

# The impact of climate change on New Zealand: A focus on extreme weather

Andrew Tait

Chief Scientist – Climate, Atmosphere and Hazards

Climate, Freshwater & Ocean Science



**NIWA**

Taihoro Nukurangi

# A summary of projected changes to and impacts from:



- Heavy rainfall and flooding
- Coastal inundation from the sea
- Storminess and high winds
- Thunderstorms and hail
- Drought duration and intensity

# Changes to extreme rainfall

NZ-wide estimates:

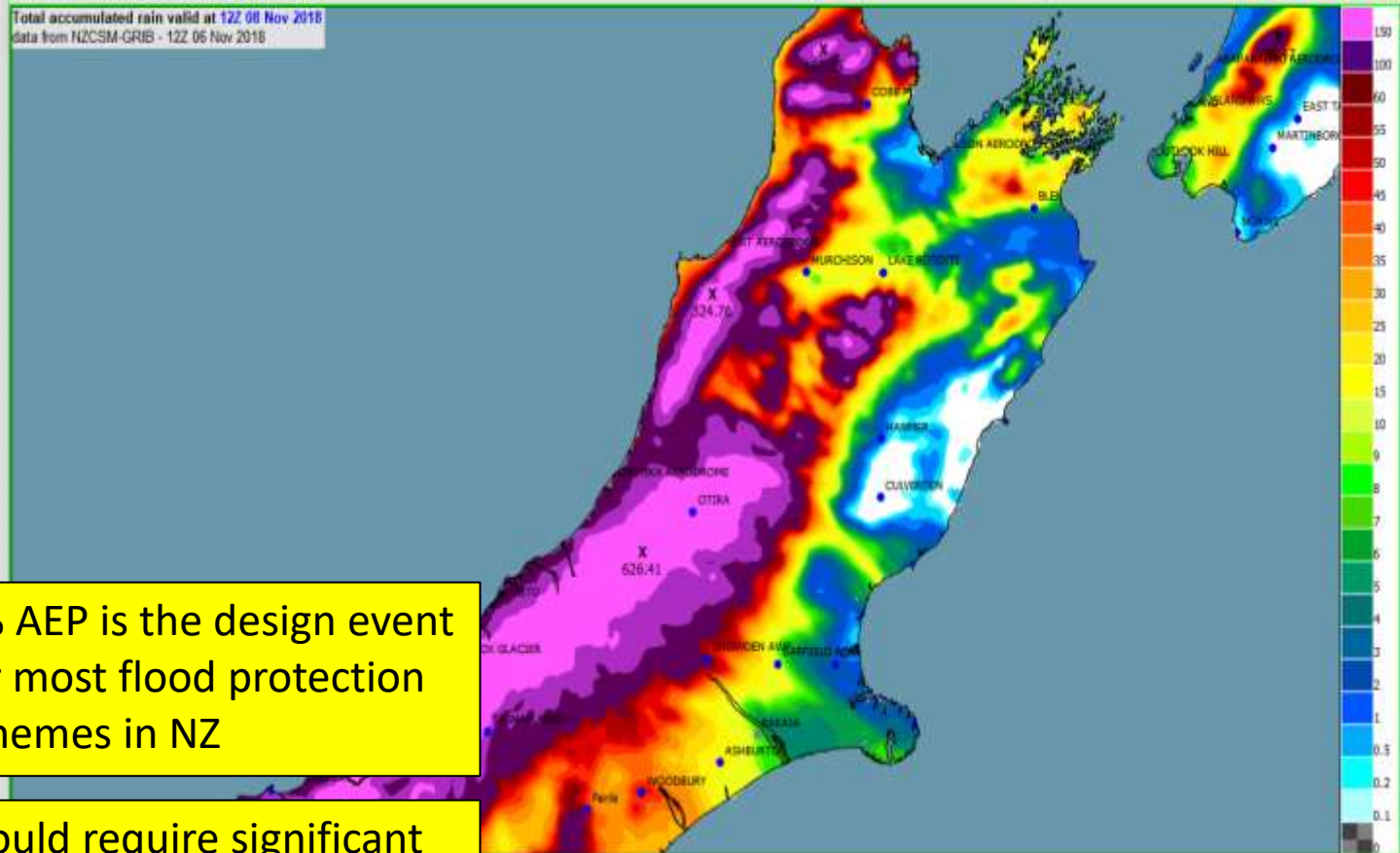
- 1-hr duration events  
~12-14% increase per °C
- 5-day duration events  
~5-6% increase per °C

What this means (e.g.):

- 1% AEP, 1 hour duration event
- Dunedin current climate = ~32mm
- 2090 under RCP8.5 (+3°C) = ~44mm
- 44mm is <0.2% AEP if occurred today
- 32mm is ~2% AEP if occurred in 2090

1% AEP is the design event for most flood protection schemes in NZ

Would require significant flood infrastructure upgrades



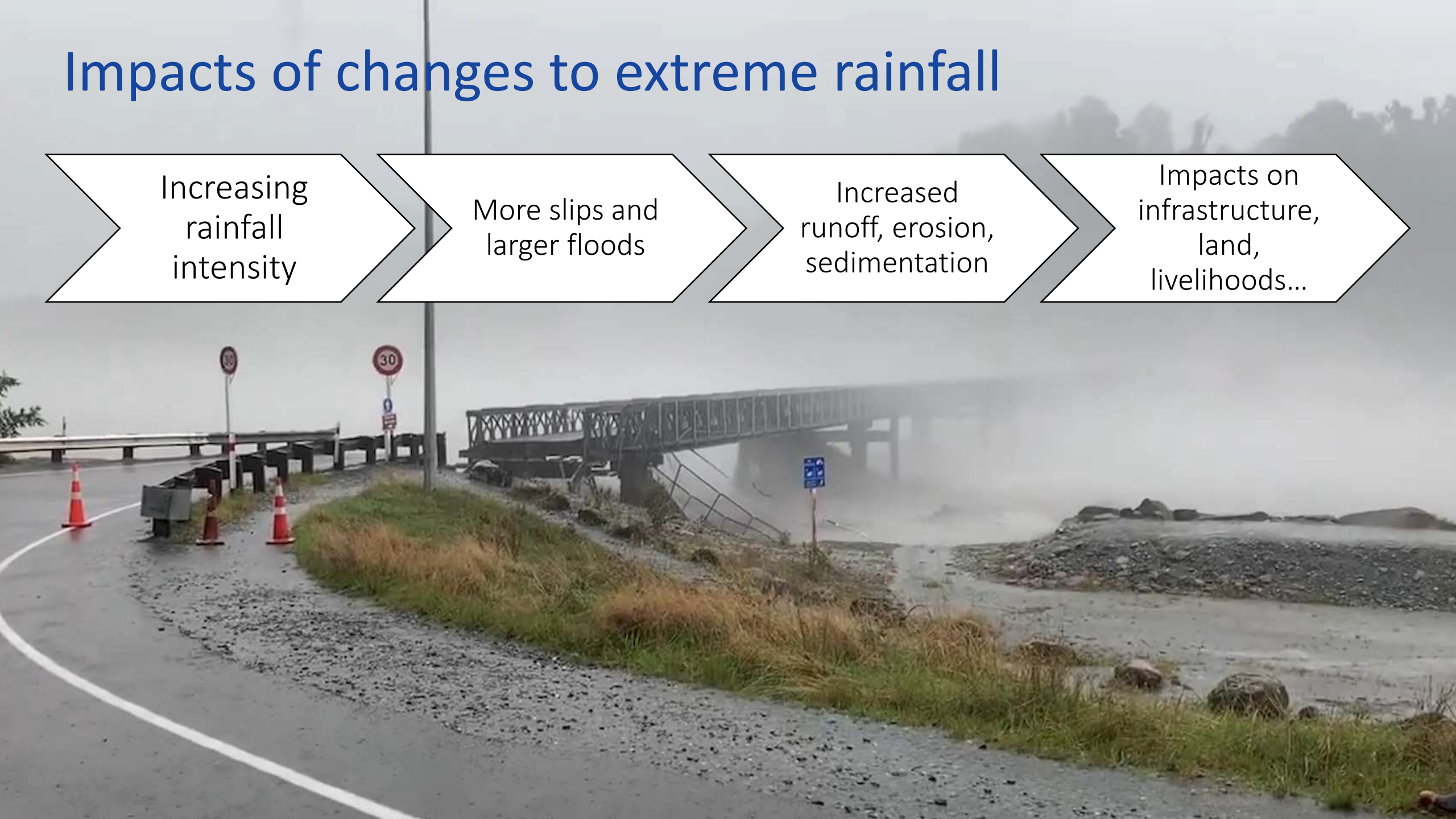
# Impacts of changes to extreme rainfall

Increasing  
rainfall  
intensity

More slips and  
larger floods

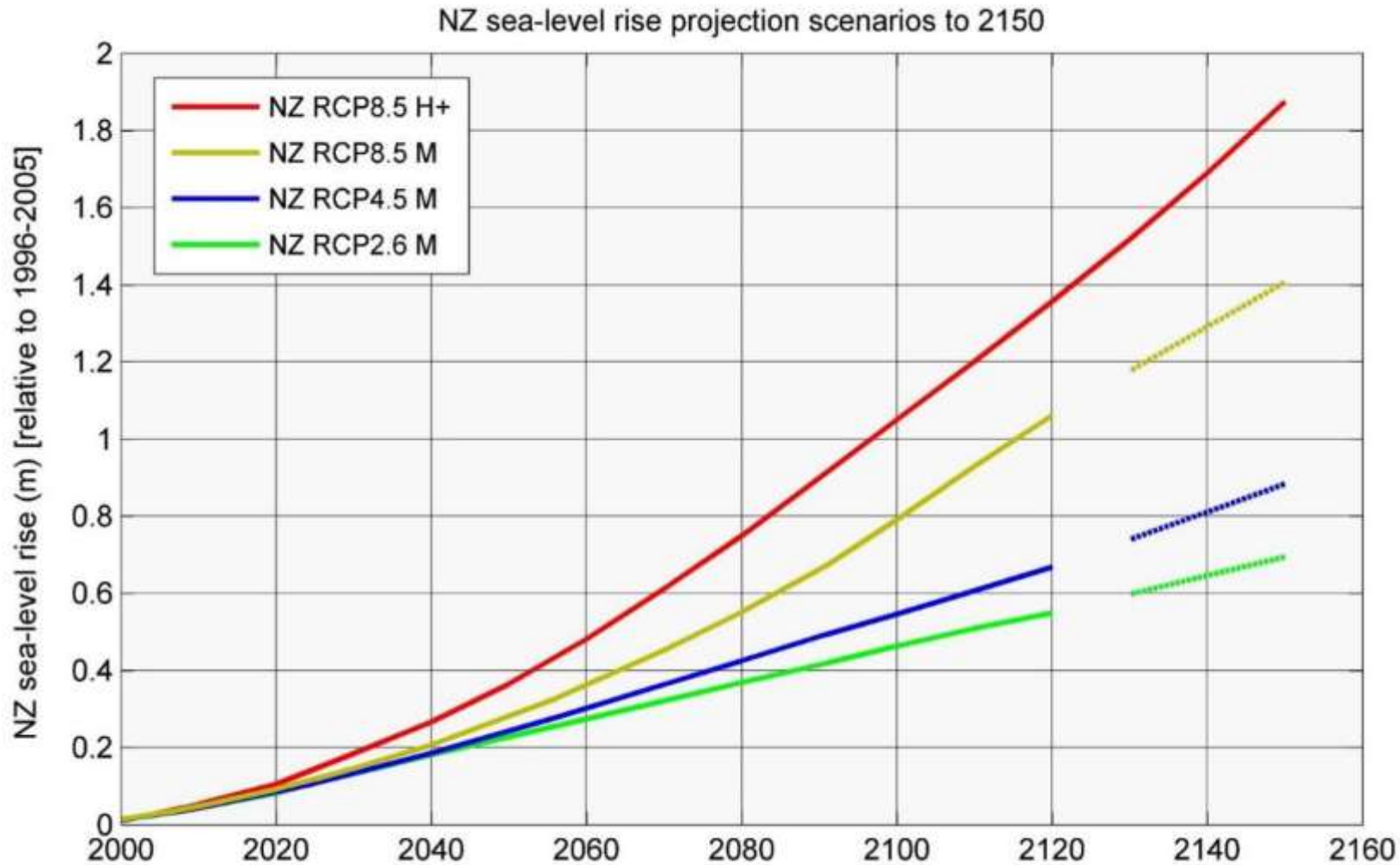
Increased  
runoff, erosion,  
sedimentation

Impacts on  
infrastructure,  
land,  
livelihoods...





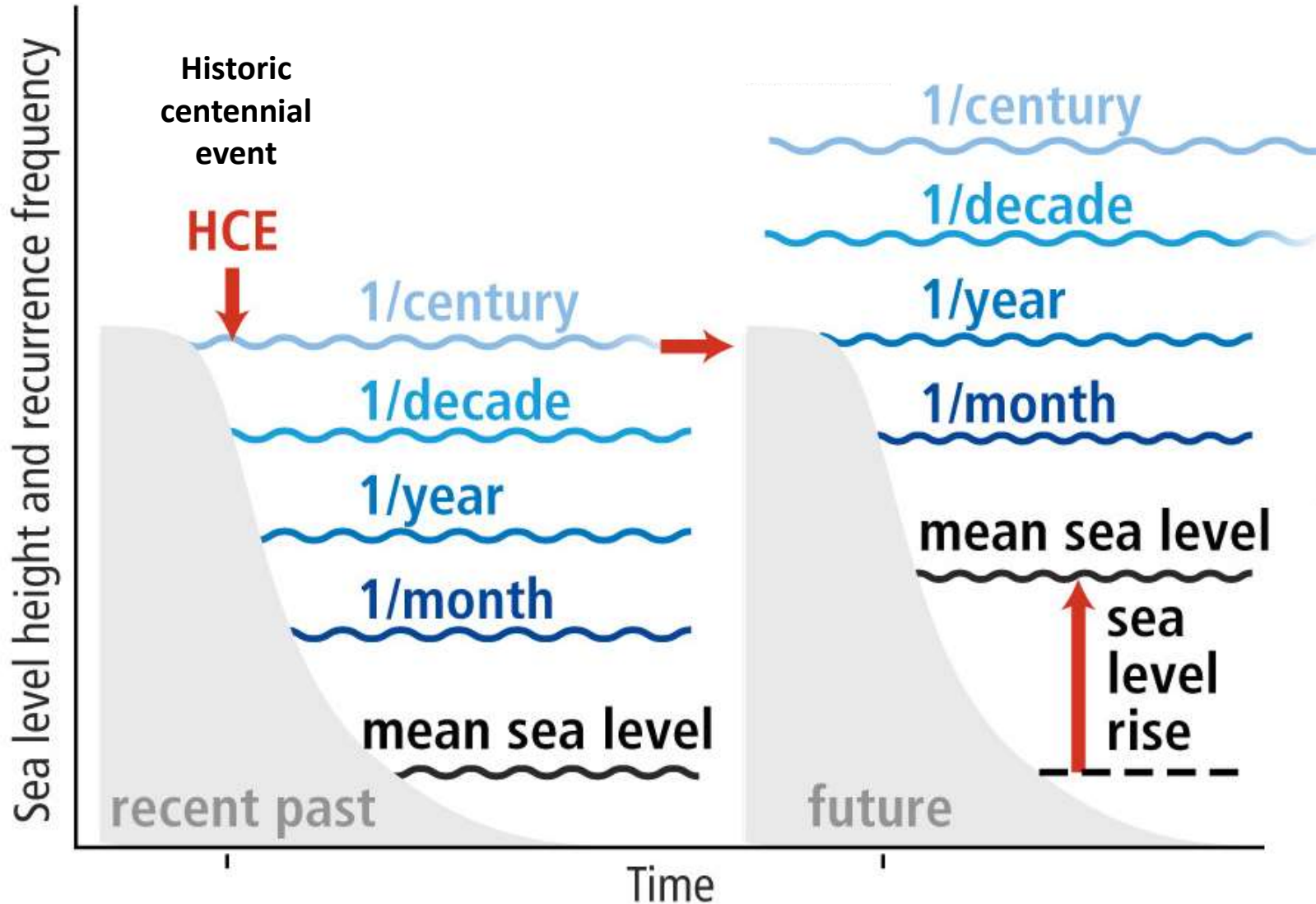
# Sea-level rise



## Two ways of thinking

- 2050: +0.25m to +0.4m
- 2100: +0.45m to +1.1m
- +0.5m by 2060 at earliest
- +1m by 2100 at earliest

# Changing frequency of extreme coastal flooding



For NZ, a change in frequency from 1/century to 1/year occurs:

- after modest sea rises of 30-45 cm
- this is projected to occur sometime between 2045 and 2070



# Impacts of sea-level rise on coastal lowlands

Rising sea level

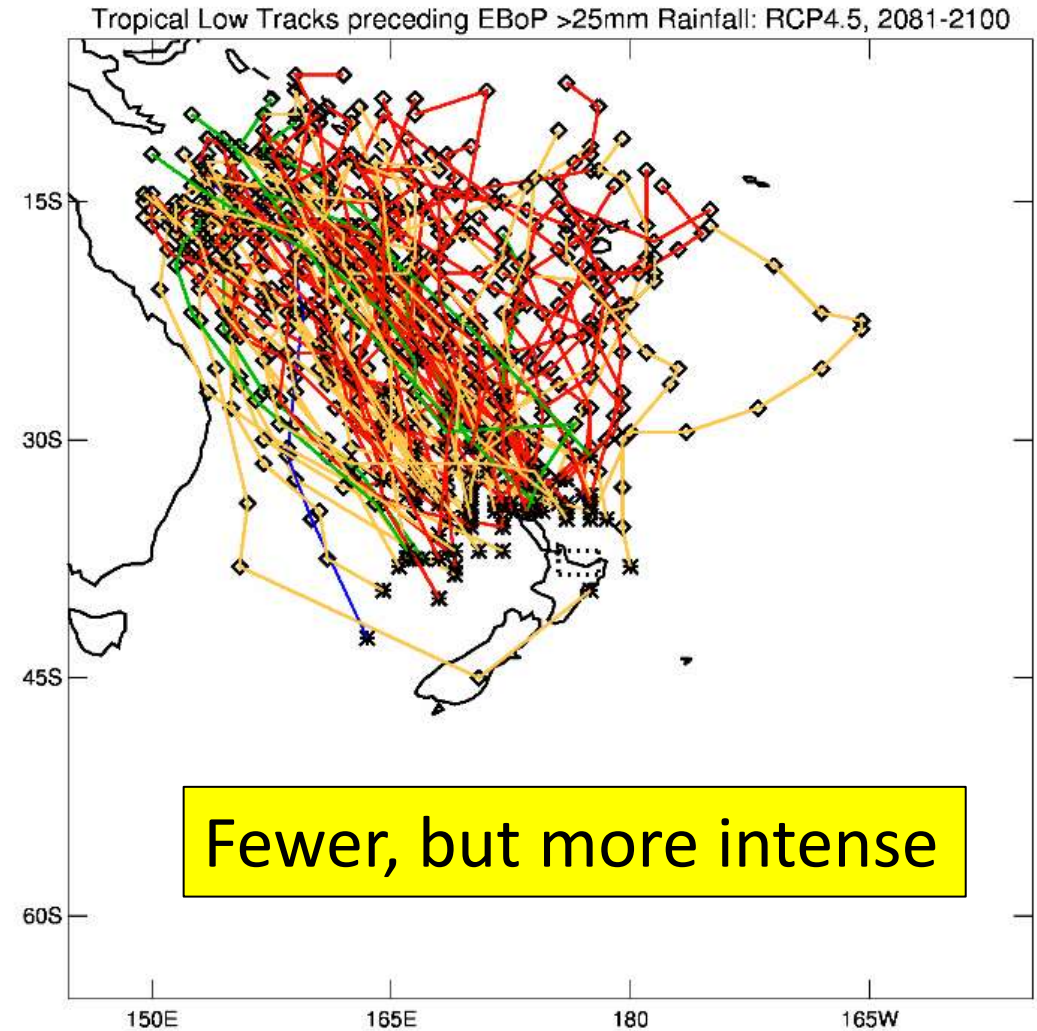
More coastal inundation events

Increased salinization of groundwater

Impacts on soils, crops, pasture, natural habitats

# Changes to storminess

- Ex-tropical cyclones are often the most damaging storms to impact NZ. There is consistent evidence that:
  - The number of South Pacific tropical cyclones is projected to decrease by the end of the century.
  - Cyclone intensity is likely to increase as seas warm.
  - They could travel further south before they lose their structure.
  - They could re-intensify as they interact with more intense Tasman Sea extra-tropical low-pressure systems.





# Changes to extreme weather

Two current research projects are focusing on climate change and extreme weather:

## Extreme events and the emergence of climate change – Whakahura

- will estimate damages and losses, for New Zealand, from future extreme weather events

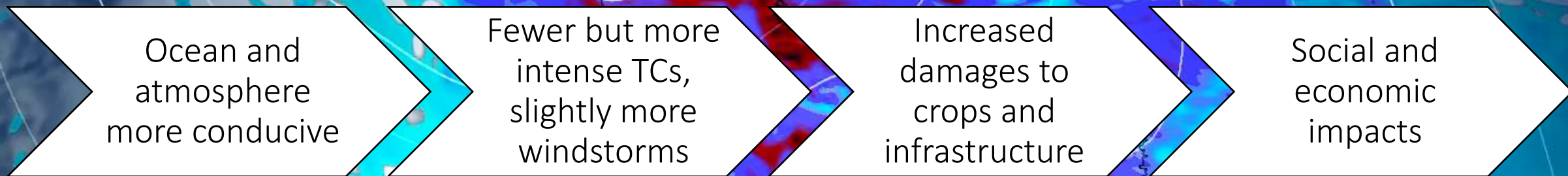
## Extreme weather event real-time attribution machine

- will produce near real-time, scientifically defensible, attribution of extreme weather events to human-induced changes in climate





# Impacts of storms and winds



Ex Tropical Cyclone Donna, May 2017



# Changes to hail

Very little is known about the effect of climate change on thunderstorms and hail. In theory:

- A warmer and more dynamic atmosphere is more conducive to thunderstorm development.
- An increase in storm vertical vorticity (the whirling motion of air inside a storm) is predicted.
- This will enable hail stones to grow larger.
- The risk of severe thunderstorms and hail is highly unlikely to diminish in the future.

Impacts can be severe

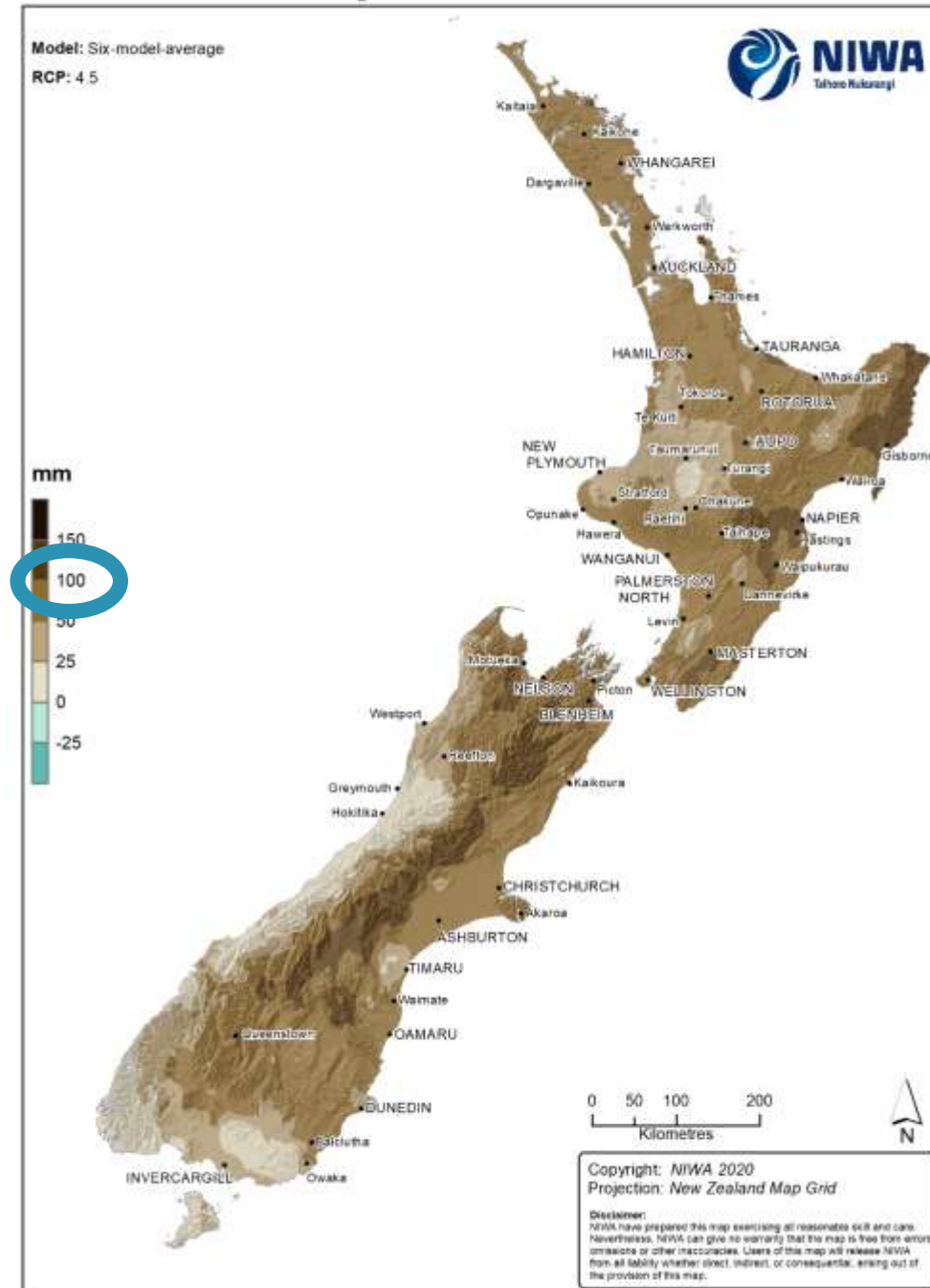


Victoria Gardens, Motueka, Dec 2020

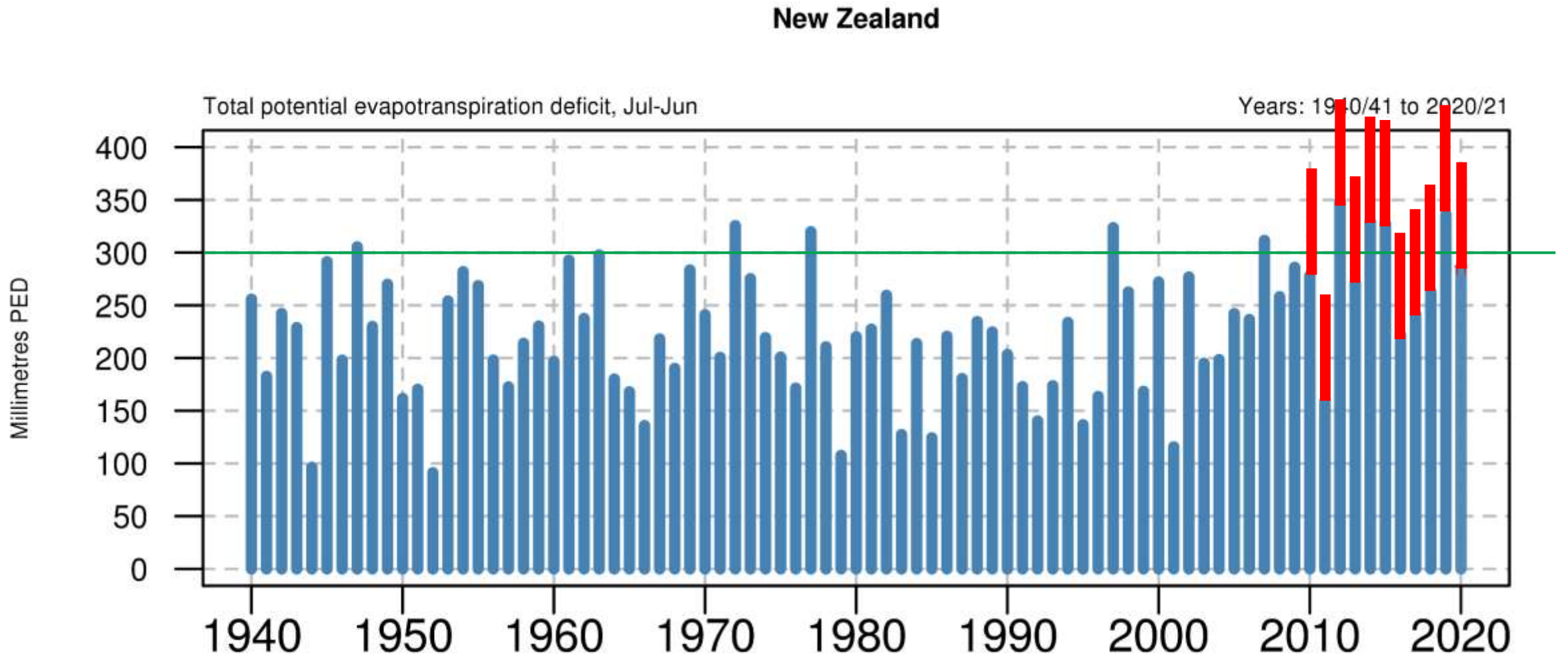


# Changes to annual accumulated drought (PED)

Annual Potential Evapotranspiration Deficit Accumulation Change Between 1995 and 2040

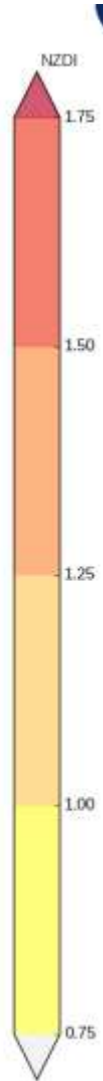
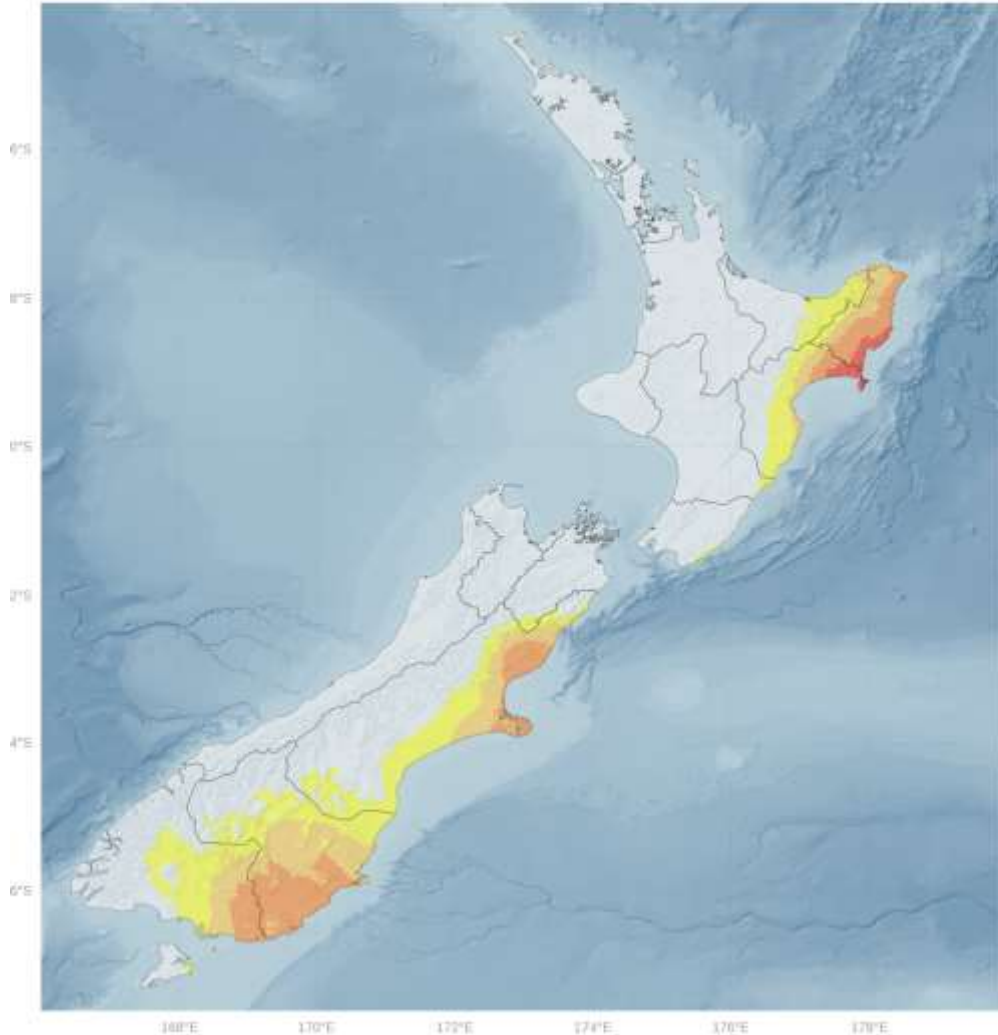


# Drought changes in a historical context

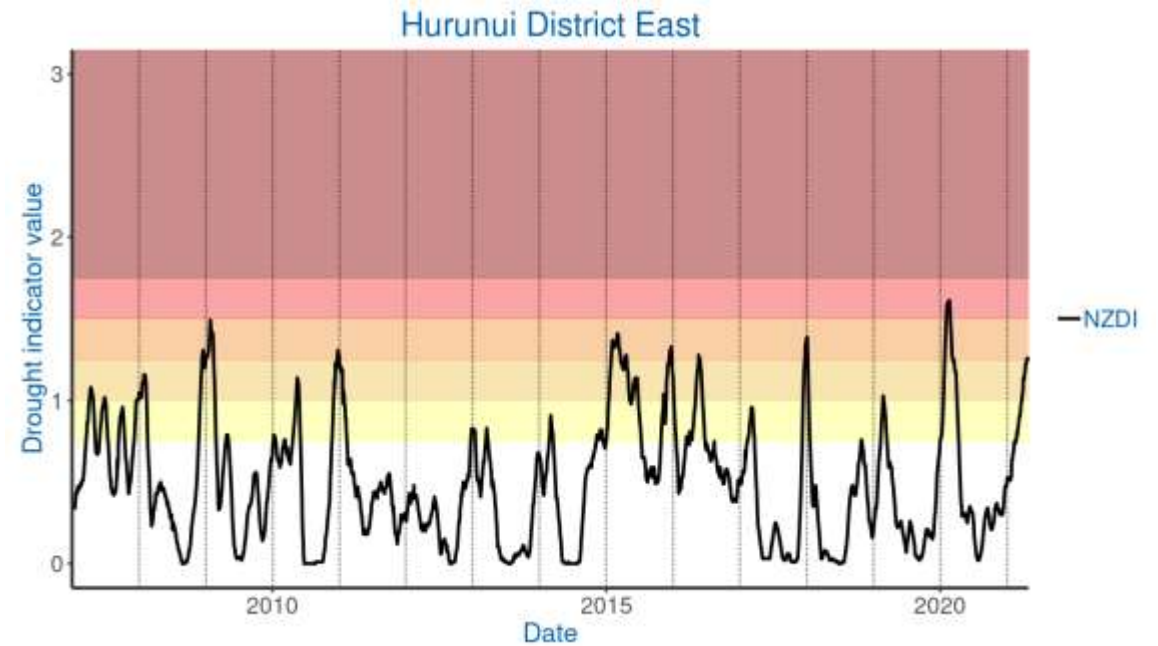


# NZ Drought Monitor

New Zealand Drought Index (NZDI)  
Date: 2021-04-27



■ Dry   ■ Very Dry   ■ Extremely Dry   ■ Drought   ■ Severe Drought



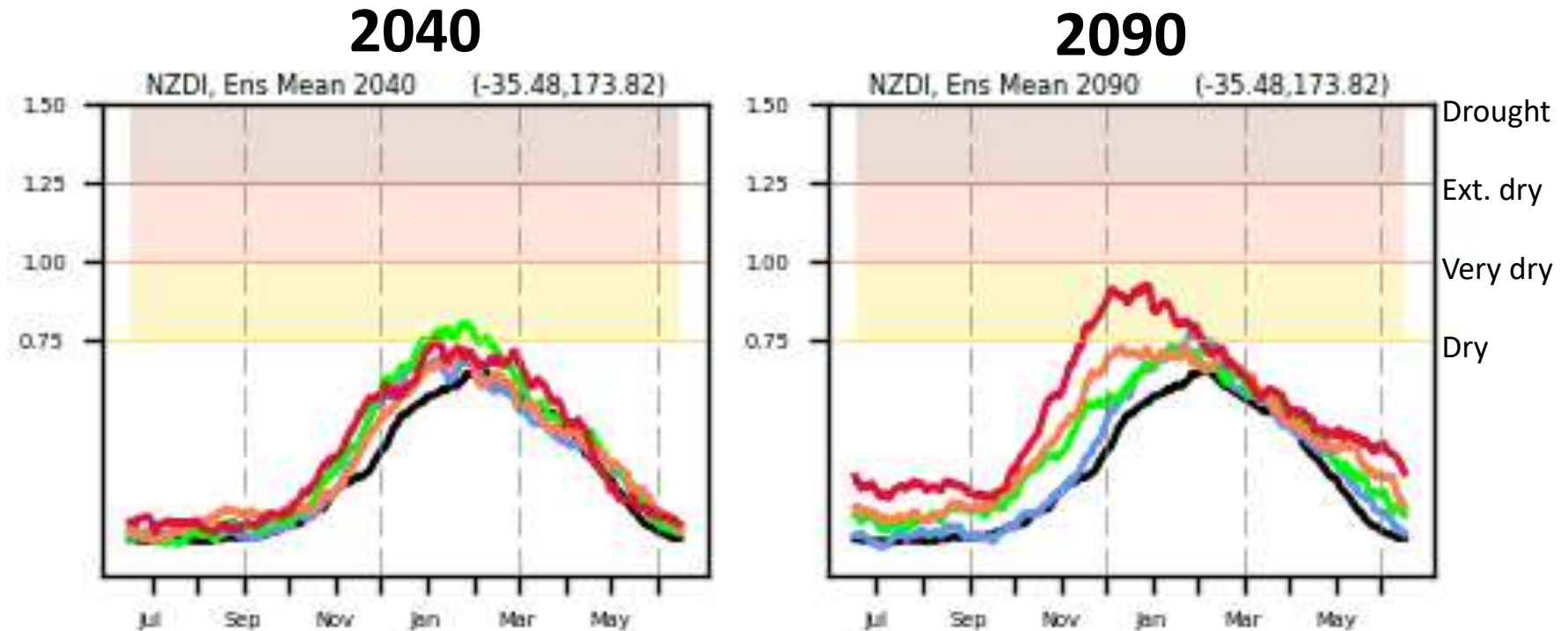
<https://niwa.co.nz/climate/information-and-resources/drought-monitor>



# Broadening of Drought Season (2020 DSC report)

Far North location

The mean annual cycle  
(July-June) of NZDI  
with the drought  
classification  
(background colours)



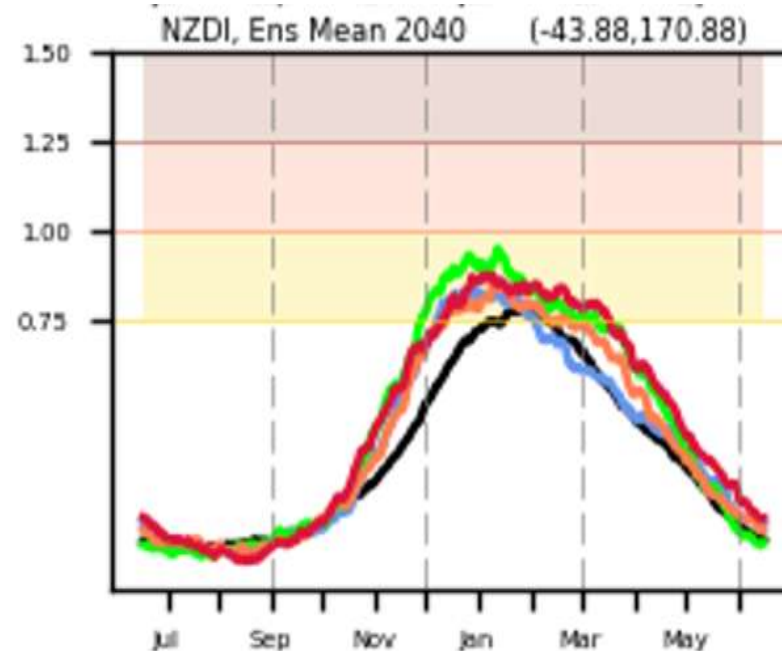
Black = historical  
Blue = RCP2.6  
Green = RCP4.5  
Orange = RCP6.0  
Red = RCP8.5

# Broadening of Drought Season (2020 DSC report)

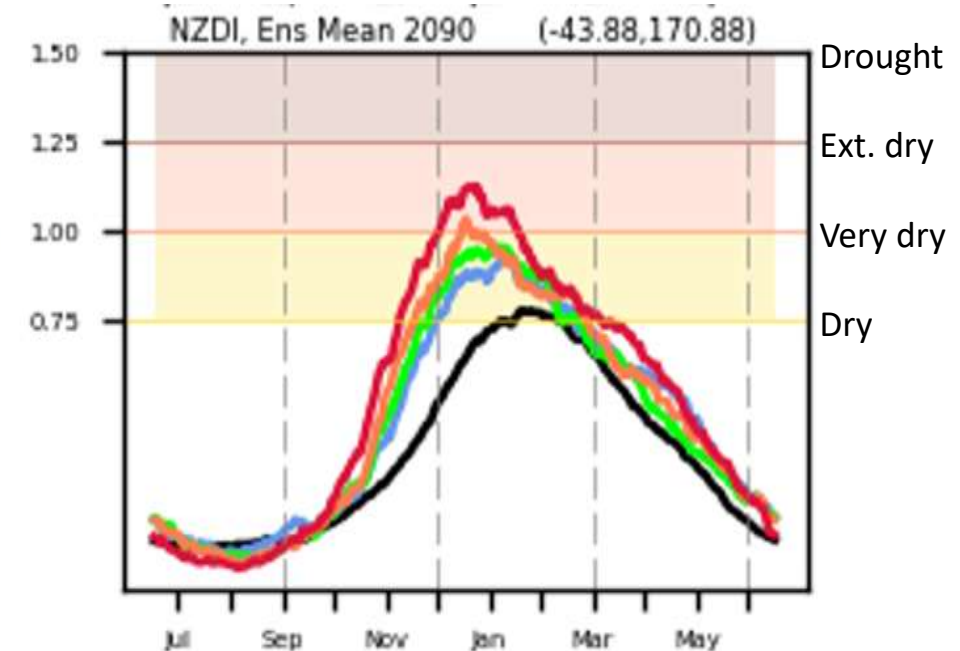
Central Canterbury location

The mean annual cycle  
(July-June) of NZDI  
with the drought  
classification  
(background colours)

## 2040



## 2090



Black = historical  
Blue = RCP2.6  
Green = RCP4.5  
Orange = RCP6.0  
Red = RCP8.5





## Key messages

- Climate models are best used to project changes in average climate conditions.
- Extreme weather events of all kinds are likely to increase in frequency and intensity, or in the least stay the same.
- NZ is already vulnerable to the impacts of extreme weather and climate events.
- Risk management for extreme events requires a long-term strategy.



Thank you

[andrew.tait@niwa.co.nz](mailto:andrew.tait@niwa.co.nz)



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Taihoru Nukurangi

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