

The New Zealand Joining Land and Sea Project

UN-GGCE International Workshop

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Today's presentation

- Introduction to LINZ projects
- Vertical datums in NZ
- Background on LINZ'S JLAS project
- What we've done so far
- Challenges and issues
- Discussion



Our vision

Seamless mapping across the land and seabed for integrated datasets and improved modelling



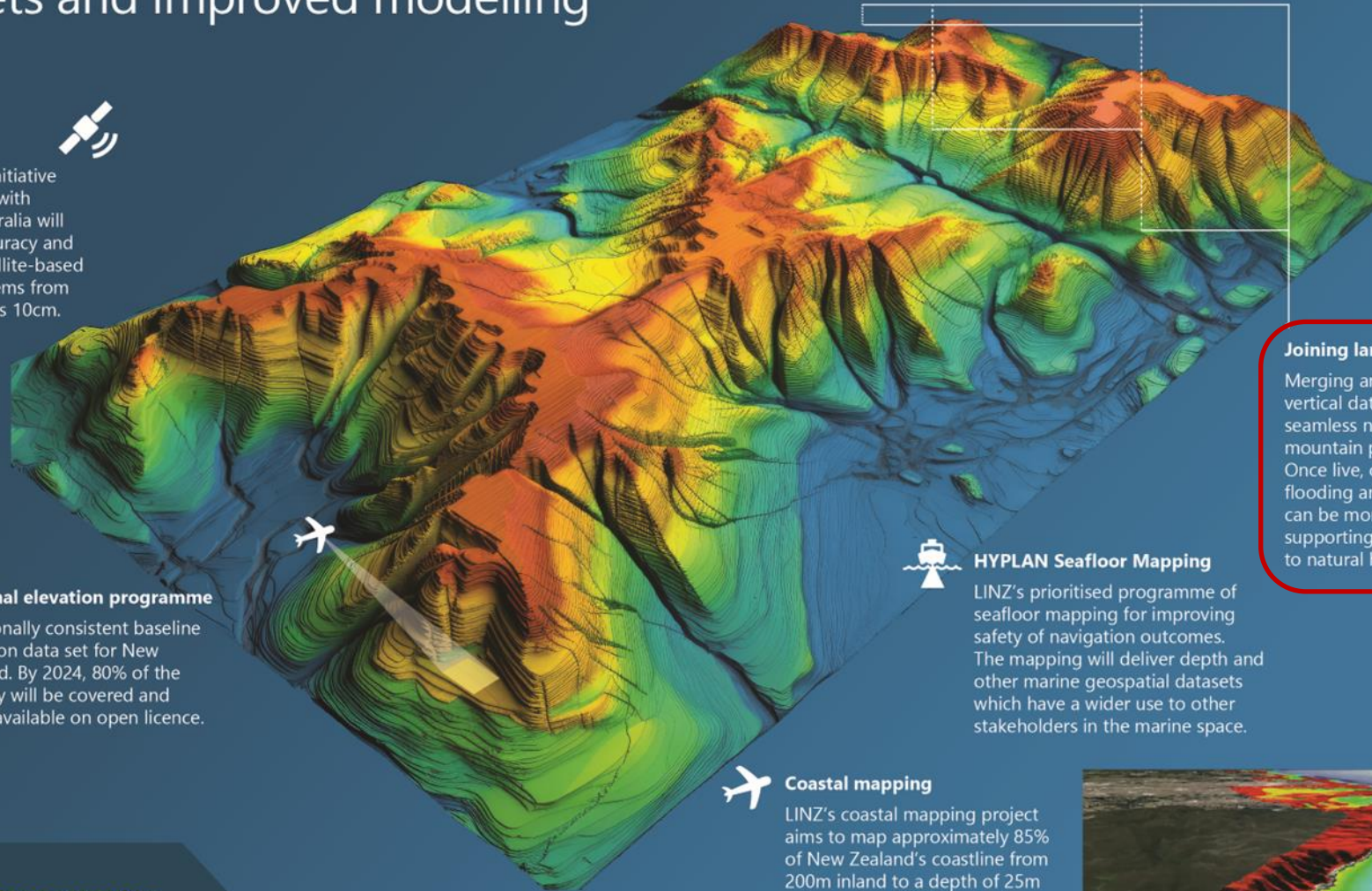
Our SouthPAN initiative in collaboration with Geoscience Australia will improve the accuracy and reliability of satellite-based positioning systems from 10m to as little as 10cm.

National elevation programme

A nationally consistent baseline elevation data set for New Zealand. By 2024, 80% of the country will be covered and freely available on open licence.

Seeking new data partnerships

Do you have LiDAR data we could include?
Planning future LiDAR data collection projects?
Let's collaborate! Chat to the team to learn more.



Joining land and sea project

Merging and aligning multiple vertical datums to enable a seamless national map from mountain peak to seabed. Once live, changes in sea levels, flooding and tsunami inundation can be more easily modelled, supporting greater resilience to natural hazards.



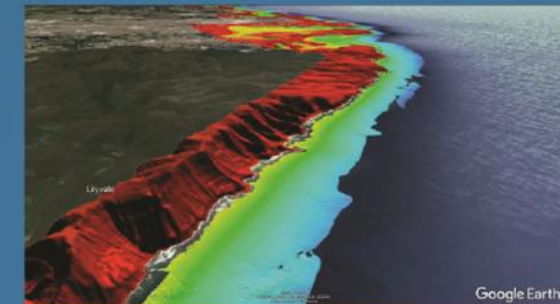
HYPLAN Seafloor Mapping

LINZ's prioritised programme of seafloor mapping for improving safety of navigation outcomes. The mapping will deliver depth and other marine geospatial datasets which have a wider use to other stakeholders in the marine space.



Coastal mapping

LINZ's coastal mapping project aims to map approximately 85% of New Zealand's coastline from 200m inland to a depth of 25m using mainly LiDAR technology to map elevation and depth across land and sea.



New Zealand Hydrographic Authority

National
Hydrographer

Adam
Greenland

Products: Charts

Marvin
Espino

Alison
Cantrill

Marcel Lanz

Christine
Clarke

Yaas
Shalla

Data: Sea

Bradley
Cooper

Jennifer
Coppola

Annette
Wilkinson

Thomas
Pouliquen

Charting Systems

Kristian
Jones

Ryan
Cleverly

Daehyun
Park

Maritime Digital
Transformation

Verena
Bosselmann-
Borsos

Mark
Broadbent


3D Coastal Mapping

Stuart
Caie

Sarah
Udy

Alysha
Johnson

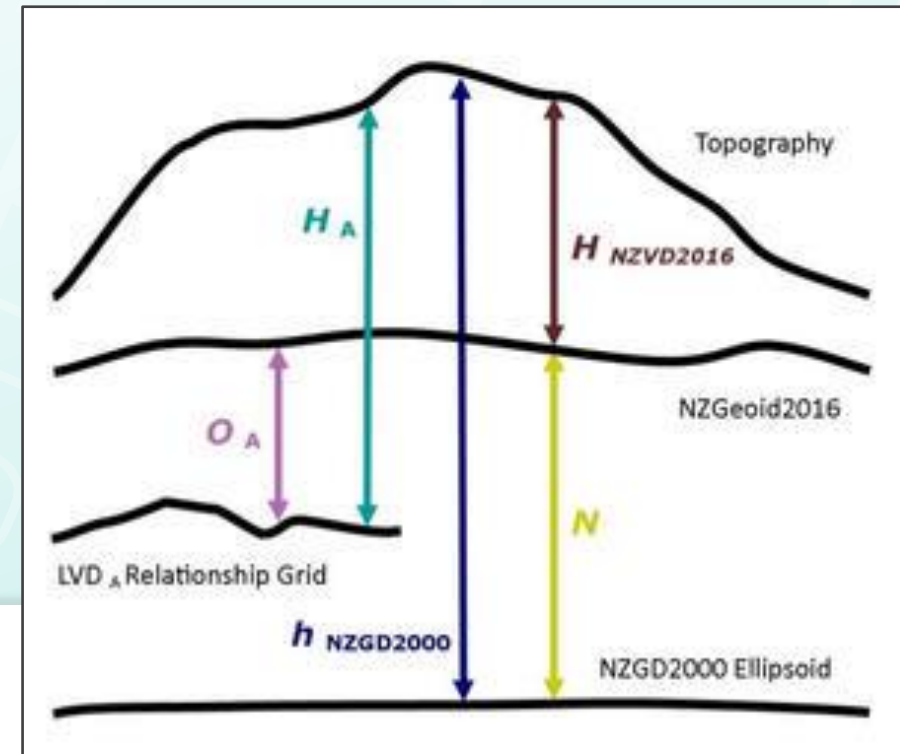
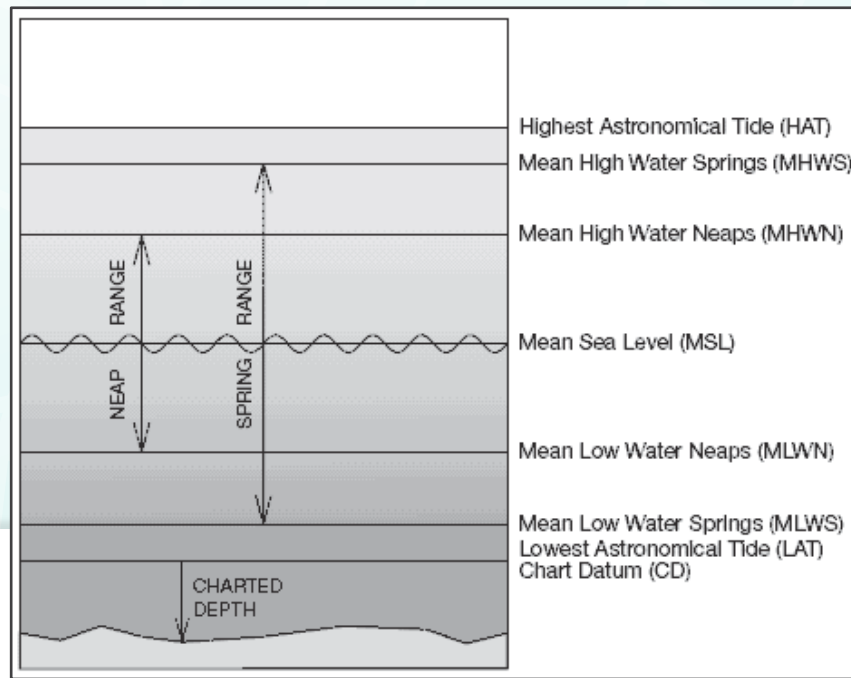
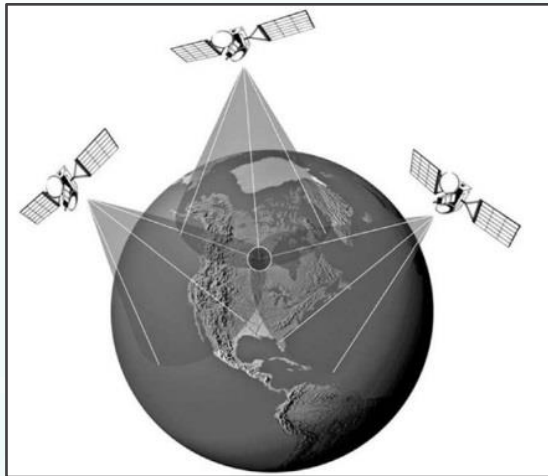
The Joining Land and Sea Project

 Auckland rural region

Background

All height/depth data is referenced to a vertical datum

- Ellipsoidal Datums – e.g. WGS84, NZGD2000
- Orthometric Datums – e.g. based on MSL, NZ Vertical Datum 2016 (geoid)
- Tidal Levels – e.g. Lowest Astronomical Tides (LAT)



Background

- For datasets to be **blended** together, they must be referenced to the **same vertical datum**
- Conversion grids on the LINZ Data Service (data.linz.govt.nz)

NZ Quasigeoid 2016

☆ ... Map +

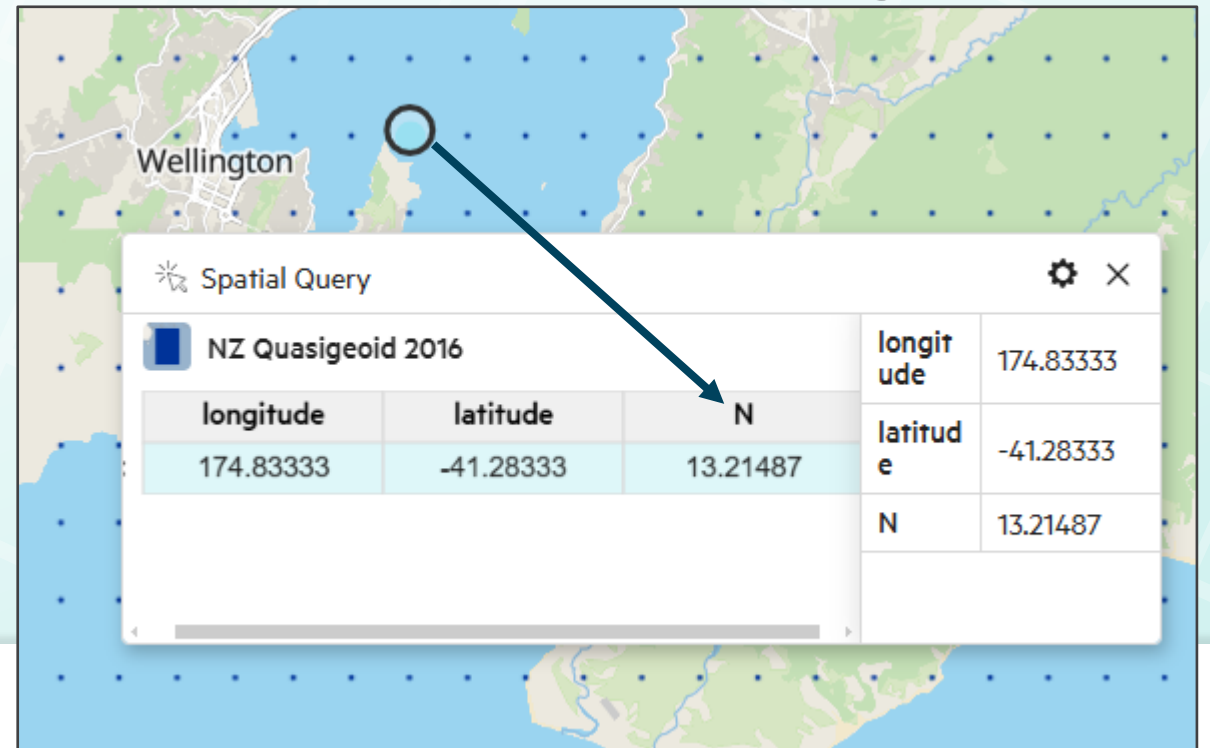
Info History Services and APIs

The relationship between the GRS80 ellipsoid and the New Zealand Vertical Datum 2016 (NZVD2016) is modelled by the New Zealand Quasigeoid 2016 (NZGeoid2016). The relationship value is represented by the attribute "N", in metres.

This relationship and NZVD2016 is formally defined in the LINZ standard [LINZS25009](#).

NZGeoid2016 can be used to convert New Zealand Geodetic Datum 2000 (NZGD2000) ellipsoidal heights to NZVD2016 normal-orthometric heights.

The conversion value is represented by the attribute "N", in metres.



Background

- Joining sea-based data and land-based data is more difficult

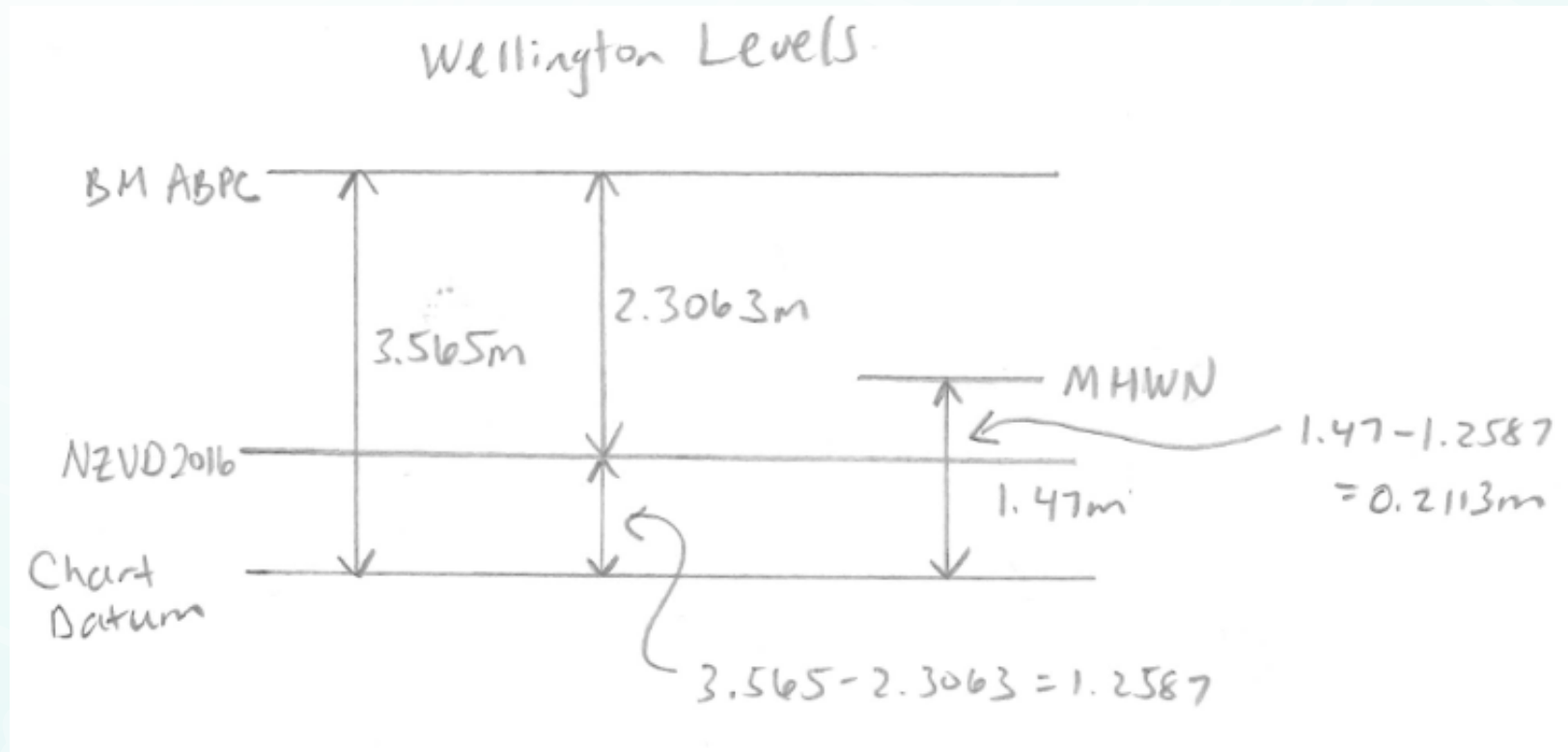


Chart Datum
(LAT)

NZVD2016
(geoid)

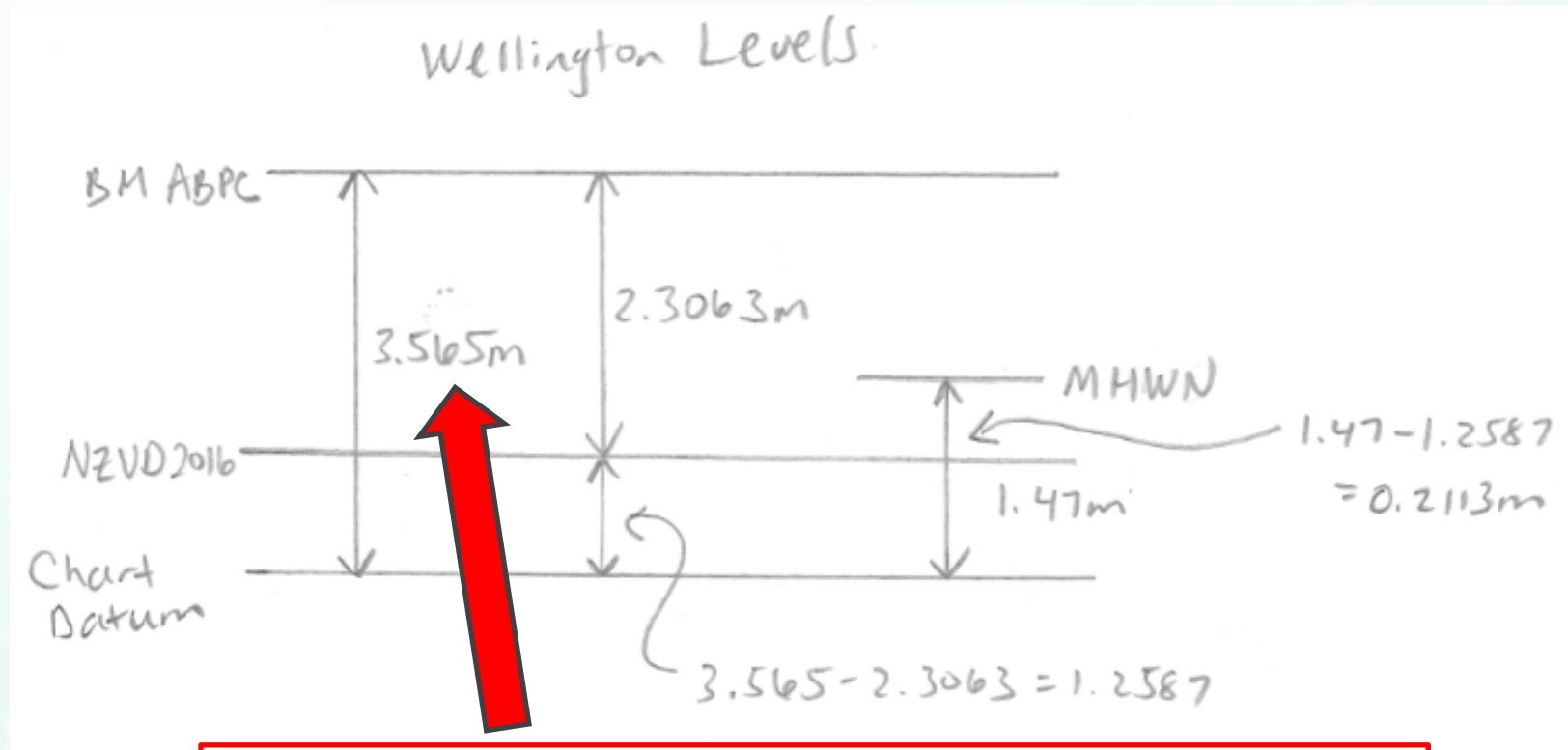
Background

- Example: finding MHWN in terms of NZVD2016



Background

- Example: finding MHWN in terms of NZVD2016



Wellington: 3.565m below B.M. K80/2 (LINZ code ABPC), a stainless steel pin set in concrete under an iron cover, at the southern end of Lambton Quay, 35m from Willis Street.

Background

- Example: finding MHWN in terms of NZVD2016

Wellington Level

BM ABPC

NZVD2016

Chart Datum

3.565m

2.3063m

3.565

ABPC: Mark details

MARK IDENTIFICATION

Code: **ABPC**
Name: **K 80/2 SO 35616**
Alternatives: **K 80/2**

Country: **New Zealand**
Land District: **Wellington**
Topo50 sheet: **BQ31**
NZTM: **5427961.112**
1748717.541
Scale factor: **0.9998722**
Convergence: **+1° 10' 19"**

NZGD 2000 COORDINATES

Latitude: **41° 17' 09.9653" S** Order: **6** [Previous coordinates](#)
Longitude: **174° 46' 33.5068" E** Authorised: **03-Aug-2020**
Ellipsoidal height (m): **15.340** Reference: **2019.09.12 - GNS Wellington TG Levelling Ellipsoidal Hgts**

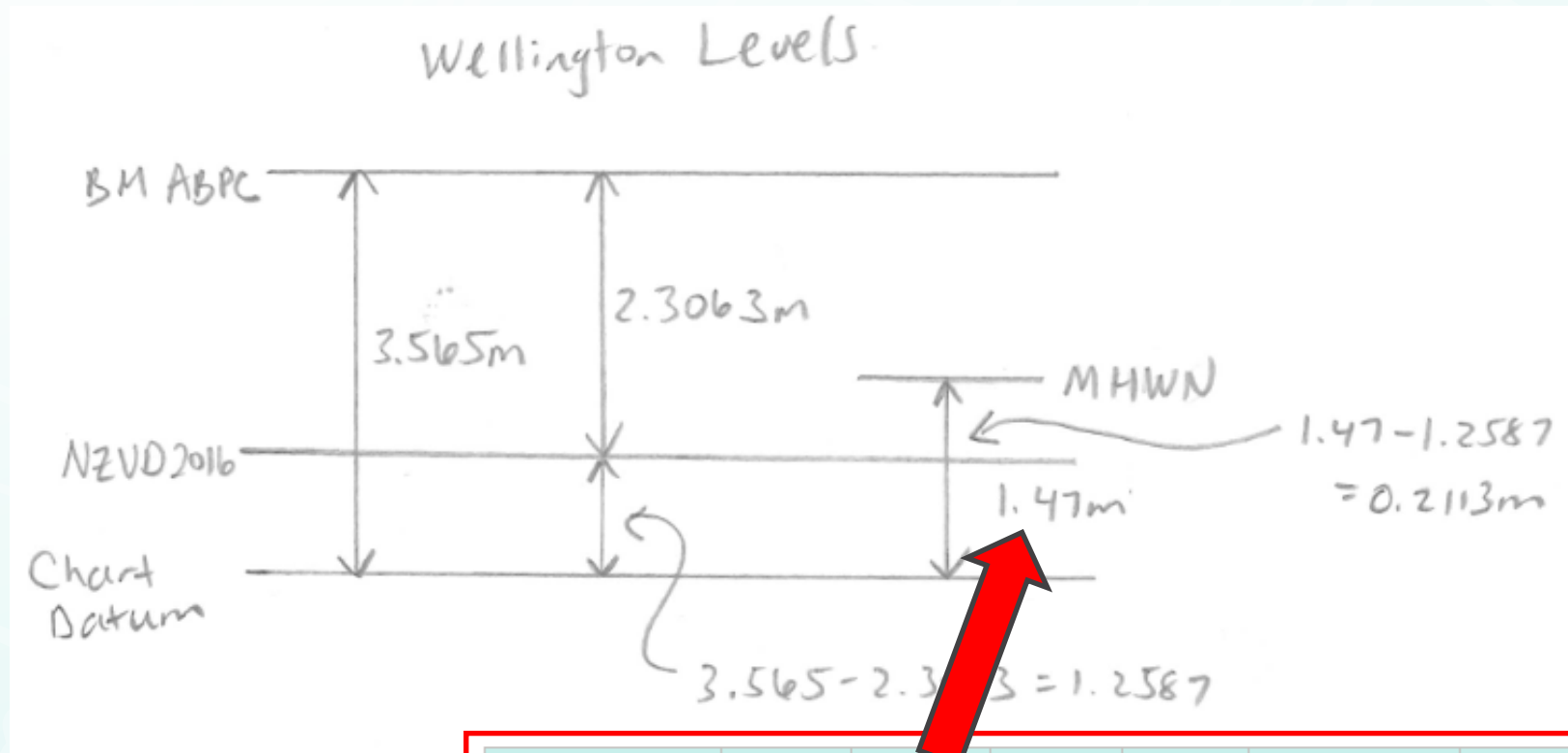
Wellington Circuit 2000	Northing (m)	Easting (m)	Scale Factor	Convergence	Previous coordinates
	801666.97	399965.25	1.0000000	-0° 00' 01"	

NEW ZEALAND VERTICAL DATUM 2016 HEIGHT

Height (m): **2.3063** [Previous heights](#)
Order: **1V**
Authorised: **05-Aug-2020**
Reference: **2019.09.12 - GNS Wellington TG Levelling**

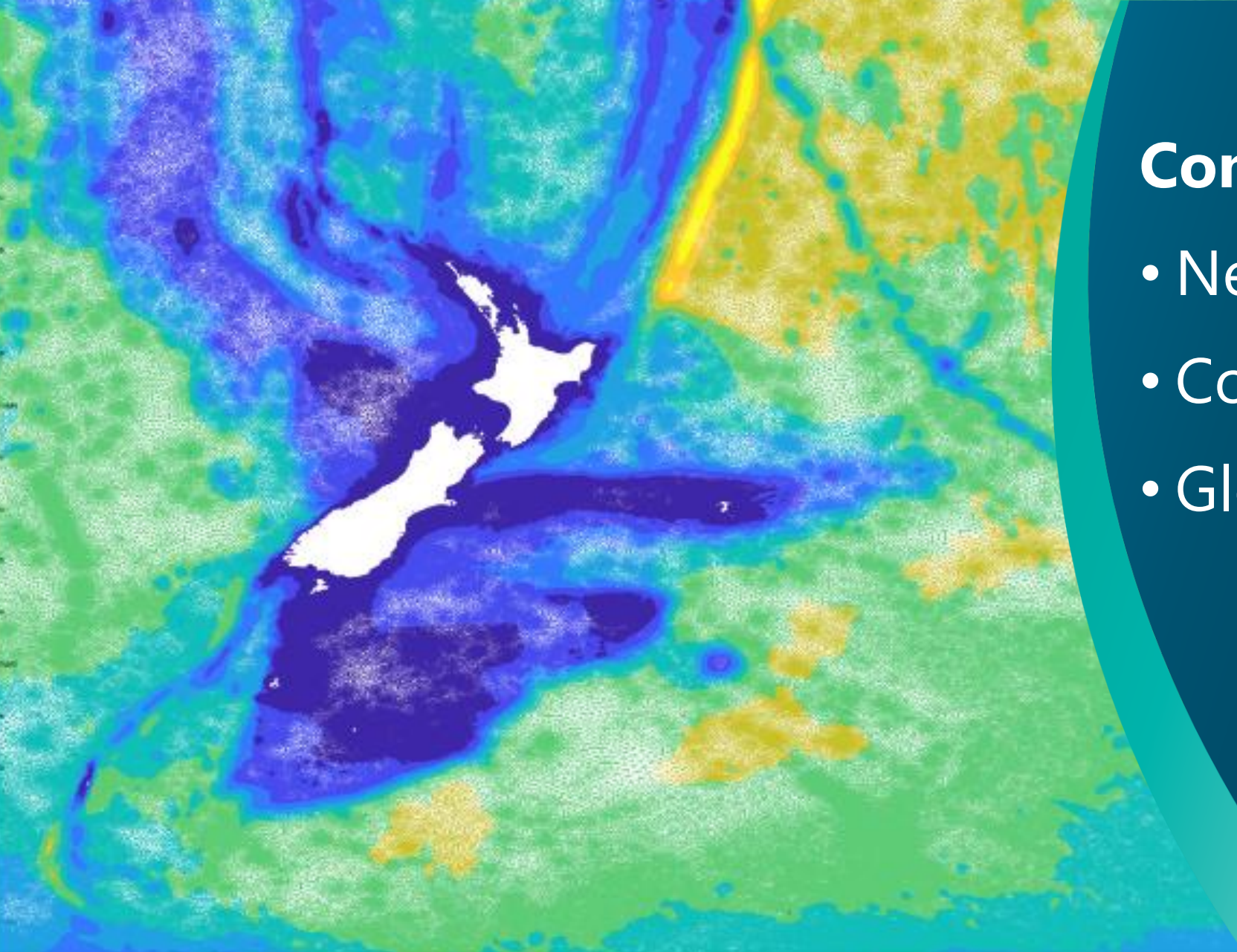
Background

- Example: finding MHWN in terms of NZVD2016



Standard port	MHWS	MHWN	MLWN	MLWS	Spring range	Neap range	MSL	HAT	LAT
Wellington	1.79	1.48	0.8	0.53	1.26	0.68	1.14	1.9	0.43



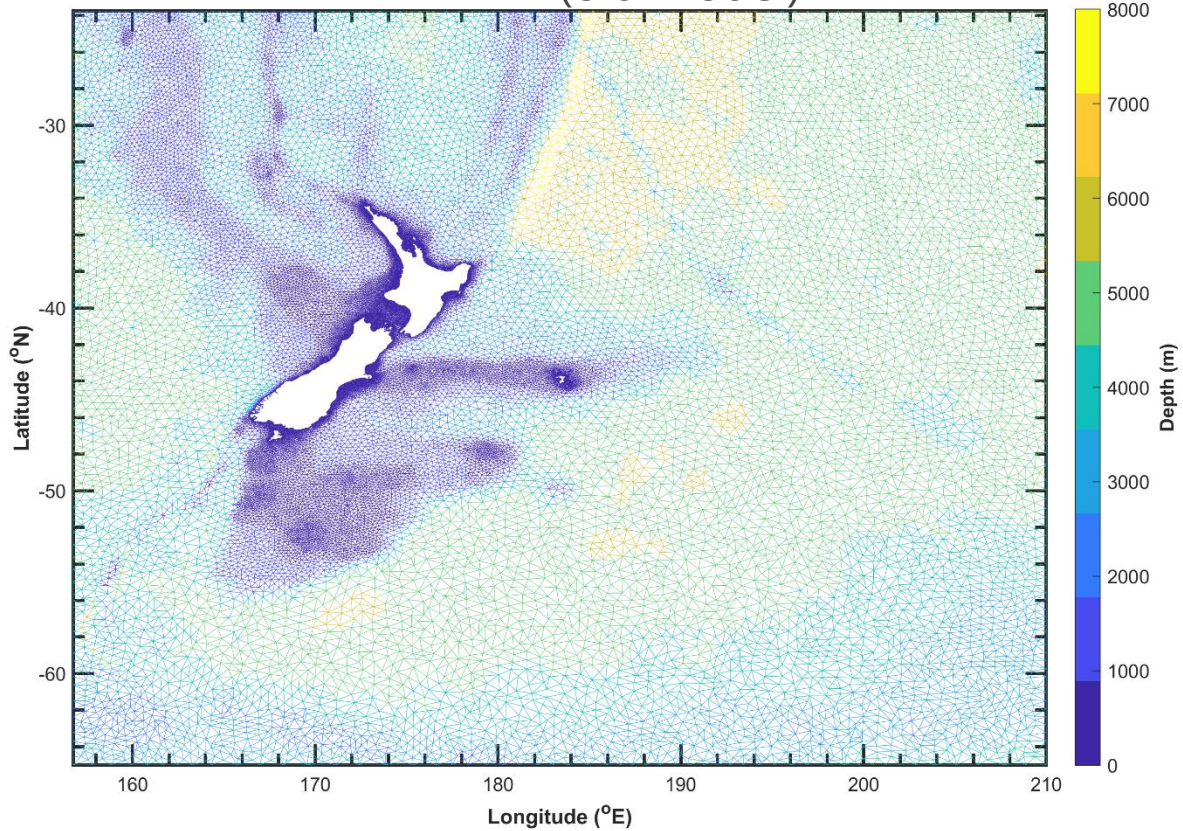


Components of JLAS:

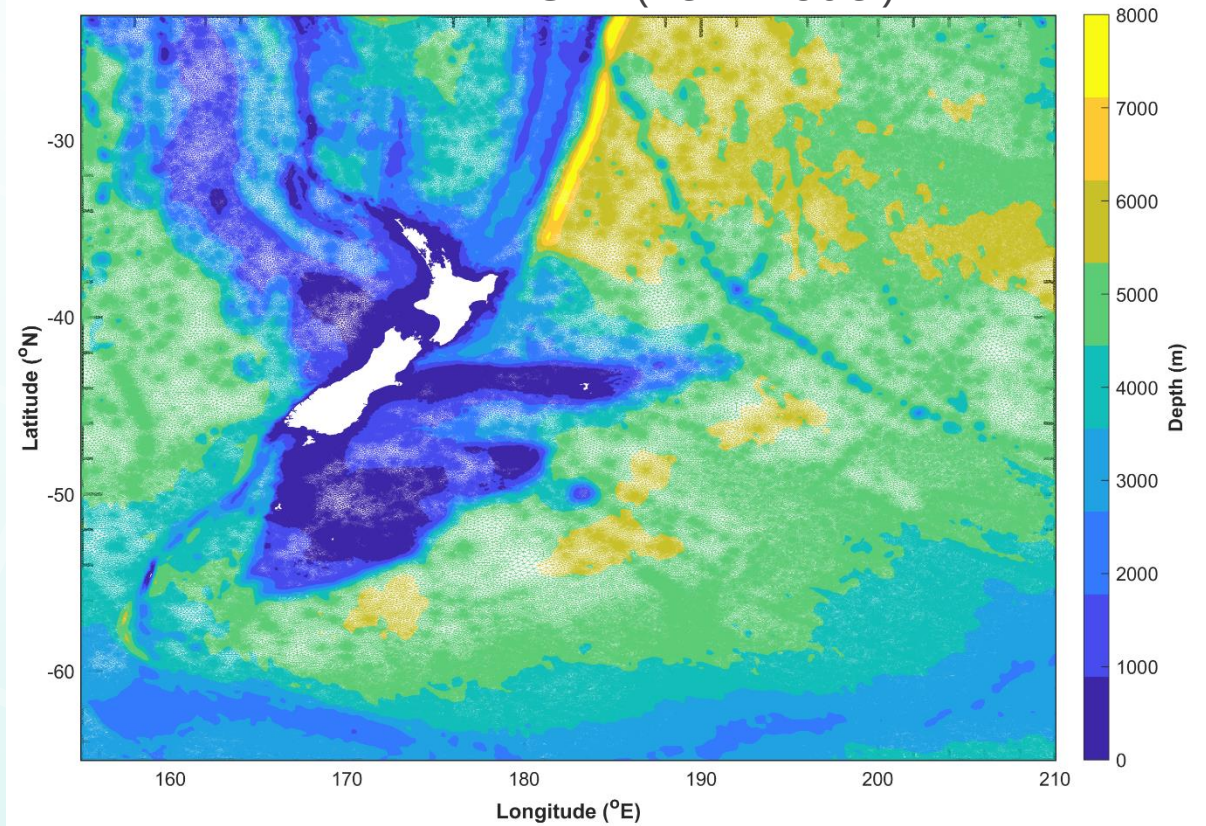
- New national tidal model
- Coastal Link Sites
- Global MSS model

NIWA's Tide Model

TIDE2D (old model)



TELEMAC2D (new model)



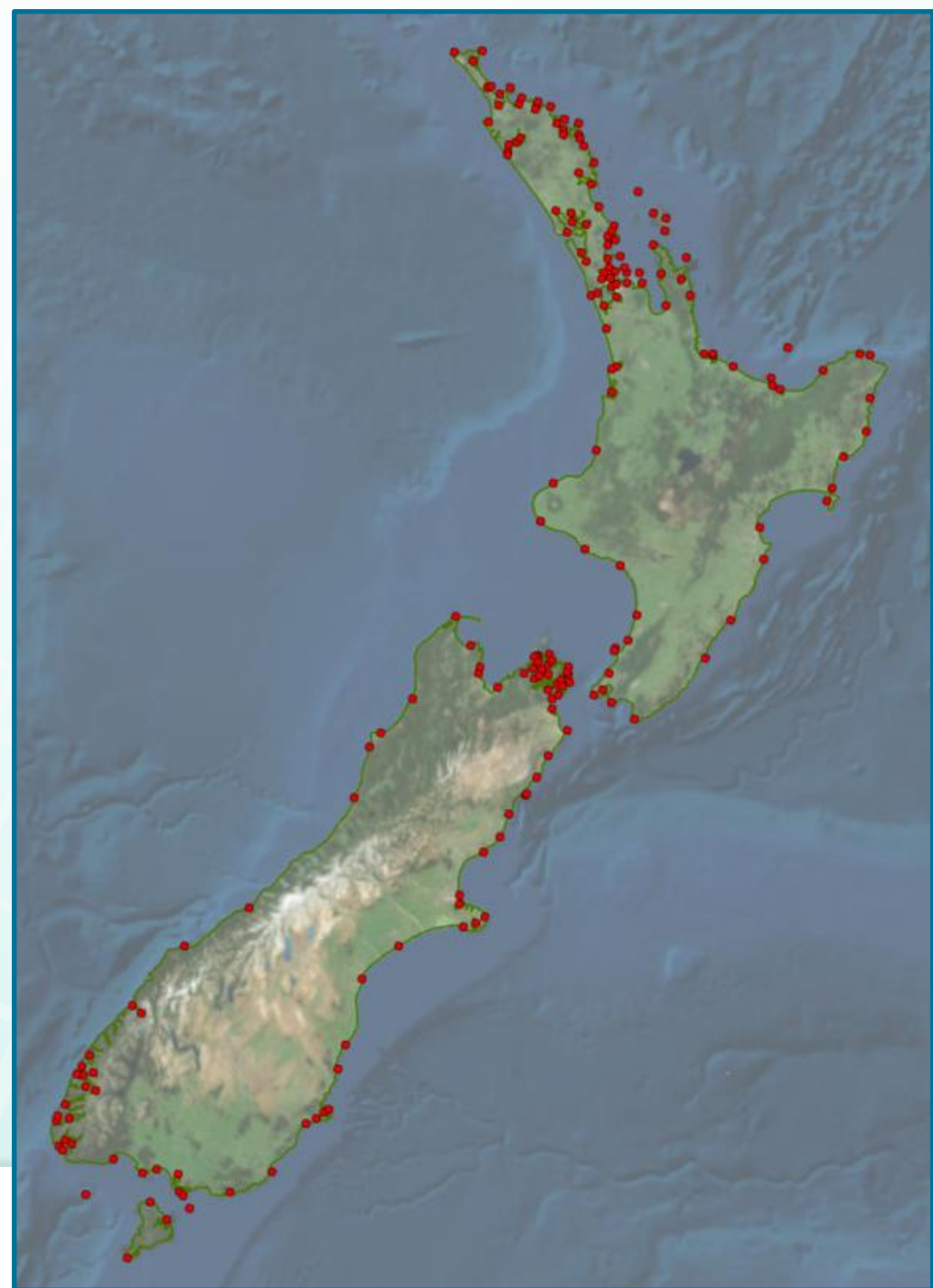
Tide Model Surfaces

HAT: Highest Astronomical Tide	LAT: Lowest Astronomical Tide
MHWS: Mean High Water Springs	MLWS: Mean Low Water Springs
MHW: Mean High Water	MLW: Mean Low Water
MHWN: Mean High Water Neaps	MLWN: Mean Low Water Neaps

*Tide surfaces are in terms of Mean Sea Level

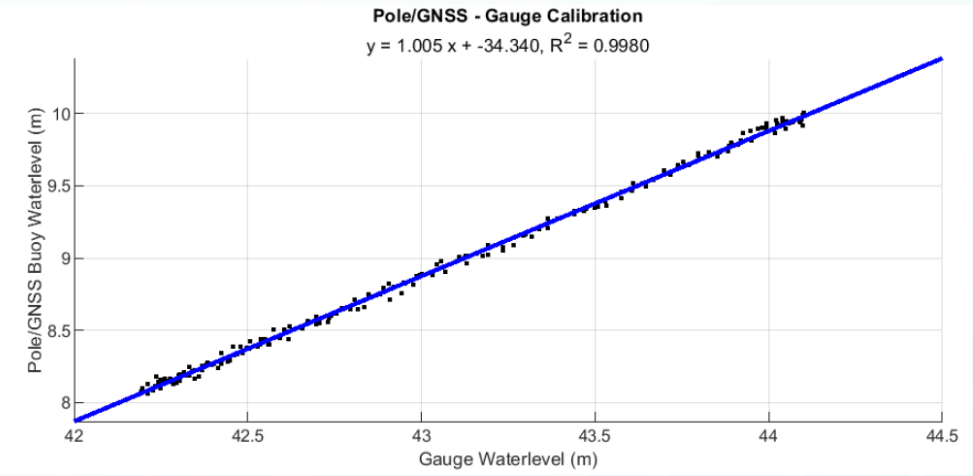
Coastal Link Sites

- Sites to tie tide surfaces to geoid
- Approx. 200 sites, including:
 - 3rd party permanent gauges
 - Tsunami sensors (open coast)
 - Hydrographic surveys
 - JLAS-contracted



JLAS Coastal Link Sites

- New short-term tide gauges (~35 days)
- Calibrating existing tide gauges
- Surveying benchmarks

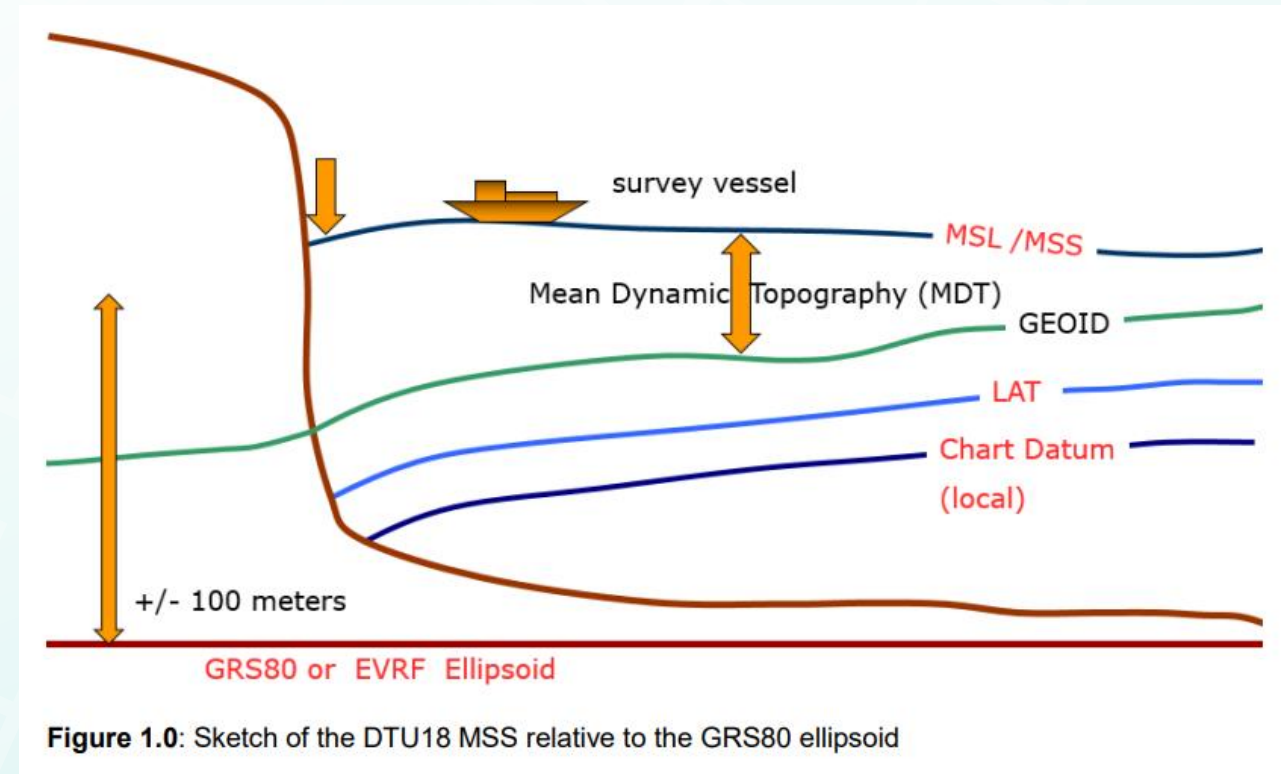


IT XX SO 4122 (LINZ Code C26A)			
	2.130		
BP 1 GREEN ISLAND (LINZ Code F6GF)		3.007	
BP 2 GREEN ISLAND (LINZ Code F6GG)	0.161	0.877	9.881
	0.716		7.751
BP 3 GREEN ISLAND (LINZ Code F6GH)			7.590
		10.668	6.874
Zero of Green Island Tide Gauge - with Geod Offset			
Zero of Green Island Tide Gauge			0.170
Derived from GNSS/Gauge Calibration 07/05/23			2.917
			2.747
Zero of GNSS Buoy (Virtual Pole Zero) and NZGD2000 Ellipsoid			

GREEN From Levelling Observations
RED Calculated
BLUE Ellipsoid Height of Control Point
ORANGE Ellipsoid Height of Gauge Zero - from calibration
PURPLE Geod Offset

Mean Sea Surface Model

- Global models:
 - DTU 21 model
 - AVISO
- Reference ellipsoid:
 - WGS84/GRS80
- Only reliable ~30 km from land



Interpolation

- Along coast, between Coastal Link Sites
- From the coastline out to the MSS model

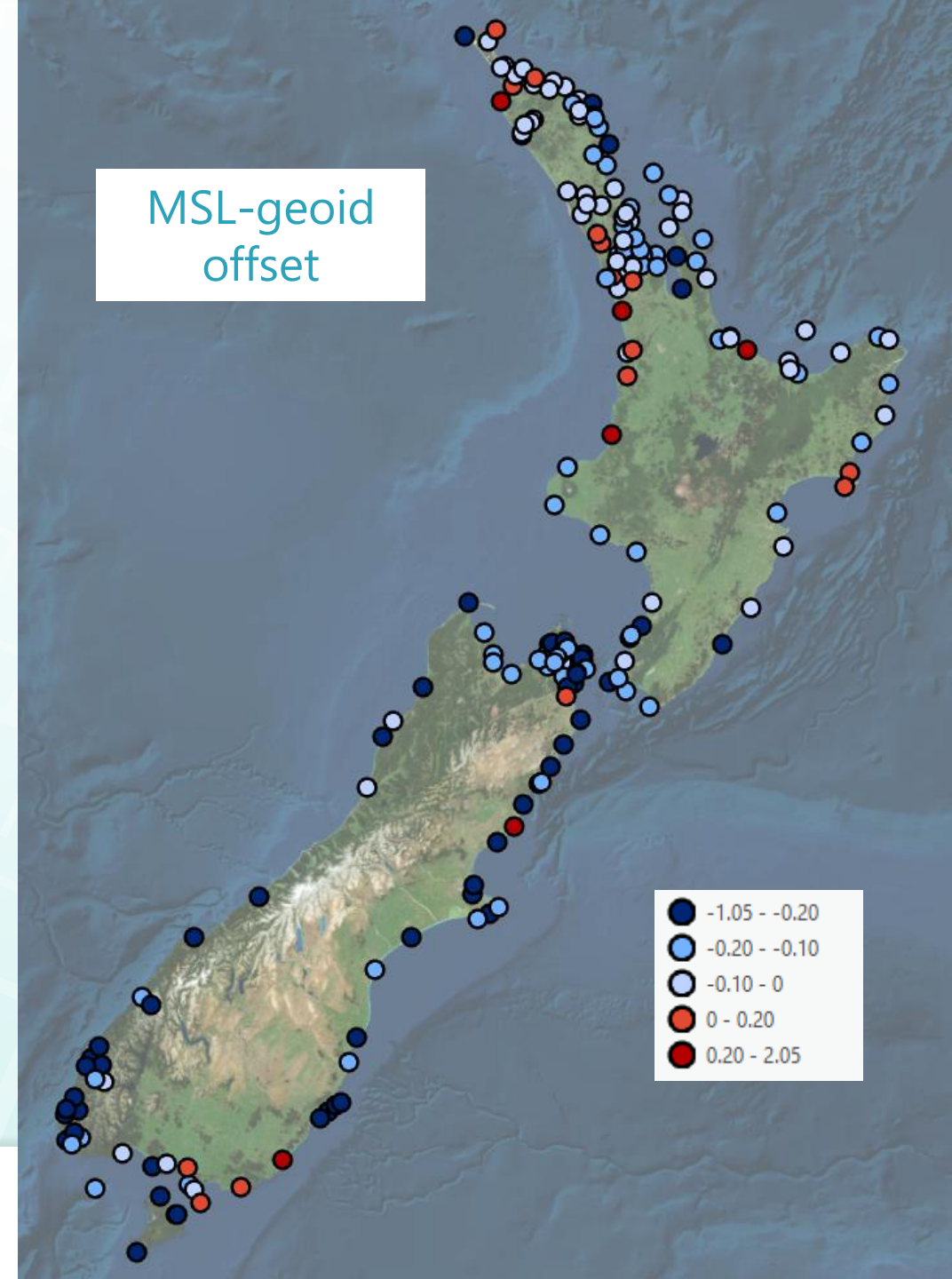
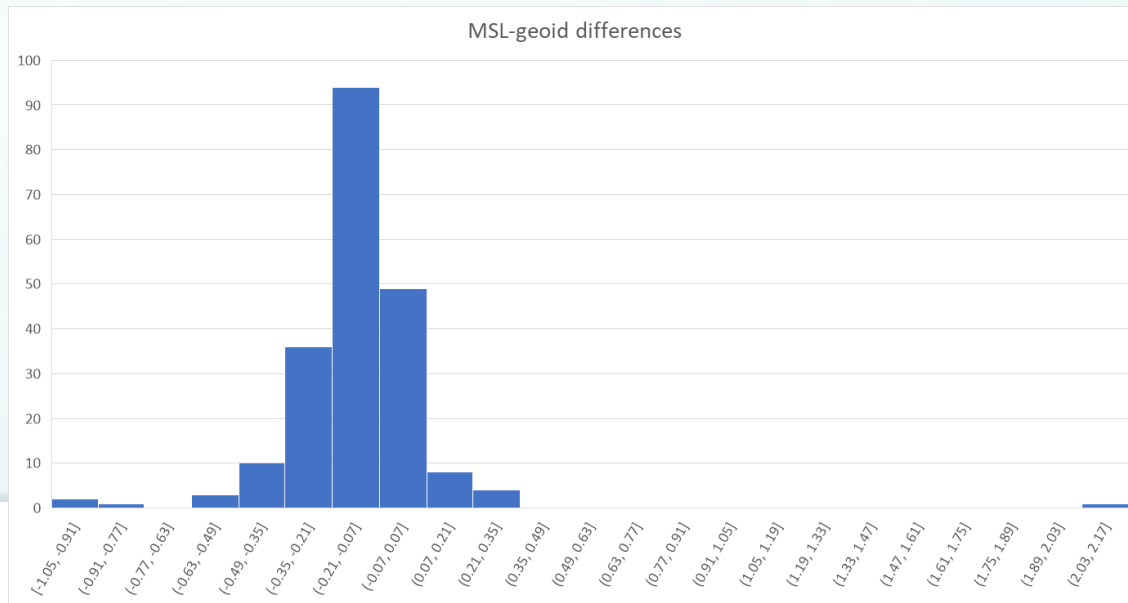
30 km
from coast

MSS



Process so far

1. Calculate MSL from tide observations
2. Use benchmarks to calculate MSL-geoid difference
3. Find and examine outliers



Challenges

- Resourcing
- Processing:
 - Very spreadsheet-based!
 - Metadata are in text files, reports
- Uncertainty in accuracy of MSL for short-term gauges
- Interpolating along a complex coastline

id	location	latitude	longitude	tg_bm	bm_ellip	bm_NZVD	cd_to_bm	cd_to_ellip	cd_to_NZVD	msl	msl_NZVD	msl_ellip
1331	Deas Cove	-45.1966	166.9719	F3AC	5.222	1.21	2.935	2.287	1.73	1.32	-0.41	3.60
1019	Deep Cove	-45.4577	167.1509	F3A1	8.542	1.13	2.435	6.107	1.31	1.31	0.00	7.42
1353	Dog Island	-46.6526	168.4112	DFH7	8.696	5.05	6.988	1.708	1.94	1.88	-0.06	3.58
1084	Doves Bay	-35.1952	174.0349	F4VJ	42.104	2.84	4.463	37.641	1.62	1.46	-0.16	39.10
1422	Dryden Bay	-41.1756	174.186	EX4N	14.944	1.77	2.775	12.169	1.01	0.84	-0.17	13.00
1028	Dunedin	-45.8787	170.5134	AFEQ	8.015	2.38	3.728	4.287	1.35	1.13	-0.22	5.42
1201	East Bay	-41.2407	174.127	EX4J	14.731	1.44	2.375	12.356	0.94	0.81	-0.13	13.16
1105	Elaine Bay	-41.0549	173.7733	EG06	17.892	3.18	4.887	13.005	1.71	1.59	-0.12	14.60
1446	Elie Bay	-41.132	173.9909	F66M	16.359	2.41	4.109	12.25	1.70	1.61	-0.09	13.86
1134	Elmslie Bay	-40.9265	173.844	F4U6	16.764	2.4	4.165	12.599	1.77	1.54	-0.23	14.14
1415	Farmer Point	-34.8045	173.1732	EVWA	43.132	3.73	5.353	37.779	1.62	1.51	-0.11	39.29
1015	Flour Cask Bay	-47.2772	167.476	BAY5	3.6	3.3553	5.269	-1.669	1.91	1.71	-0.20	0.05
1400	Flower Pot	-44.2398	183.7612	EHN9	11.63	2.37	3.291	8.339	0.92	0.58	-0.35	8.91
1330	Fresh Water Basin	-44.6682	167.9265	EB2M	9.233	2.35	3.967	5.266	1.62	1.41	-0.20	6.68
1092	Front Islands	-45.7401	166.7242	EBMD	6.708	1.2	2.885	3.823	1.69	1.10	-0.59	4.92



Thoughts and next steps

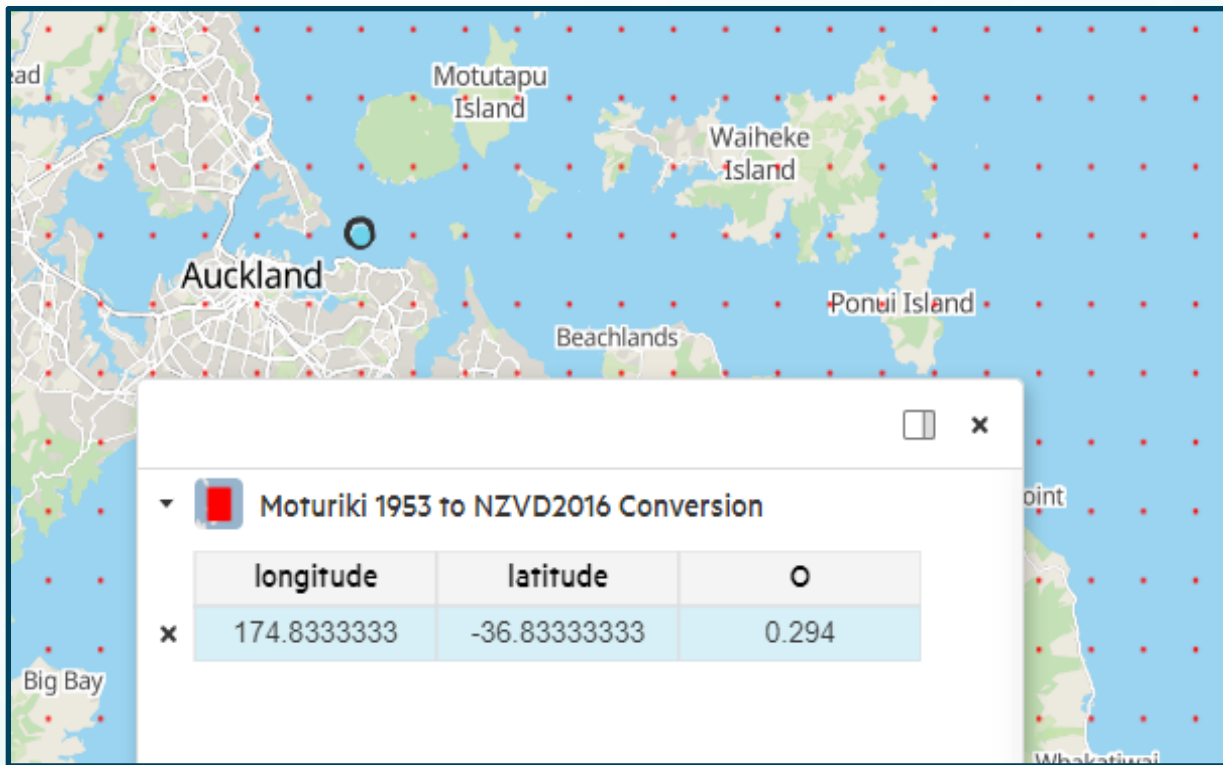
- Accuracy of MSL Calculations:
 - Use LAT instead of Chart Datum
 - Adjust using nearby long-term sites (meteorological effects)
- Use ellipsoid instead of geoid:
 - Calibrations and BM occupations using GNSS
 - Allows for easier comparison with MSS global models

Thoughts and next steps

- Resourcing:
 - Internal/external workshops
 - Outsourcing – e.g. database creation, interpolation
- Divide into analysis areas
- Evaluate MSS models
- How to calculate/represent uncertainty

Eventually...

- Conversion grids on the LINZ Data Service
- Online coordinate converter



Toitū Te Whenua
Land Information
New Zealand

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New Zealand Vertical Datum Conversions

Use this form to convert heights between different vertical datums used in New Zealand. See [instructions for carrying out height conversions](#) for more information.

If you want convert coordinates between other datums, projections and height systems used in New Zealand use the [coordinate conversion](#) form.

Input height system

New Zealand Vertical Datum 2016

Ellipsoidal

Auckland 1946 (from NZVD2016)

Bluff 1955 (from NZVD2016)

Dunedin 1958 (from NZVD2016)

Dunedin-Bluff 1960 (from NZVD2016)

Gisborne 1926 (from NZVD2016)

Lyttelton 1937 (from NZVD2016)

Moturiki 1953 (from NZVD2016)

Napier 1962 (from NZVD2016)

Nelson 1955 (from NZVD2016)

One Tree Point 1964 (from NZVD2016)

Stewart Island 1977 (from NZVD2016)

Taranaki 1970 (from NZVD2016)

Wellington 1953 (from NZVD2016)

New Zealand Vertical Datum 2009

Highest astronomical tide tidal surface (TEST ONLY)

Lowest astronomical tide tidal surface (TEST ONLY)

Mean sea level tide surface (TEST ONLY)

Mean high water tide surface (TEST ONLY)

Mean low water tide surface (TEST ONLY)

Output

Input

Enter coordinates

Not sure?

Details

spaces

Summary

- The JLAS project is integral to many others at LINZ
- Good progress with tide model and link sites
- Main challenges related to:
 - Resourcing
 - Data management
 - Interpolation

Brooklands Lagoon, opposite Kairaki, Canterbury Region.

Discussion and Questions