The northwest wave climate and sediment process: implications for coastal restoration.

Karin Bryan, University of Waikato

Raglan Whāingaroa

Kāwhia

Aotea

Erosion at Raglan beach forces retreat of public toilets

Rachel Moore

October 20, 2022, · 03:09pm

Share

The toilet block on Ngarunui Beach in Raglan was installed in 2019 and will be moved starting October 17.

CHRISTEL YARDLEY / STUFF

Raglan Whāingaroa

2011

2023

Kāwhia

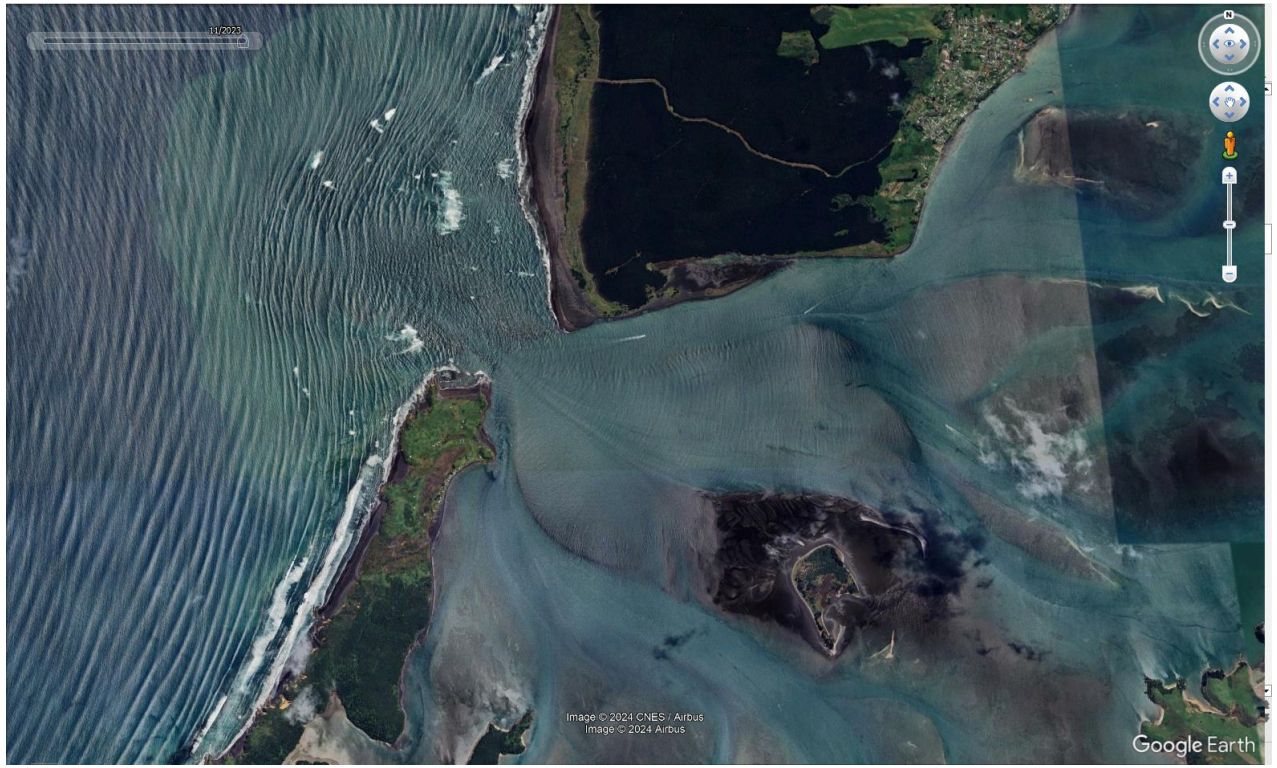
2011

2023

Aotea

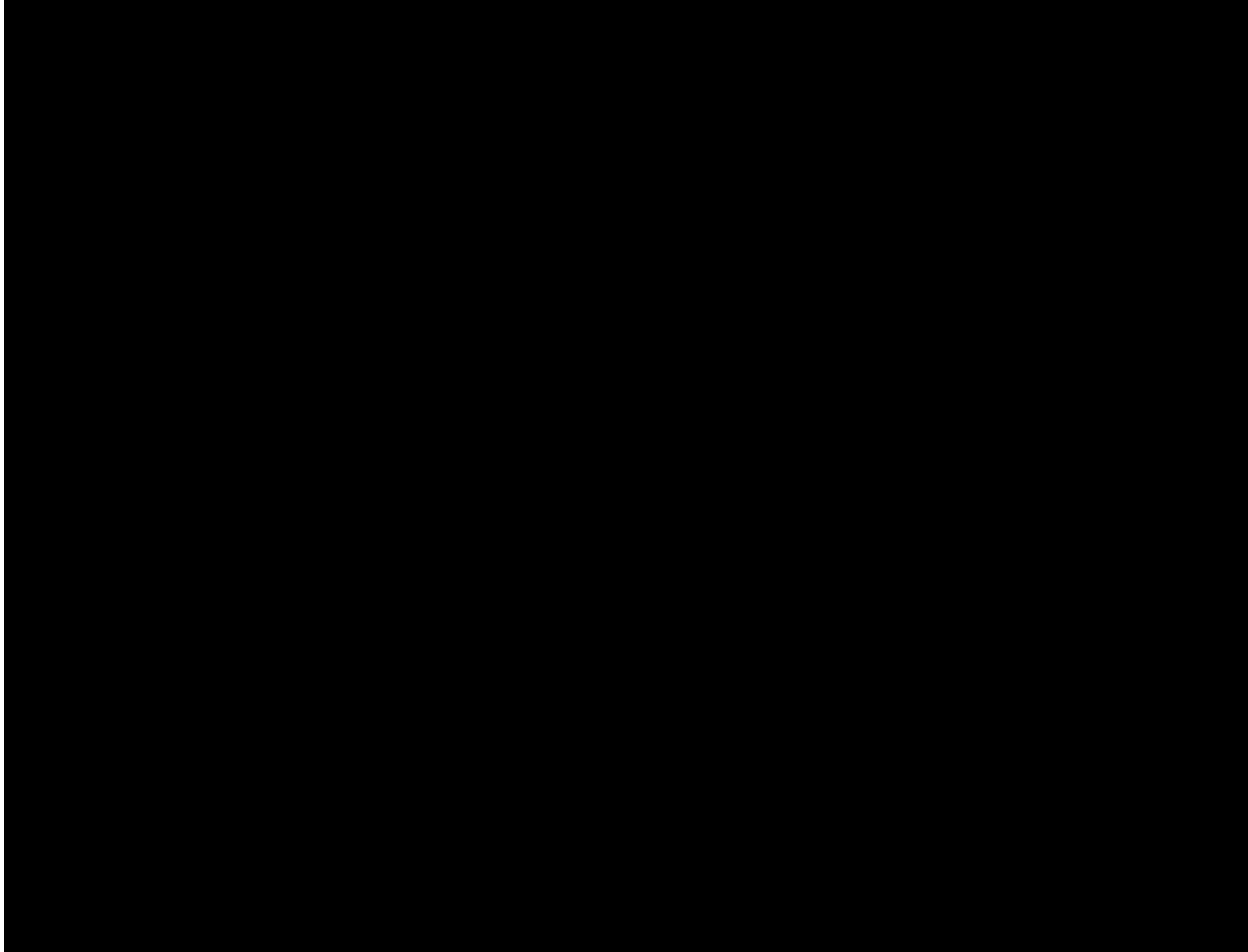
2009

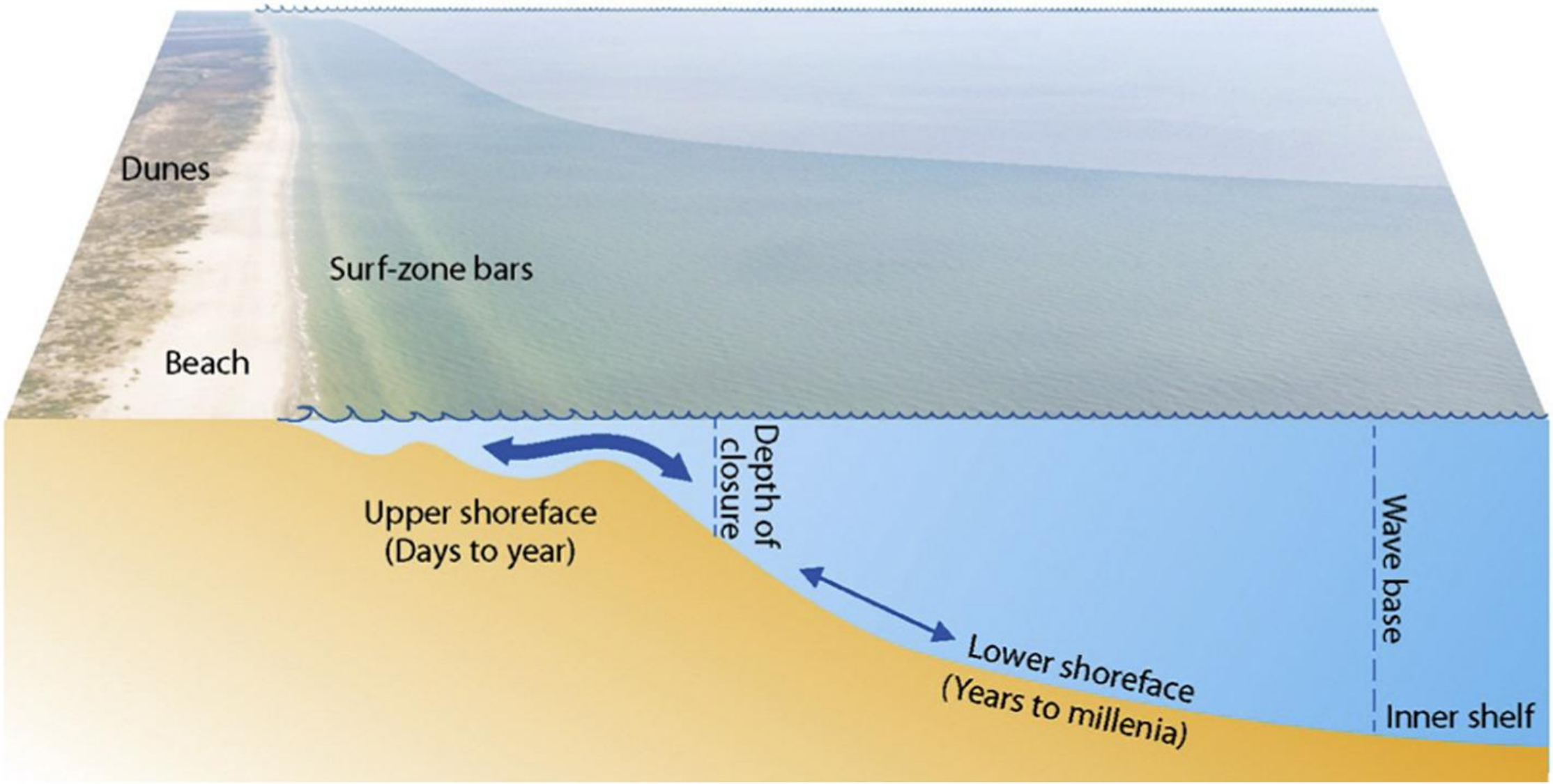
2023



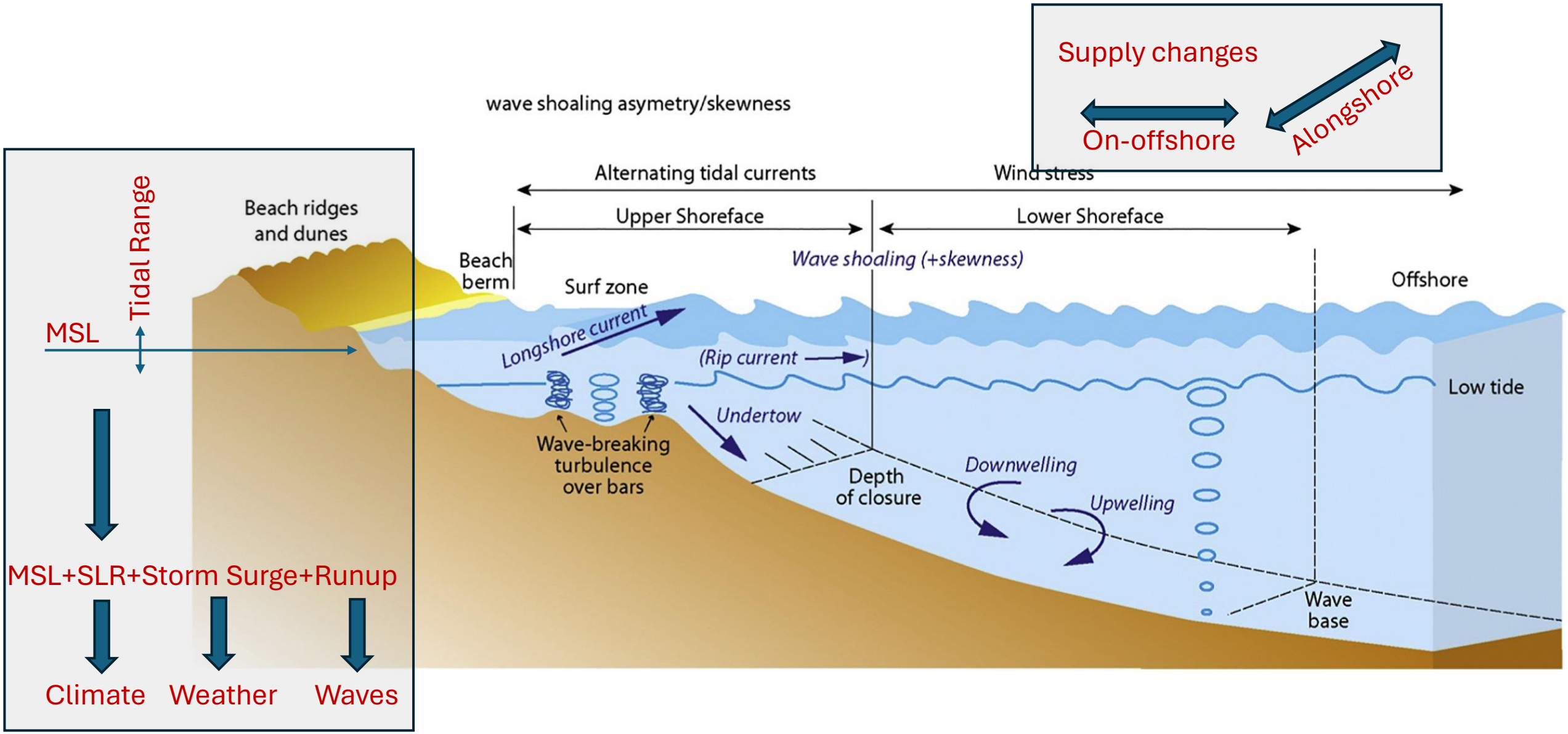
Landsat Timelapse on Google Earth Engine

Aim: To explore the drivers of change on our northwest coast



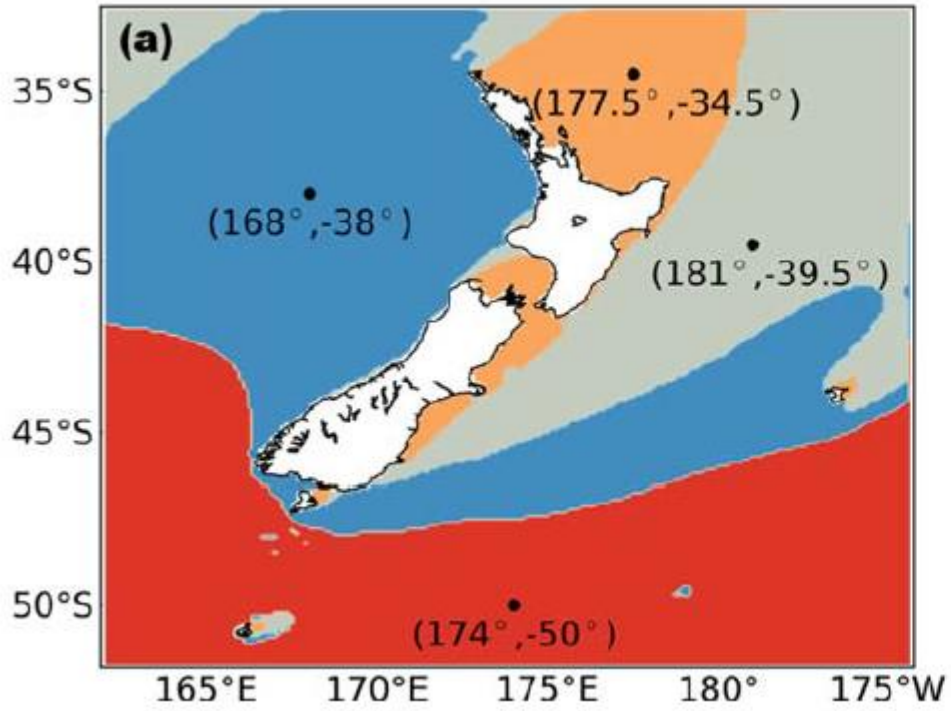


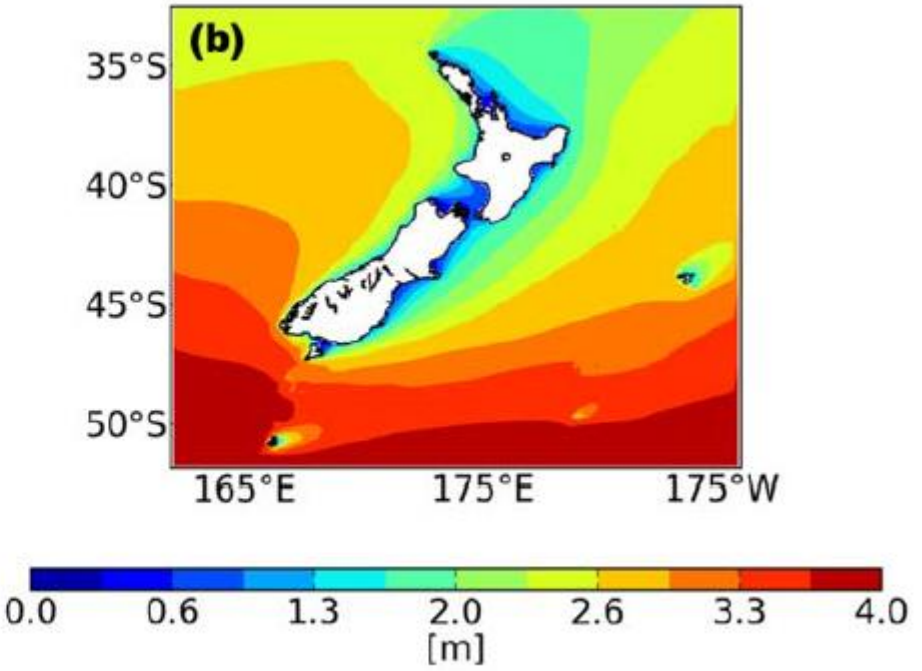
Anthony and Aagaard, Earth Science Reviews 2020



Anthony and Aagaard, Earth Science Reviews 2020

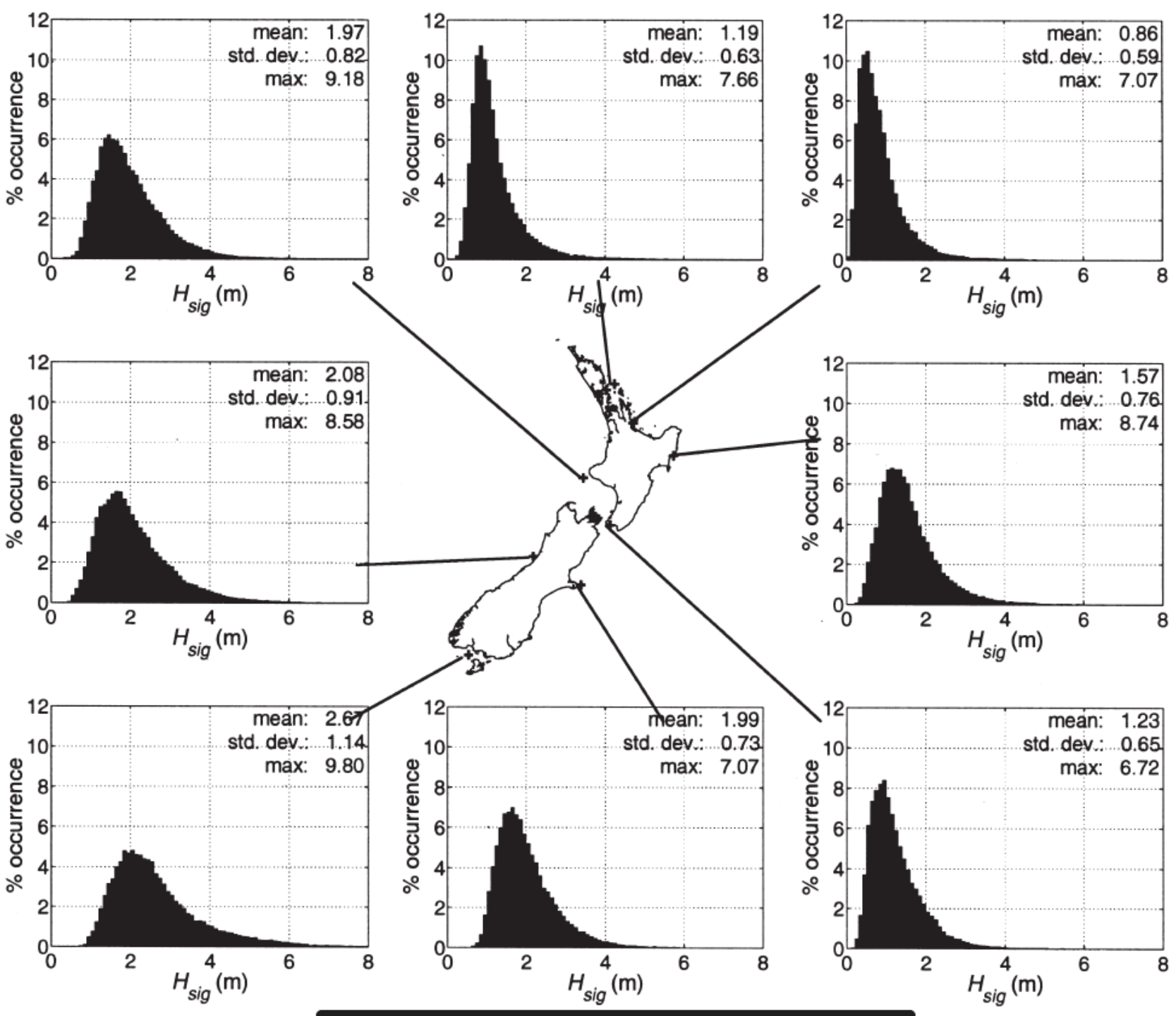
Our major wave climate regions





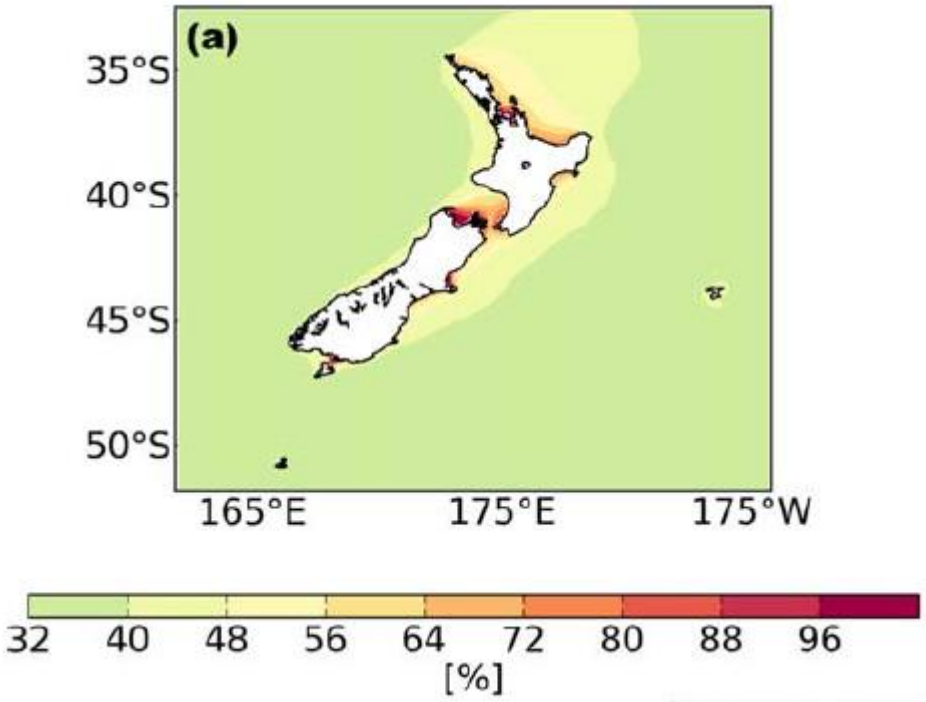
Early work

(Gorman et al. 2003)

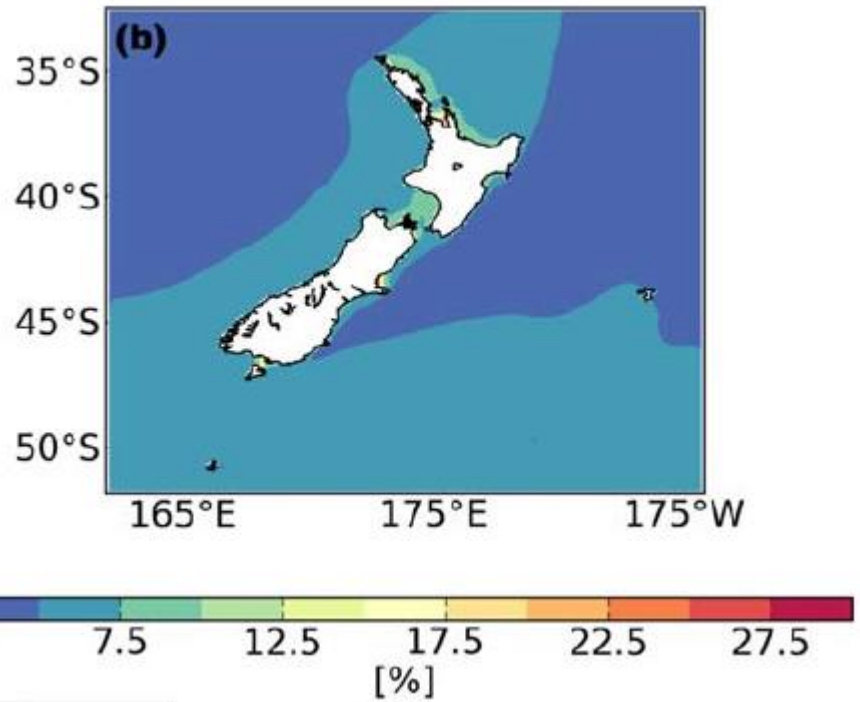


What is our main source of variability

Seasonal



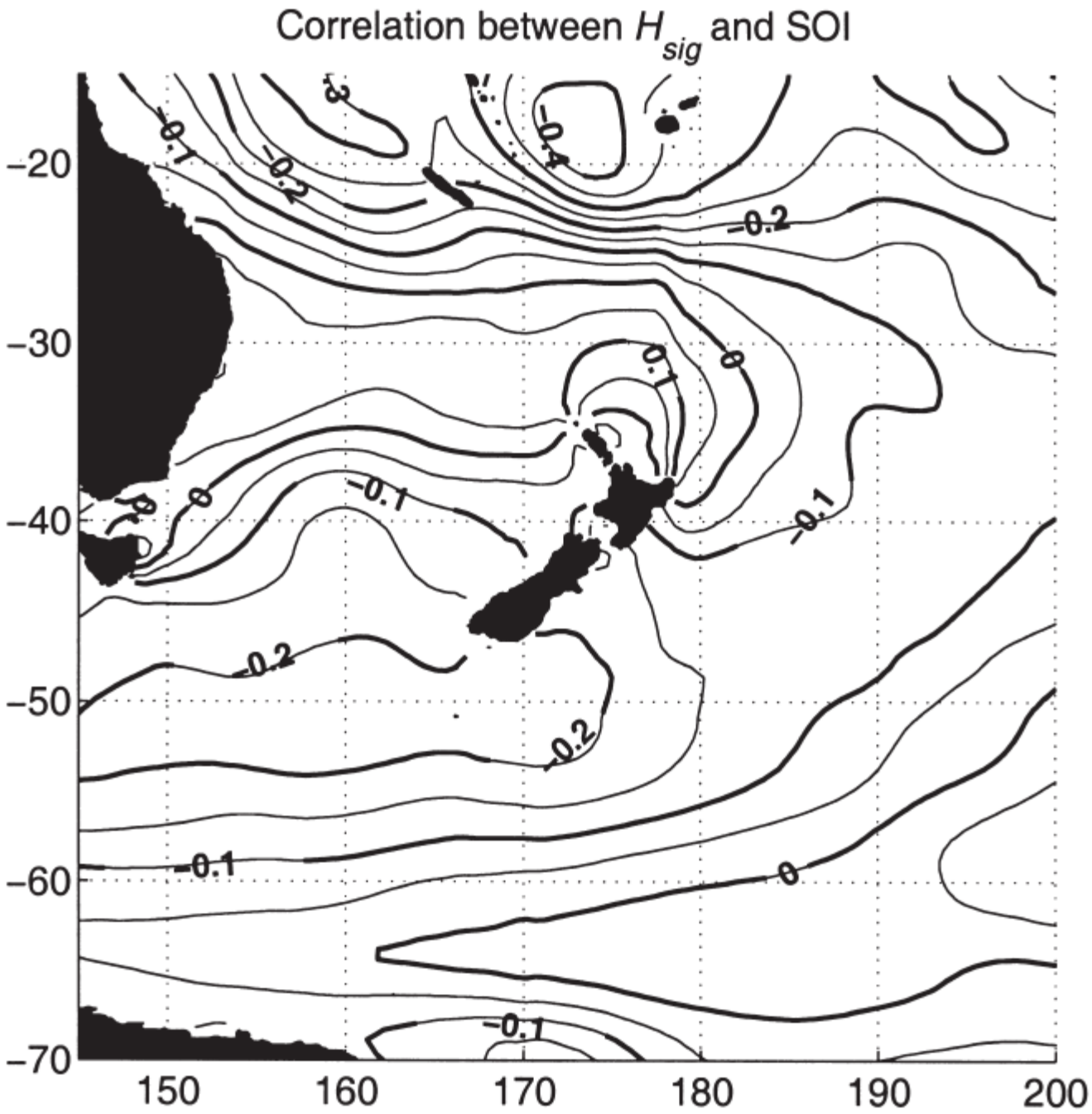
Interannual



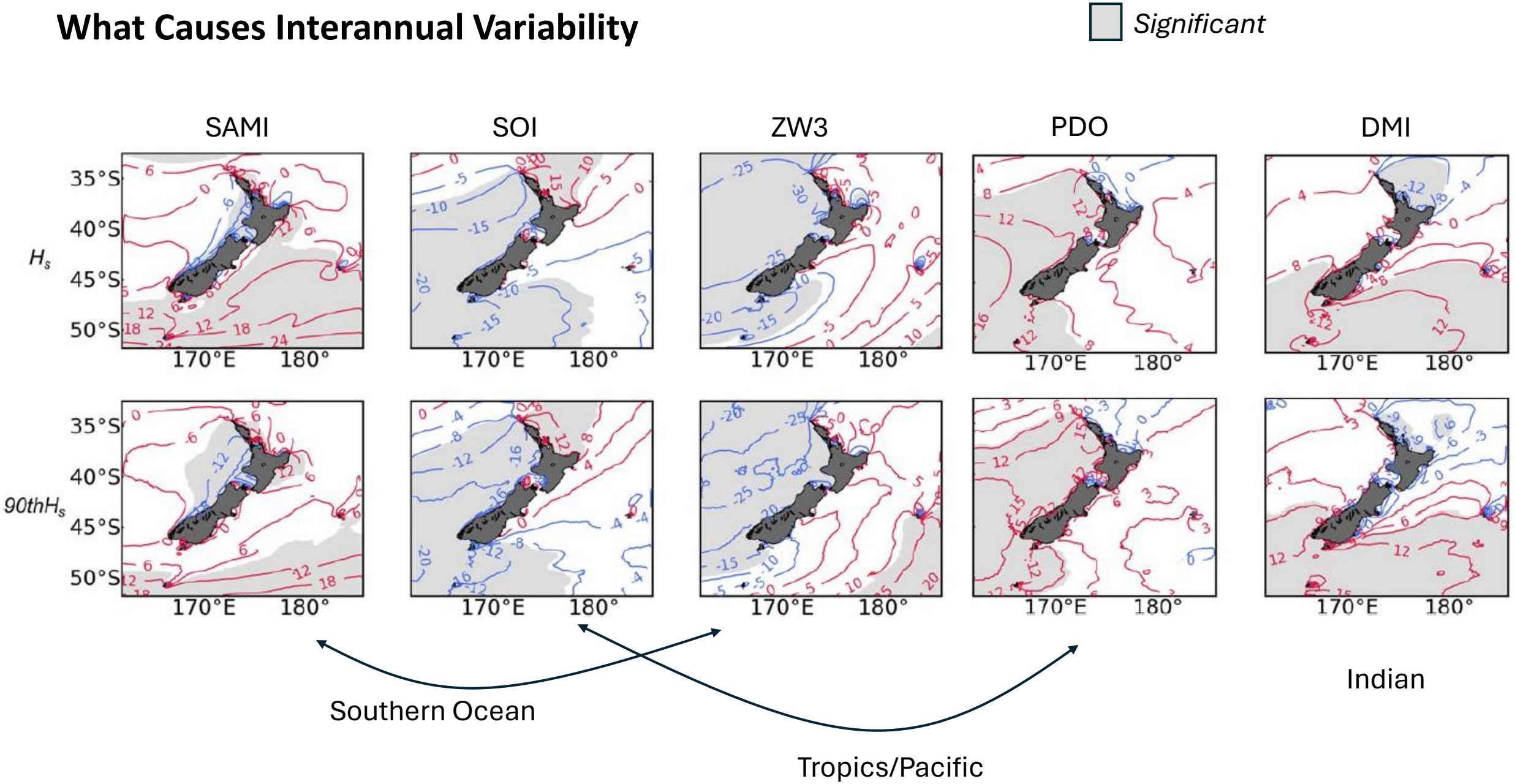
Godoi et al., 2016

What Causes Interannual Variability

Early work (Gorman et al., 2003)

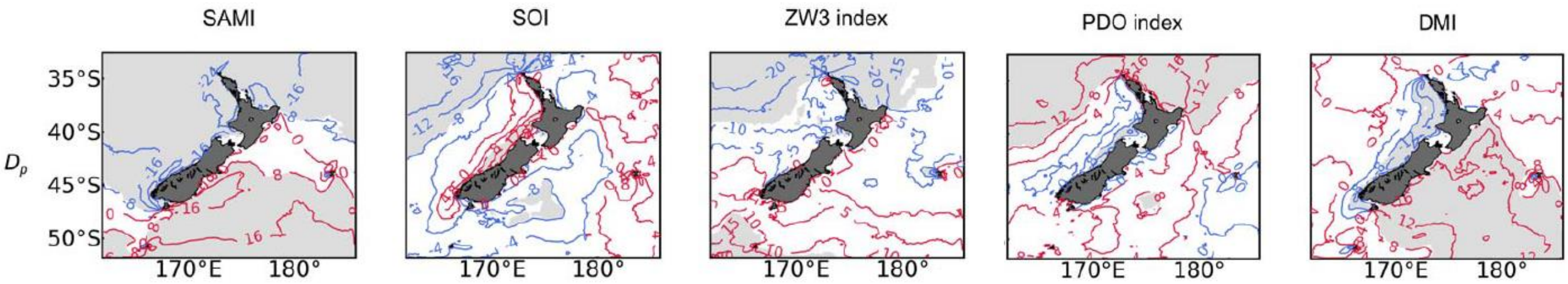


What Causes Interannual Variability

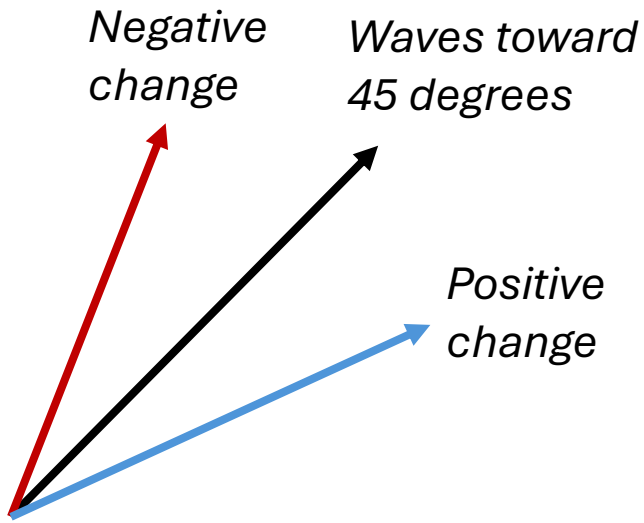


Godoi et al., 2016

What do we know about our wave direction

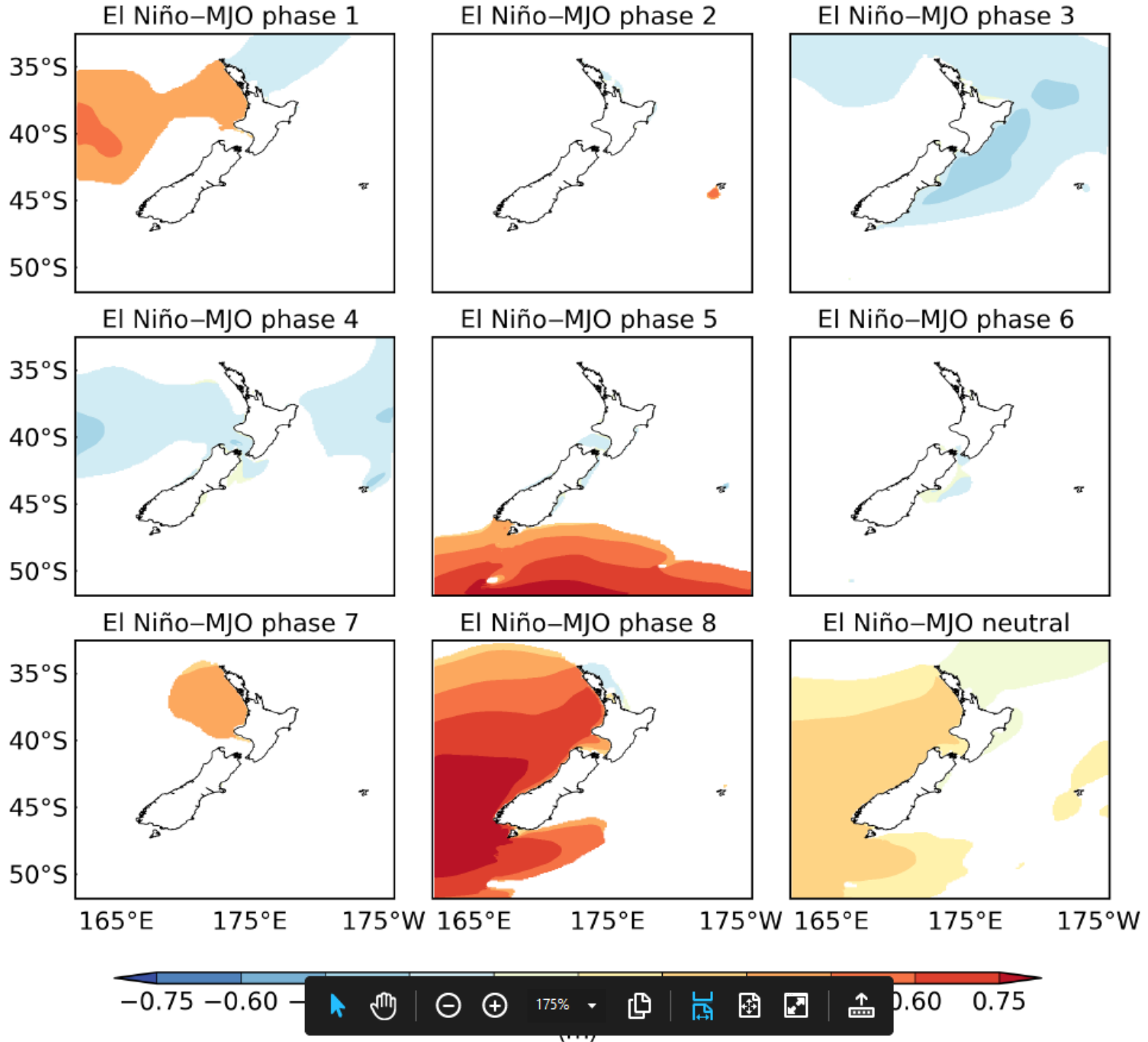


Negative change: more drift northward, erosion on southern sides



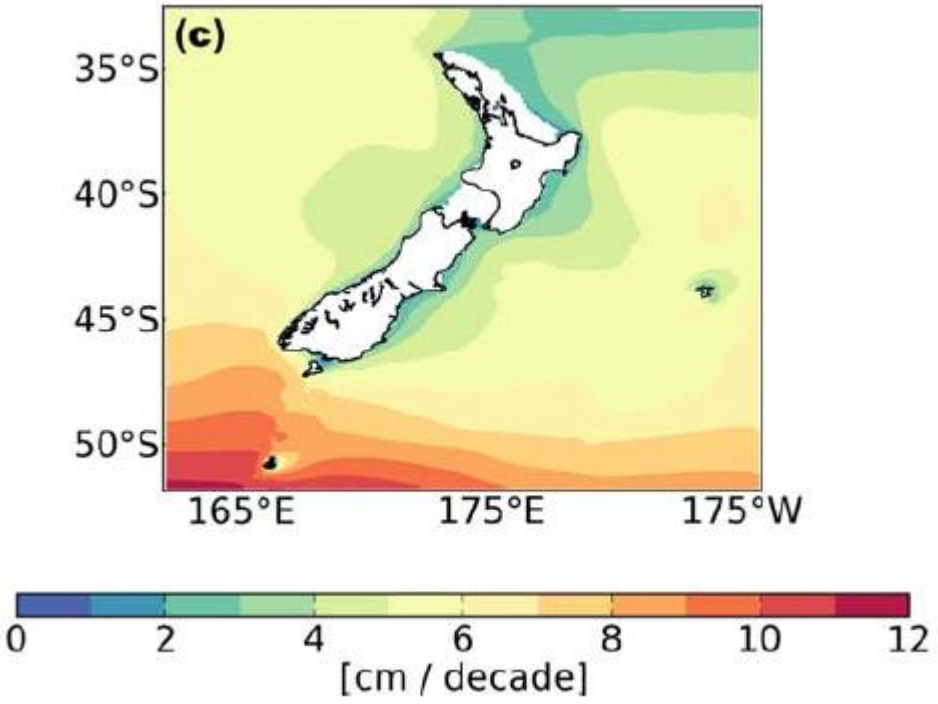
Godoi et al., 2016

The Madden Julian Oscillation

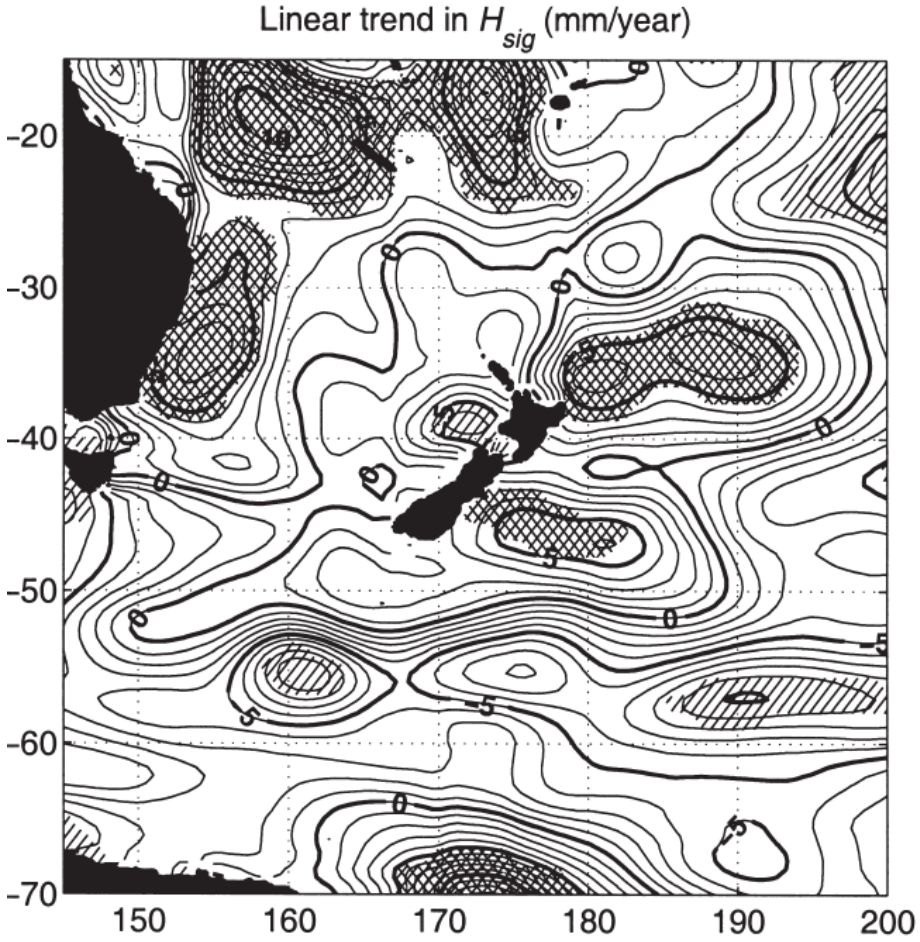


Godoi et al., 2018

How are the waves changing?

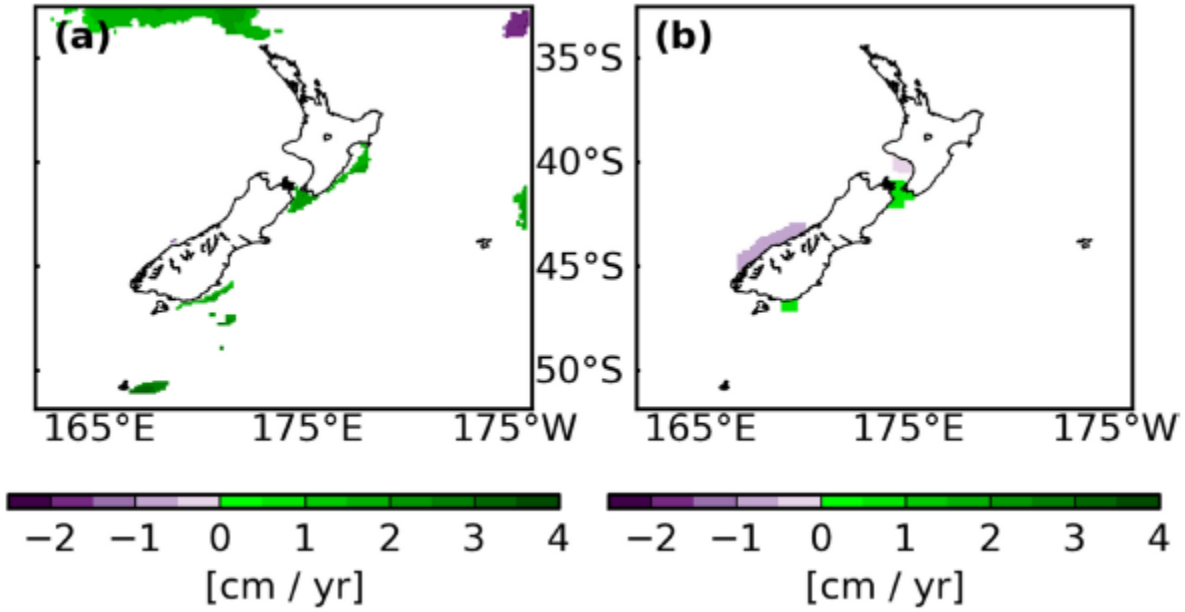


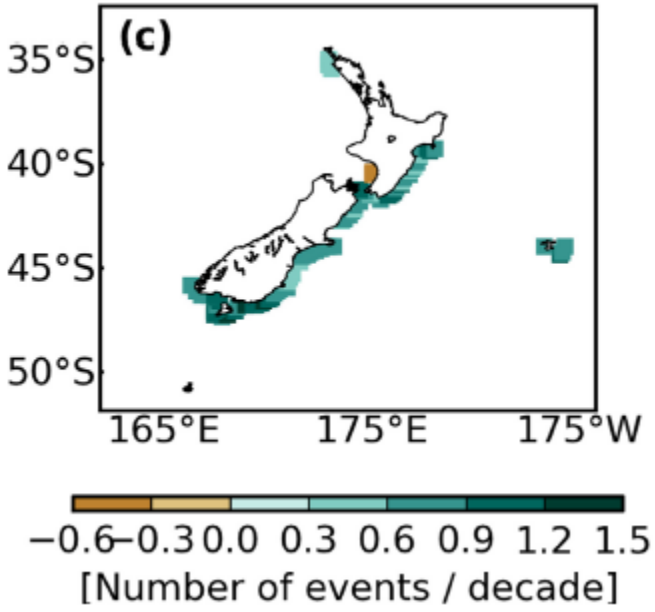
Godoi et al., 2016



Gorman et al., 2003

Are the extremes changing?



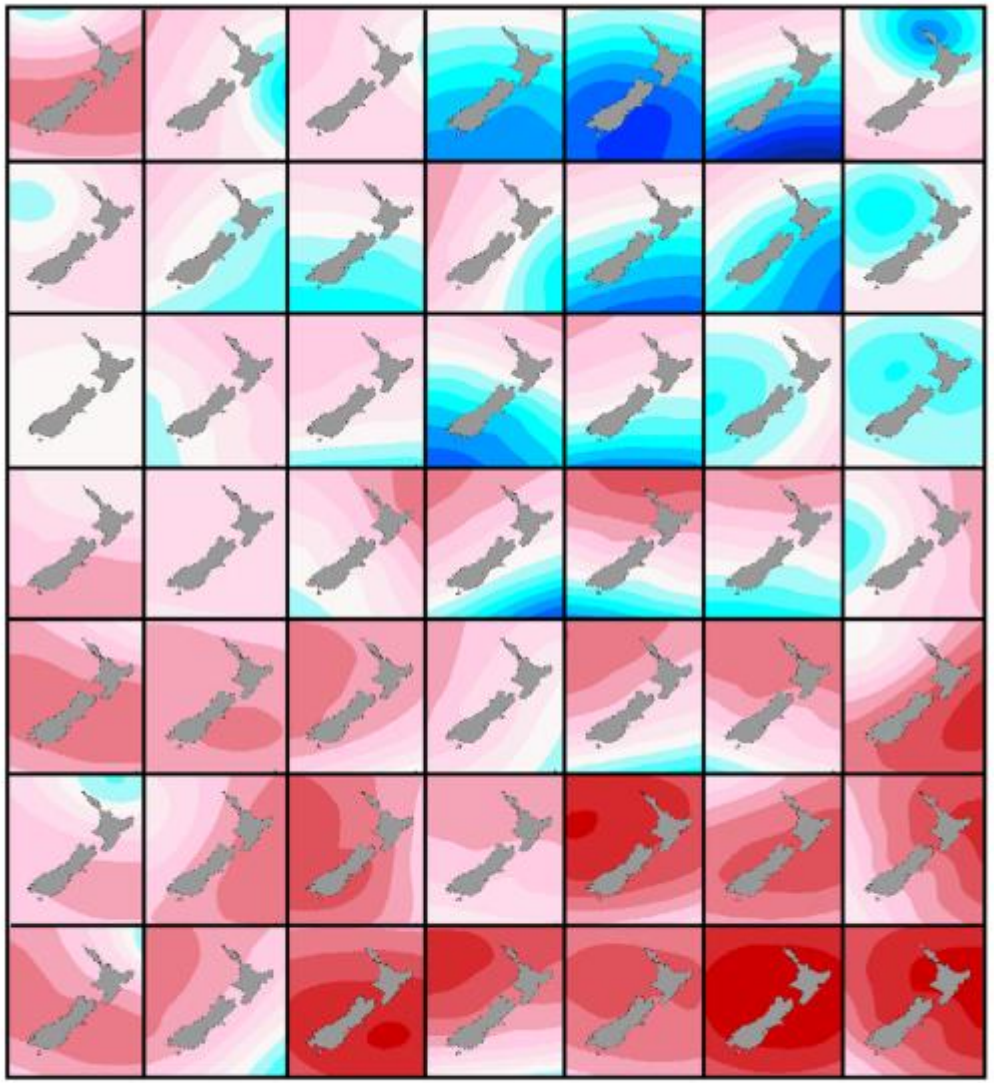


Very sensitive to changes in wind sources!!

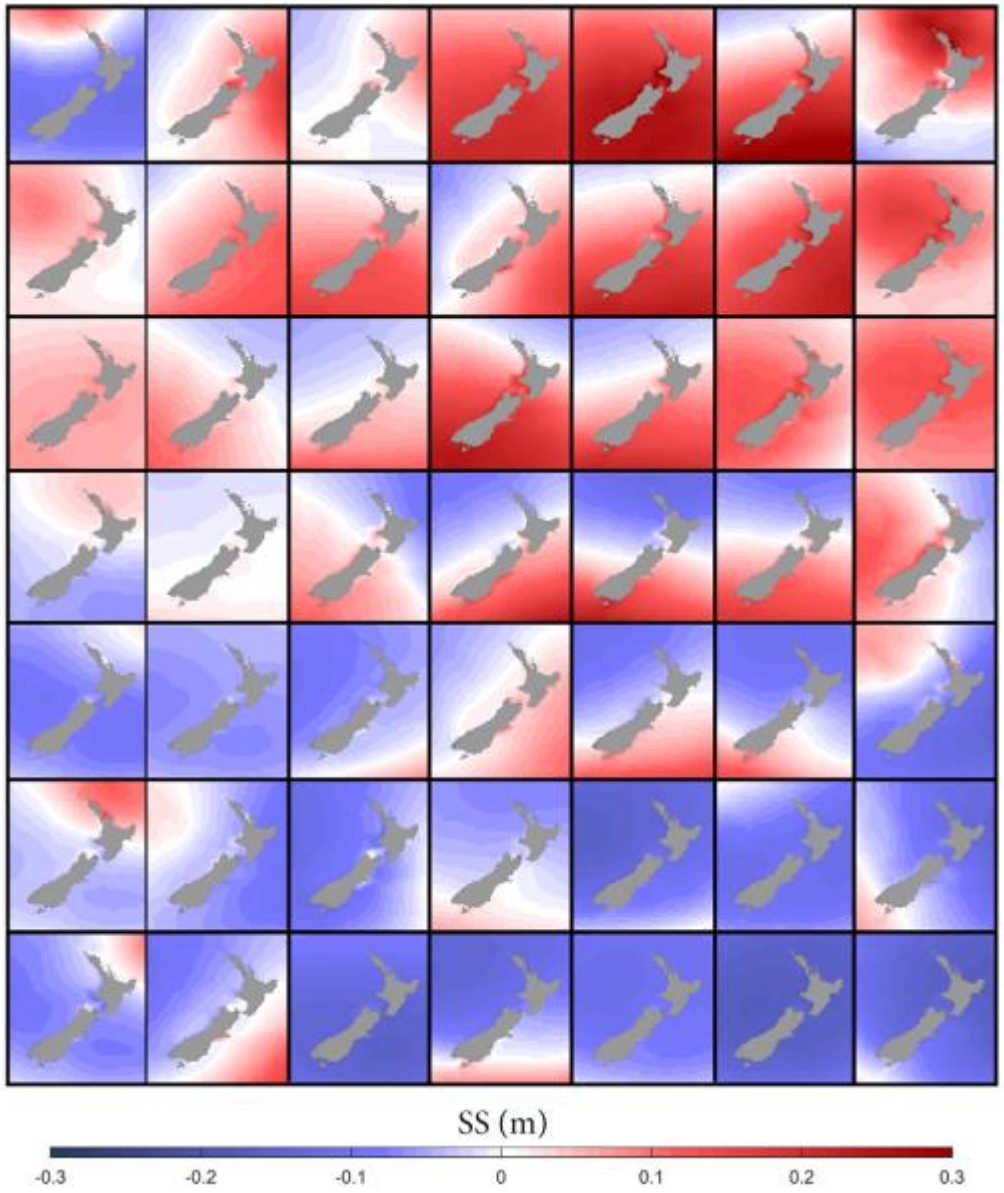
Godoi et al., 2017

Forecasting in the future: Downscaling methods

Weather pattern

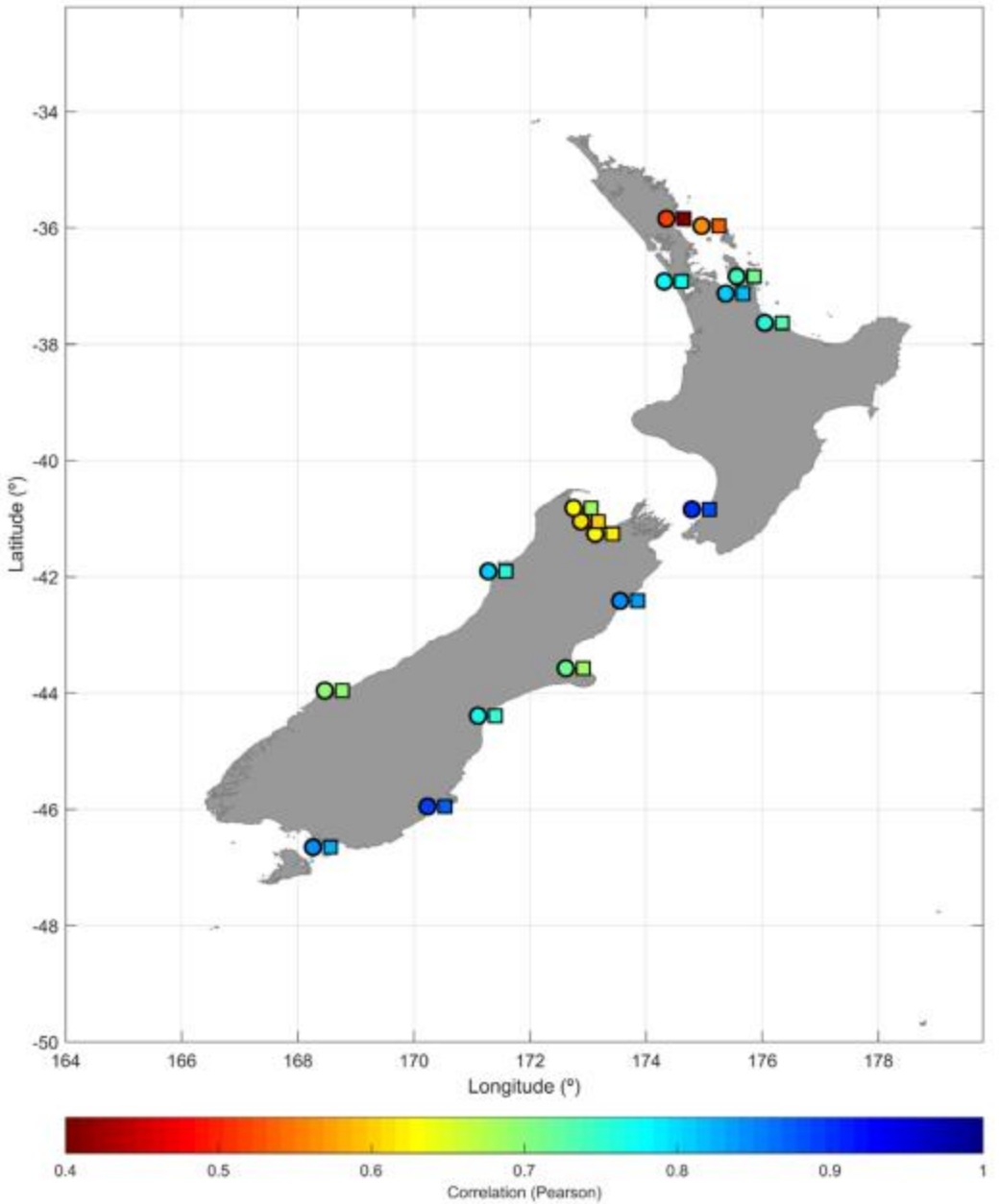


Surge pattern



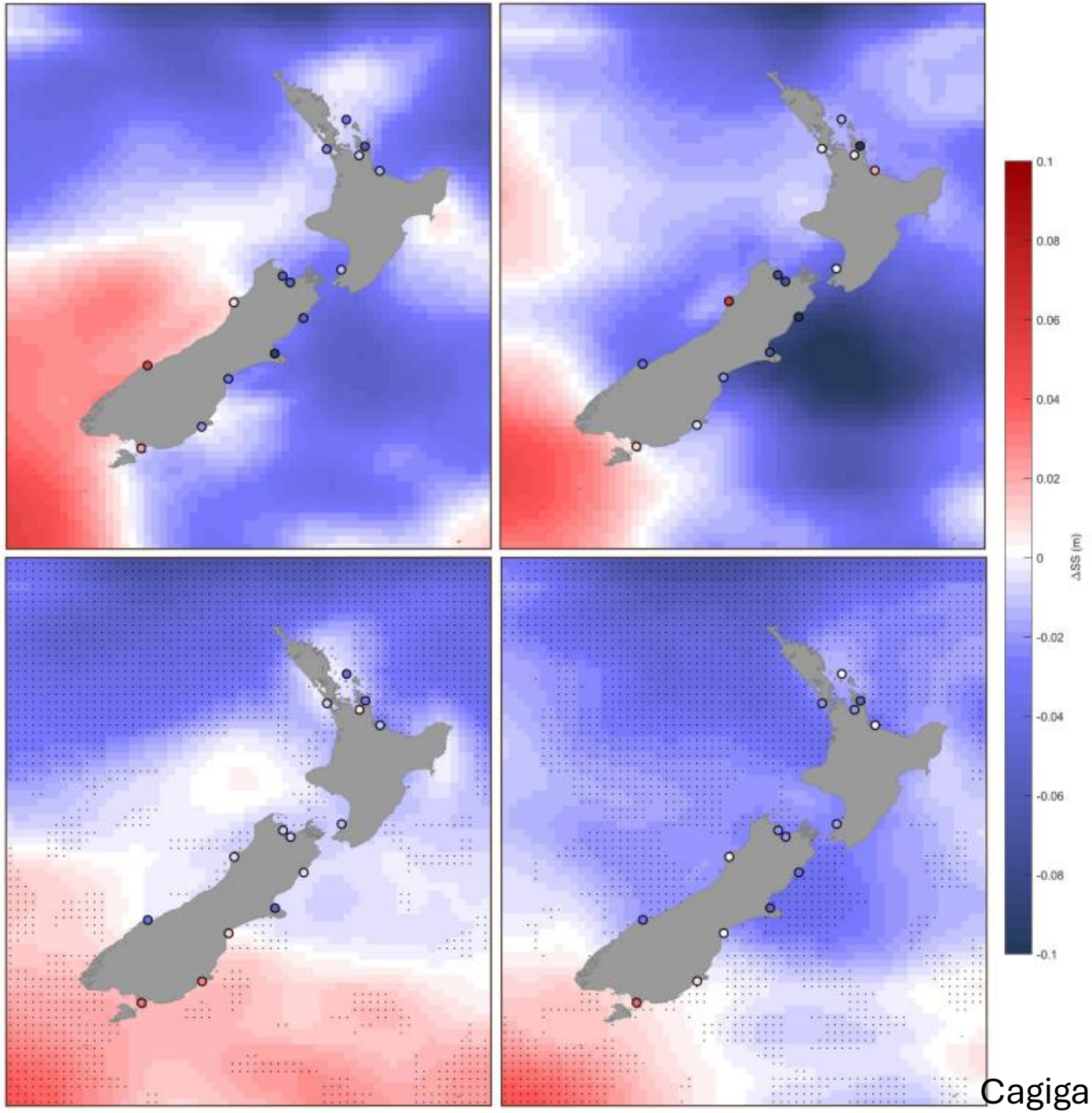
Cagigal et al., 2019

Validation



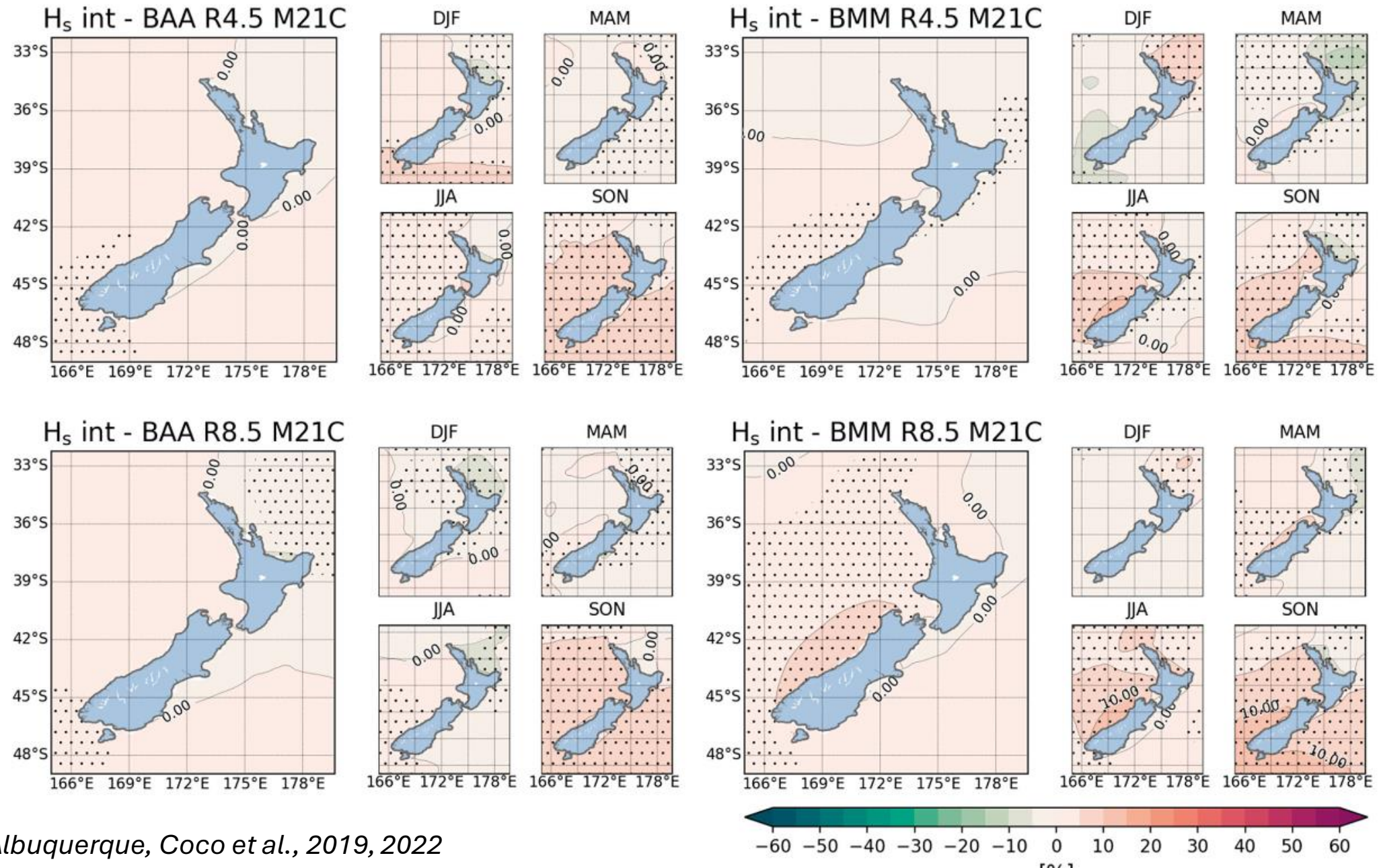
Cagigal et al., 2019

Predicted changes in storm surge..



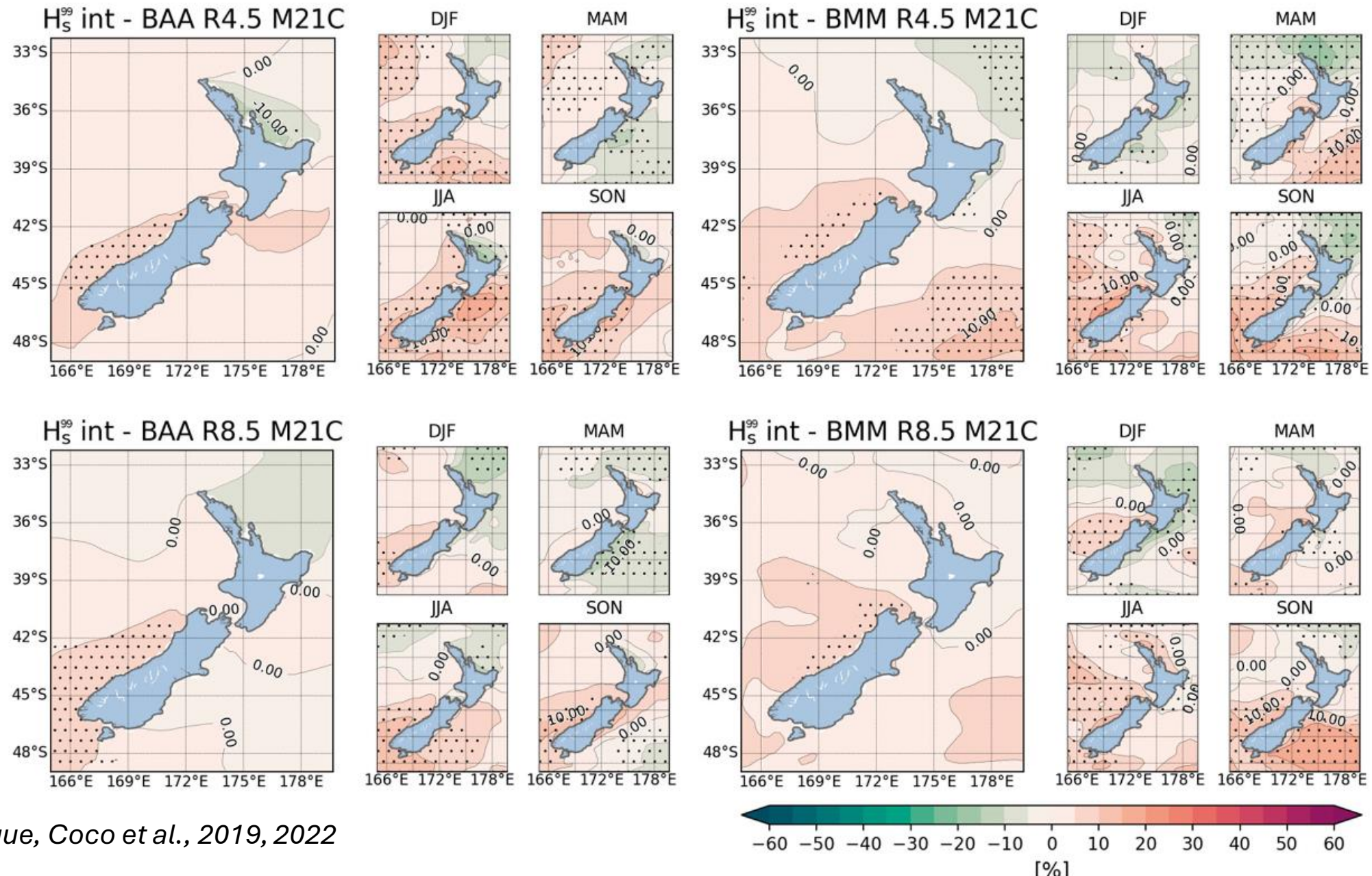
Cagigal et al., 2019

Predicted changes in Waves



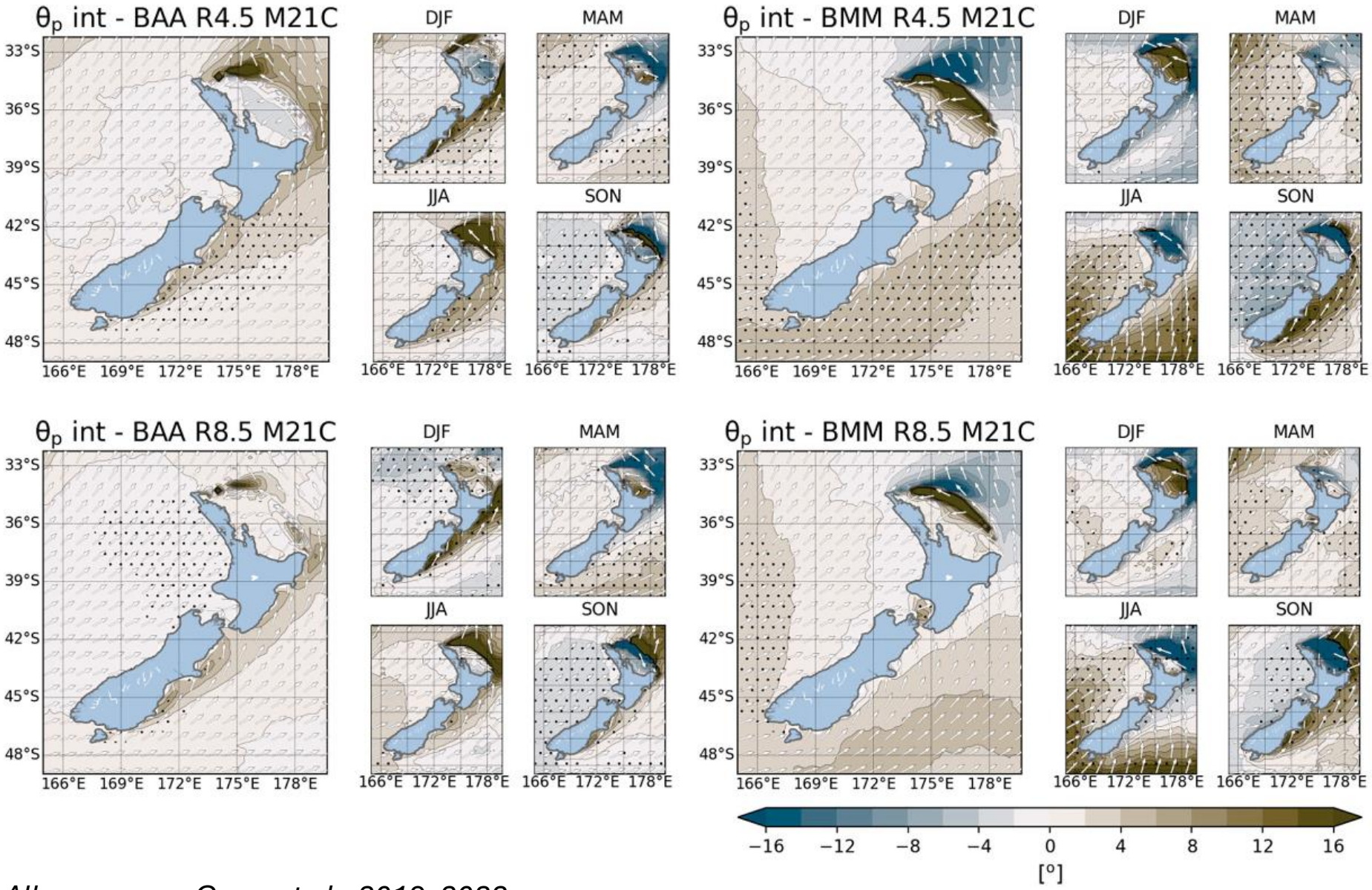
Albuquerque, Coco et al., 2019, 2022

Predicted changes in Waves



Albuquerque, Coco et al., 2019, 2022

Predicted changes in Waves



The black dots are significant

Negative change

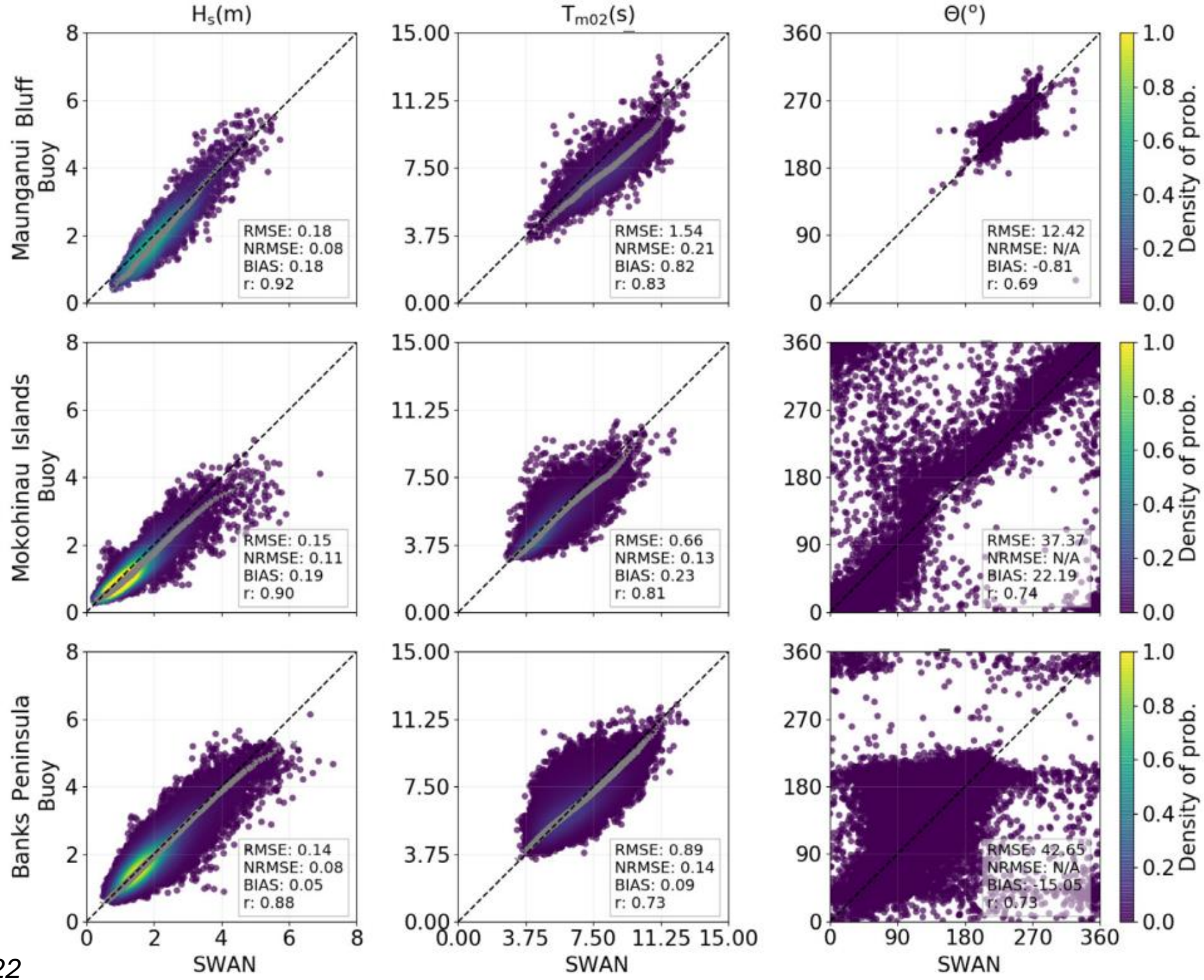
Waves toward 45 degrees

Positive change

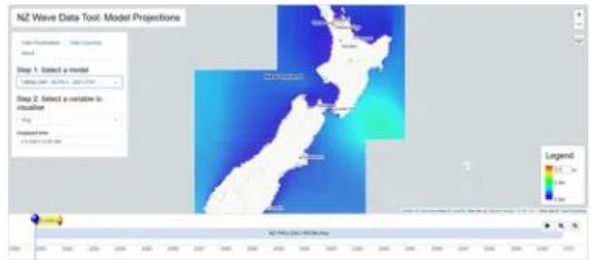
Sort of consistent with what has been happening

Albuquerque, Coco et al., 2019, 2022

Predicted changes in Waves Uncertainties



Albuquerque, Coco et al., 2019, 2022

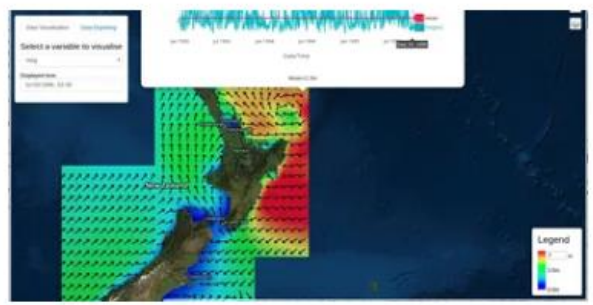


Visualise and Download Our Wave Projection Data

Here we provide four time-slices of high resolution (9 km) wave climate data for the New Zealand waters. We developed a set of historical and projected (1993–2006, 2026–2046, 2080–2100) wave climatologies from 3 global climate models (ACCESS1-0, CNRM-CM5 and MIROC5) and two representative concentration pathways (RCP 4.5, RCP 8.5).

Click here for access

Wave Hindcast Data - NEW ZEALAND



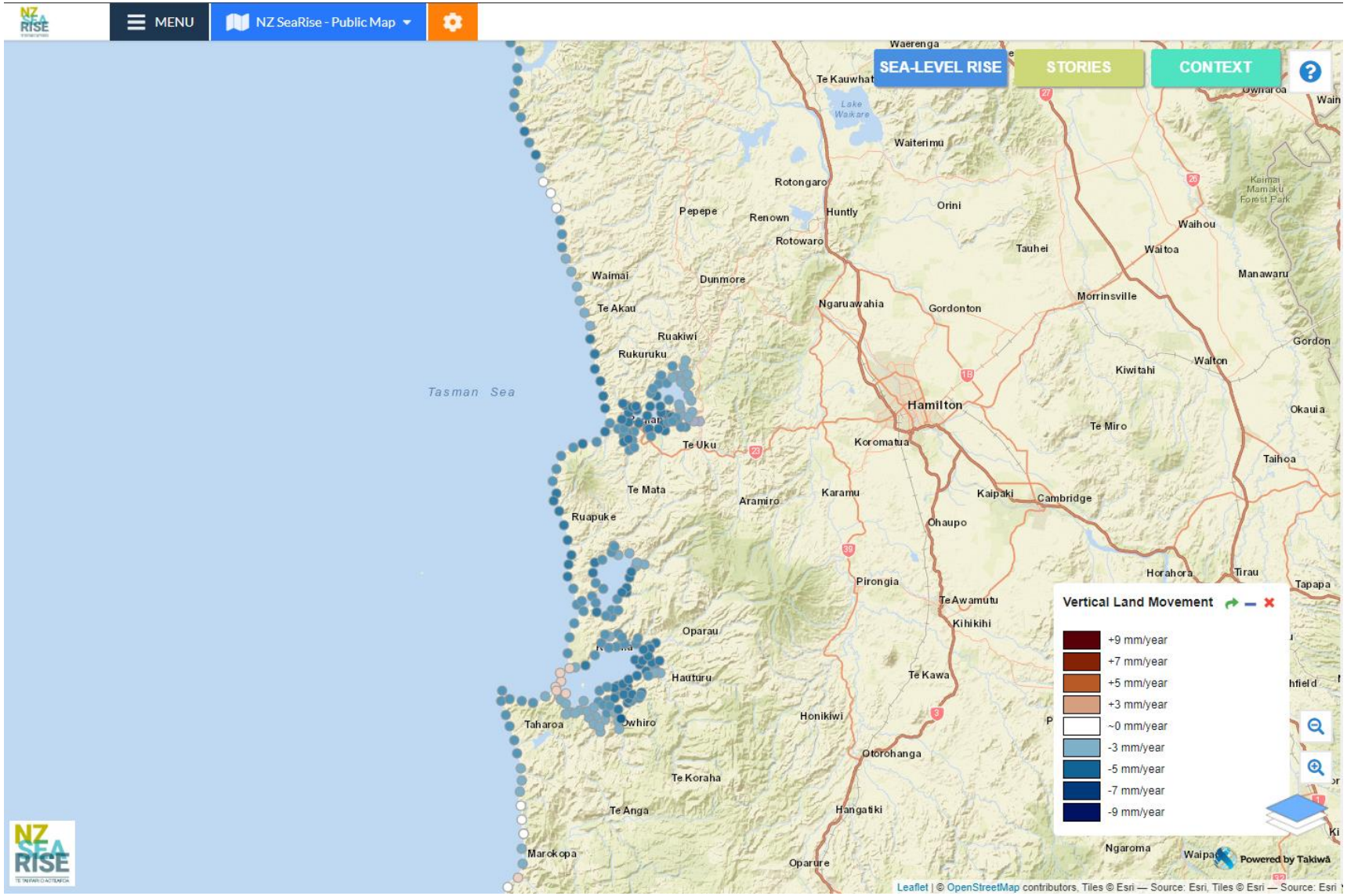
Visualise and Download Our Wave Hindcast Data

The database comprises a set of integrated and partitioned wave parameters downscaled from a global wave hindcast with SWAN. Three-hourly data at a 9Km resolution is available for visualisation and download throughout the whole New Zealand area.

A comprehensive description of the data, methods and validation, together with a wave climate analysis along New Zealand can be found in Seas and swells throughout New Zealand: A new partitioned hindcast

Click here for access

Sea Level Rise



2956

Sea Level Rise Predictions by Decade

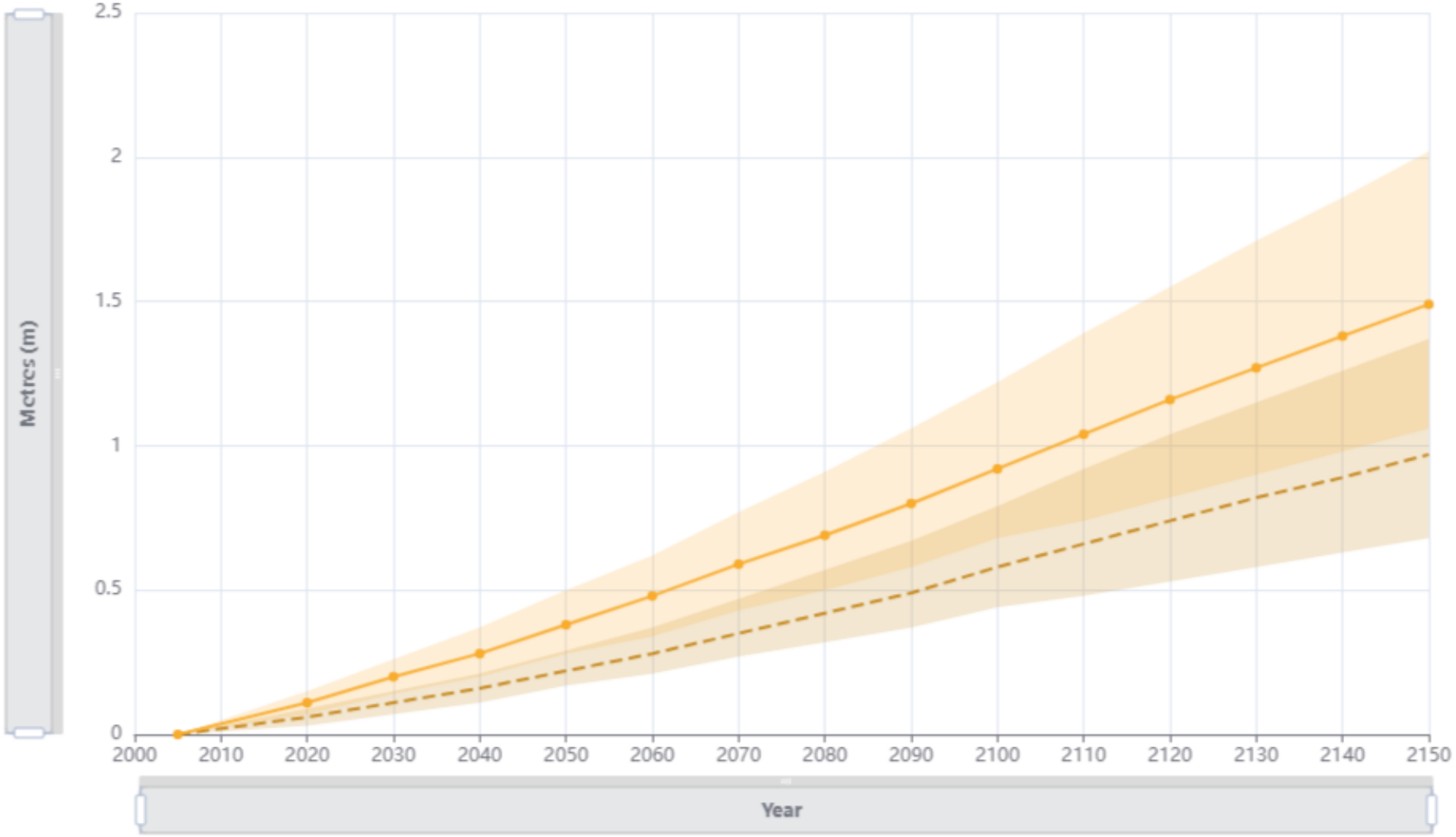
Projection to 2150
(medium confidence)

SSP Scenario	Add VLM
SSP1-1.9	+ VLM
SSP1-2.6	+ VLM
SSP2-4.5	+ VLM
SSP3-7.0	+ VLM
SSP5-8.5	+ VLM

Projection to 2300
(low confidence)

SSP Scenario	Add VLM
SSP1-2.6	+ VLM
SSP2-4.5	+ VLM
SSP5-8.5	+ VLM

Save chart image | Save chart data

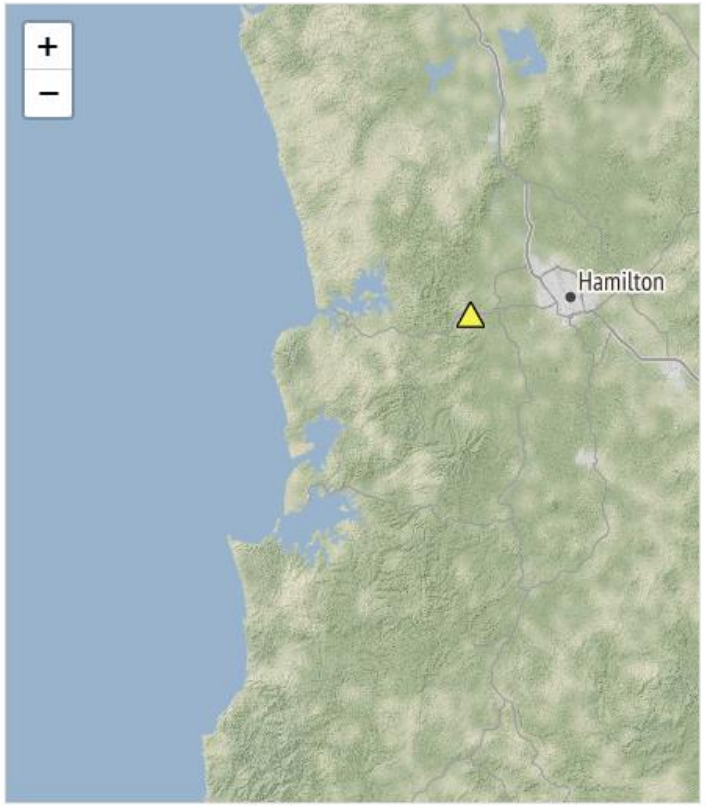


This graph shows sea level rise with vertical land movement under potential climate change scenarios (lines) and likely confidence intervals (faded colour blocks) for each shared socio-economic pathway (SSP) in this area. NZ SeaRise projections use a baseline of 1995-2014 with a mid-point (zero) at ~2005.

Continuous GPS

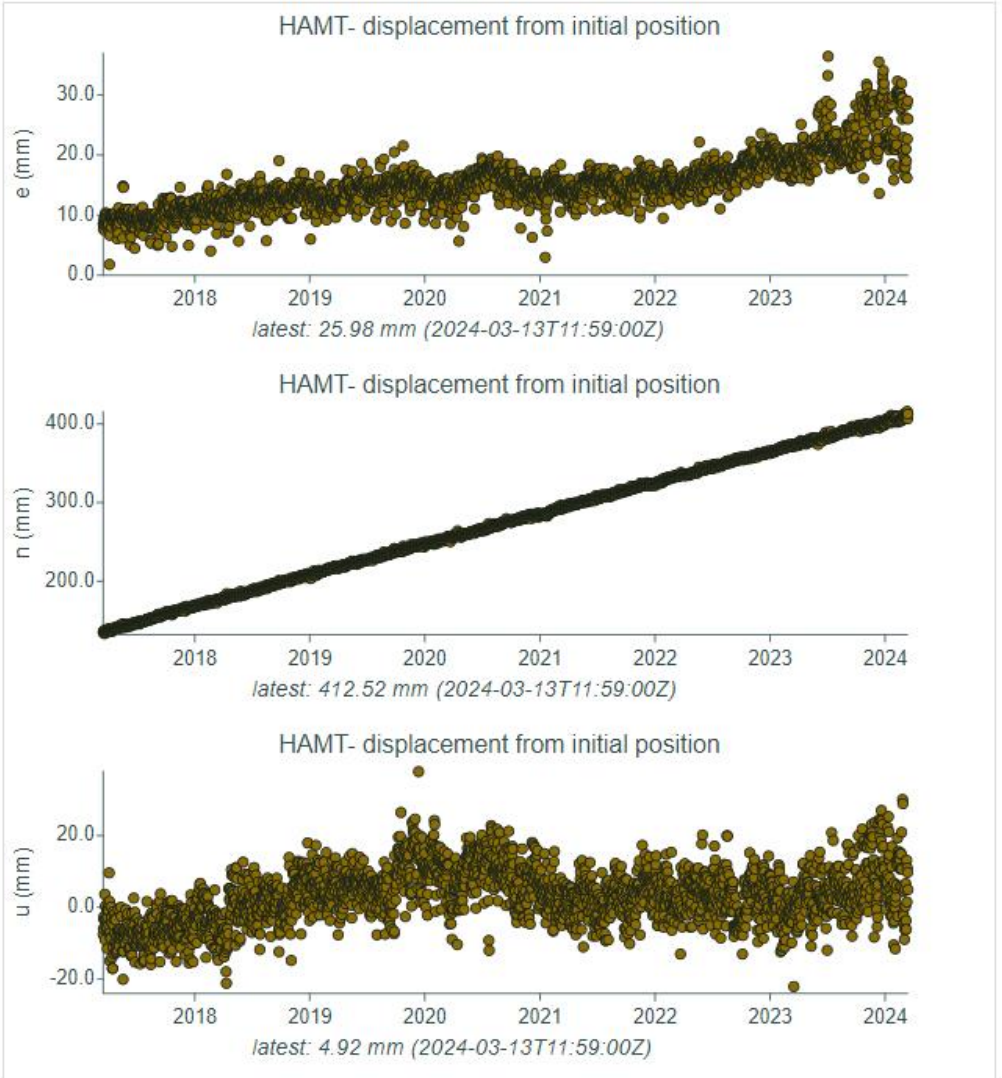
GNSS Time Series Map

Interactive map showing all GNSS sites. Click on a site to display Plot graphs.



GNSS Time Series Plot - Hamilton

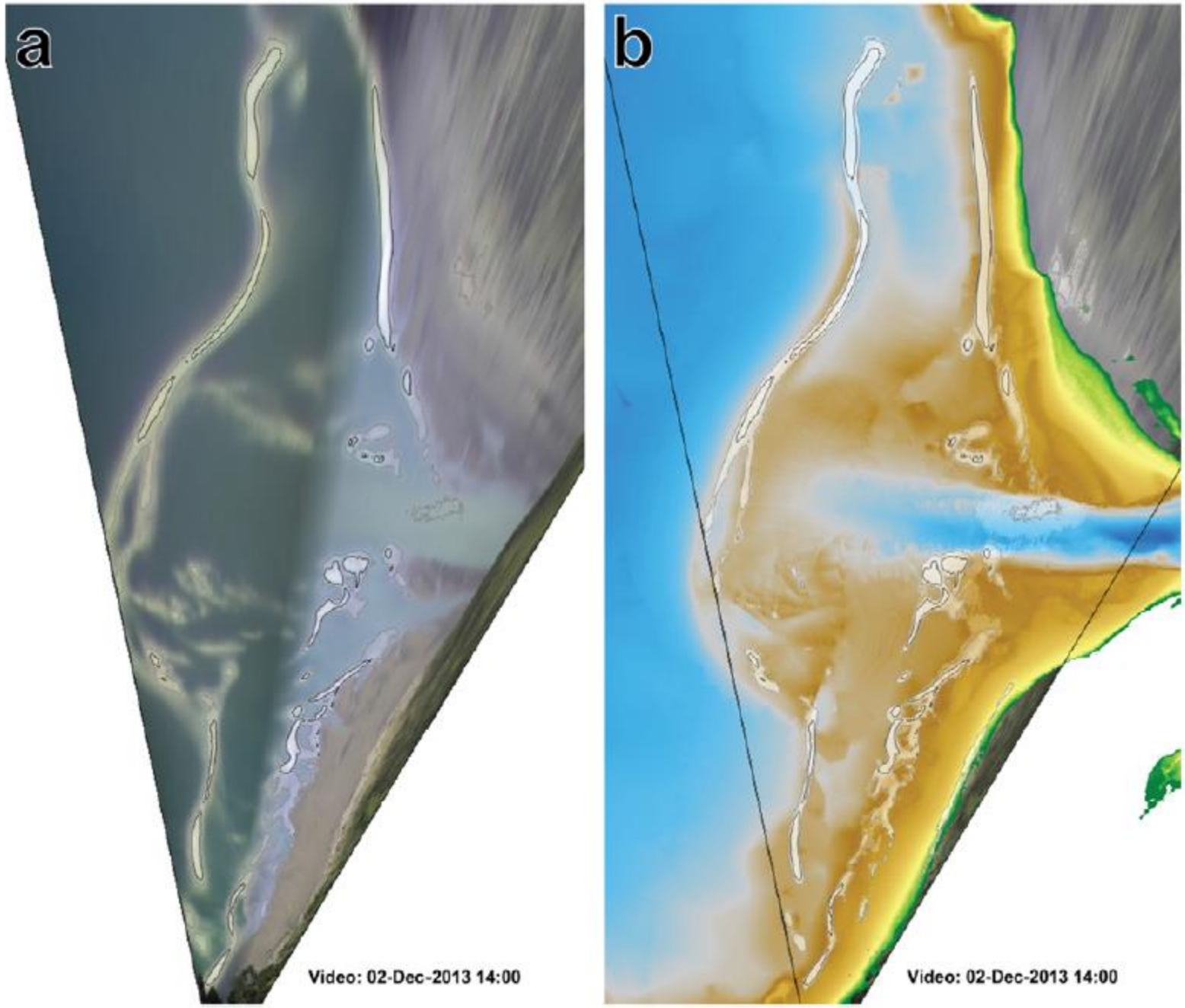
Show Data of (•) Displacement ( ) Quality/Average



These GNSS Times Series graphs are restricted to a maximum of 7 years of observations and can be produced from using data via the GeoNet FITS API.

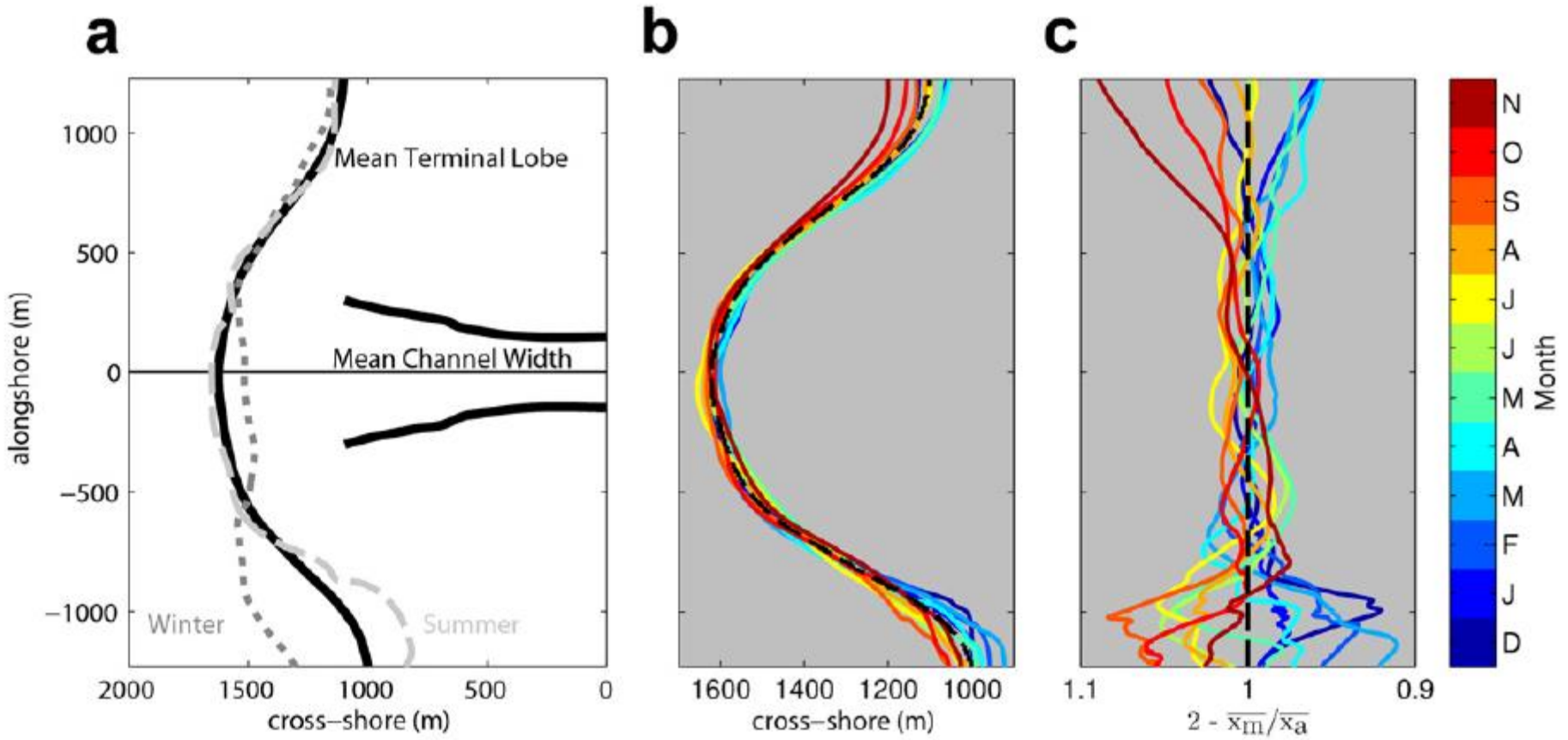
Back to the question of sediment supply……

Unfortunately, these 3 system are strongly dominated by interactions with the ebb-tidal delta.



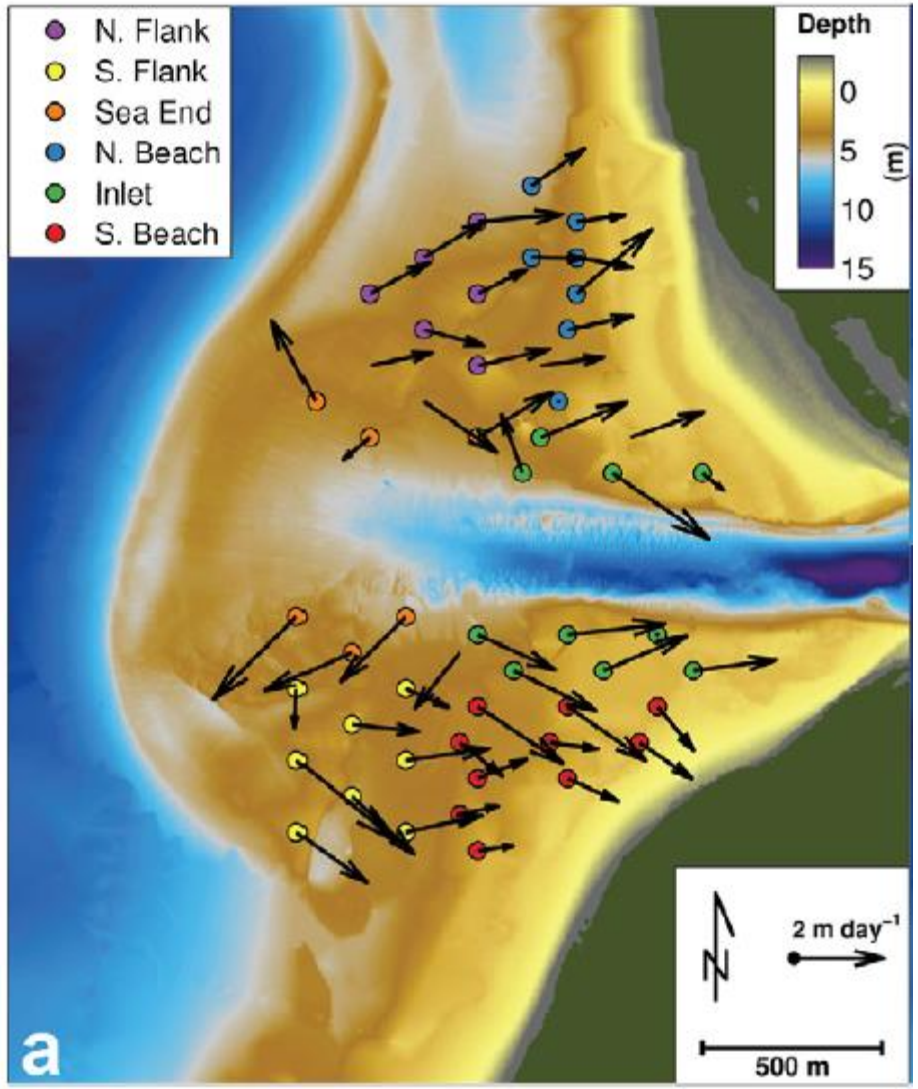
Harrison et al., 2017

The flapping ‘wings’ of the delta



Harrison et al., 2017

The chaotic behaviour of the swash bars



Summary

- The wave climate is gradually increasing and will likely continue to do so.
- Waves are likely to shift more northward increasing littoral drift.
- Storm surge is likely to stay the same or decrease.
- We are very confident the sea level will rise, and this might be worse along this coast because it is sinking.
- Inlet systems are chaotic and hard to predict, making localised changes

Funding

- Natural Hazards Platform.
- NSC resilience challenge.
- Brazilian Science without Borders.
- NZ Sea Rise Project (not to me).

Stay tuned

- Future Coasts Aotearoa
- Our Changing Coasts
- NSC?