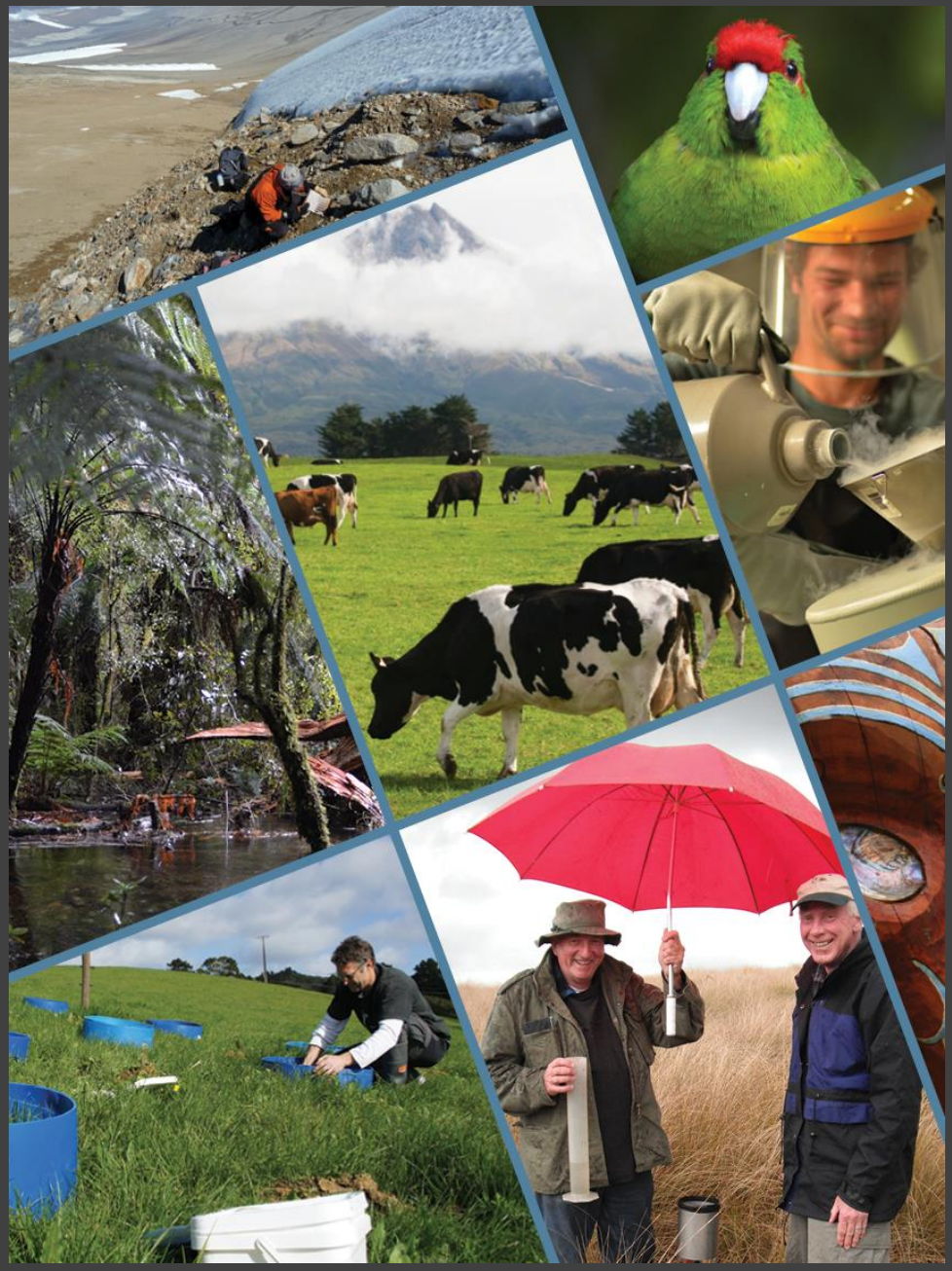


Climate change impacts and implications for decision making in Aotearoa New Zealand

Paula Blackett[1]
Nick Cradock-Henry[2]
Stephen Flood[2]
Judy Lawrence[3]

[1] NIWA
[2] Landcare Research
[3] Victoria University of Wellington

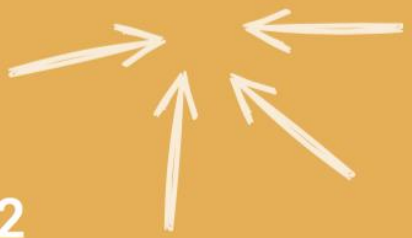
CLIMATE CHANGES, IMPACTS & IMPLICATIONS FOR NEW ZEALAND

Anthropogenic climate change poses critical challenges for New Zealand's environment, economy and society.

The CCII programme undertook targeted research on climatic conditions, impacts and implications for New Zealand up to 2100, through five inter-related Research Aims (RAs):

RA1

Improving climate projections.



RA2

Identifying pressure points, critical steps and potential responses.

RA3

Identifying feedbacks, understanding cumulative impacts & recognising limits.

RA4

Enhancing capacity and increasing coordination to support decision-making.

RA5

Exploring options for New Zealand under different global climates.

13. THE ROLE OF ANTHROPOGENIC CLIMATE CHANGE IN THE 2013 DROUGHT OVER NORTH ISLAND, NEW ZEALAND

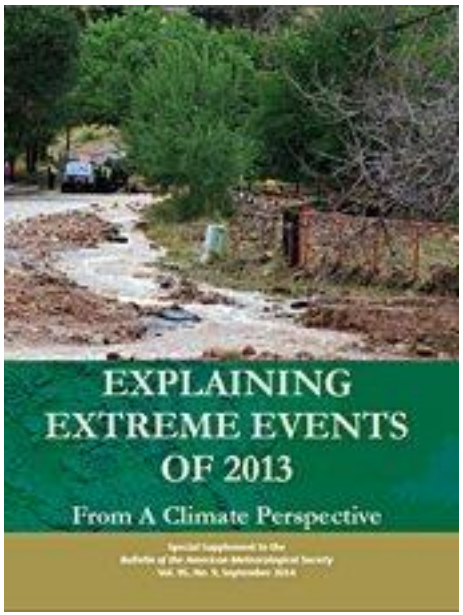
LUKE HARRINGTON, SUZANNE ROSIER, SAM M. DEAN, STEPHEN STUART, AND ALICE SCAHILL

For the 2013 New Zealand drought, evidence from a number of models suggests that the meteorological drivers were more favorable for drought as a result of anthropogenic climate change.

Introduction. In the latter part of the 2012/13 austral summer season (January–March), the North Island of New Zealand endured its most severe drought in 41 years of widespread measurements of potential evapotranspiration deficit (Porteous and Mullan 2013). For the 2013 drought, 34.2% of the North Island land surface experienced its highest recorded cumulative deficits (Supplementary Fig. S13.1), significantly greater than the 14.3% recorded for the previously severest drought (1997/98). The New Zealand Treasury (2013) estimates reduced agricultural production, attributed to the drought, cost the national economy at least US$1.3 billion, with continued impacts expected for another two years (Blackham 2013).

record total number of dry days of 78.2 for January to March.

Was this event influenced by climate change? Previous studies concerning the attribution of individual drought events to (anthropogenic) climate change have primarily focused on precipitation departures (Rupp et al. 2013; Trigo et al. 2013) and prolonged temperature extremes (Rupp et al. 2012; Hoerling et al. 2013). For a maritime, midlatitude climate like New Zealand's, temperature is not reflective of synoptic-scale drying and, thus, does not perform well as an indicator of drought (Clark et al. 2011; Seneviratne 2012). Furthermore, analysis of precipitation



Harrington *et al*. (2014)

"…Climate change is making a difference to New Zealand now, affecting our droughts and our rainfall extremes…"

Climate Change Impacts and Implications (CCII) KEY QUESTION (from MBIE RfP)

What are the predicted climatic conditions and assessed/potential impacts and implications of climate variability and trends on New Zealand and its regional biophysical environment, the economy and society, at projected critical temporal steps up to 2100?

What's going to happen and when?

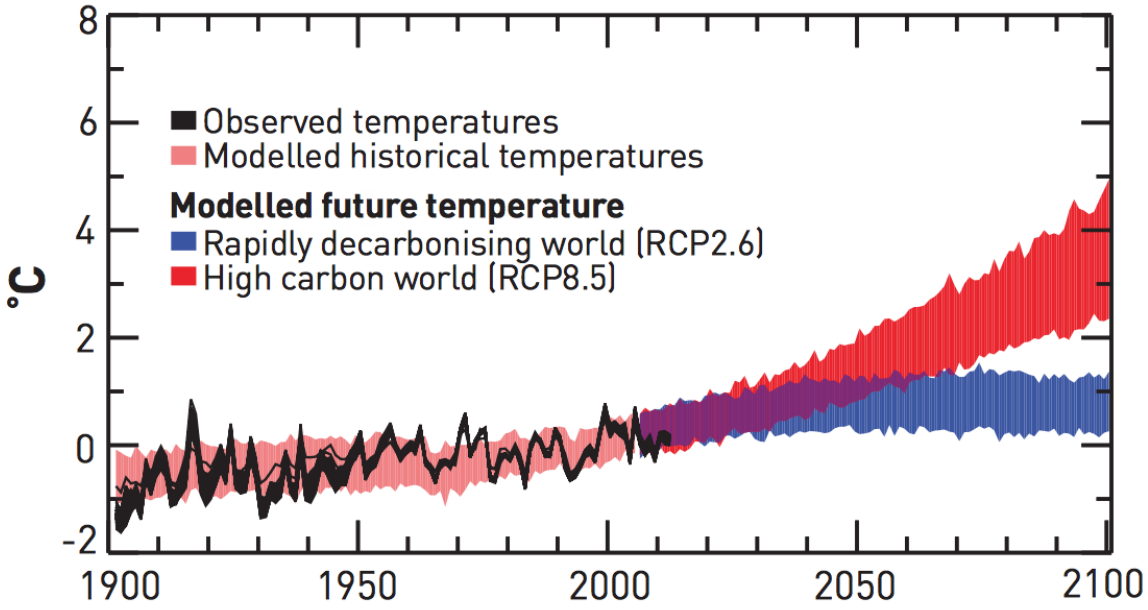
CCII Research Organisations

OBJECTIVES

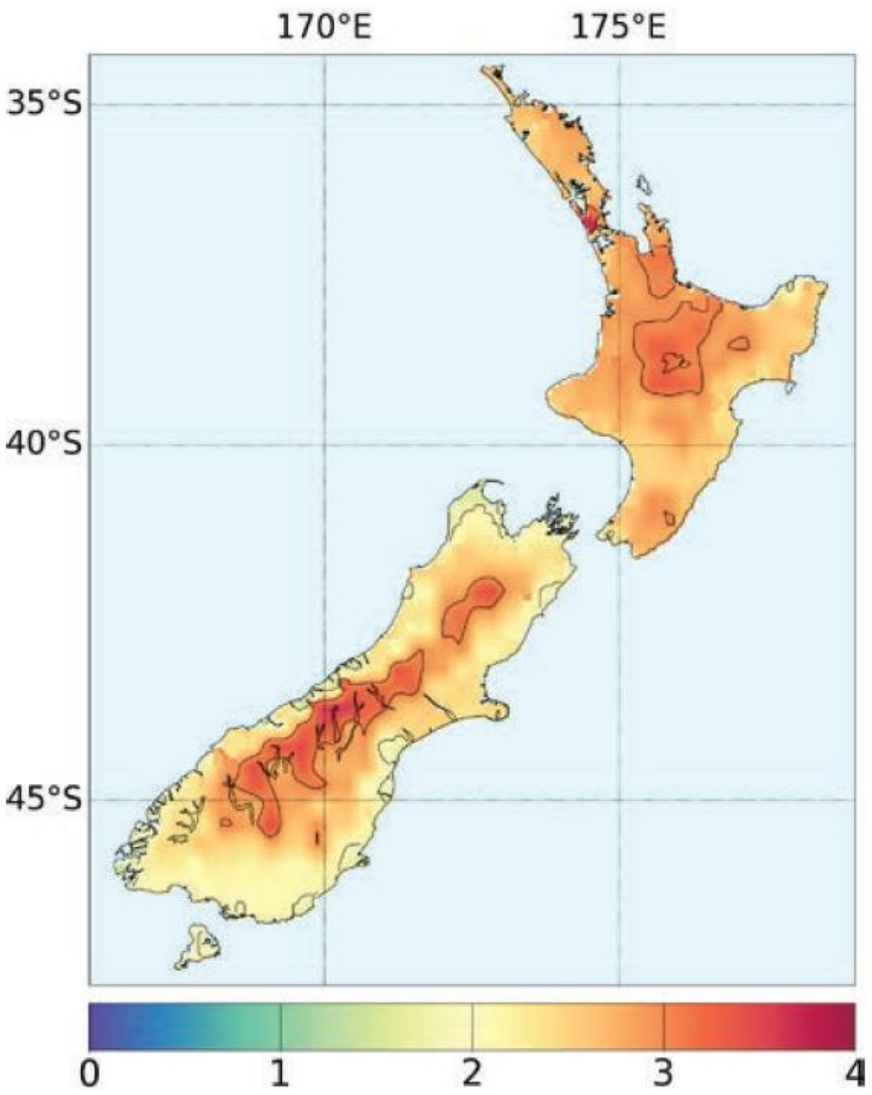
- Update and improve projections of climate trends, variability and extremes across New Zealand out to 2100, based on the latest global projections
- **Generate new knowledge about the potential impacts and implications of climate change and variability on**
  - **Environment: natural ecosystems and native species**
  - **Economy: many productive activities which depend on the environment**
  - **Society: to enable continued growth and prosperity**

CLIMATE CHANGE IMPACTS: New Zealand

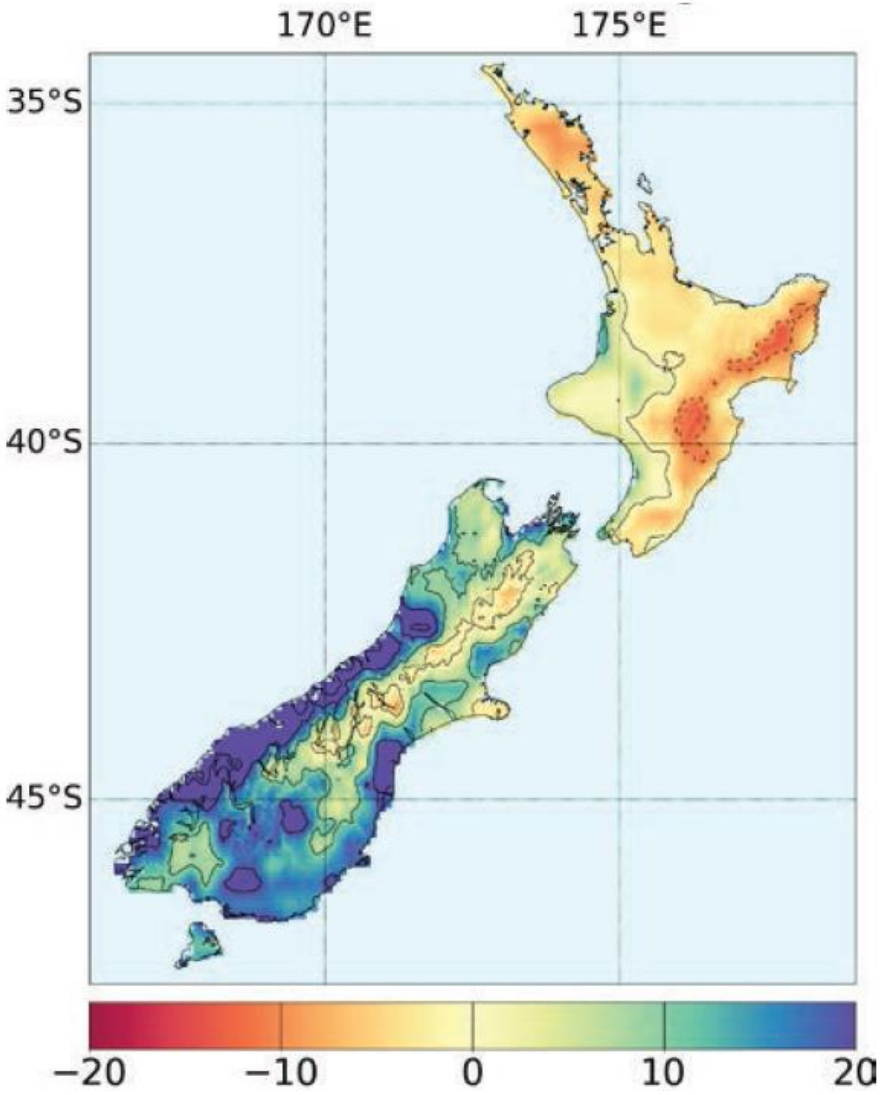
- New Zealand has warmed by about 0.9°C since 1900
- Temperature to rise by another 0.8°C [low carbon, blue] (above 1986-2005 average)
- Temperature to rise by about 3.5°C [high carbon, red]



IPCC (2014)



Average change in T (°C) by 2090 under RCP 8.5



Average change in rainfall (%) by 2090 under RCP 8.5

Tait et al. (2016)

Daily temperature extremes and frosts

- More days > 25°C particularly at northern locations.
  - +60 more hot days per year (over 25°C) for northern areas by 2090.

- ‘Very high’ and ‘extreme’ fire danger index days increase by up to 400% by 2040 and 700% by 2090.

- Significant shifts in rainfall patterns.

- Large decrease in number of frost days.
  - Spring and autumn frost-free land area expected to at least triple by 2080s.

- Average temperatures expected to rise further, depending on future greenhouse gas emissions.

Rainfall

- Extreme rainfalls to increase (+7% for every 1°C)

Drought

- Droughts more frequent and more intense
- Time in drought to double or triple by 2040 (E/N NZ)

Strong winds

- Extreme winds in winter, decrease in summer
- Coastal regions: frequency of heavy swells, add to the effects of higher sea levels

Snowfall

- 30–80% in accumulation at 1000 metres and by about 5–50% at 2000 metres by 2090

RA4 ENHANCING CAPACITY AND SUPPORTING DECISION MAKING

AIM

Generate new knowledge about decision-making across communities of practice relevant for addressing climate risks, including how climate information is used and can be communicated

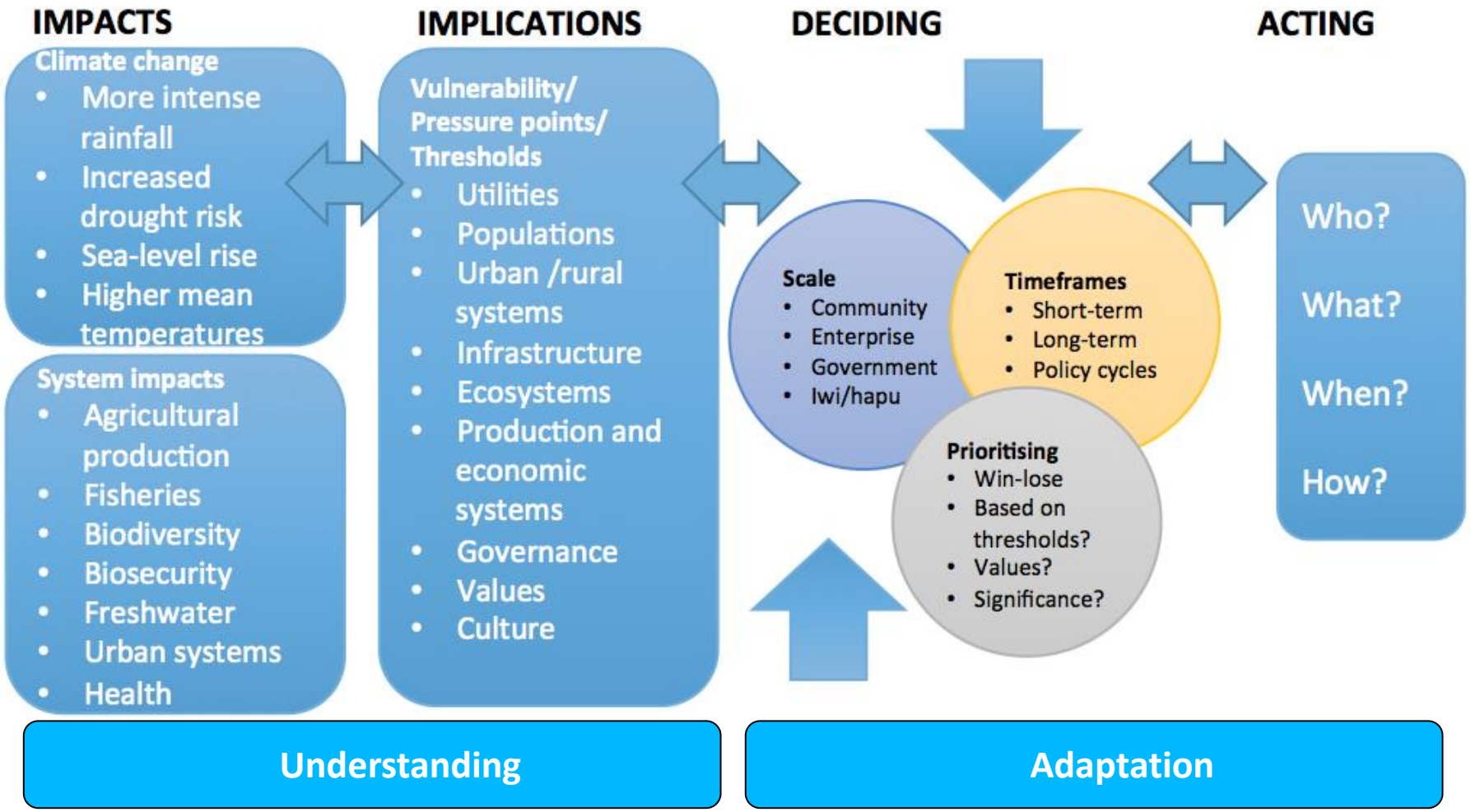
WHY?

Close(r) alignment between CCII outputs and decision makers' needs increase likelihood of success.

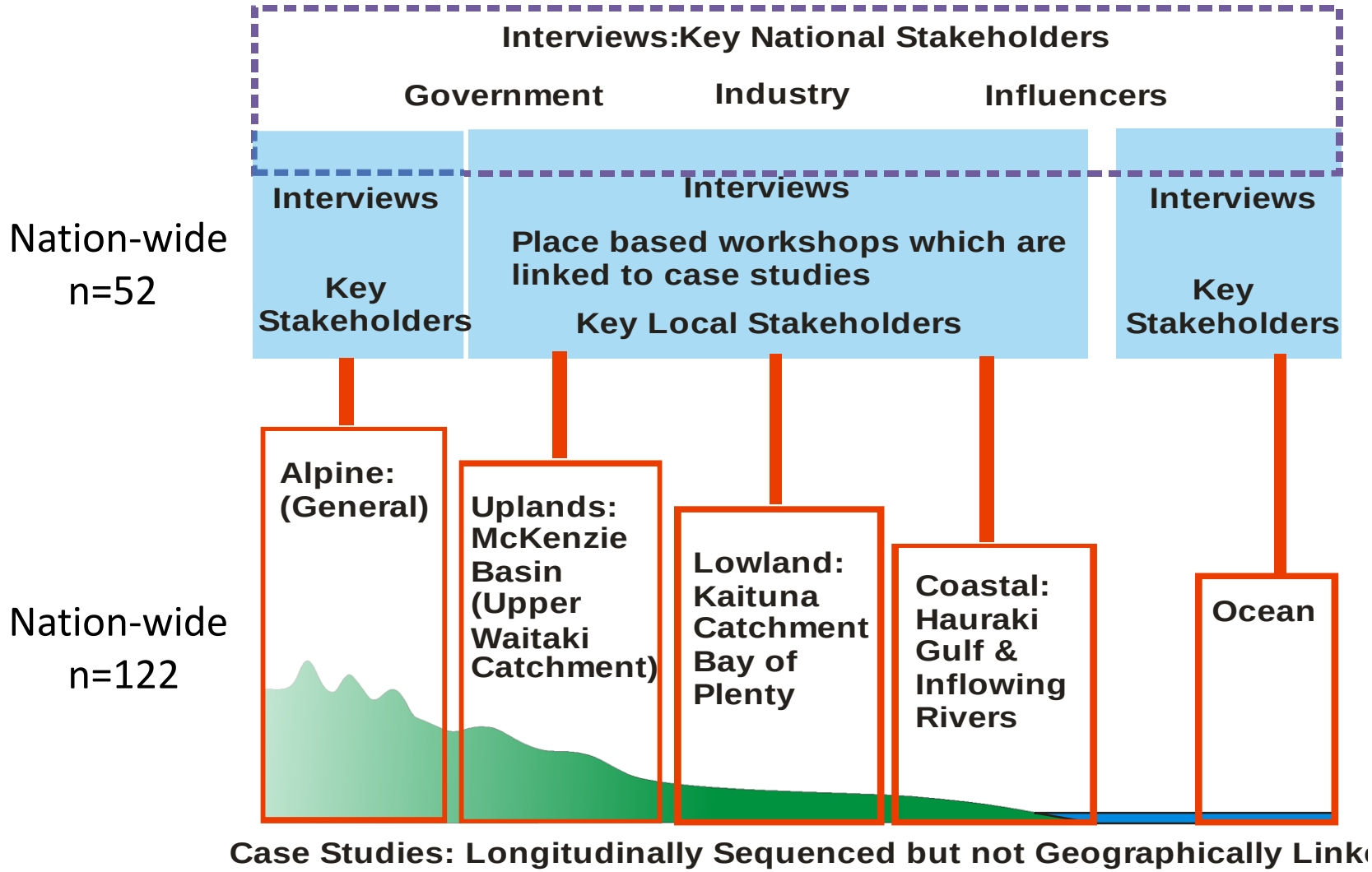
HOW?

Working with stakeholders to co-create new knowledge.

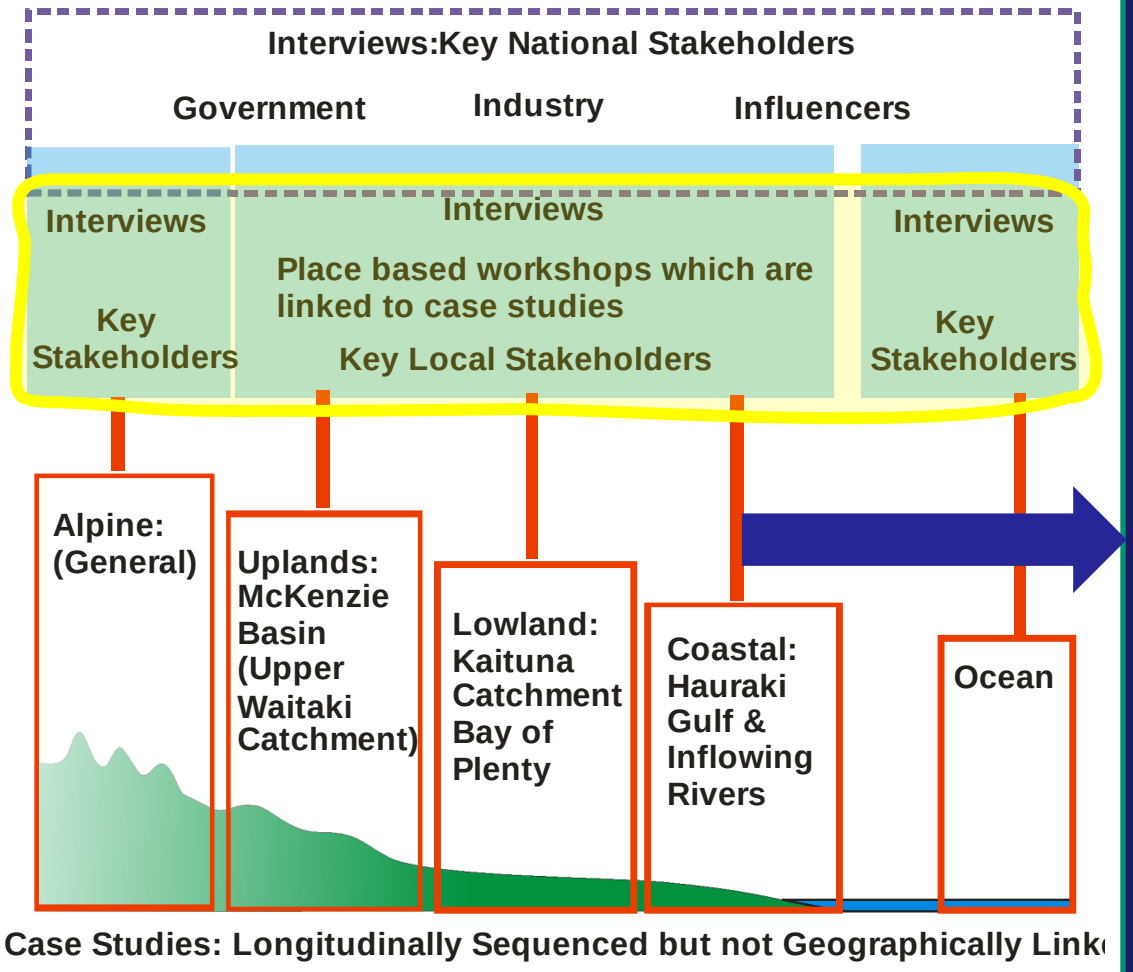
FRAMING ADAPTATION DECISIONS



RA4 STRUCTURE AND SCOPE



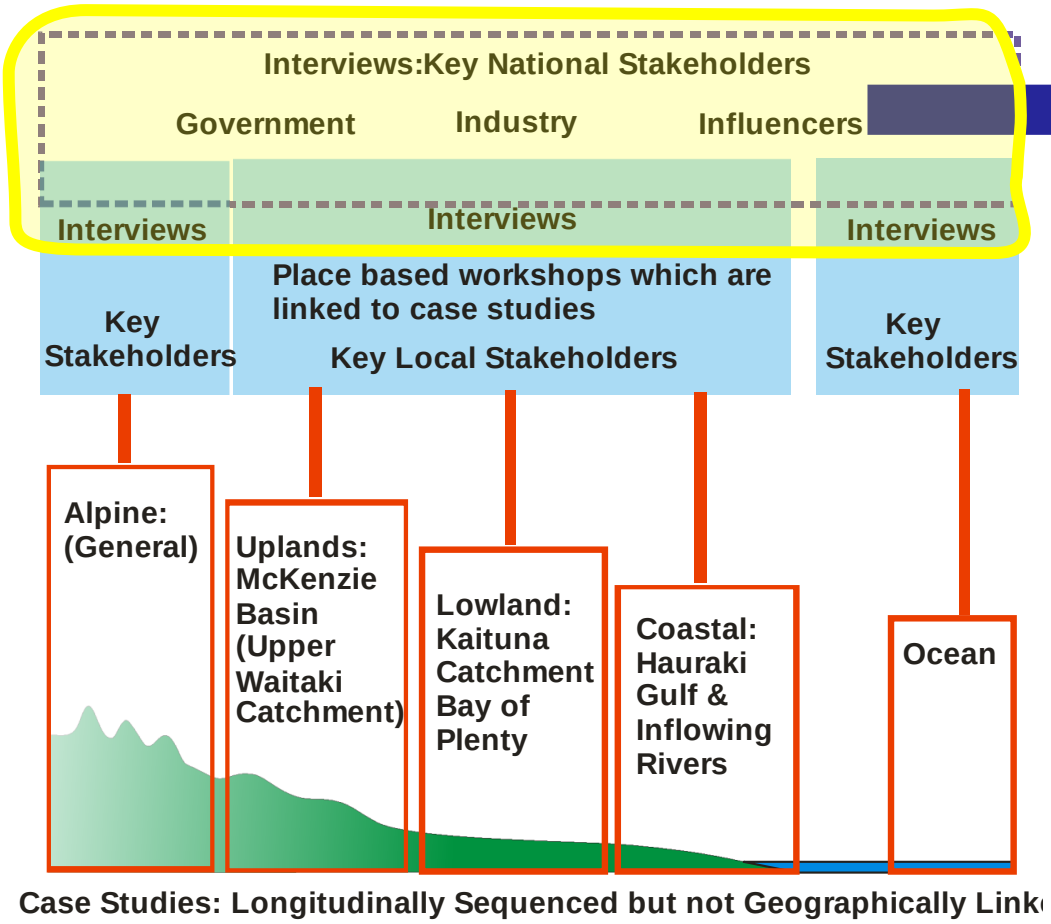
RA4 STRUCTURE AND SCOPE



Involved diverse groups of participants

- What is CCII & Research plans
- Alignment with local interests
- Locate local impacts and implications on aerial photos

RA4 STRUCTURE AND SCOPE

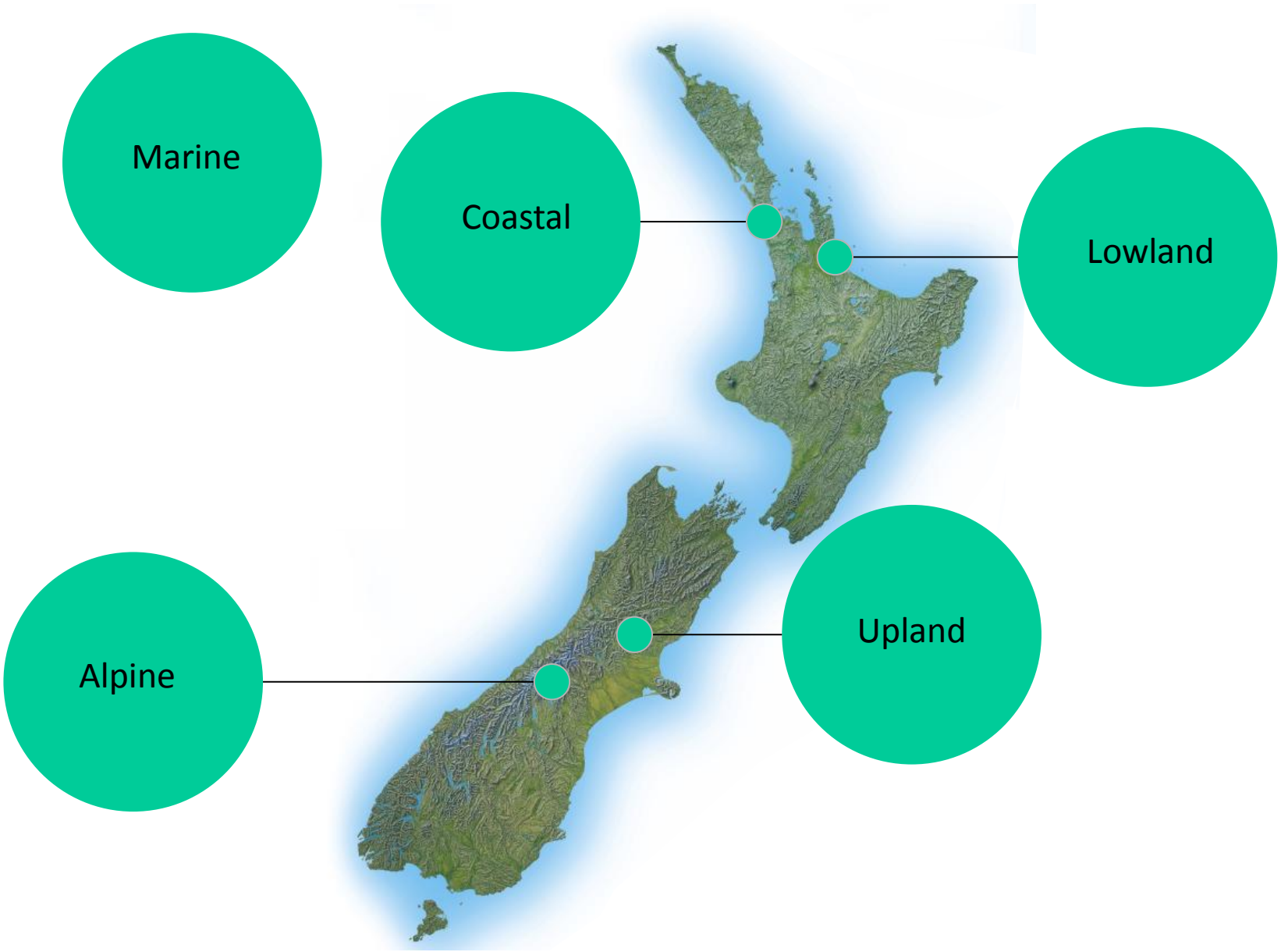


Current practice

- What climate parameters are crucial to your activities?
- How does climate affect your activities?
- What drives your decision making?
- What climate information do you need and in what form?

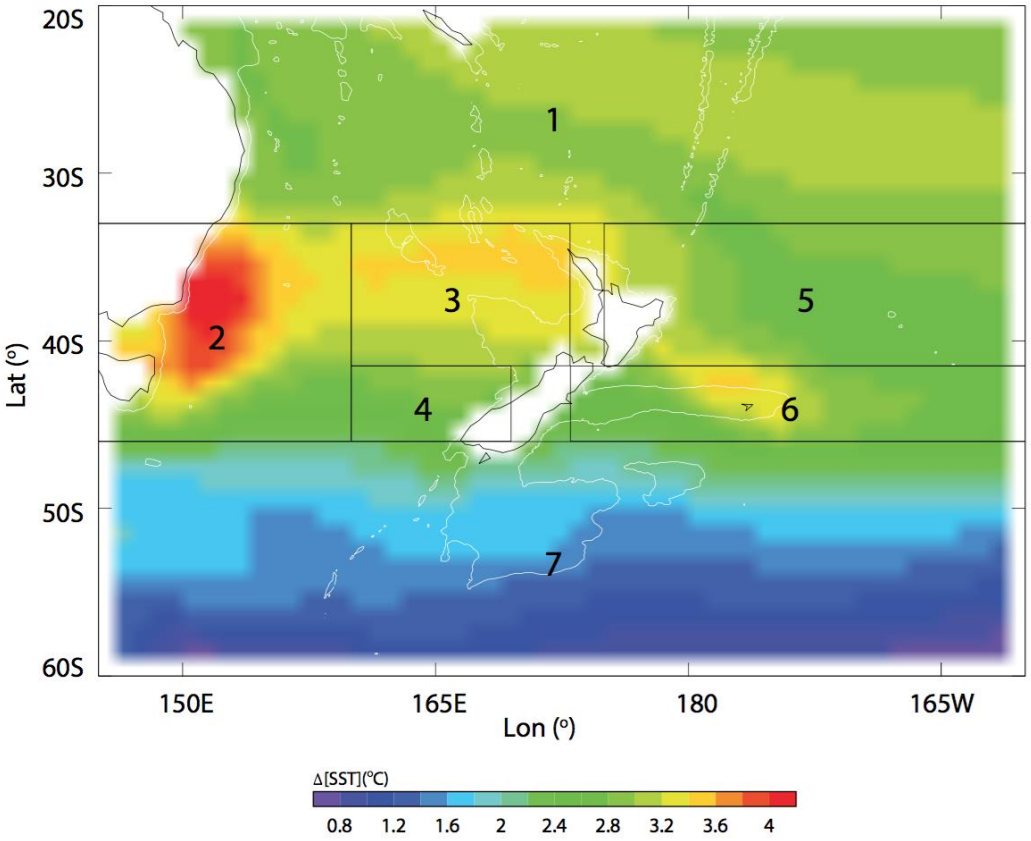
Future focus

- How is risk addressed?
- What is your capability?
- What would you do differently under changing climate conditions?
- What decisions will be affected by changing climate?


Marine
Coastal
Lowland
Alpine
Upland

Marine
Coastal
Lowland
Upland
Alpine

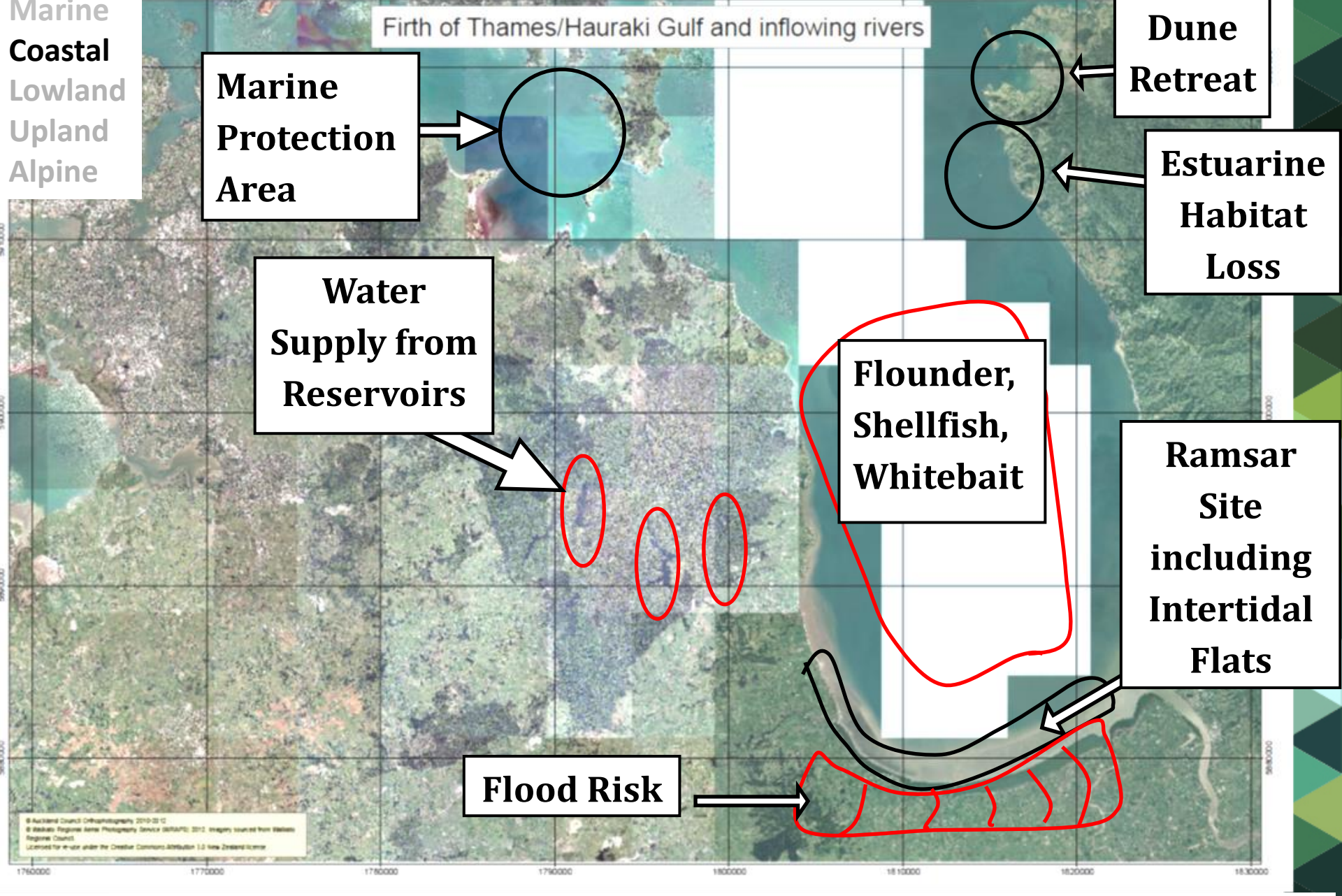
Projected change in sea surface temperatures for the 21st Century under RCP 8.5



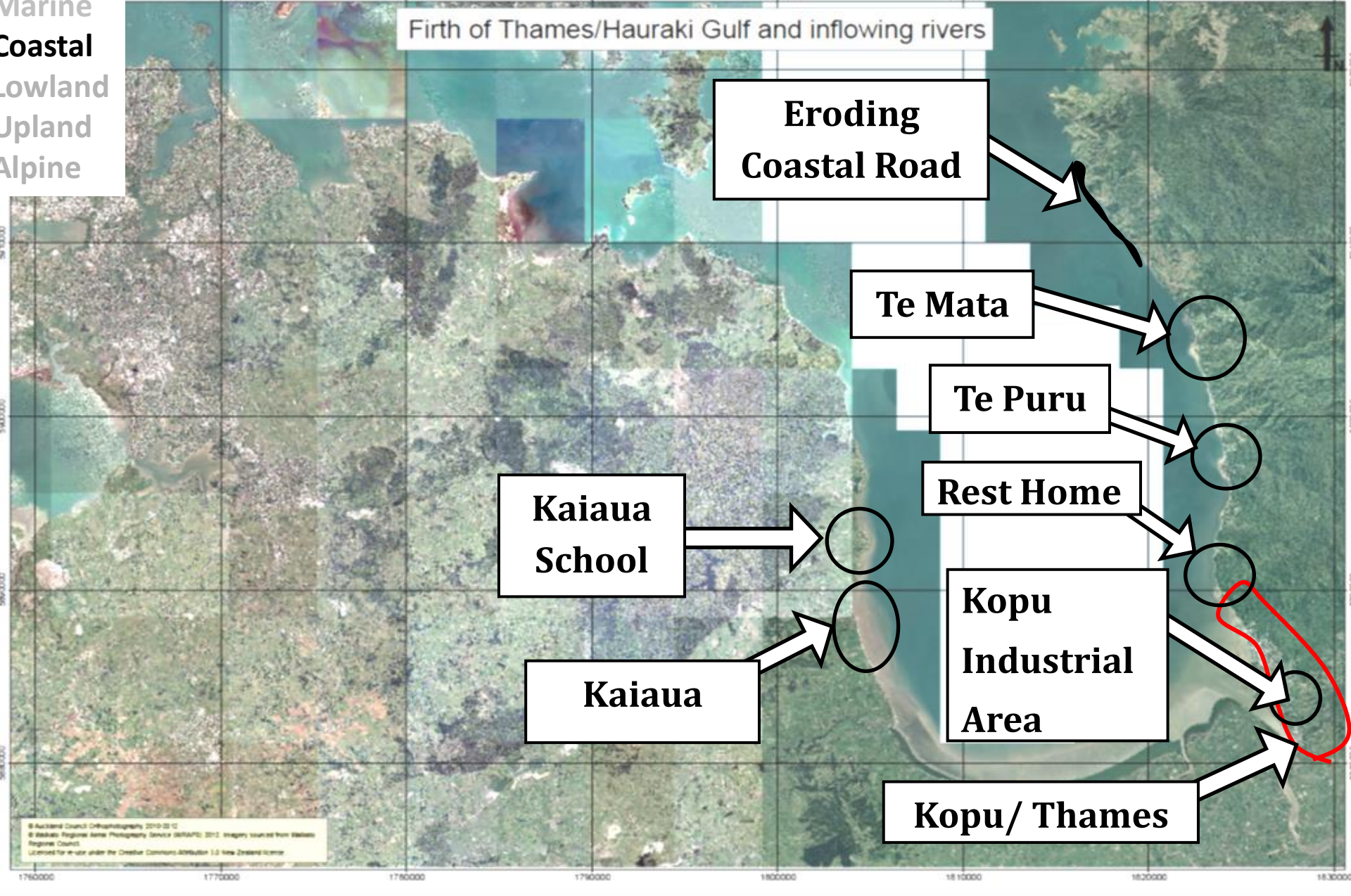
Regional variation of climate change impacts needs to be considered in management and policy decisions.

Sub-antarctic waters south of 50°S and the eastern Chatham Rise, which support important fisheries, and Subtropical waters north-east of NZ amongst the most sensitive to climate change.

Law et al. (NIWA, 2016)

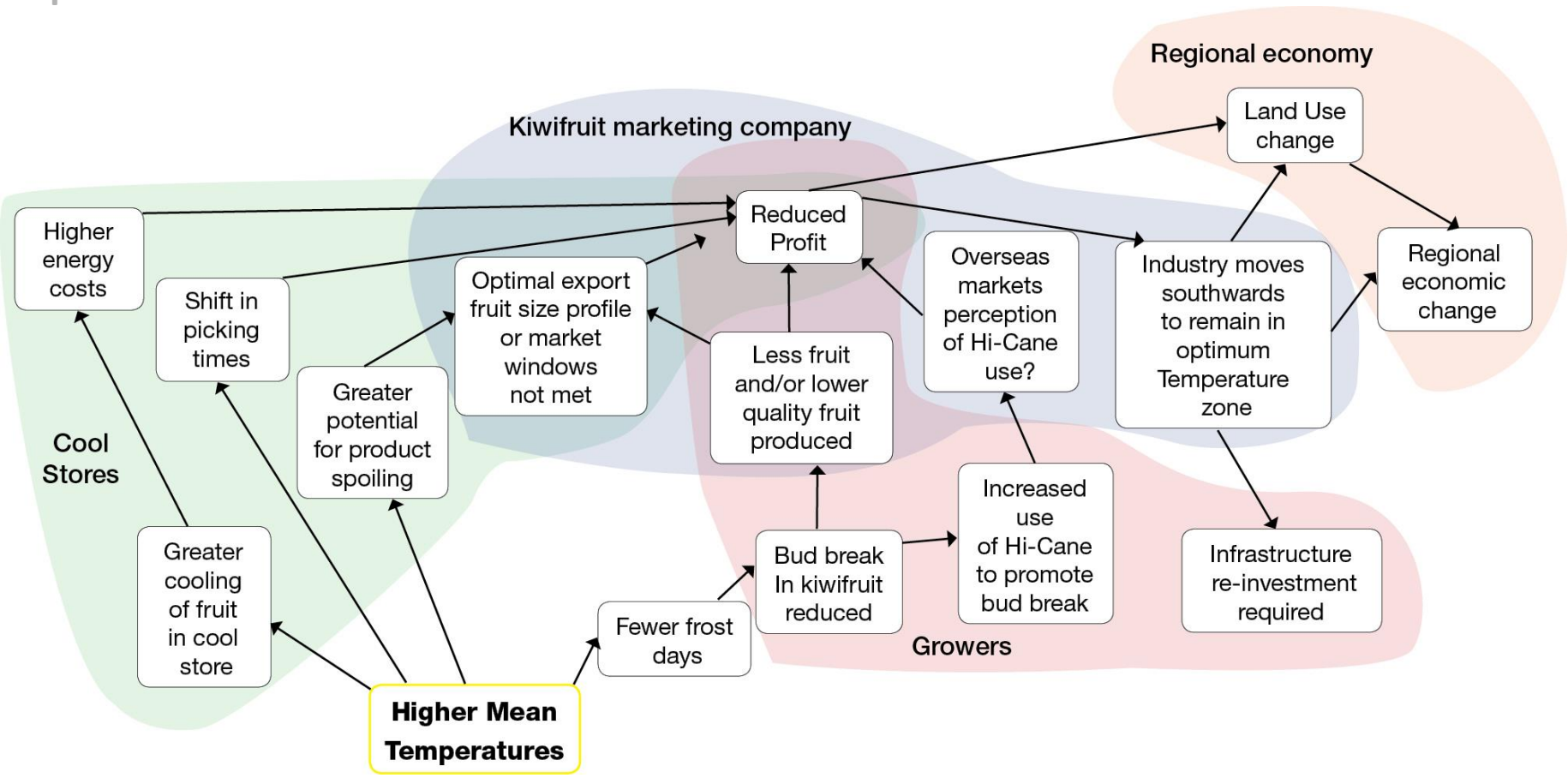


VULNERABLE ECOSYSTEMS AND ENVIRONMENTAL IMPACTS

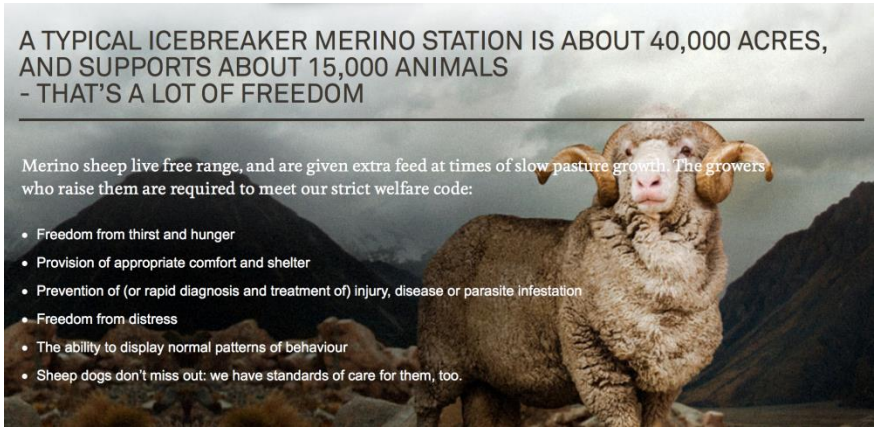


VULNERABLE COASTAL INFRASTRUCTURE

Marine
Coastal
Lowland
Upland



Marine
Coastal
Lowland
Upland
Alpine



Industry has strong strategic decision-making culture based on branding fine wool: entirely dependent on a particular climate regime.

- Cold
- Cold
- Cold

"You tend to get more variation [in wool quality] in a season where one comes out of a drought and then hit a spring and get a big flush of feed, so the feed levels go up and that can impact on tensile strength, so how sound the fibre is…" [Merino industry respondent]

Variability, not extremes affect wool quality:

Italian suit vs. industrial carpet

Marine
Coastal
Lowland
Upland
Alpine

Hon Dr Nick Smith

Minister of Conservation

Media Statement

29 January 2014

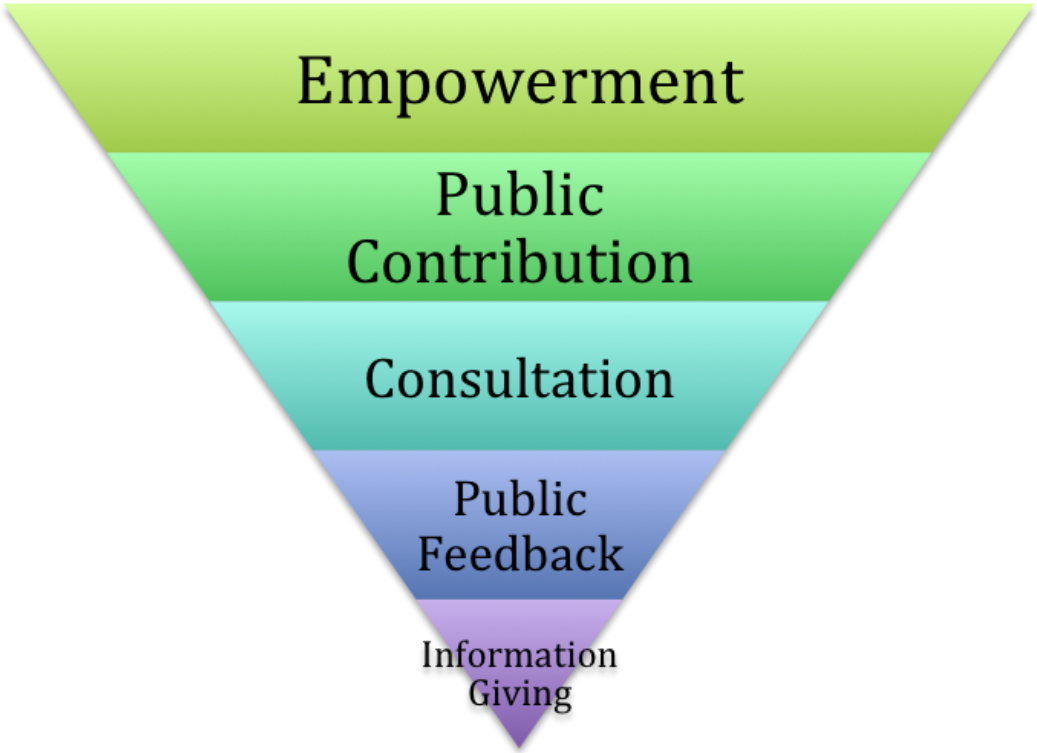
- This 'Battle for Our Birds' is going to cost about $21 million over the next five years, out of DOC's annual $335 million budget.
- It involves about 500,000 hectares of additional pest control this calendar year to respond to that beech mast. In addition to this, DOC will extend 1080 use by 50,000 hectares a year during the next five years.

Warmer temperatures increase the likelihood of 'mega mast' events [beech trees produce more seeds, resultant increase in pest populations]

Implications for biodiversity and pest management: changing mast-frequency will have significant financial and logistical planning implications.

CLIMATE CHANGE COMMUNICATION

1. Know your audience/stakeholders and get their attention.
2. Move from impacts to implications.
3. Consider risk and uncertainty.
4. Tap into power of group participation and social identity.



2015 Online Survey

- 200+ people contacted
- 61 responses
- 16 Questions
- Rank the importance of climate change impacts for decision making
- Rate the potential usefulness of climate change products/outputs (e.g. web resources, infographics, videos)

DATA DRIVEN STORYTELLING

greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao

Wellington City Council
Absolutely Positively Wellington
CLICK

PIONEERED BY THE ROCKEFELLER FOUNDATION
100 RESILIENT CITIES

rabid

STORM SURGE ON A RISING SEA

What have we already experienced?

2013 20–22 JUNE

$9.3 MILLION COST FOR WELLINGTON

$39.9m nationwide cost

"*Worst Storm*
since 1968's Wahine Storm"

PETONE
rail damage
and disruptions

ISLAND BAY
flood wall and
road damage

OWHIRO BAY
road damage
and flooding

2013 Winter Storm brought strong winds and high waves damaging coastal areas and infrastucture.

STORM SURGE ON A RISING SEA

What can we expect in the future?

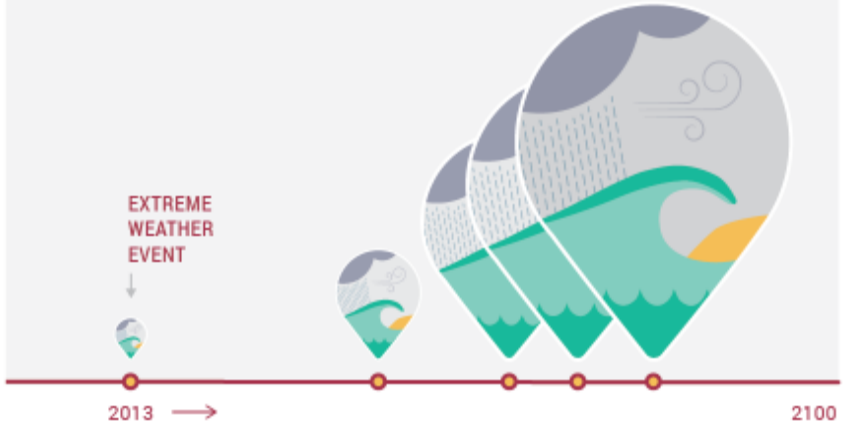
CLIMATE CHANGE

SHIFTS

WEATHER EXTREMES

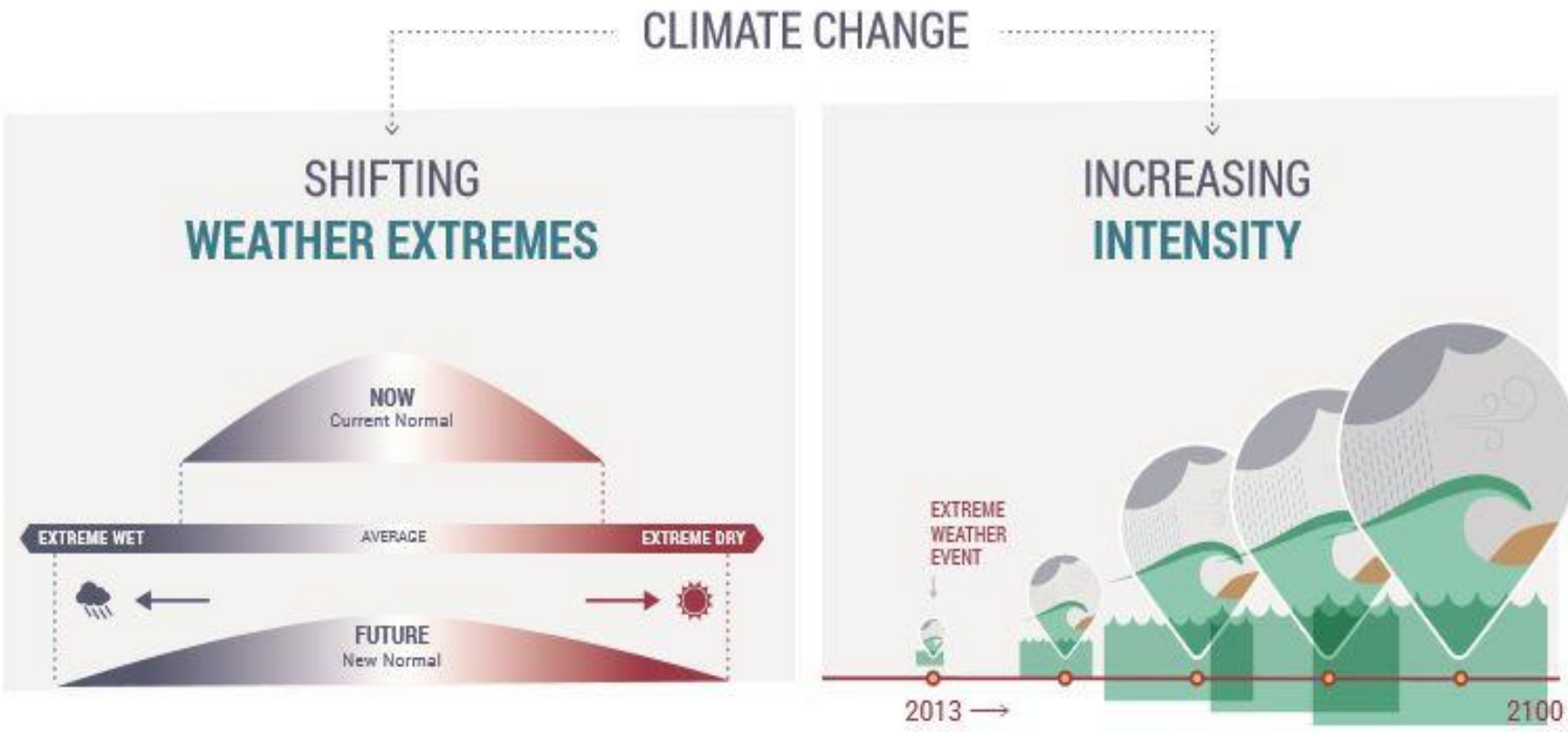
INCREASES

INTENSITY & FREQUENCY



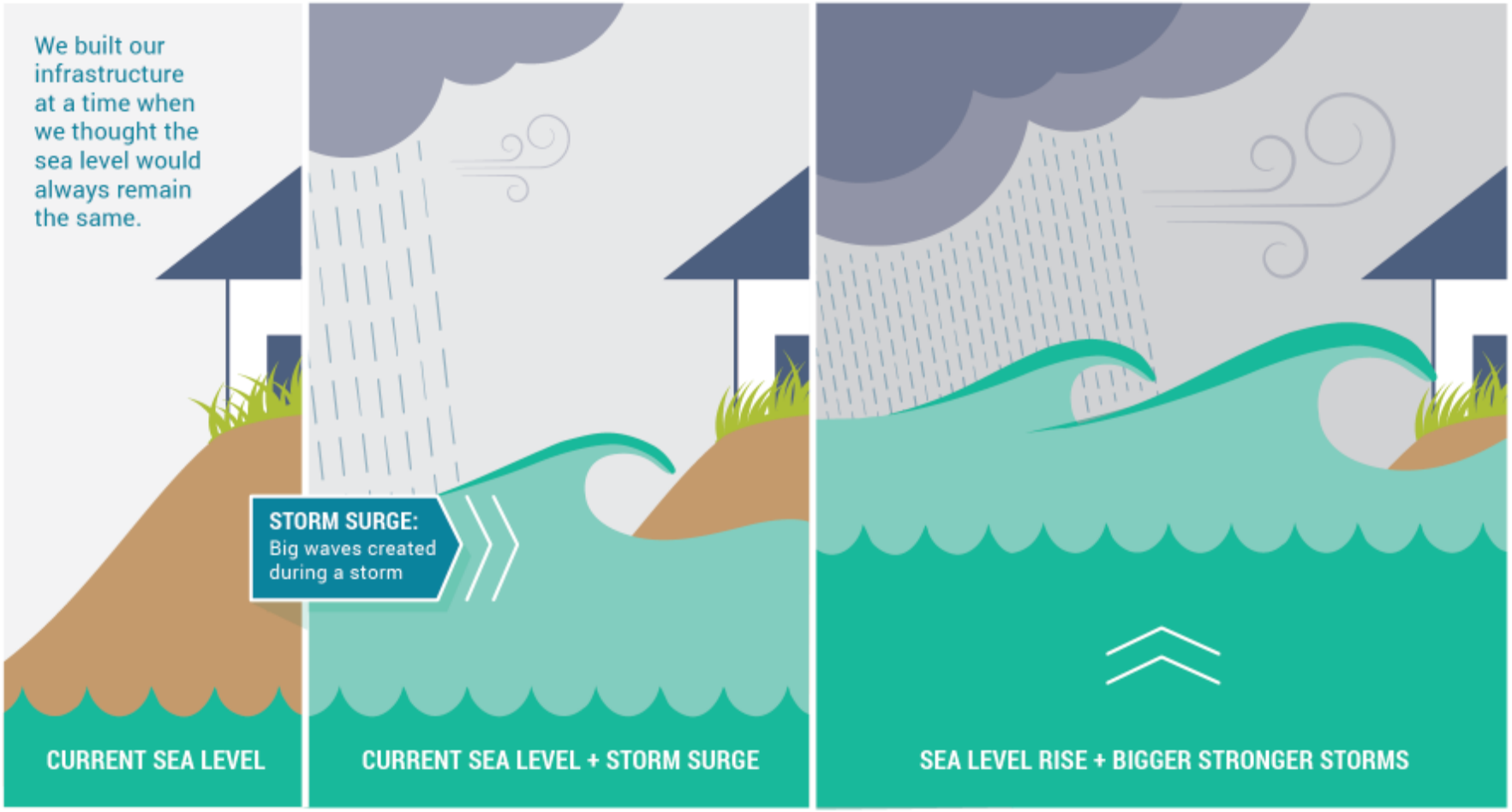
Climate Change will mean **bigger storms more often.**

STORM TIDE ON A RISING SEA



STORM SURGE ON A RISING SEA

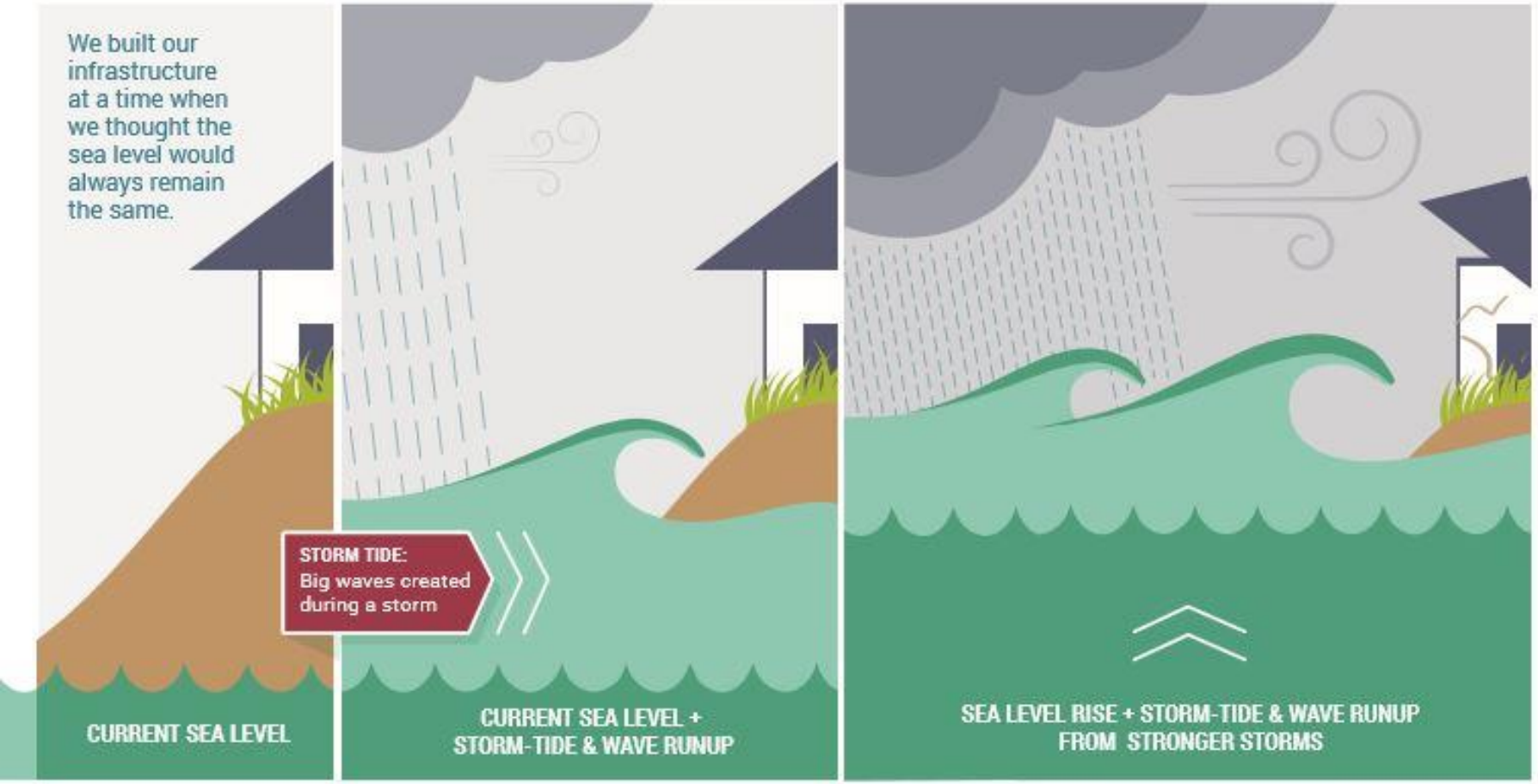
What does this mean for coastal areas?



Rising sea-levels and bigger storms makes coastal areas vulnerable.

STORM TIDE ON A RISING SEA

What does this mean for coastal areas?



Rising sea-levels and bigger storms threatens coastal areas.

STORM SURGE ON A RISING SEA

What are the projected impacts for Wellington?

Fresh Water Affected

Drainage Affected

Rail line Damage

Road Flooding

Beach Erosion

Property Damage

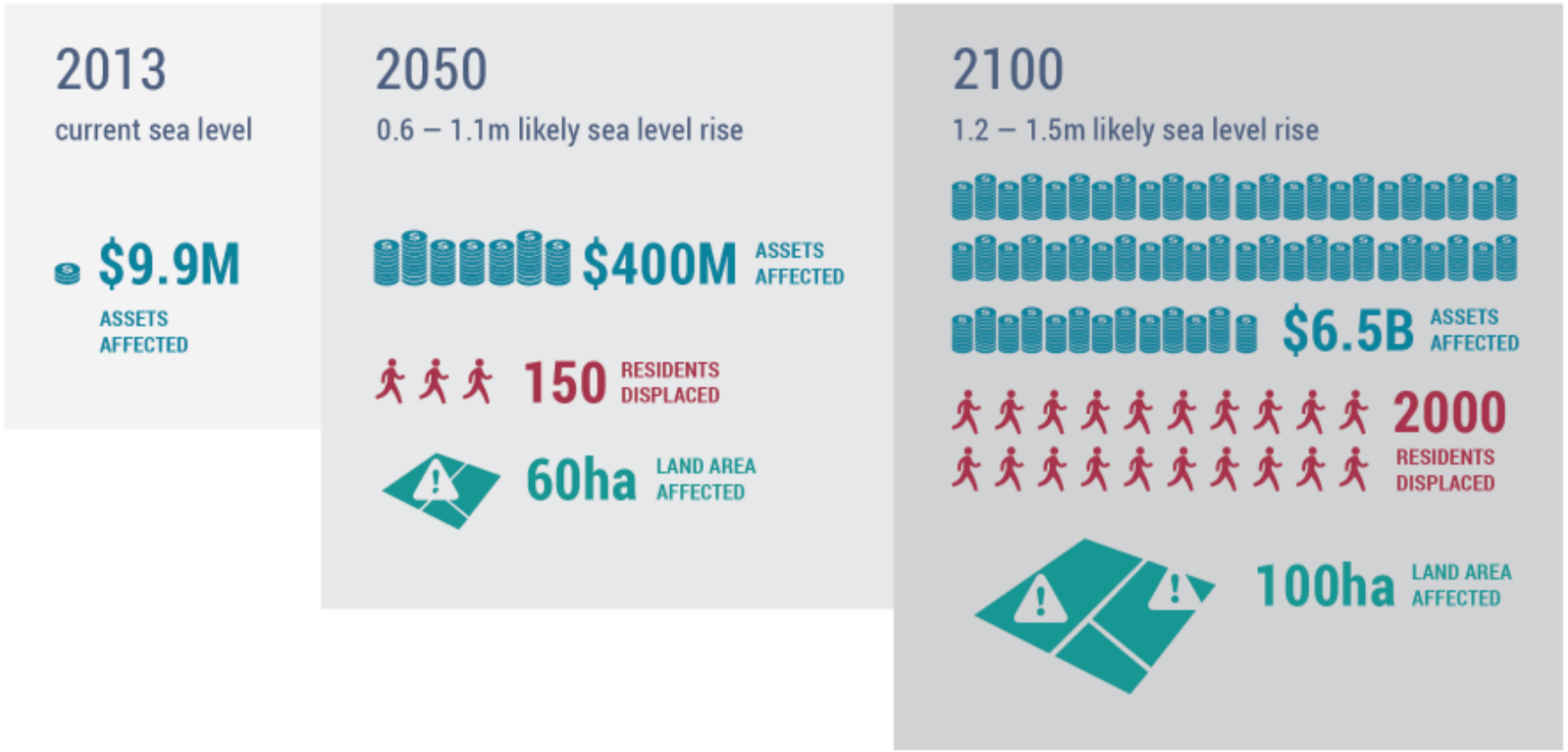
Wetland Damage

Port Damage

Increasing damage to property, infrastructure and the economy is likely.

STORM SURGE ON A RISING SEA

What are the estimated costs for Wellington?



Increasing damage to property, infrastructure and the economy is likely.

OUTCOMES

- Creating new links
  - Strengthening existing ones
- Information dissemination
- Creating more interactions and conversations between social scientists and physical process scientists
- Fostering a community of practice
- Building capacity
- Starting new conversations
  - Improving quality and quantity of data

KEY FINDINGS AT THE NATIONAL SCALE

Implications of climate change

- Governance and institutions
- Decision making
- Climate change information
- Capacity and capability

Barriers to decisions making

Critical leverage points

GOVERNANCE (RULES AND ORGANISATIONS)

Fragmented - between organisations and within organisations

Will make it difficult to response to multiple impacts & implications of climate change

Policy settings keep changing

The rules of the game change, its hard to know how to play and difficult to plan long term

Economics (and present cost) dominates

Long term investments are passed over in favour of short term ones

DECISION MAKING

Different types of decisions and different drivers

Public Sector:	Private Sector	Influencers
Regulation & Functions	Production focus Economic incentives	Issue or Sector based

Timeframe of decision

Longer timeframes	2-5 yrs	1-5 yrs

Coping with uncertainty

Issue focused, static	Issue focused, static	Often not considered

Changes to decision making is occurring

INFORMATION

1. Understanding future climate change risk

Long term trends , interactions and interdependencies bio-diversity and bio-security challenges, pollinators, plant hybridisation, mangroves ecosystem change, hydrology changes to pathogens and disease water quality …….

Known unknowns - unknown unknowns - interaction interdependencies

2. Implications of CC

Lack a systems perspective – fragmented, focused on primary sector, lacks social and economic aspects, freshwater, urban systems e.g. storm-water wastewater implications

3. Adaptation decision-making

Making adaptation decisions – few participants had gone this far

CAPACITY AND CAPABILITY

Processes in place to manage risk currently (formal, semi –formal experienced based

Confidence to respond to issues – confident in ability to deal with most known issues, not the less known. Not equipped to deal with changing risk

Ability to access resources in-house, in-house/contractors, practical skills critical

Challenges

- **Changing personal networks (people move)**
- **Rely on external knowledge/skills**
- **Low priority**
- **Lacking critical skills (hydrology, integrative)**
- **Fragmented groups**
- **Issues in translation (science to prac**tice)

BARRIERS

Five kinds of barriers emerged as influencing decision-making:

- Governance (e.g. leadership)
- Policy (expertise and experience)
- Uncertainty (local data?)
- Resources (competition for resources)
- Psychosocial factors (e.g. perceptions of time; contested nature of climate change)
- Political commitment and policy persistence (presentist bias)

Governance and psychosocial barriers are the biggest impediments to effective decision-making on climate change impacts and implications

OPPORTUNITIES

More linked-up thinking - councils, business influencers

Information sharing – knowledge brokers; role of influencers

Innovative solutions e.g. new land uses

Smart tools for adaptation— simple and fast models, adaptive assessment tools

Greater attention to local impacts and values

Working with financial institutions for long term planning

CRITICAL LEVERAGE POINTS

- Community engagement
  - Shift understanding of changing risk profiles
  - Understanding of community values
- Private sector “leading by example”
- Role of finance and insurance sectors
- A focus on consequences an path dependency of today’s decisions
- A long-term adaptive focus with tools and measures

CONCLUSIONS AND RECOMMENDATIONS

- Impacts will compound and cascade
- New institutions and measures needed to address changing climate risk profiles that occur concurrently and compound
- Funding measures
- Analytical tools for costing the future
- Measures that can address short-term and long-term decisions that do not create path dependency and future disruptive costs

CONCLUSIONS AND RECOMMENDATIONS (cont'd)

- Need more adequate measures to motivate adaptation to climate change impacts
- The effect of climate change on the management of pests and diseases and the impact on the integrity of our biodiversity
- Capability and capacity to conduct multi-disciplinary research programmes that address the climate change challenges

RESEARCH LINKAGES AND NEXT STEPS

- Impacts and implications research is being extended through
  - Deep South Challenge (cascading impacts)
  - Resilience Challenge (Governance, Edge, Rural)

- MPI Sustainable Land Management and Climate Change programme (SLMACC)

- RSNZ Marsden Fund

- Visualisation to communicate risk and impacts

- Development of decision making tools and measures

- Adaptation Technical Working Group

Thank – you

LANDCARE RESEARCH
MANAAKI WHENUA