West Coast Region Coastal Hazards mapping methodology

TTPP Coastal Hazards draft variation

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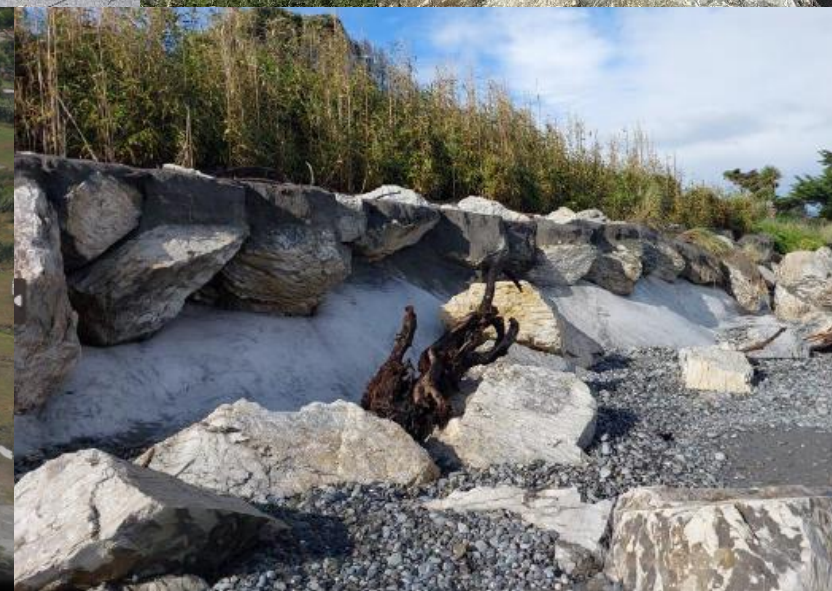
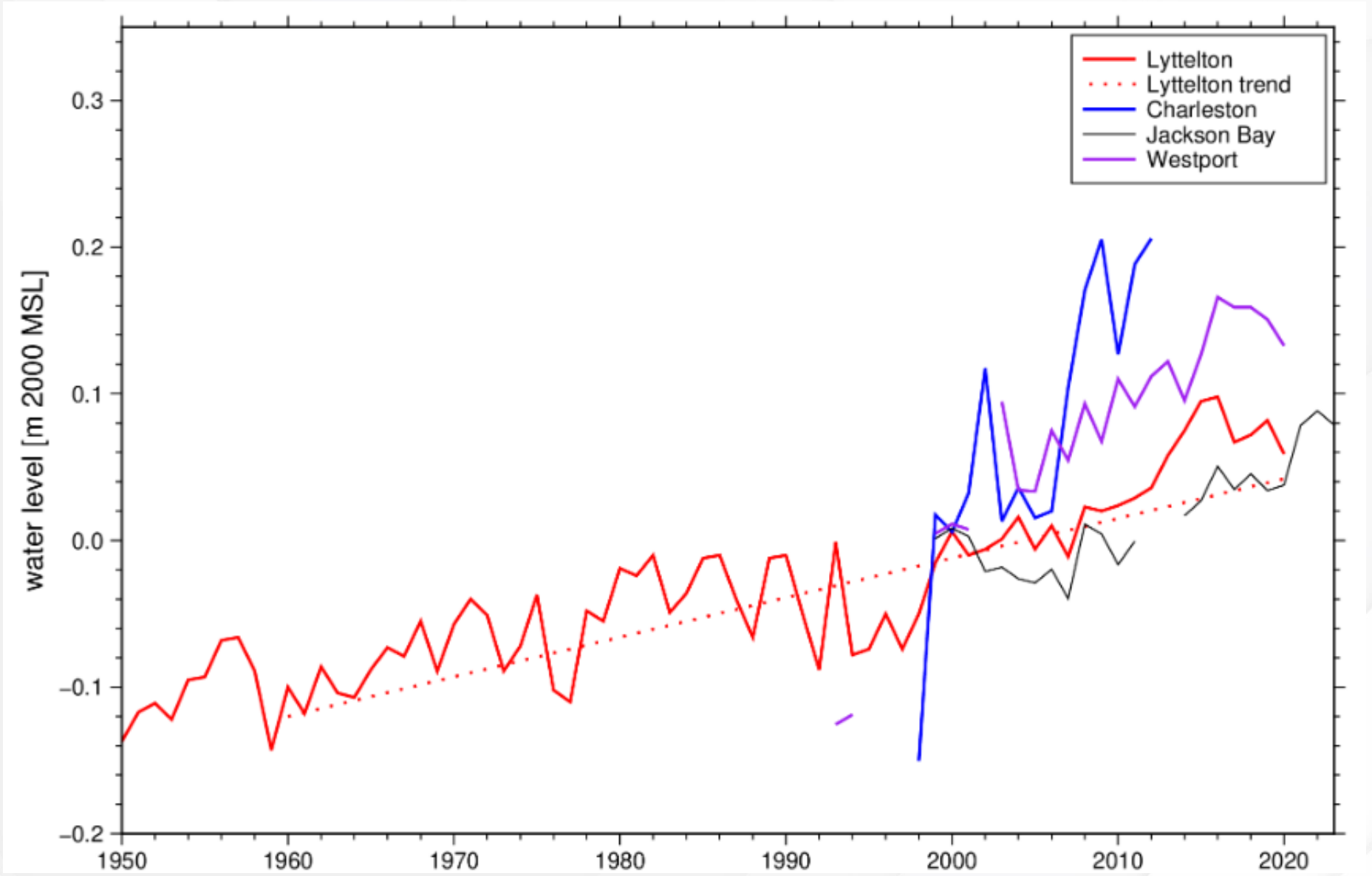
Climate, Freshwater & Ocean Science

29/04/2024

Coastal hazards



Recorded Sea level rise



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

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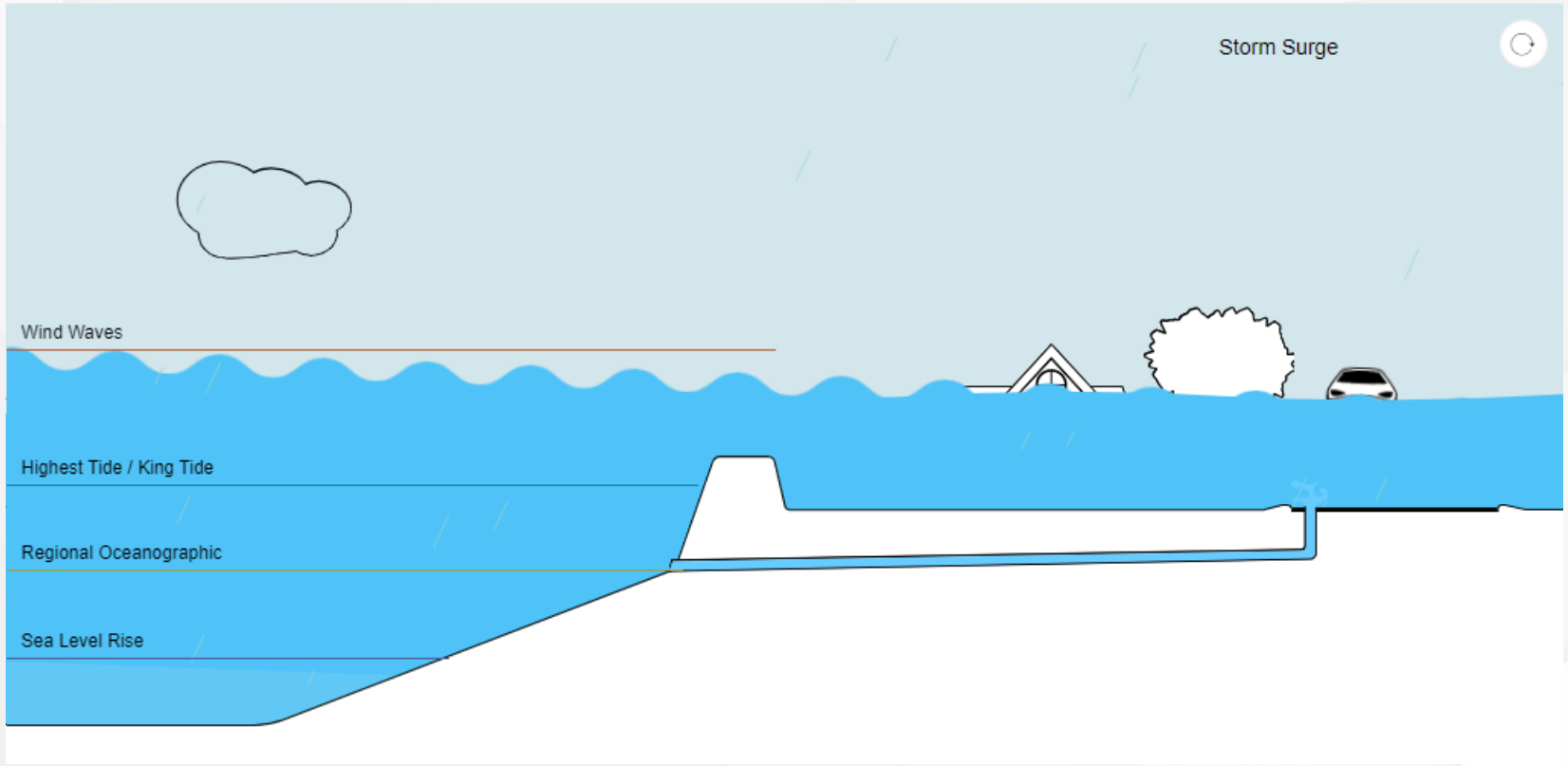
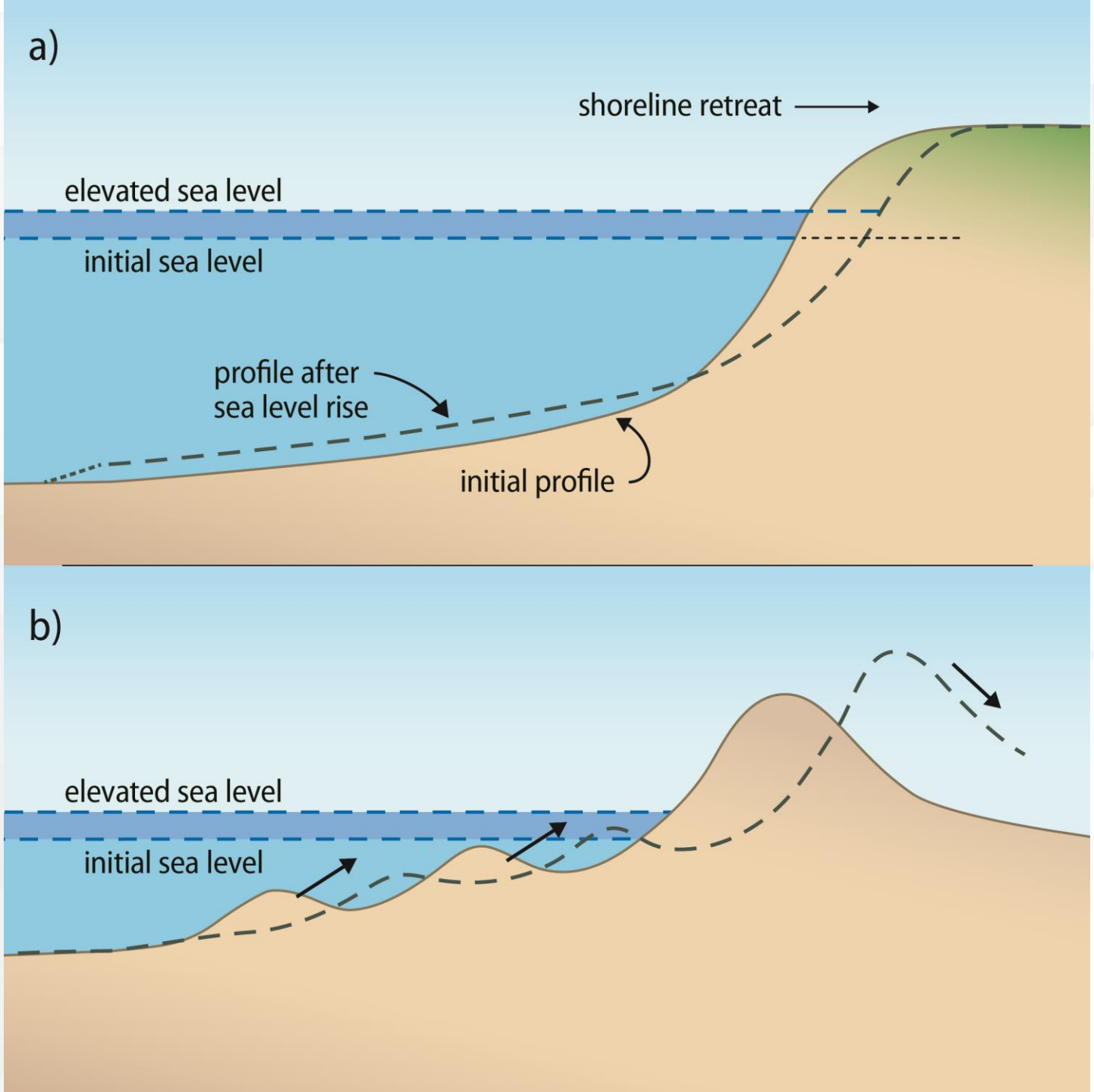
Sea level rise and coastal inundation



https://coast.noaa.gov/stormwater-floods/understand/

Sea level rise and erosion

SLR shifts depth of closure upward and creates accommodation space that needs to be filled by incoming sediment or sediment from the shoreface. Causing a (landward) retreat of the shoreface by a volume equivalent to



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

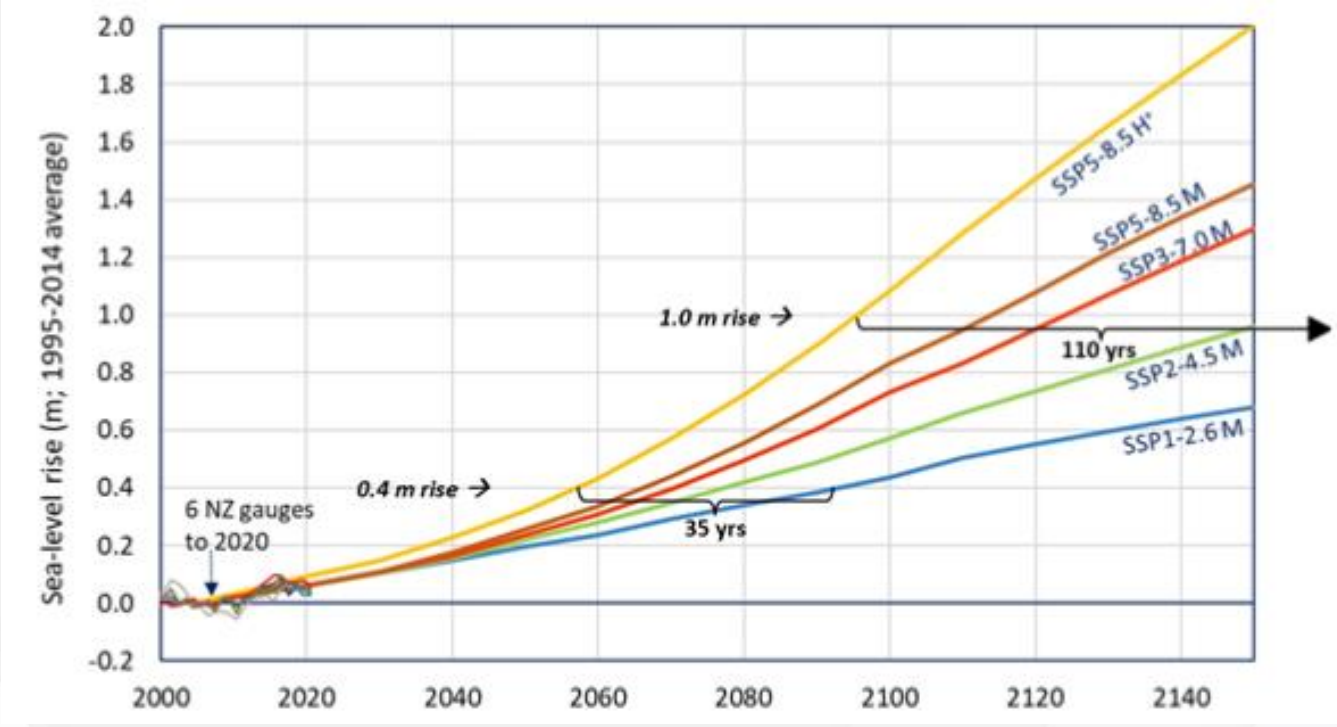


Table 6: Summary of approximate year when absolute sea-level rise (SLR) heights could be reached using the recommended projections for a central location in Aotearoa New Zealand

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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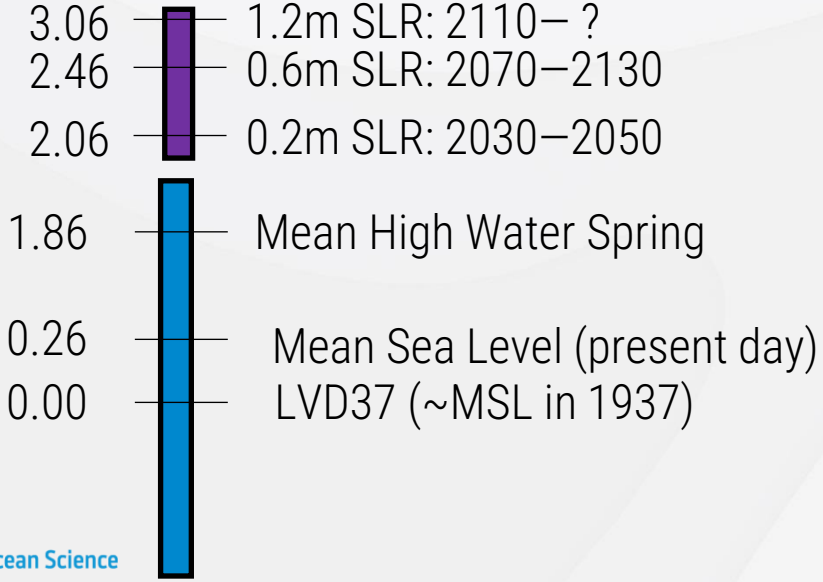
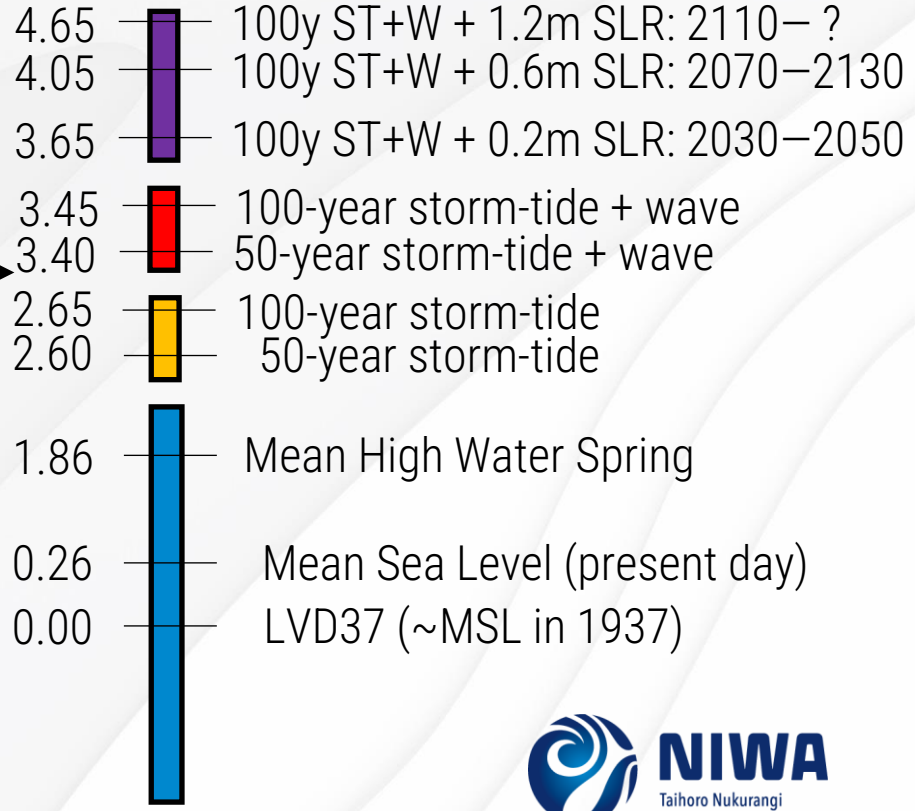
Coastal inundation

TC Fehi →



TC Fehi →



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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)

- Tsunami Hazard covered under GNS study
- No groundwater component

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Methodology

Coastal inundation

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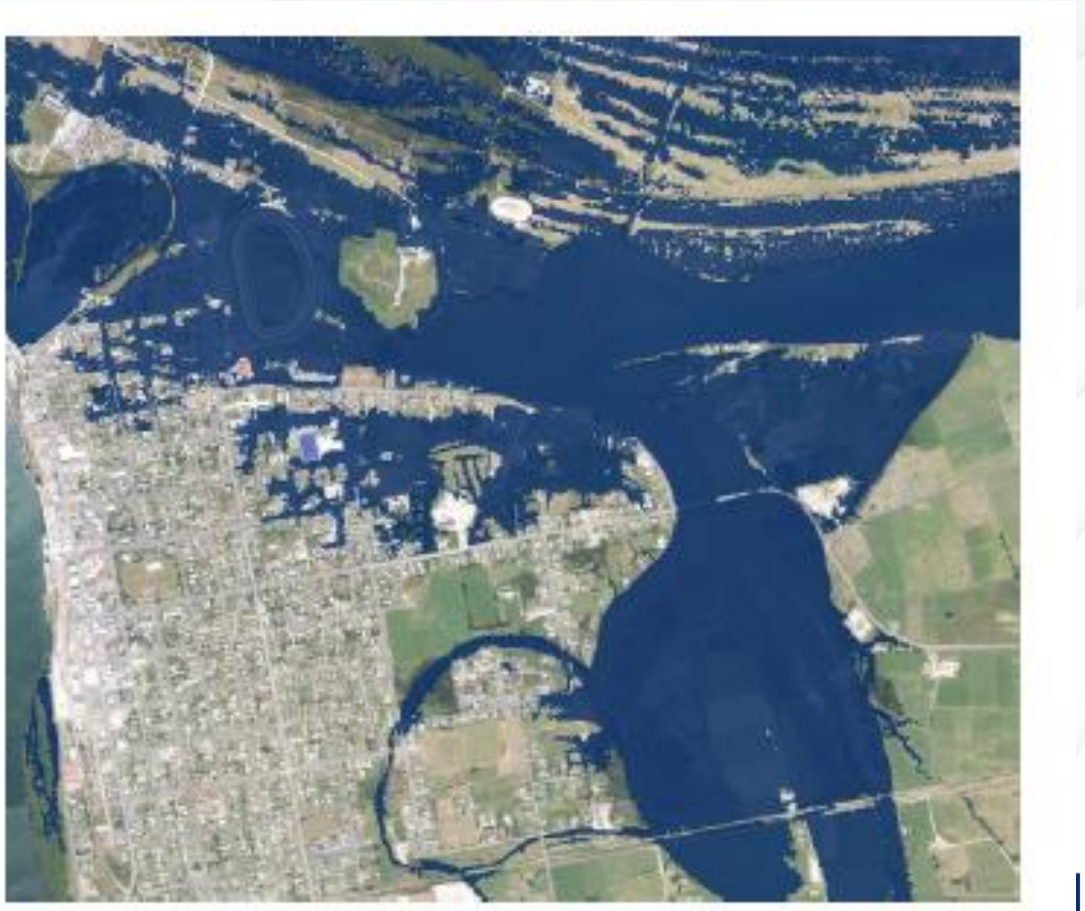
Coastal inundation

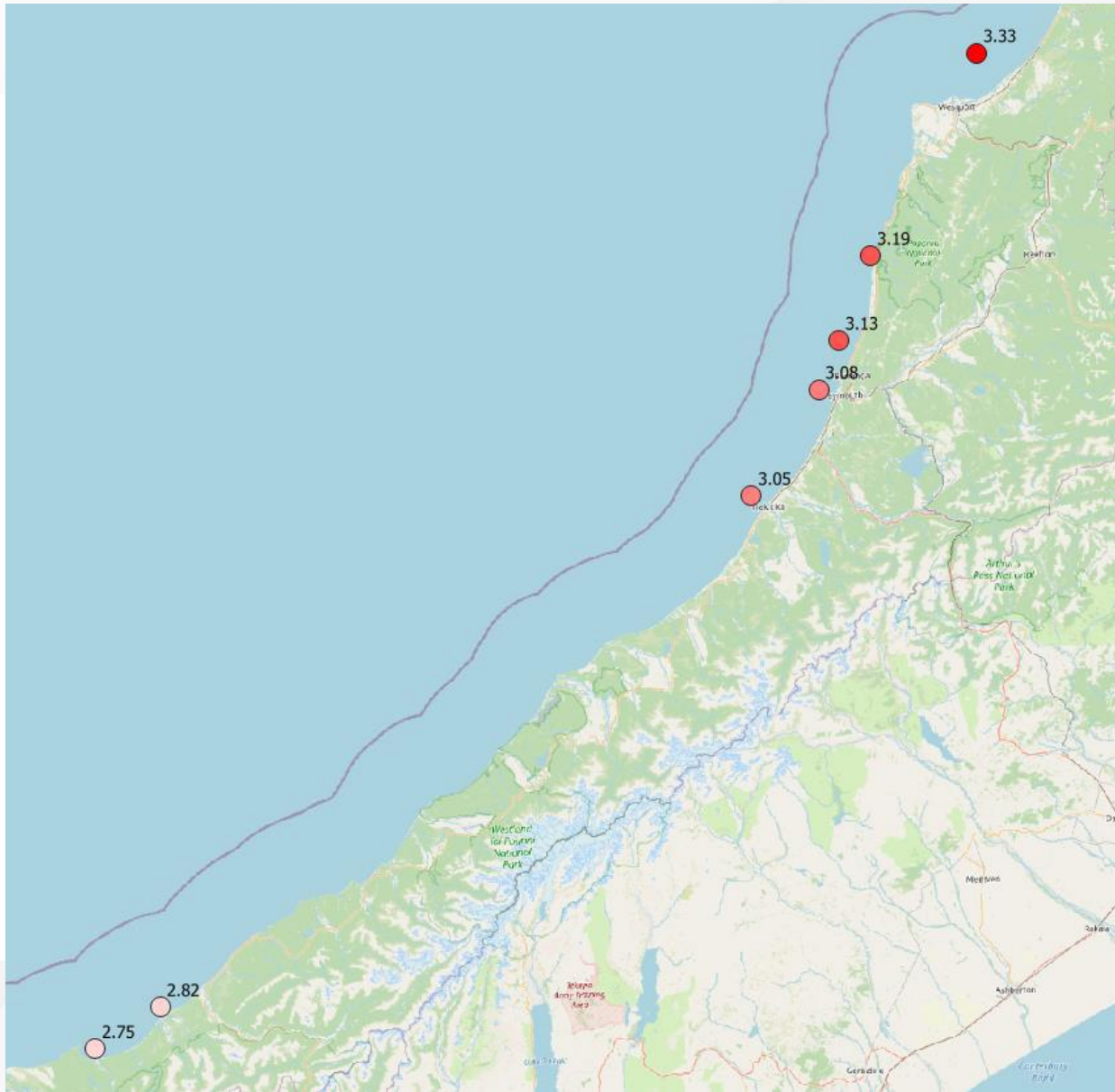
"Bathtub" inundation

Physics based model (hydrodynamics model)



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 hindcast are too biased for extreme waves
  - Stephens et al. (2020) method produces unrealistically high runup
  - 0.8m wave setup (5-6m swell at storm surge peak)



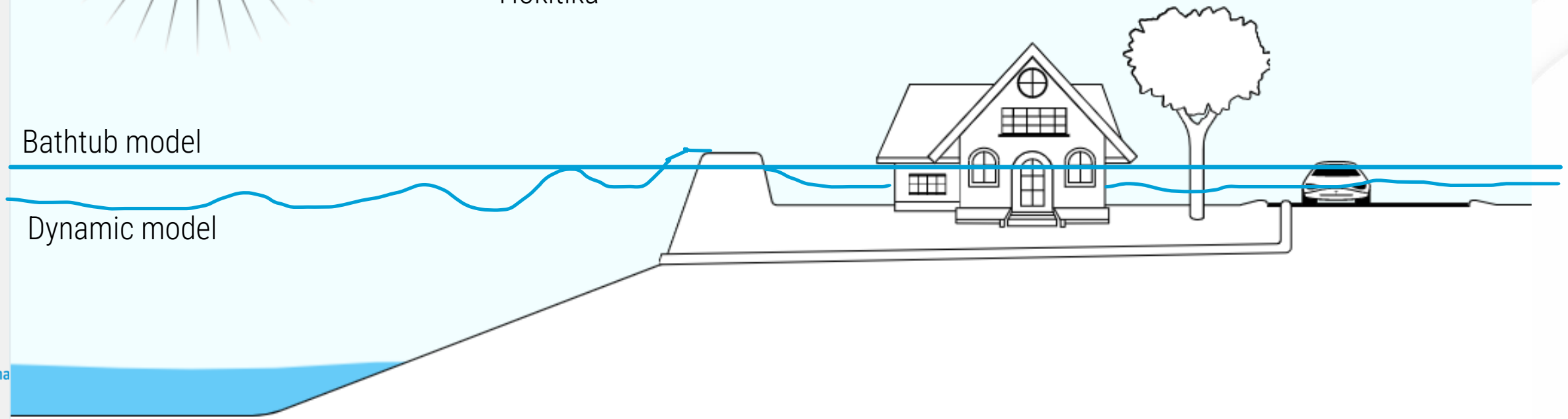
Bathtub model

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



How do we know the dynamic inundation model works?

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

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Methodology

Coastal erosion

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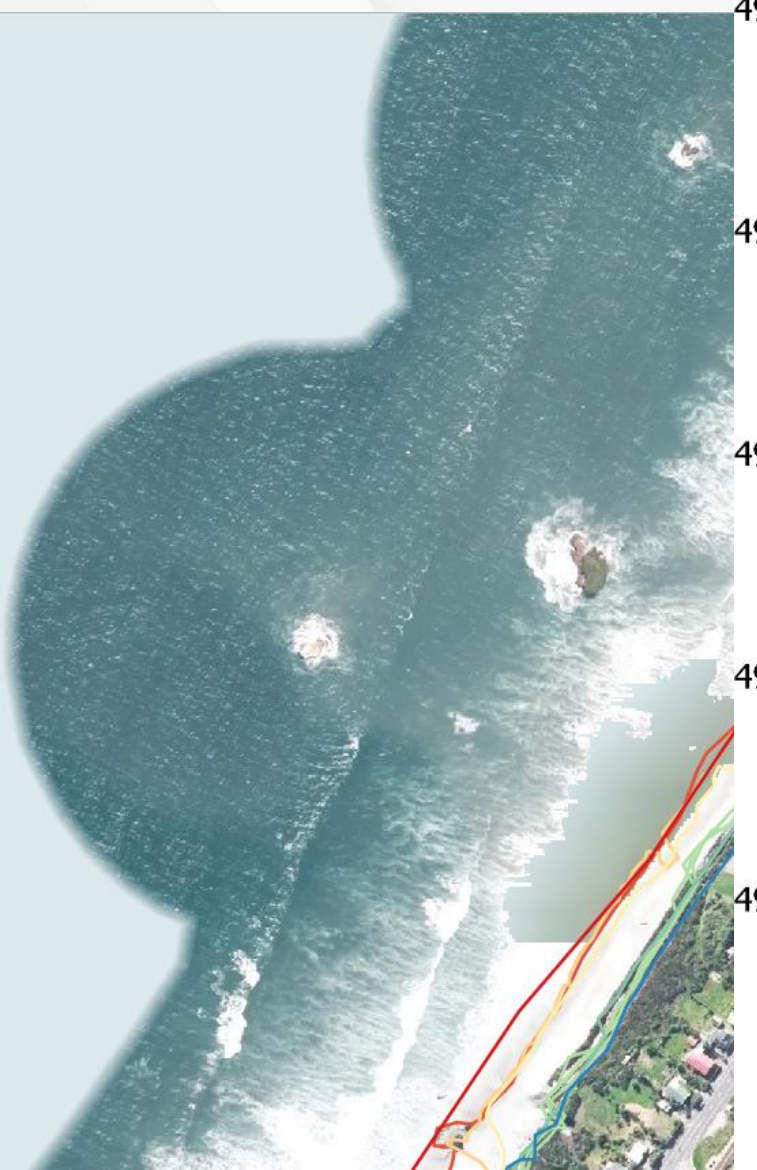
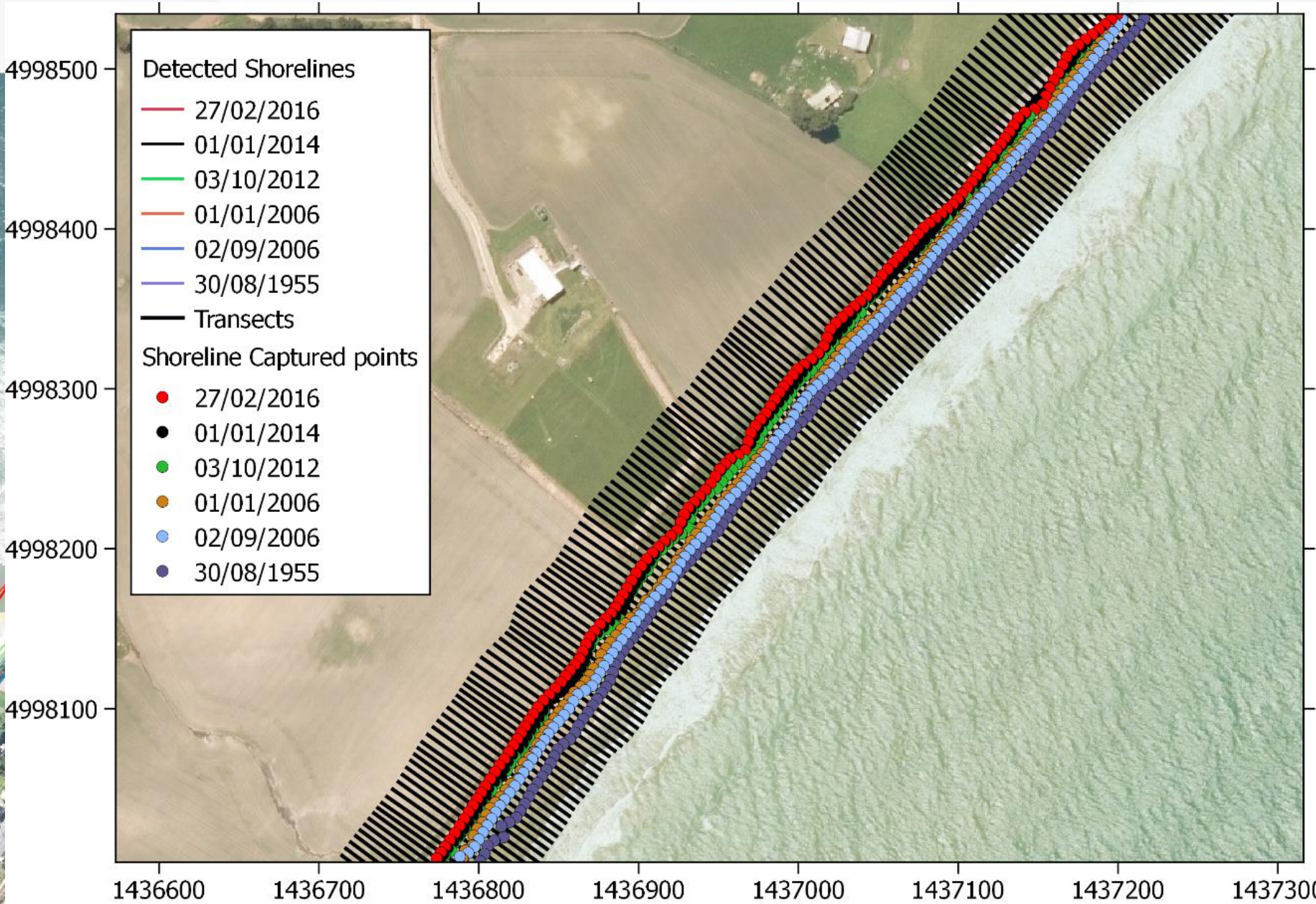
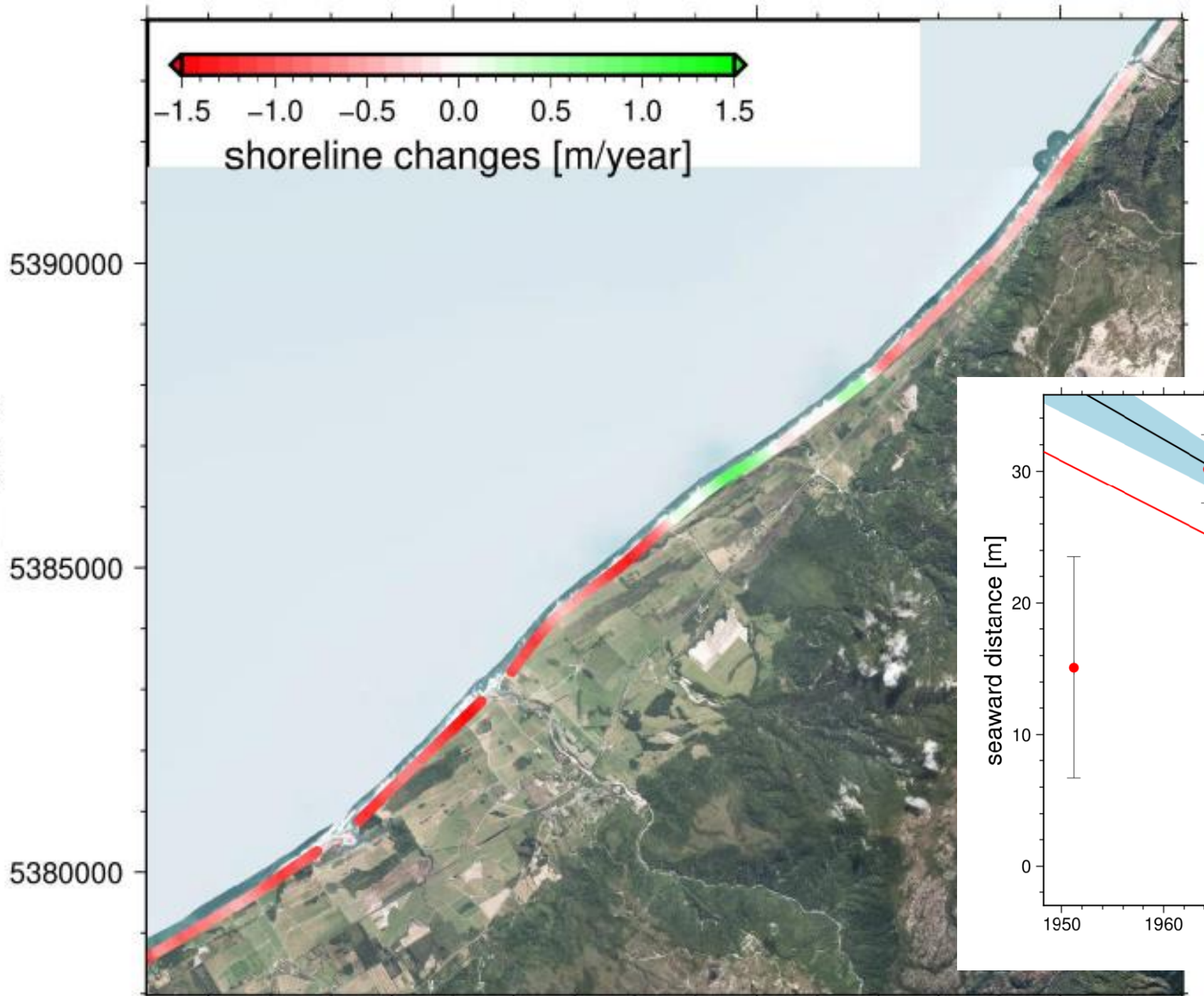
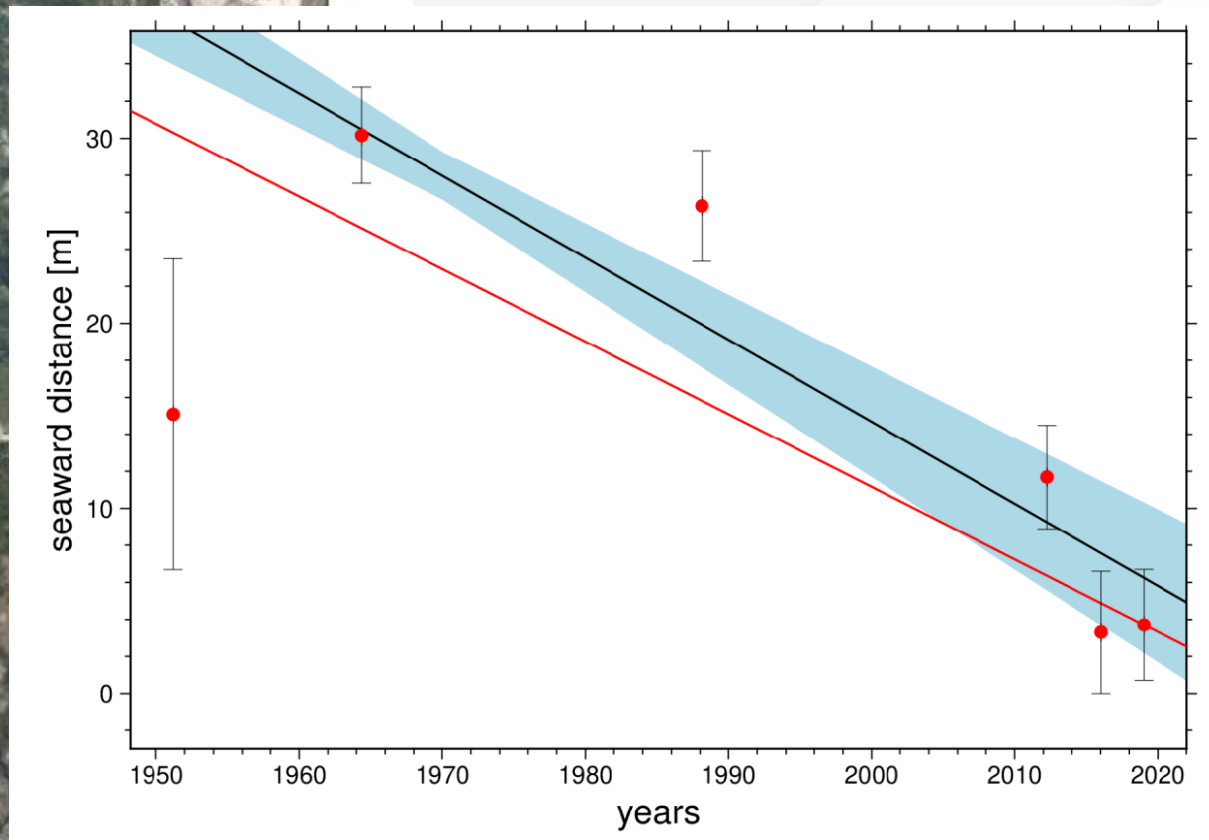
Coastal erosion






−1.5 −1.0 −0.5 0.0 0.5 1.0 1.5
shoreline changes [m/year]
5390000
5385000
5380000

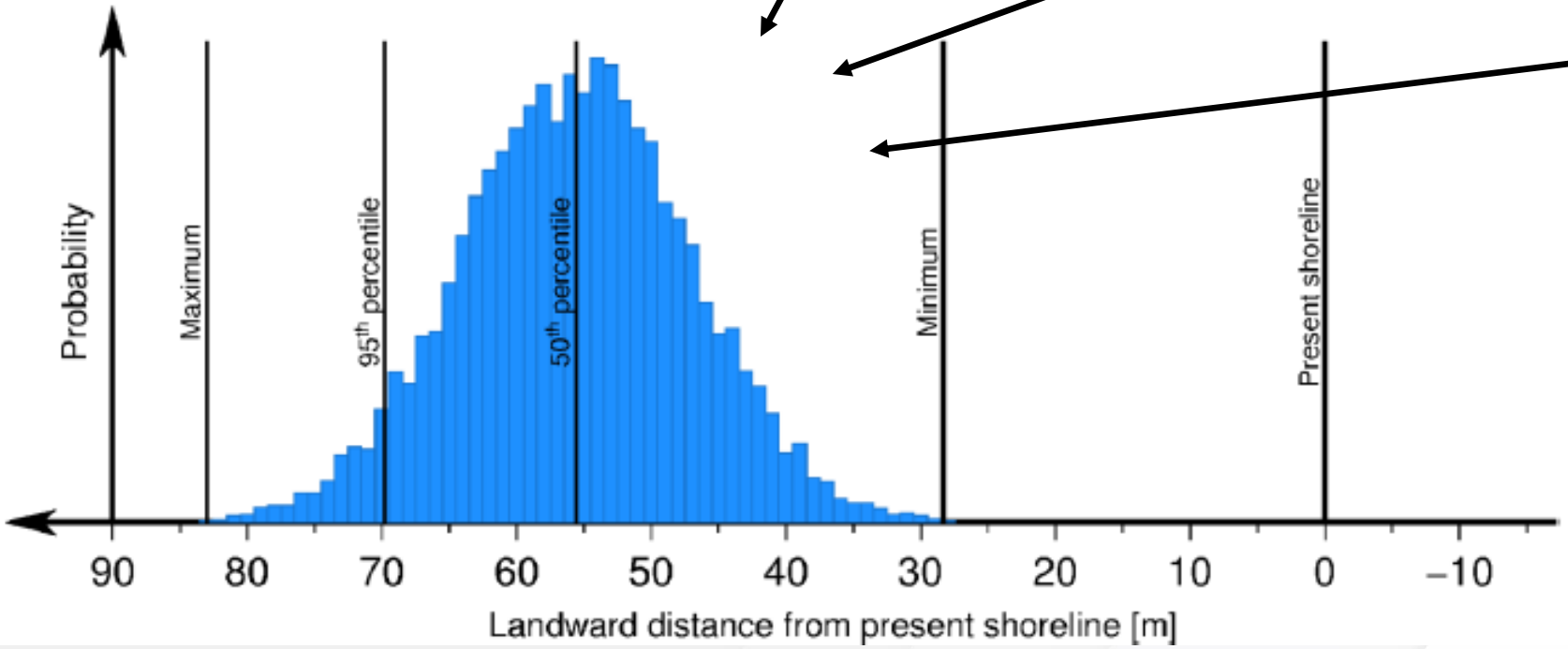

seaward distance [m]
30
20
10
0
1950
1960
1970
1980
1990
2000
2010
2020
years

Erosion Hazard zone

Historical change

Short-term cut/ roll over

Retreat acceleration with accelerated SLR



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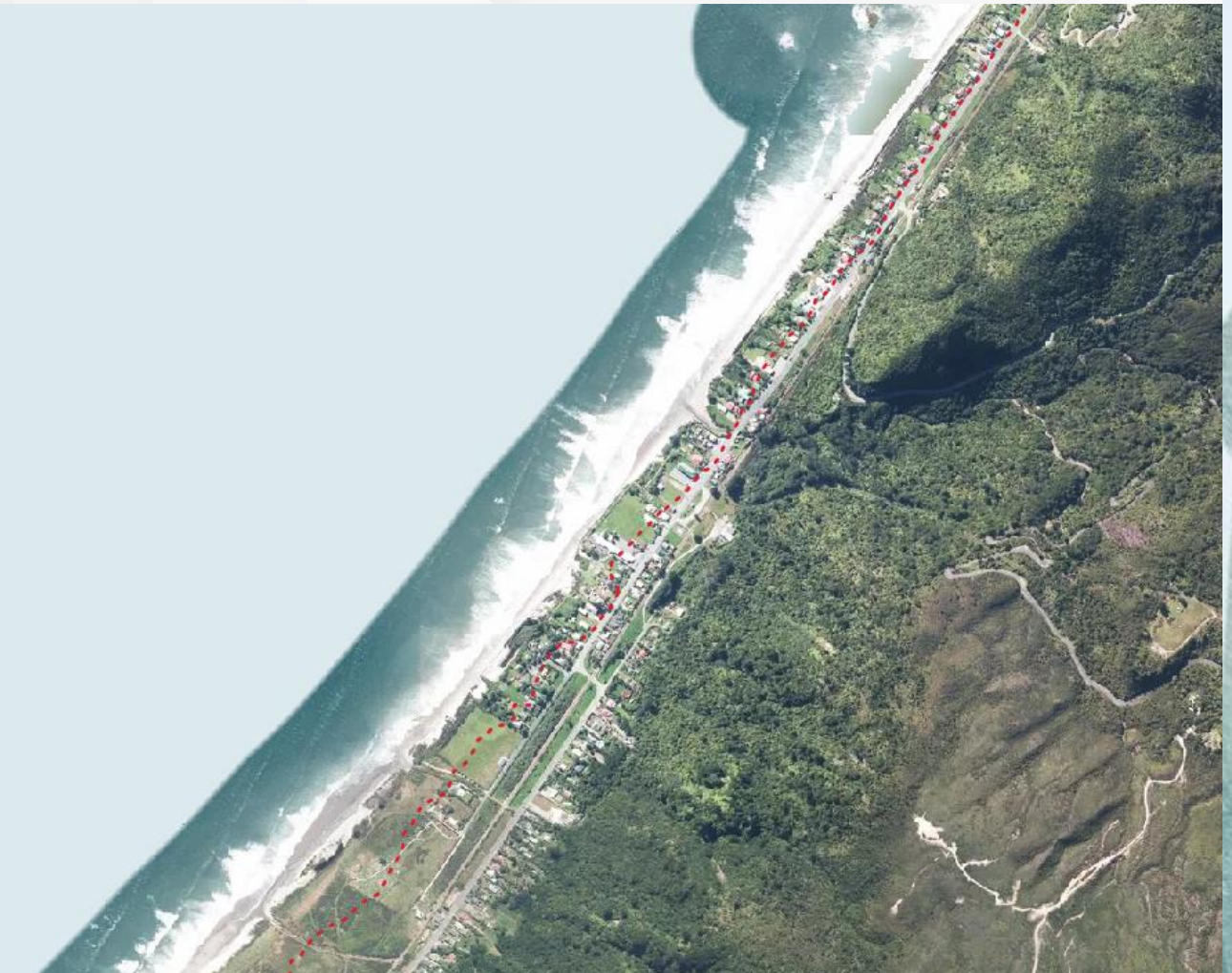
Erosion hazard lines



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TTPP Layers: merged erosion-inundation hazards

Coastal Hazard Severe

- Areas subject to coastal inundation and significant erosion risk
  - Max extent between
    - 100-year ARI inundation with 1m SLR
    - Coastal erosion zone for 100-year outlook
- Locations based on the WCRC Coastal Hazard Areas – risk based

Coastal Hazard Alert

- Areas subject to coastal inundation
- TTPP Plan based on space shuttle topographic data

Coastal Setback

- Areas we didn't have information
- 100m from the coast

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Results

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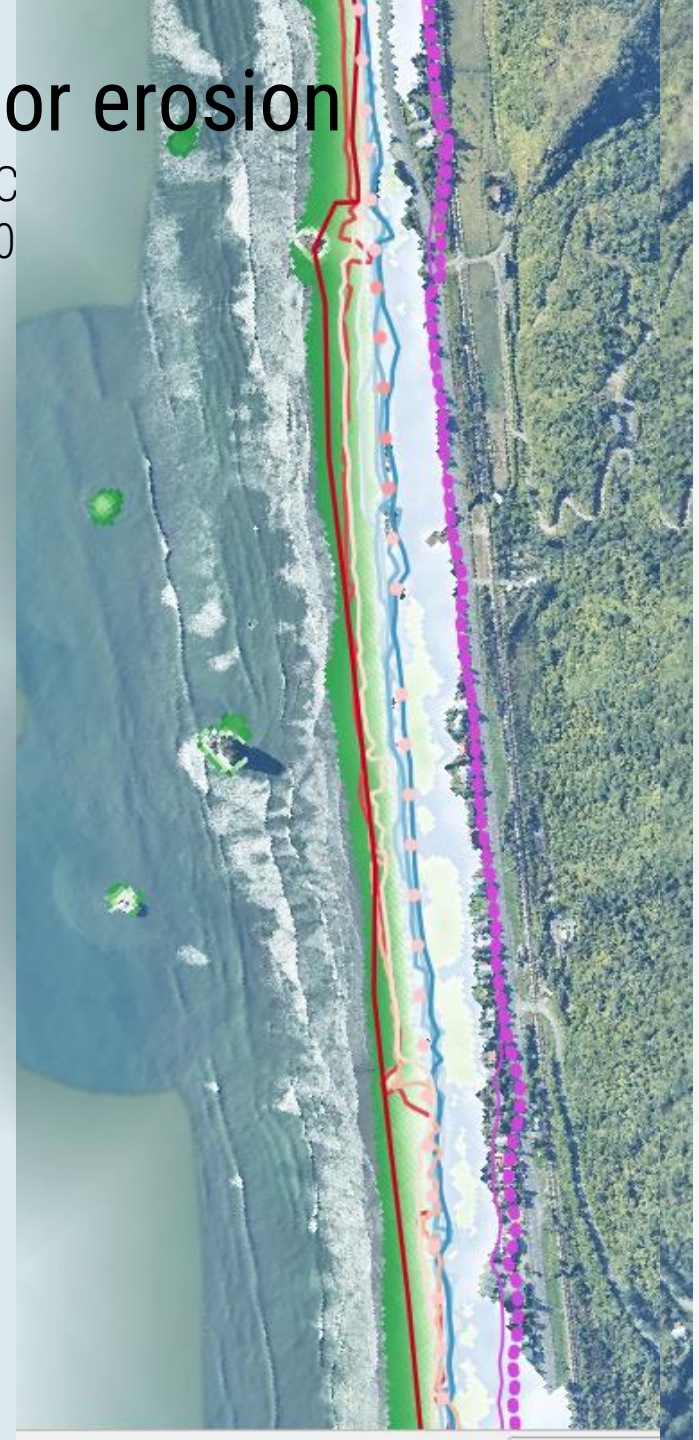
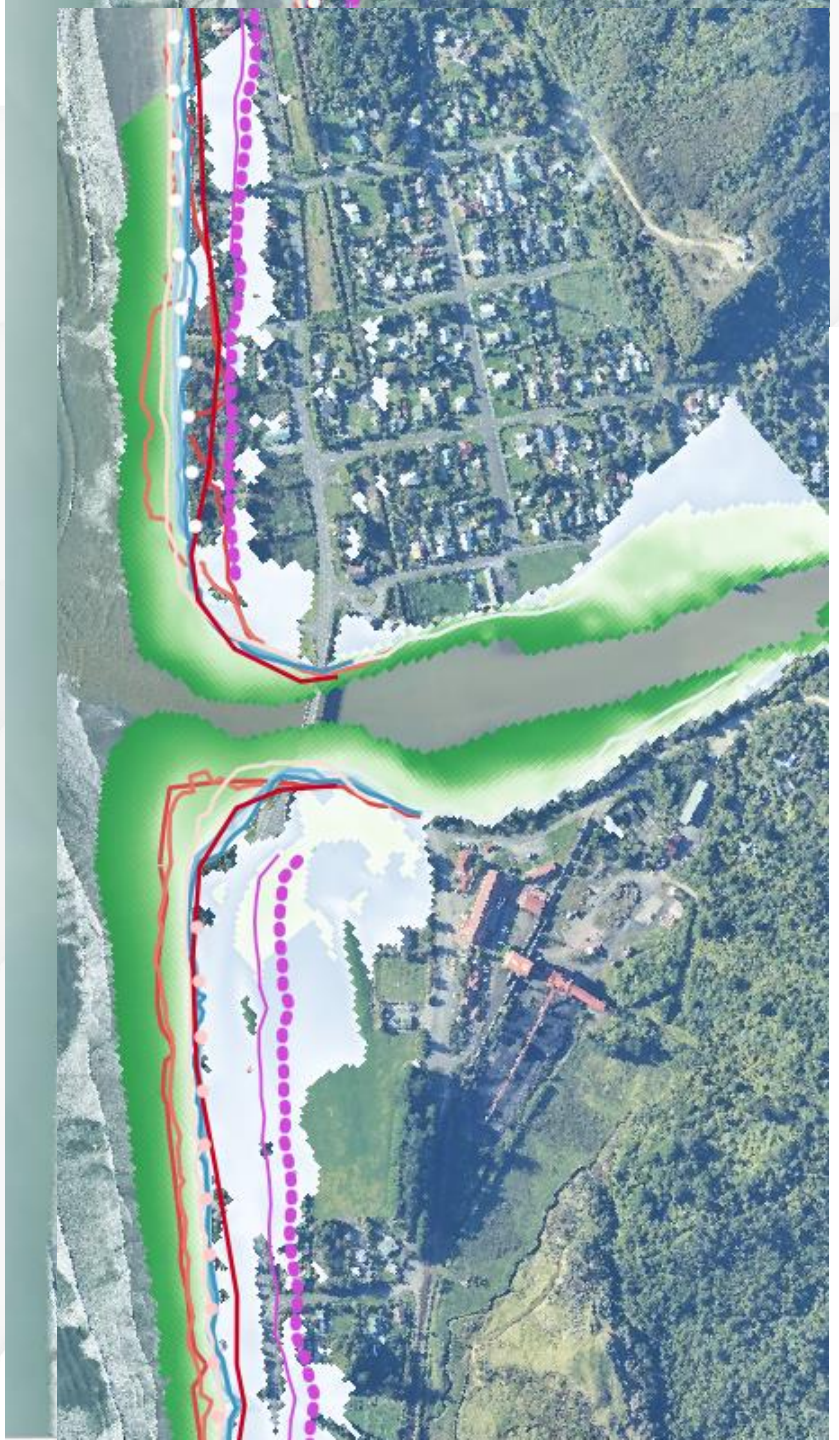
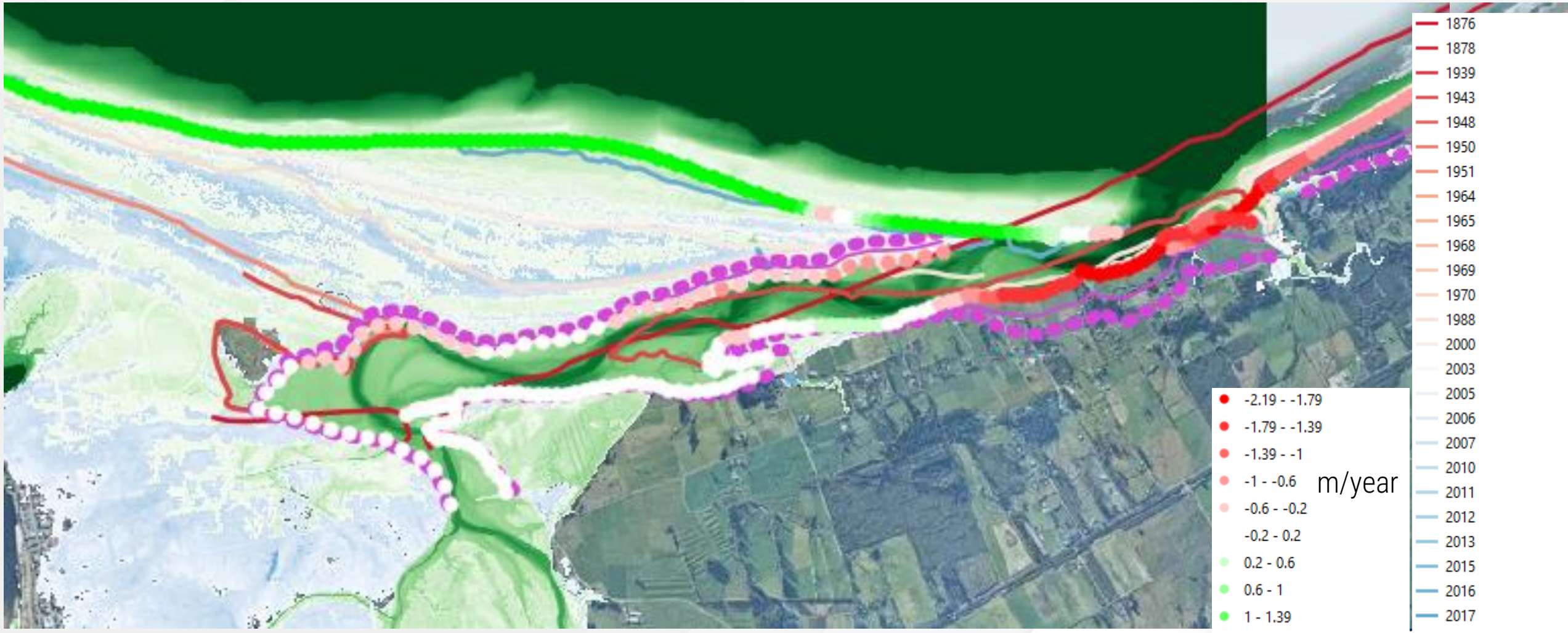
Granity/Ngakawau/Hector erosion

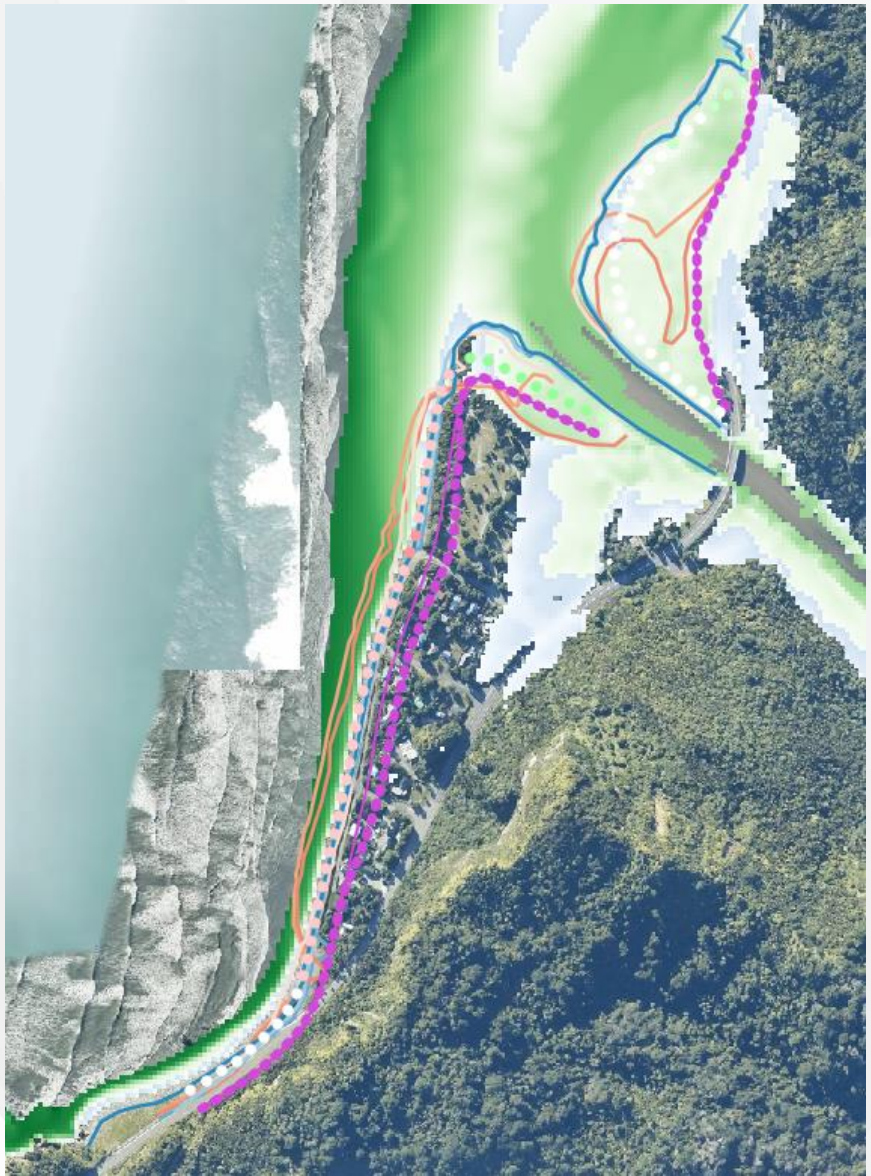


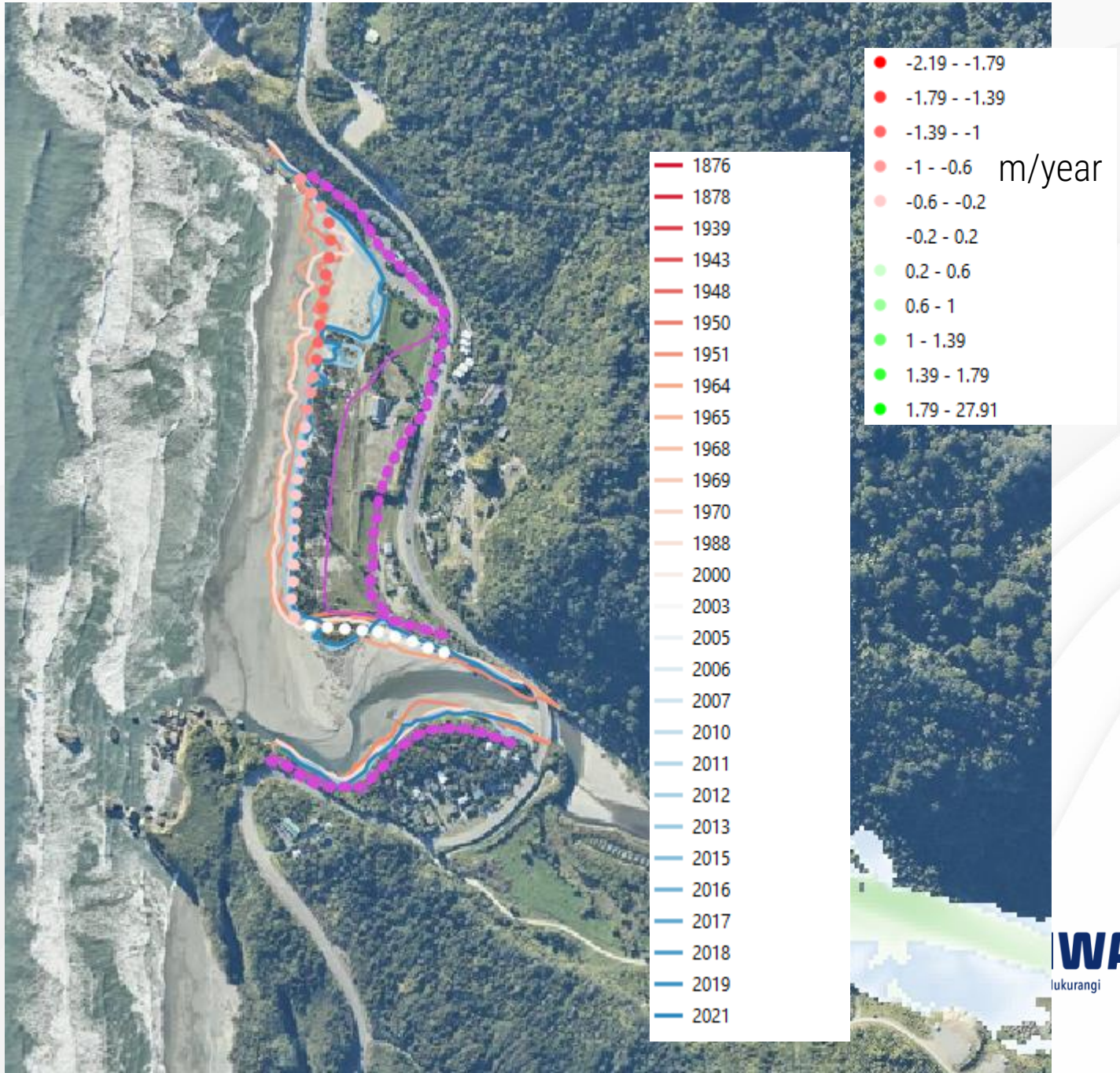


Orowaiti erosion hazard



Punakaiki

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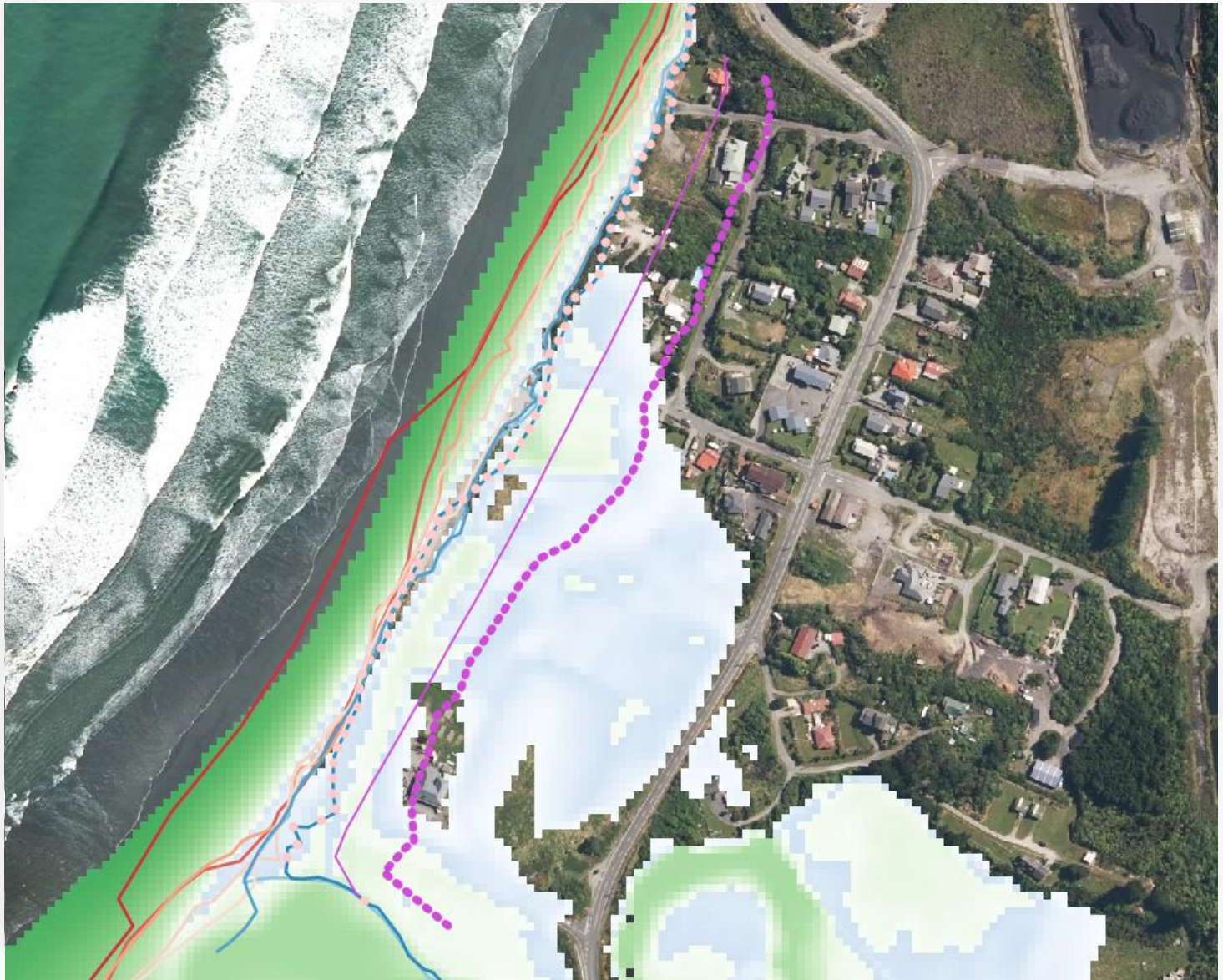
2011
2012
2013
2015
2016
2017
2018
2019
2021
-2.19 - -1.79
-1.79 - -1.39
-1.39 - -1
-1 - -0.6
-0.6 - -0.2
-0.2 - 0.2
0.2 - 0.6
0.6 - 1
1 - 1.39
1.39 - 1.79
1.79 - 27.91
m/year

Rapahoe



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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

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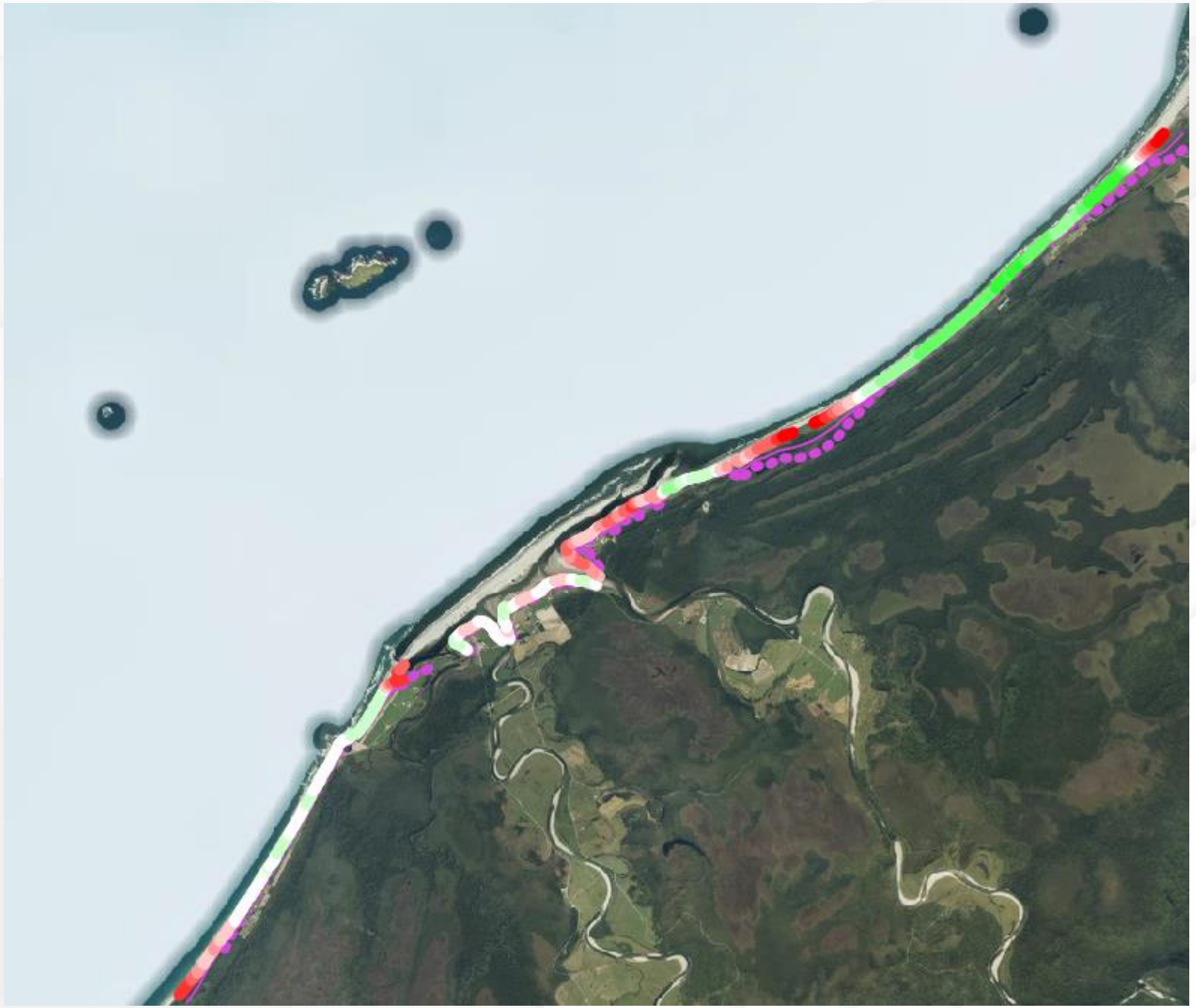
Haast erosion rates



Okuru

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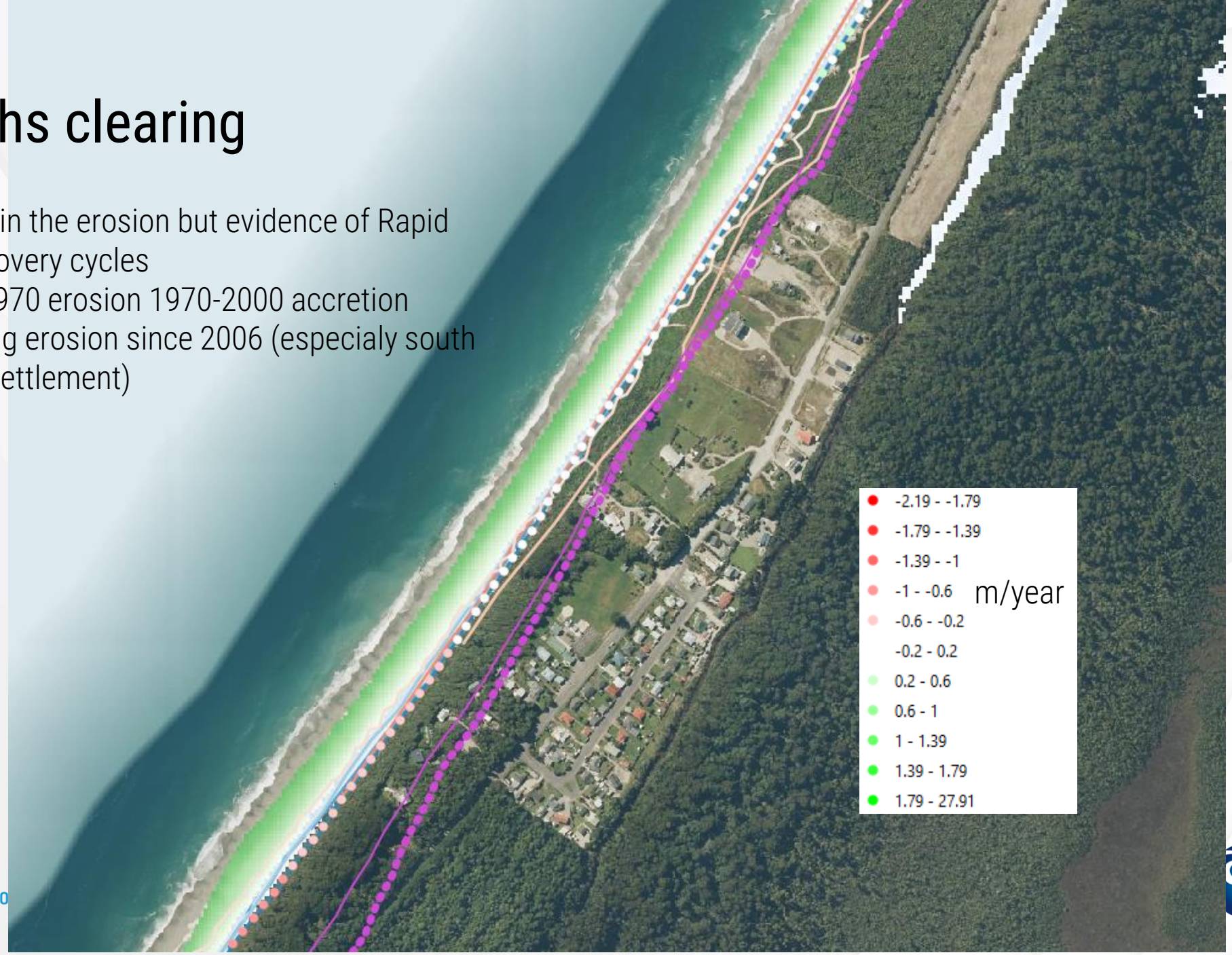
Hannahs clearing

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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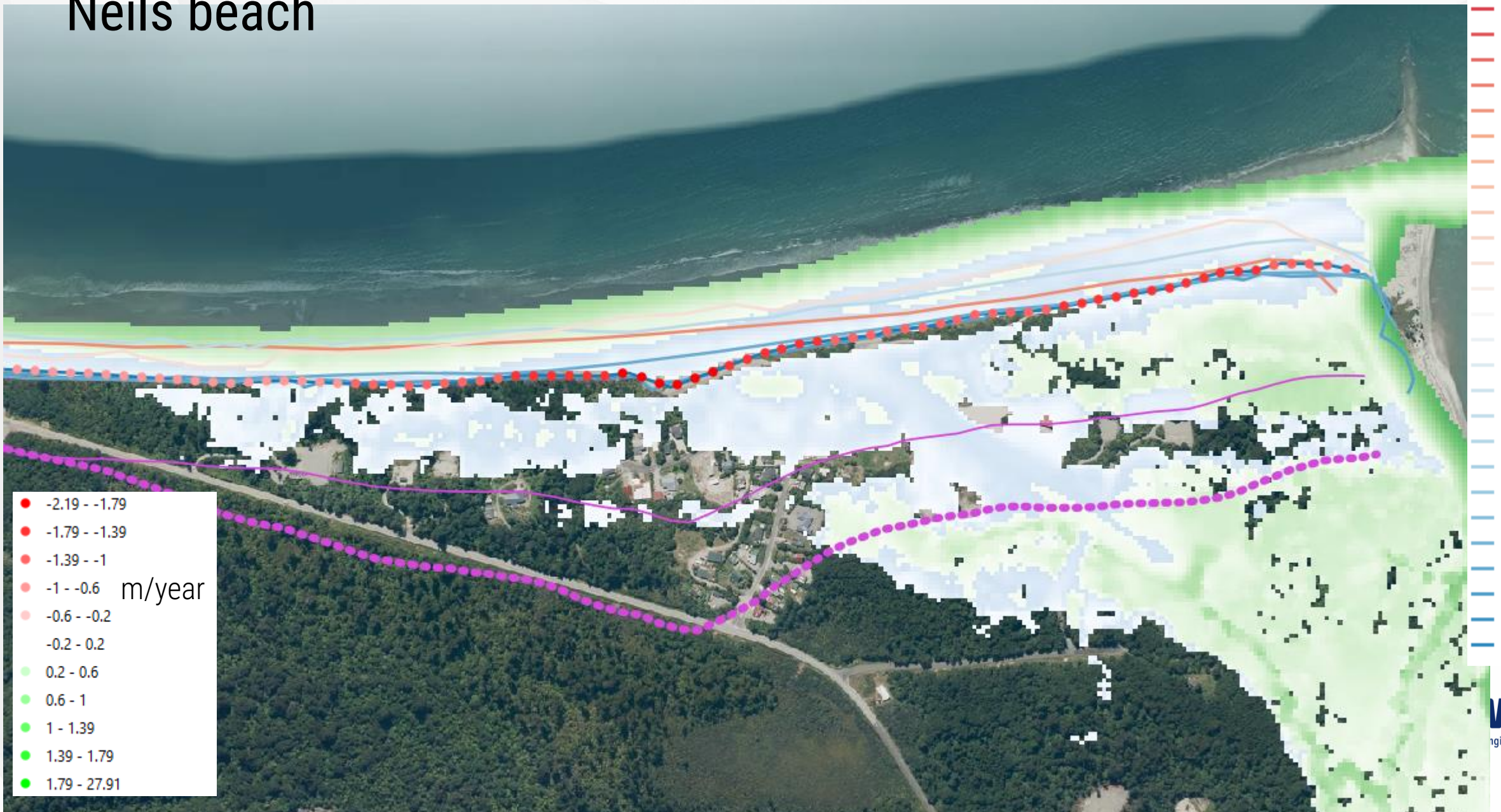
Neils beach


-2.19 - -1.79
-1.79 - -1.39
-1.39 - -1
-1 - -0.6
m/year
-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
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Jackson Bay

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Nga Mihi!