

**Mā te haumaru ō nga puna wai ō  
Rākaihautū ka ora mo ake tonu:  
Increasing flood resilience across Aotearoa**



Uncertainty Road Show

Emily Lane

24 May 2022

# Flooding – NZ's most common and consistently damaging natural hazard



November 2021  
Tai Rāwhiti  
rnz.co.nz LDR / Alice Angeloni



Edgecumbe April 2017



New Plymouth November 25 2020  
NPDC Twitter



Waiho, March 2019

Photo / Wayne Costello, DOC

# Flooding – NZ's most common and consistently damaging natural hazard



Northland, July 2020



Canterbury May 2021

Stacy Squires/Stuff



Westport February 2022



CENTRAL



- Legislation: RMA, CDEM Act, Building Act, Soil Conservation and Rivers Control Act
- MfE: Guidance for natural hazards
- NEMA: Emergency and post-emergency recovery phases
- MPI: Coordinate rural community after large floods
- Central Government: may provide money to councils to help after large floods
- DIA: Currently coordinating a Community Resilience Work Programme on flooding

REGIONAL



- Manage rivers and catchments, control land use
- Provide information on where flooding occurs
- Operate/maintain flood defence systems
- River flows, lake levels, previous floods
- Issue flood warnings

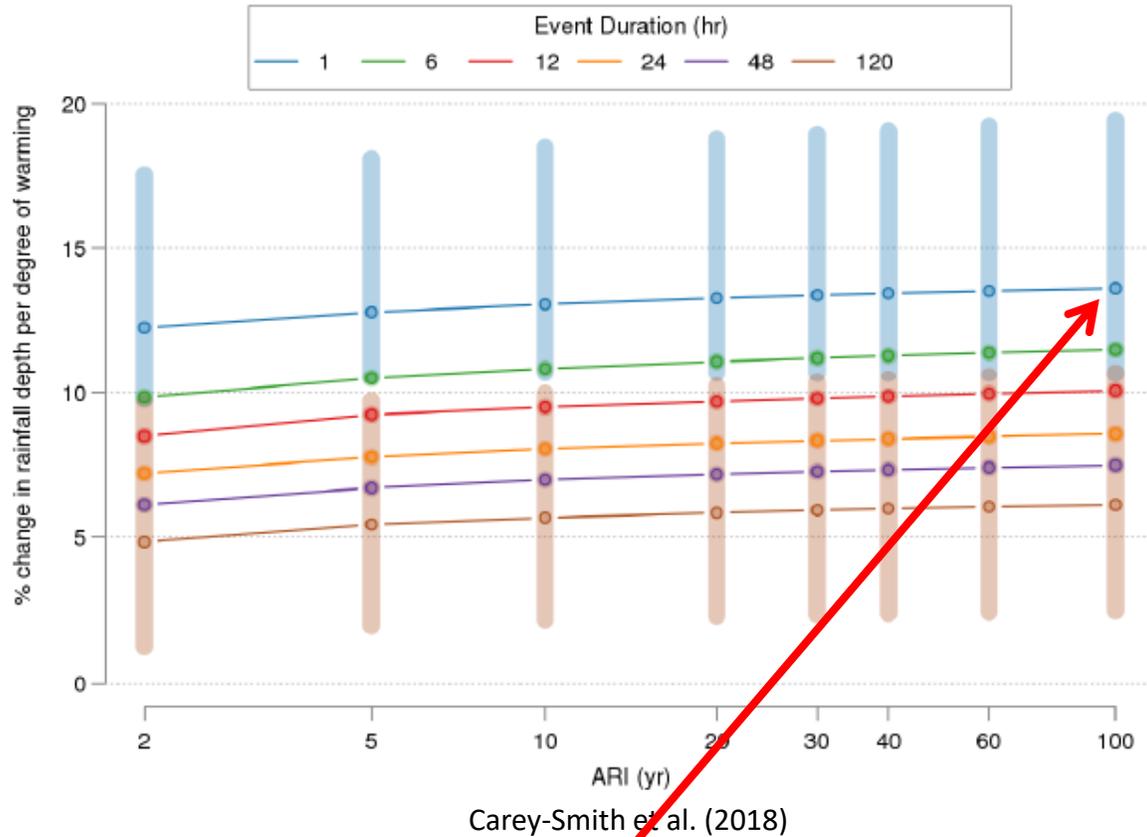
LOCAL



- Control building and effects of land use (e.g. Subdivisions, floor height etc)
- Provide flood information via Hazard Register or District/City Plan
- Coordinate with emergency services during events and assist in recovery

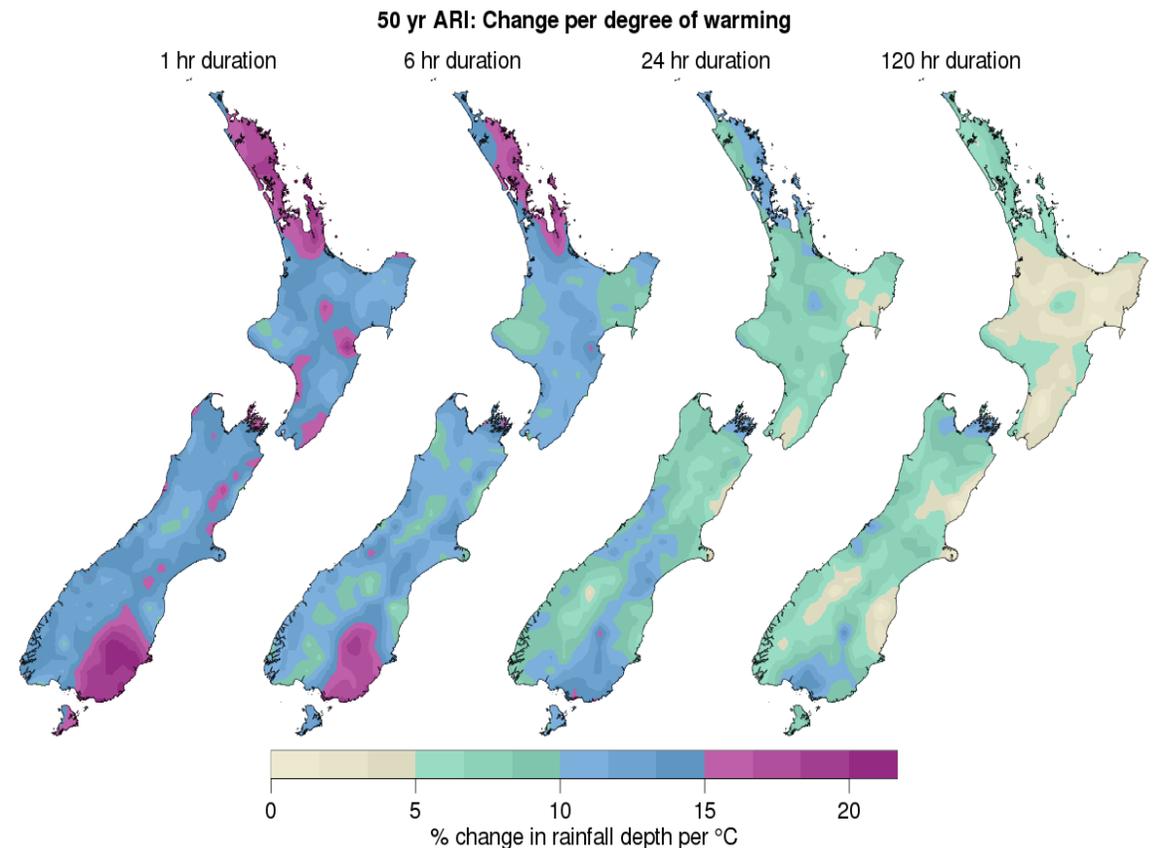
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# Climate Change: Changes to extreme rainfall

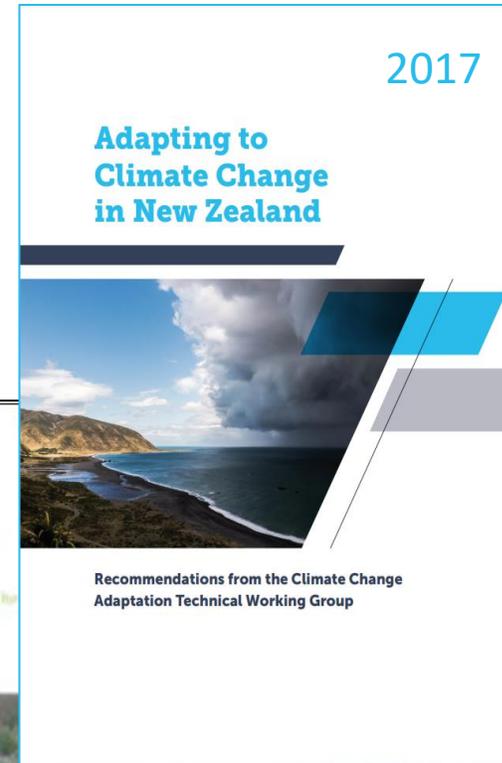
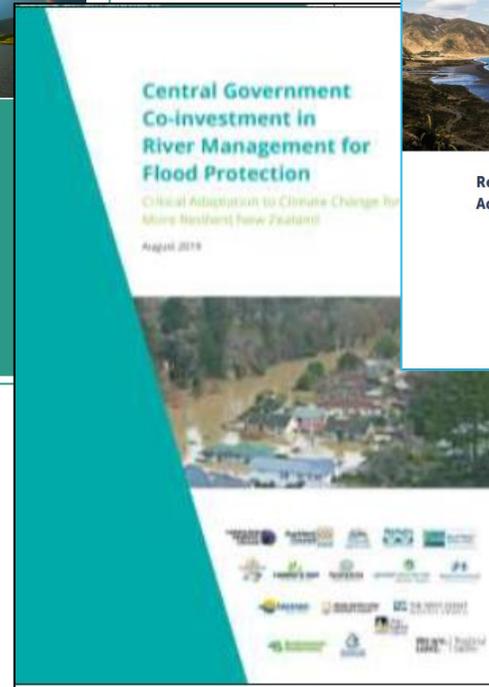
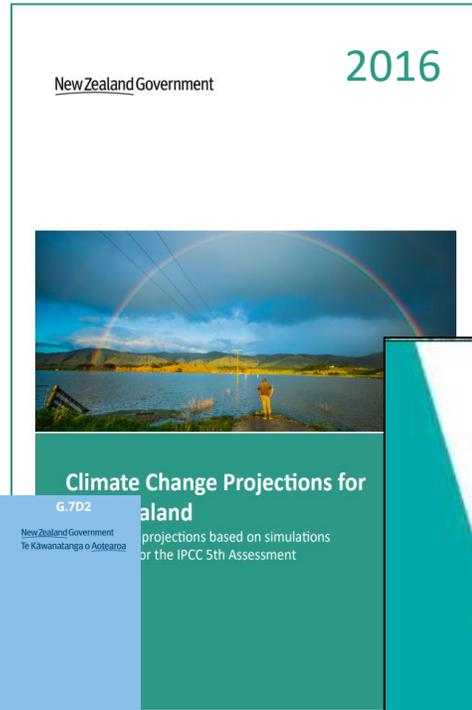
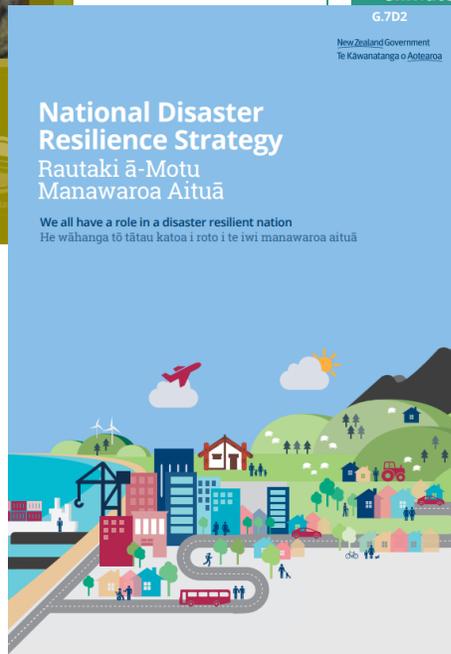
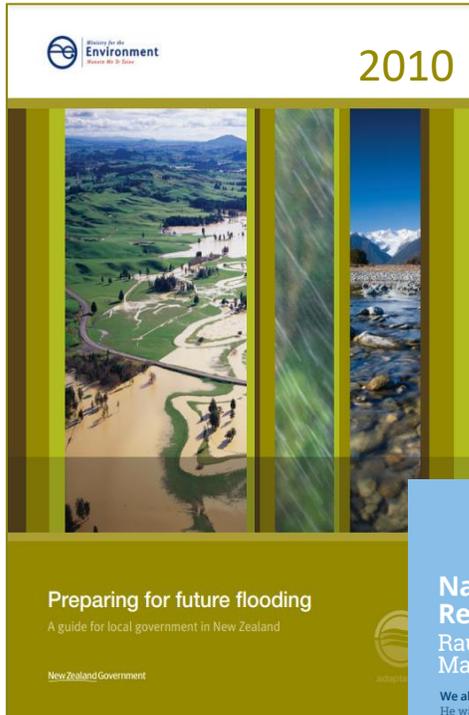


- E.g. 1-hour duration, 100-year return period = 14% increase in event depth per degree of warming
- Large range of model results

- Rainfall intensity will increase across NZ
- Shorter durations increase the most
- Events become more spatially concentrated - 'spikier'
- Larger increase with more warming
- Uncertainty around ex-tropical cyclone numbers, but increasing intensity



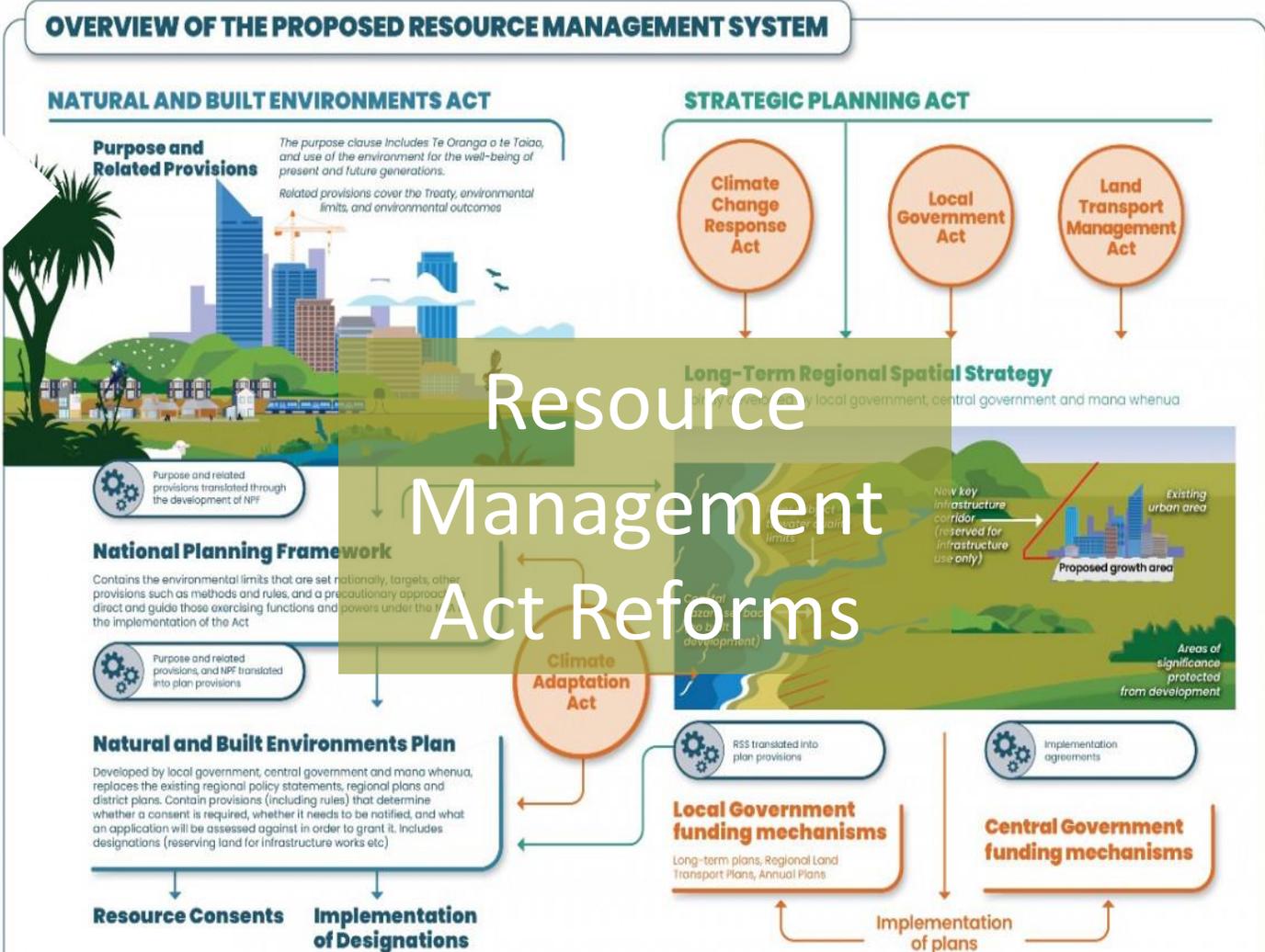
# Many responses...



**Mā te haumarū ō nga puna wai ō Rākahautū ka ora mo ake tonu:**  
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**Financial Sector (Climate-related Disclosures and Other Matters) Amendment Bill**  
 Government Bill  
 As reported from the committee of the whole House



**Resource Consents    Implementation of Designations**

A CALL FOR NATIONAL LEADERSHIP AND URGENT ACTION TO  
MEET THE FLOOD HAZARD RISKS ARISING FROM CLIMATE CHANGE

# Central Government Co-investment in Flood Protection Schemes

**\$1.5 billion urgently needed to protect New Zealanders from floods – investment support from government falling woefully short**

6 APRIL 2022



**Kia urutau, kia ora:  
Kia āhuarangi rite  
a Aotearoa**  
Adapt and thrive:  
Building a climate-  
resilient New Zealand

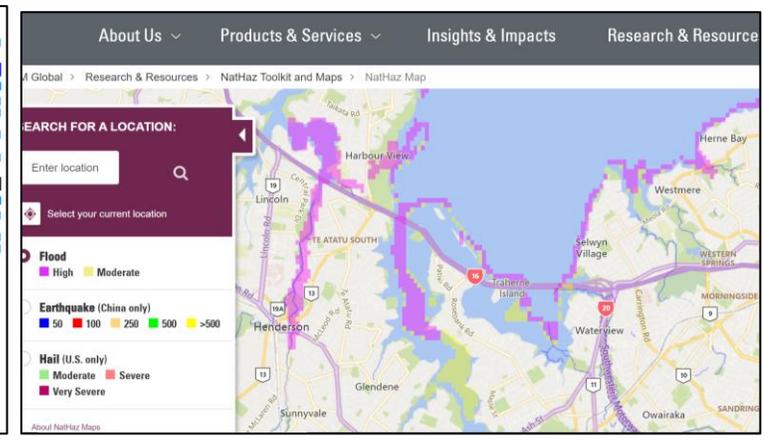
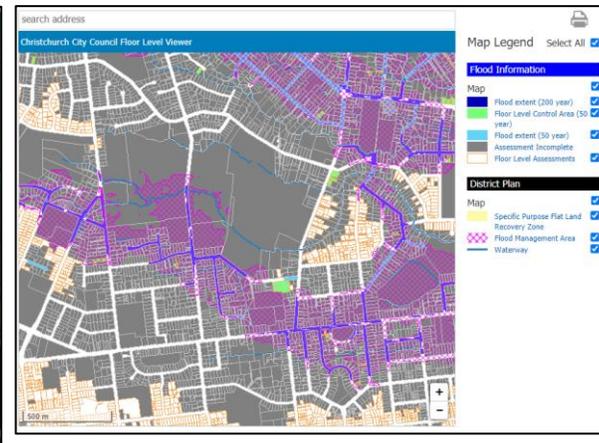
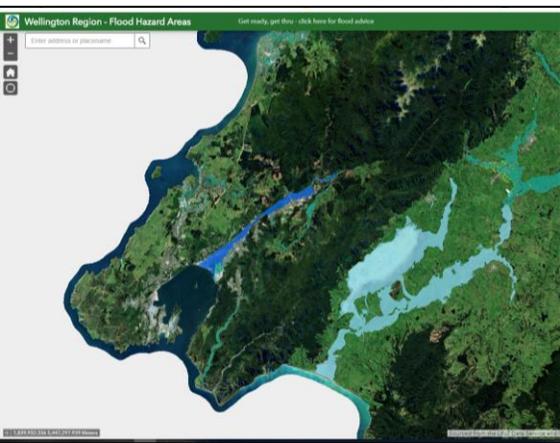
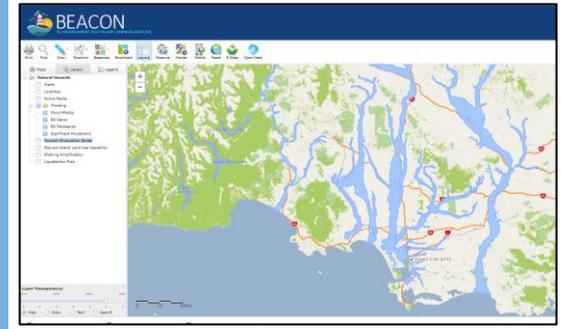
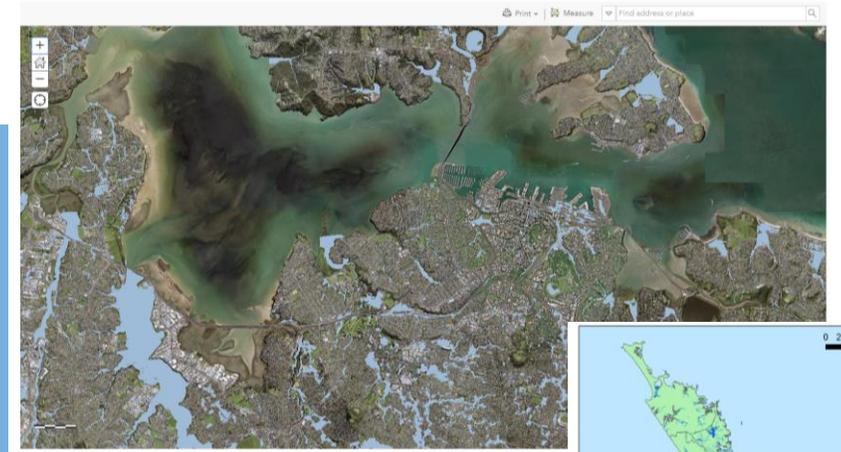
Draft national adaptation plan · Managed retreat

# This all requires good data...

Current flood hazard data has no consistency in terms of:

- Whether or not flood modelling is done
- AEP (Annual Exceedance Probability) modelled
- Resolution
- Methodology
- Climate change effects

Or it is behind a paywall for insurance companies



# MBIE Endeavour 5-year Research Programme:

## Reducing flood inundation hazard and risk

### Mā te haumarū ō ngā puna wai ō Rākaihautū, ka ora mo ake tonu

#### Overall aim: A more Flood-Resilient Aotearoa New Zealand

Produce an updateable nationally-consistent flood inundation hazard and risk assessment for current conditions and future scenarios under climate change.

Create a forum between science, iwi, policy-makers and stake-holders to ensure desired outcomes

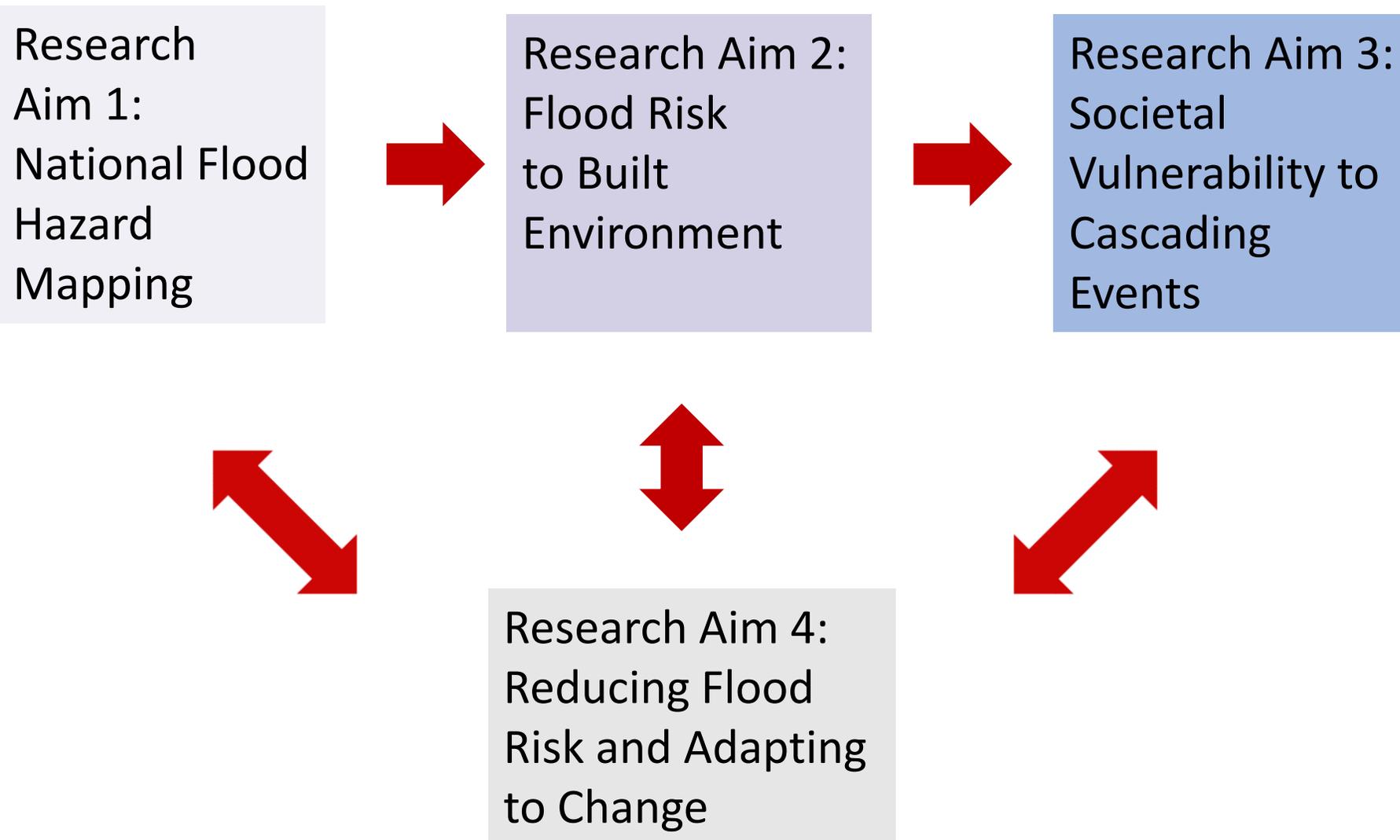
#### Why?

National screening tool:

- Identify where the flood hazard/risk are high – especially in rural areas where there may not currently be information.
- Identify where the flood hazard/risk may increase under climate change.
- Work with local and central government, iwi, stake-holders to determine how to use this information to increase resilience



Mā te haumarū ō ngā puna wai ō Rākaihautū ka ora mo ake tonu:  
Increasing flood resilience across Aotearoa



E rere kau mai te awa nui mai i te kāhui maunga ki Tangaroa, ko au te awa, ko te awa ko au.

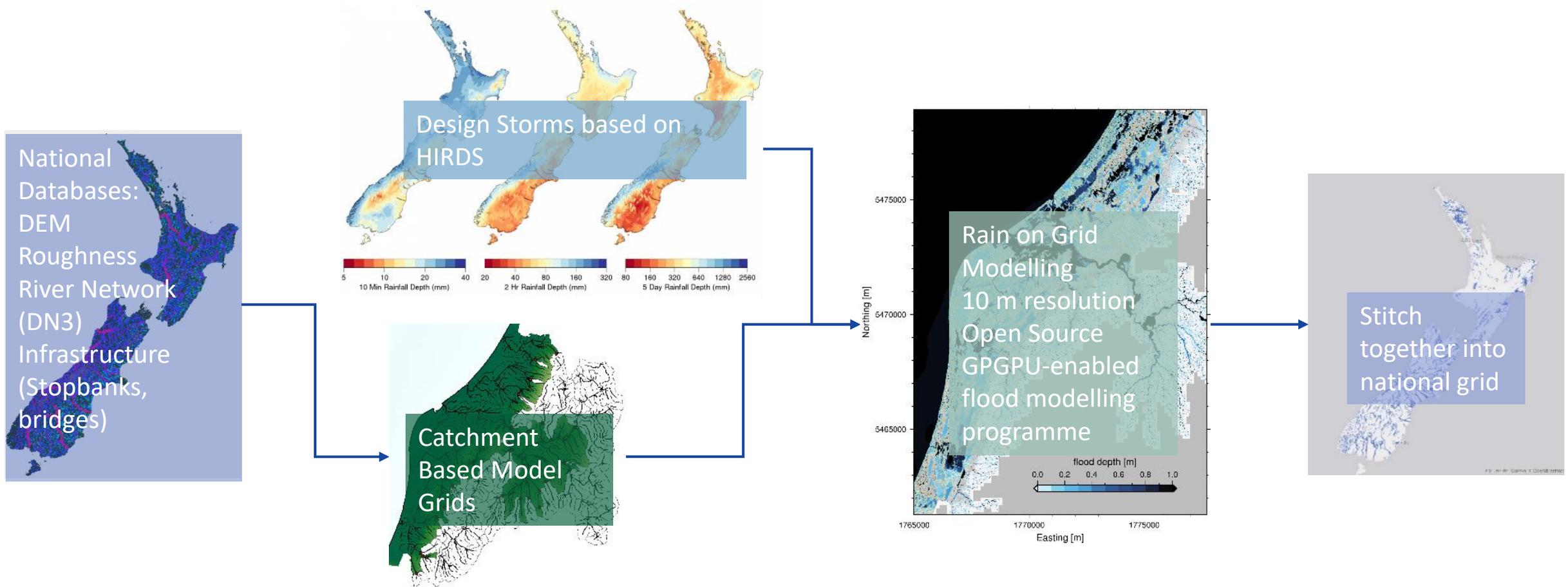
- Deep spiritual connection with the land and the rivers
- Different conceptions of risk:
  - wāhi tapu,
  - taonga species,
  - marae and other assets
- Kaupapa-Māori based solutions that enhance the mauri of the awa
- Ensuring iwi retain sovereignty of their data

- Working with the hapū of Wairewa Rūnanga Kāti Mako and Ngāti Irakehu
  - (Dr Benita Wakefield and Kaitiaki Advisory Group)
- Understanding knowledge of flooding from a Māori perspective
- Developing a climate change flooding strategy for the rūnanga following Te Tāhū o te Whāriki.
- More generally, developing a framework for flood risk and climate change for iwi and rūnanga across Aotearoa

Mō tātou, ā, mō kā uri ā muri ake nei

# RA1 – National Flood Mapping:

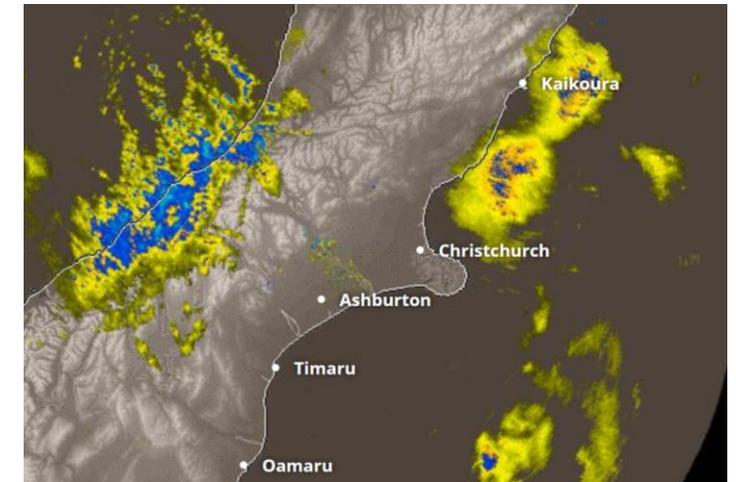
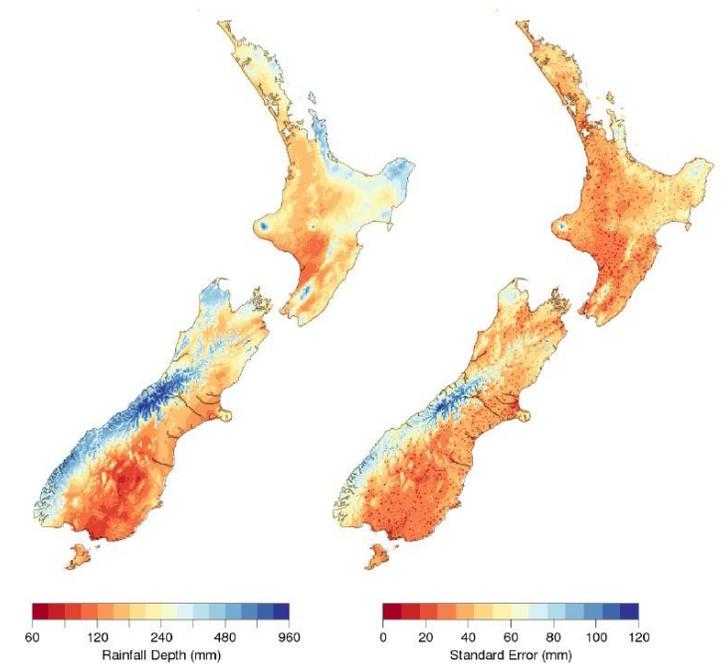
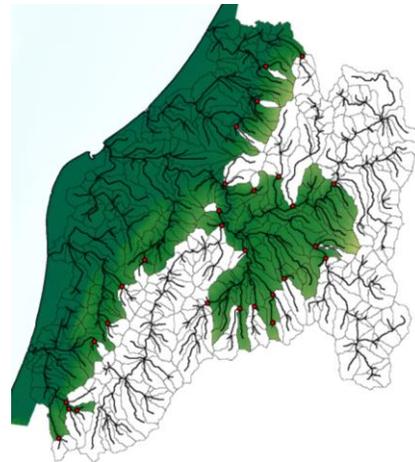
Create a semi-automated system and methodology for nationally consistent flood maps for a range of design storm events, including climate change impacts, validated against a database of historical floods.



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# RA1 – National Flood Mapping:

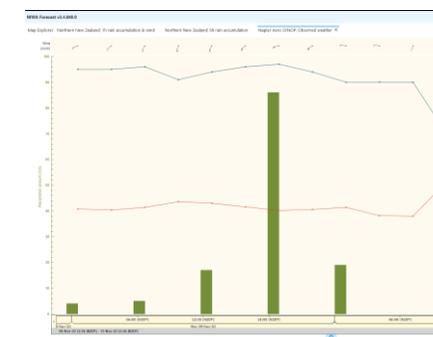
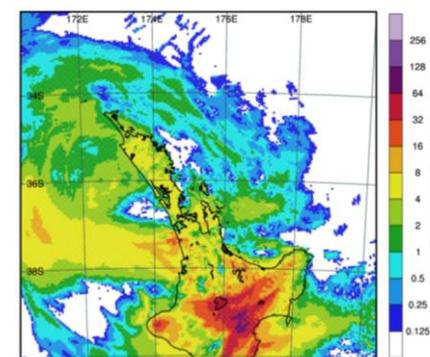
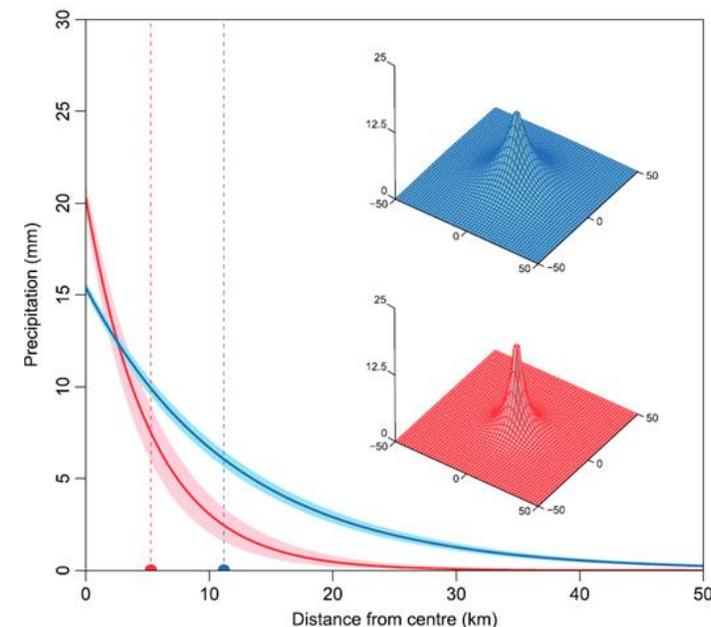
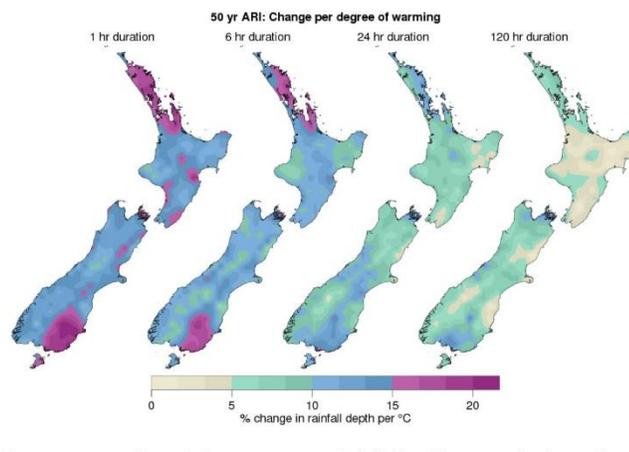
- Develop consistent nationwide design storm events based on improved HIRDS (High Intensity Rainfall Design System)
- Using rain radar observations and pattern recognition techniques to better represent the spatial and temporal patterns of rainfall.
- Rainfall in upper catchments will be converted to hydrographs using TopNet – a flow routing model
- Rainfall on the floodplain will directly force the flood model
- BG-Flood – open source GPGPU flood solver



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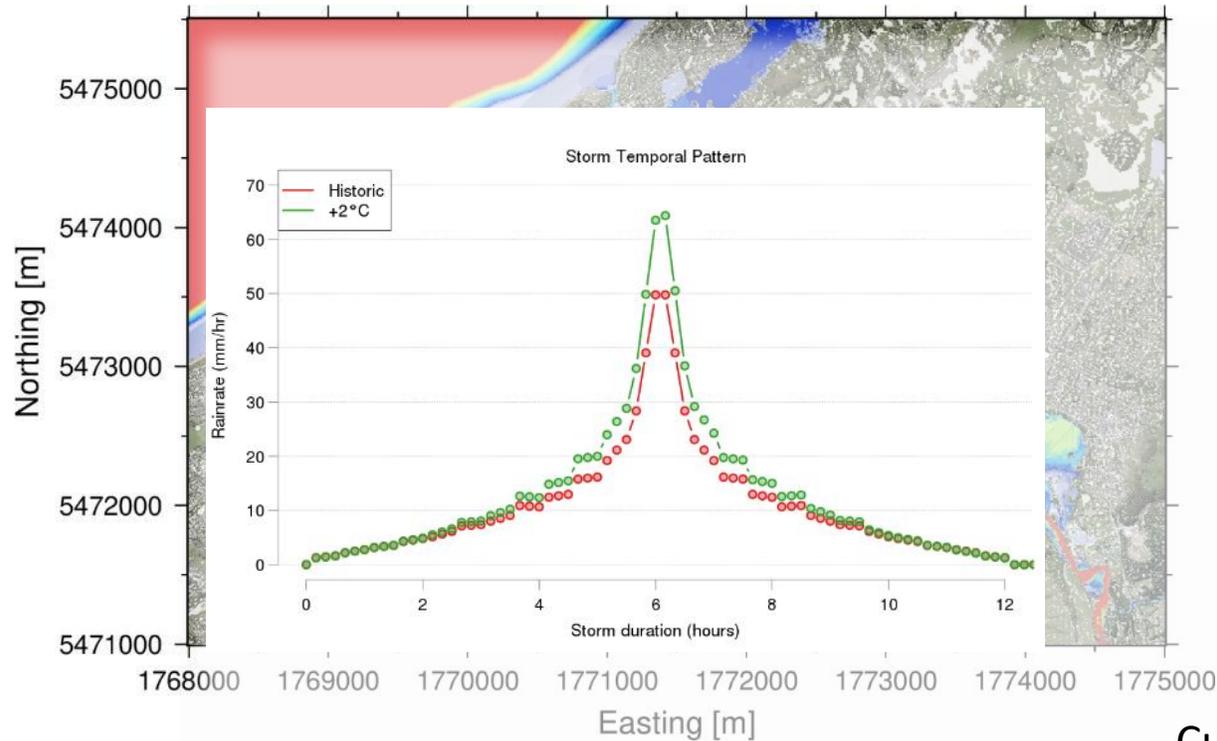
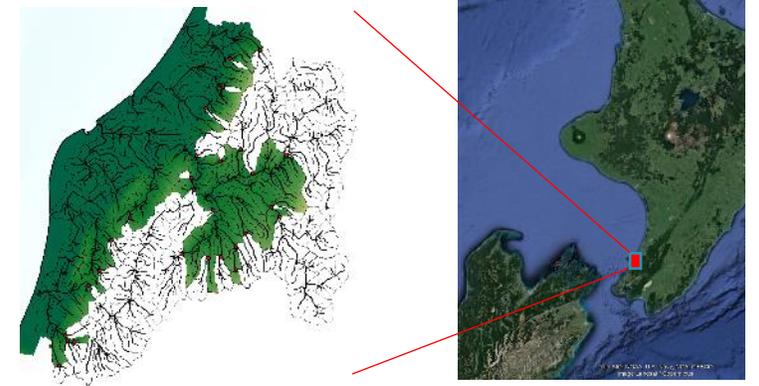
# RA1 – National Flood Mapping: Climate Change

- We live in a changing climate
- As temperatures increase, short intense rainfall events will become more frequent and ‘spikier’
- These will be especially problematic in urban areas
- Sea level rise exacerbates flooding in low-lying coastal regions (reduced drainage, increased groundwater level)
- We need to understand how these changes affect our flood hazard

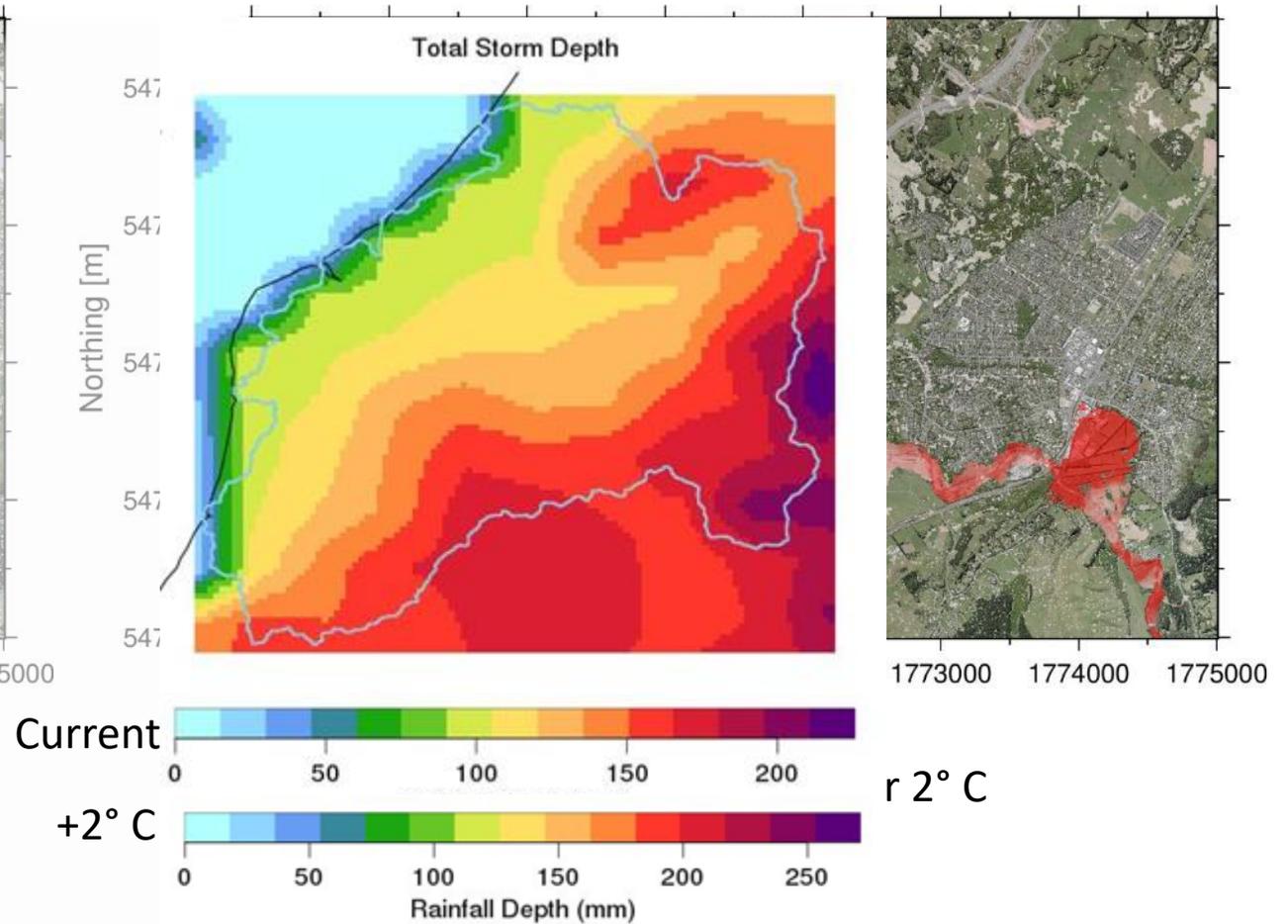


**Mā te haumarū ō nga puna wai ō Rākahautū ka ora mo ake tonu:**  
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# Waikanae 1% AEP 12-hour storm Current and Climate Change scenarios



Current Day



+2°C

# How does our modeling fit with your modeling?

## Hierarchy of Models

- High resolution
- Bespoke
- High level of detail (drainage networks etc)

Sub-catchment Stormwater scale

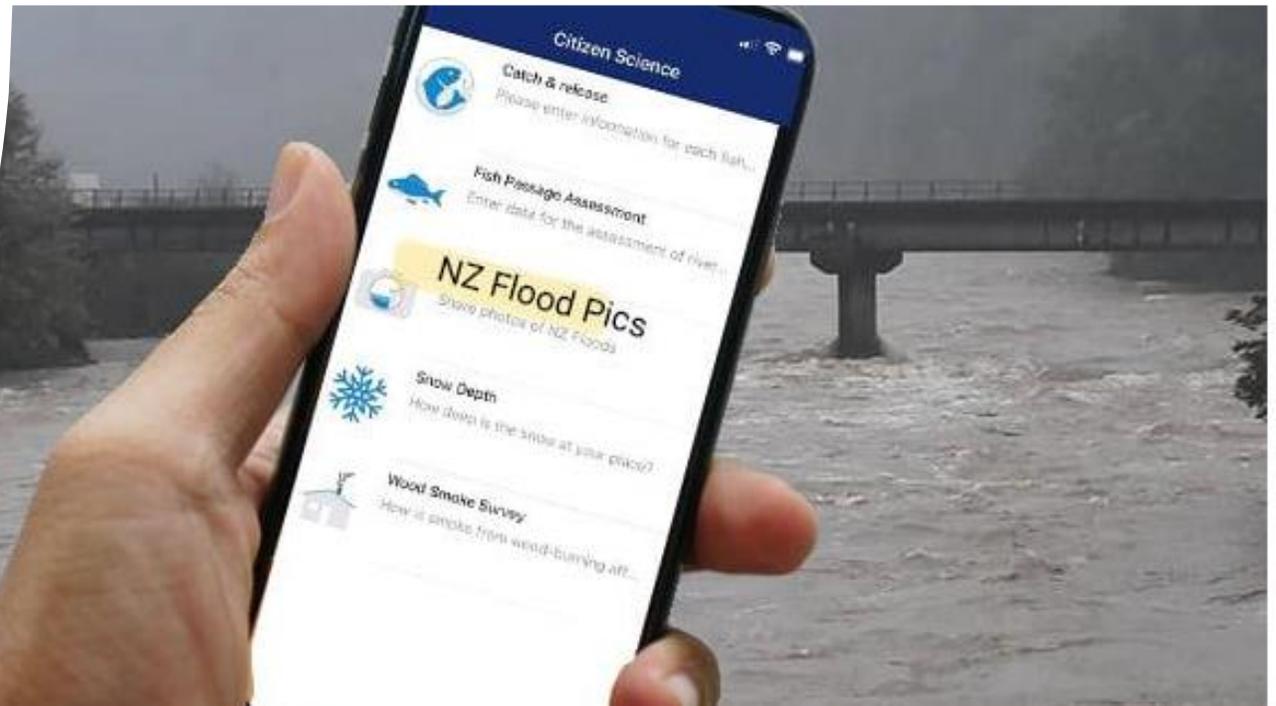
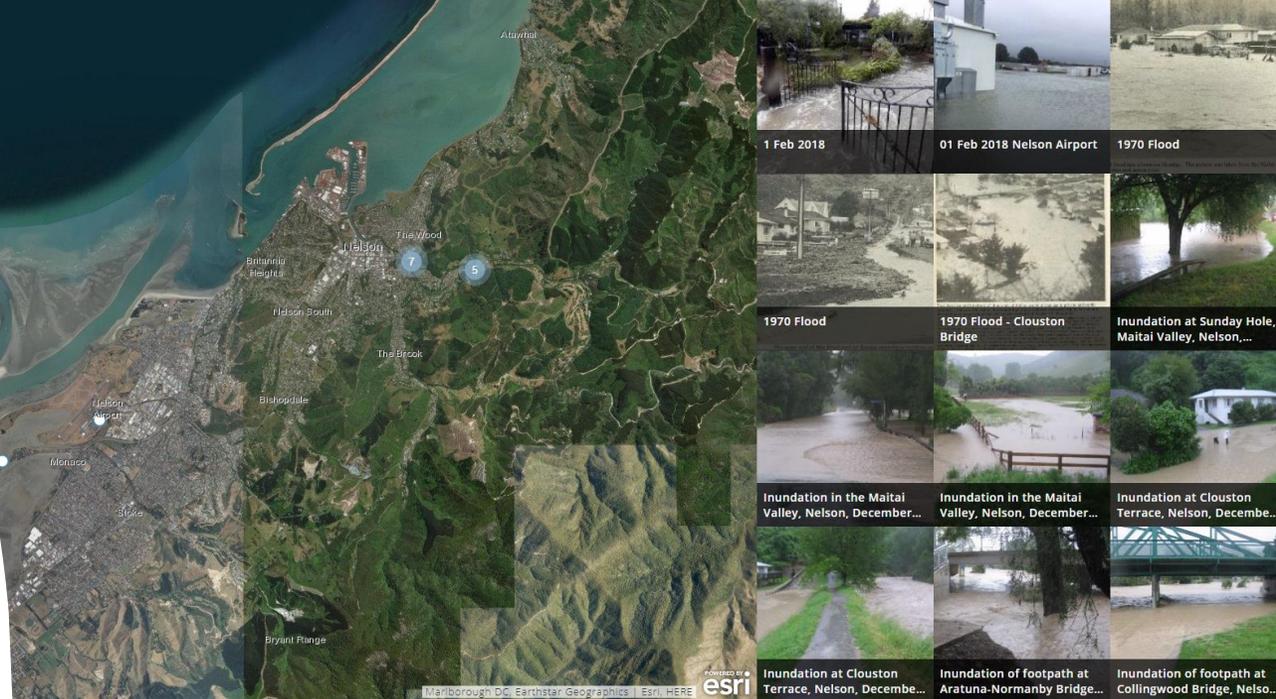
Catchment scale

- Large scale/Broad brush
- Subgrid scale parametrisations
- Intended for:
  - high level comparisons
  - Screening purposes

Regional/National Scale

# Historical and current Floods

- Drew Lorrey (NIWA) and Jon Rix (T&T) collecting citizen science flood photos
- <http://www.nzfloodpics.co.nz/>
- NIWA Citizen Science App downloadable for Apple or Android
- <https://apps.apple.com/nz/app/citizen-science/id1439168937>
- [https://play.google.com/store/apps/details?id=nz.co.niwa.citizenscience&hl=en\\_NZ&gl=US](https://play.google.com/store/apps/details?id=nz.co.niwa.citizenscience&hl=en_NZ&gl=US)
- Repository of Historical Floods
- Reconstructing flood heights from historical photos

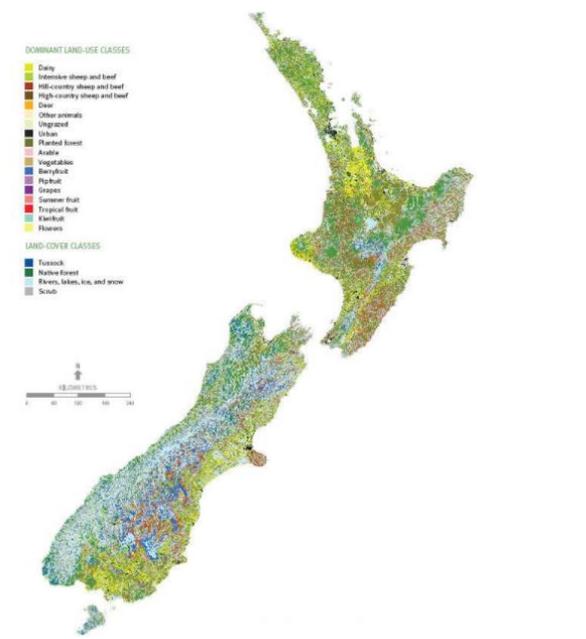


# RA2 – Flood Risk to the Built-Environment



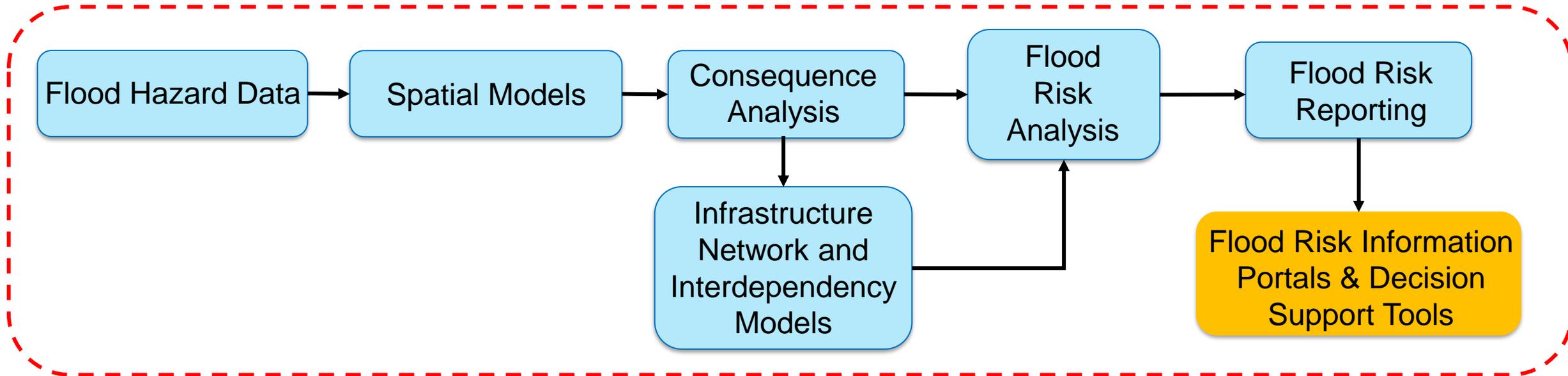
Figure 9.3: Land use in New Zealand, 2004

Return to the point in the document where this figure is located.



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## RA2 – Flood Risk to the Built-Environment



*Develop a flexible modelling tool to assess flood risk in Aotearoa New Zealand.*

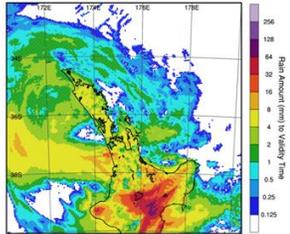
- *Land use*
- *Built environment*
- *Infrastructure networks*
- *Future risk & uncertainty*

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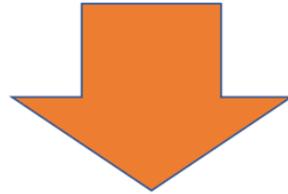
# RA 3 Societal vulnerability to cascading events

**Step 1: Current system**

## Cascading systems loop – Stop bank breach



**Extreme rainfall event  
Higher than normal tide**



Stop banks overtopped  
Drainage impeded

Impact on:  
Road networks  
Water & power supply  
Wastewater systems  
Farms affected  
Homes and Business  
are flooded

Community affected:  
Ability to earn an  
income  
Ability to insure  
People move  
Reduced services for  
those remaining  
Quality of life

Pressure to upgrade  
levels of service:  
Higher stop banks  
Increased drainage

Maintain current  
system?  
Repair to the  
same standard

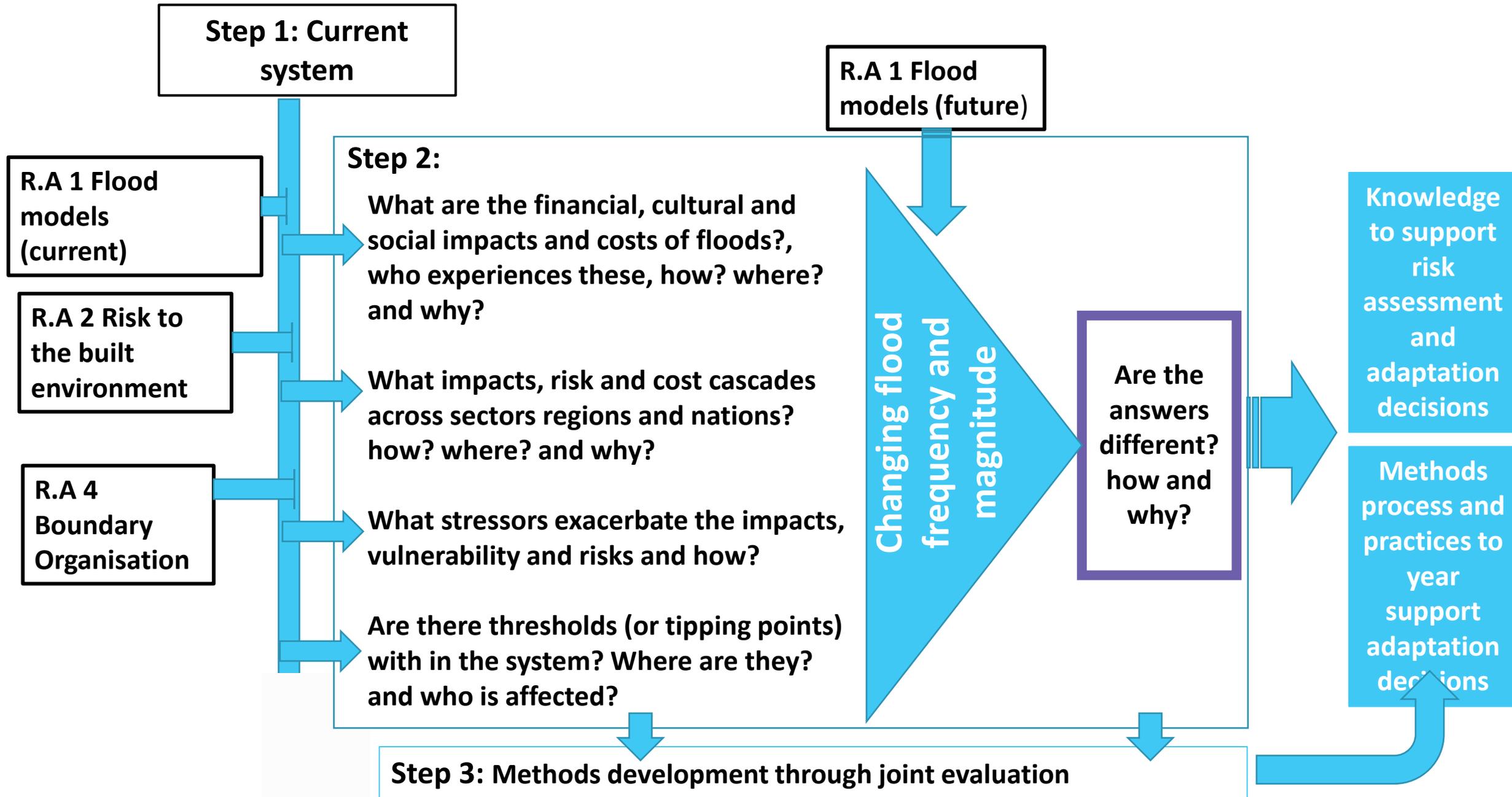
Ability to finance upgrade?  
Small rating base/high debt  
Lending and insurance policy

**New system emerges  
Take adaptation action**

No  
Yes



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# RA 4 Reducing Flood Risk

- What-if Scenarios
- Market Signals and Responses
- Guidance for Government



## Aotearoa-NZ:

- a) has a housing crisis
- b) is experiencing huge development pressures.
- c) is shifting toward more dense urban development
- d) is changing from RMA planning to a more long-term Spatial Planning.

How can we better link climate futures with development futures?  
What development options carry the least flood risk?  
What can we mitigate flood risk?



Assoc. Prof. Silvia Serrao-Neumann



Prof Iain White

# RA 4 Reducing Flood Risk

- What-if Scenarios
- **Market Signals and Responses**
- Guidance for Government



## Flood risk implications for the real estate market:

- Property tax = 60% of local government tax
- Increasing adaptation costs will decrease tax income
  - E.g. SLR exposed home prices 7% lower than the similar unexposed ones in the US (Bernstein et al. 2019)
- So far not seen in Australia (Melbourne, Fuerst and Warren-Myers 2019) or New Zealand (Kapiti Coast, Fillippova et al. 2020)

How will NZ housing market pricing respond to the climate change risk?



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# RA 4 Reducing Flood Risk

- What-if Scenarios
- Market Signals and Responses
- Guidance for Government



Aotearoa-New Zealand currently has a **fragmented risk governance system** across and between the levels of government.

There is a lack of a clear national directive, long-term planning and information gaps affecting local flood risk management. There is a need to ensure that the findings of the project inform national and local decision making.



Assoc. Prof. Silvia Serrao-Neumann



Prof Iain White

# RA 4 Reducing Flood Risk



# Te Whāriki o te Wai



Assoc. Prof. Silvia Serrao-Neumann



Prof Iain White

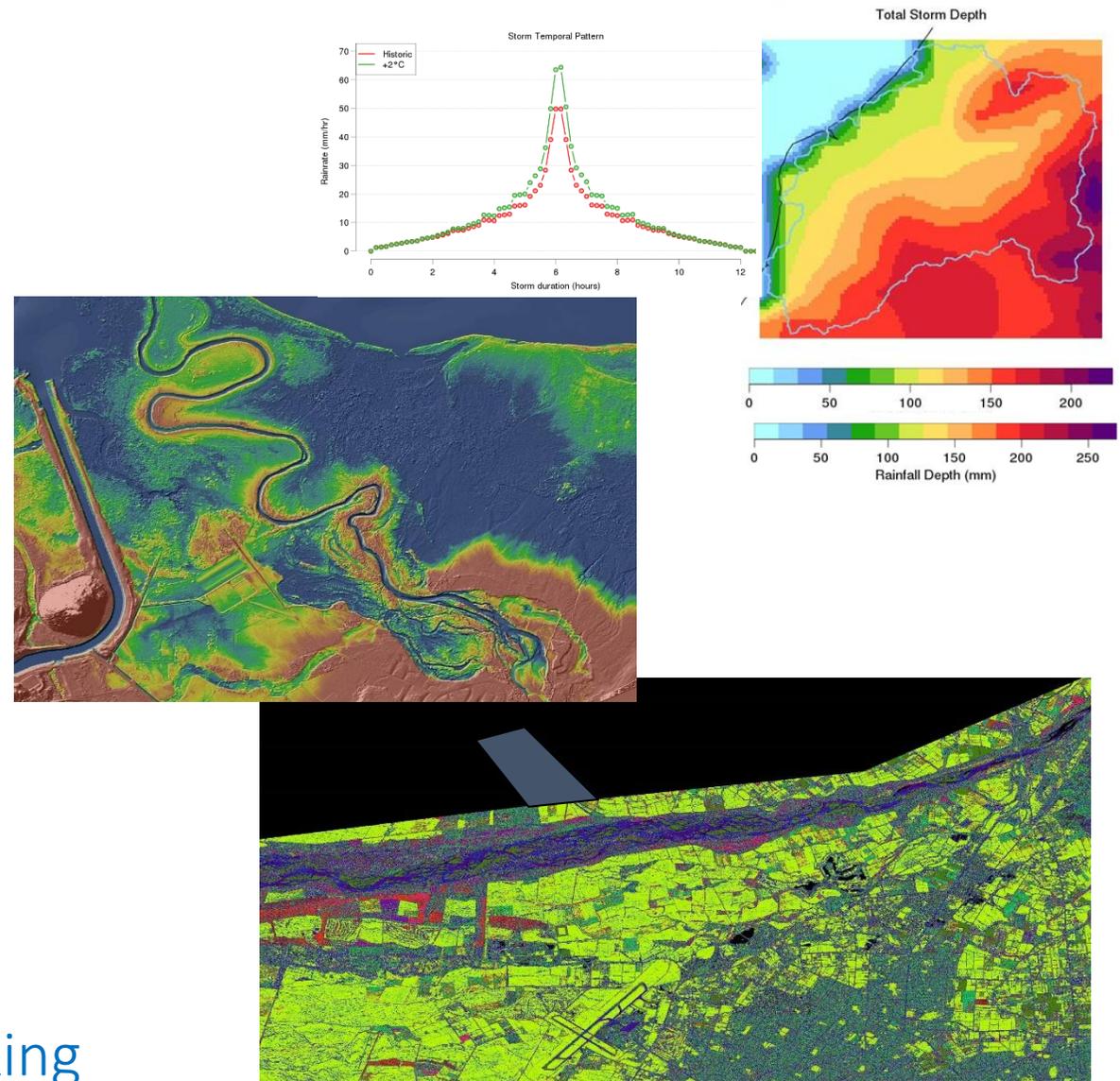
# Local and Regional Benefits

- Development of next generation methodologies:
  - Climate change
    - Could become national guidance depending on MfE
  - Risk (especially to infrastructure networks)
  - Understanding cascading impacts of flooding
    - Economic, social and cultural
  - Community engagement
  - Treatment of uncertainty
- Provides flood hazard maps for locations without data
- Open-source interim and final outputs



# Open Source Outputs:

- Flood hazard and risk layers
- Website and GIS layers
- Consistent regionally-appropriate design storms for all Aotearoa
- Current and Climate Change Scenarios
- Hydraulically-conditioned DEM
- $Z_0$  roughness maps (equivalent to depth dependent Mannings N)
- Methodology for incorporating climate change
- Guidance for national scale modelling
- National scale risk assessments
- Assessment of stopbank benefits
- Tools to support adaptation decision-making



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Richie Goldsbury

## Long term

- This Endeavour will set up the framework for continued flood hazard and risk assessments, methodologies for community engagement and a platform flood issues , Te Whāriki ō te Wai
- This is an iterative process – it won't be finished at the end of the Endeavour, we are focused on continual improvement
- NCCRA requires re-evaluation every 6-year
- Envisage updating flood hazard and risk on a similar timeframe (additional LiDAR, infrastructure data, improved methodology, climate change etc.)
- Will be looking to government to fund this ongoing work

If you are interested in receiving ongoing information from this programme or you wish to be involved in Te Whāriki o te Wai please contact:

Belinda Sleight [belinda.sleight@waikato.ac.nz](mailto:belinda.sleight@waikato.ac.nz)



## Thank you

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