general insurance seminar
Tides of Change
12-13 November 2012
Sofitel Sydney Wentworth

Actuaries Institute

Practical Stress Testing using Realistic Disaster Scenarios

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Aim of the Research

- To develop a methodology and a series of realistic disaster scenarios (RDS) to provide insurers with property exposures in Australia a practical approach for stress testing against loss from physical catastrophes

The Need for an RDS Approach

- Concentration risk management
  - APRA identified “a lack of analysis using stress testing or scenario analysis to set the risk appetite” in a recent industry review
- Less complex approach
  - Easily understood by non-technical board members
- Good practice
  - Multi-model doesn’t just mean running multiple stochastic cat models

Existing Global Approaches

- Lloyds
  - 10+7 predefined events >USD100bn
  - Includes double events
  - Event Damage Factor tables
- Karen Clark and Company
  - “Characteristic Events”
  - Events are “floated” to ensure stability

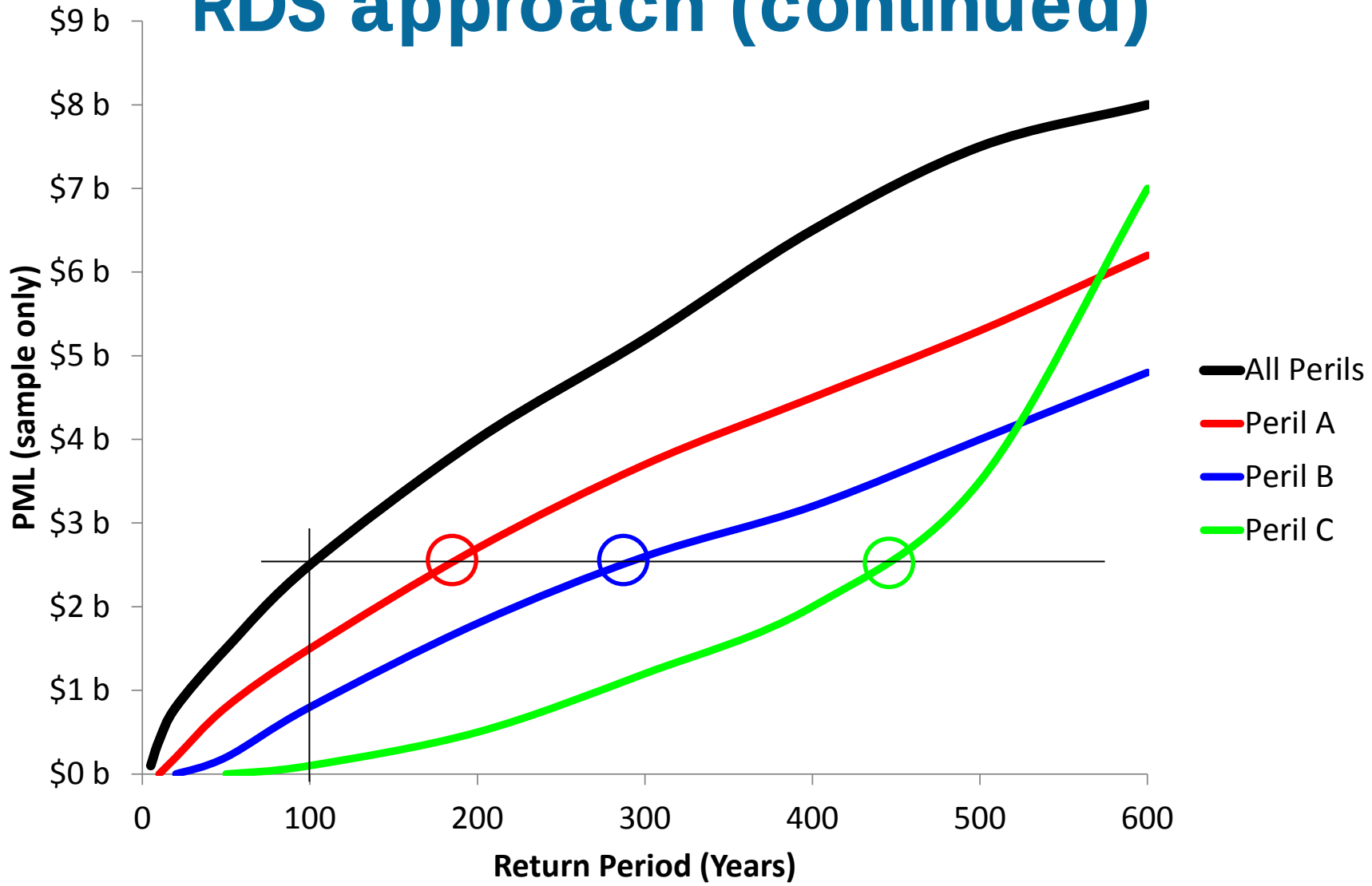
Scope

- Geographical
  - Australia
- Classes
  - Residential, commercial, industrial, motor
- Perils
  - Cyclone, earthquake, bushfire, flood, storm, hail

RDS approach

1. Develop insurance industry Probable Maximum Loss (PML) curves by peril
2. Determine all perils industry PMLs
3. Define scenarios for each peril to demonstrate individual and all perils losses at the 1-in-100 and 1-in-200 year levels
4. Apply scenarios to insurance portfolios to estimate RDS losses

RDS approach (continued)



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Previous research

- Industry exposure → Redo
- Cyclone model → Rescale
- Earthquake model → Rescale
- Other Perils model → Redo
- Terrorism → Remove

Inflation

- Population growth
  - ABS Census 2011 Estimated Resident Population Australia
- Inflation
  - CPI All Groups Australia
- Wealth
  - GDP per capita: Chain volume measure

- Applied to exposures and losses to 1/1/2013

Cyclone

Event set simulation

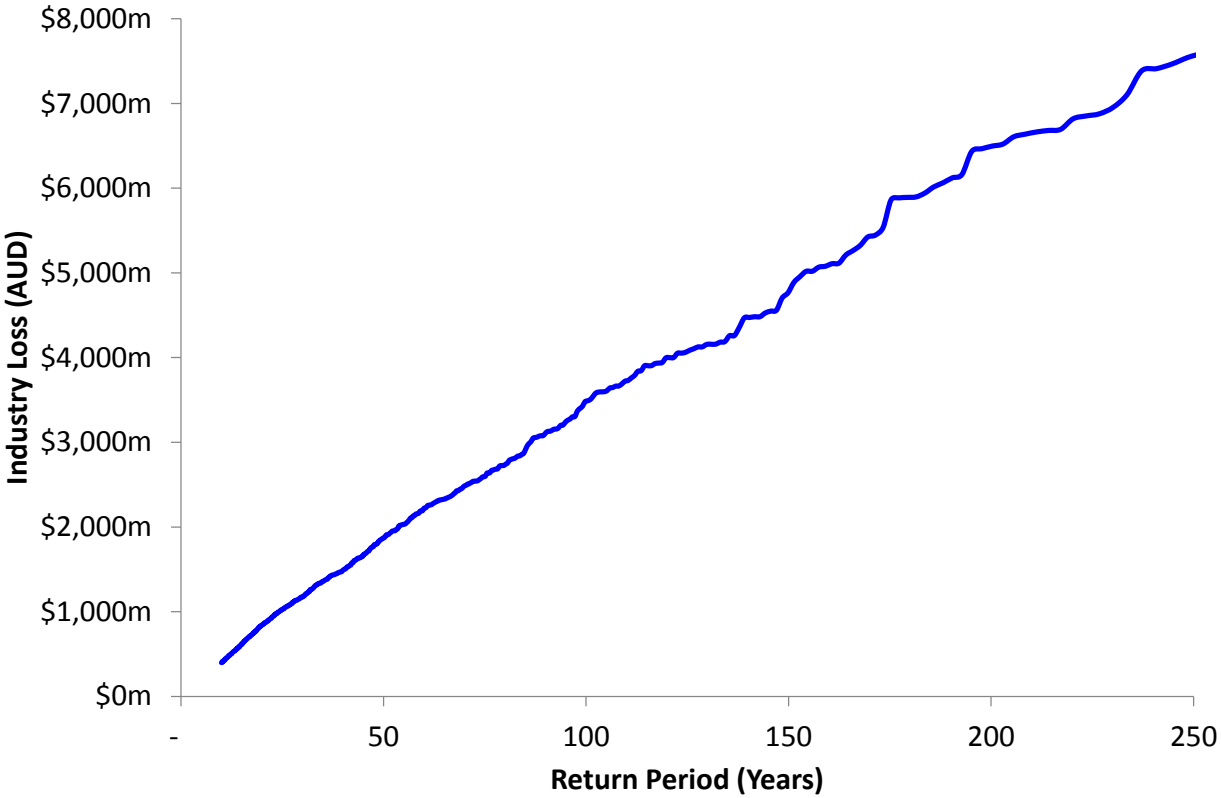
- Full tracks generated from 100 starting gates

Hazard and loss

- Allows for terrain, topography and local building codes

Financial adjustments

- Includes demand surge and scaled to 1/1/2013



Earthquake

Event set simulation

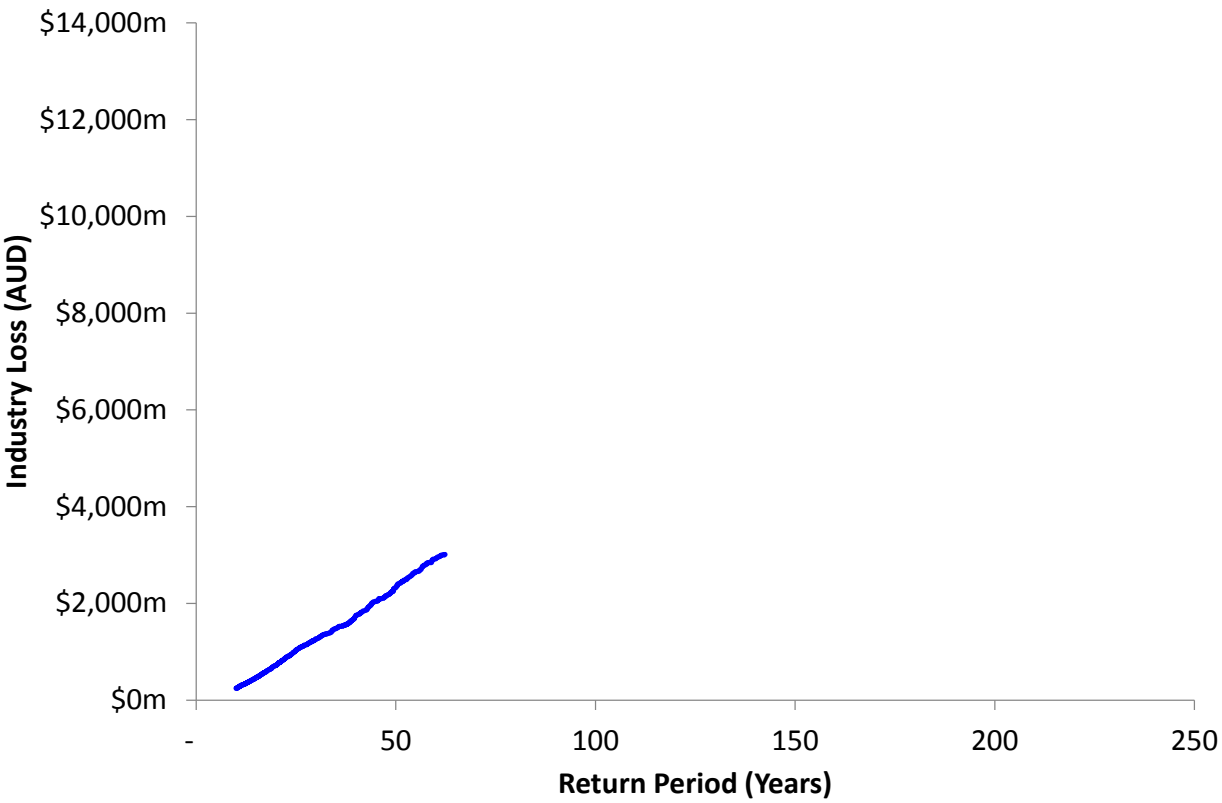
- Australian and Indonesian events on land and under sea

Hazard and loss

- Allows for soil effects and improvements from building codes

Financial adjustments

- Includes demand surge and scaled to 1/1/2013



Losses for "Other Perils"

- Industry losses from ICA event list, rescaled to 1/1/2012 by Risk Frontiers
- Rescaled to 1/1/2013 and ranked to create low return period PML curves
- Upper limits fitted to published research on maximum potential events

Bushfire

Top ICA Events (1967-2012)

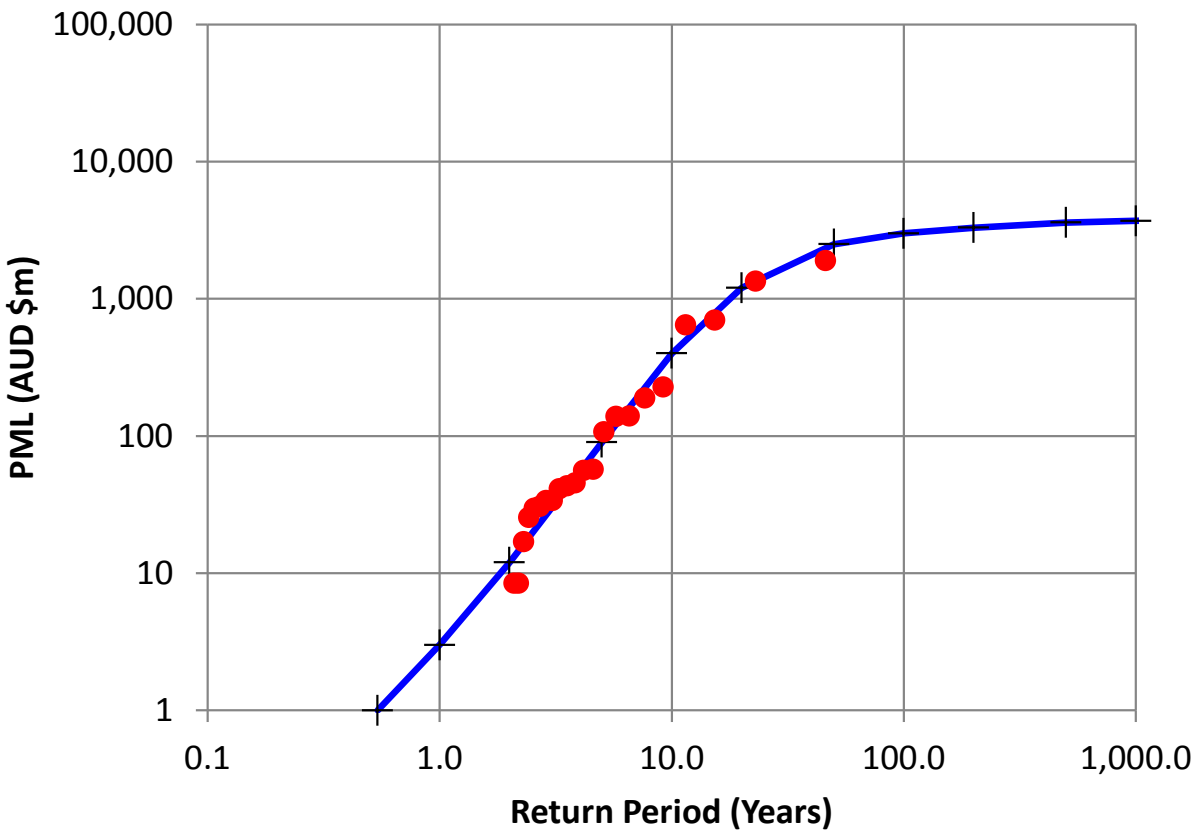
Date	Event	State	Deaths	Homes destroyed	Rescaled Insured Loss ($m)
Feb-83	'Ash Wednesday'	Vic & S.A	76	2,450	1,901
Feb-09	'Black Saturday'	Vic	173	2,000	1,340
Jan-03	Canberra	ACT	4	500	699
Feb-67	Hobart	Tas	?	1,454	646
Jan-94	Sydney & other	NSW	4	?	228

Other Significant Events

Date	Event	State	Deaths	Homes destroyed
1898	'Black Tuesday'	Vic	?	?
1851	1851 'Black Thursday'	Vic	15	?
1939	'Black Friday'	Vic & NSW	68	1,000
1957	Leura Blue Mtns	NSW	13	231
1926	Gippsland	Vic	41	227
1943/44	West, Central, South	Vic	54	642

Note :
"Homes destroyed", "Houses damaged" and "Housing Equivalents" are often used interchangeably by media and the scientific community making historic comparisons difficult

Bushfire



Maximum Loss

- $4 billion (but multi-event potential across a wide area is high)

RDS Locations

- Blue Mountains
- Adelaide Hills
- SE/SW Victoria, Gippsland, Dandenongs

Flood

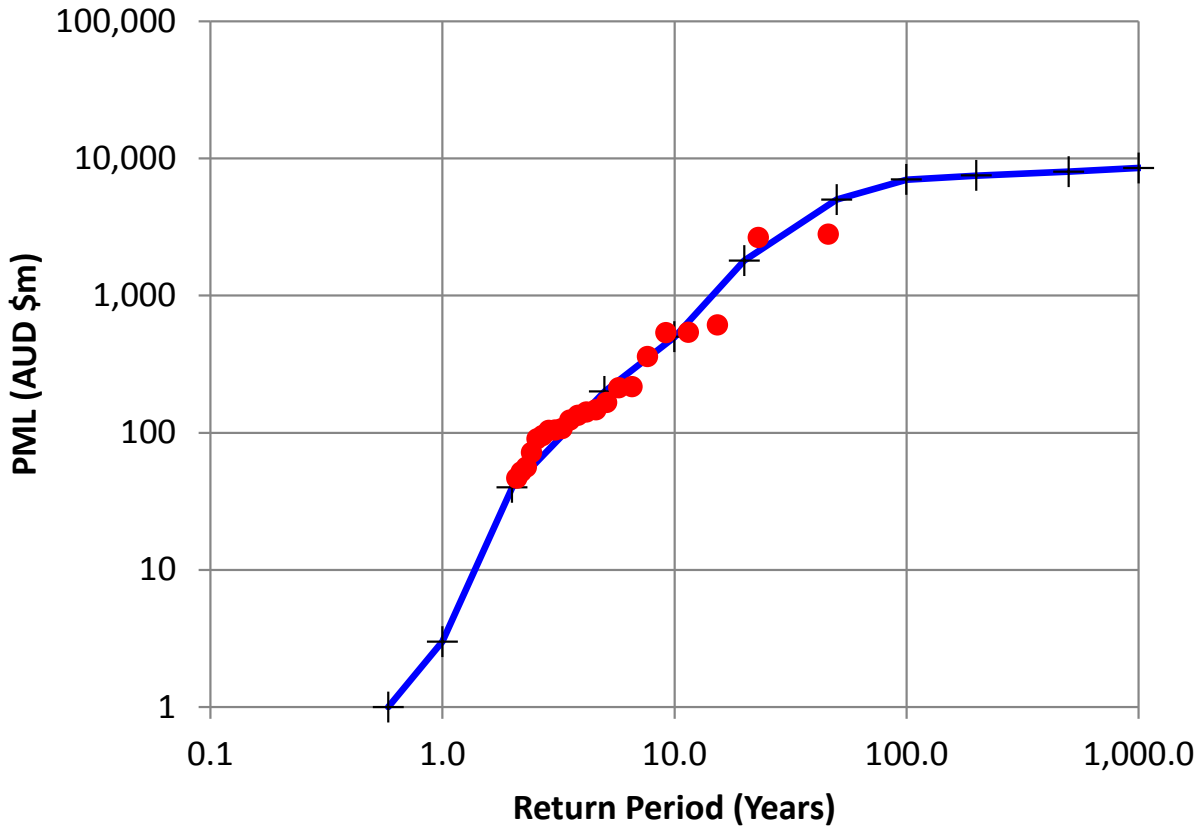
Top ICA Events (1967-2012)

Date	Event	State	Deaths	Homes destroyed	Rescaled Insured Loss ($m)
Jan-74	Brisbane flood (TC Wanda)	QLD	15	1,526	2,800
Feb-11	Brisbane catchment	QLD	35	?	2,652
Nov-84	Sydney	NSW	6	?	612
Apr-74	Sydney	NSW	?	?	539
Feb-08	Mackay	QLD	?	2,000	537
Feb-11	Melbourne	Vic	?	?	437

Other Significant Events

Date	Event	State	Deaths	Homes destroyed
1955	Parsons-Hunter. Singleton, Maitland, Bulga	NSW	35	1,753
1950	Grafton-Kempsey	NSW	5	360
1925	Murrumbidgee (Gundagai/Nangus)	NSW	8	252
1900	Hawkesbury	NSW	1	140

Flood



Maximum Loss

- $10 billion (assuming current market treatment of flood related loss)

RDS Locations

- Brisbane & SE Queensland
- Hawkesbury/ Nepean
- Georges River
- Hunter/ Newcastle

Storm

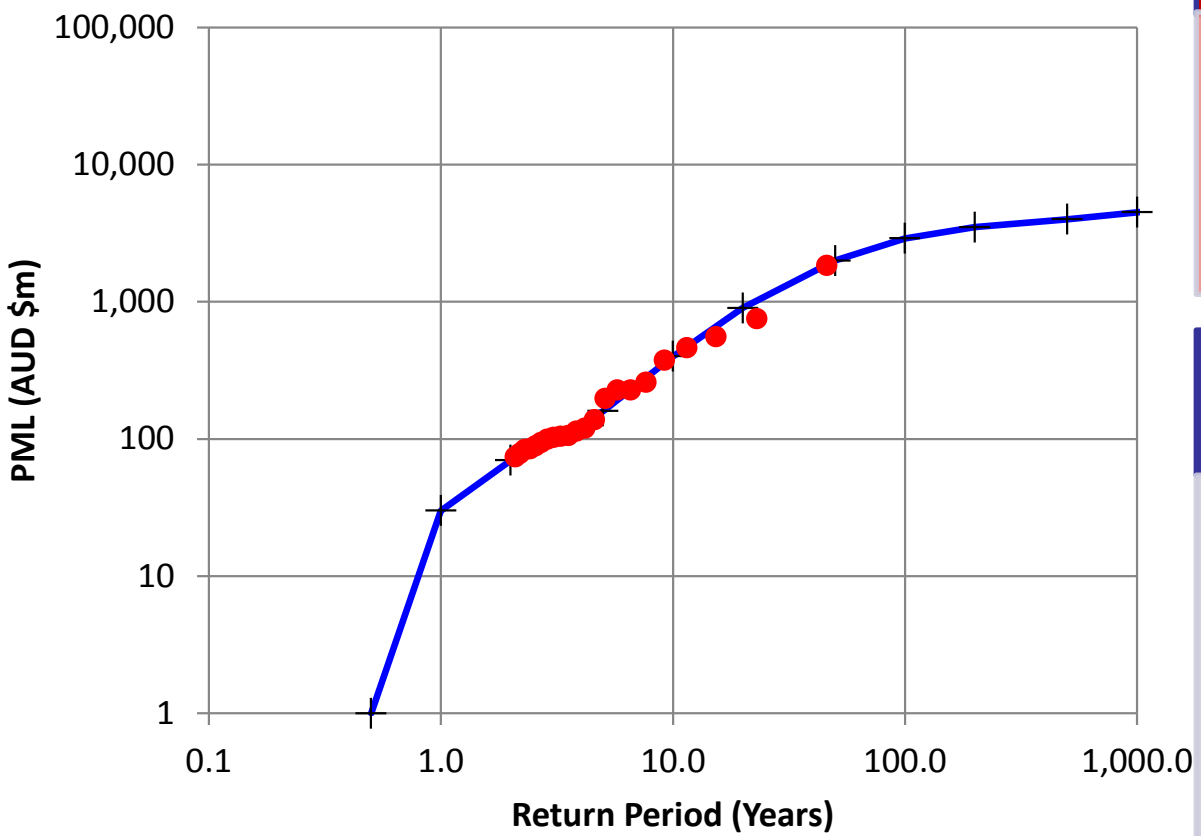
Top ICA Events (1967-2012)

Date	Event	State	Homes destroyed	Max wind km/h	Rescaled Insured Loss ($m)
2007	Newcastle/Hunter 'Severe Storm'	NSW	?	?	1,844
2011	Melbourne Christmas Day	Vic	?	?	754
1991	Sydney	NSW	580	230	556
2011	Melbourne 'Severe Storms'	Vic	?	?	463
2008	Brisbane	QLD	?	?	376

Other Significant Events

Date	Event	State	Homes destroyed/ damaged	Maximum wind km/h
1961	Ungarie	NSW	79/70	144
1949	Sydney	NSW	60/200	152

Storm



Maximum Loss

- $6 billion (impact on multiple locations possible from one "event")

RDS Locations

- Sydney (southwest through north)
- Melbourne
- Brisbane
- NE Queensland

Hail

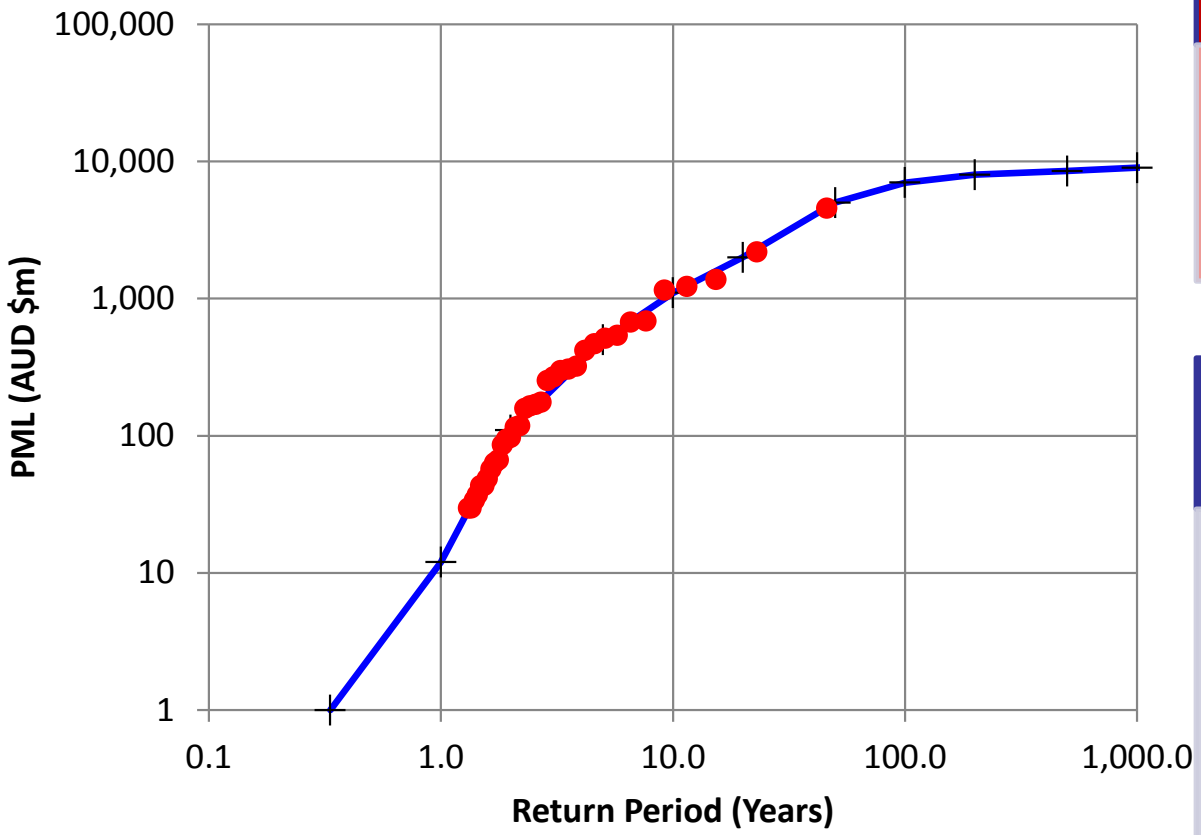
Top ICA Events (1967-2012)

Date	Event	State	Maximum hail size (cm)	Homes destroyed	Rescaled Insured Loss ($m)
Apr-99	Sydney	NSW	7	?	4,548
Jan-85	Brisbane	QLD	7	?	2,124
1990	Sydney	NSW	8	1,450	1,373
Mar-10	Melbourne	Vic	10	?	1,228
2010	Perth	WA	5	?	1,155

Other Significant Events

Date	Event	State	Maximum hail size (cm)	Homes destroyed
1958	Sydney	NSW	4.4	240
Dec-80	Brisbane (Brighton)	QLD	6.3	500

Hail



Maximum Loss

- $10 billion (super-cells could affect multiple areas in one event)

RDS Locations

- Sydney north west
- Sydney south east
- Brisbane
- Melbourne

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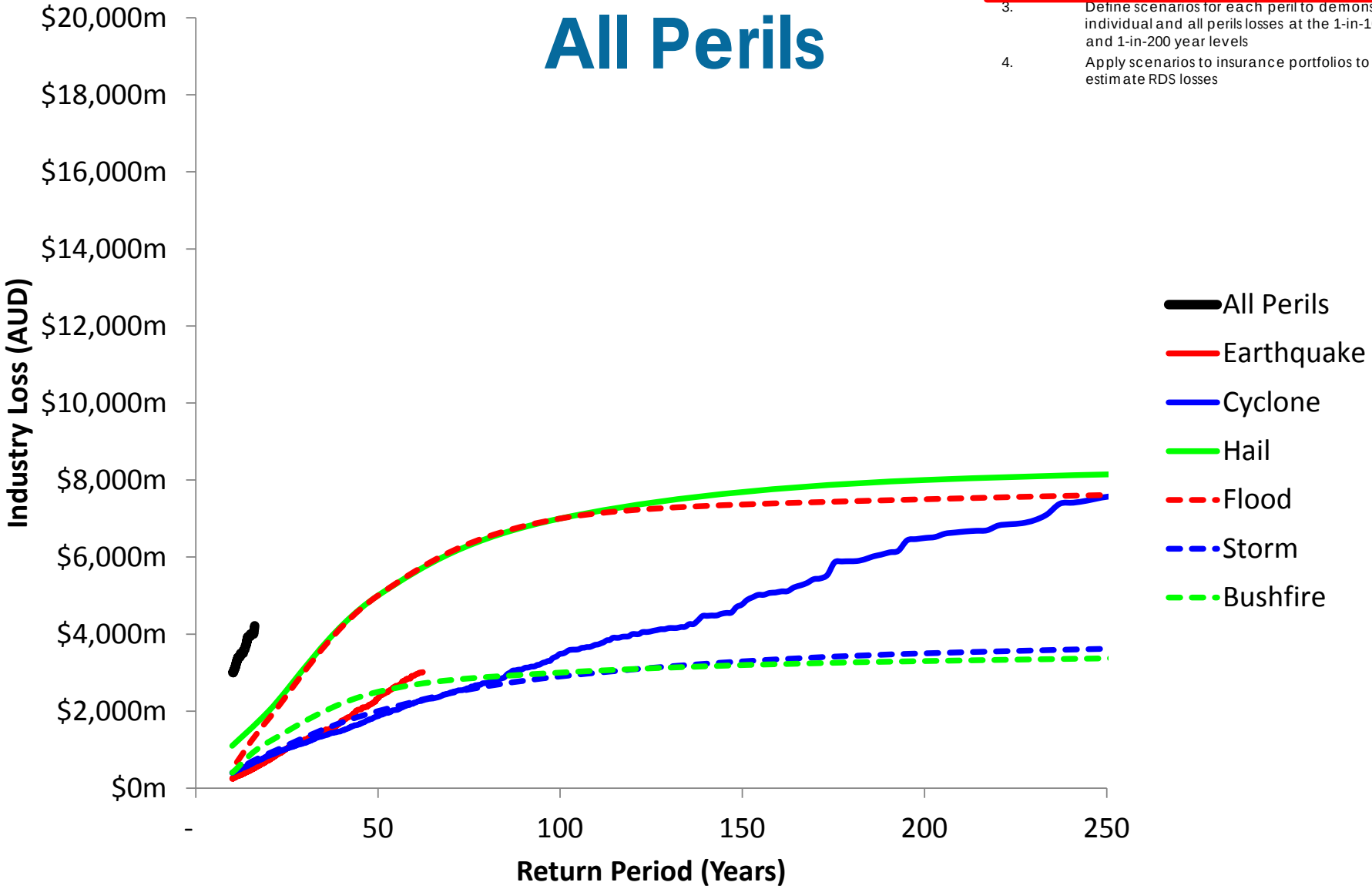
All Perils



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Loss Matrix

	By peril 1 in 100	By peril 1 in 200	All perils 1 in 100	All perils 1 in 200
Cyclone	3.5	6.5	8.8	13.5
Earthquake	4.6	9.8	8.8	13.5
Bushfire	3.0	3.3	NA	NA
Flood	7.0	7.5	8.8	13.5
Storm	2.9	3.5	NA	NA
Hail	7.0	8.0	8.8	13.5

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Methodology

Postcode	Exposure	% Loss	Loss
4064	2,649m	2.3%	59m
4065	2,051m	2.3%	47m
4066	4,089m	2.2%	91m
4067	1,565m	1.5%	24m
4068	5,371m	1.5%	83m
4069	7,223m	1.8%	134m
4070	2,872m	1.4%	40m
4072	35m	1.5%	1m
4073	2,348m	1.2%	28m
4074	5,721m	1.3%	73m

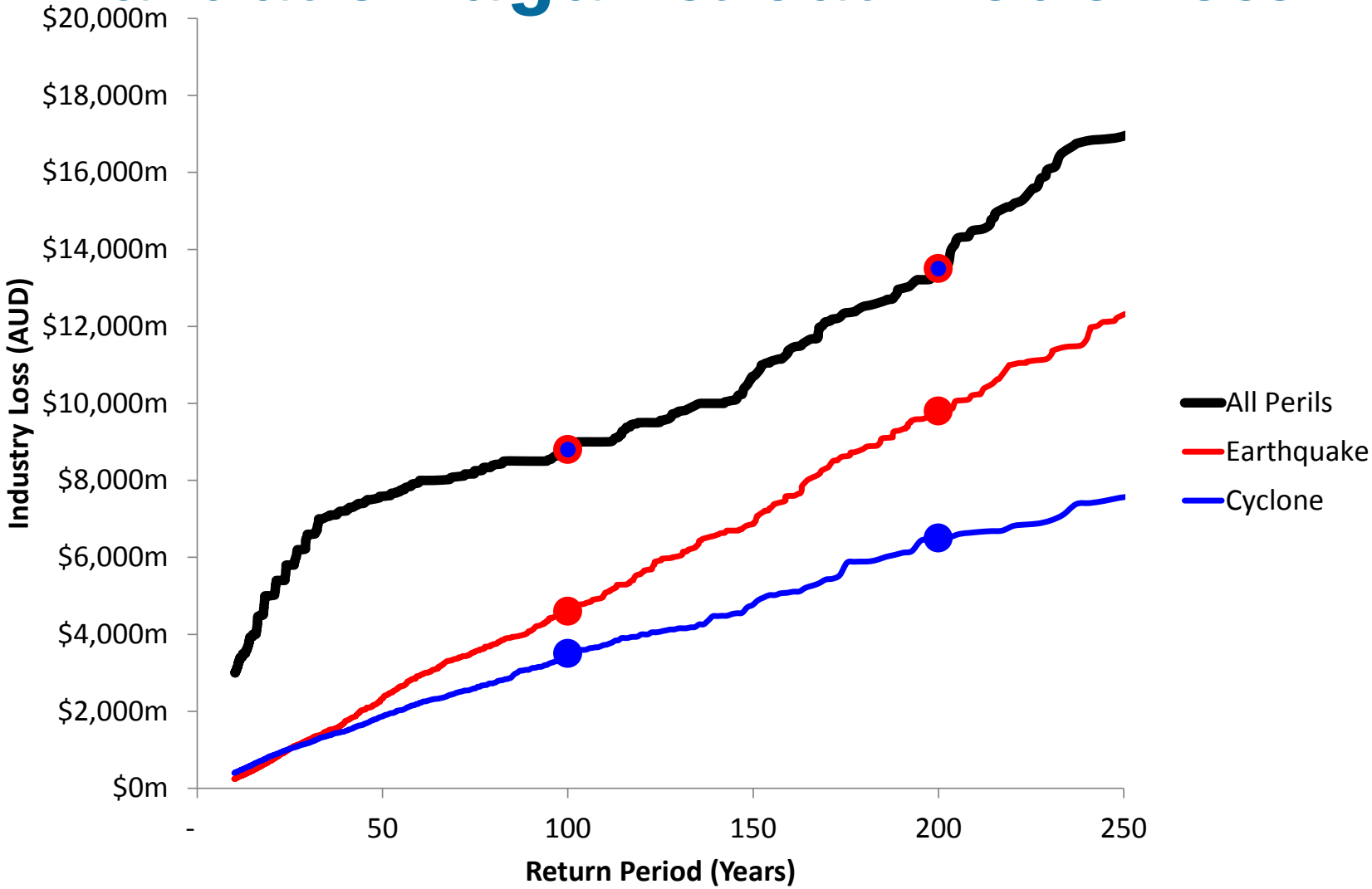
RDS01 – Cyclone $13.5b

RDS02 – Cyclone $8.8b

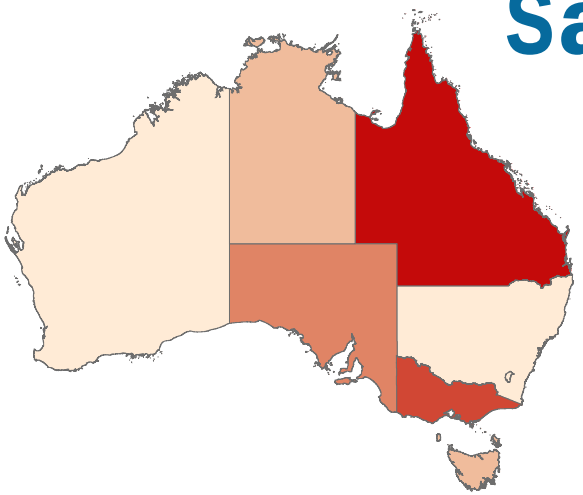
RDS05 – Earthquake $13.5b

RDS13 – Flood $13.5b

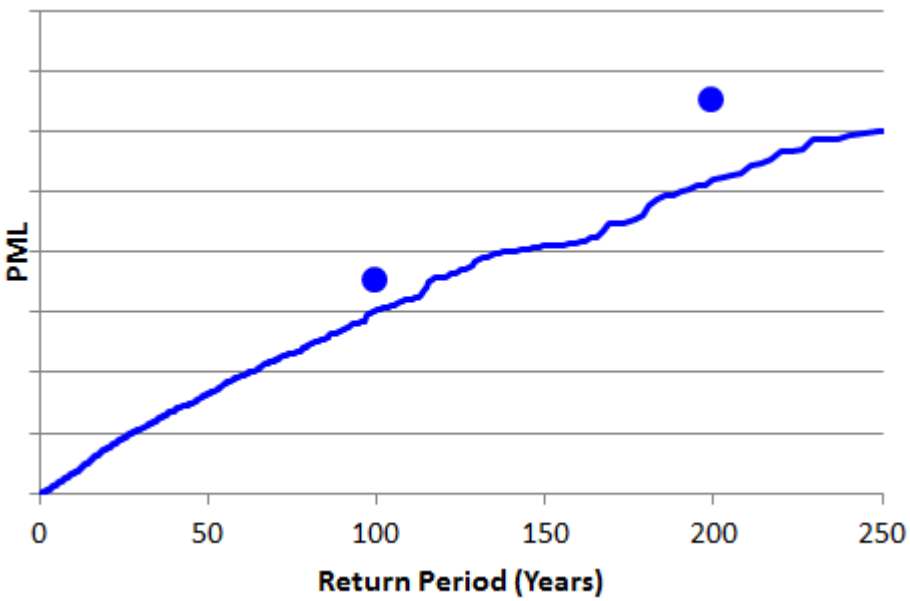
Validation against cat model loss

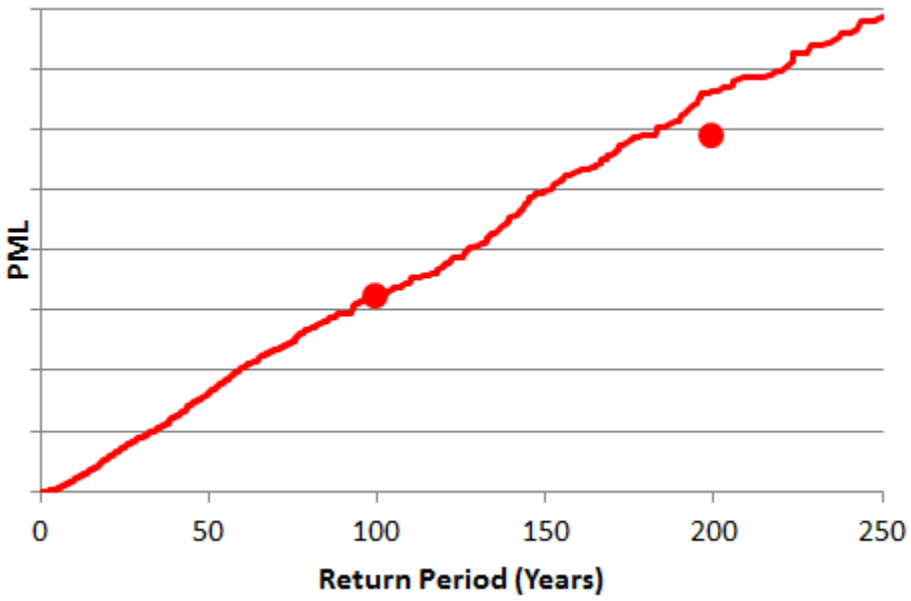


Sample insurer A

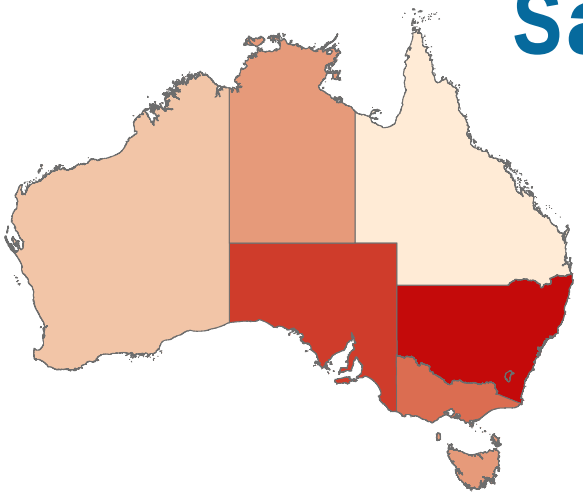


- Larger market share in Queensland and Victoria

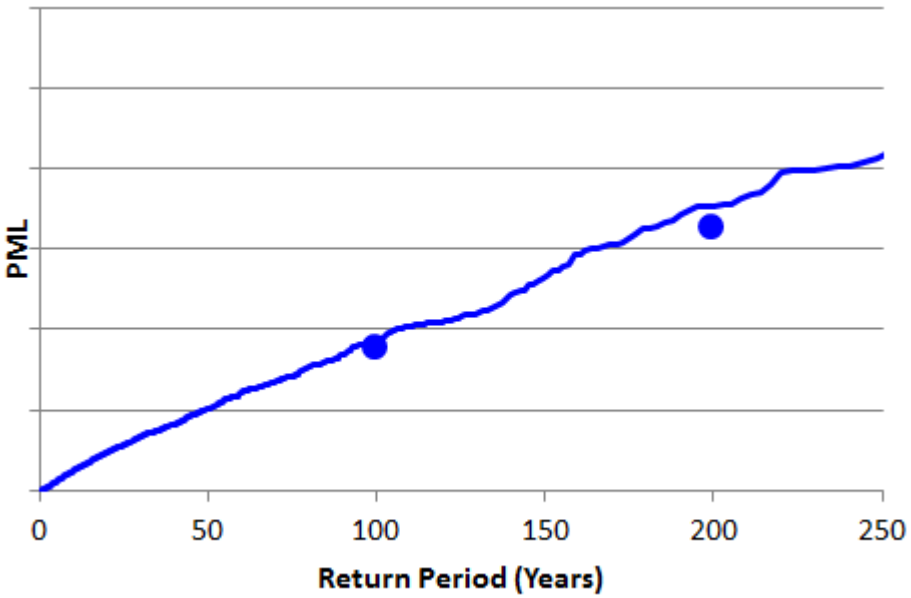


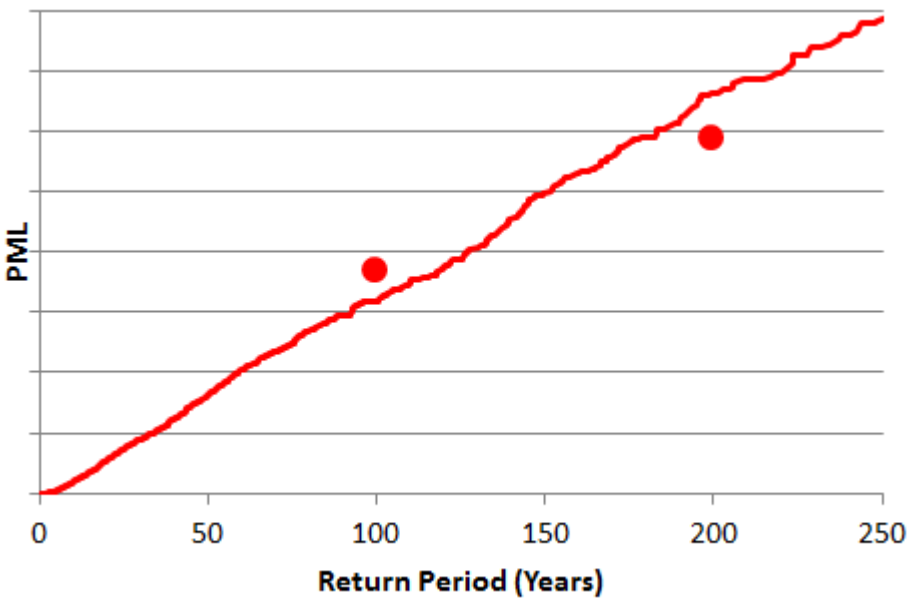


Sample insurer B

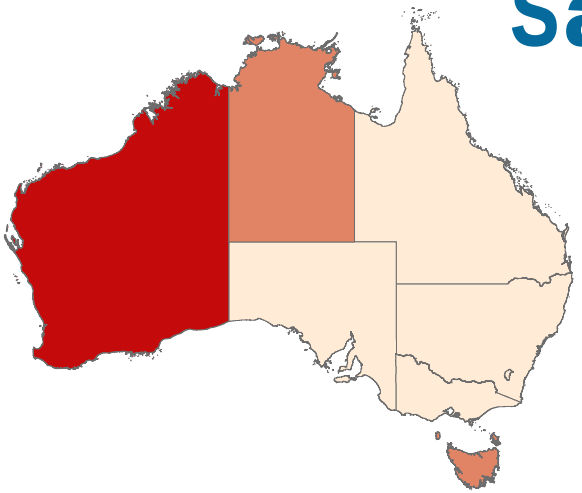


- Larger market share in New South Wales, ACT and South Australia

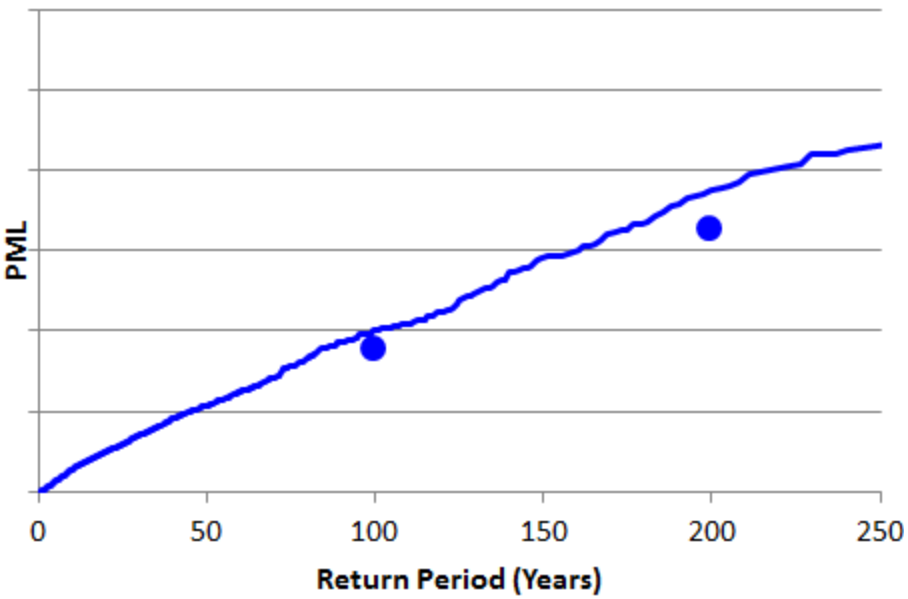


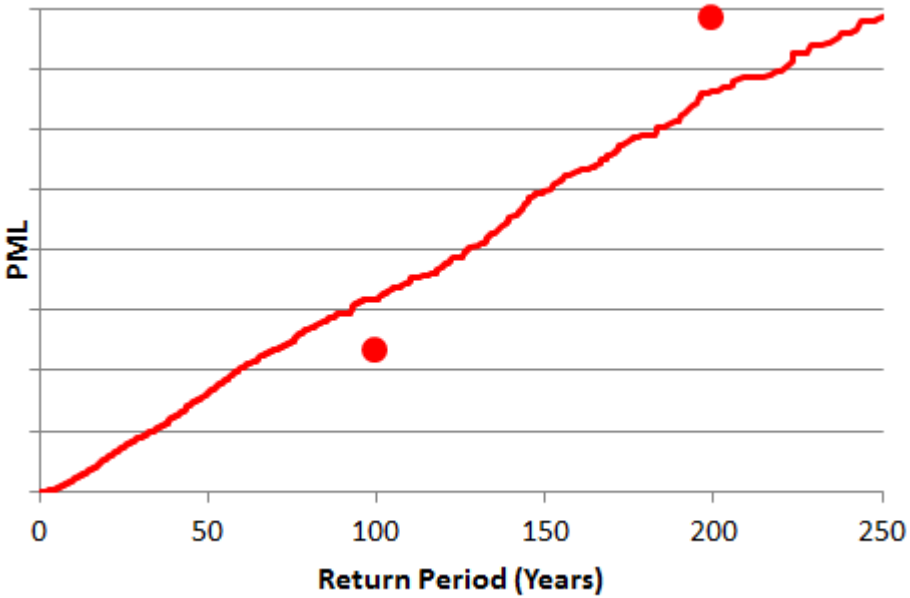


Sample insurer C



- Larger market share in Western Australia





Pros and Cons

- ✓ Gives a quick answer
- ✓ Easily understood
- ✓ Numbers match for diverse companies
- ✓ Can compare portfolios/insurers

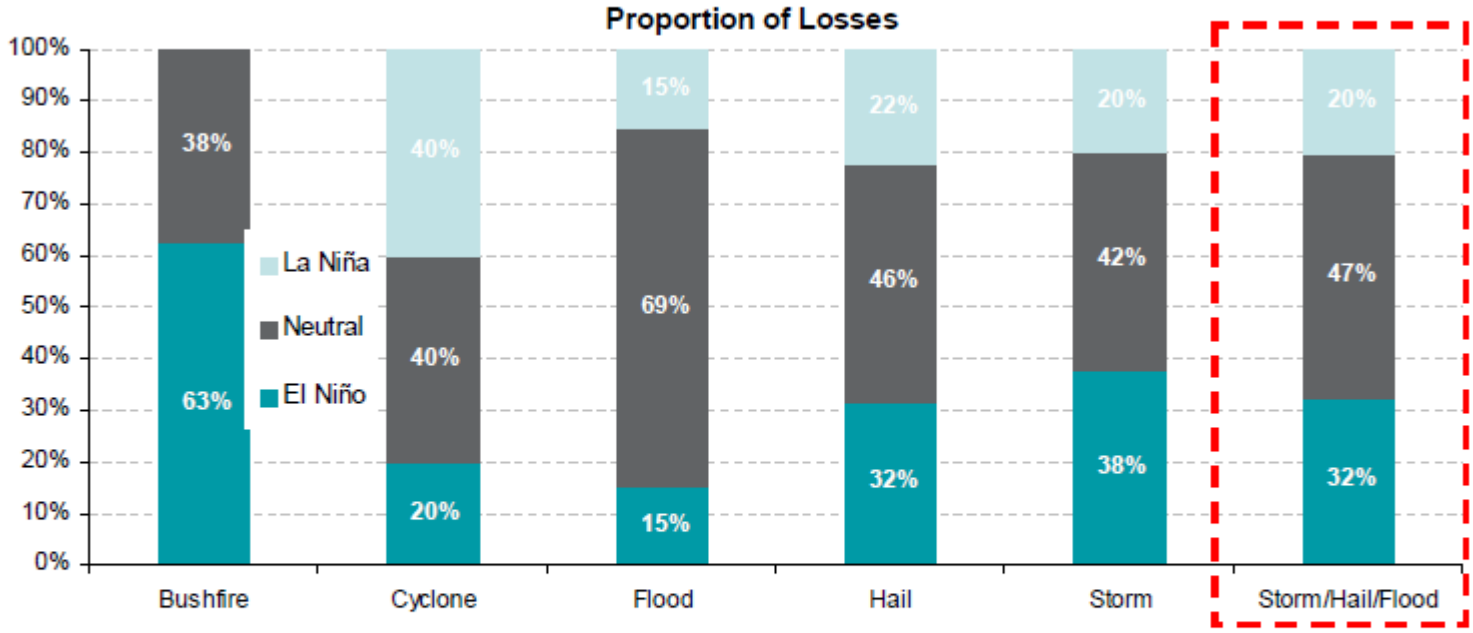
- ✗ Less useful for insurers with concentrated exposures
- ✗ No account of portfolio complexities

Other Methods

- Pure concentration management
  - Too conservative unless considering most severe events
- Loss multiple by ICA zone
  - Used prior to cat models
  - Seen as inferior
  - Could make a comeback as another in the suite of multi-models

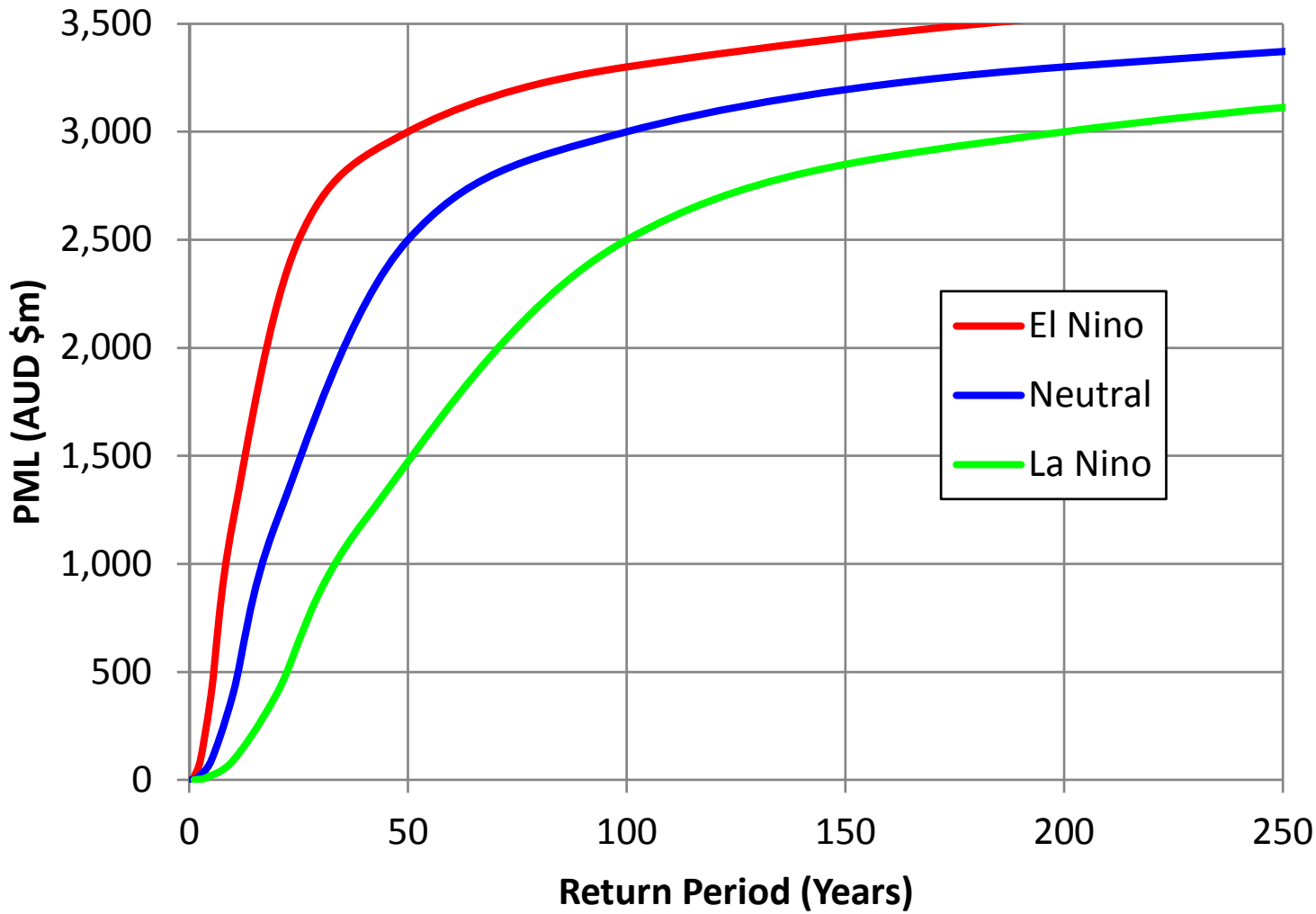
Waves, Wind and Water: Weather perils and insurance
Dmitry Gorelik - 16th GI Seminar 2008

ENSO by Peril – Event Counts



- Size of the event can skew the representation of losses over time
- Frequency of losses shows that:
  - Bushfires tend to occur during the El Nino Phase
  - Cyclones during Neutral and La Nina
  - Storm/Hail Flood during Neutral and El Nino phases

Bushfire - El Nino Southern Oscillation



Future Enhancements

- More events
- Split by Residential/ Commercial/ Industrial/ Motor
- “Smear” events to ensure stability
- Include multi-event clusters (eg. bushfire)
- Expand to include New Zealand

Conclusions

- An RDS approach can be used to determine PMLs at specific return periods given adequate scenario definition
- Care must be taken to consider shortcomings of this approach, especially with less diversified portfolios
- This method provides a useful additional measure for quantifying catastrophe concentration risk

Contact

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Realistic Disaster Scenarios v1.0

FreeCatModel.com