
Waikato
REGIONAL COUNCIL
Te Kaunihera ā Rohe o Waikato

Climate Change

Seachange Stakeholder Working Group

25 November 2014

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Doc# 3225545

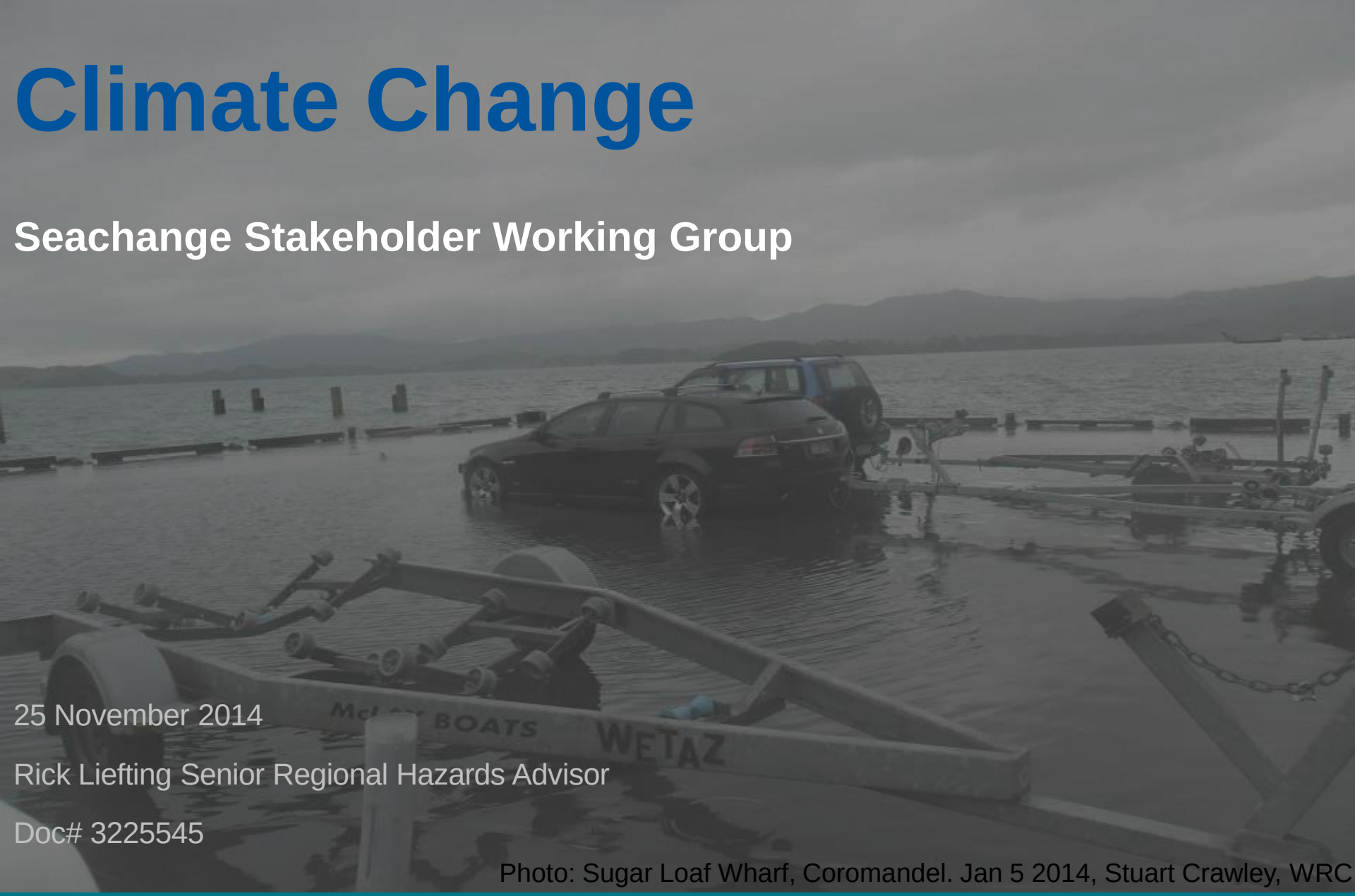


Photo: Sugar Loaf Wharf, Coromandel. Jan 5 2014, Stuart Crawley, WRC

Topics

- IPCC Overview
- Effects on Oceans
- Effects on Hazards (Primary Focus of Presentation)
  - Flooding
  - Coastal Hazards
  - Management

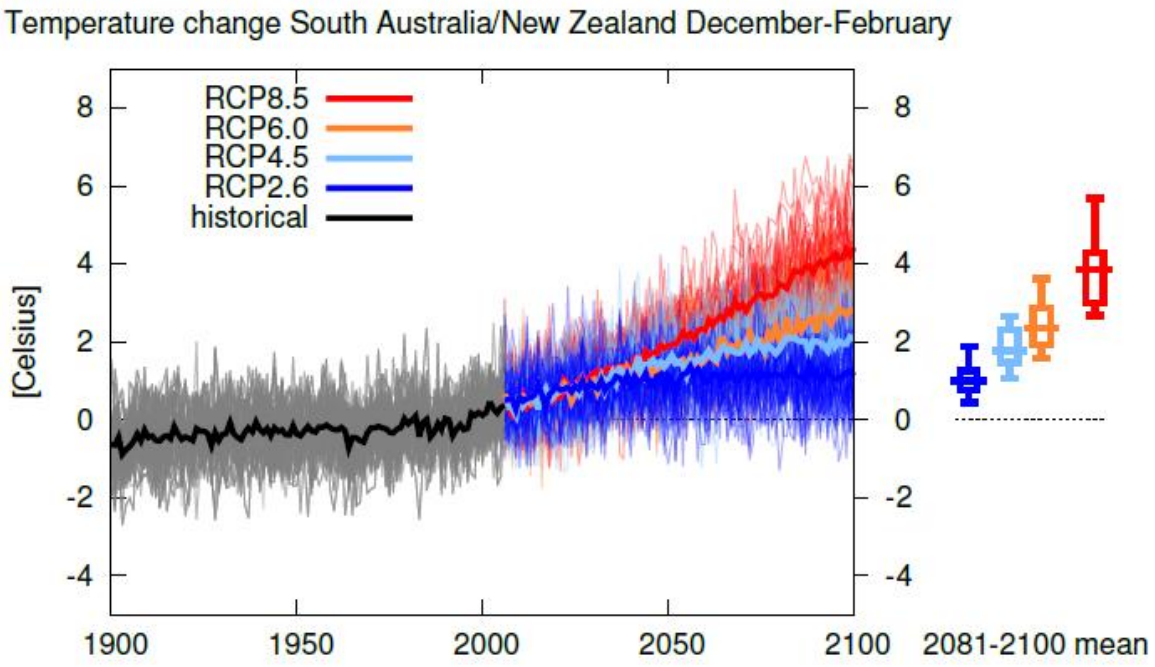
IPCC Overview

IPCC Working Group I: Key findings

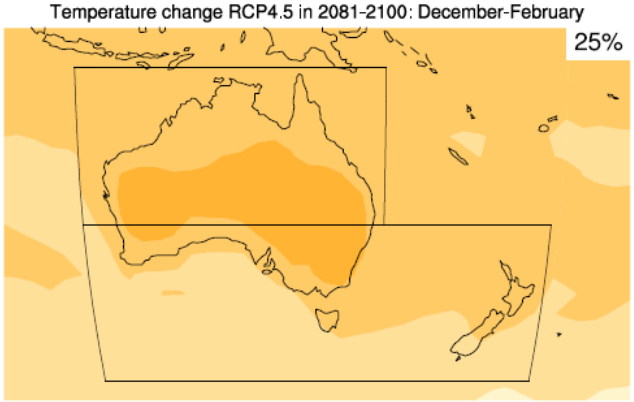
- There is a consistent message, with similar projections to the previous two IPCC assessments
- Uncertainty in projections for a particular RCP is now explicitly provided as 5% and 95% confidence levels – main uncertainty for users is which RCP to adopt (down to global choices)
- It is extremely likely that human influence has been the dominant (>50%) cause of the observed warming since the mid-20th century.
- Overall, frequency of storms may not increase, but more intense storms/rainfall are likely to occur
- Cumulative emissions of CO_2 largely determine global mean surface ΔT and SLR by late this century & beyond. Most aspects of climate change will persist for many centuries even if emissions of CO_2 are eventually halted

Source: in Bell 2014

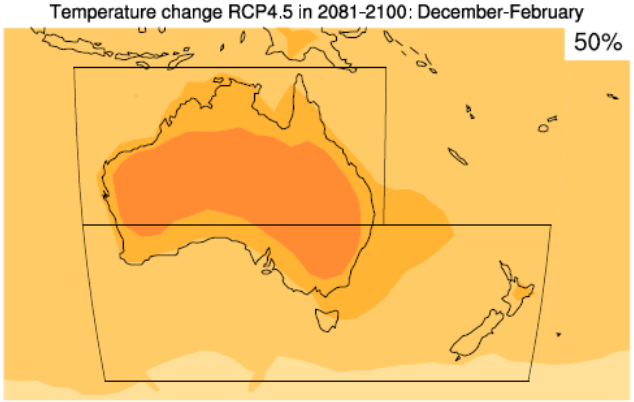
Regional Atlas (WGI) – Australia/NZ



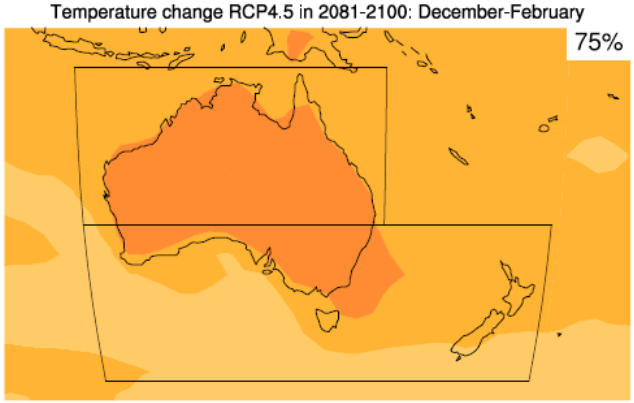
- NZ has warmed by about 0.9ºC since 1900
- NZ's temperature is expected to rise:
  - a further ~0.8-1.2ºC in a "rapidly de-carbonising world"
  - a further ~3.5-4ºC in a high-carbon BAU world [above 1986-2005 mean]



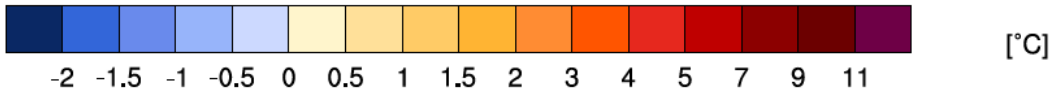
RCP 4.5 (25% CI)



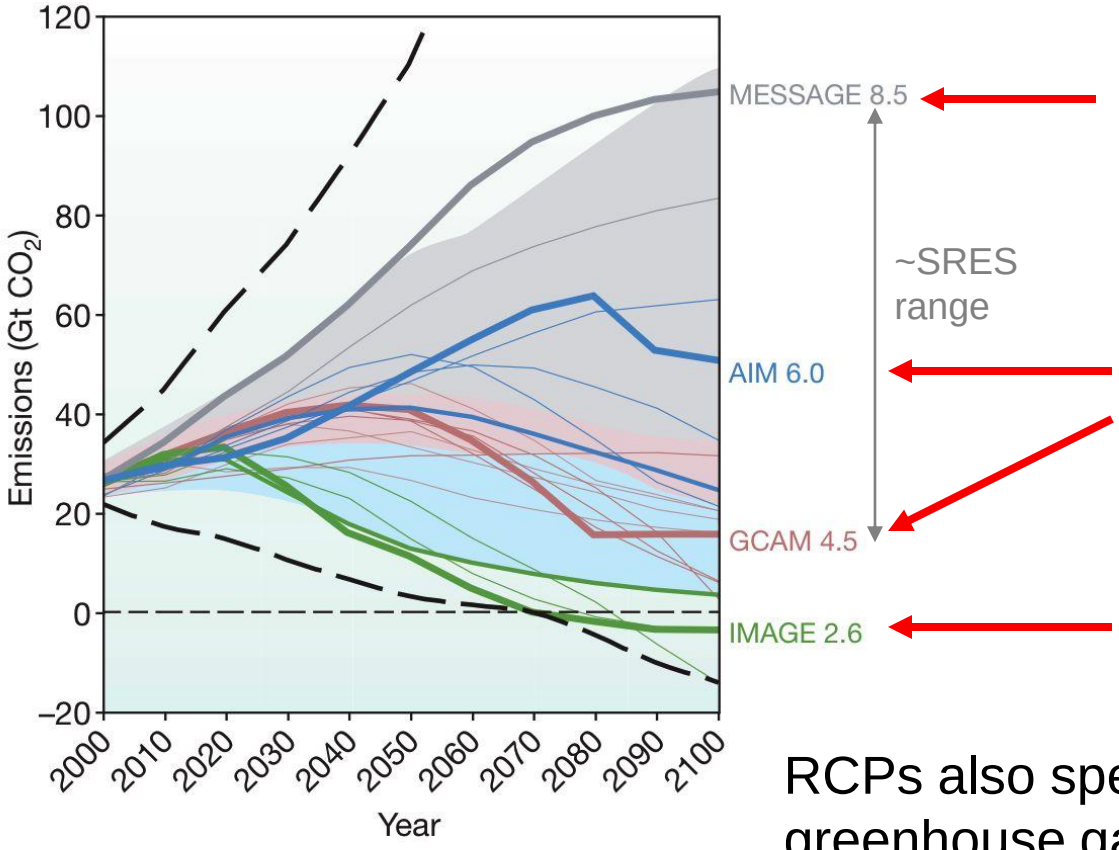
RCP 4.5 (median)



RCP 4.5 (75% CI)



Representative Concentration Pathways (RCPs)
The new scenarios used for the AR5
(about choices for the global village)



RCP8.5: High no-effective mitigation scenario (BAU)

RCP6.0, RCP4.5: Medium stabilization scenarios

RCP2.6: Mitigation scenario - very low forcing

RCPs also specify emissions of other greenhouse gases, aerosols

Source: Moss et al., Nature, Feb 2010 in Bell 2014

New Zealand's changing climate and oceans: The impact of human activity and implications for the future

An assessment of the current state of scientific knowledge by the Office of the Chief Science Advisor

July 2013

Table 1: Summary of projected changes (increases are relative to the 1980-2000 average)

Geographic zone	Ocean acidification	Temperature & extremes	Wind and circulation	Mean Precipitation	Seasonal & extreme precipitation and drought
All New Zealand	pH changes are greater in cooler waters.	The midrange of projections is an average temperature increase of 0.9°C by 2040, 2.1°C by 2090.	Increase in strongest winter winds by 2100.	Little change in the mean for all New Zealand but large geographical variation.	Heavier and more frequent extreme rainfalls, but also more droughts. On average, 2 or more extra weeks of drought annually by mid-century for much of North Island and eastern South Island.
North Island	Upwelling areas such as the Hauraki Gulf are more vulnerable to a given change.	Halving or more of the number of frosts by 2100 in the central plateau (to <15 days per year). 40+ extra hot days (>25°C) a year in Auckland by 2100.	Less westerly wind component and more easterly episodes, as tropical zones move south in summer.	By 2040 overall precipitation decreases in the east by up to 5% (though seasonally variable), with smaller changes in the west.	West - In summer and autumn rainfall decreases, in winter and spring rainfall increases by up to 5%. East (Gisborne/Hawkes Bay)- decrease in rainfall in winter and spring by up to 5 to 10%.

Oceans

Hot, Sour & Breathless - Ocean under stress

How is the biggest ecosystem on Earth faring in the lead up to Rio+20

Partners

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European Project on Ocean Acidification
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Mediterranean Sea Acidification in a Changing Climate
Dr Patrizia Ziveri, patrizia.ziveri@uab.cat, http://medsea-project.eu

PML | Plymouth Marine Laboratory

SCRIPPS INSTITUTION OF OCEANOGRAPHY

OCEANA | Protecting the World's Oceans

UK Ocean Acidification Research Programme

EPOCA

MedSeA

Ocean Stress Guide

What the ocean will experience this century without urgent and substantial reduction in greenhouse gas emissions.

Stressor	Causes	Result	Direct effects	Impacts	Feedback to climate
Warming ● A relatively mature study area in terms of physical changes and physiology but poorly studied at ecosystem and biogeochemical level	● Increasing greenhouse gas emissions to the atmosphere	● Temperature increase, particularly in near-surface waters ● Less ocean mixing due to increased stratification ● Increased run-off and sea-ice melt will also contribute to stratification in Arctic waters	● Decreased carbon dioxide solubility ● Increased speed of chemical and biological processes ● Reduced natural nutrient re-supply in more stratified waters	● Stress to organism physiology, including coral bleaching ● Extensive migration of species ● More rapid turnover of organic matter ● Nutrient stress for phytoplankton, particularly in warm waters ● Changes to biodiversity, food webs and productivity, with potential consequences for fisheries, coastal protection and tourism	● Reduced ocean uptake of carbon dioxide due to solubility effect ● Increased oxygen consumption, carbon dioxide production and decrease in oxygen transfer to the deep ocean ● Potential decrease in the export of carbon to the ocean's interior ● Decreasing productivity except in the Arctic
Acidification ● Developed as a research topic in past decade	● Increasing atmospheric carbon dioxide emissions ● Coastal nutrient enrichment, methane hydrates and acid gases from industrial emissions may also contribute locally	● Unprecedented rapid change to ocean carbonate chemistry ● Much of the ocean will become corrosive to shelled animals and corals, with effects starting in the Arctic by 2020	● Reduced calcification, growth and reproduction rates in many species ● Changes to the carbon and nitrogen composition of organic material	● Impeded shell or skeletal growth and physiological stress in many species, including juvenile stages ● Change to biodiversity and ecosystems, and the goods and services they provide ● Cold and upwelling waters currently supporting key fisheries and aquaculture likely to be especially vulnerable	● Reduced ocean uptake of carbon dioxide due to chemical effects ● Changes to the export of carbon to the ocean's interior ● Higher oxygen use throughout the water column due to changing composition of organic material
Deoxygenation ● Emerging issue, poorly studied					
All three togeth ● Few studies					

- Ocean acidification can reduce organisms' thermal tolerance, increasing the impact of warming
- Combined effects further increase risk to food security and industries depending on healthy and productive marine ecosystems

- Major change to ocean physics, chemistry and ecosystems
- Risk of multiple positive feedbacks to atmosphere, increasing the rate of future climate change

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Oceans - Key points

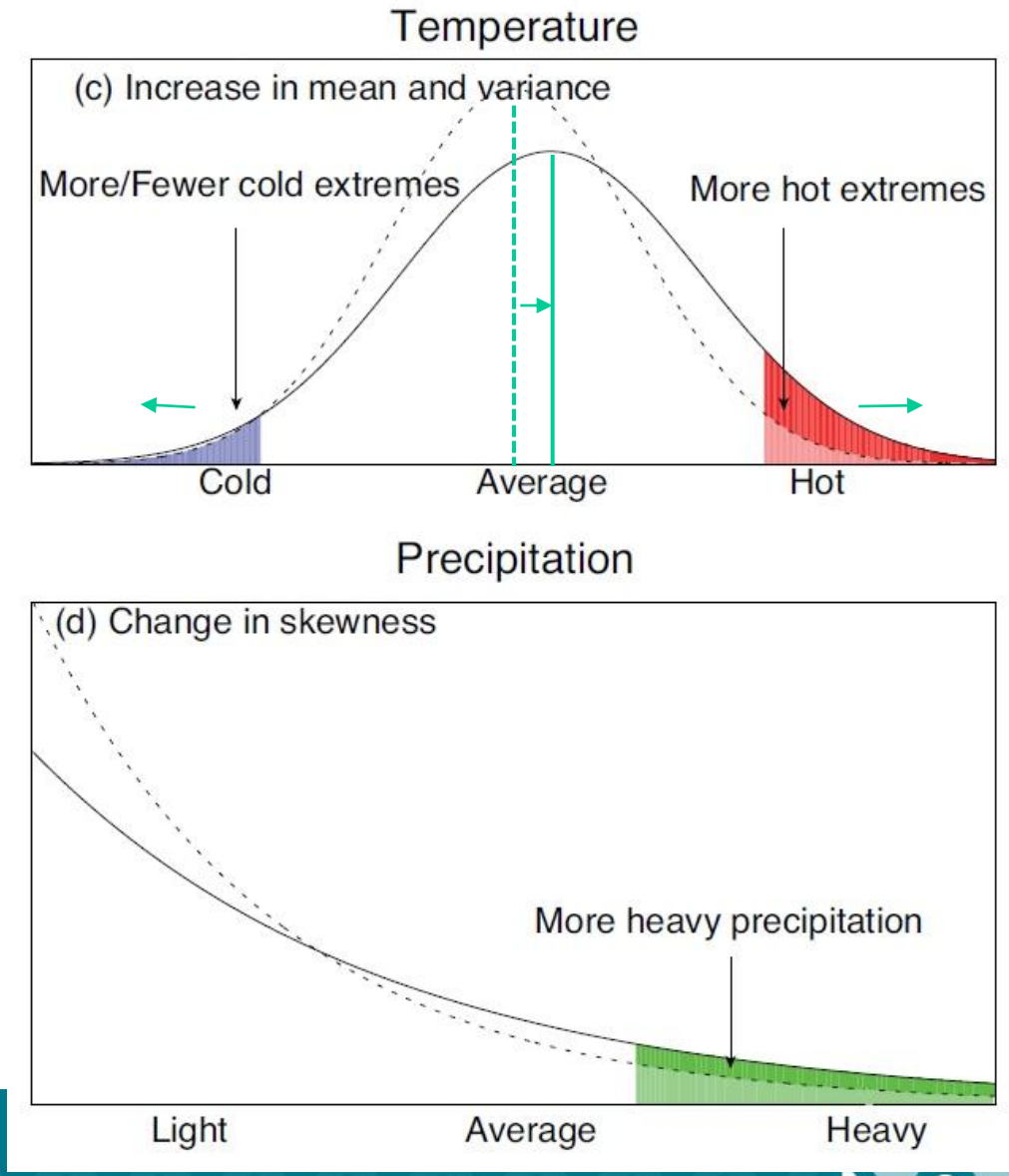
- Recent NIWA research in the Firth of Thames has shown that it is acidified
- It is most likely that in this case the major driver is runoff of organic matter and inorganic nitrogen (DIN) from land (Source: John Zeldis, NIWA)
- Climate Change projected to exacerbate Acidification
  - Both from increased CO2 and potentially increased Runoff from catchments.
- Manage Run-off at local/regional scale

Hazards

- Rainfall event Northwest Coromandel
- Coastal Inundation
- Management

Means and extremes (climate change)

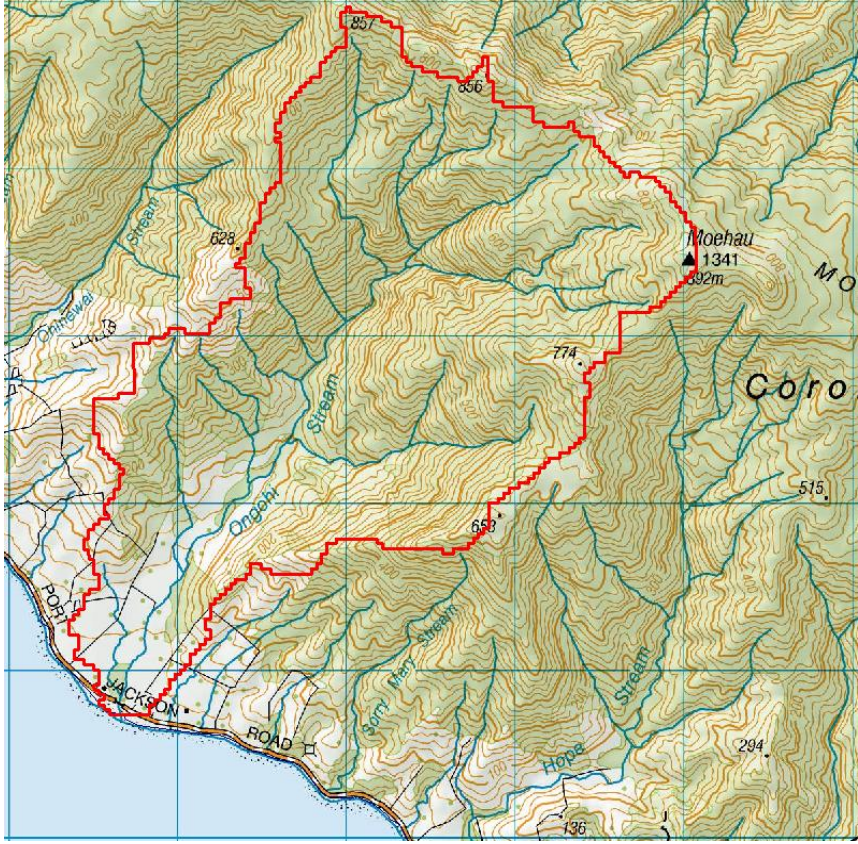
For NZ, mean changes for *T*, precip may be quite tolerable or adapted to, but ….. the **extremes** (hazards) either end will be the challenge



Source: WGI, Chap 1, AR5 (IPCC) in Bell 2014

Ongohi Stream

- High Rainfall event June 2014
- Estimated 100+ Year Return Period rainfall event localised in several catchments.
- Nearest Rain gauge (30 km south) < 2-5 year rainfall event



- 'Typical' Coromandel Catchment
- Dodged a bullet, very little development


ONGOHI STREAM VALLEY

Healthy environment

Strong economy

Vibrant communities

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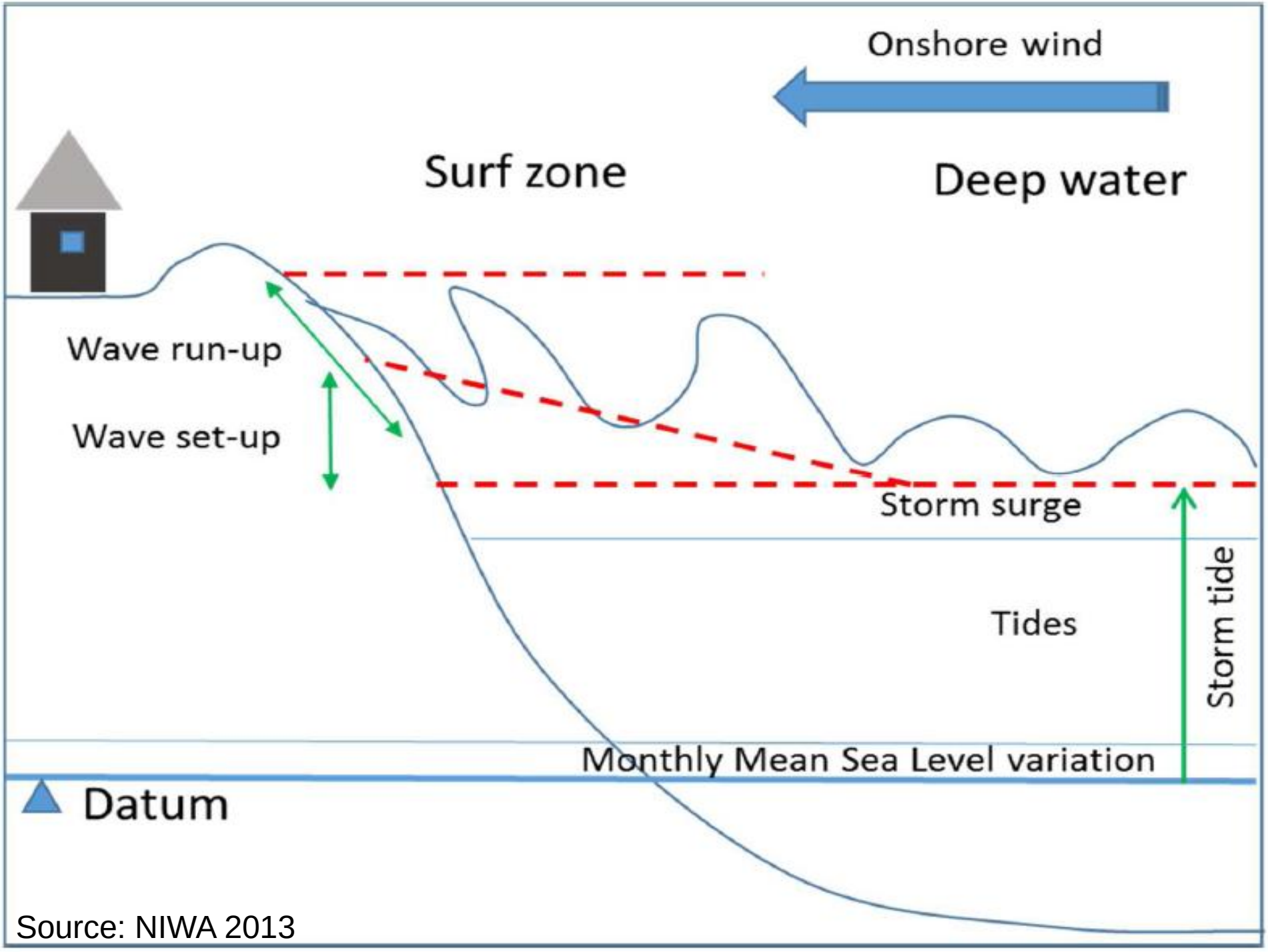
Coastal Inundation

- Inundation along the coast and within estuaries caused by:
  - Astronomical Tides (varies along coast)
  - Climate (sea temperature changes >> sea level +/- 0.25)
  - Storm Surge – wind set up and Barometric pressure (1 HPa = 1 cm)
    - Generally less than 1.0 m
  - Storm Tide = Astronomical Tides + Storm Surge
  - Wave effects
    - Wave Set up ('static' water level along the coast – varies)
    - Wave Run up ('Swash' of wave up the beach/coast – varies)
- Effects of Climate Change
  - Sea level rise
  - Increased frequency and Intensity of storm and wave events

Sea Level Rise

- The MfE (2008 IPCC 4) guidance still valid and applicable.
- WRC RPS states at least 0.8 m (MfE guidance)
- NIWA advocating 1.0 m SLR to 2115 - in line with MfE guidance
- Differentiation between Existing and Green Fields
- Green Fields - NIWA advocating to use 1.5 m - 2.0 m
  - AC Unitary Plan – 2.0 m forth Green fields
  - Not tested, no Central Govt guidance
- MfE SLR guidance update Feb 2015



Source: NIWA 2013

Pauanui Waterways

King Tides

February 2, 2014

- Perigean Spring Tide
  = *Moon closest to earth*
- Occurred with 'average' air pressure
- Lower pressure = greater water level

Whitianga - Buffalo Beach 'Mother Browns Creek'

A 'normal' tide in 100 years time predicted to be between ~ <u>0.5 m to 0.8 m</u> HIGHER than the king tide water levels shown in these pics.

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Tairua - Paku Boat Ramp

Tairua – Fishing Club, tide coming up through storm water drains

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Tairua

Photo: Sugar Loaf Wharf, Coromandel. Jan 4 2014, Stuart Crawley, WRC

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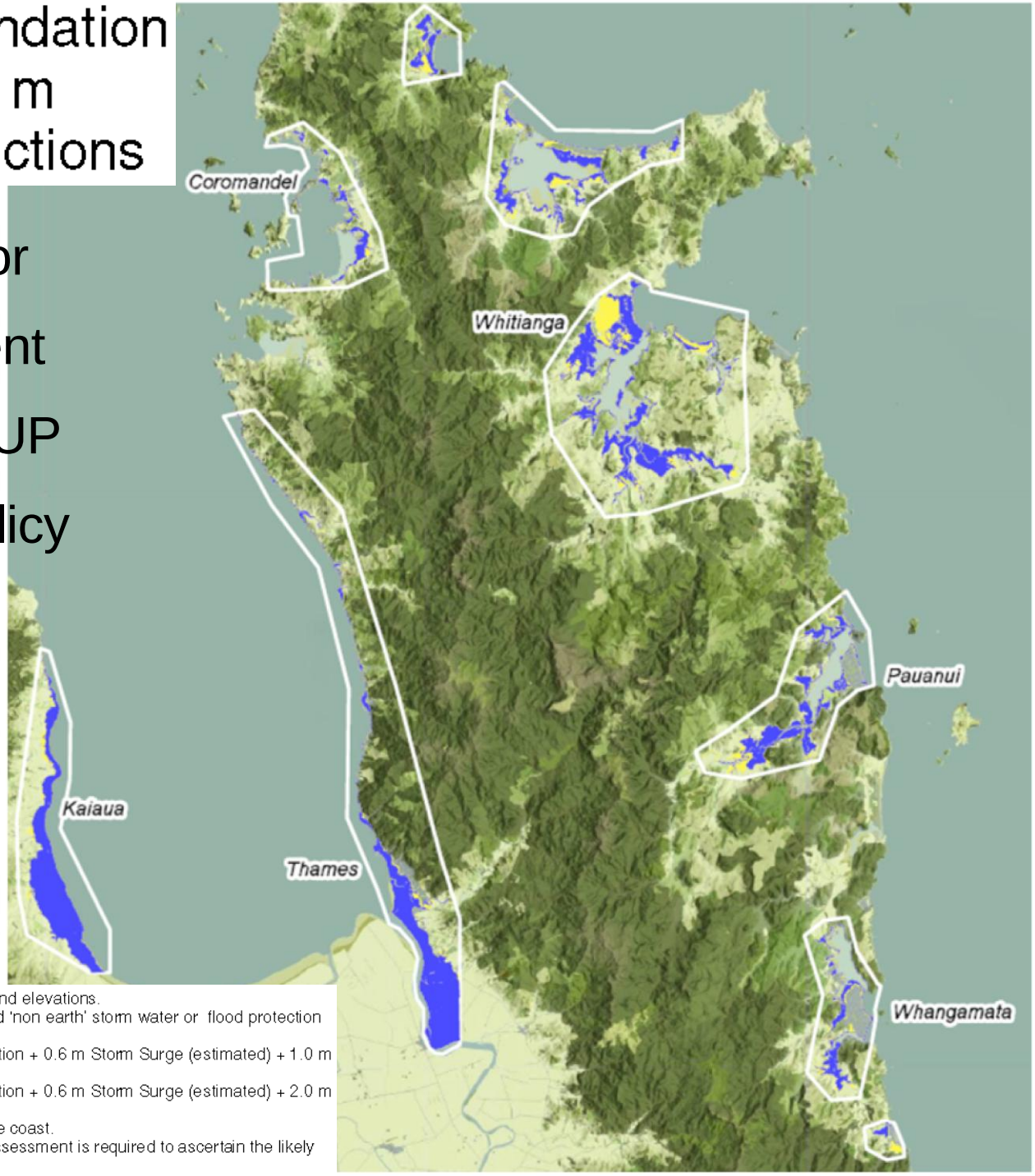
Whangapoa Aug 2014

Indicative Coastal Inundation for 1.0 m and 2.0 m Sea Level Rise Projections

- 2 m SLR threshold for Greenfield development
- Auckland Proposed UP
- In line with NZCP policy
- MfE Guidance



Legend

- 1 m Sea level Rise
- 2 m Sea level Rise
- Extent of Modelled Inundation

The inundation modelling is based on a LiDAR derived 1 m DEM of ground elevations.
The inundation modelling does not include effects of existing or proposed 'non earth' storm water or flood protection assets such as culverts, pipes, floodgates or sheet piling.
"1 m Sea level Rise" comprised of: Local MHWS + 0.25 m Climate Variation + 0.6 m Storm Surge (estimated) + 1.0 m Projected Sea Level Rise.
"2 m Sea level Rise" comprised of: Local MHWS + 0.25 m Climate Variation + 0.6 m Storm Surge (estimated) + 2.0 m Projected Sea Level Rise.
The Sea Level Rise scenarios do not include local wave effects along the coast.
The inundation areas are therefore 'indicative' and further site specific assessment is required to ascertain the likely effects of projected Sea Level Rise

Hazard Management Issues for Land Development.

- Uncertainty
  - Historical data, methodology, Time frames, perceptions of Risk
- Guidance
  - Statutory and non statutory, planning for uncertainty, are the right decisions being made?
- Land use
  - Existing Vs Greenfields
- Engagement
  - Bottom up approach, Citizen Science, takes time - but worth it!

Existing development

- Managing (coastal) hazards/risk in existing development areas is not easy
- There is no silver bullet
- However, one thing is guaranteed:

Owners of property in hazard areas

will be significantly affected, due to:

Physical loss of property

Financially

(Regulatory restrictions/insurance/$$ for mitigation)

New development

- Main issue is of permanence.
  - Once freehold title is issued is VERY hard to remove
  - Public perception is that if ‘council’ allowed development we are ‘safe’.
- Two options:

Don’t allow new development in hazard prone areas.

Don’t use freehold title land ownership.

Planning options (Mick Strack School of Surveying UoO)

- Prediction of time scale and extent is imprecise
  - adaptive management allows for progressive decision-making based on actual events
- Buy and lease back
  - central or local government purchase of vulnerable land, then leased back for fixed term
  - land can still be occupied until the threat is realised
- Rolling easements
  - ambulatory easements for public access (like marginal reserves)
  - will also preserve the open character of coastal land
  - give owner ample notice to withdraw when land is lost

Planning options (Mick Strack School of Surveying UoO)

- Coastal reserves
  - esplanade reserves are only established when land is subdivided.
  - they should be designated or established whenever possible
- Development setbacks
  - no land use change should be consented without reference to an established setback line
- Tenure restrictions
  - no new coastal titles should be fee simple (which implies certain freedoms)
  - all new titles could be renewable leases fixed by limited duration or a specified event (erosion)

Summary

- More certainty about Climate Change
- Not if, but when significant effects will occur
- Some uncertainty in timing
- Global issue, but local/regional/national, engagement, management and guidance is key.