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Taihoro Nukurangi

Opening Statement on Coastal Hazards

Hearing of Te Tai o Poutini Plan. Variation 2 -Coastal Hazards

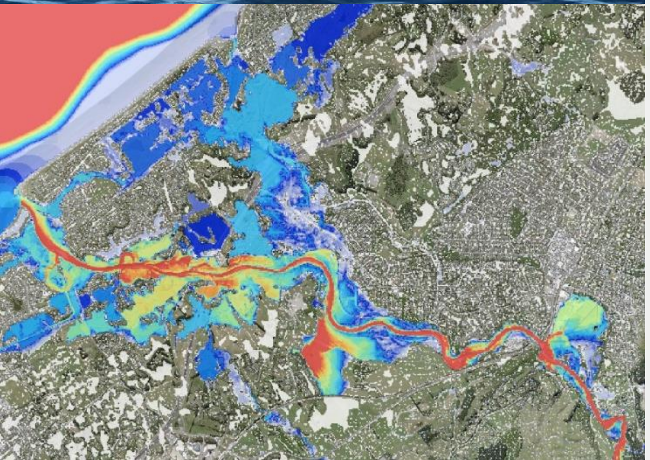
Cyprien Bosserelle

NIWA Taihoro Nukurangi

18/03/2025

Climate, Freshwater & Ocean Science

Cyprien Bosserelle



Qualifications

- MSc. Geohazard and risk (2006). University of Montpellier, France
- PhD University of Western Australia (2013) Hydrodynamic and sand transport

Experience

- Coastal Scientist at ASR, Raglan (2007—2009)
- Coastal Scientist at Pacific Community, Fiji (2013—2017)
- Hydrodynamics scientist at NIWA, Christchurch (2017– present)

Expertise

- Coastal hazard monitoring and assessments
- Flood-inundation model & forecast development
- Tsunami hazard assessment

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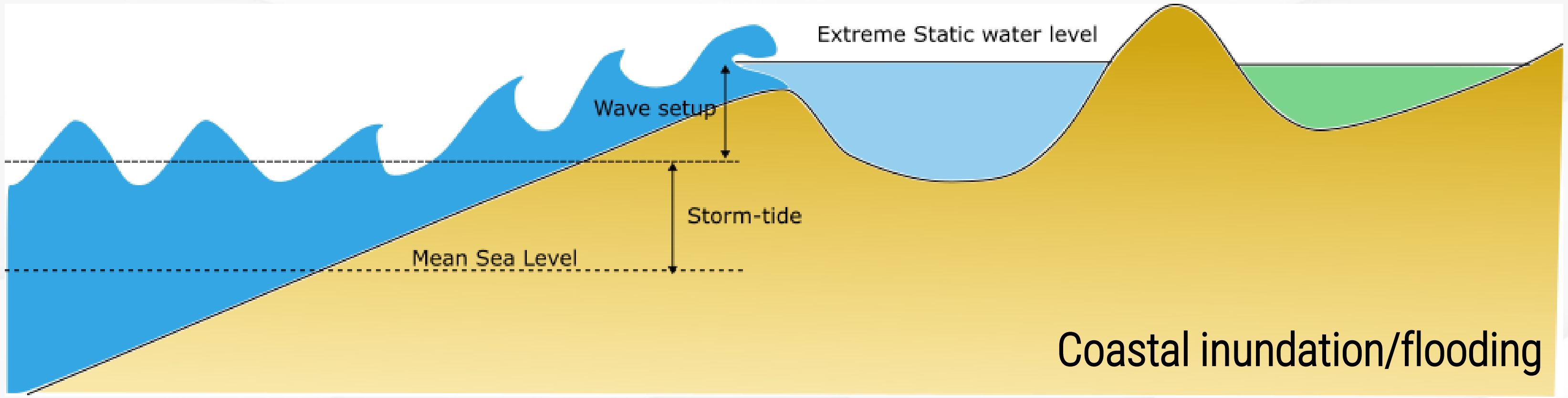
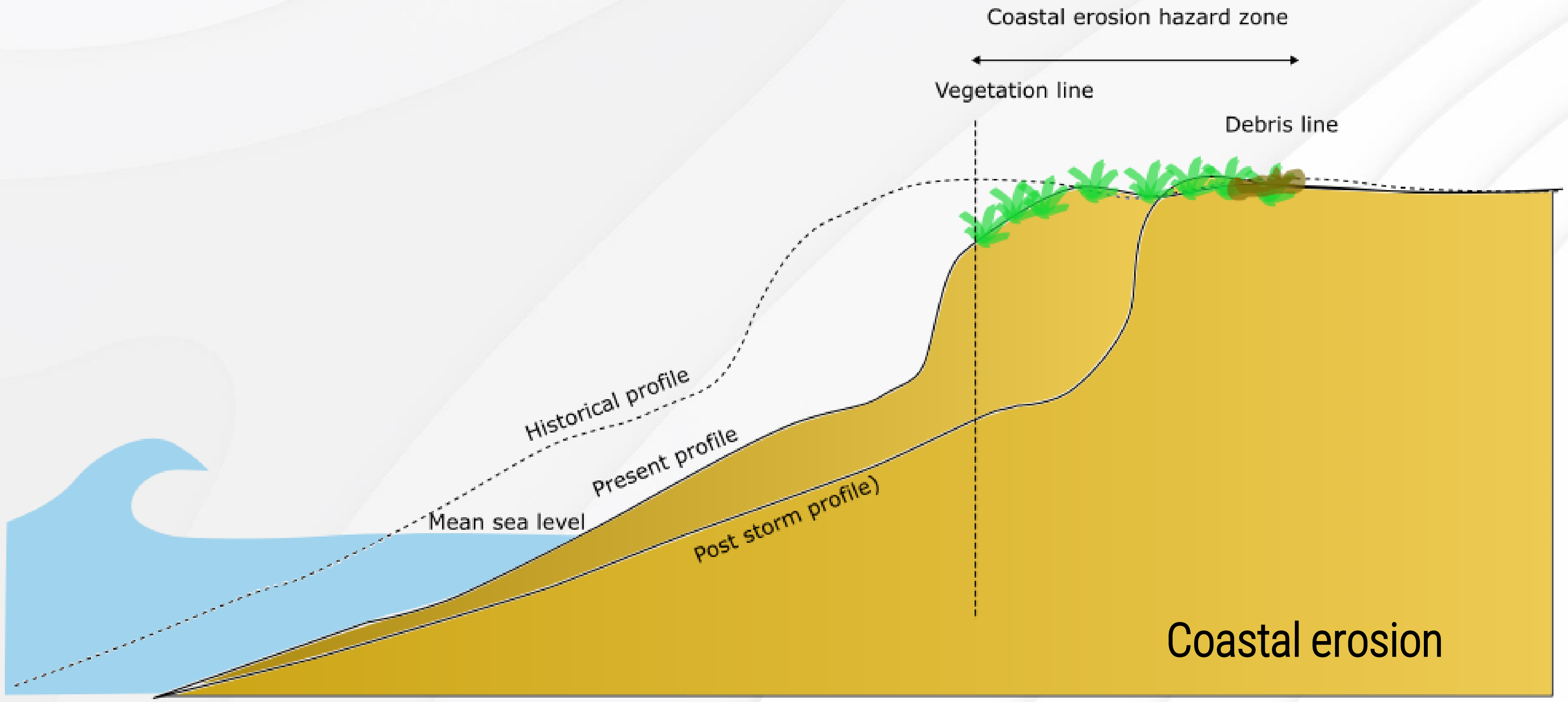
Coastal hazards





Modified from Christchurch City Council

Tsunami or groundwater are treated separately

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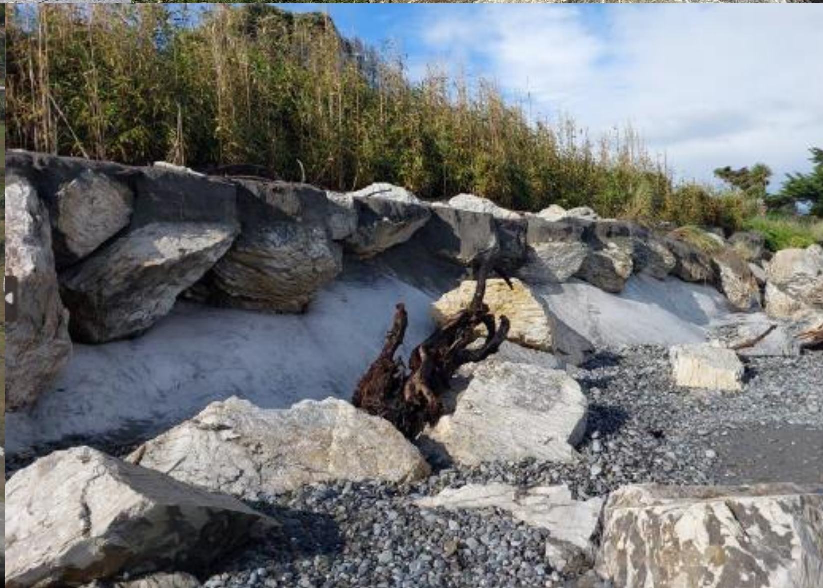
Coastal hazards

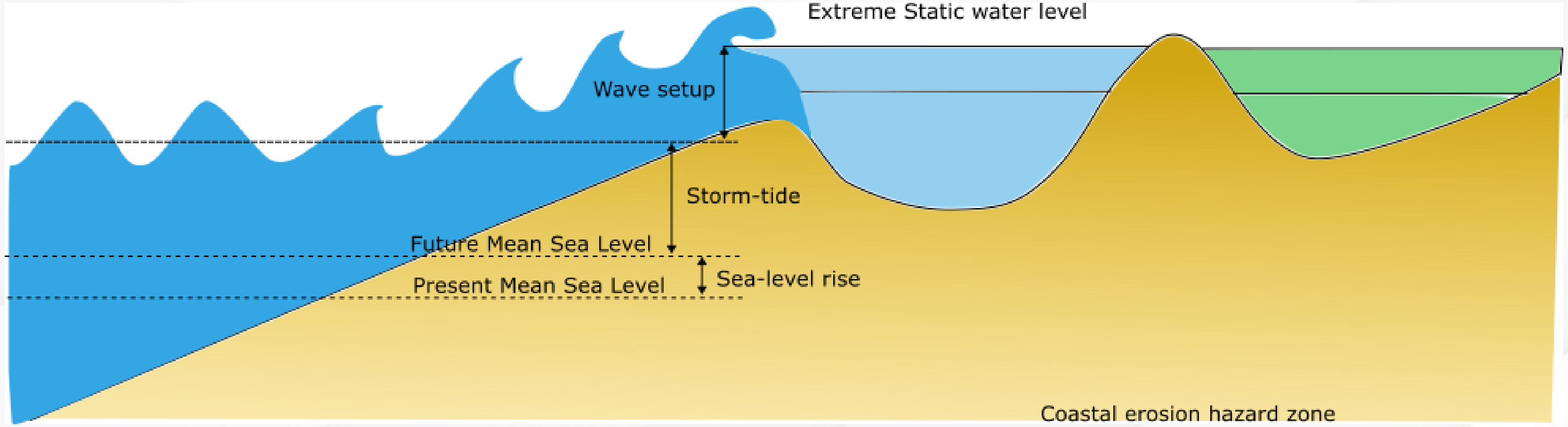


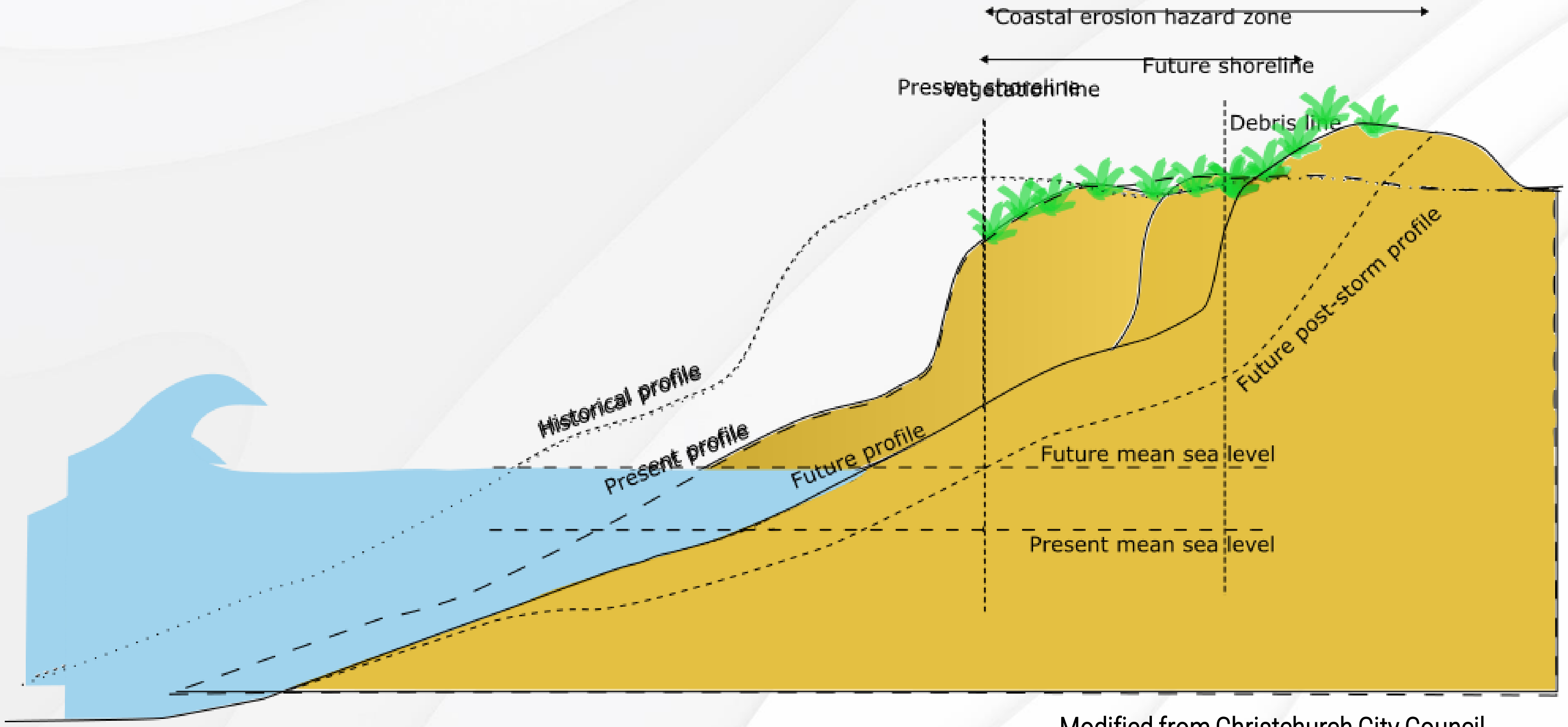


Coastal hazards

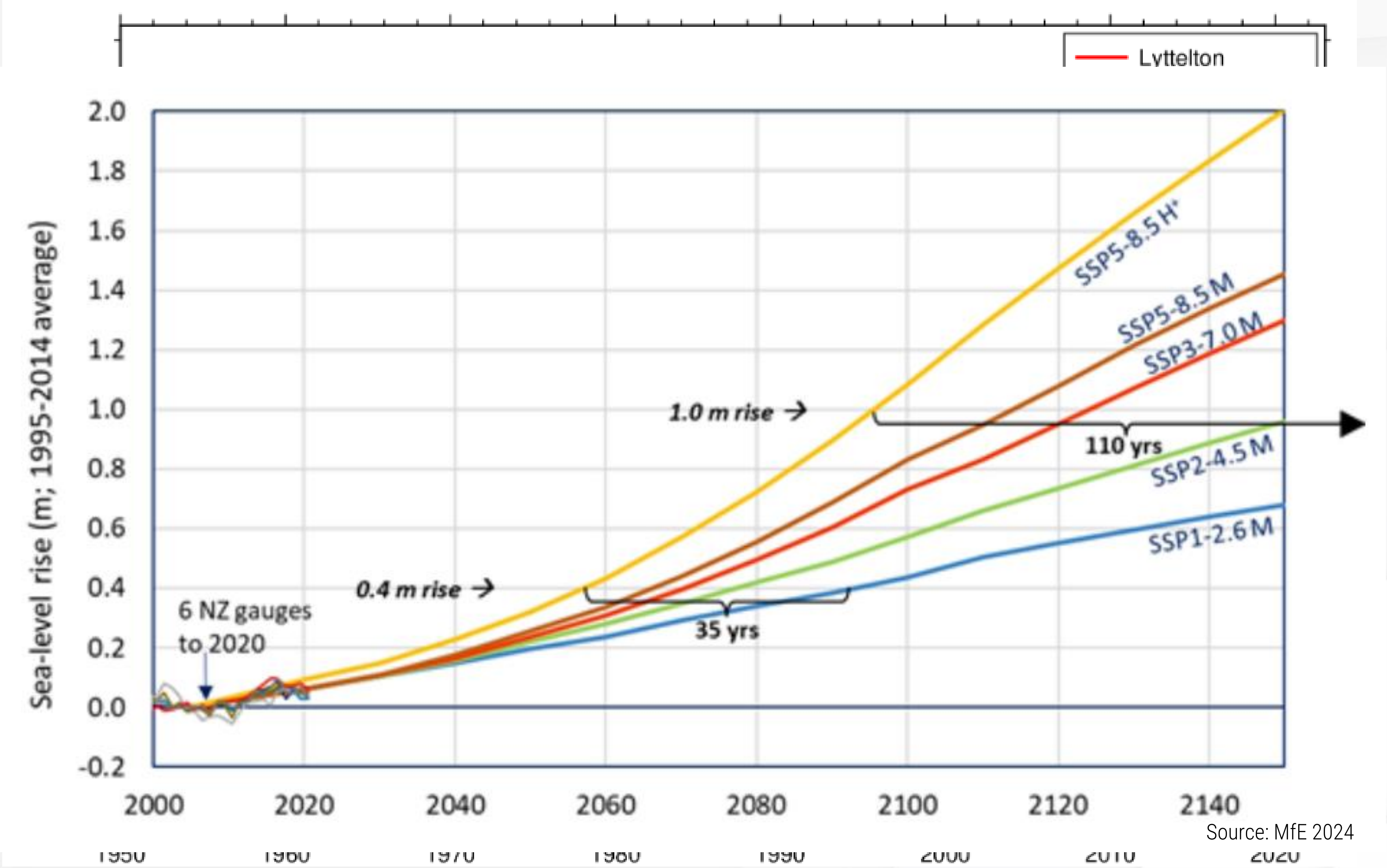
worsen with sea-level rise





Modified from Christchurch City Council

Sea level is rising on the West Coast



Historical rate: 2.7 mm/year
Since 1980: 3.2 mm/year

Source: MfE 2024

Projected sea level rise

RCP: Representative Concentration Pathway
SSP: Shared Socioeconomic Pathways } Scenarios

M = Medium confidence = moderate polar ice sheet melt
H+ = Low confidence = rapid polar ice sheet melt

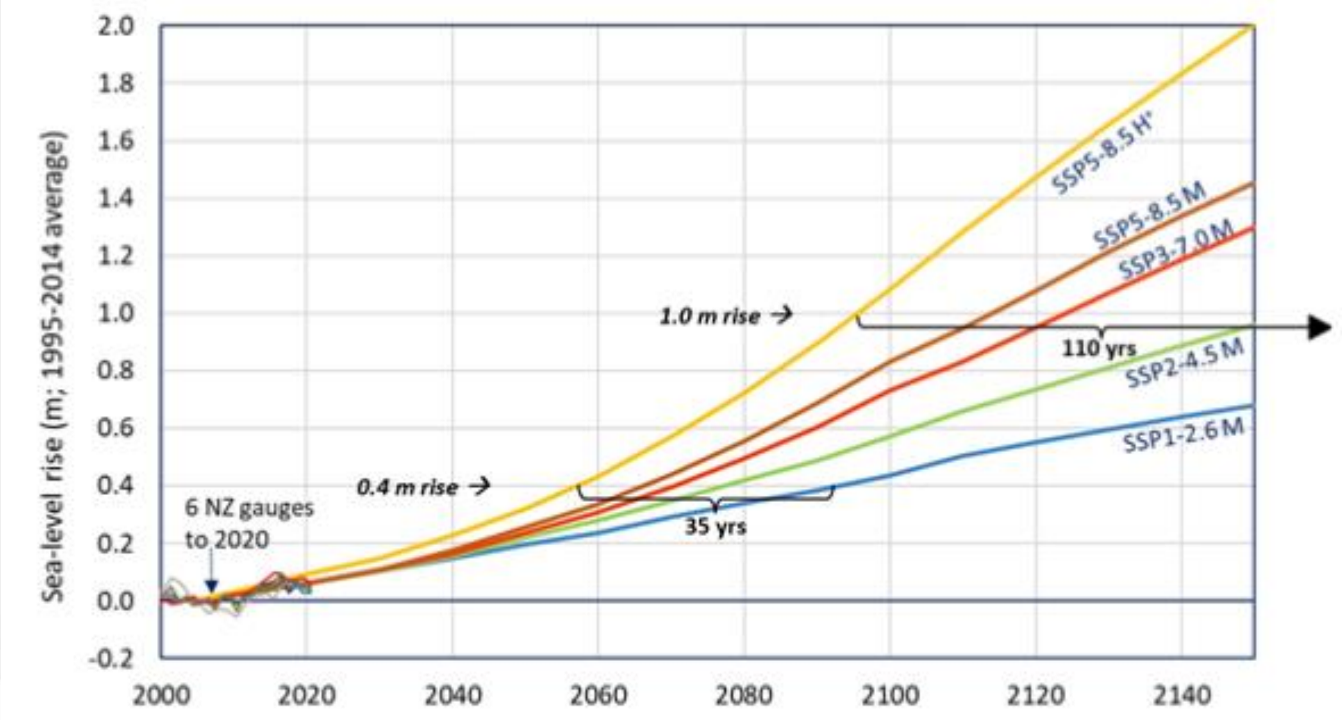


Table 6: Summary of approximate year when absolute sea-level rise (SLR) heights could be reached using the recommended projections for a central location in Aotearoa New Zealand

SLR (metres)	Year achieved for SSP5-8.5 H+ (83rd percentile)	Year achieved for SSP5-8.5 (median)	Year achieved for SSP3-7.0 (median)	Year achieved for SSP2-4.5 (median)	Year achieved for SSP1-2.6 (median)
0.2	2035	2040	2045	2045	2050
0.3	2050	2055	2060	2060	2070
0.4	2055	2065	2070	2080	2090
0.5	2065	2075	2080	2090	2110
0.6	2070	2080	2090	2100	2130
0.7	2080	2090	2100	2115	2150
0.8	2085	2100	2110	2130	2180
0.9	2090	2105	2115	2140	2200
1.0	2095	2115	2125	2155	>2200
1.2	2105	2130	2140	2185	>2200
1.4	2115	2145	2160	>2200	>2200
1.6	2130	2160	2175	>2200	>2200
1.8	2140	2180	2200	>2200	>2200
2.0	2150	2195	>2200	>2200	>2200

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Coastal hazards

Coastal erosion

- CHA 3: Hector, Ngakawau and Granity
- CHA 4: Orowaiti Lagoon
- CHA 12 and 13: Punakaiki Village (Pororari Beach) and Punakaiki River Beach
- CHA16: Rapahoe
- CHA 25: Haast Beach to Waiatoto
- CHA 26: Neils Beach to Jackson Bay

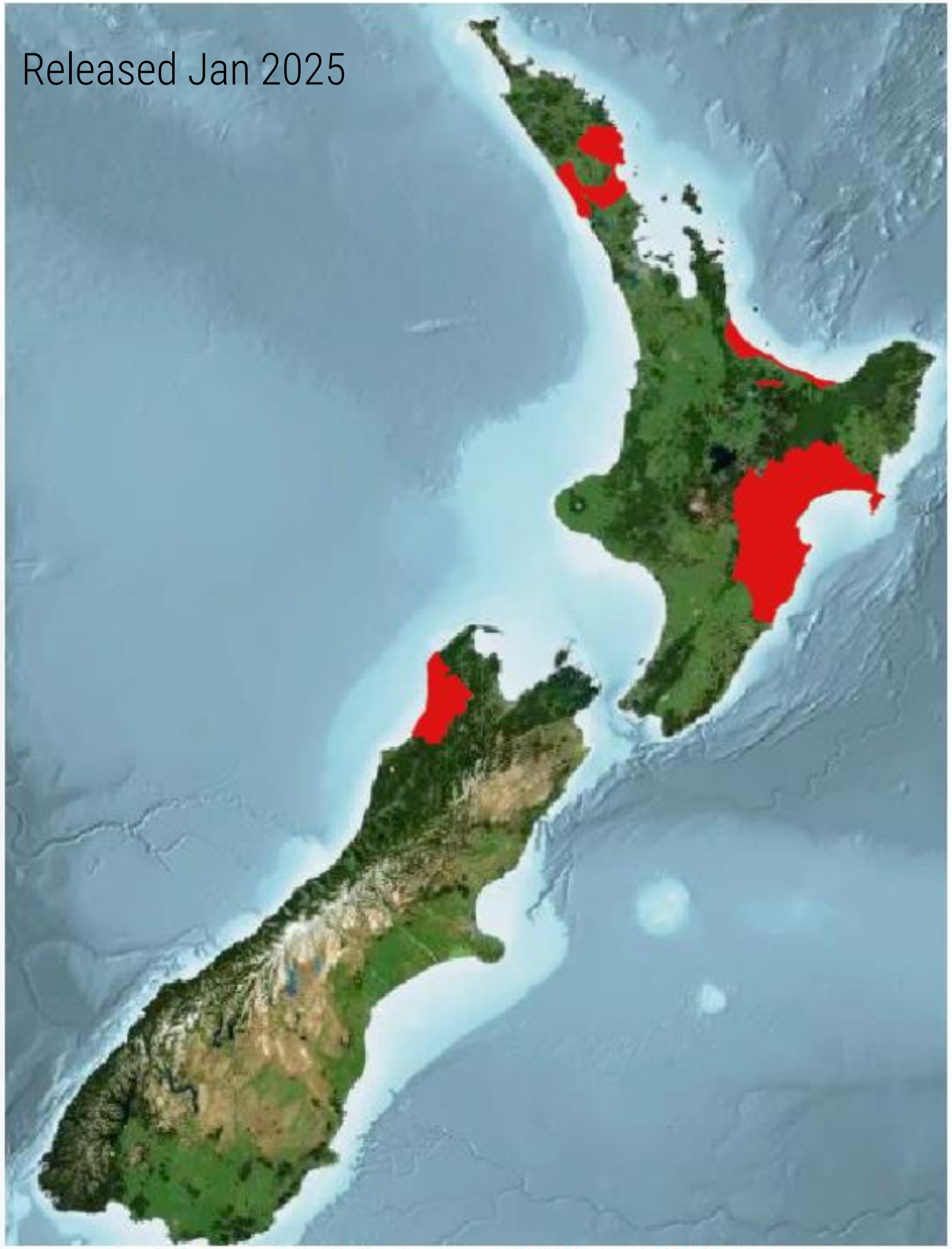
(all areas identified as priority in a prior analysis)

Coastal inundation

- Jackson Bay to Granity (Whole LiDAR coverage)
- Westport/orowaiti (not including Carter Beach)
  Using dynamic model

- Tsunami Hazard covered under GNS study
- No groundwater component

LiDAR record



Spatial coverage of additional regions of LINZ datasets highlighted in red.

Tonkin+Taylor reviewed draft report

- Review letter from T+T is based on draft report
- Overall, the review found the methodologies are appropriate
- Most of the comments are requests for clarifications
- Clarifications and modifications to the draft report were discussed with T+T in a meeting before finalizing the report
- Clarifications were added to the final report (released to the public) addresses all of T+T comments

Outputs

- Coastal inundation (Jackson Bay to Granity) 1 in 100 years coastal present Sea level; +0.2, +0.4, +0.6,+0.8, +1.0, +1.2 m SLR
- Coastal Erosion (only for CHA) 50-year and 100-year coastal erosion hazard zone estimates

Coastal alert overlay

Coastal severe overlays

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Coastal erosion Methodology

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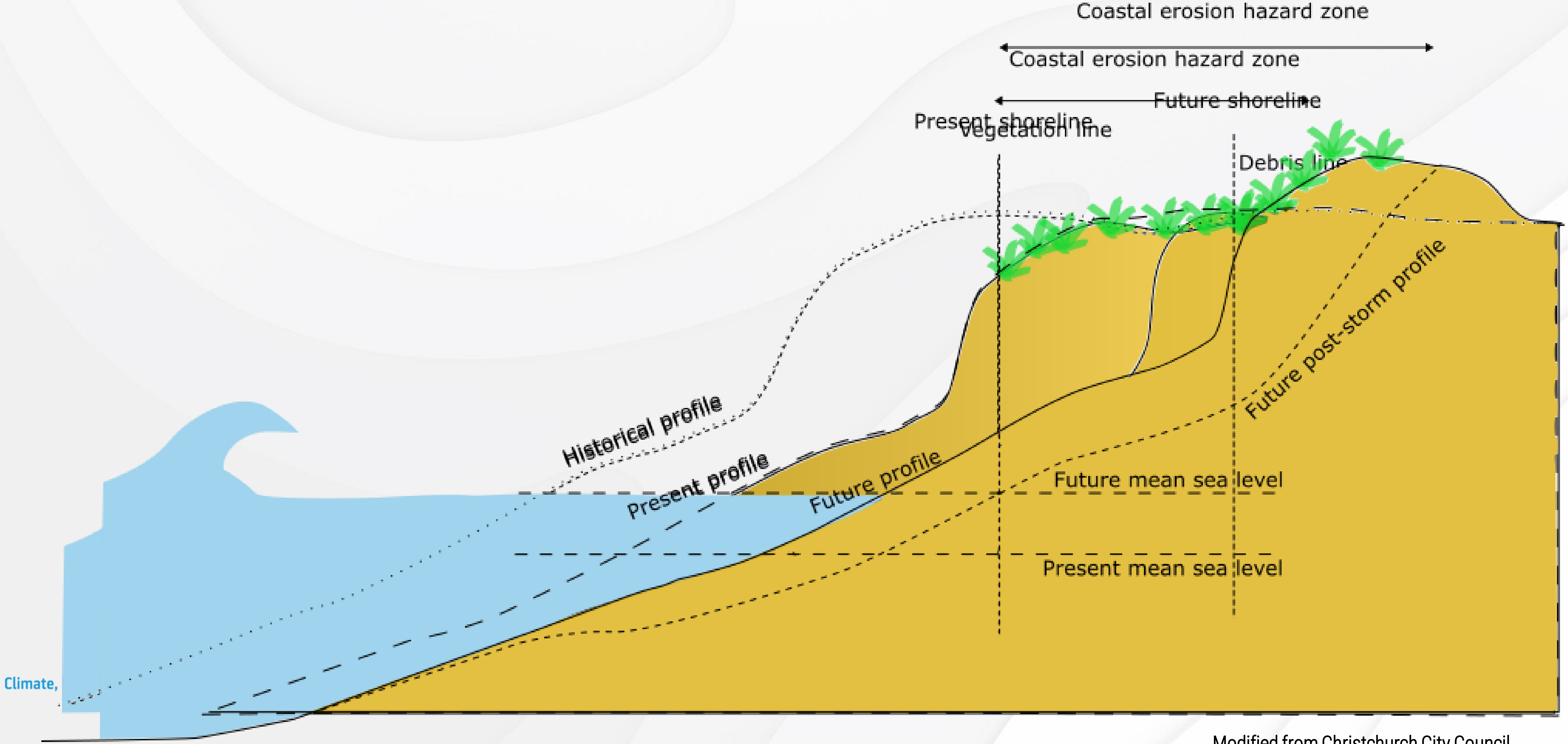
Coastal erosion hazards



Modified from Christchurch City Council

Coastal erosion: historical rates

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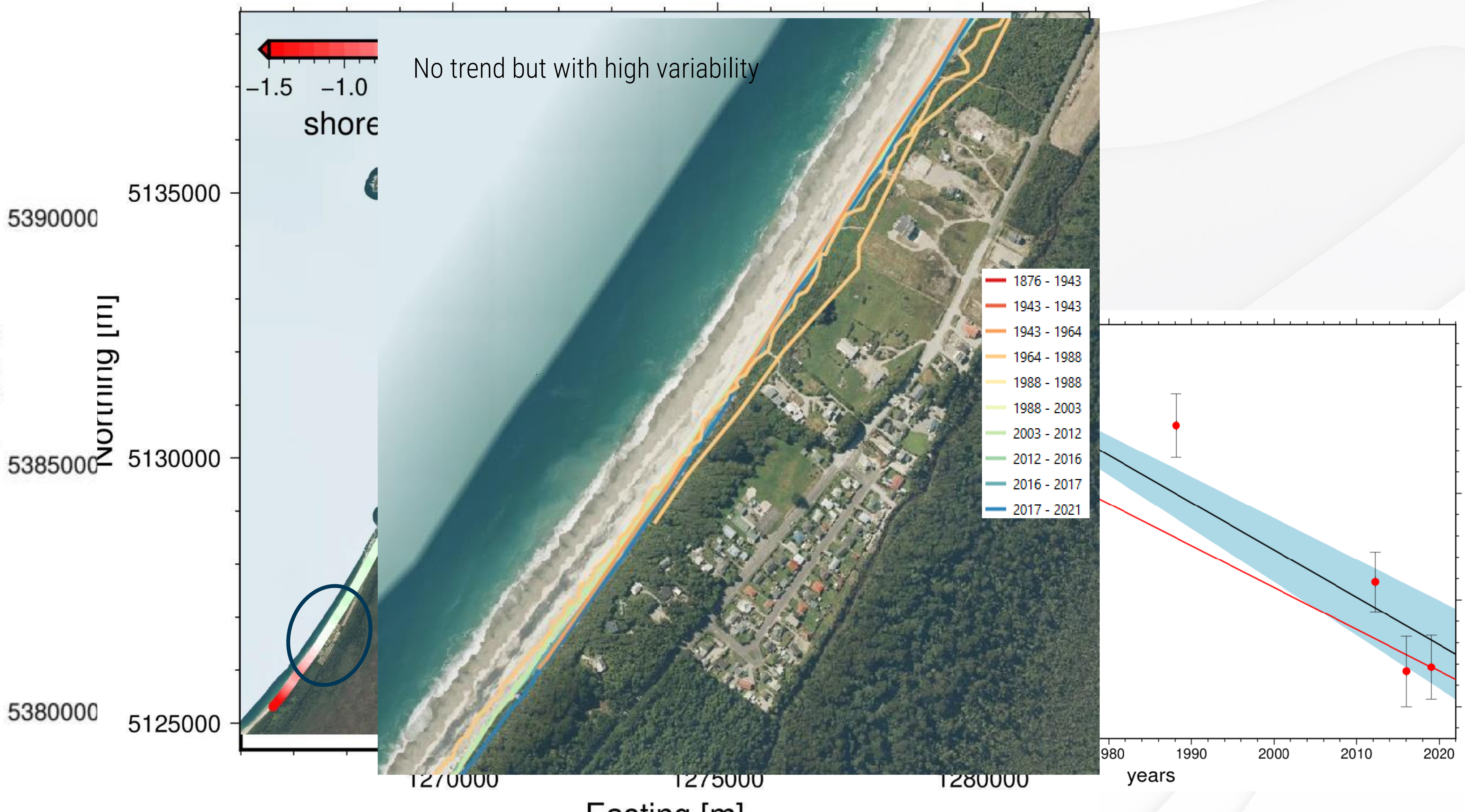
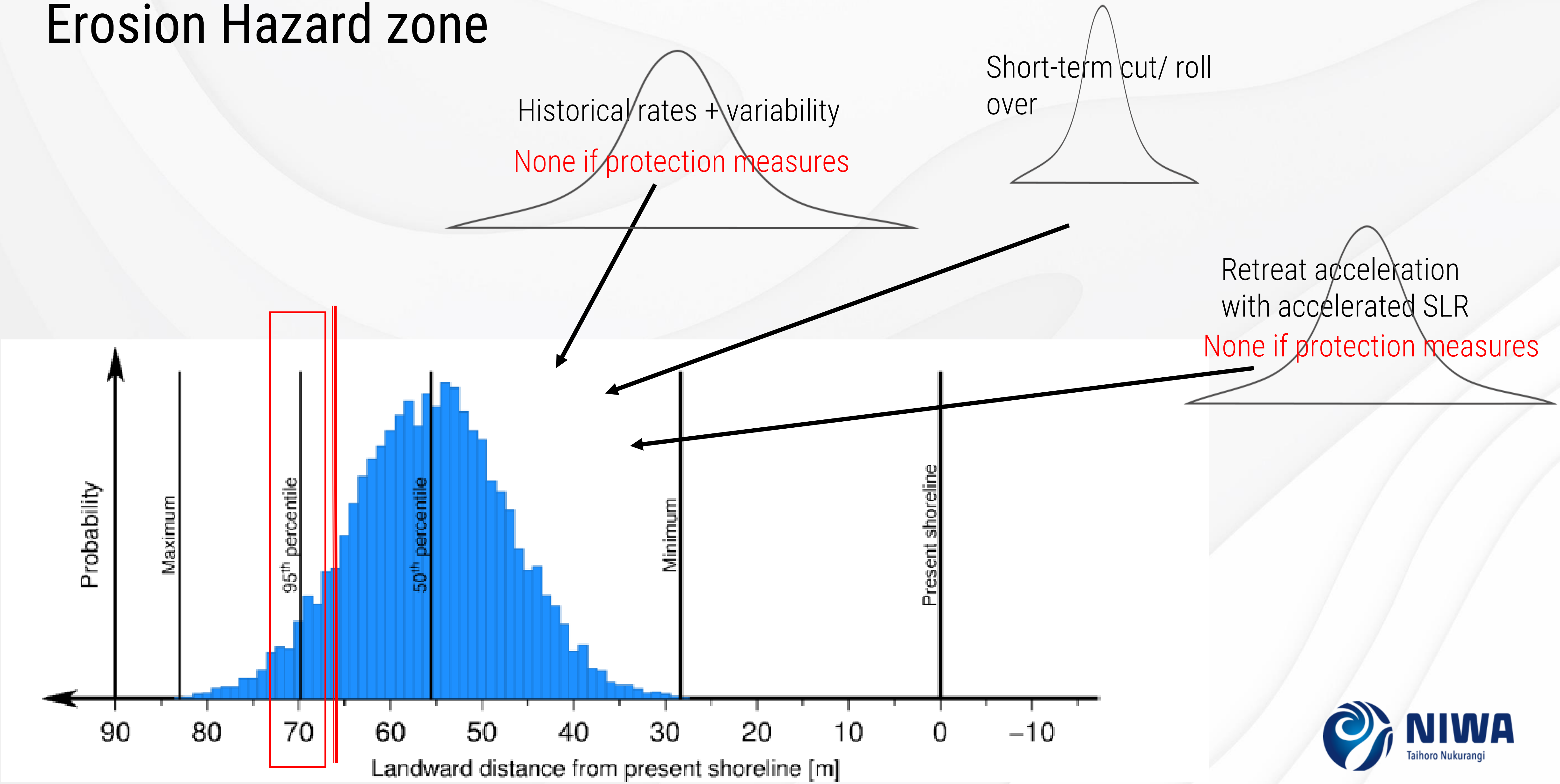

No trend but with high variability
−1.5
−1.0
shore
5390000
5385000
5380000
5135000
5130000
5125000
Northing [m]
1270000
1275000
1280000
Easting [m]
1876 - 1943
1943 - 1943
1943 - 1964
1964 - 1988
1988 - 1988
1988 - 2003
2003 - 2012
2012 - 2016
2016 - 2017
2017 - 2021
980
1990
2000
2010
2020
years

Erosion Hazard zone



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Erosion hazard lines

Landward extent limited to known hard/consolidated rocks

Accounting for existing coastal structures

- Accounted-for :
  - Granity school
  - Orowaiti
  - Punakaiki
  - Okuru
  - Jackson Bay

- Not used for
  - Soft structures (likely to disappear; e.g. gravel bund)
  - Smaller structures = private seawall
  - Newer than 2020-2022 (e.g. Hannahs Clearing)

Structures do not remove the hazard

- Seawall can fail
- Typically designed to be "topped-up"

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Coastal inundation Methodology

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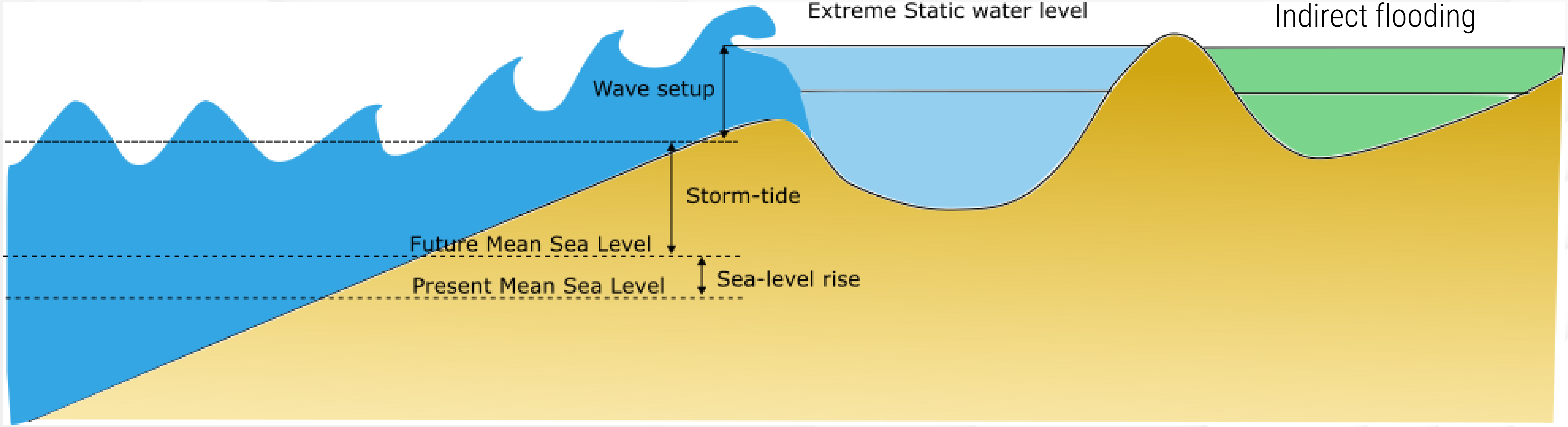
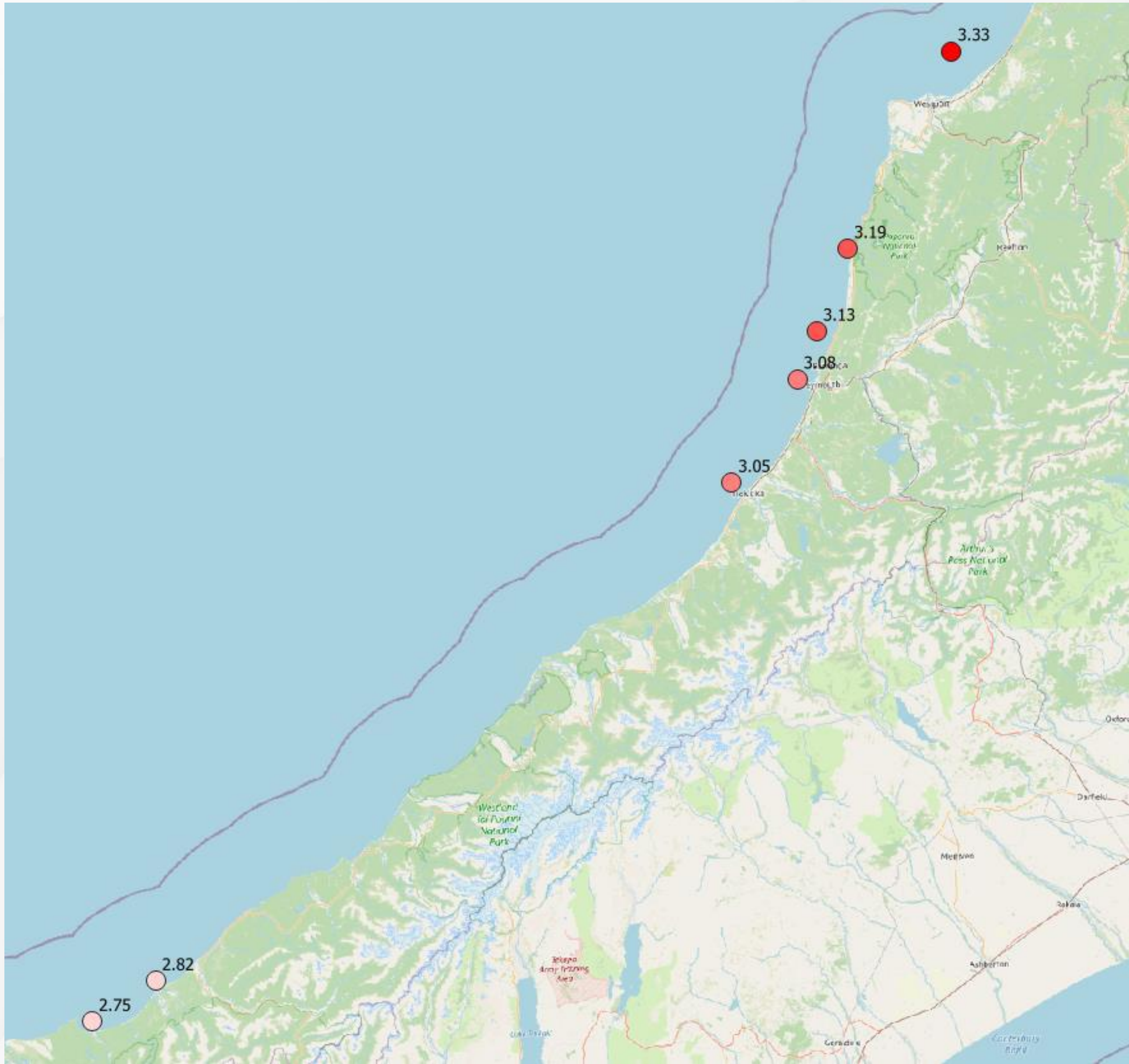
Coastal inundation hazards



Modified from Christchurch City Council

Identify 100-year ARI Storm-tide + waves

- Linear relationship between MWHS and Extreme WL
- Wave setup associated with storm-tide is more complex :
    - No available joint-probability
    - Existing wave hindcast are too biased for extreme waves
    - Stephens et al. (2020) method produces unrealistically high wave setup
    - 0.8 m wave setup (5-6m swell at storm surge peak)
- SLR increment every 0.2m to 1.6m



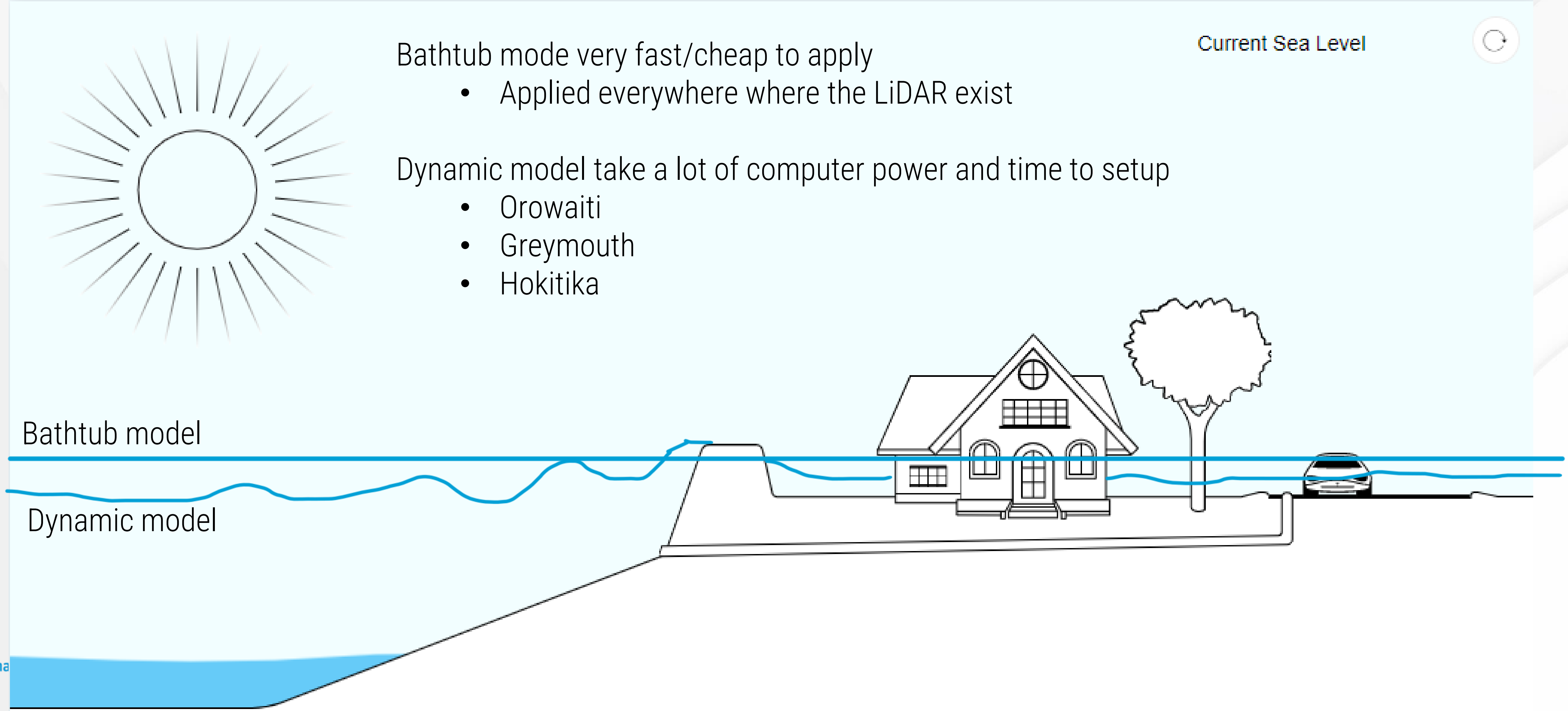
Bathtub model vs dynamic model

Bathtub mode very fast/cheap to apply

- Applied everywhere where the LiDAR exist

Dynamic model take a lot of computer power and time to setup

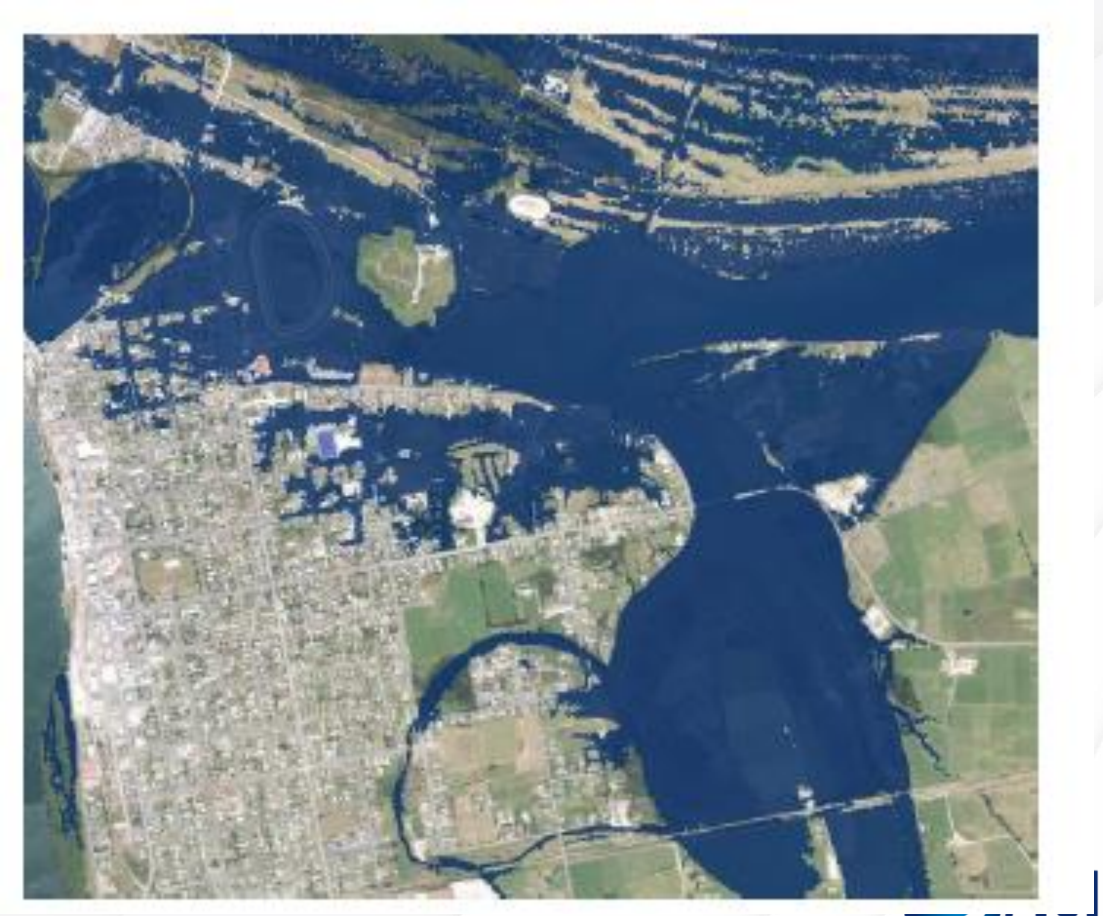
- Orowaiti
- Greymouth
- Hokitika



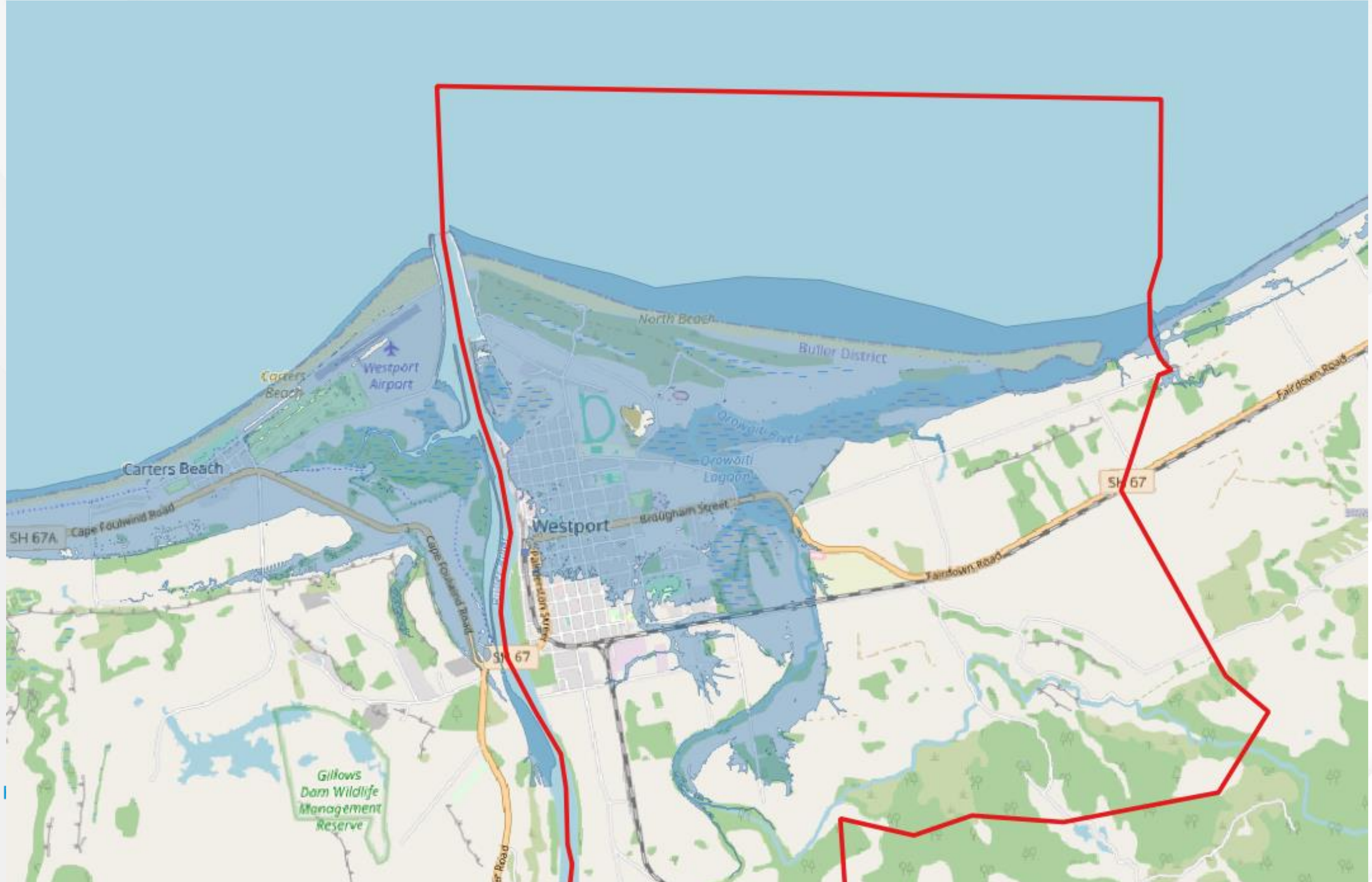
Coastal inundation

"Bathtub" inundation

Physics based model (hydrodynamics model)



Model area for dynamic model



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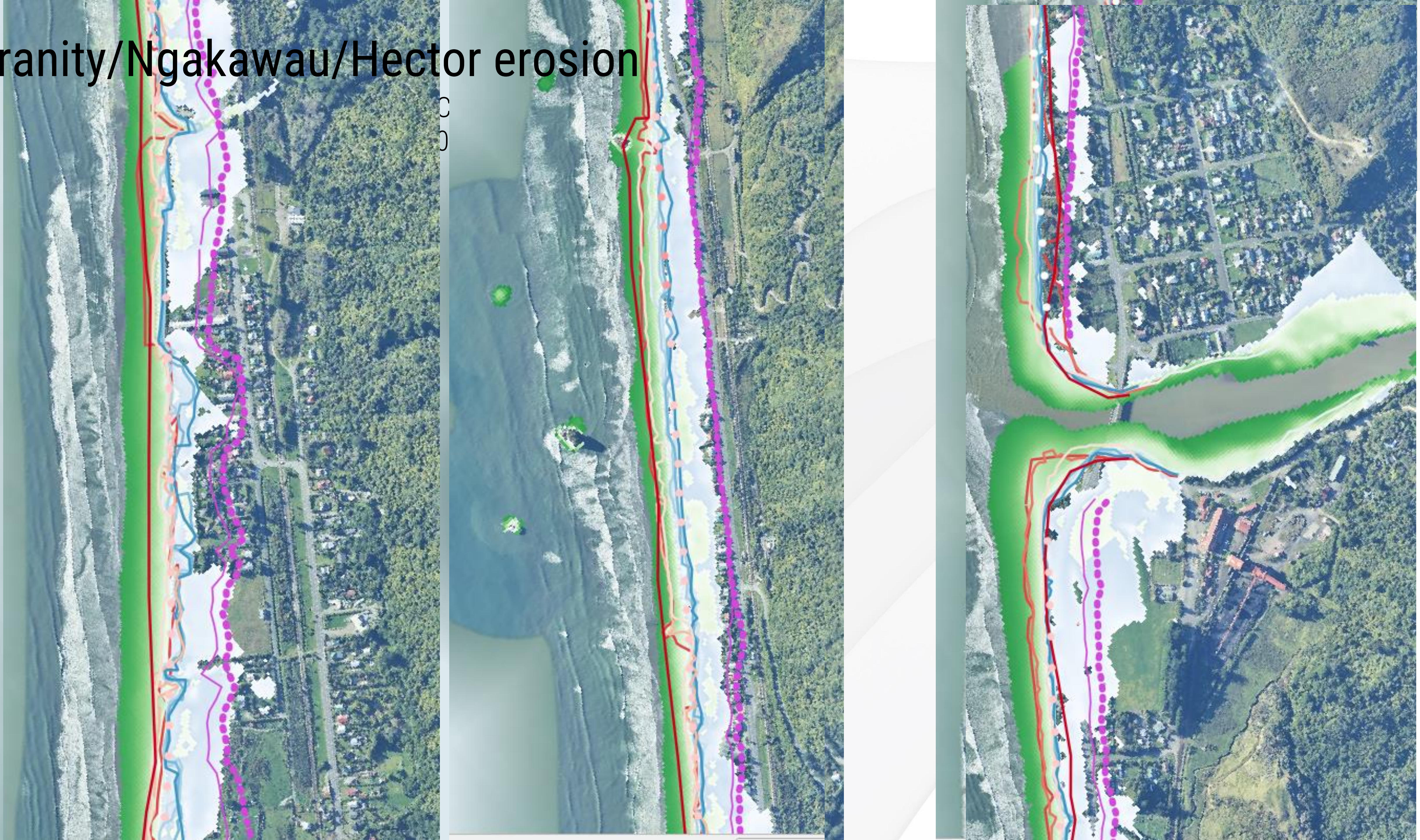
How do we know the dynamic inundation model works?

Mean error = 0.01 m abs mean error 0.08 m (within measurement error)

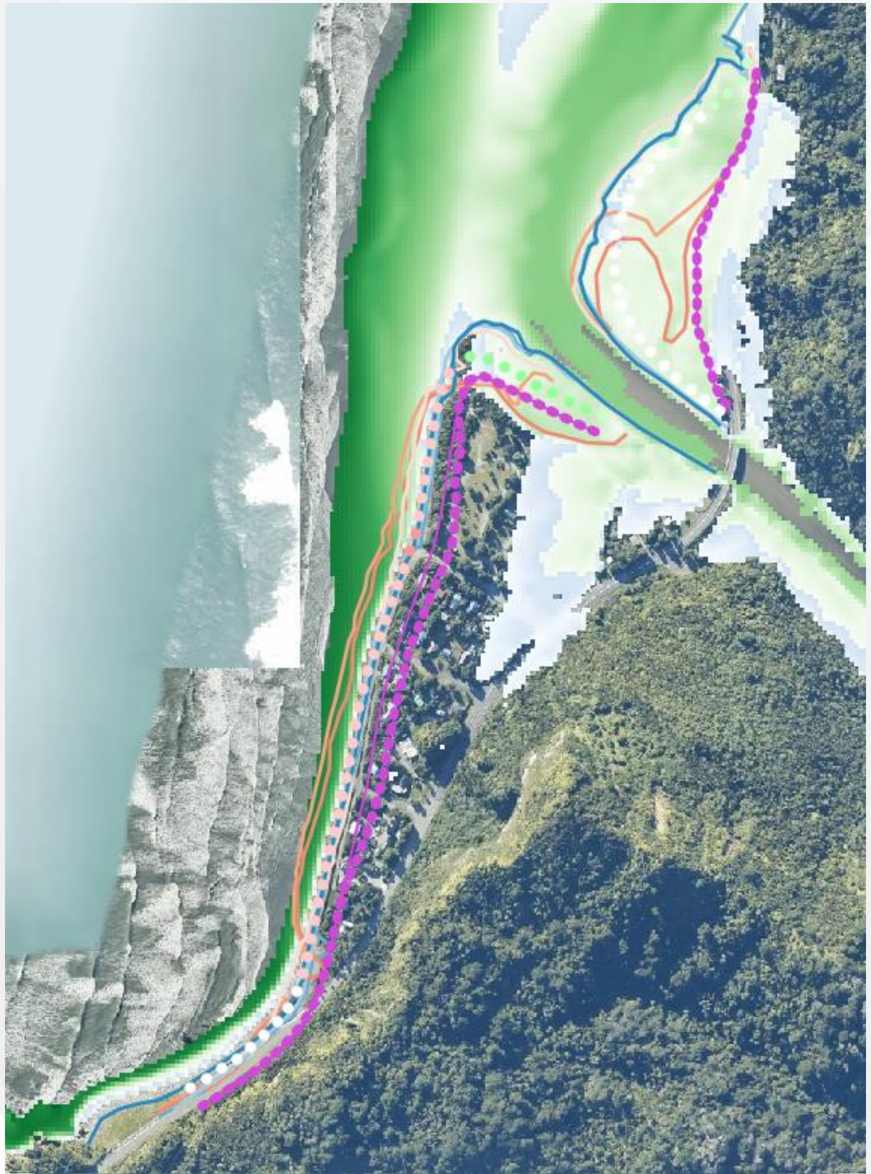
Detailed results

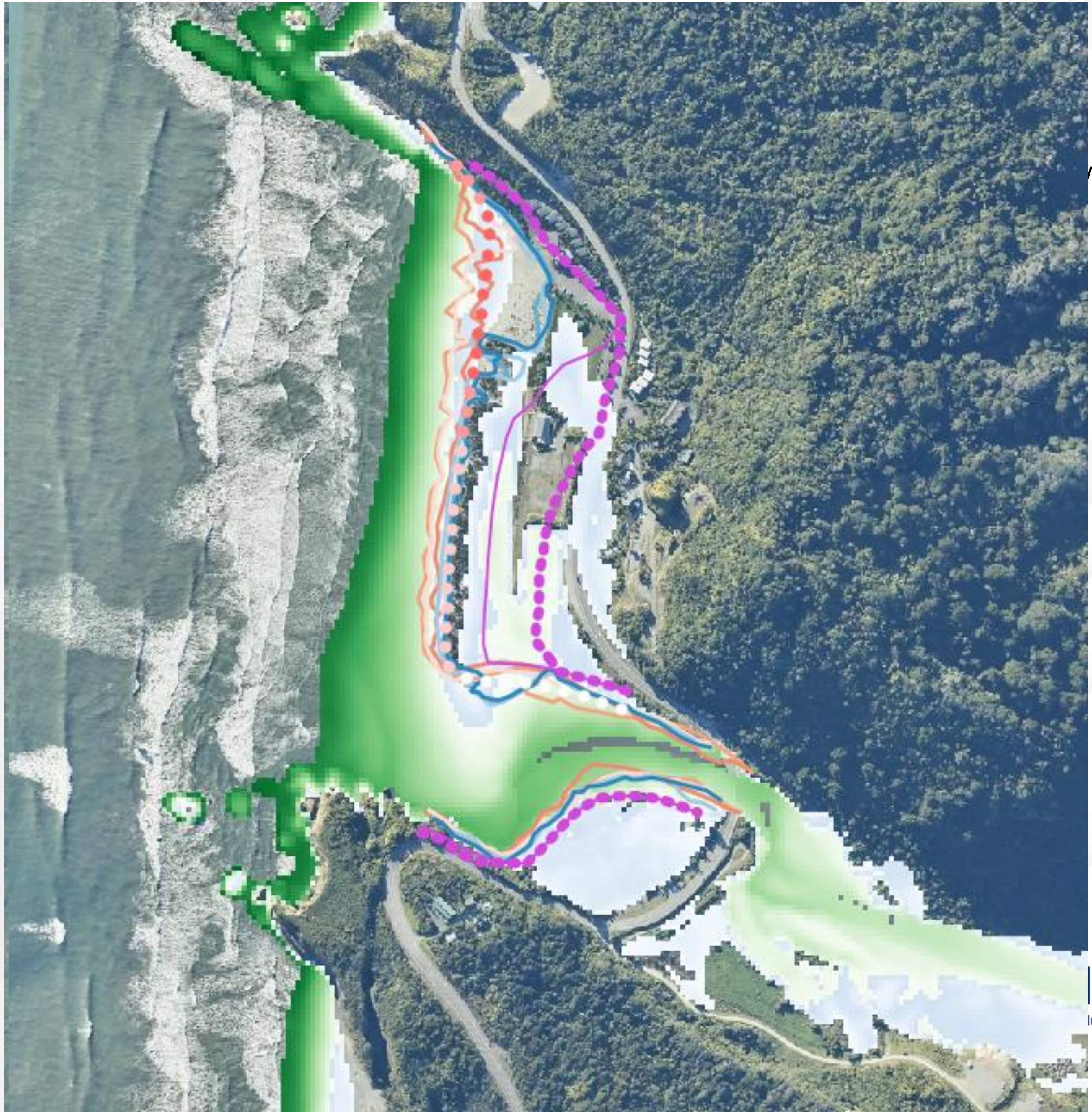
Granity/Ngakawau/Hector erosion



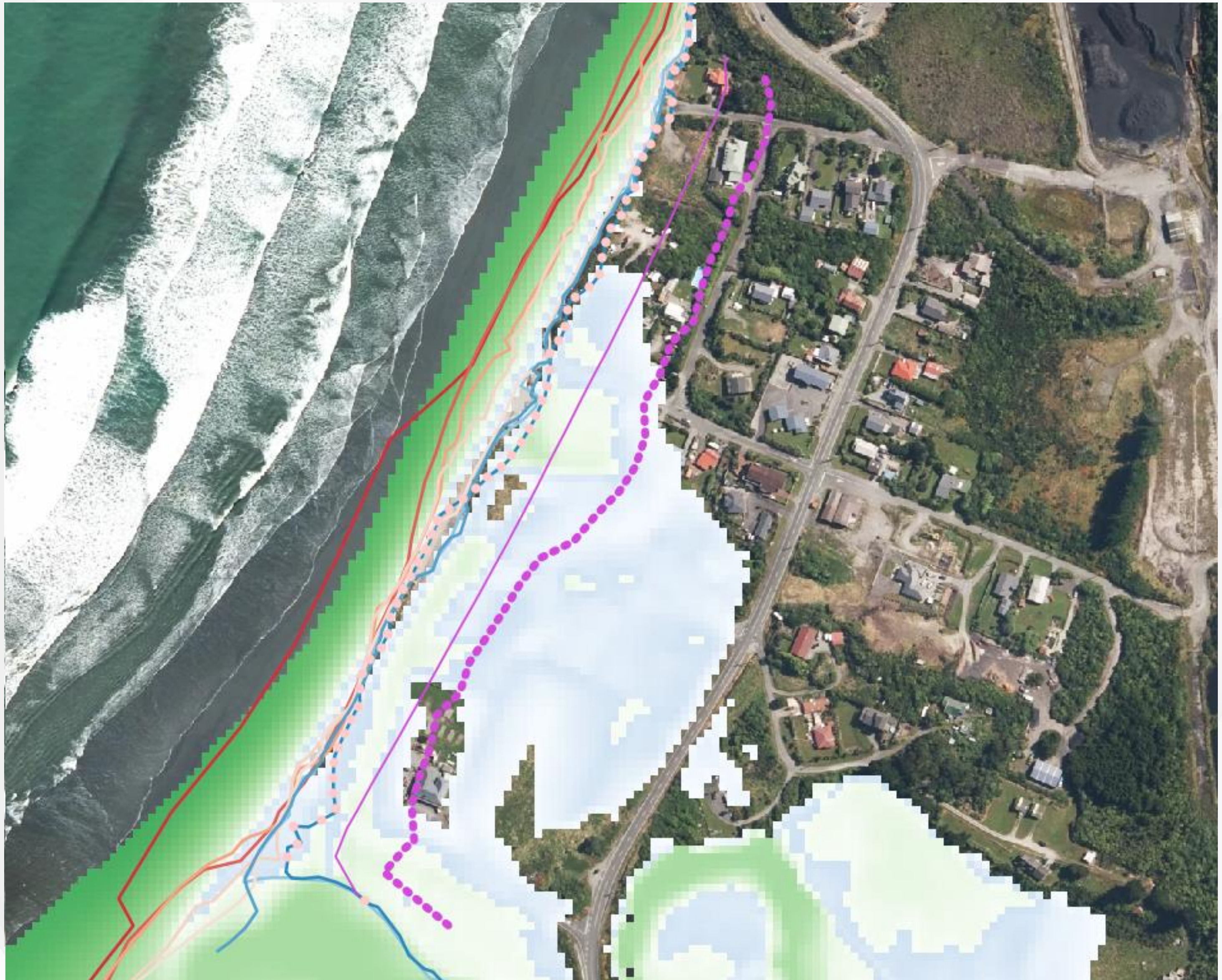
Orowaiti erosion hazard

Punakaiki





Rapahoe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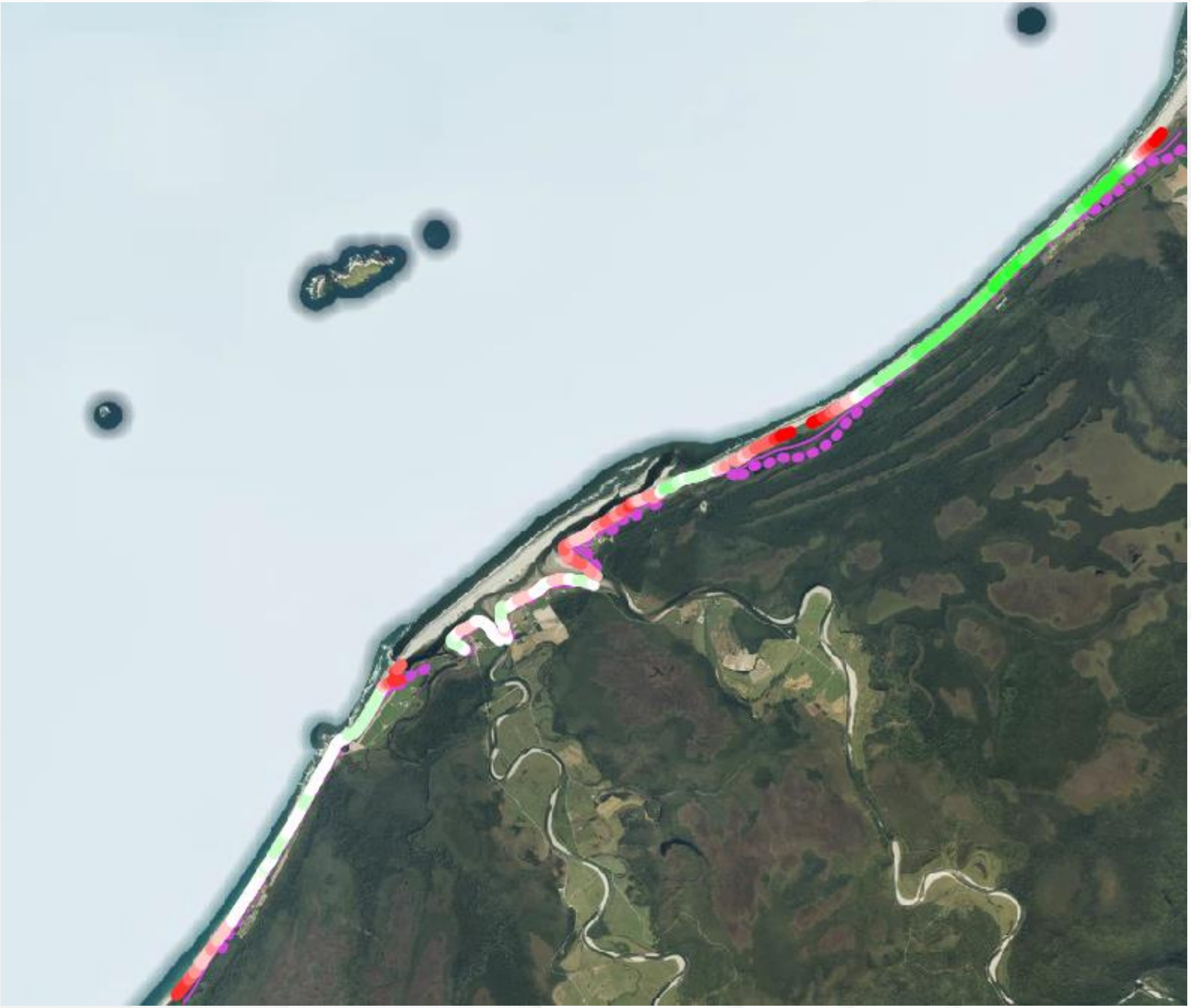
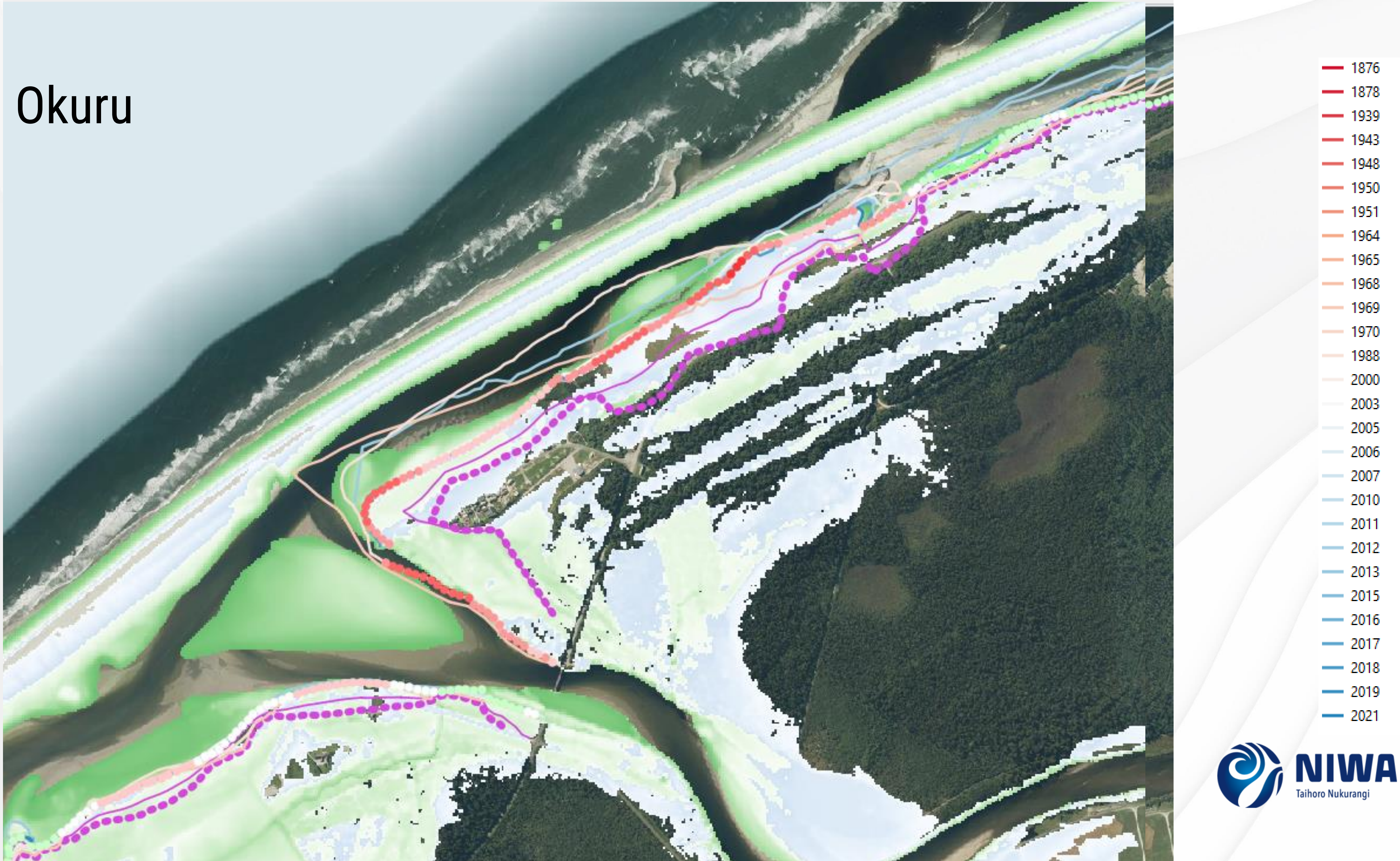
2017
2018
2019
2021
-2.19 - -1.79
-1.79 - -1.39
-1.39 - -1
-1 - -0.6
-0.6 - -0.2
-0.2 - 0.2
0.2 - 0.6
0.6 - 1
1 - 1.39
1.39 - 1.79
1.79 - 27.91
m/year

Haast erosion rates



Okuru



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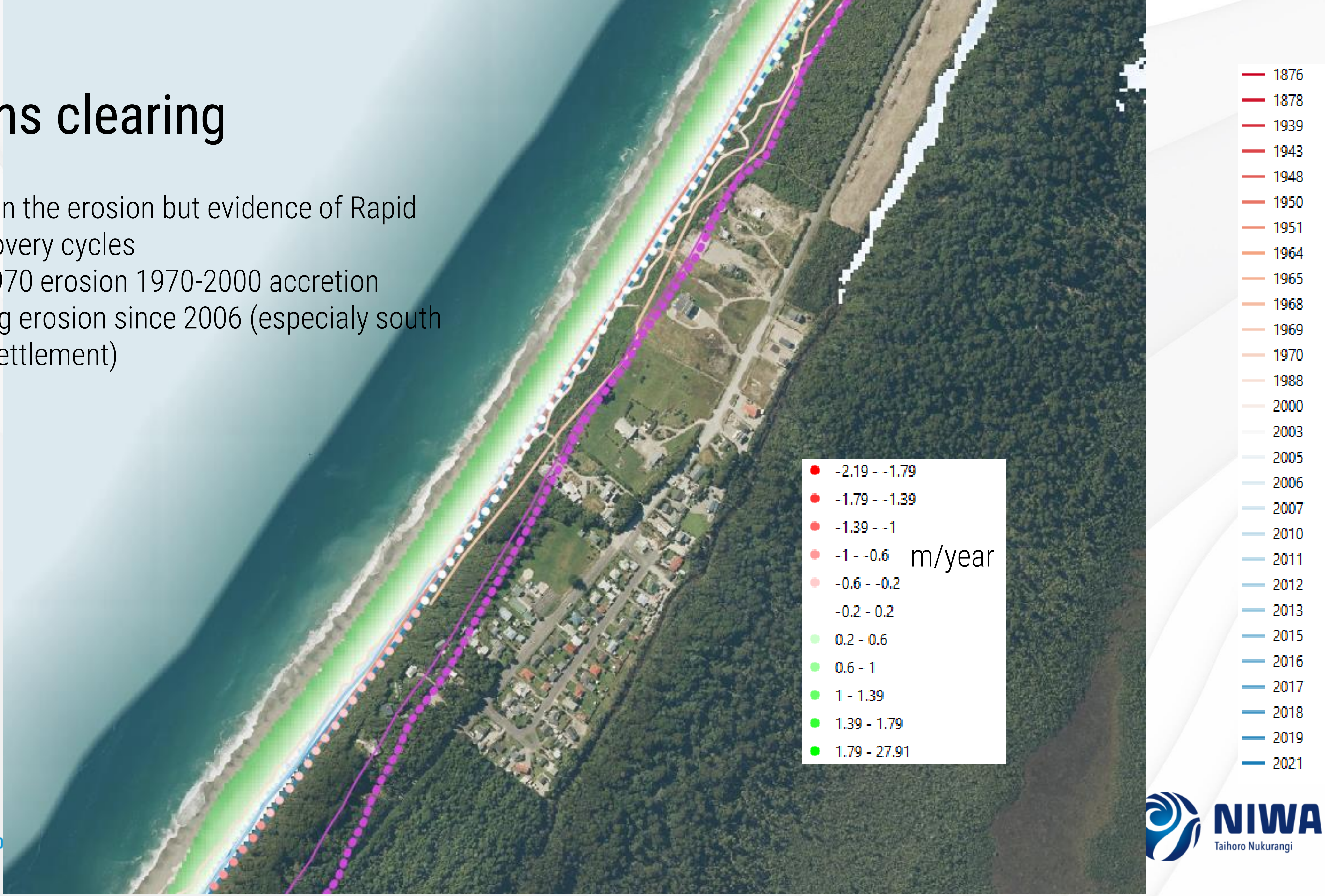
Hannahs clearing

No clear trends in the erosion but evidence of Rapid erosion and recovery cycles

- 1950-1970 erosion 1970-2000 accretion
- Ongoing erosion since 2006 (especialy south of the settlement)



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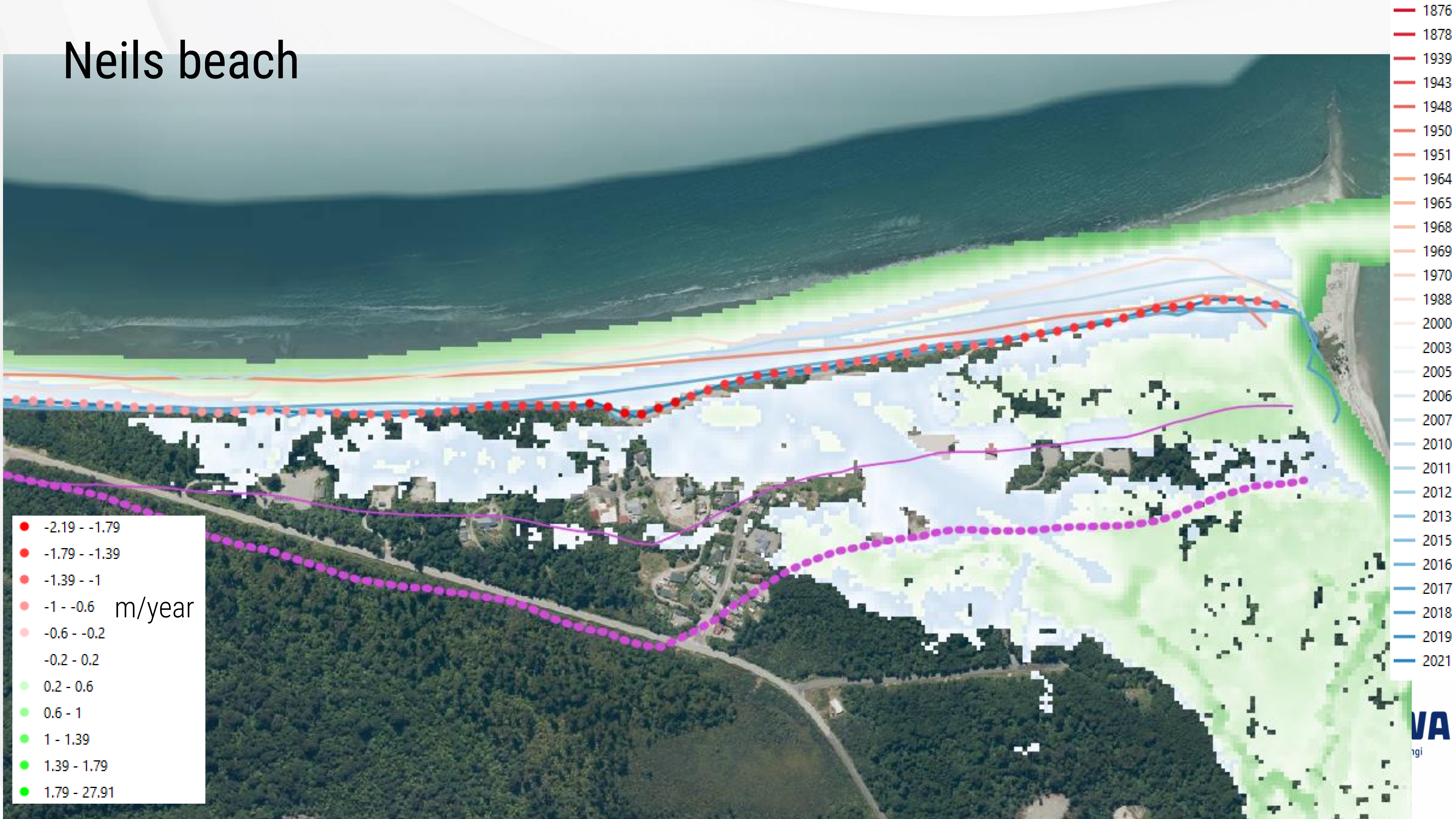
Neils beach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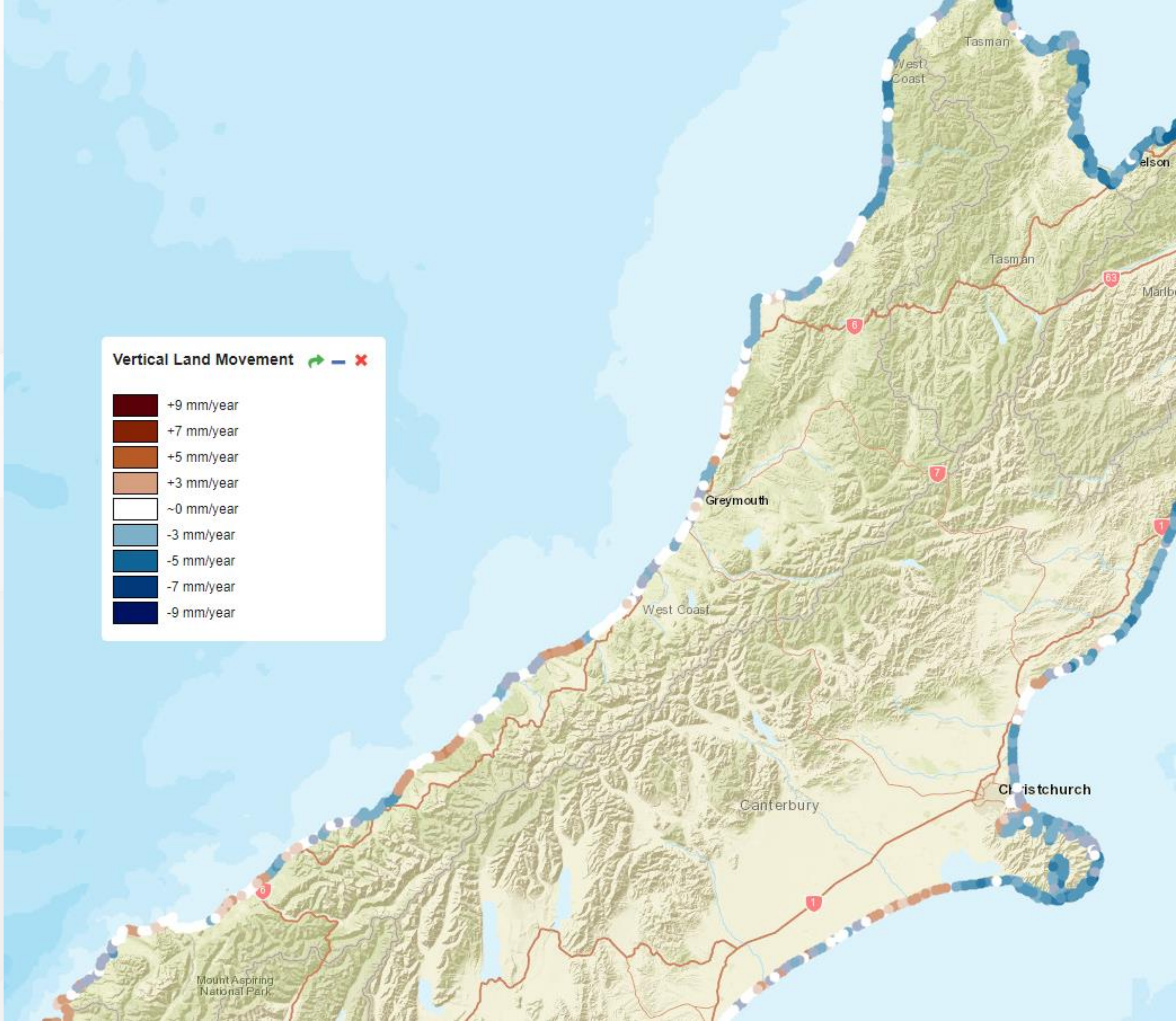
2019
2021
-2.19 - -1.79
-1.79 - -1.39
-1.39 - -1
-1 - -0.6
-0.6 - -0.2
-0.2 - 0.2
0.2 - 0.6
0.6 - 1
1 - 1.39
1.39 - 1.79
1.79 - 27.91
m/year

Jackson Bay

Nga Mihi!

VLM



NZ SEA RISE
TE TAI PARI O AOTEAROA
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Land elevation data