

Impacts of severe-weather: Chasing resilience for NZ

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Climate, Freshwater & Ocean Science



NIWA

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Context: NZ's exposure to weather

- **Geographic setting:**
 - Straddles 34–53°S latitudes (sub-tropics to Southern Ocean)
 - Strong maritime influence
 - Southern Alps (rainfall, lee-slope winds, heat)
- **Economy and health (strongly weather-dependent):**
 - Agriculture (too much water or not enough, snow, wind, heat)
 - Horticulture (wind, hail, frost, rain, heat)
 - Tourism and domestic holidaying
 - Māori economy
 - Transport and infrastructure: criticalities often relate to severe weather
 - Insurance (NZ has high penetration of non-life cover, EQC)
 - Health & Safety: heatwaves, wild fire, hail, lightening, winds, floods

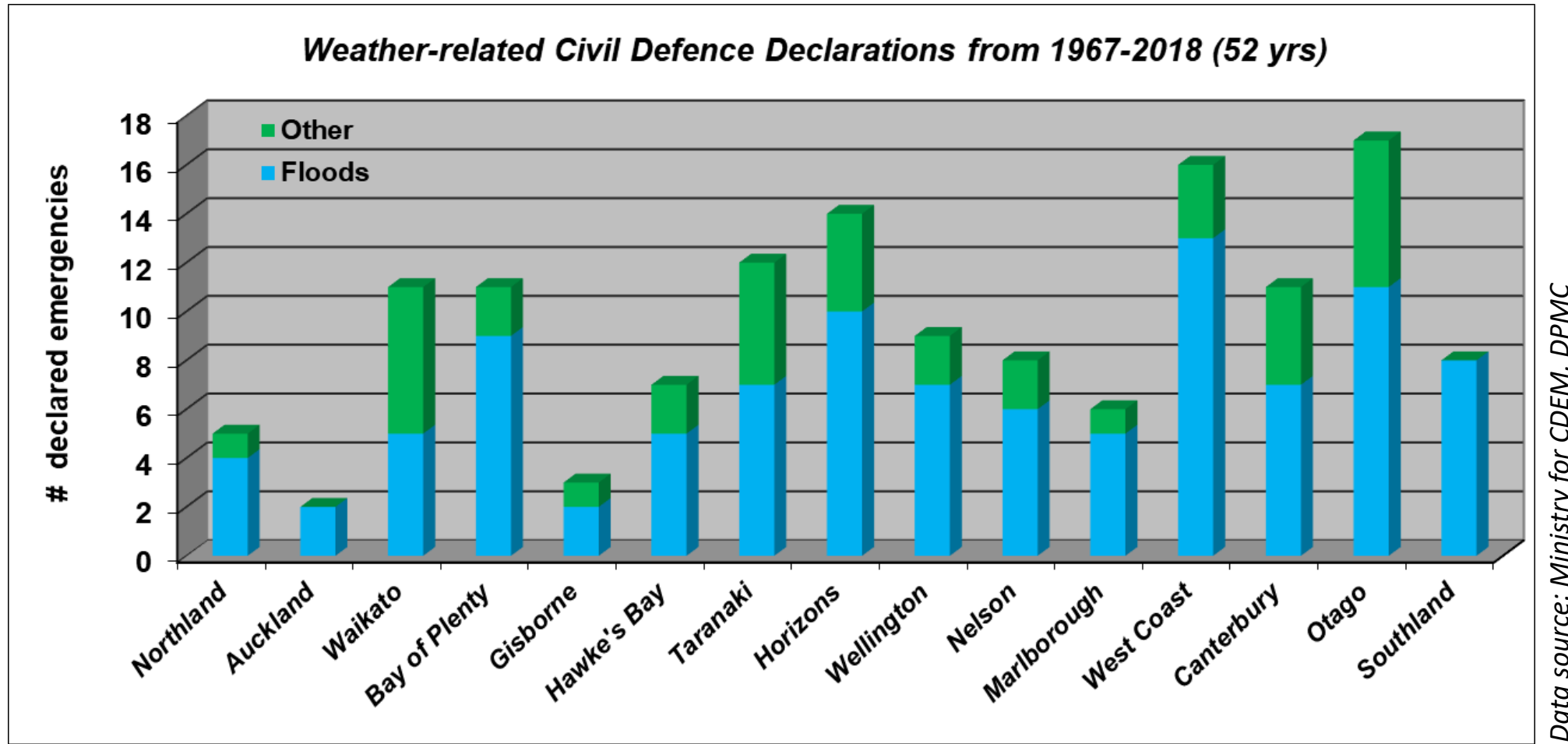


Context: Risk from severe weather

- **Assets and infrastructure:**
 - Development in 1900-1950s based on limited data and knowledge
 - Continued development on flood and coastal plains
⇒ increasing the risk
 - Values of assets/infrastructure have increased rel. to CPI
 - River flood control (devolved to regional councils in 1991 – RMA)
- **Event management (4 R's: Reduction, Readiness, Response, Recovery)**
 - 4 R's in CDEM Act, devolved to regions; improved responses to events (few casualties now)
 - Readiness – forecasting skill has significantly improved
 - Holy grail is to forecast risk e.g., estimates of consequences and No. of affected people before the event unfolds– inform response



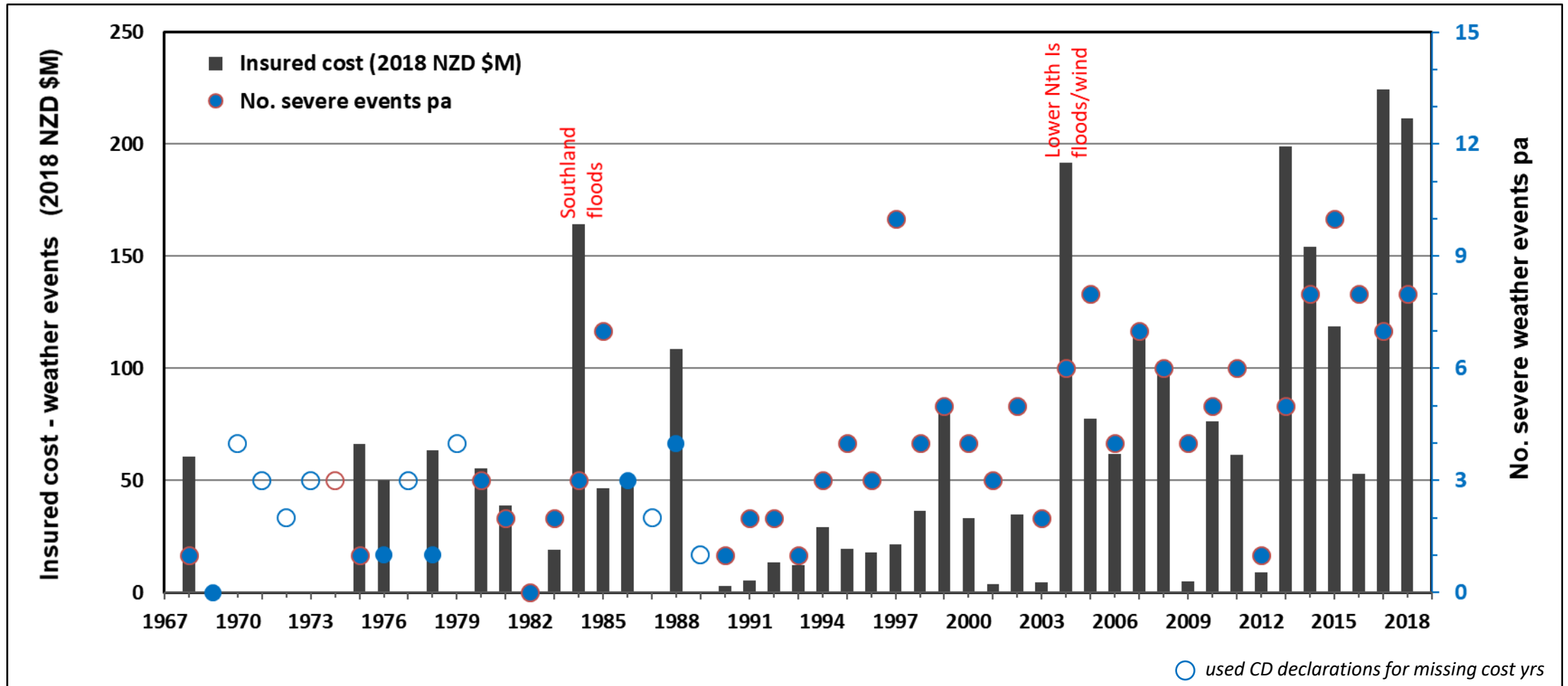
Weather-related civil-defence declarations [1967–2018]



72% of CD weather-related declarations for any region are mainly related to **flooding**

Most weather-related declarations over 52 yrs: Otago (17); West Coast (16); Horizons-Manawatu (14); Taranaki (12)

NZ insurance payouts: weather-related events [1968–2018]



Insured costs: \$2.7B (2018) in 42 yrs; half since 2007

Total uninsured damage & losses: ???

Largest costs: \$148M (2018) Feb 2004 Lower Nth Is. floods
 \$148M (2018) Jan 1984 Southland floods

NIWA Historic Weather Events Catalog

Eastbourne, June 1947

- Developed by NIWA's Impacts & Risk programme since 2005
- Events from 1840 onwards to present
- High bar for a weather event to be included:
 - see Submission for criteria
 - events can impact several regions
 - many nuisance events not included
- Compiled from several information sources - mainly:
 - newspaper reports, books, reports
 - images including weather maps (not loaded at this stage)



Search

Start

End

Affected areas

- tasman-ineison
- Marlborough
- West Coast
- Canterbury
- Otago

Hazards

- All
- Flooding
- Fog
- Hail

Impacts


- All
- Affected Lifeline Area
- Casualties

Containing


July 2017 New Zealand Flood (2017-07-20)


A large complex low pressure system brought heavy rain and gales to Otago and Canterbury, causing significant flooding during the period 20-22 July. The Bay of Plenty area was also badly affected.


New Zealand


 Multi Hazard at New Zealand


Duration: 3 days - From the 20th to the 22nd of July.

 Insurance claims totalled \$20.9 million.

 MetService SEVERE WEATHER WARNING 7:51pm 19-Jul-2017. HEAVY RAIN FOR BAY OF PLENTY AND ROTORUA
A large complex low pressure system is expected to move over the country on Thursday, and its associated front should move across the North Island from late morning to overnight Thursday, bringing a burst of heavy rain to the northern parts of the Island. The heaviest falls are expected in Bay of Plenty and Rotorua from Thursday afternoon to overnight, where 90 to 110mm of rain could accumulate in 9 to 12 hours.

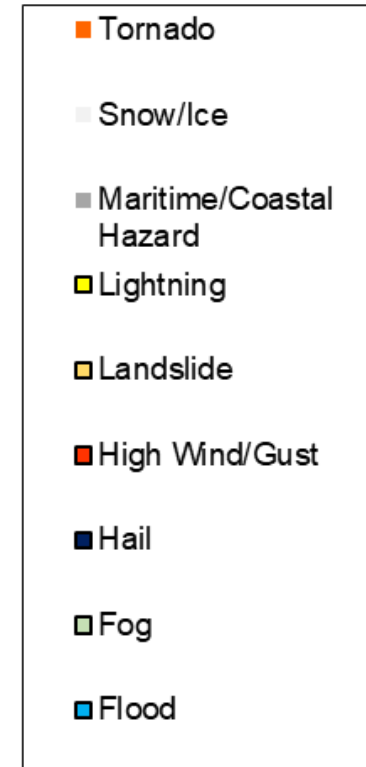
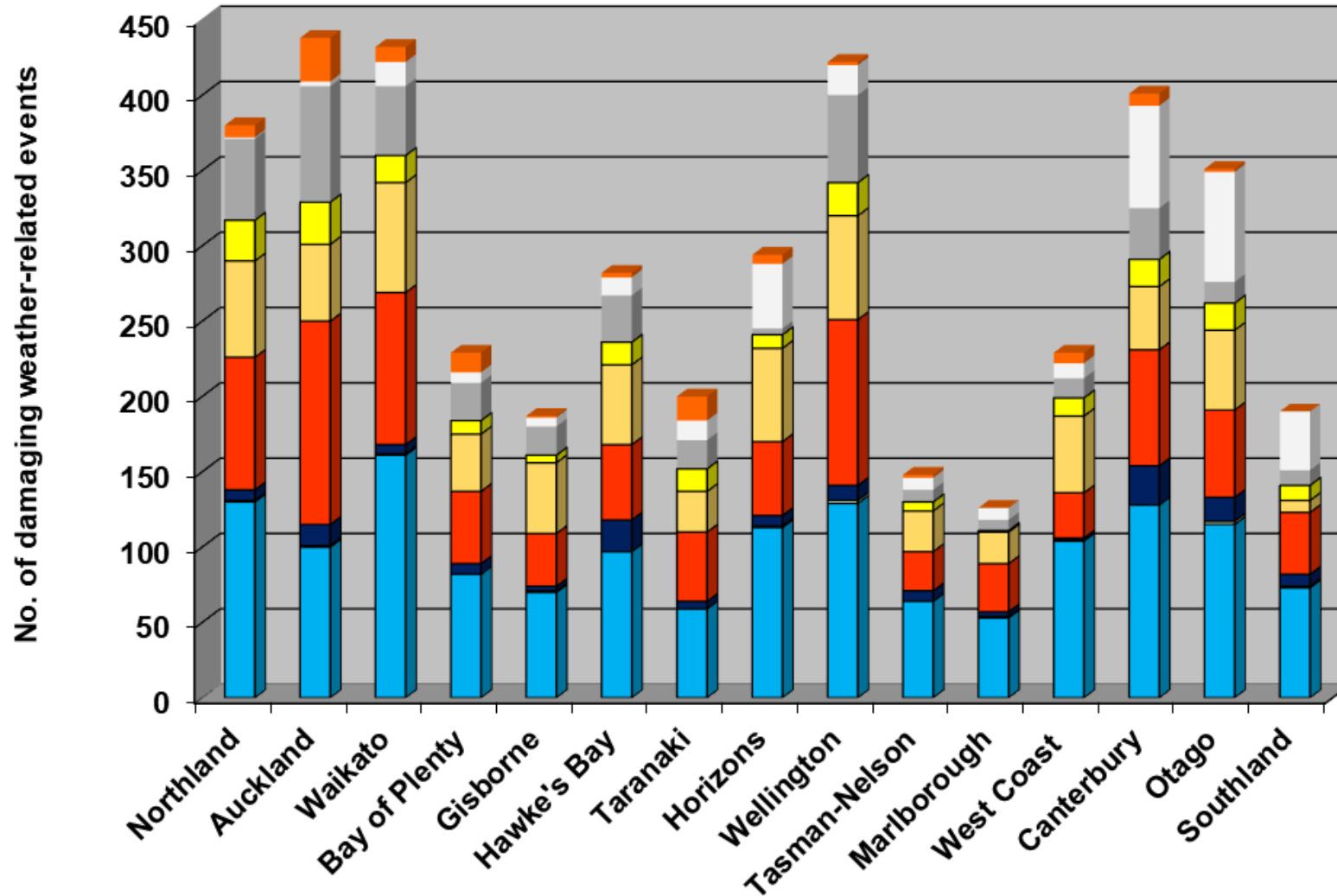
 MetService SEVERE WEATHER WARNING 9:52am 20-Jul-2017. HEAVY RAIN FOR BAY OF PLENTY, CANTERBURY AND EASTERN OTAGO. ALSO, STRONG WINDS FOR AUCKLAND, BAY OF PLENTY AND GISBORNE. A large complex low pressure system is expected to move over the country today and slowly move east during Friday and Saturday. An associated front crosses the North Island, bringing a period of severe gale northeasterlies and a burst of heavy rain to northern parts of the Island. The strongest winds are expected in Bay of Plenty and Gisborne where northeast gusts could reach 120 km/h in exposed places. The heaviest rain is expected in Bay of Plenty and Rotorua from this afternoon to overnight tonight, and 100mm of rain could accumulate in 12 hours. Rain is also expected to become heavy over eastern districts of the South Island during Friday and continue into Saturday as the complex low pressure system moves east. The heaviest falls are expected in Canterbury and eastern Otago where up to 160mm of rain could accumulate, with snow lowering to 800 metres about the Canterbury High Country during Friday evening.

 MetService SEVERE WEATHER WARNING 8:08pm 20-Jul-2017. HEAVY RAIN FOR BAY OF PLENTY, CANTERBURY AND EASTERN OTAGO. NORTHEAST GALES ABOUT BAY OF PLENTY AND GISBORNE EASING THURSDAY NIGHT.

 MetService SEVERE WEATHER WARNING 9:17am 21-Jul-2017. HEAVY RAIN AND SEVERE GALES FOR PARTS OF



Historic Weather Events by main hazard type for New Zealand regions (1840-2017)



Most common severe events

✓ (in south)

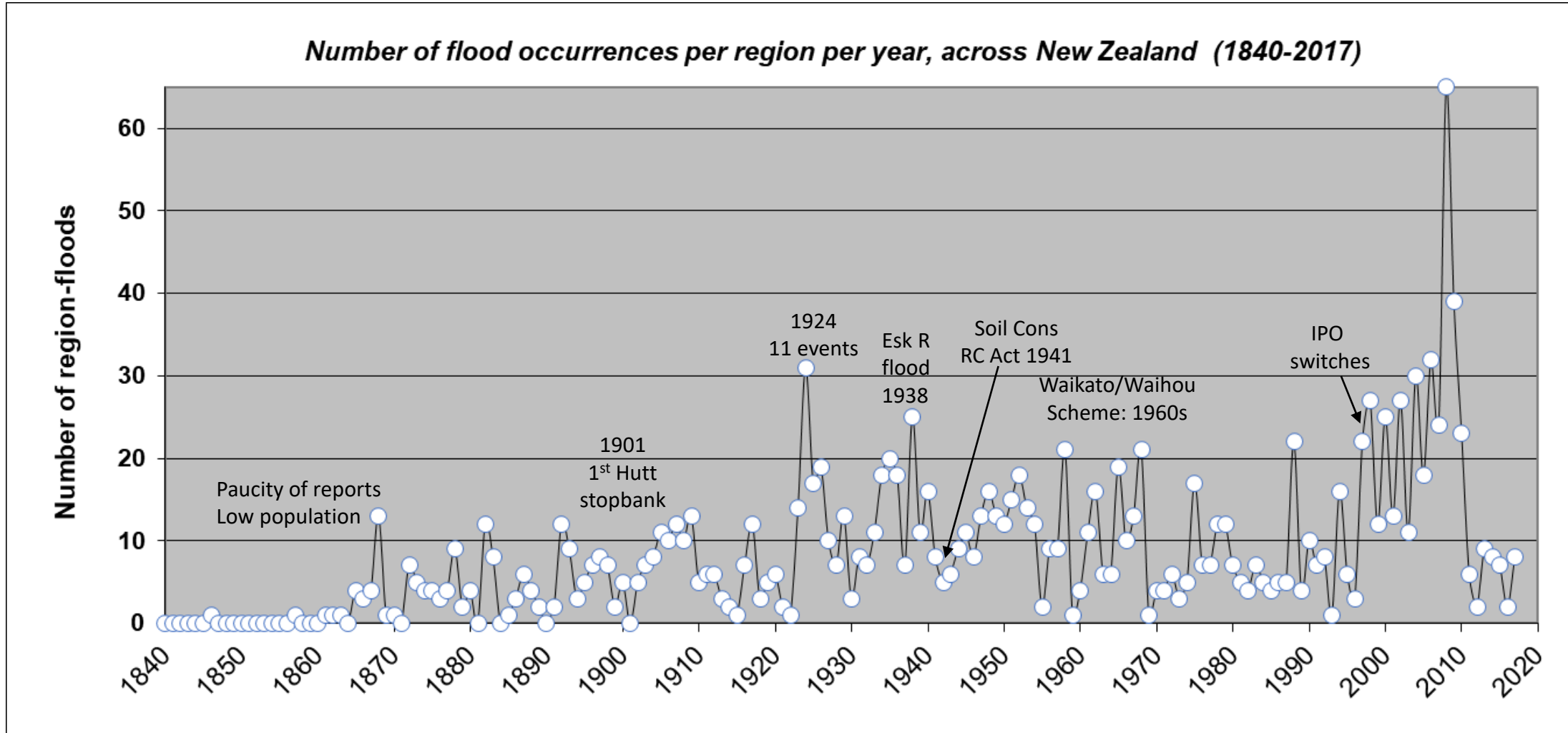
✓

✓

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North – ex TC influence
 Maritime – largely ship wrecks
 Floods – highest Waikato/Coromandel
 Winds – highest Auckland, Wellington

NZ flood occurrences per region each year [1840–2017]



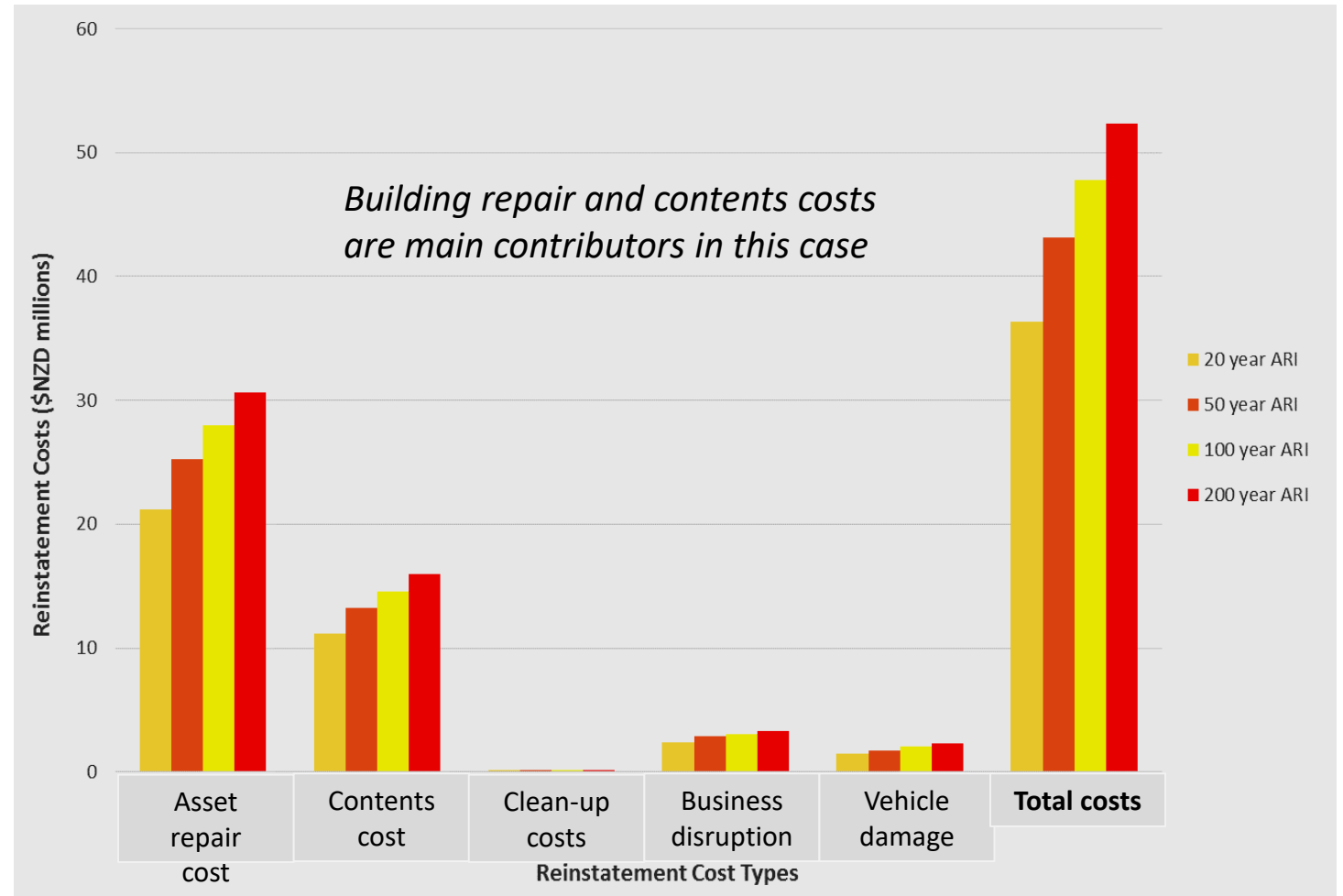
No clear trend, early history sparse, few in 1970s-1980s (stopbanks?, IPO)
2008 (\$100M insured cost – lots of disruptive events e.g. 13 in Wellington)

RiskScape Multi-hazard Impact and Loss Model



- Risk from multiple hazards: flood, wind, tsunami, coastal, EQ, landslides, volcanoes
- Collaboration between NIWA and GNS Science (open use)
- Risk:
 - = **Consequences** of natural hazard exposure, taking into account **vulnerabilities** of assets/people, for different **likelihoods** of an event
 - Measured as: people affected, damage, disruption, displacement, clean-up costs, indirect losses

RiskScape simulations: Takaka flood likelihood scenarios (Tasman DC)



RiskScape: Asset and topography databases

1. Collated several asset databases for RiskScape, – no single national asset register



Pre- and post-event surveys

- Spatial location + footprint
- Floor area
- Construction costs (for reinstatement)
- Attributes needed to assess damage:
 - **Asset age**
 - No. of storeys
 - **Floor height** (seldom known - floods)
 - Roof cladding (wind)
 - Roof shape (wind)
 - Eaves
 - Wall cladding
 - Openings
 - etc

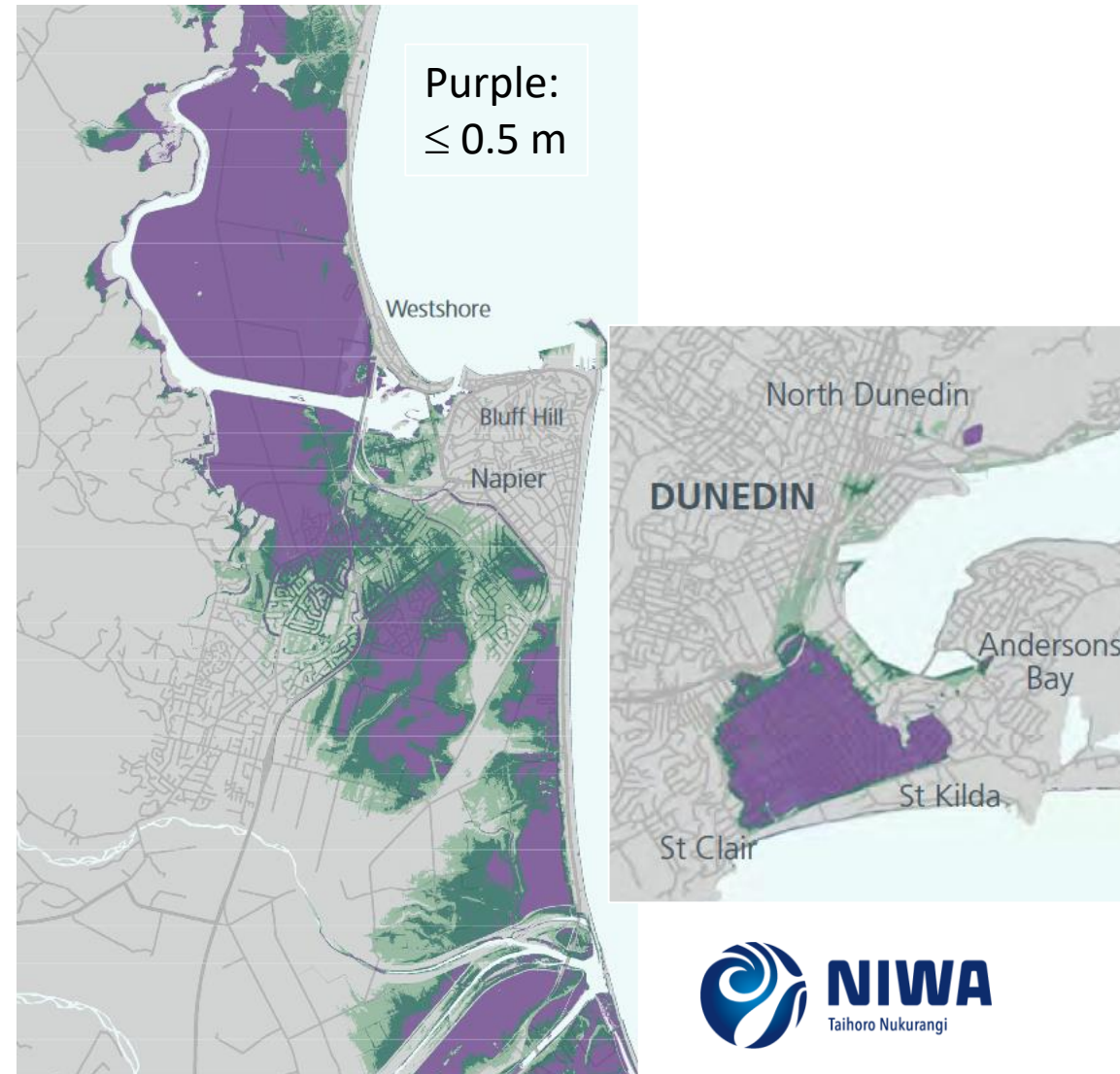
2. Topographic databases need to be accurate for flood risks – LiDAR essential

Current national topography underestimates coastal risk by 50%

NZ's coastal risk exposure for ≤ 0.5 m above spring tide

Based solely on land elevation (LiDAR)

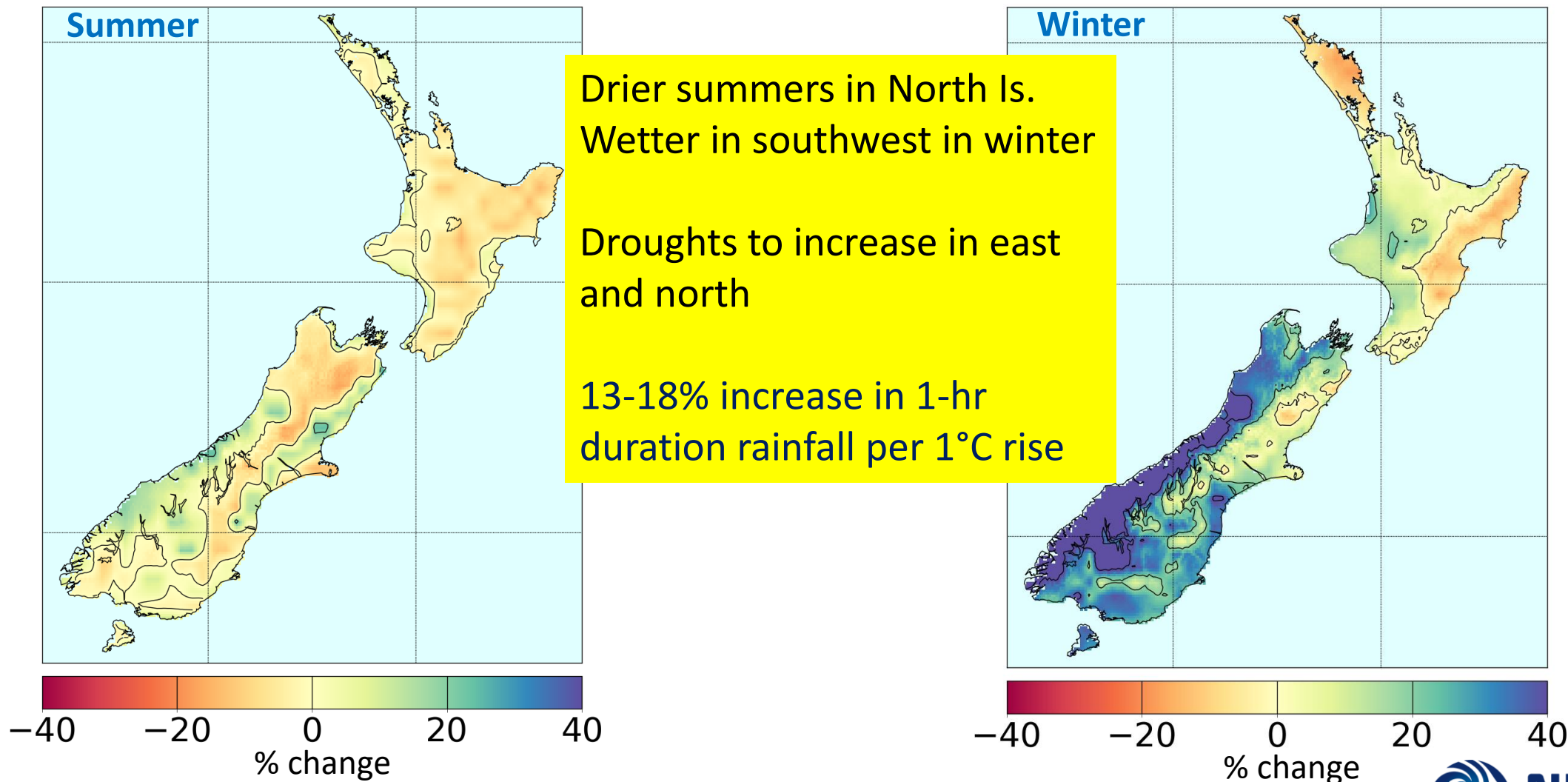
- Population (NZ Census 2013)
 - ~46,000 residents (excl. Red Zone - Chch)
- Buildings in NZ
 - Residential: ~9,000 houses
 - All types: ~13,000
 - Replacement cost (2017): NZ\$3.2B
- Roads
 - 924 km (90% are “local roads”)
 - ~65% are in Waikato/Coromandel region
- Jetties & wharves
 - ~1,500 structures (total 100 km)



Rainfall: % changes in average by 2090 (RCP8.5)

Precipitation: RCP8.5, 2090, DJF

Precipitation: RCP8.5, 2090, JJA



Financial costs of climate change-related weather events

- NIWA's Weather @ Home project – lots of simulations of severe weather events (with & without climate change)
- Worked out fraction of attributable risk (FAR) for a severe weather event due to climate change influences
- FAR ranged from 5% to 40% for rainfall events causing floods (12 events) and 15-20% for droughts (2 events)

Climate change-related floods and droughts has cost the NZ economy at least \$120M for insured damages for floods and \$720M for economic losses from droughts over the last decade

$$\text{FAR} \times \$\$_{\text{total}} = \$\$_{\text{attributable}}$$

Sample of Table 1 (floods)

Year	Date	Event	FAR	Cost (\$M)	Attributable Cost (\$M)
2007	10 -12-Jul	North North Island	0.30	68.65	20.595
2017	3-7 April	North Island	0.35	66.4	23.24
2013	19-22 April	Nelson, BoP	0.30	46.2	13.86
2017	7-12 March	Upper North Island	0.40	41.7	16.68
2015	18-21 June	Lower North Island	0.10	41.5	4.15
2016	23-24 March	West Coast-Nelson	0.40	30.2	12.08
2015	2-4 June	Otago	0.05	21.5	1.075
2015	13-15 May	Lower North Island	0.30	21.9	6.57

Source: Frame, Rosier et al (2018). Report for Treasury

Increasing risk the “new norm”

Ongoing development or intensification in hazard-prone land

More frequent and higher consequences on back of sea-level rise, more intense rainfall or dry spells

Past weather events not a reliable guide for future risks

Paradigm shift is needed to manage risk

Do we continually react, clean up & stay put?

Do we protect?

- What are limits to this strategy? Residual risk rises too

Or do we anticipate and adapt?

- Build back better or somewhere else
- Can we be adaptive and work with uncertainty
- Timely investment - not too soon, or too late
- Land use planning – reduce, hold or avoid the rising risk



Thank you

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