General Insurance Seminar

Insuring Tomorrow

Actuaries Institute

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Can actuaries really afford to ignore climate change?

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No

Can actuaries really afford to ignore climate change?

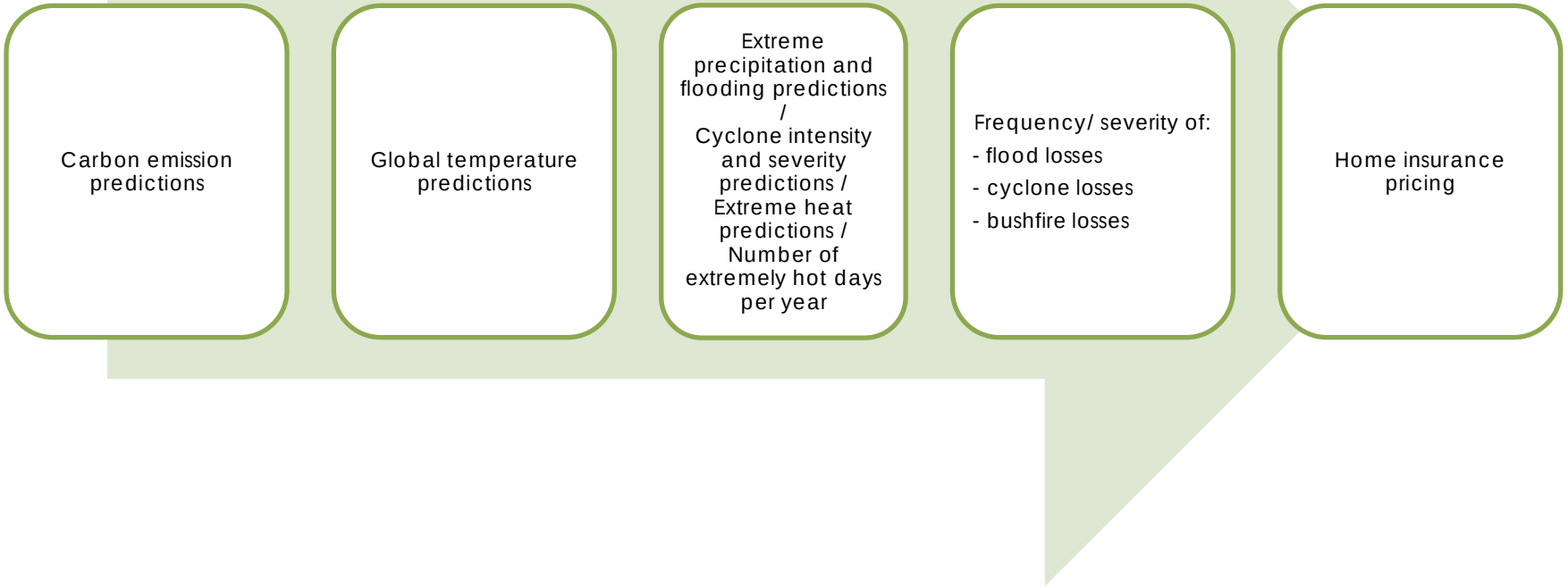
- **… because it's our job:**
  - To understand and manage the insurance risk through pricing and capital
  - To ~~do~~ interpret and apply the science
- **Role of actuary in home insurance**
- **What we've done and what we've found**
- **Current climate science**
- **Case study – Cyclones**
- **What needs to be done**

Role of the actuary

- Providing clear unbiased advice to Insurance boards and regulators
- Advising home/property insurance underwriters, claims and portfolio managers on improving rating models, adjusting premiums and managing risk
- Advising governments on implementing cost effective mitigation
- Assisting insurers in understanding affordability problems and managing reputation and political risk
- Understand implications for capital and reinsurance

What have we done?

Framework



What have we done?

- **Collaborated with experts in climate science**
- **Augmented previous work with scenario modelling**
  - Bushfire, Cyclone and Flood only
  - Based on latest scientific knowledge (IPCC)
  - Detailed home insurance portfolio pricing analysis
- **Framework**
- **Identified gaps and priorities**
- **Not done yet!**
  - Other perils + multiple perils: Hail, Coastal, Storm surge, erosion, drought
  - Excluded uninsured property: public assets and currently unaffordable
  - More climate science and actuarial science required

What did we find?

- Wide range of increases by 2100
- Affordability, Affordability, Affordability
- Abrupt changes are scary

What did we find?

1) Wide range of increases by 2100

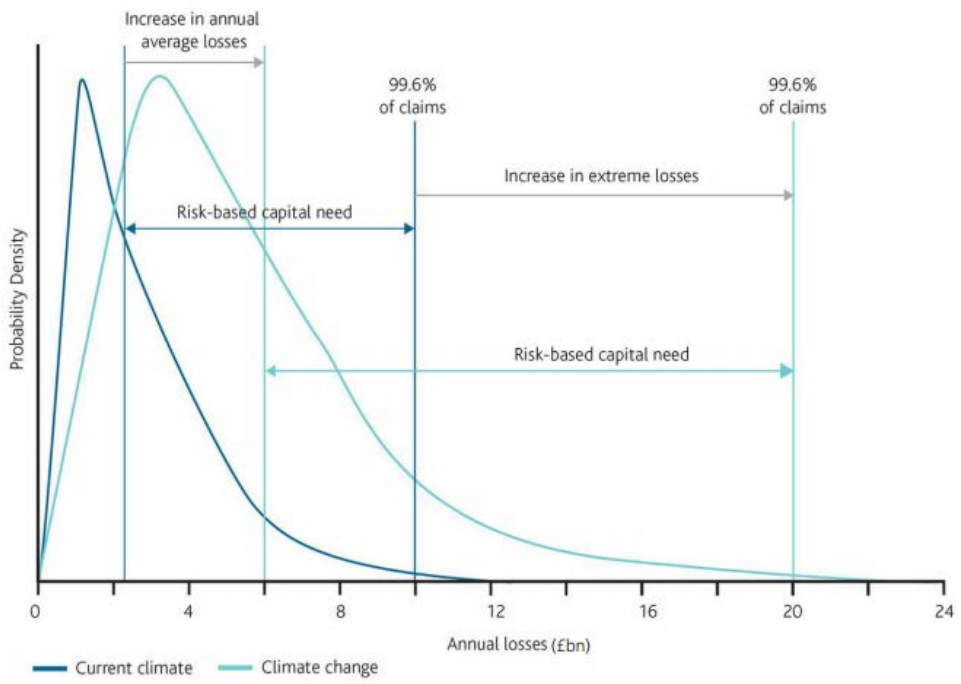
- Uncertainty in the future emissions levels
- Uncertainty on impact on perils, especially cyclones
- Uncertainty at local vs global level
- Generally results of same order as previous studies, but our results likely to **understate increases**
  - Other + multiple perils
  - Missing low probability high severity climate events
  - Changes in exposure due to economic growth
  - Changes in pricing, including cost of capital
  - (No allowance for mitigation & adaption)

Peril	2013 claims cost $M	Predicted Increase
Bushfire	134	29% to 116%
Cyclone	302	0% to 230%
Riverine Flood	414	7% to 54%

What did we find?

Capital requirements

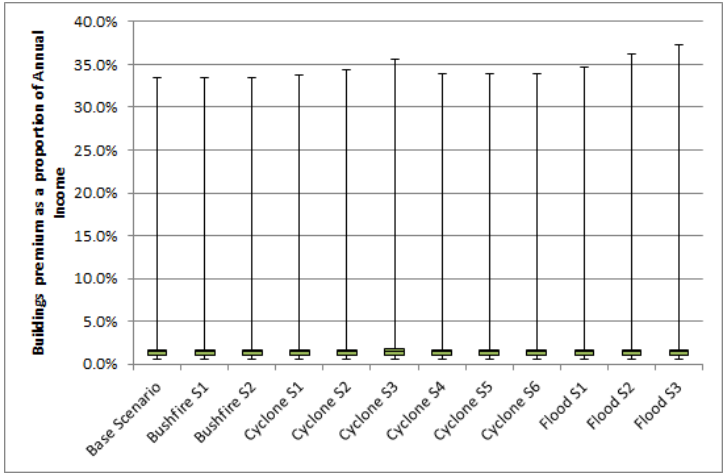
- For skewed loss distributions, with VaR based capital requirements, required capital increases by more than average annual loss
- No allowance for this in our figures



What did we find?

2) Affordability is the big problem

- As expected - no impact on median home (low exposure to bushfire, cyclone and flood)
- As expected - Mean homes see increases up to 12%
- 300k homes see real increases up to 48%
- 60k-80k homes see real increases up to 104%
- Likely to under estimate:
  - Same reasons as mean
  - Also variability within geographic zone
  - Homes with currently unaffordable insurance excluded
- Location, Location, Location
- Mitigation, Mitigation, Mitigation



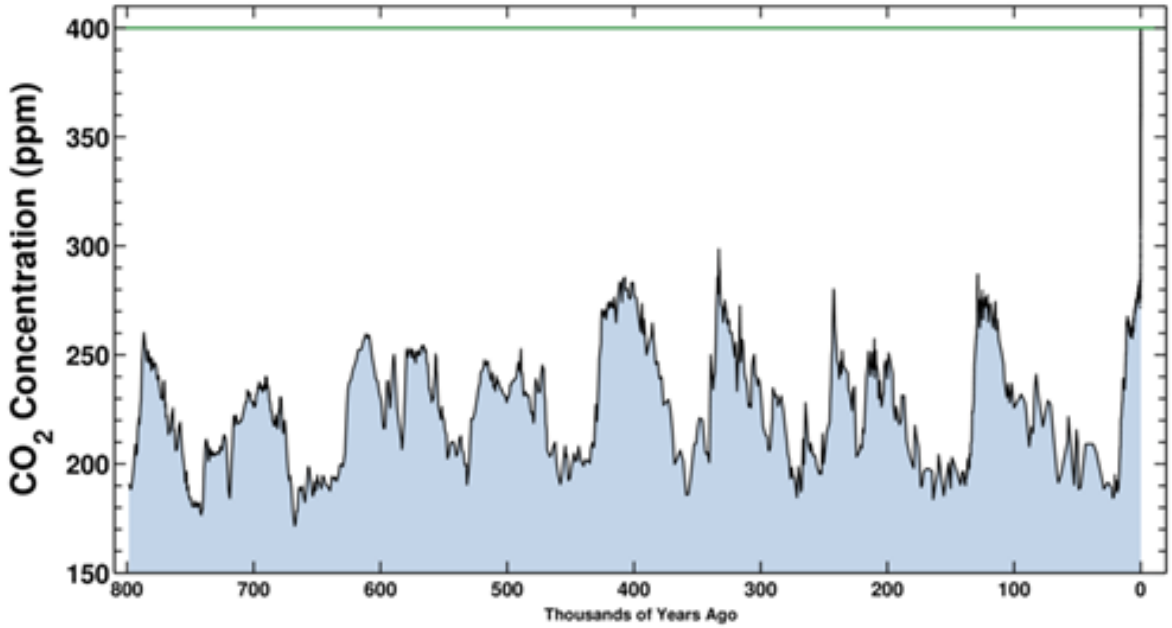
What did we find?

3) Potential for abrupt changes

- **No allowance in our results for "within pathway" variability**
- **No allowance in climate models for "abrupt events" with low probability, high severity**
  - Ice sheet collapse
  - Permafrost and clathrates melts
  - Soil carbon loss
  - Boreal and tropical forest collapse
- **Individually small probabilities of occurrence by 2100 … but**
  - what about overall annual changes?
  - What about 1-in-200 year capital levels?
  - Further work needed
  - For now, scenario testing

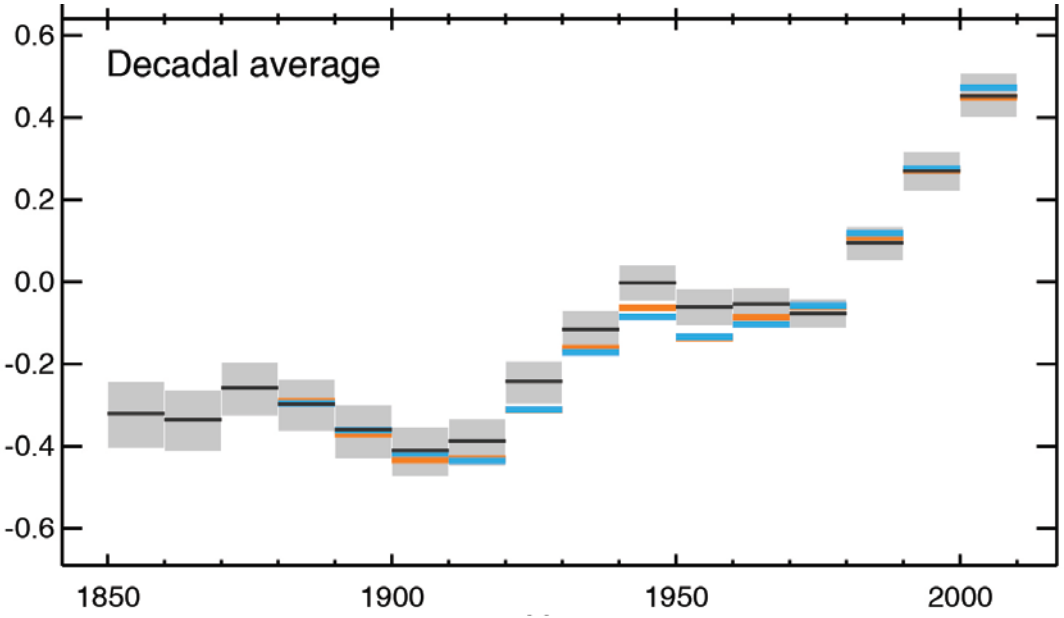
Current climate science

- Historical increases in atmospheric carbon dioxide



Current climate science

- **Historical increases in temperature**

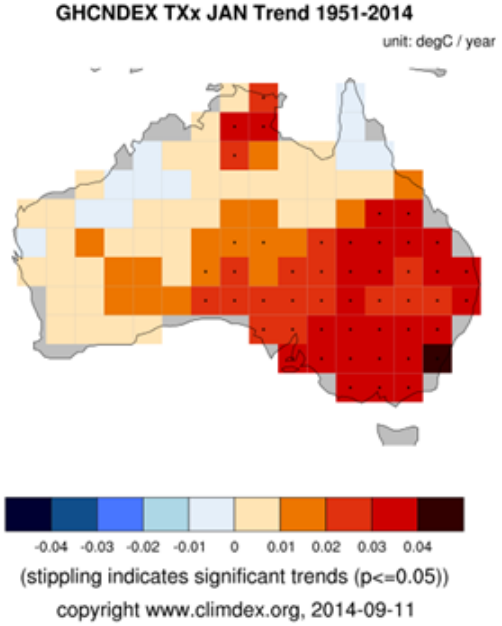


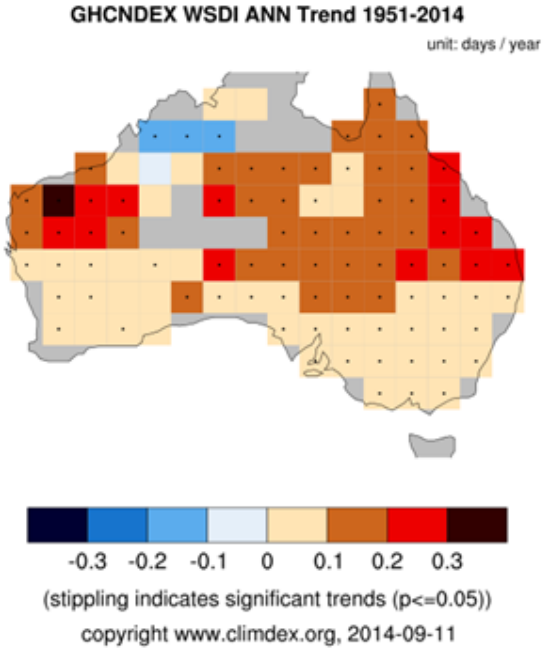
Each of the last 3 decades warmer than preceding decade

2014 warmest on record – remarkable given no El Nino.

Current climate science

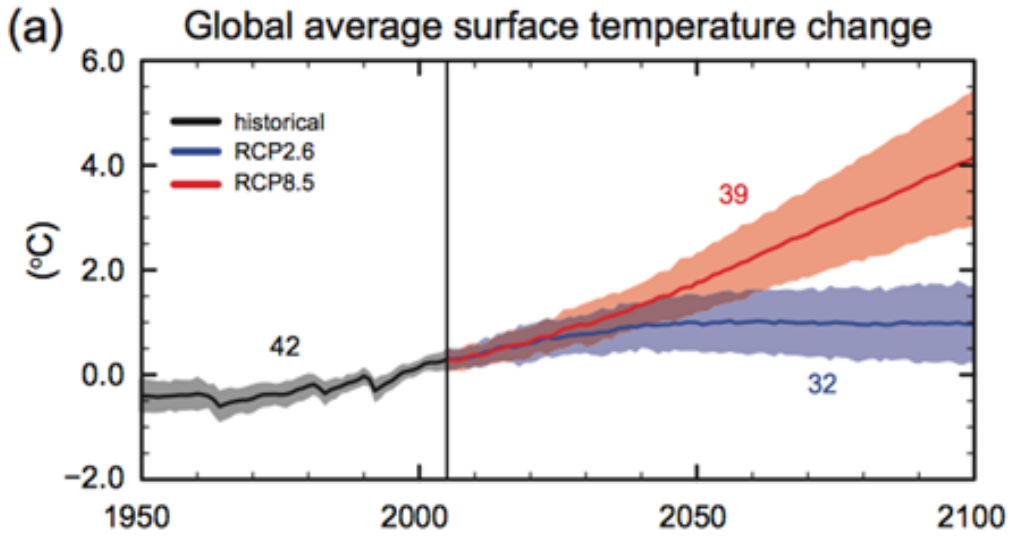
- How climate change is affecting catastrophes in Australia: heatwaves

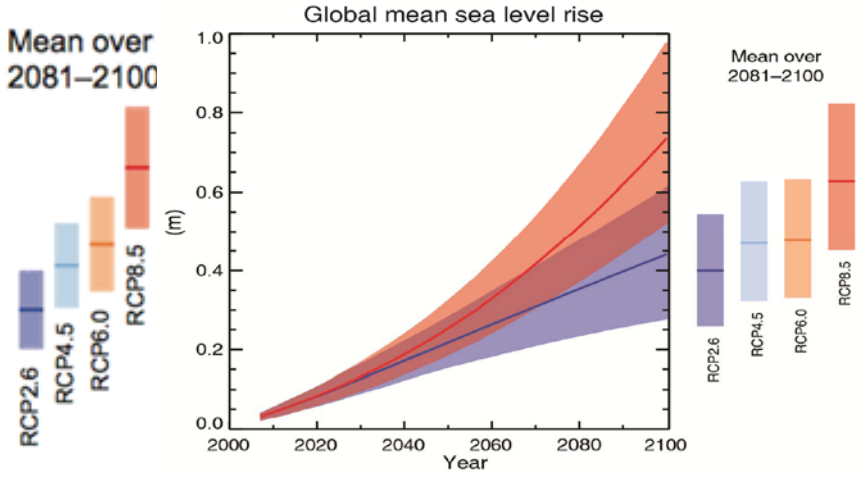




Current climate science

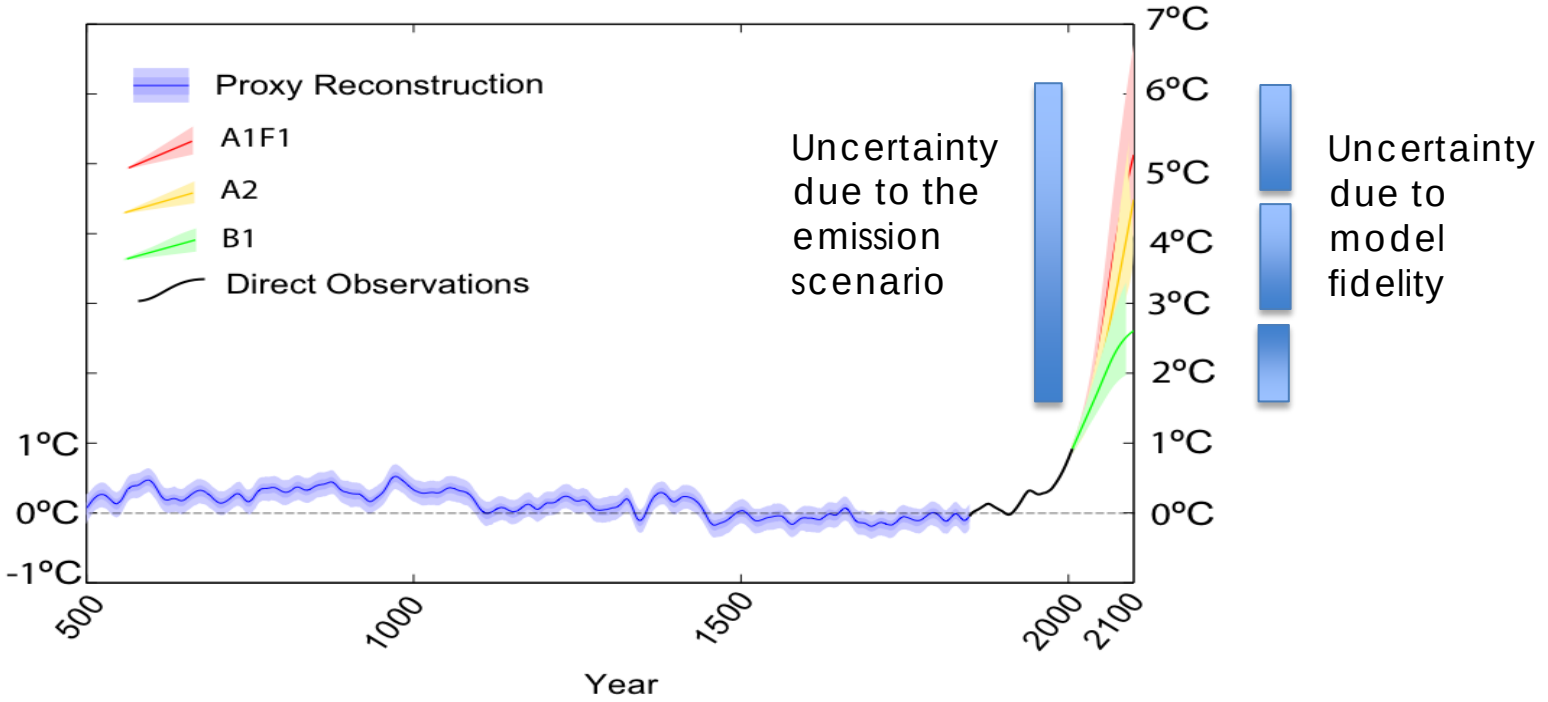
- Future increases in temperature and sea level





Current climate science

- **Uncertainties in climate predictions**



Uncertainties in climate predictions

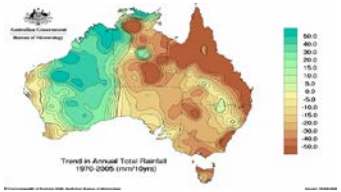
Decreasing value

Decreasing skill

✔

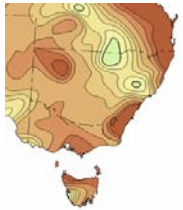
Global

✔



Continent

? - developing



State

✗

City / catchment

Current climate science (cont.)

- **Abrupt changes in the climate system**
  - 'Very unlikely' with probability of 0-10%
    - Atlantic Meridional Overturning circulation (AMOC) collapse
    - Catastrophic methane release
    - Ecosystem collapse
  - 'Exceptionally unlikely' with probability 0-5%
    - Ice sheet Collapse
  - Reversing these changes are either unknown or not reversible for thousands of years

Cyclone Case Study

Cyclone Case Study

	Literature
Historical Observations	(IPCC, 2014)medium confidence: • There has been no regional change in the number of tropical cyclones or in the proportion of intense cyclones over the period 1981-2007, • The frequency of severe land falling tropical cyclones in north east Australia has declined significantly since the late 19th century, and • The east-west distribution of tropical cyclones has changed since 1980.
Projected change	(IPCC, 2014)low confidence: • Tropical cyclones are projected to increase in intensity but their frequency is projected to remain similar or decrease. • Tropical cyclones are predicted to occur further south.

Cyclone Case Study

- **Why is it tricky to understand future cyclone activity?**

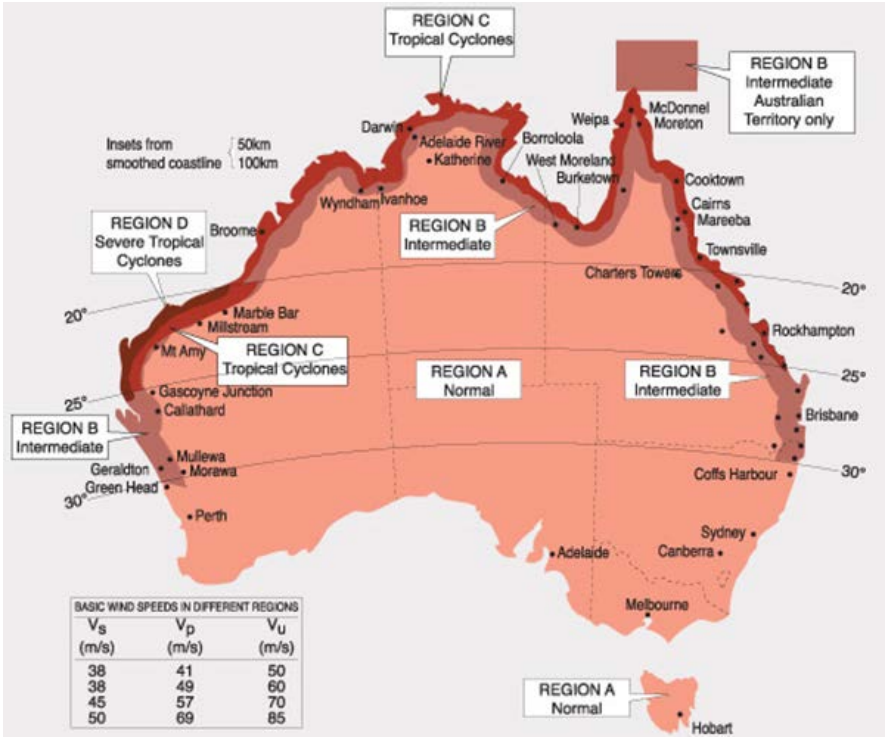
Ocean Basins	Effect of Ocean Warming	Effect of Wind Shear Change	Effect of Relative Humidity Change	Net Effect
Atlantic and East Pacific	↑	↓	↓	?
West Pacific and Indian Ocean	↑	↑	↑	↑

Cyclone Case Study

- **Scenarios 1 to 3 – Examining increase in cyclone intensity**
  - Difficulty finding linkage between increase in wind speed and building damage in AUS literature
  - Used damage functions from US Hurricane studies. Is that appropriate?
  - small increases in intensity lead to damages of much higher magnitude, e.g. increase in wind speed of 8.7% leads to increase in damage of 104% (Nordhaus 2006)
  - 30%, 100% and 230% increases in losses

Cyclone Case Study

- **Scenarios 4 to 6 – Examining pole ward shifts**
  - Each scenario considered a shift of 1 degree latitude in cyclone genesis and decay
  - Abbs and Rafter (2009) predict shift of 100km (approx 1 degree)
  - Holmes (2008) recommends extending cyclone prone region C down 2 degrees
  - 3 degrees movement encompasses Brisbane and Gold Coast



Cyclone Case Study

- **Scenarios 4 to 6 – Examining pole wards shifts (cont.)**
  - Real impacts to cyclone AAL range between 15%-68%
  - Brisbane cyclone premium rates would increase by over 250% under southern shift of 3 degrees
  - Decaying cyclone region could extend as far as Newcastle NSW and Perth WA

What we haven't done that needs to get done

- **Further actuarial work**
  - Consider other perils, e.g. storm surge, hailstorms
  - Impact of co-incident events
  - Impact of abrupt changes to climate system
  - Impact of expected exposure changes to population
  - Impact on other classes of insurance

- **Further climate modelling**
  - Understanding the variability as well as the mean of climate simulation outcomes
  - Increasing the granularity of climate models, both geographically and in time increments
  - Further research on cyclones and flooding in Australia