

An assessment of subduction zone generated tsunami hazards at New Zealand Ports

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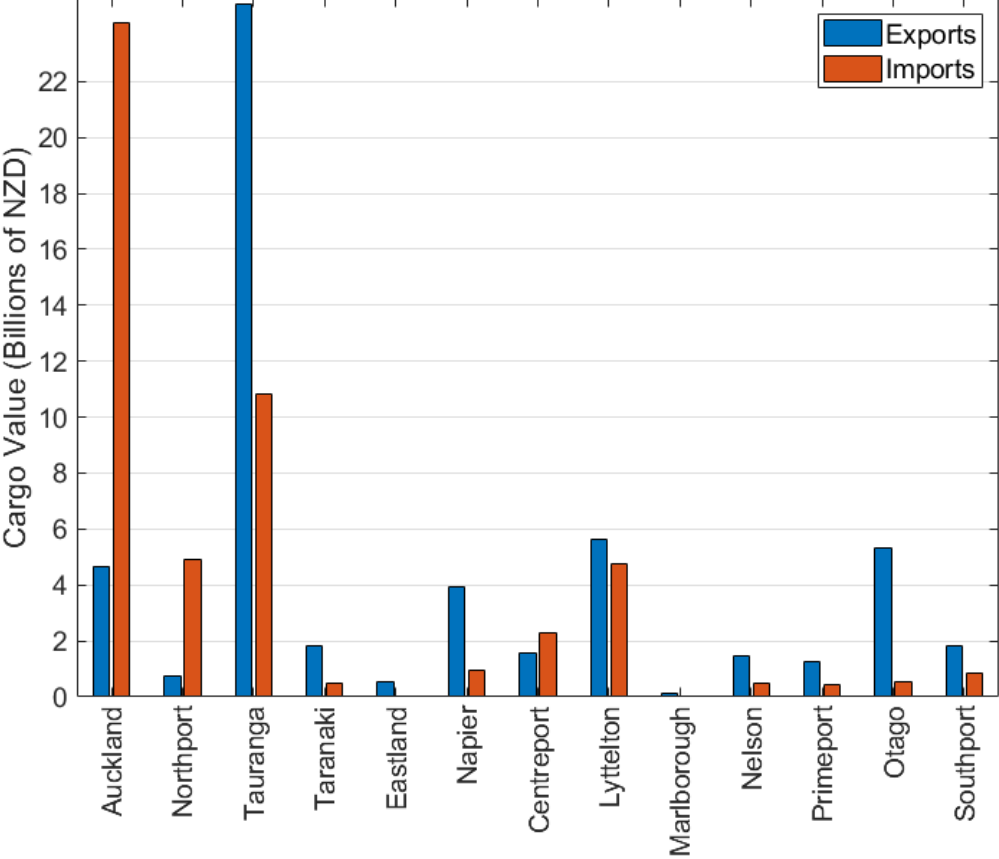
RNC Infrastructure

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Overview

- NZ port system a critical part of the national infrastructure network
 - International trade
 - Regional recovery
 - Transport (particularly inter-island)
- Long coastline and distribution of ports means exposed to range of potential tsunami sources
 - Local + Distant subduction zones
- This study focussed on assessing tsunami hazard for range of sources and magnitudes
 - Hazard at single ports
 - Events where multiple ports are exposed
 - Importance and function of the ports exposed

NZ Ports

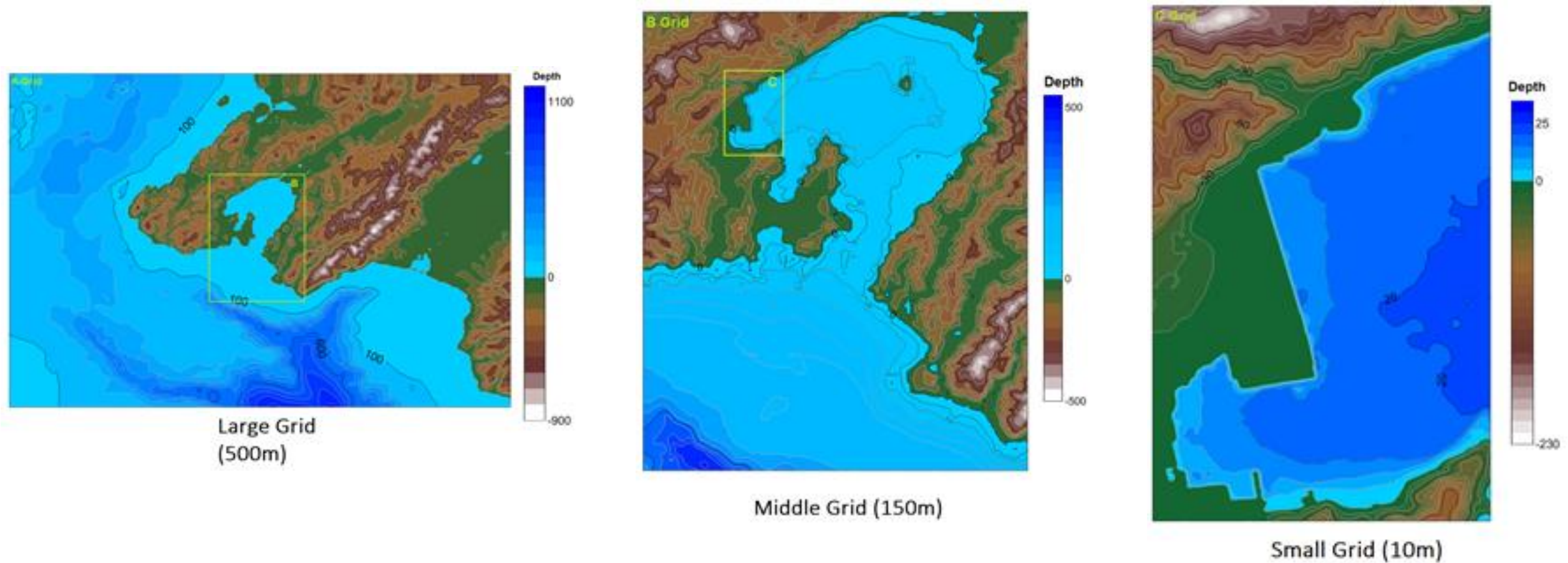


Propagation Models

- Model to predict wave heights and current speeds at location based on seismic source model
- Requires:
 - Accurate bathymetric-topographic maps
 - Seismic source model
- Models run with ComMIT (Community Modelling Interface for Tsunami)
- Outputs:
 - Water Levels (cm)
 - Current speeds (knots)

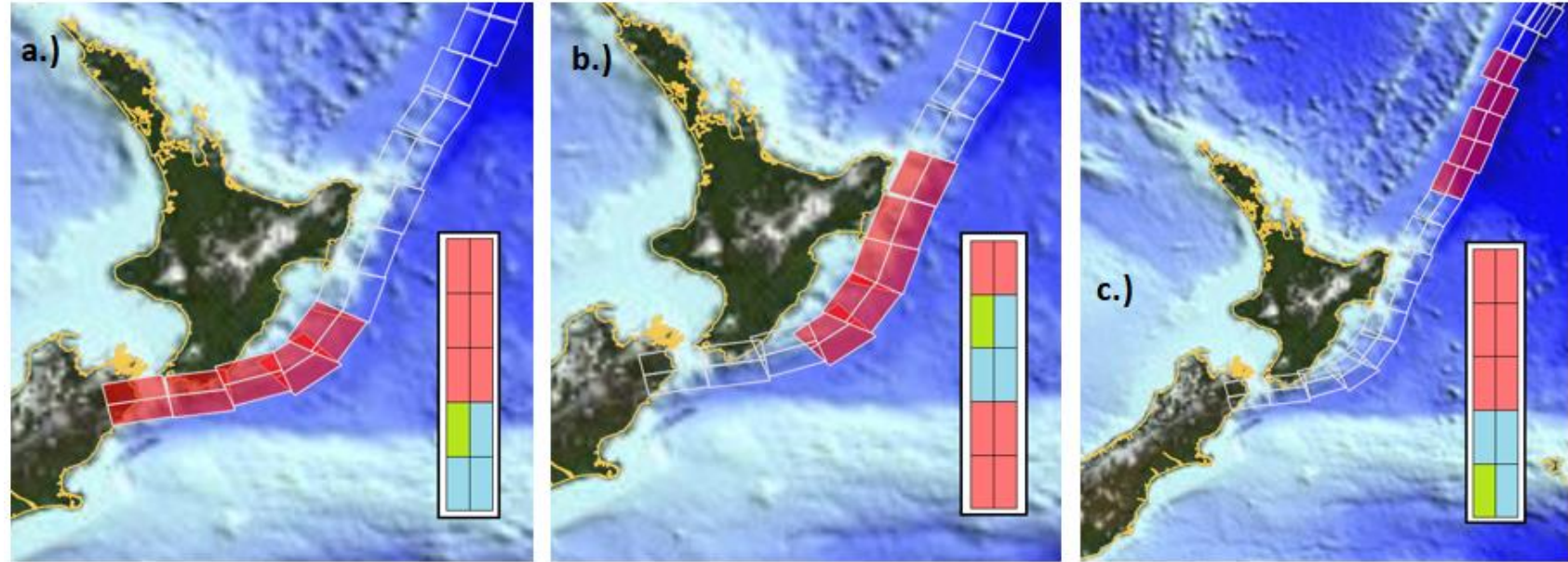
Propagation Models

- Bathymetry-topography

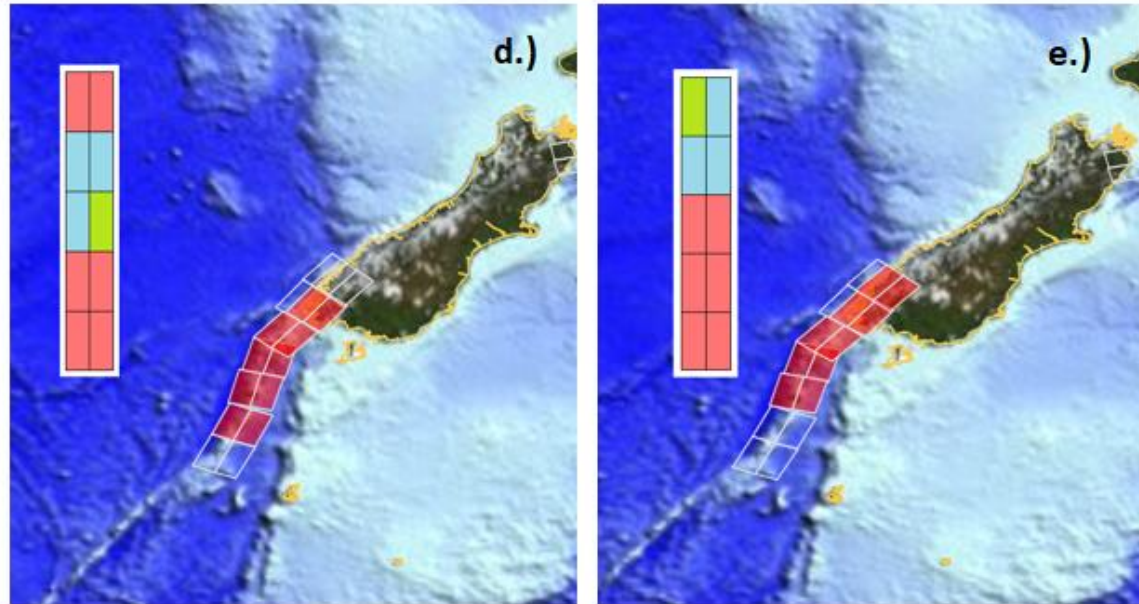


Tsunami Sources - Local

- Hikurangi S
- Hikurangi N
- Kermadec
- Puysegur S
- Puysegur N

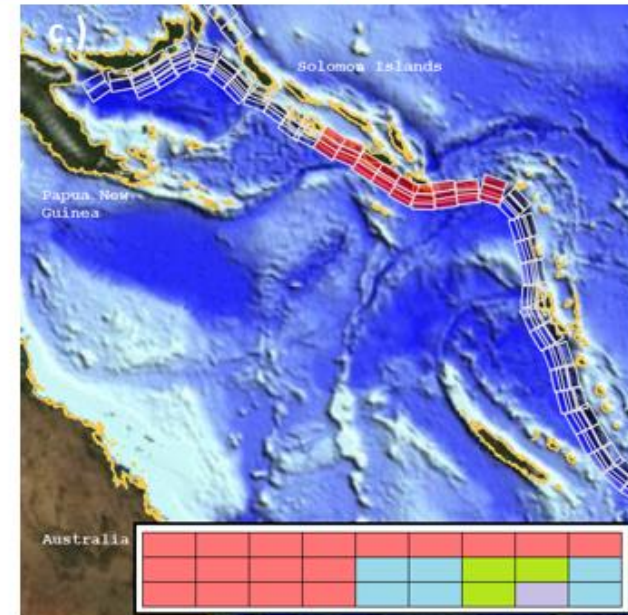
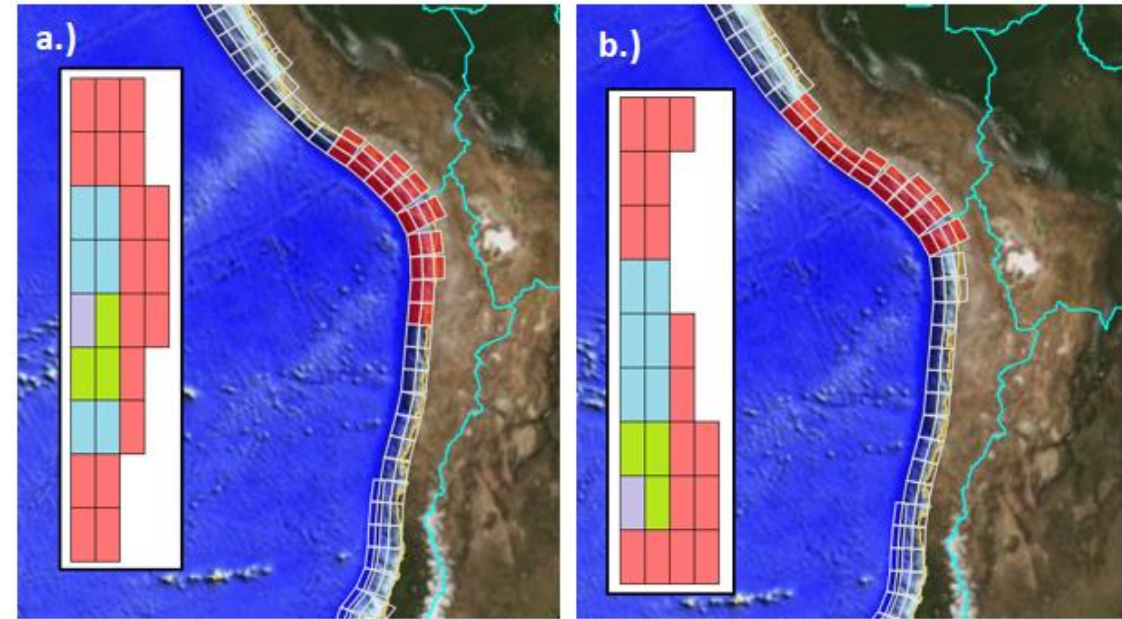


- M_w 7.0 – 9.0 earthquakes
 - Variable slip applied to each segment
 - Variable fault plane area.
 - Green = M_w 7.0-8.0
 - Green + Blue = M_w 8.5
 - Green + Blue + Red = M_w 9.0



Tsunami Sources - Distant

- Chile
- Peru
- Solomon Islands
- M_w 8.0 – 9.5 earthquakes
 - Variable slip applied to each segment
 - Variable fault plane area.
 - Purple = M_w 8.0
 - Purple + Green = M_w 8.5
 - Purple + Green + Blue = M_w 9.0
 - Purple + Green + Blue + Red = M_w 9.5



Hazard + Port Impacts

- Water Levels
 - Damage will be dependant on elevation of port infrastructure
- Current Speeds
 - Vessel damage and port functionality disruption
 - Damage to port infrastructure

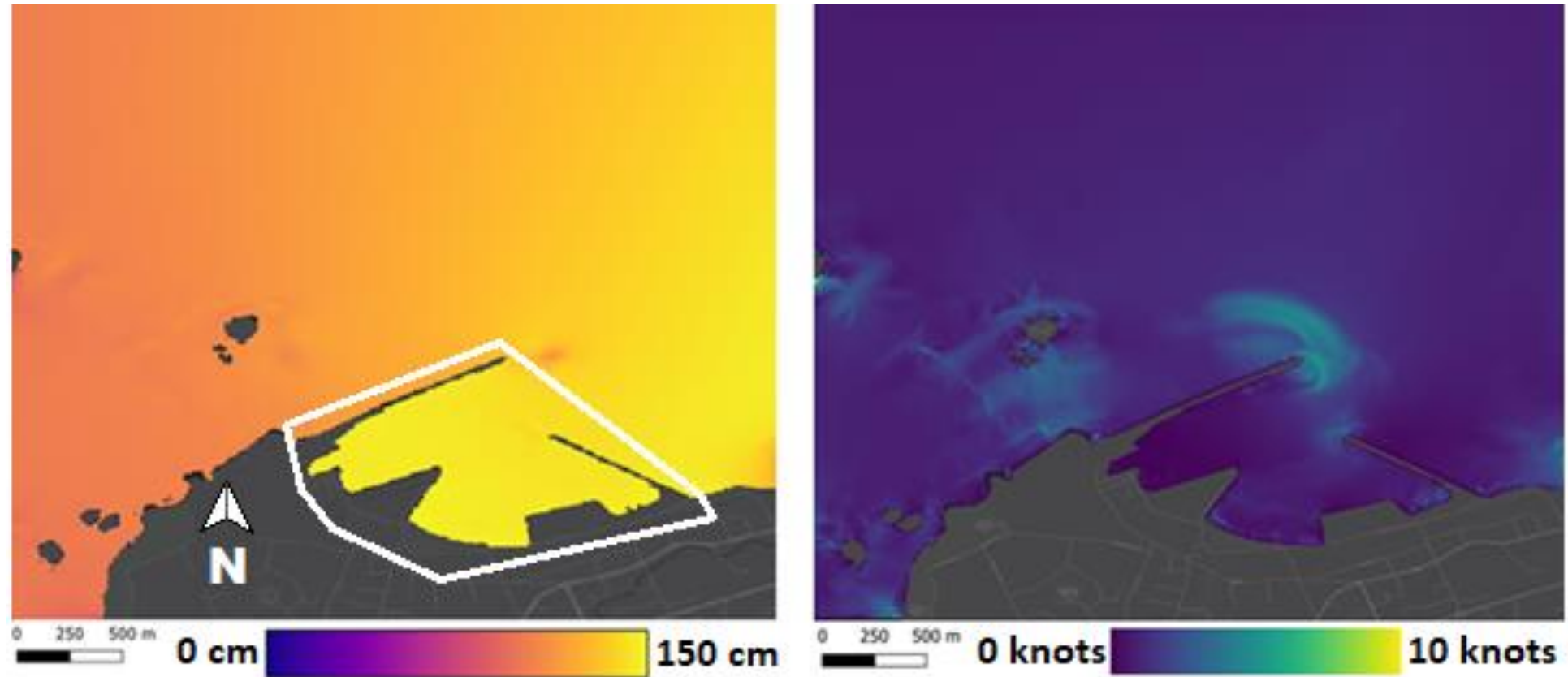


Damage	Range of Current Speeds
No damage expected	< 3 knots
Minor/moderate damage possible	Between 3 and 6 knots
Major damage possible	Between 6 and 9 knots
Extreme damage possible	> 9 knots

From Lynnet et al. (2014)

Results – Single Ports

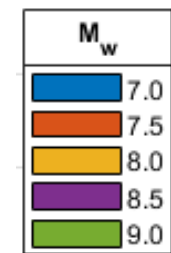
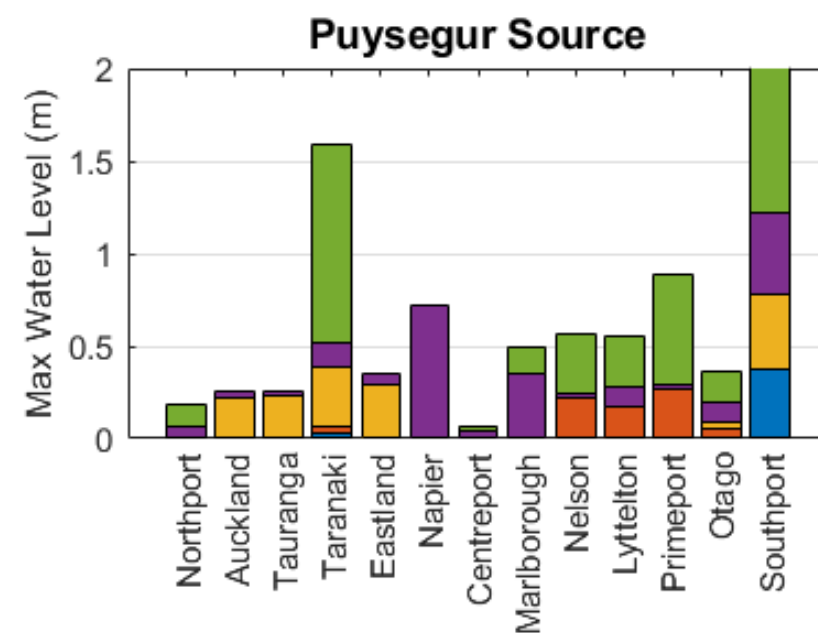
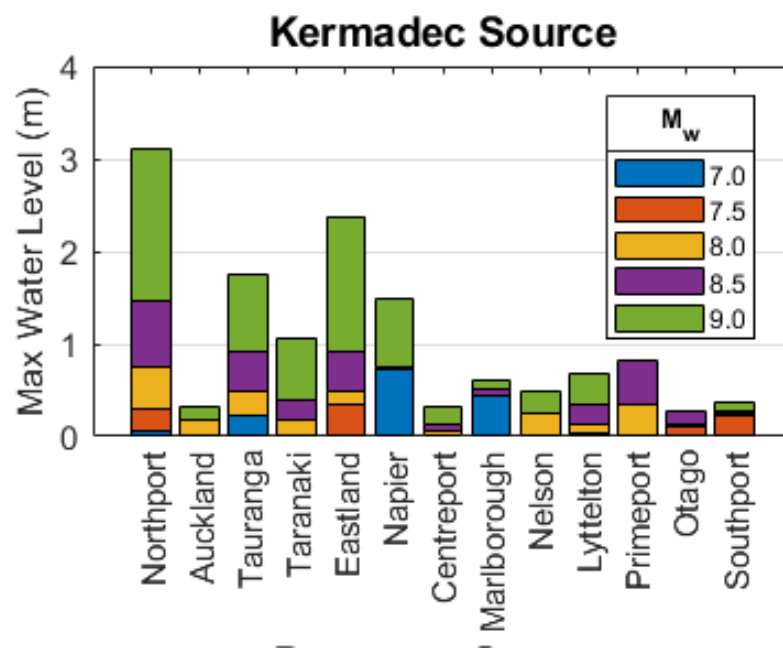
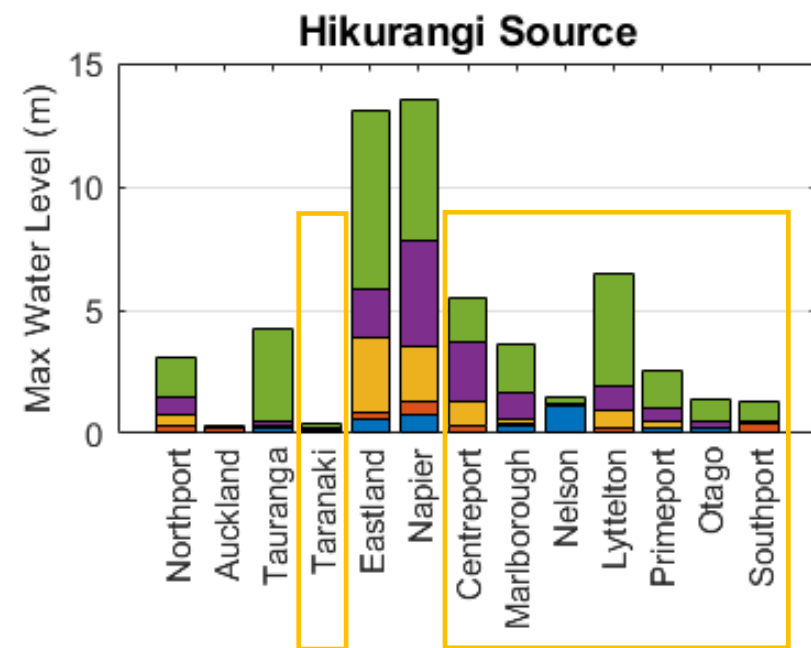
- Variability of water level and current speed surrounding port
 - Identify maximum values + extract for each event



Port Taranaki for Mw9.0 South Hikurangi earthquake

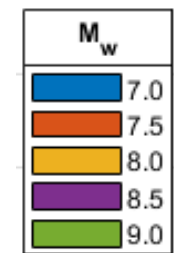
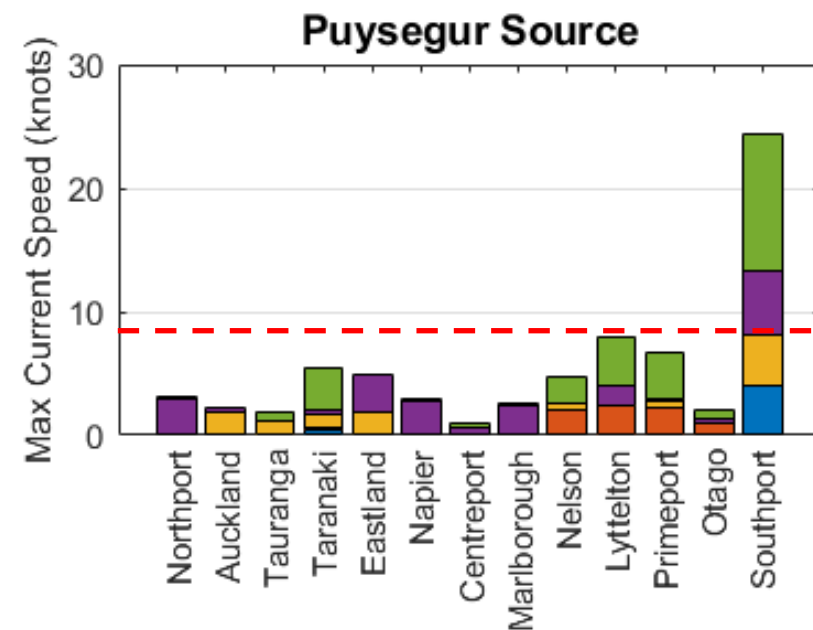
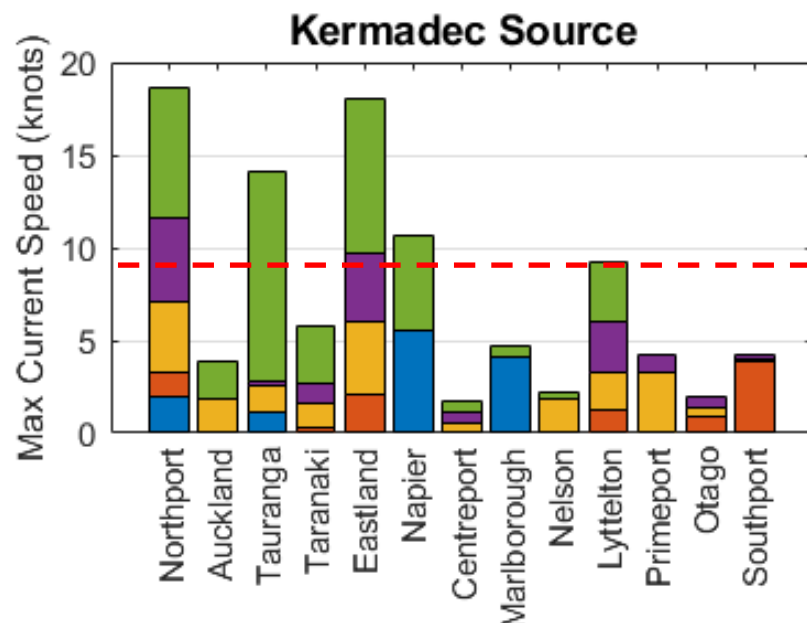
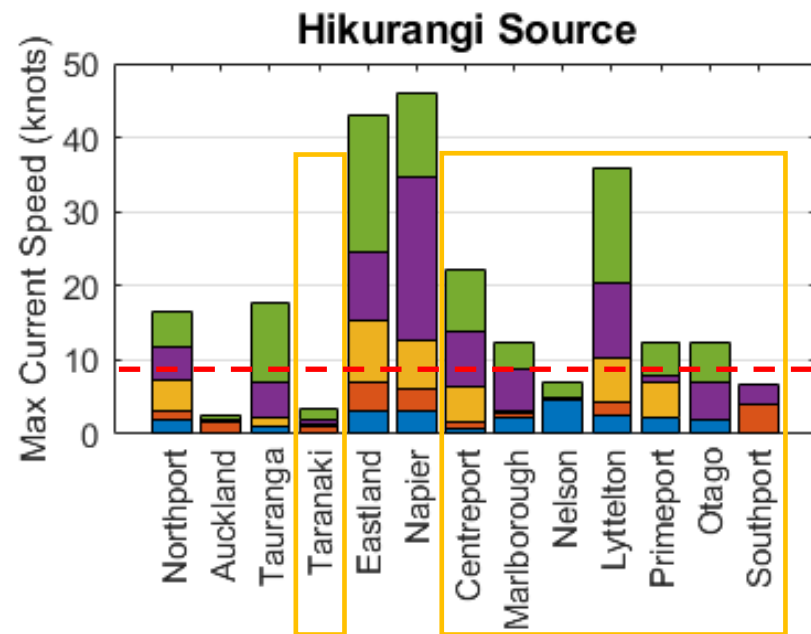
Results – Local Source

- Water Levels



Results – Local Source

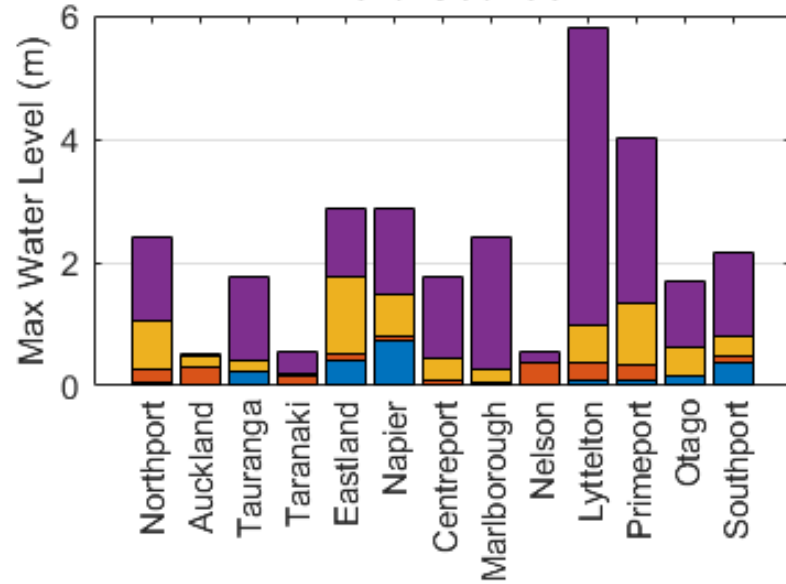
- Current Speed



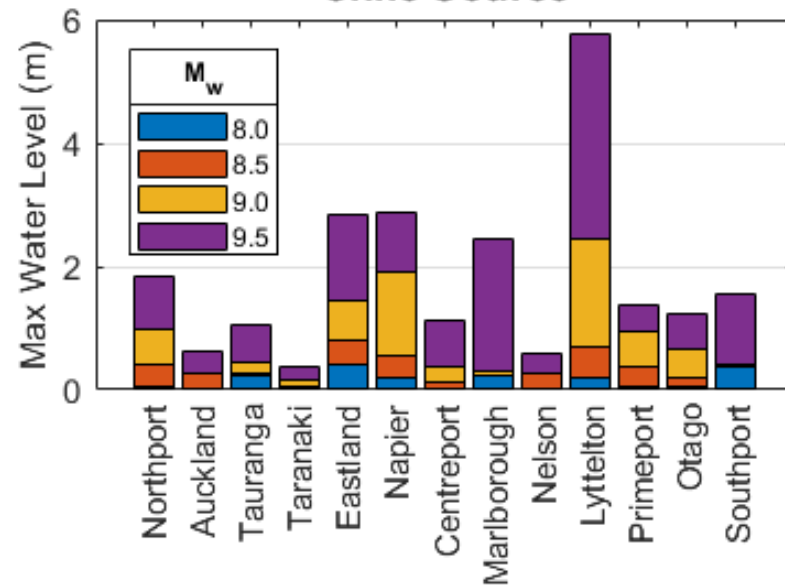
Results – Distant Source

- Water Levels

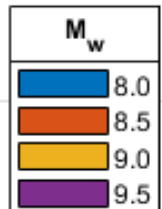
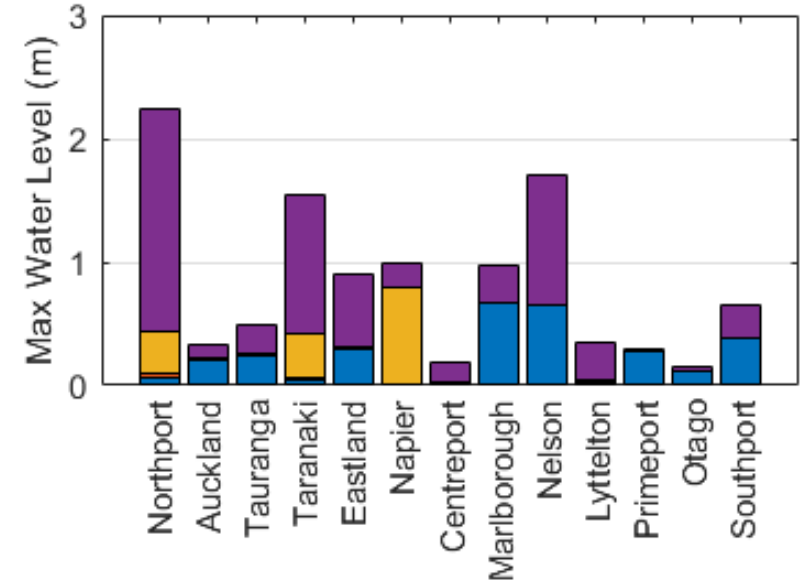
Peru Source



Chile Source

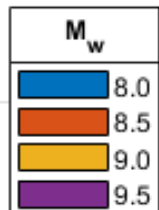
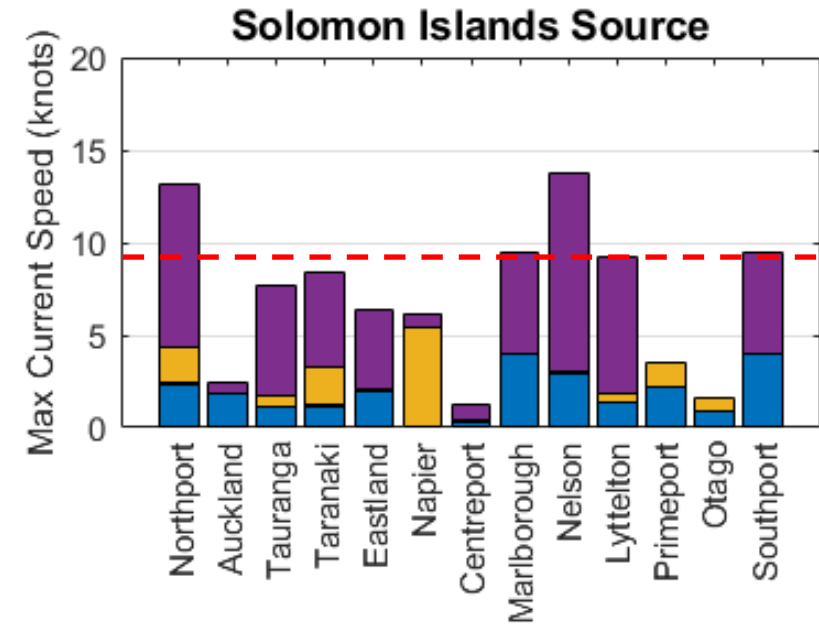
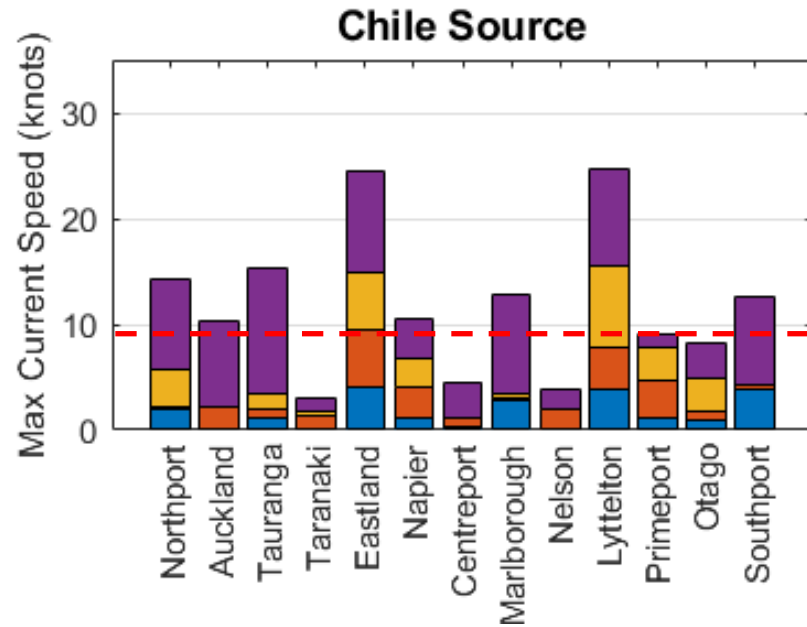
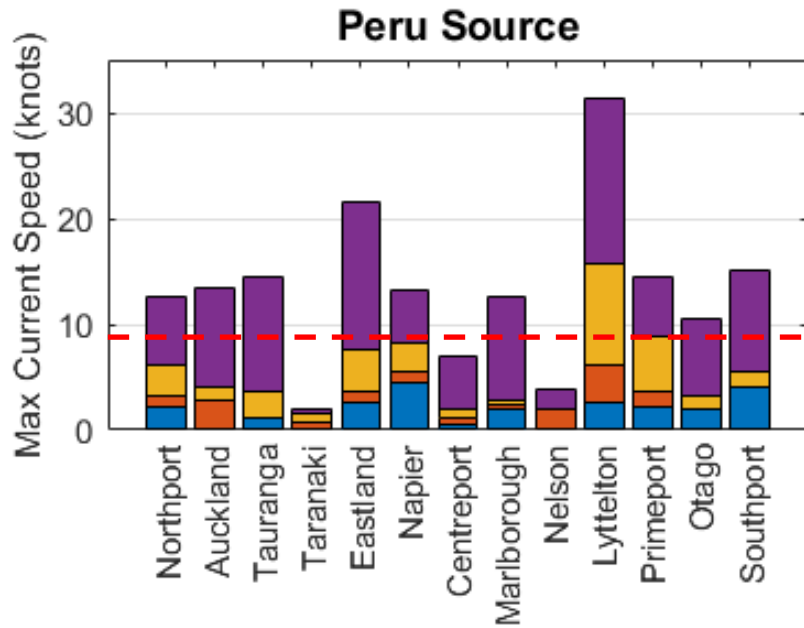


Solomon Islands Source



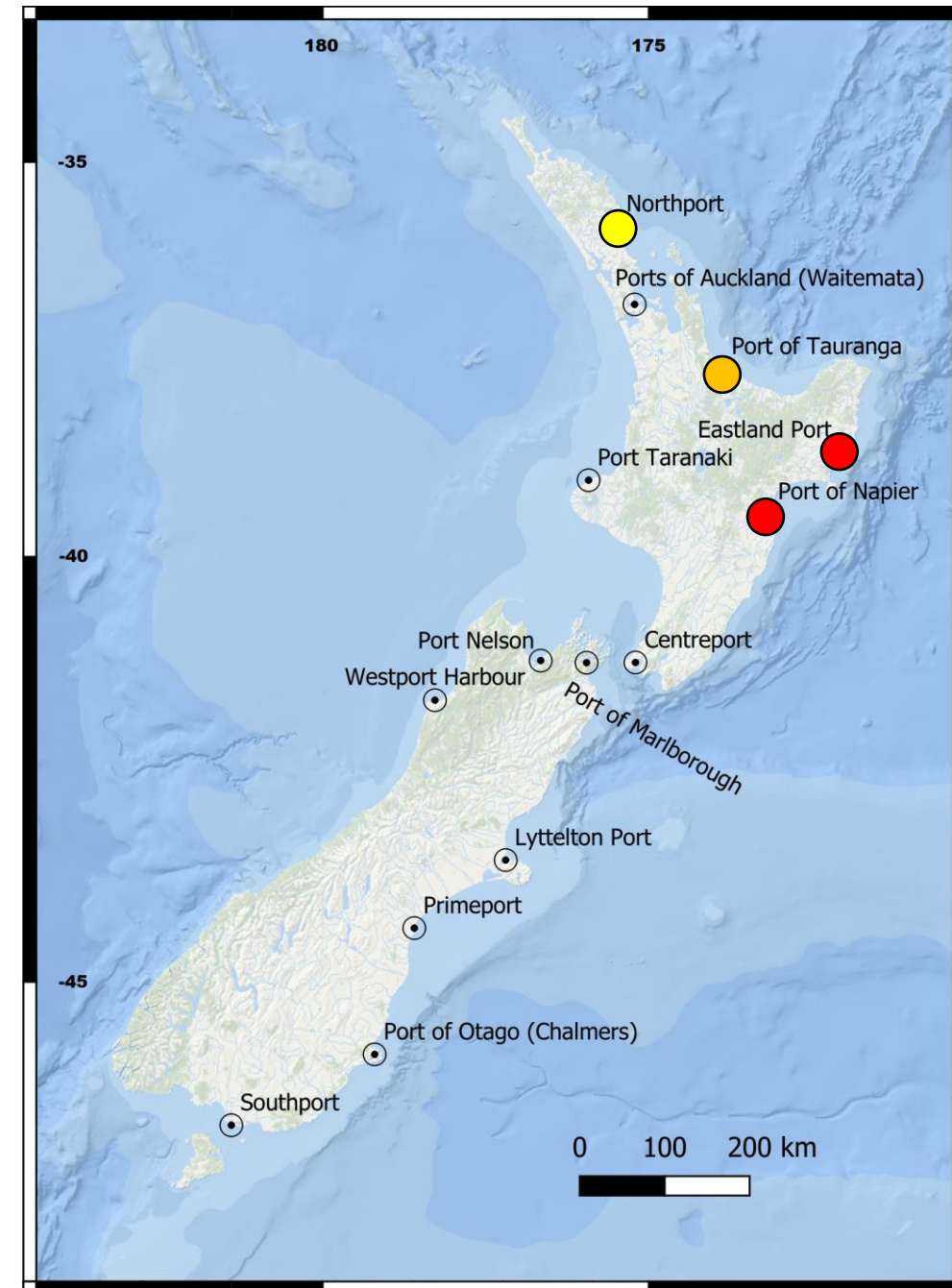
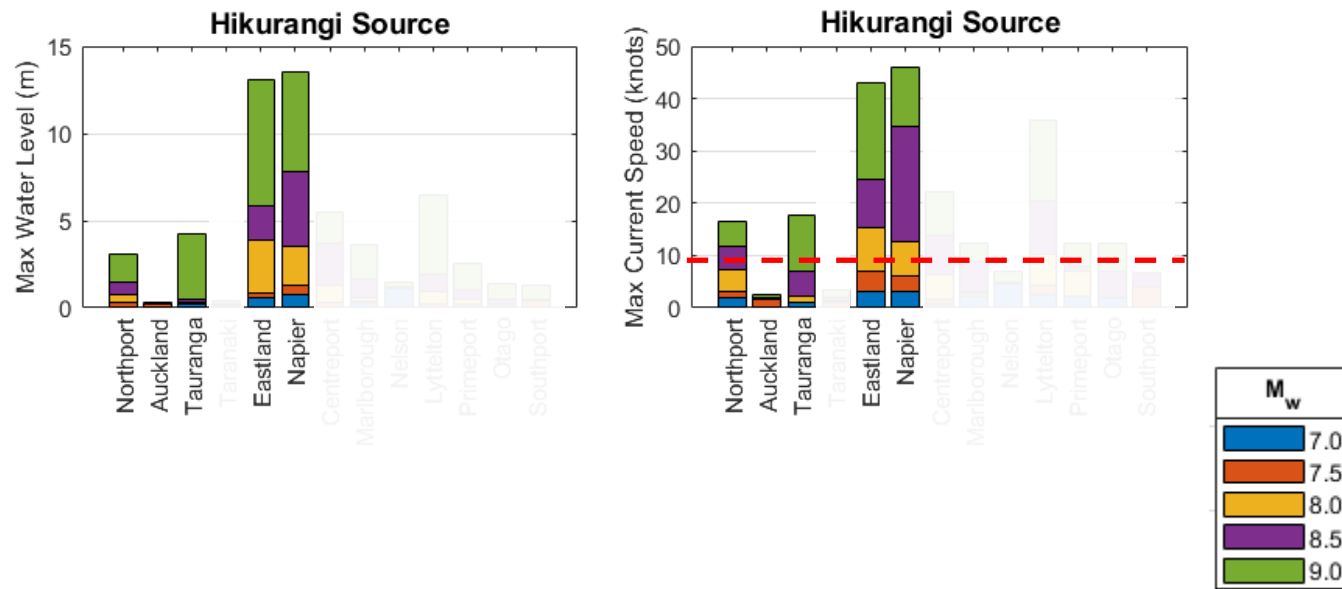
Results – Distant Source

- Current Speed



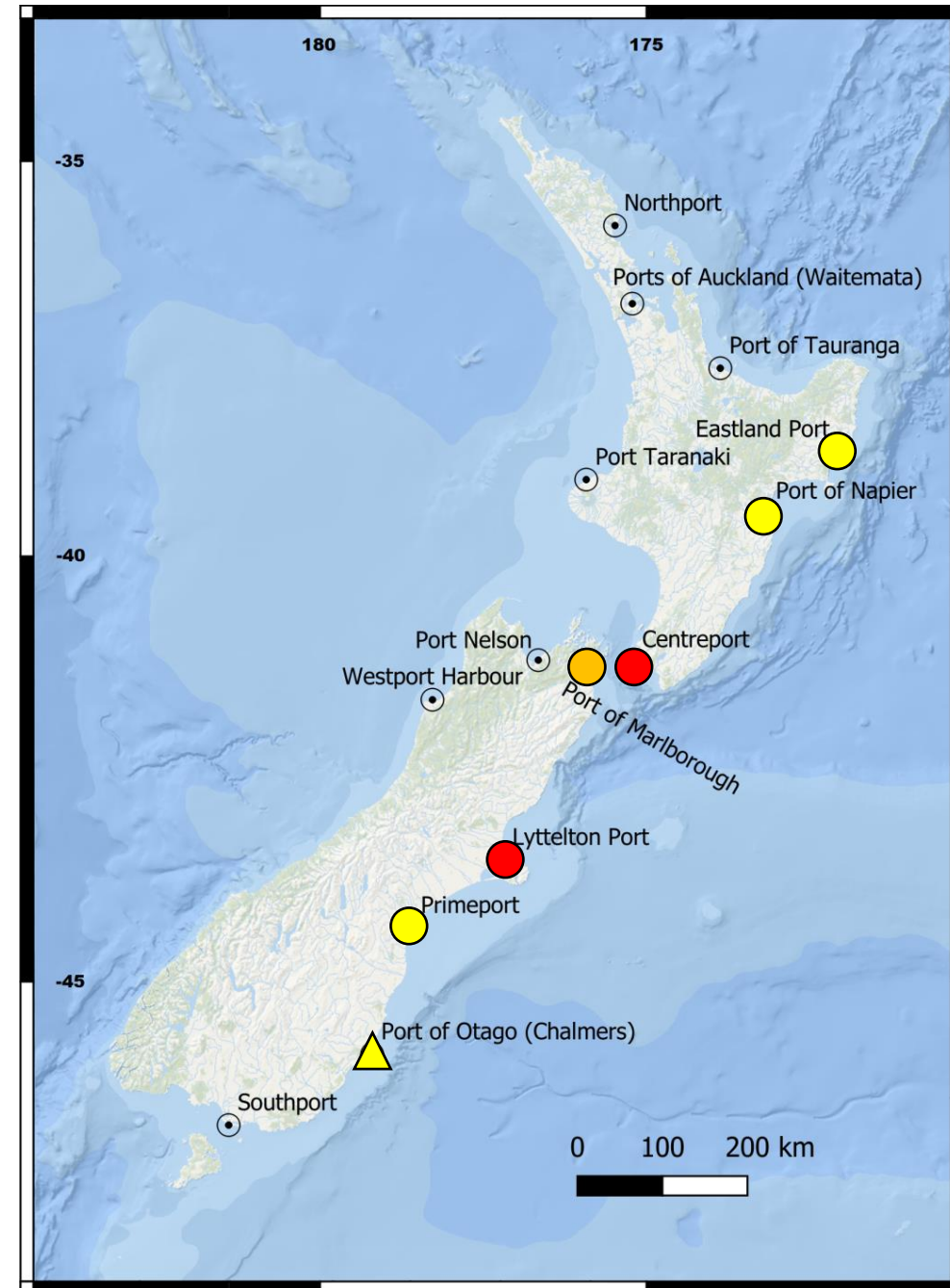
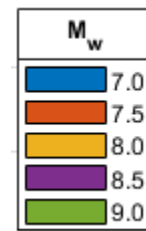
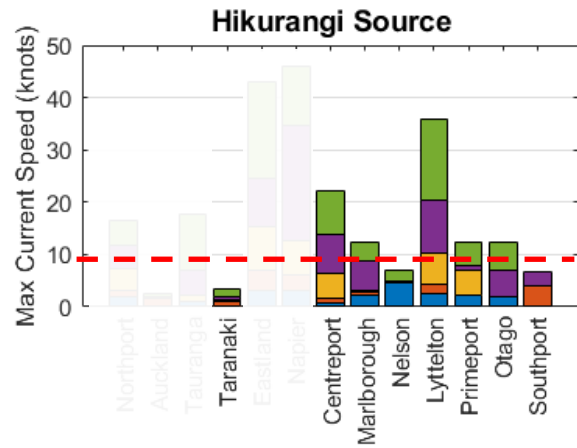
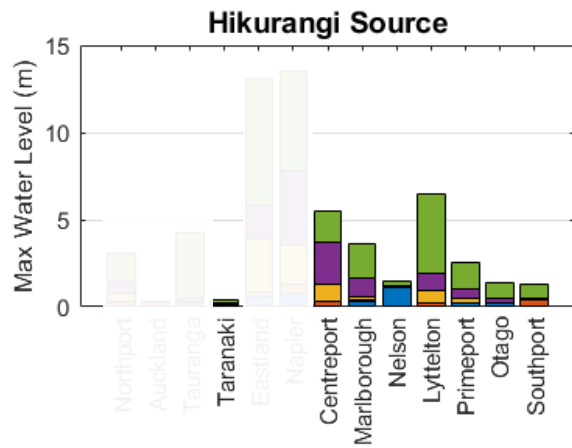
Results – Hikurangi North

- Significant potential impacts at Eastland + Napier $M_w 8+$
- Extends to Northport and Tauranga at $M_w 9$
 - Marsden Point
 - Main export hub
- Potential impacts at Centreport + Marlborough



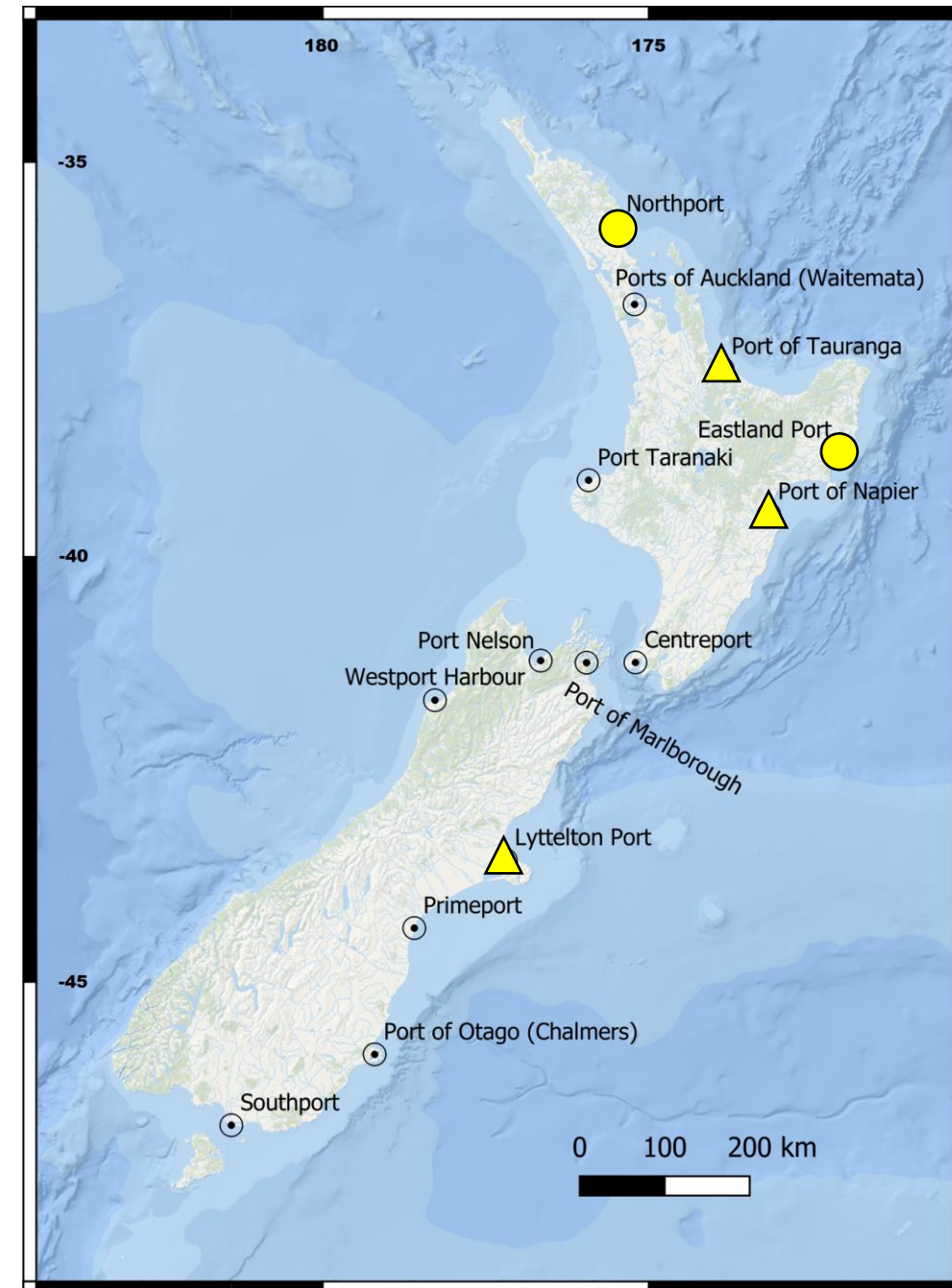
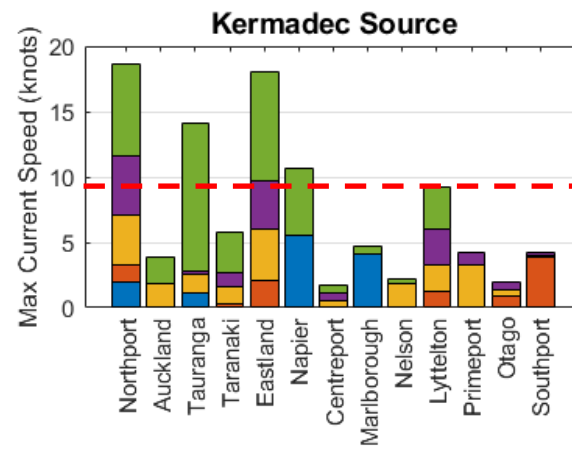
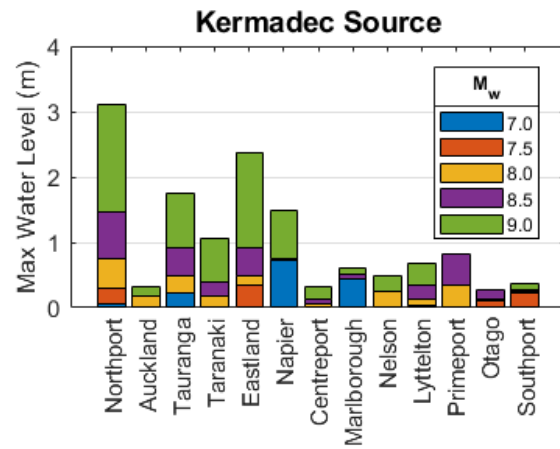
Results – Hikurangi South

- Extends to Centreport, Marlborough, Lyttelton + Primeport
- Potential impacts at Eastland + Napier remain
- Impacts on both ends of interisland link
- Lyttelton key port in SI



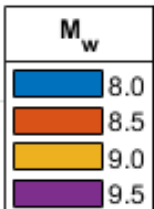
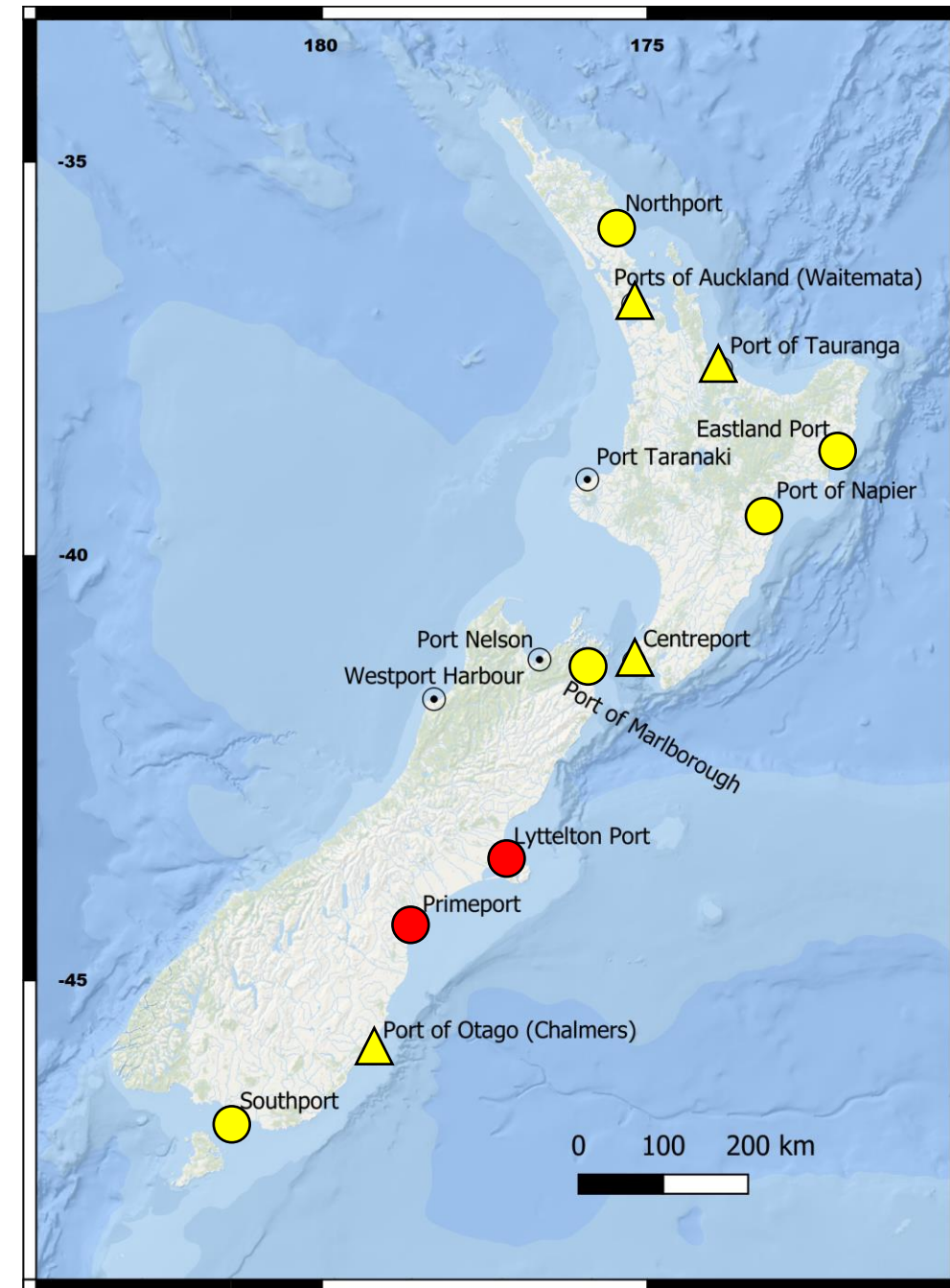
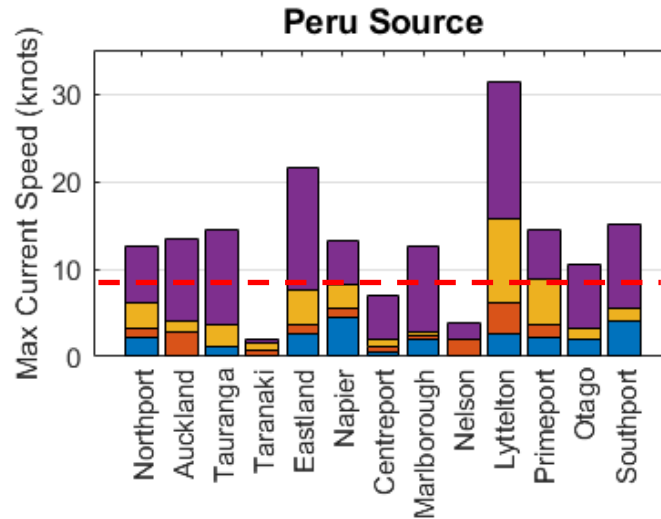
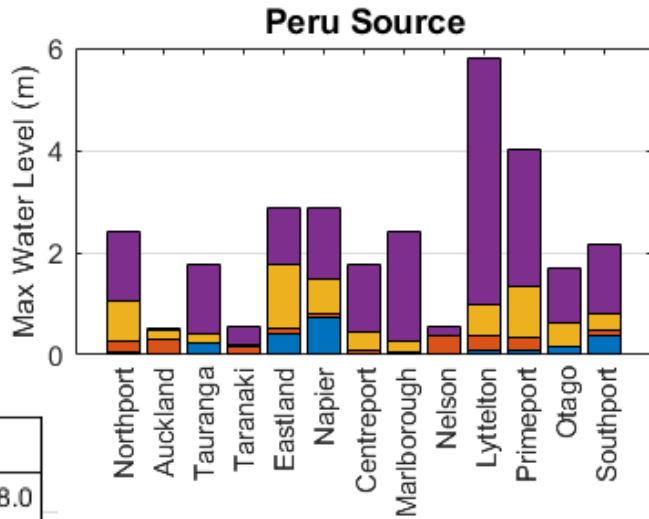
Results - Kermadec

- Less significant compared to Hikurangi events
- Wave related impacts at Northport + Eastland
- Current related impacts at Tauranga, Napier and Lyttelton



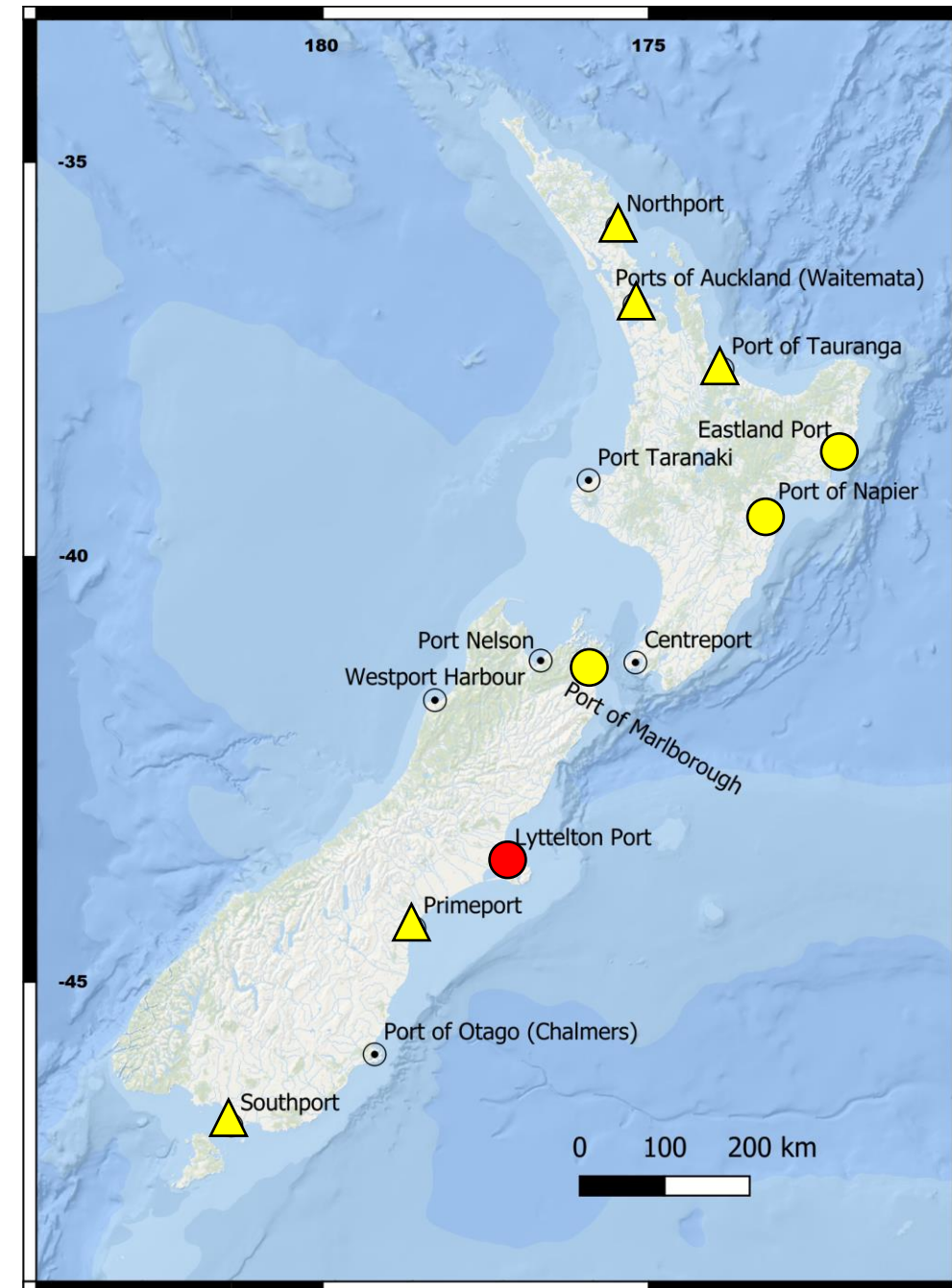
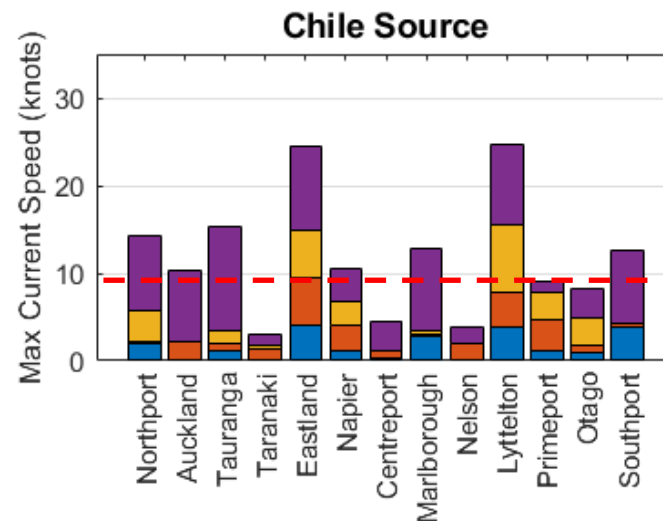
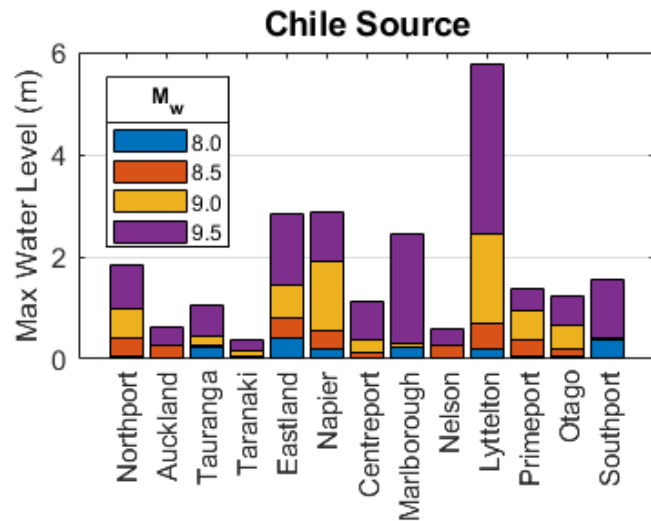
Results – Peru Source

- Wave related damage
 - At least 7 ports
- Current related damage
 - 10 ports
- Potential for wide-ranging disruption
 - Interisland link
 - Major ports exposed



Results - Chile Source

- Wave related damage
 - At least 4 ports
- Current related damage
 - 9 ports
- Reduced disruption
 - One side of interisland link
 - Major ports exposed



Discussion

- Ports of Auckland + Otago least exposed across all these events
- Interisland link exposed to multiple events
- Two different Hikurangi source regions have potential for significant damage
 - Wave related impacts at multiple ports
 - Southern source more significant for wider port network
- Peru + Chile sources have potential for wide ranging disruption from wave and current related impacts

Summary

- Number of scenarios could result in damage and disruption across multiple ports, affecting import and export and inter-island travel
- Hikurangi and South American subduction zone have potential for most severe impacts
- Highlight the importance of assessing ports as key linked components of the national transport system

Questions?