



Climate Leases: Property Value Under Climate Change

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Climate Sigma

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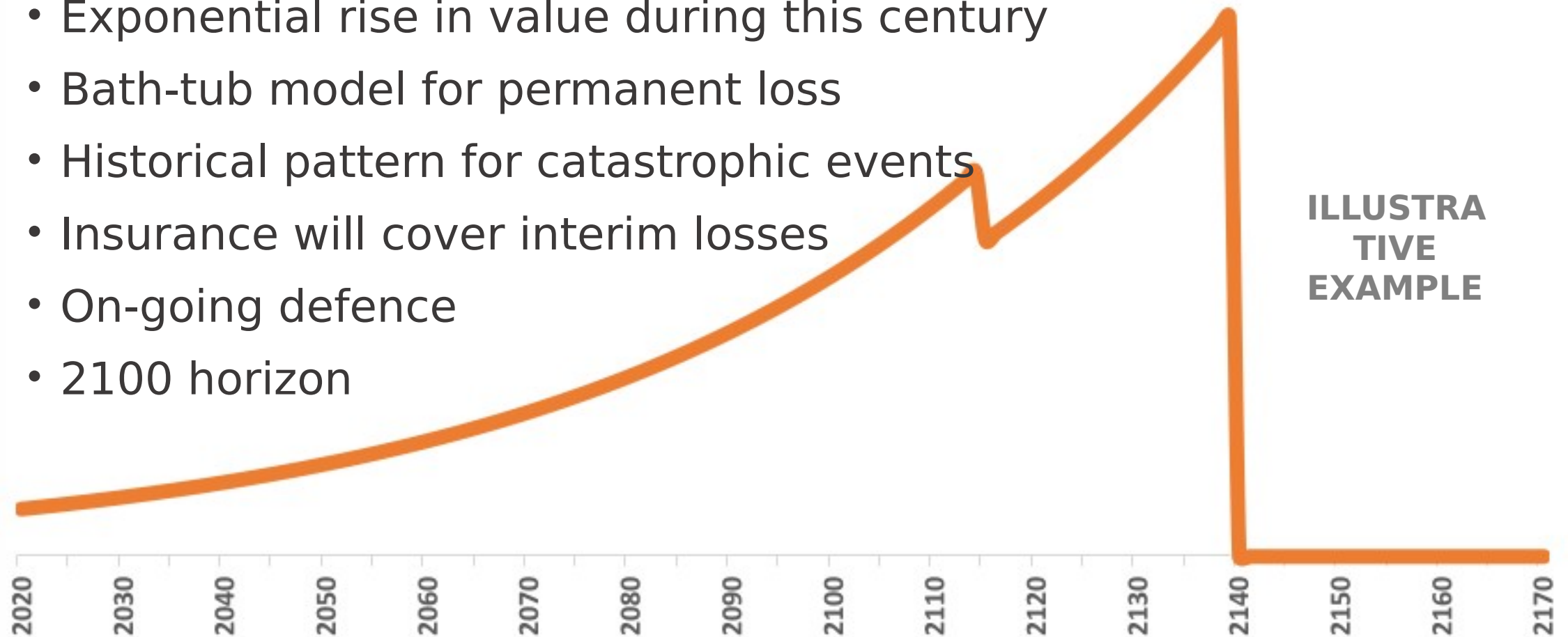
Unrelenting development in hazardous locations



Current Pricing of Coastal Property

Current pricing assumes:

- Exponential rise in value during this century
- Bath-tub model for permanent loss
- Historical pattern for catastrophic events
- Insurance will cover interim losses
- On-going defence
- 2100 horizon



Climate Change Imposing Time Limit

Climate Change Imposing Time Limit on Freehold Coastal Property

- Sea Level Rise
- Increased Storminess

Freehold Property Effectively Converting to Leasehold

- Perpetual rights (freehold) converting to temporary rights (leasehold)
- Maximum term is period of safe use

Existing Mechanisms to Convert from Leasehold to Freehold

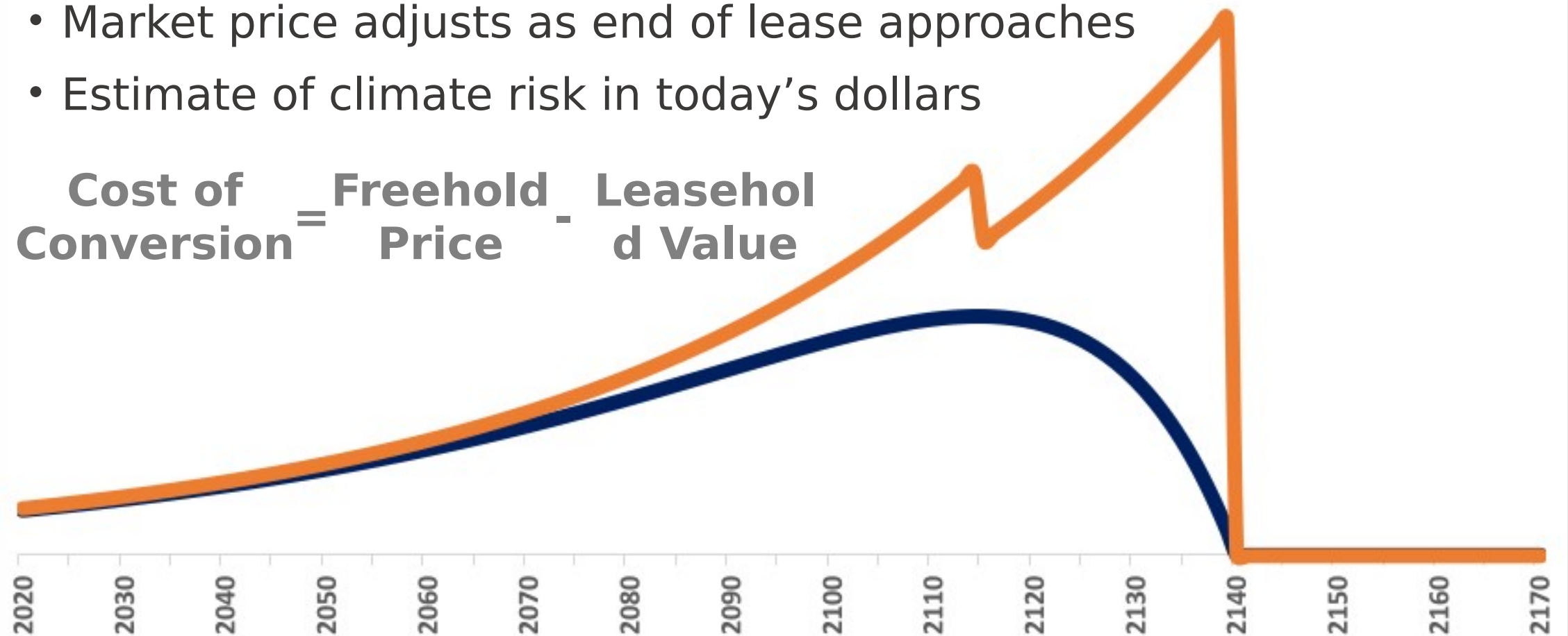
- Conversion from leasehold to freehold common in many markets
- Some conversions in opposite direction

Lease Valuation Provides Estimate of Risk

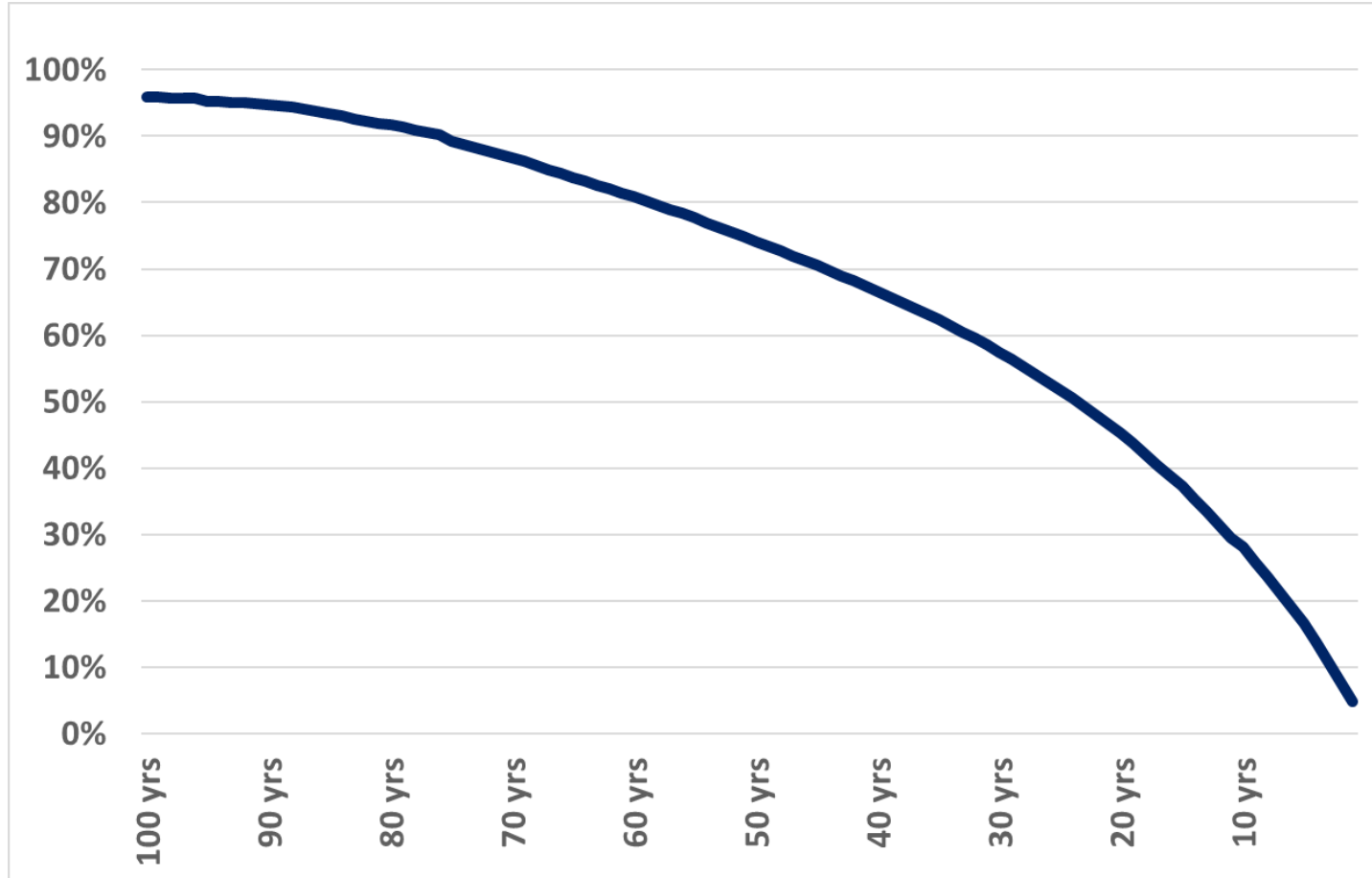
Difference Between Leasehold Value and Freehold Price:

- Market price adjusts as end of lease approaches
- Estimate of climate risk in today's dollars

$$\text{Cost of Conversion} = \text{Freehold Price} - \text{Leasehold Value}$$



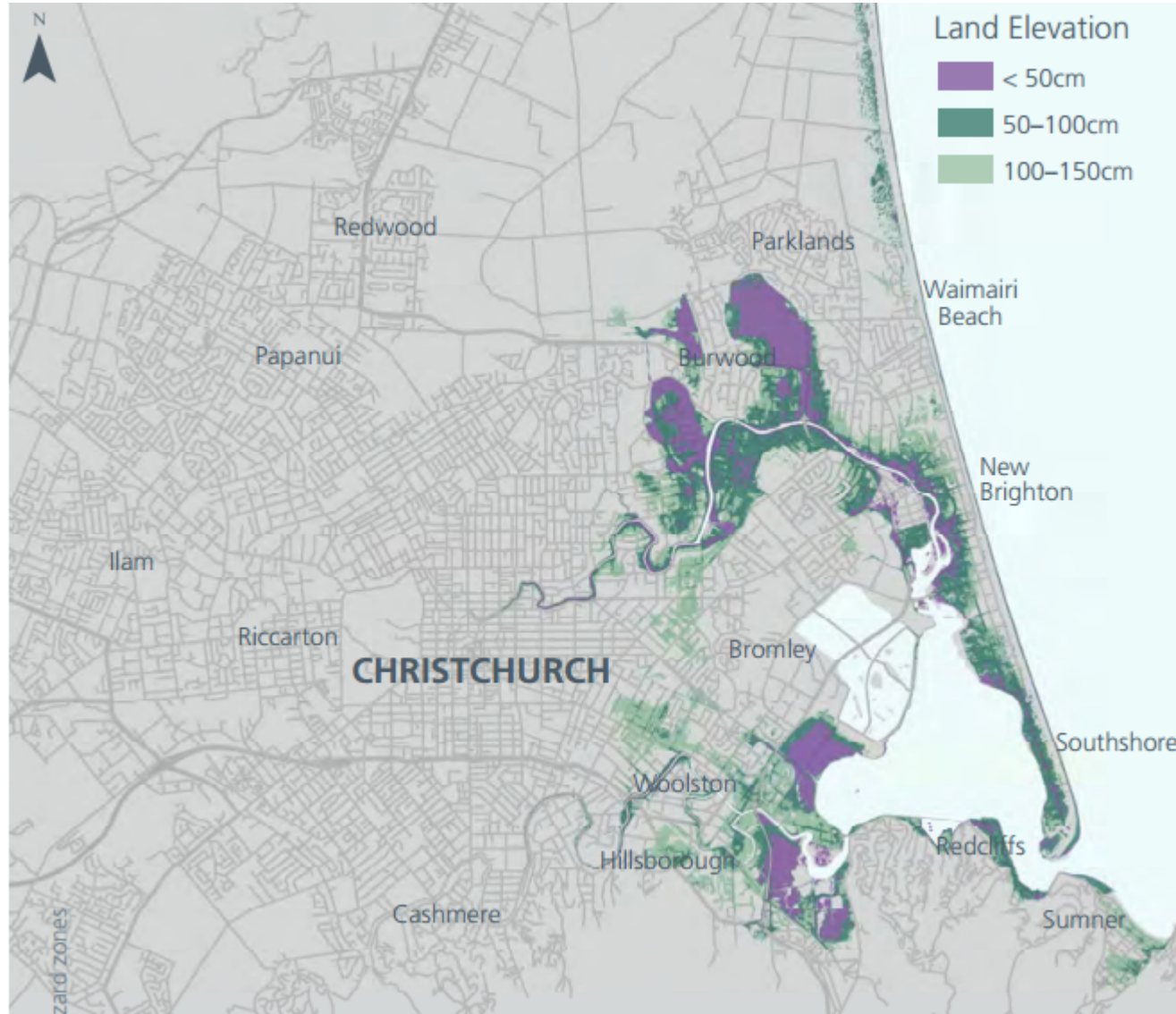
Existing Liquid Market for Leases: Central London



“Leasehold Relativity”

- Value of leasehold property as % of equivalent freehold property
- Value declines as end of lease approaches
- Assumes regular lease payment (rent)

“Bath Tub” Method of Sea Level Rise



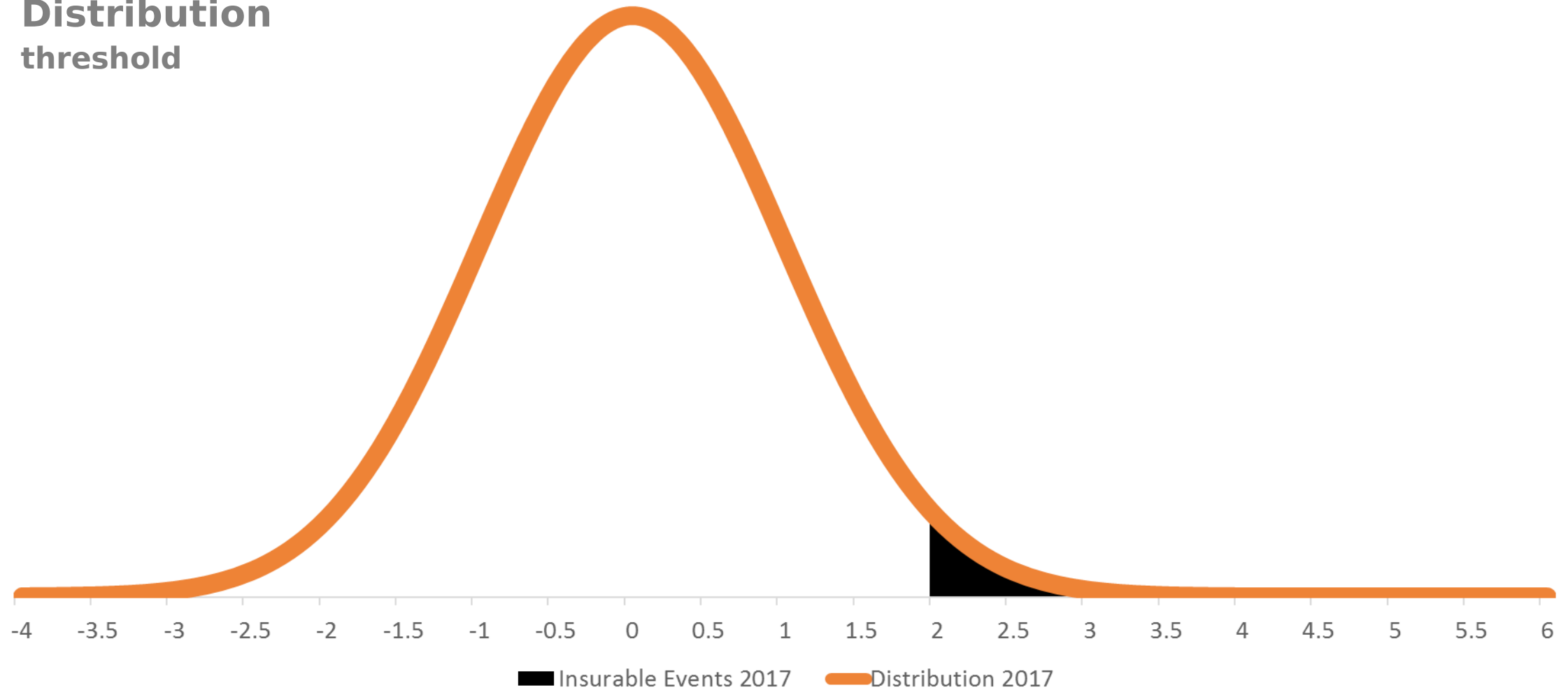
Superimpose
s expected
sea level rise
on existing
elevation

Source: Parliamentary
Commissioner for the
Environment, New Zealand,
2015

Climate Change Is Shifting Distributions

Temperature, Sea Level, Precipitation, Storm Surge...

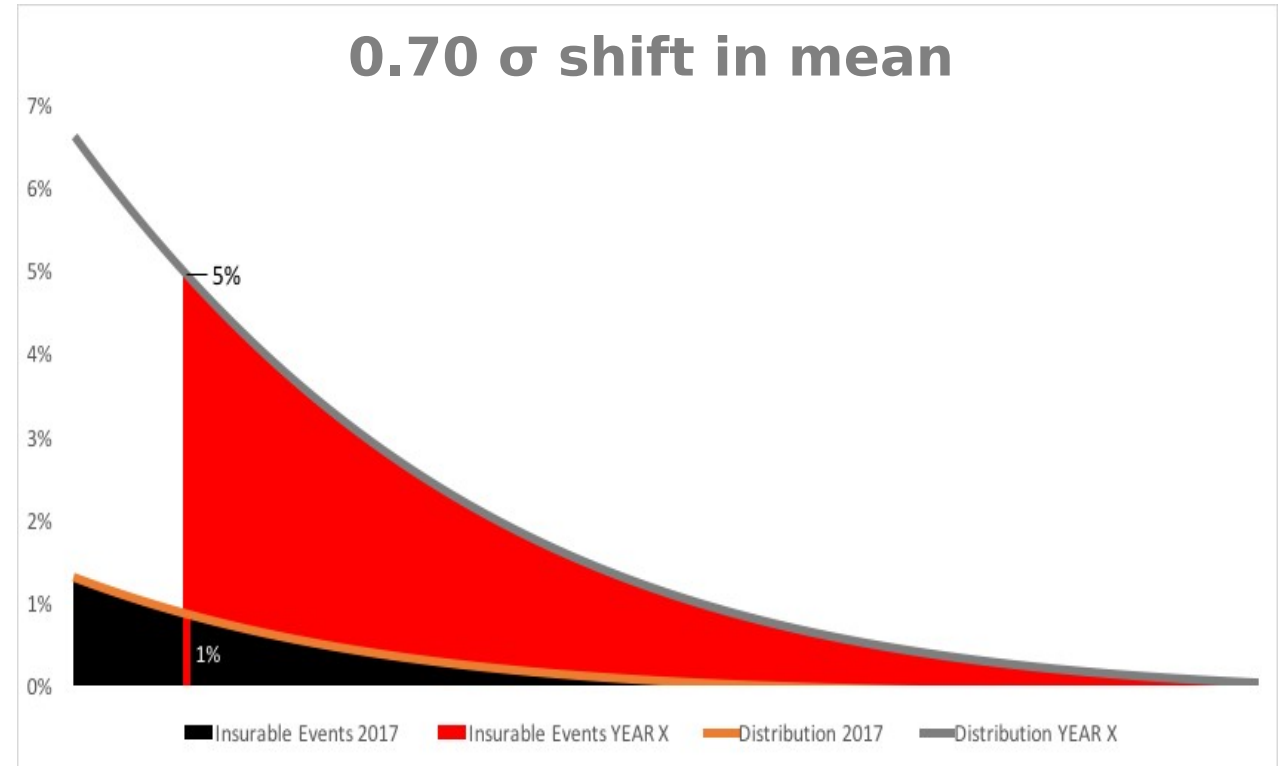
Normal Standard
Distribution
threshold



Change in σ Triggers Key Thresholds

Insurance Economics & Infrastructure Design Specifications

| Current AEP (Return Interval) | AEP Threshold | Shift in Standard Curve (σ) to Reach AEP Threshold |
|-------------------------------|---------------|---|
| 1% (100 yrs) | 5% (20yrs) | 0.70 σ |
| 0.5% (200 yrs) | | 0.95 σ |
| 0.2% (500 yrs) | | 1.25 σ |



Even modest shifts in curve
make previously low
probability events uninsurable

Case Study: Wellington

Parliamentary Commissioner for the Environment 2015 Report

| SLR | Wellington |
|-------|-----------------|
| 0cm | Every 100 years |
| 10cm | Every 20 years |
| 20cm | Every 4 years |
| 30cm | Once a year |
| 40cm | Every 2 months |
| 50cm | Twice a month |
| 60cm | 3 times a week |
| 70cm | Every tide |
| 80cm | Every tide |
| 90cm | Every tide |
| 100cm | Every tide |

With 10cm Sea Level Rise:

Properties exposed to **1% AEP** events will face those events with **5% AEP**
= 500% increase in risk

10cm SLR expected in Wellington by:

2035 - 2040 (RCP4.5)

2035 - 2040 (RCP8.5)

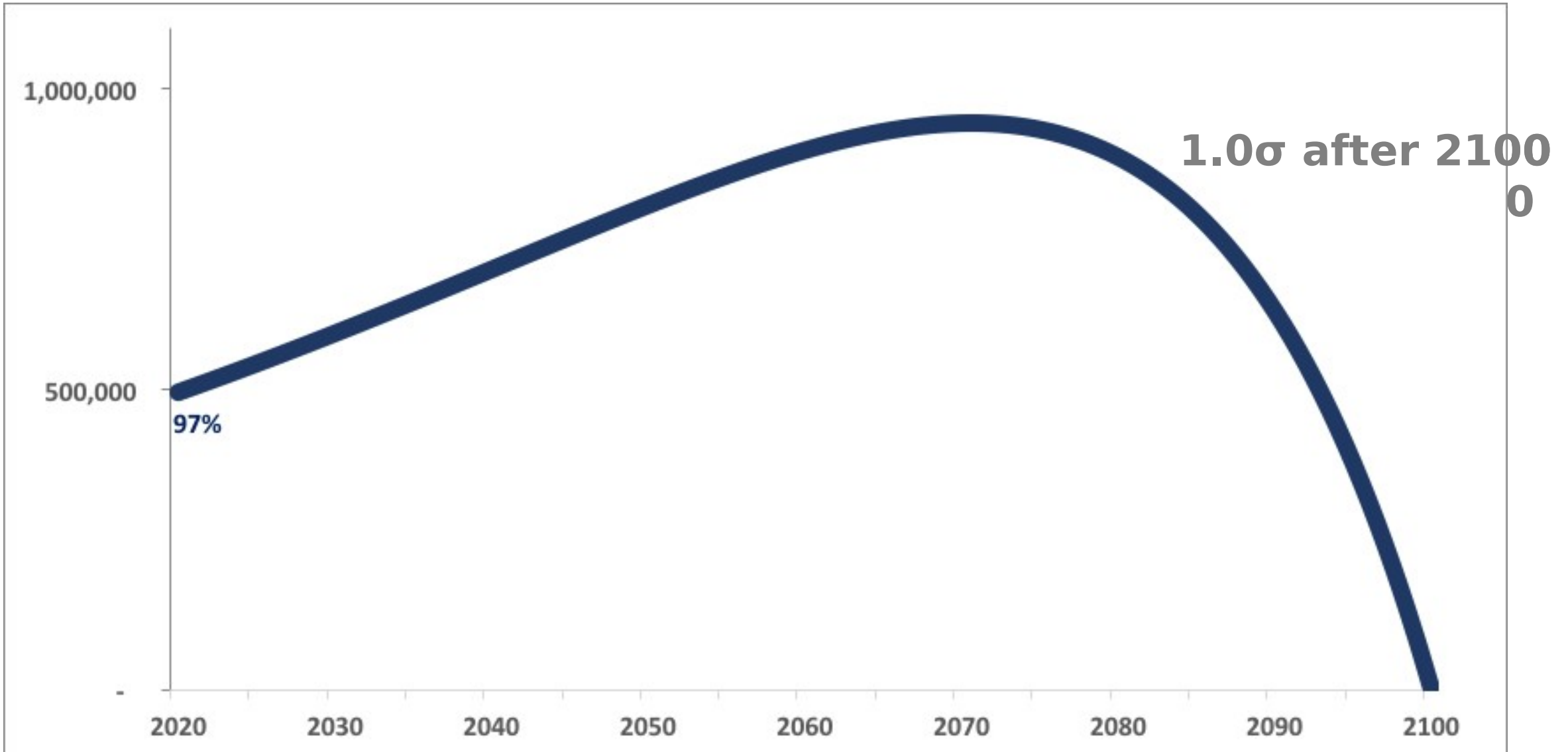
RCP: Representative Concentration Pathway, Intergovernmental Panel on Climate Change (IPCC)

Source: Hunter (2015) *Sea-Level Extremes at Four New Zealand Tide Gauge Locations and the Impact of Future Sea-Level Rise*



Climate Lease Model: Area with 0.5% AEP

\$500K property in 1:200yr inundation area



Model Exclusions

Valuation model does not address:

- Social, cultural & ecological loss
- Distribution impacts
- Unintended consequences
- Legal considerations

Implications for Loss & Damage Mechanism

Valuation model potentially:

- Quantifies permanent loss of property value
- Addresses attribution challenge of Loss & Damage
- Provides guidance on adaptation investments
- Focuses near term economic development
- Supports risk communication (i.e. Tragedy of Horizon)



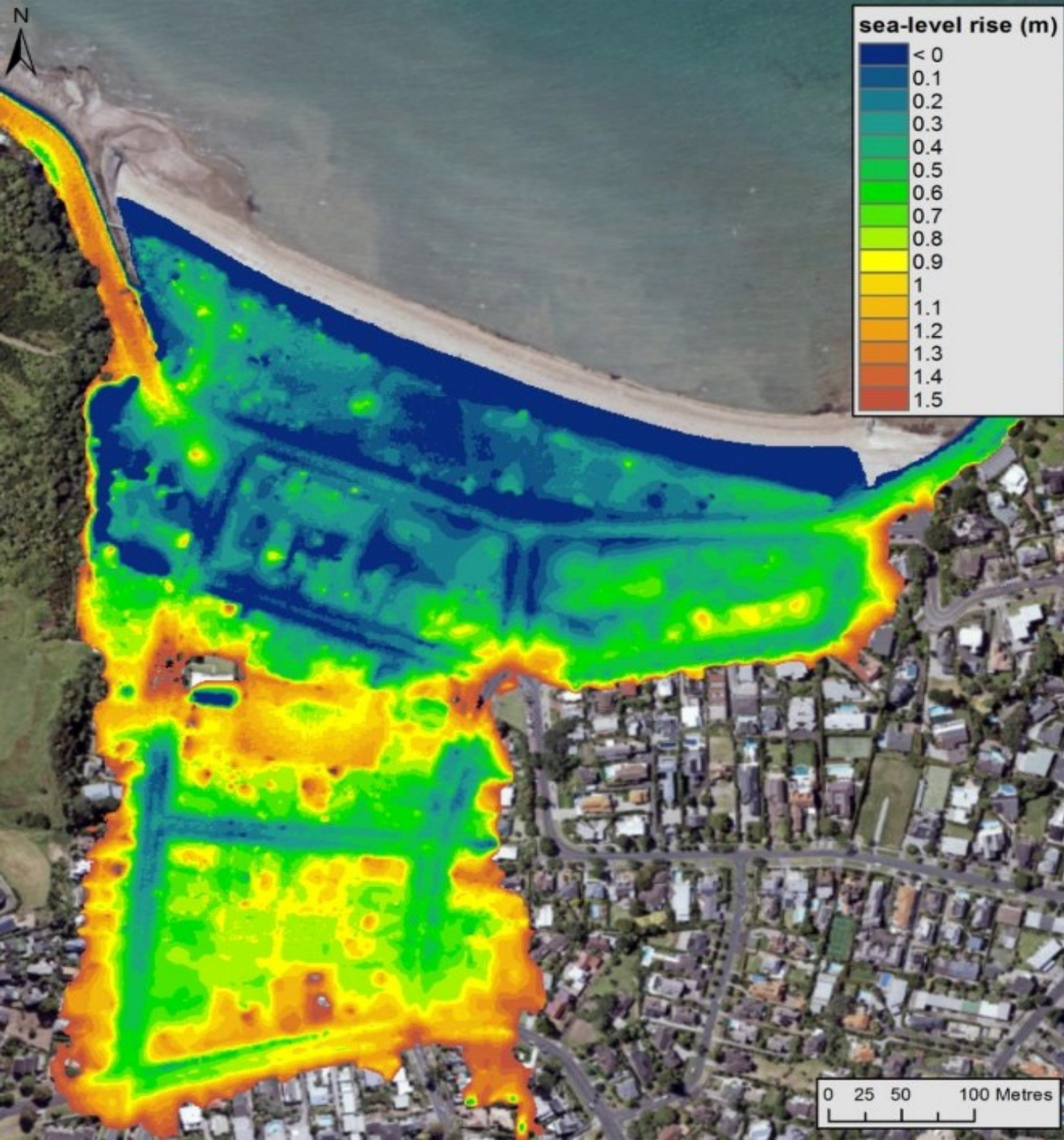
Climate leases applicable to any
Questions?
location with rapidly escalating
hazards

Climate Leases: Early Simplifications

- Normal Standard Distribution
- Constant rate of change in *distributions* over next century
- No change in shape of distribution (i.e. $\sigma=1$)
- Constant damage ratio despite increased severity of events
- Single hazard: extreme sea levels
- Single source of change: sea level rise impact on extreme sea levels

Climate Leases: Key Assumptions

- No change in price from loss of housing supply elsewhere
- No change demand from urban decay as critical mass of neighboring properties are abandoned
- No change in demand as a result of other climate change impacts
- Where insurance is not currently available, credit still retreat when risk reaches threshold
- No lease payments during the term of the lease (e.g. zero coupon)



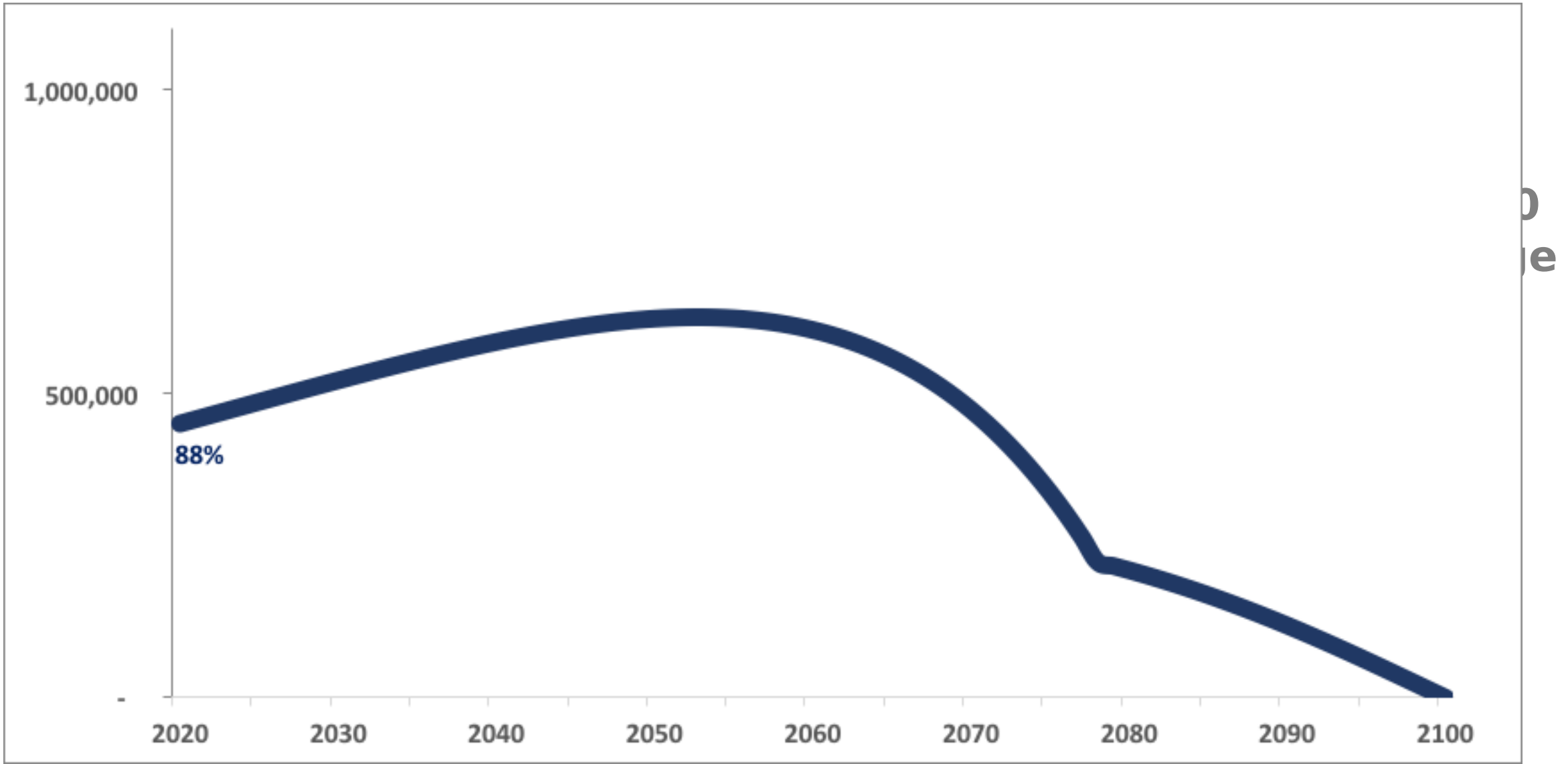
Mission Bay (Auckland)

Effect of 10cm Sea Level Rise increments on exposure to 1% AEP coastal storm

- Sea level rise only
- Change in storminess (e.g. storm surge and precipitation) not included

Climate Lease Model: Area with 1% AEP

\$500K property in 1:100yr inundation area

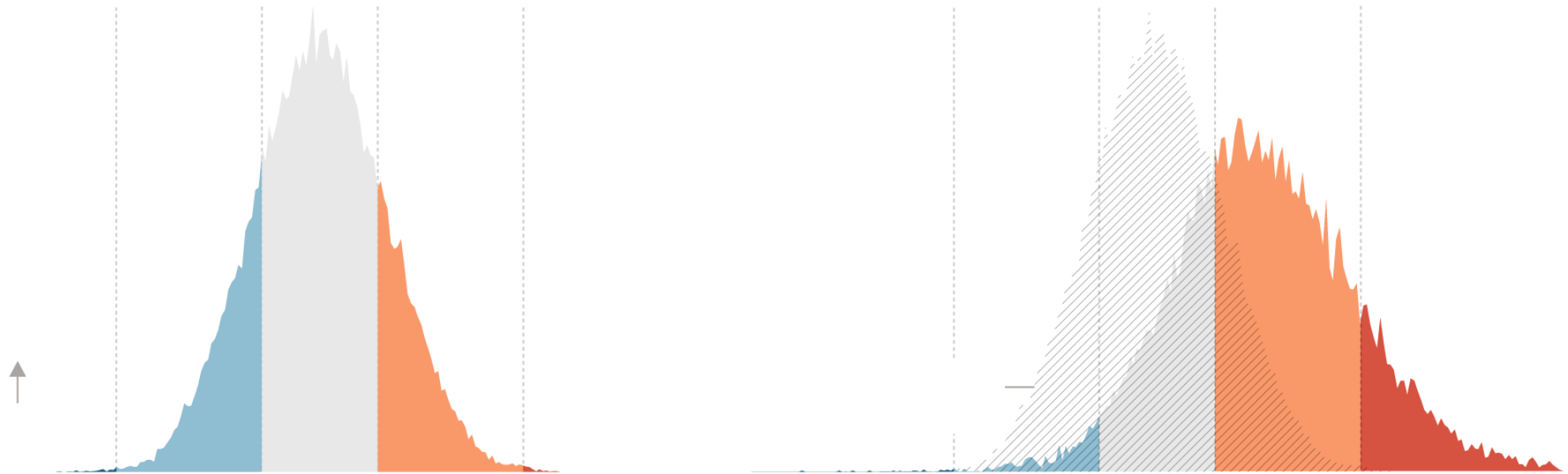


Temperature Has Already Shifted

Shift to the Right and Fatter Tails

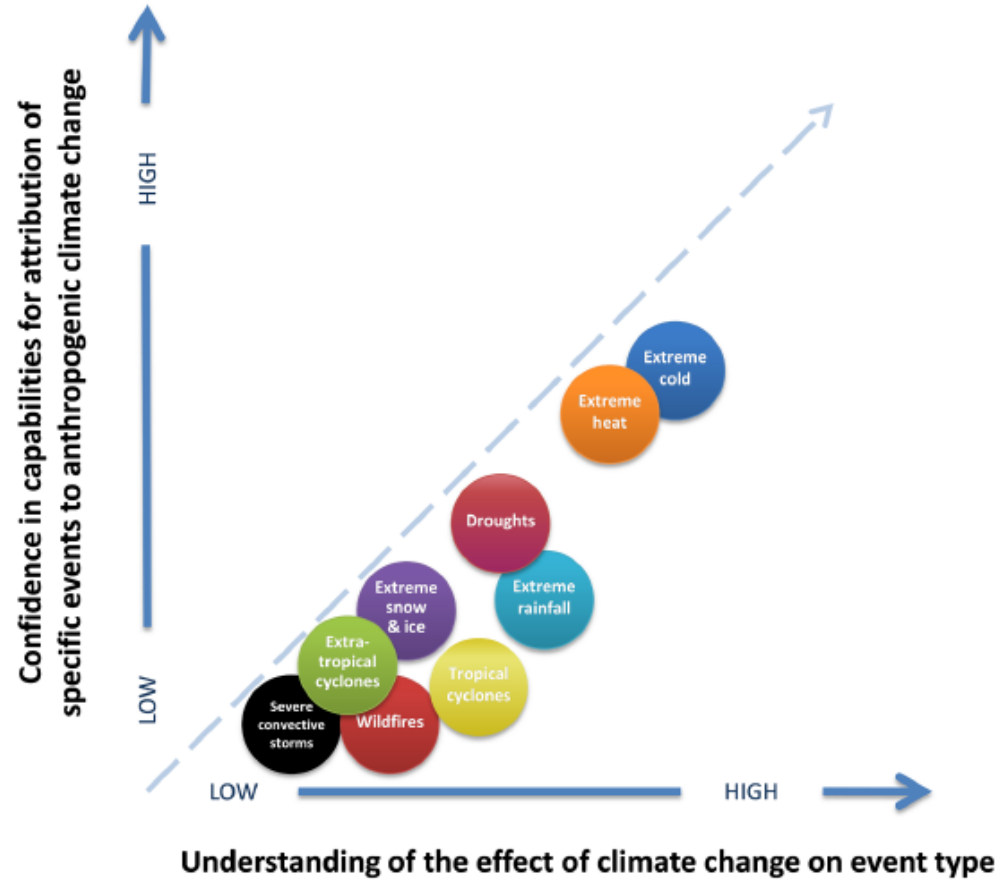
1951 - 1993

2005 - 2015



Temperature expected to move $\sim 3.0\sigma$ by 2050

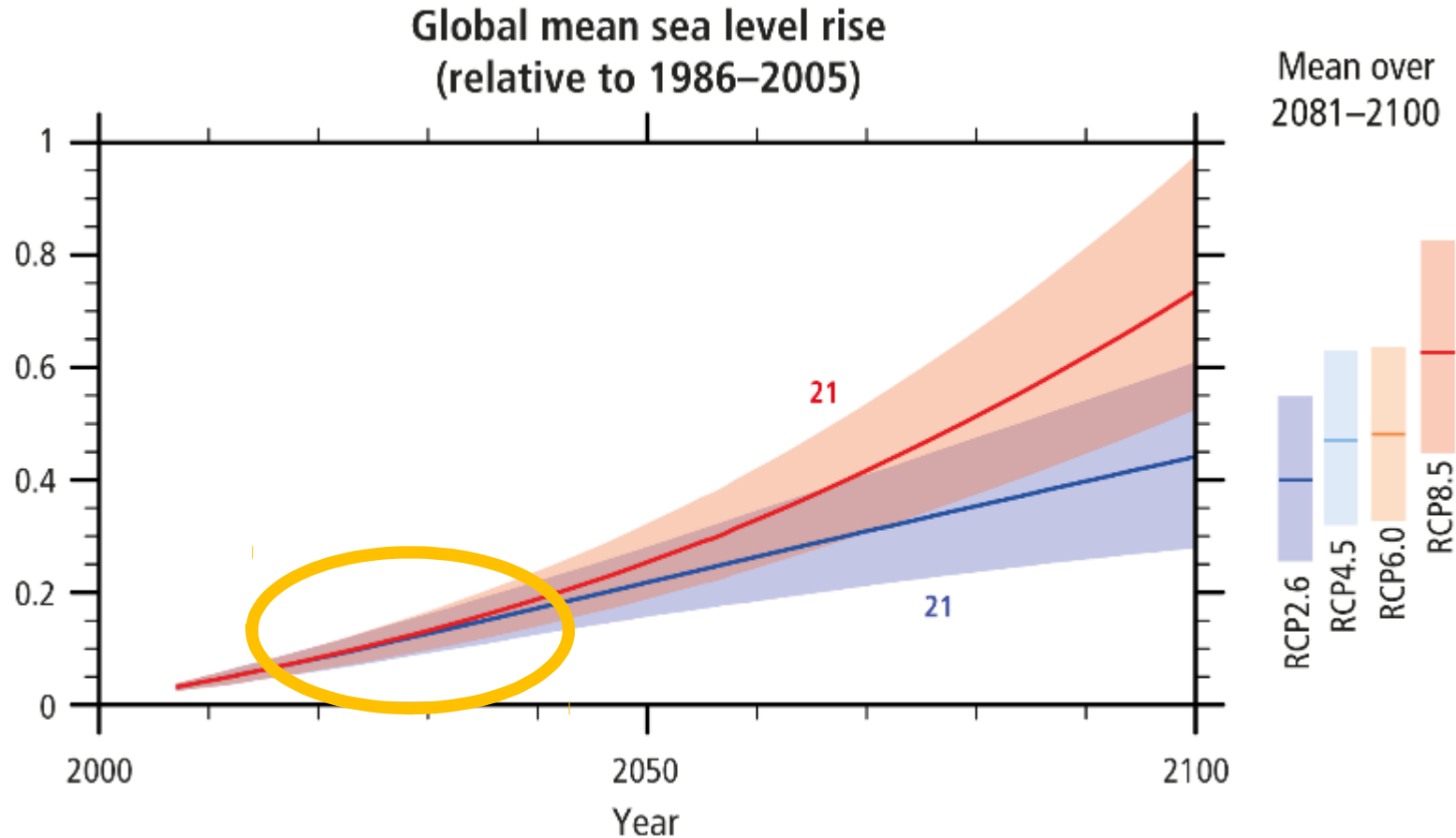
Confidence in Attribution of Extremes



From: PNAS assessment (2016).

IPCC 2013: Global Mean Sea Level Rise

Relative to 1986 - 2005



Excludes any sea level rise from ice sheet collapse

Little divergence between scenarios until after 2040