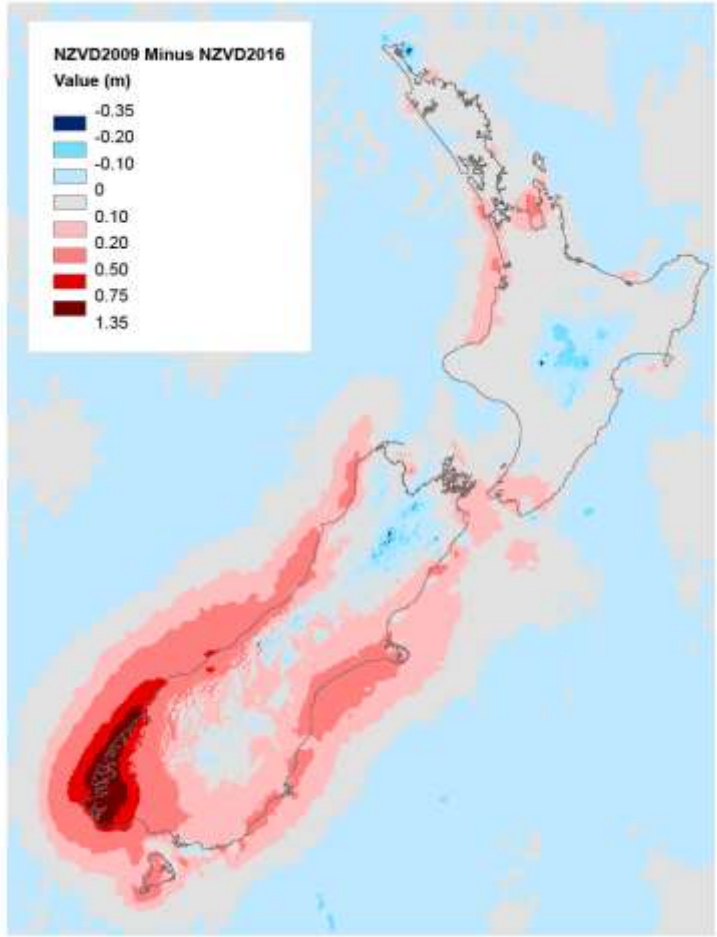
- Inclusion of airborne gravity flown across New Zealand
- Increased nominal accuracy to ±0.02m
- Better links to existing datums
  - LVD relationship grids



# Differences between NZGeoid2009 and NZGeoid2016

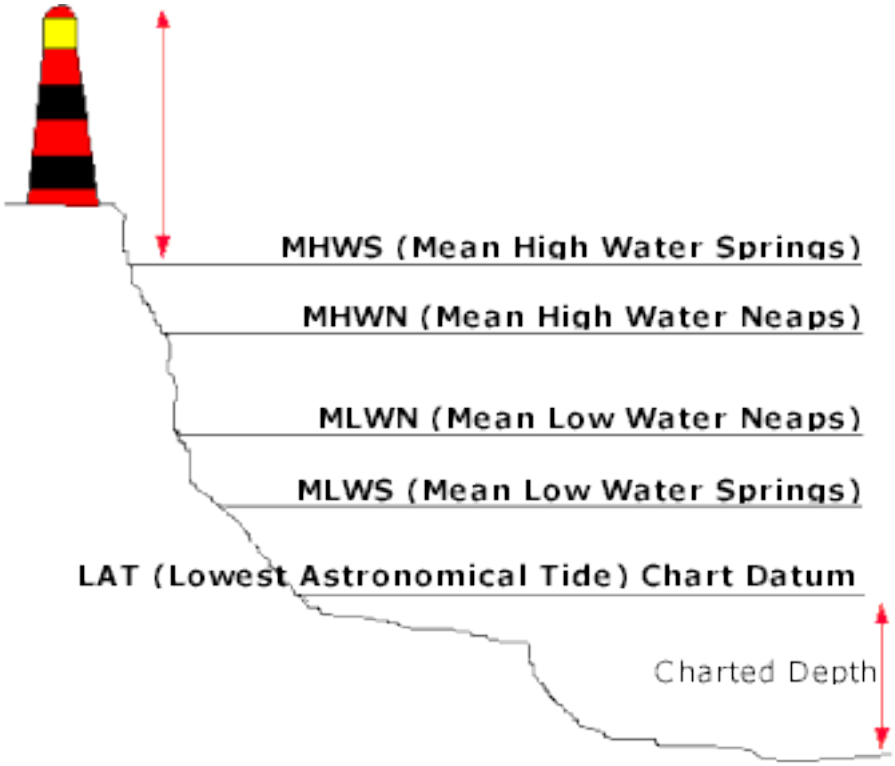
Most significant changes:

- Coastal areas
- Mountainous regions



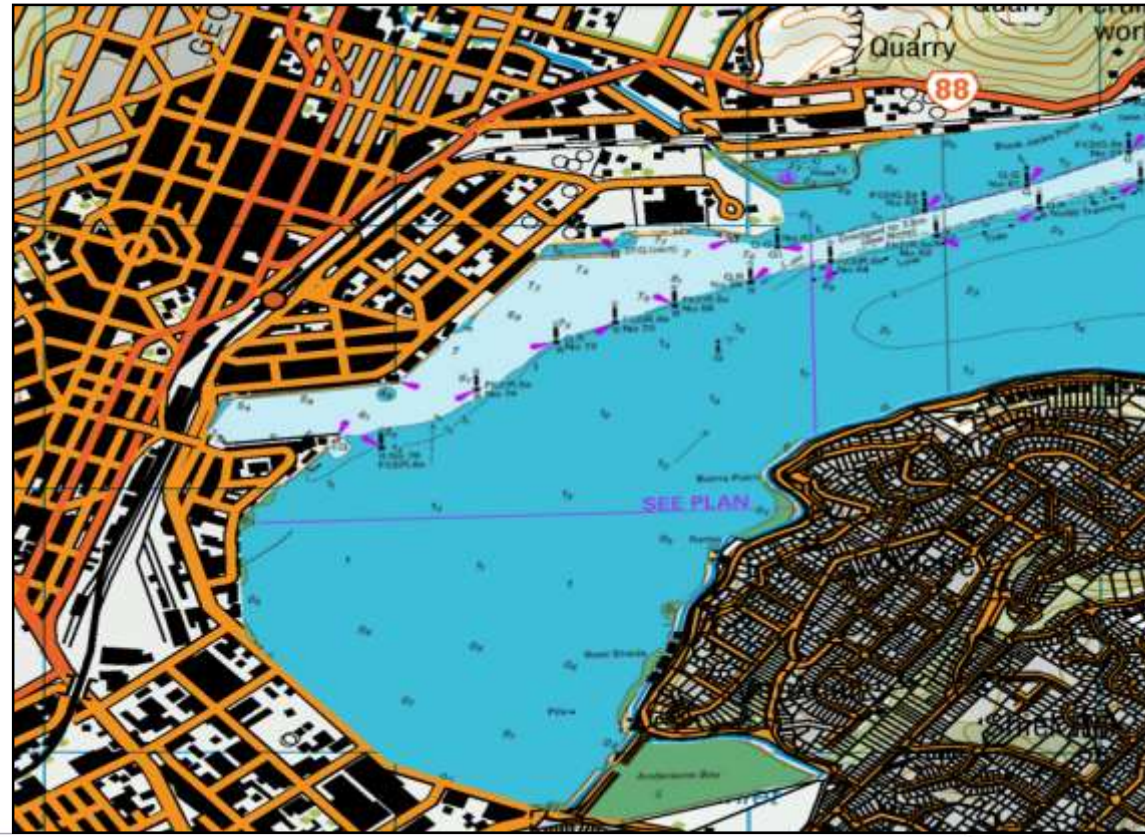
# MHWS and other tidal datum determination

- Like the existing LVDs NZVD2016 currently can not be used to define other tidal datums such as MHWS
- Still need to use evidence based approaches to establish MHWS boundaries



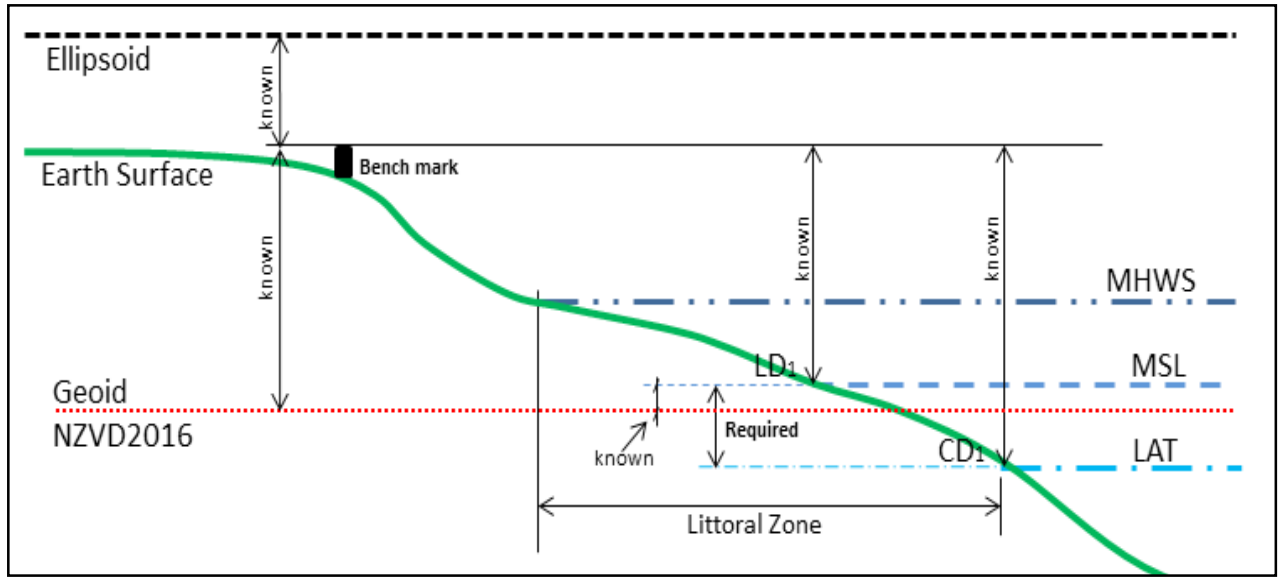
# Joining land and sea datasets

- Datasets usually defined in terms of different vertical datums and reference surfaces
  - Topography – MSL
  - Hydro – LAT/CD
  - Cadastral – MHWS
  - Geodesy – MSL & ellipsoid
- Challenge is to combine different datasets



# Relating vertical datums

- For elevation datasets to be blended together, they must be referenced to a common vertical datum
- Need for a transformation tool



# The JLAS Project:

**Aim:**

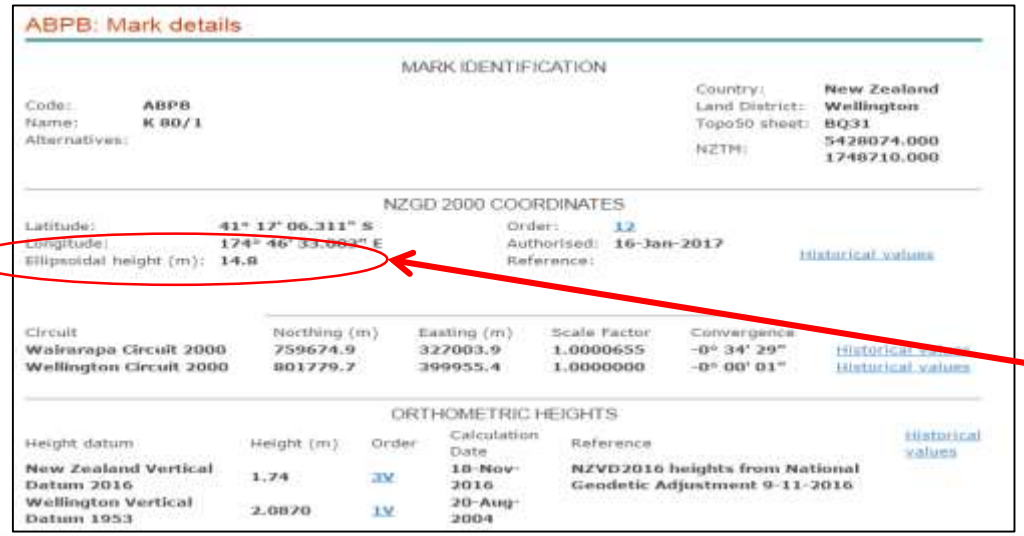
To provide the tools to enable the transformation between geometric and physical datums and enable the computation of sea level boundaries using NZGD2016

**Challenges:**

- We have relatively few long term tide gauges to compute transformations between the various datums
- The current tidal model is outdated and of relatively low accuracy
- DEMs and near shore bathymetry is generally of low accuracy
- What do we use as the zero level for the tidal model
- Do we factor in sea level rise and vertical deformation at the tide gauges?

# Assessing tidal gauge data

- Tidal records > 1 month duration
- Observations since 1990
- Ellipsoidal heights at TG locations



ABPB: Mark details

MARK IDENTIFICATION

Code: ABPB
Name: K 80/1
Alternatives:

Country: New Zealand
Land District: Wellington
Topo50 sheet: BQ31
NZTM: 5428074.000 1748710.000

NZGD 2000 COORDINATES

Latitude: 41° 17' 06.311" S
Longitude: 174° 46' 33.663" E
Ellipsoidal height (m): 14.8
Order: 12
Authorised: 16-Jan-2017
Reference:
Historical values

| Circuit | Northing (m) | Easting (m) | Scale Factor | Convergence | |
|---|---|---|---|---|---|
| Wairarapa Circuit 2000 | 759674.9 | 327003.9 | 1.0000655 | -0° 34' 29" | Historical values |
| Wellington Circuit 2000 | 801779.7 | 399955.4 | 1.0000000 | -0° 00' 01" | Historical values |

ORTHOMETRIC HEIGHTS

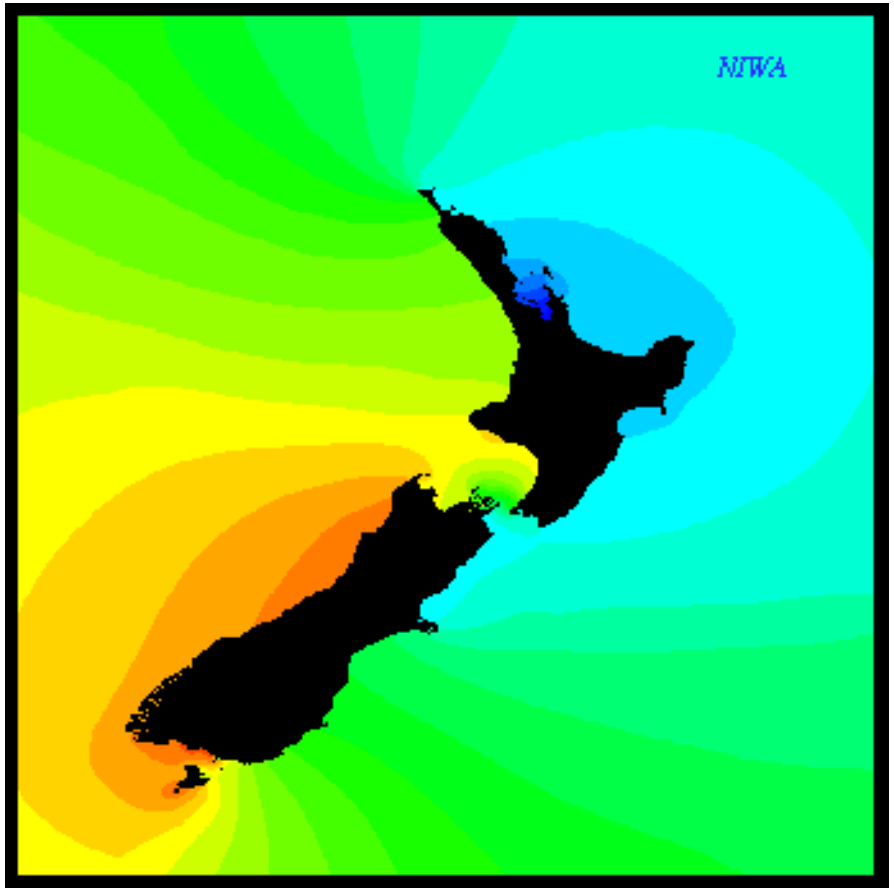
| Height datum | Height (m) | Order | Calculation Date | Reference | Historical values |
|---|---|---|---|---|---|
| New Zealand Vertical Datum 2016 | 1.74 | 3V | 18-Nov-2016 | NZVD2016 heights from National Geodetic Adjustment 9-11-2016 | |
| Wellington Vertical Datum 1953 | 2.0870 | 1V | 20-Aug-2004 | | |

**Tidal Levels referred to Datum of Soundings**

| Place | Lat S | Long E | Heights in metres above Datum | | | | Datum and Remarks |
|---|---|---|---|---|---|---|---|
| | | | MHWS | MHWN | MLWN | MLWS | |
| Wellington | 41°17' | 174°47' | 1.7 | 1.4 | 0.7 | 0.4 | 3.002m below LINZ mark code ABPB. |

# Assessing national tidal model

- Developed by NIWA 1996-2000
- DEM created – global seabed DEM, NIWA bathy, digitized coastal hydro charts
- Particularly poor in harbours and where there are large tidal gradients
- Unknown accuracy



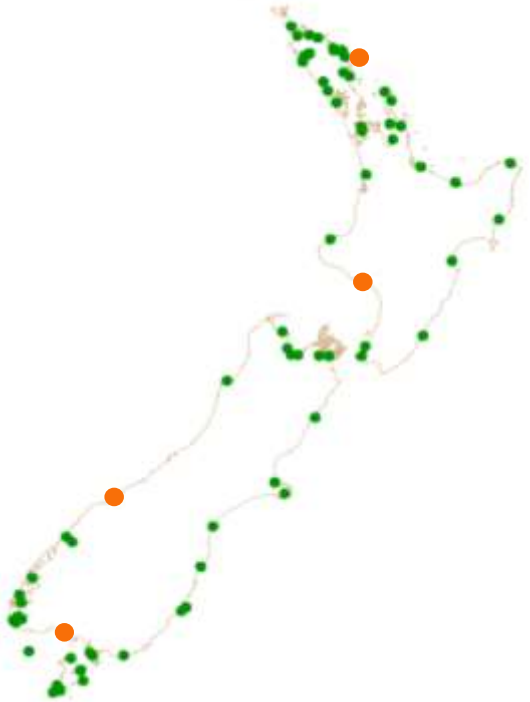
# Phase 1: Using existing NIWA tidal model

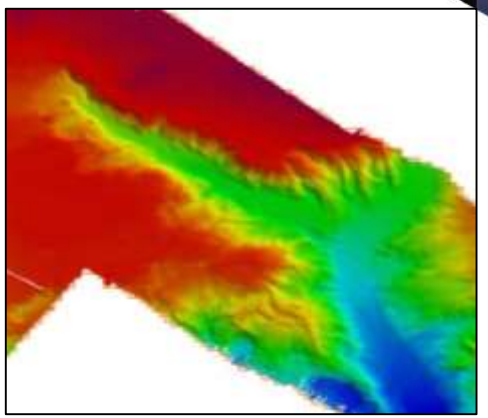
- Compute relations between datums at tide gauges
- Assess accuracy of current tidal model and incorporate
- Develop on-line transformation tool development

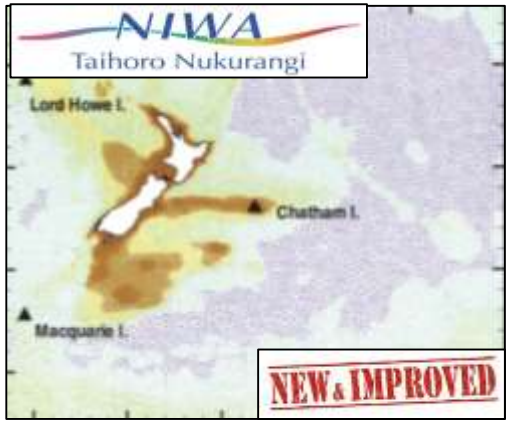

Sites used for current NIWA Tide Model

# Phase 2: Incorporate a new tidal model

- Improve elevation model, on and offshore around the coast
- Additional/temporary tide gauges
- Update tide data and satellite altimetry to develop improved tidal model
- Update transformation tools



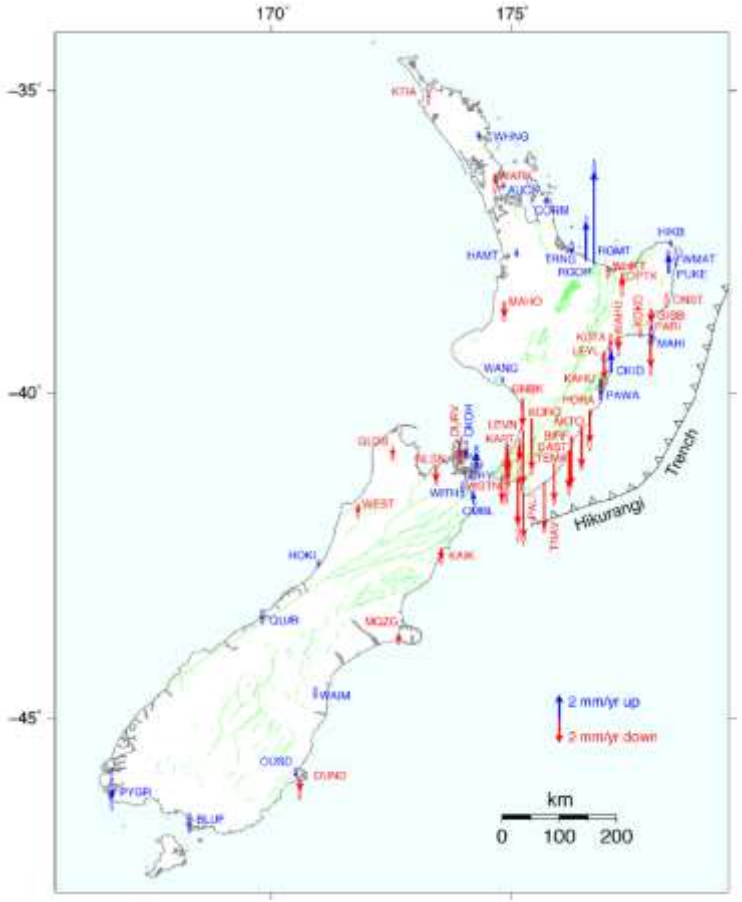




# Phase 3: Incorporate vertical rates of deformation and sea level rise

Regional trends - lower North Island subsiding at 1-3mm/year

Sea level rising by 3mm/year




Vertical rates estimated at near-coast GNSS sites. (GEONET/LINZ)

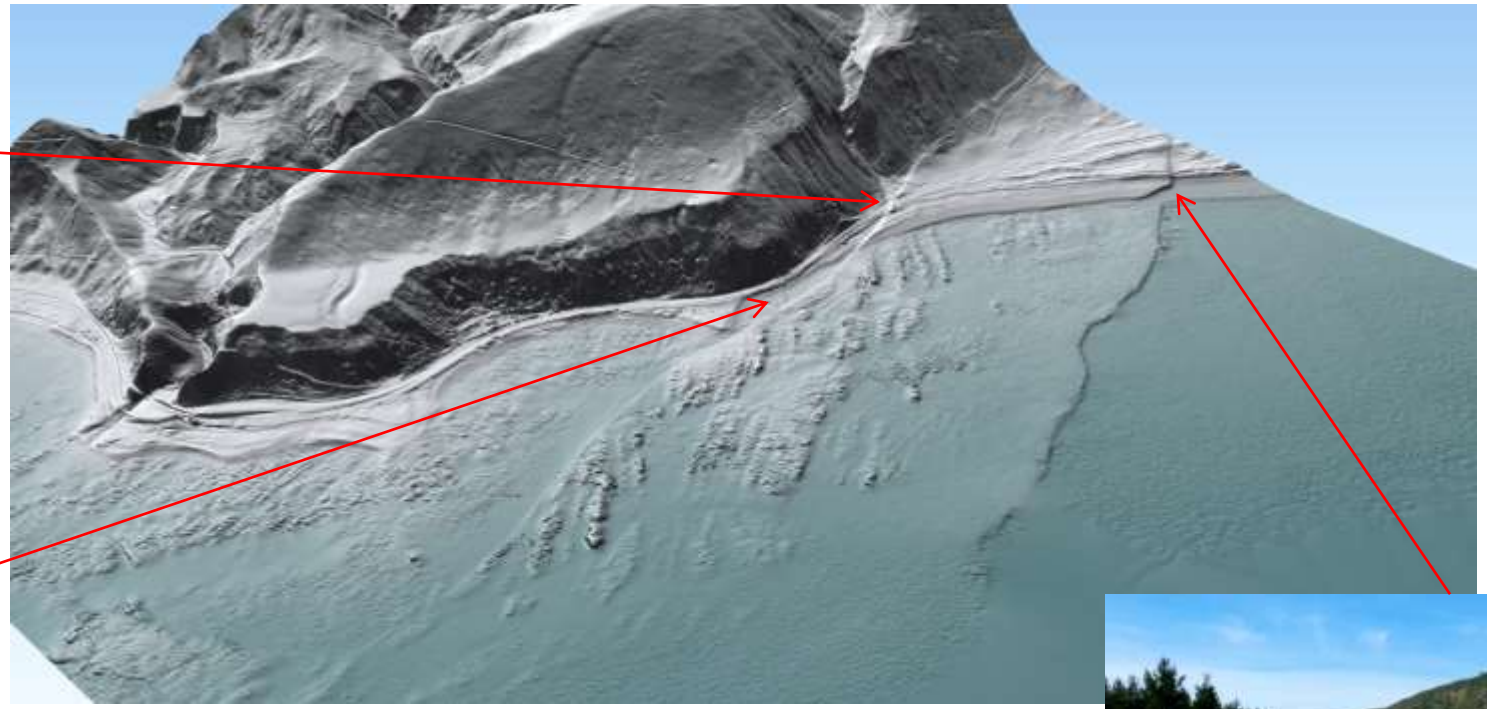


Beavan, R.J.; Litchfield, N.J. 2012. Vertical land movement around the New Zealand coastline: implications for sea-level rise, *GNS Science Report* 2012/29

# Benefits and Applications

- Improved modelling:
  - Sea level rise
  - Flooding
  - Tsunami
- Integrated ocean and coastal mapping
- Shoreline studies
- Hydrographic surveying:
  - Integrating bathymetric datasets
  - Collecting and Processing survey data
  - Surveying on the ellipsoid

Significant ground displacement occurred during the Kaikoura earthquake. Joined up land and and marine LIDAR show faults breaks running off-shore



# Presentation Summary

- There is a need for a tool that easily transforms from one VD to another
- LINZ's JLAS aims to build such a tool
- The proposed solution is a Phased approach
- The benefits to NZ include improved modelling for resiliency and gaining efficiencies in hydrographic surveying

# Questions

## Acknowledgements

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