

# Natural Disasters & Global Climate Change

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# Introducing Risk Frontiers

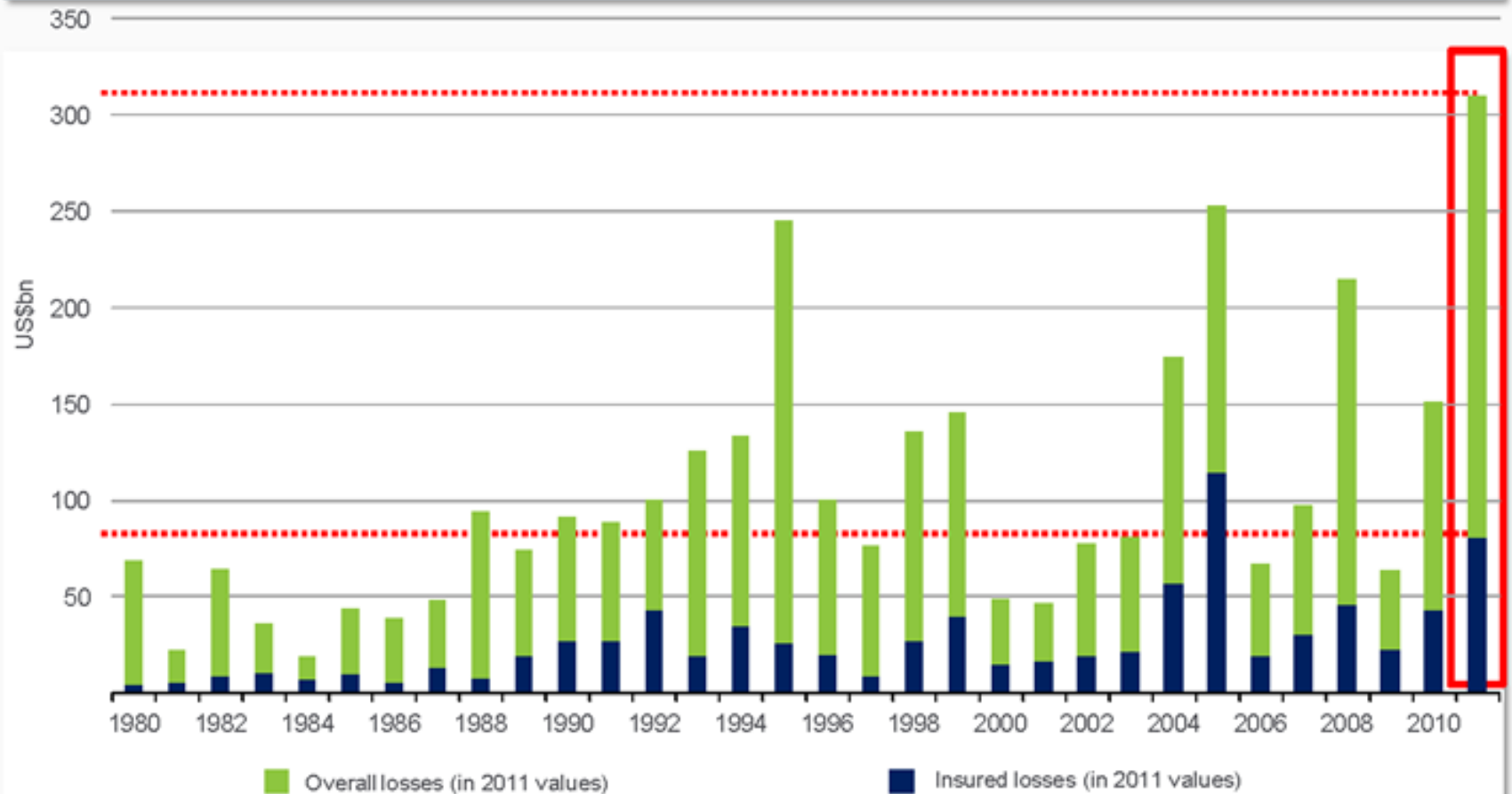
An independent R&D company created in 1994

- undertake research into natural hazards
- develop databases of natural hazards and their impacts on communities
- develop Catastrophe loss models and software to improve the pricing of impacts of natural hazards
- develop an independent view of catastrophe risks
- undertake post-event reconnaissance of natural disasters
- improve decision making in respect to the management of natural hazard risks

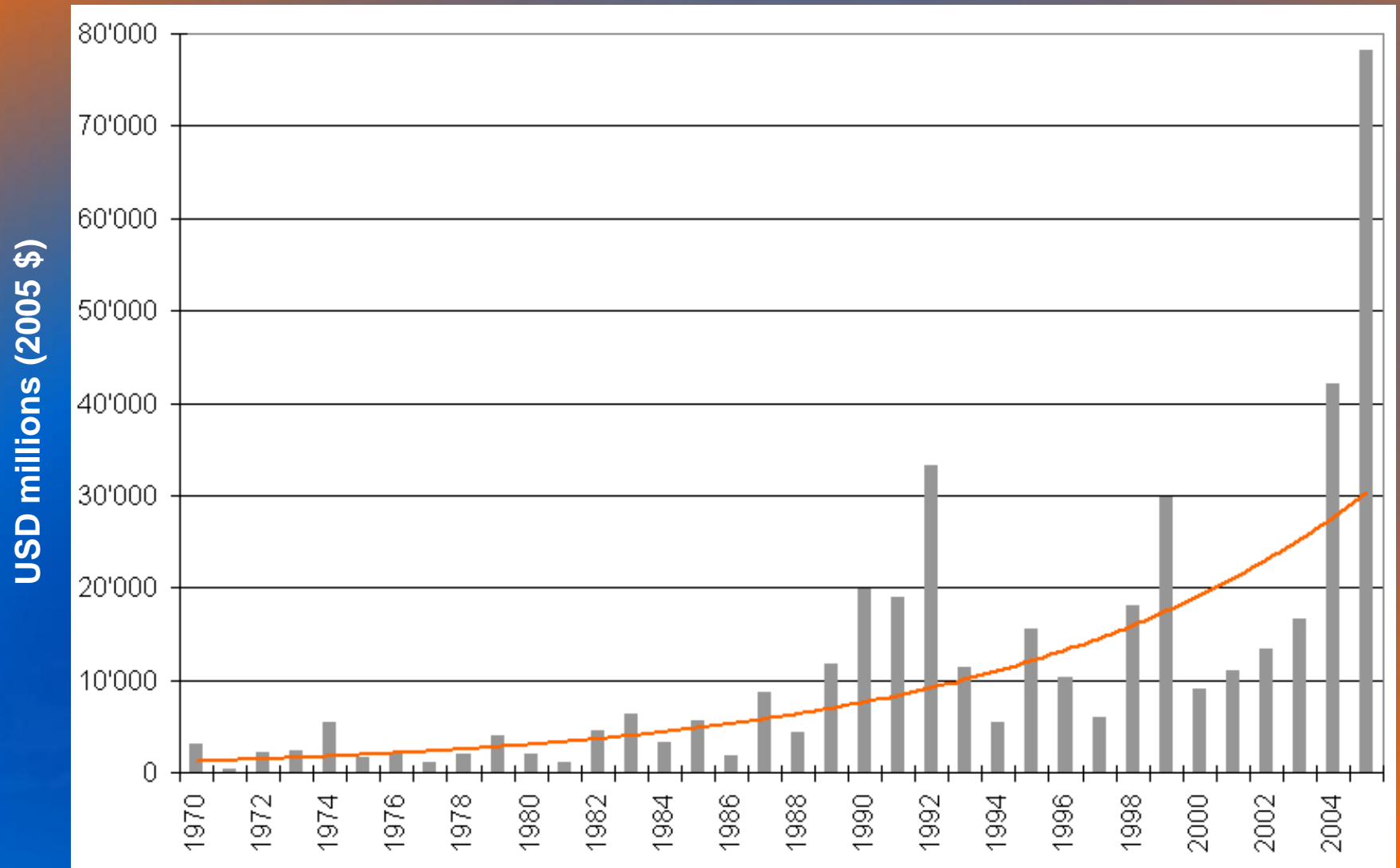
# Worldwide Natural Disasters 1980 – 2011

## Overall and Insured Losses

Losses in 2011 (January – September): Overall = US\$ 310bn; Insured = US\$ 80bn

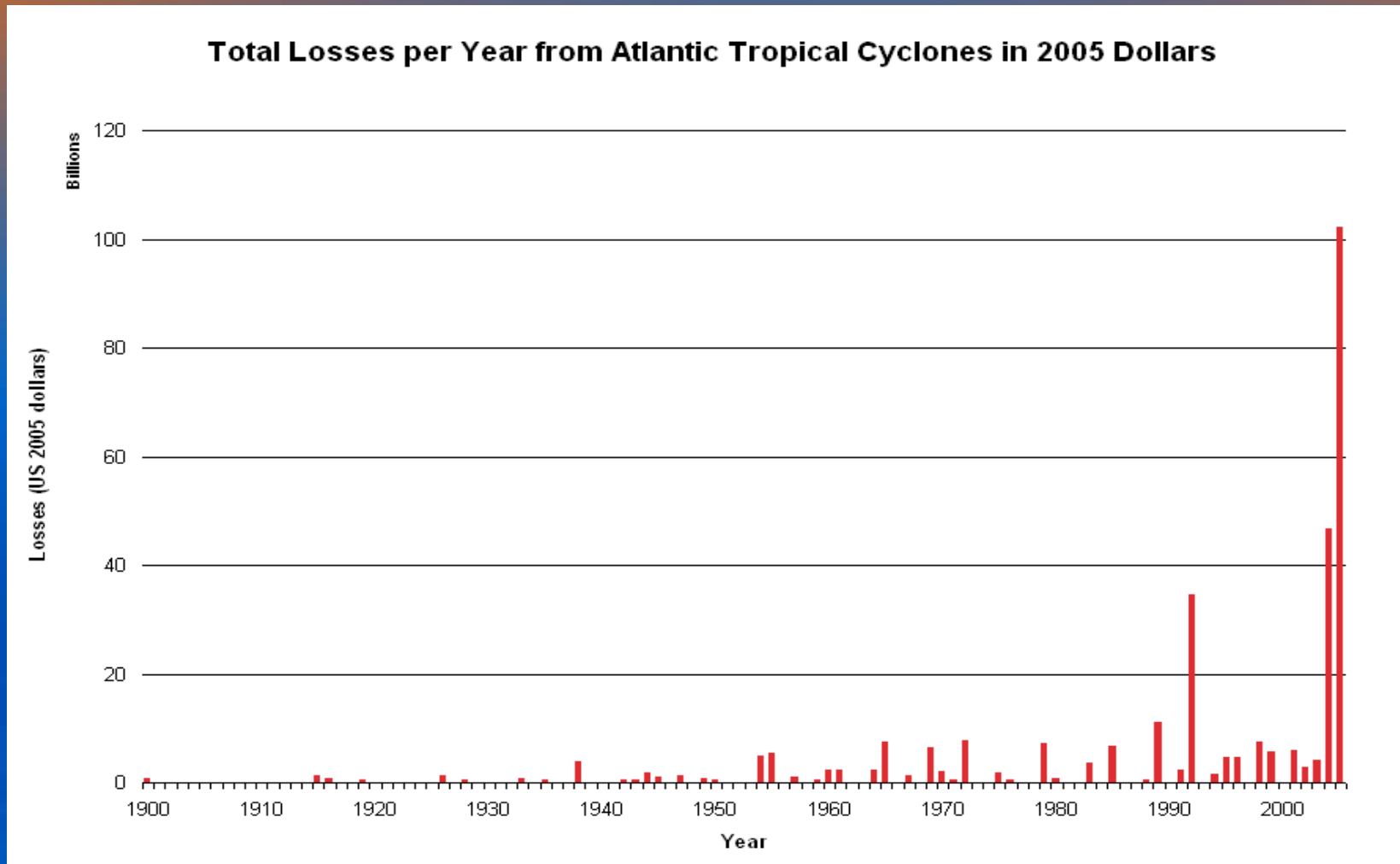


# Insured Costs of weather-related natural disasters have been increasing



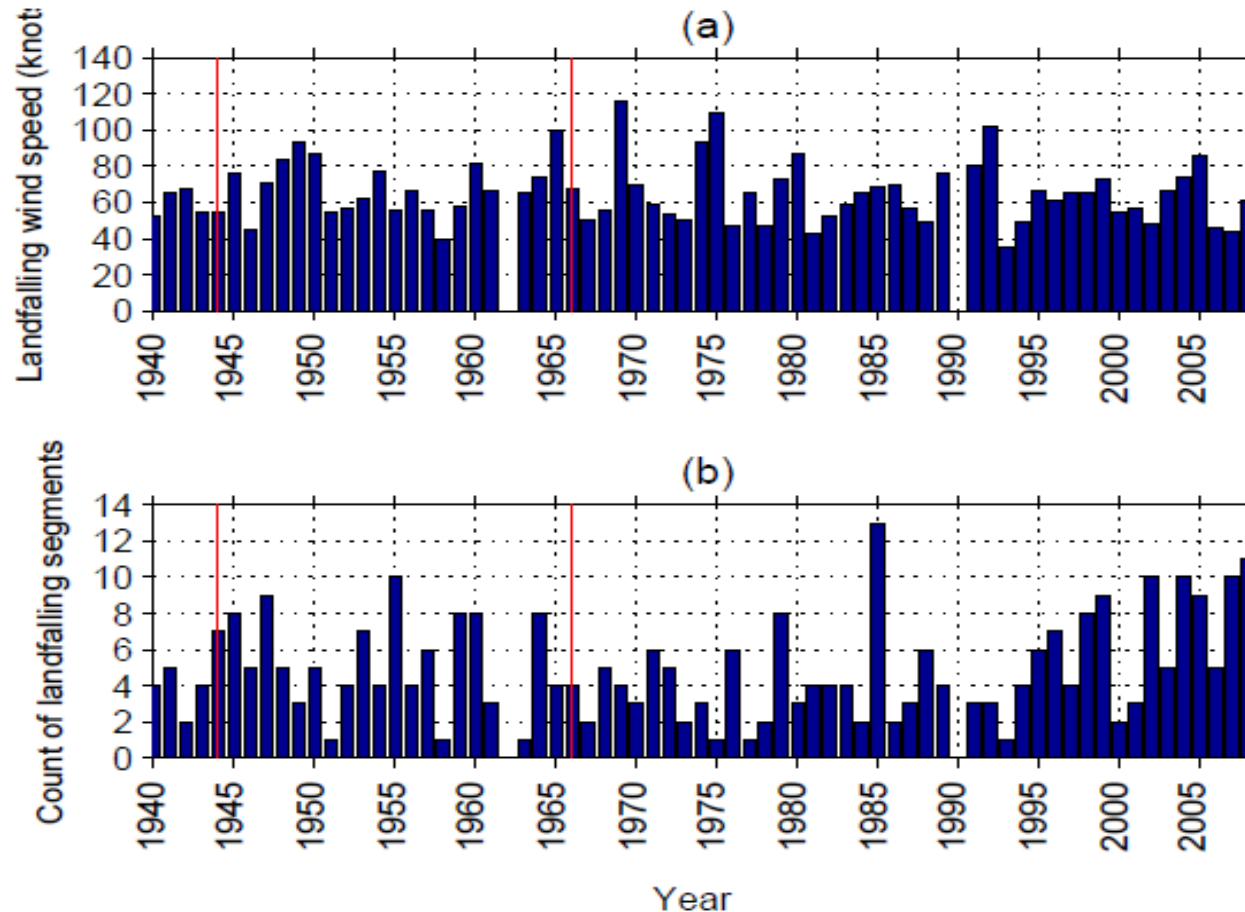
Source: Swiss Re sigma Catastrophe database

# Annual Hurricane Damage



(Pielke et al. (2008))

# Damage to property linked to landfalling events



(Source;  
Chen et  
al.  
(2009))

*Damage trend can't be due to storm behaviour!*



# Florida: Coastal development

**Miami Beach 1926**



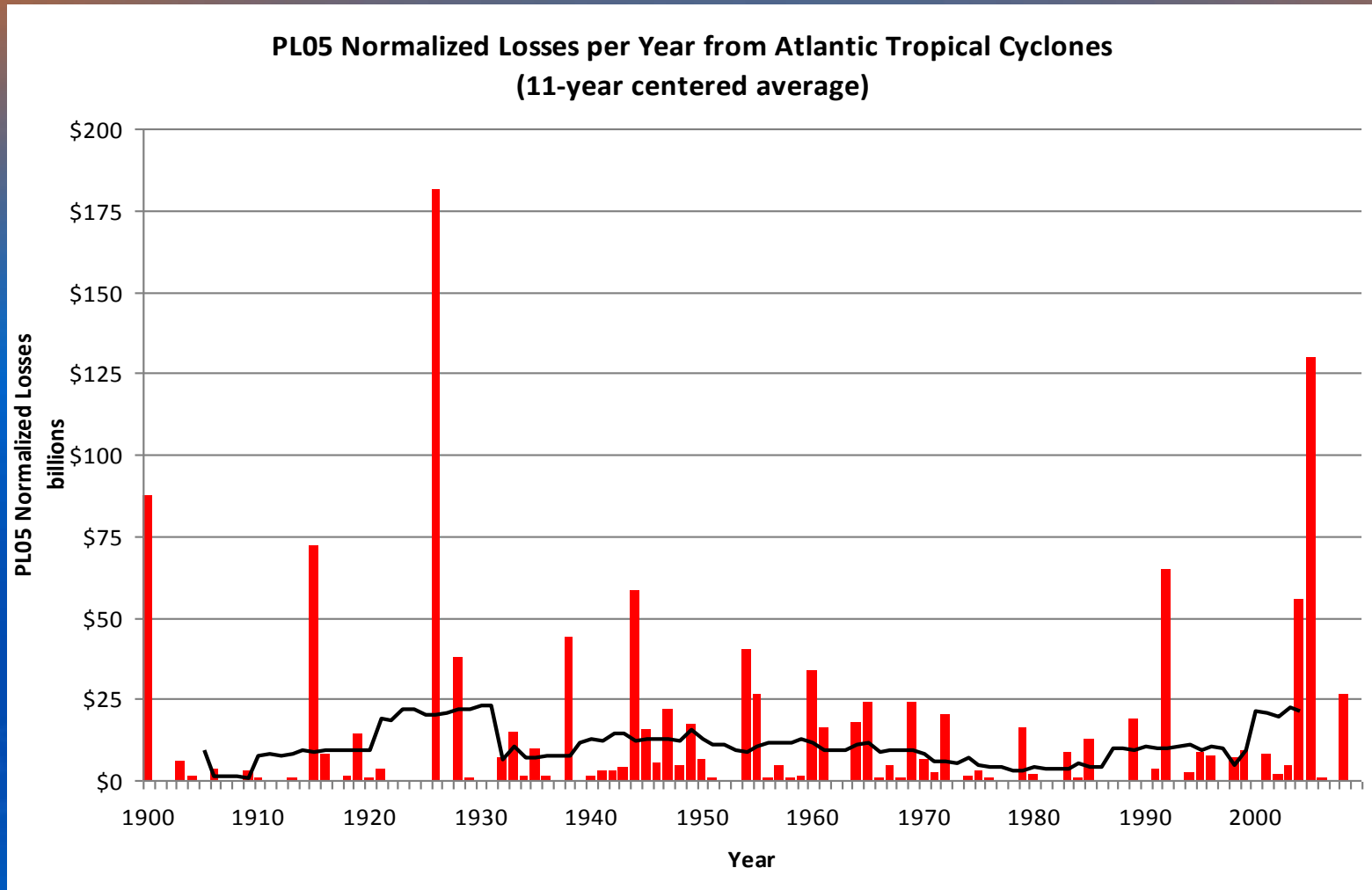
**Wendler Collection**

**Miami Beach 2006**



**Joel Gratz © 2006**

# Hurricane damage if landfall in 2008 (US\$ billions)

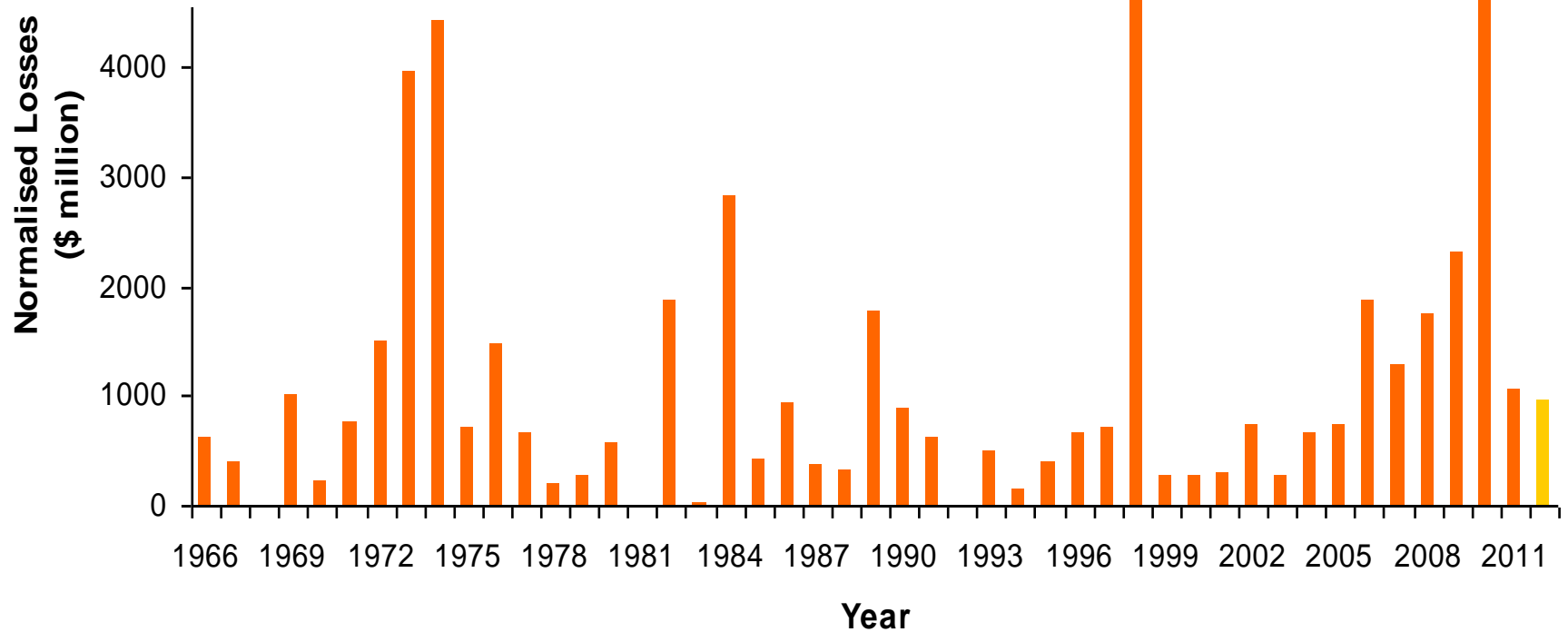
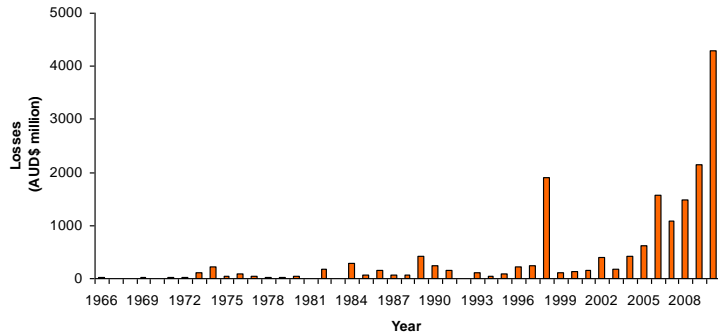


(updated from Pielke et al. (2008))

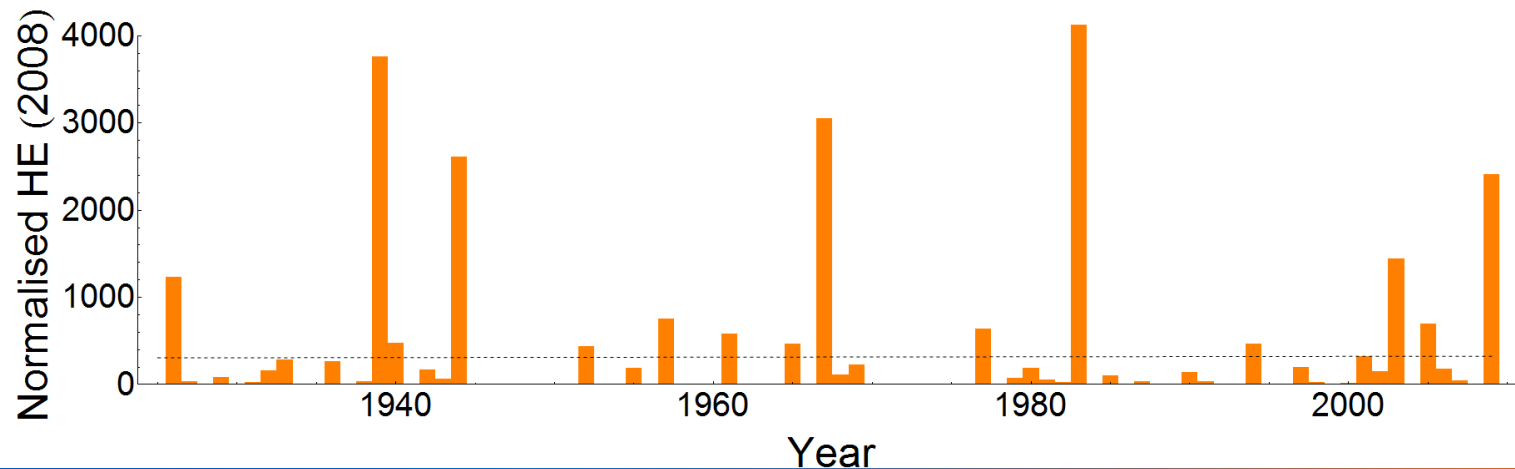
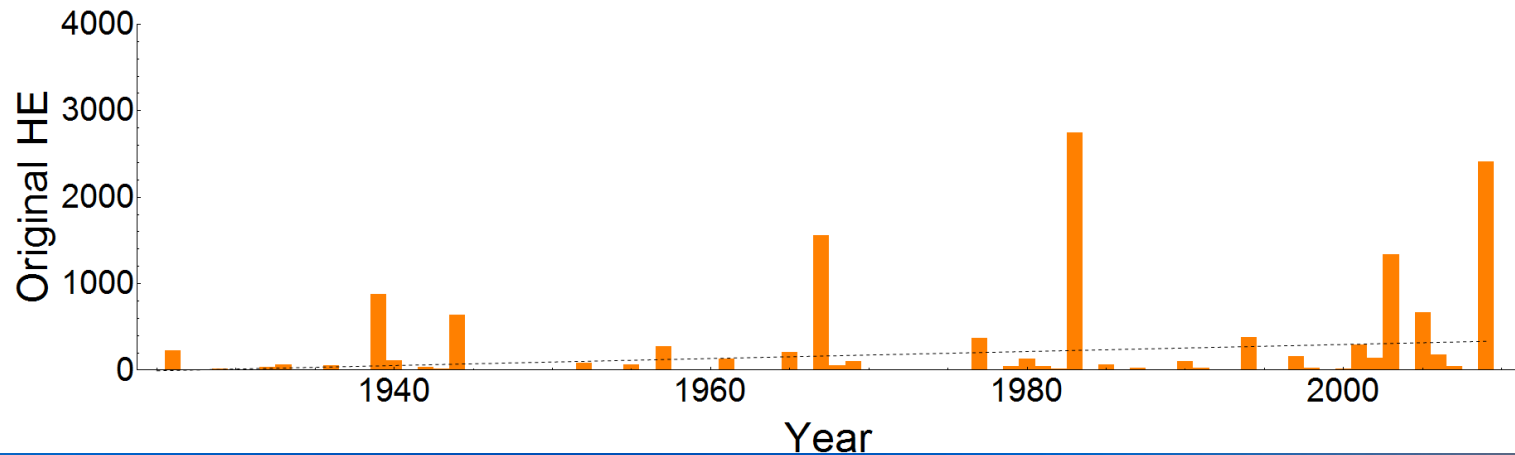


# Normalised Australian Weather Losses

(year 2011/12 societal conditions)



# History of Australian bushfire losses

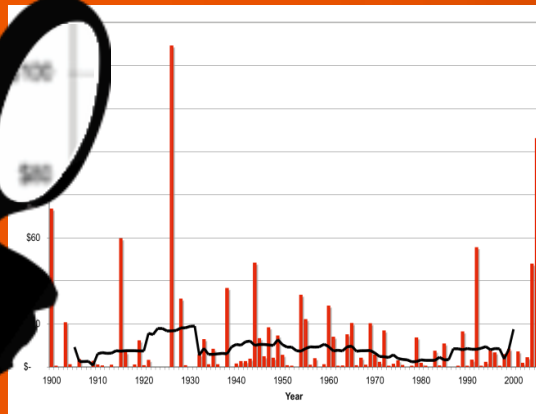


(Source: Crompton et al. (2010))

# Climate Change & Natural Disasters

- *Increasing exposure of people and economic assets has been the major cause of long-term increases in economic losses from weather- and climate-related disasters (high confidence). Long-term trends in economic disaster losses adjusted for wealth and population increases have not been attributed to climate change, but a role for climate change has not been excluded (high agreement, medium evidence) (IPCC, 2012).*
- *Climate change neither is nor should be the main concern for the insurance industry. Accumulation of wealth in disaster prone areas is and will always remain by far the most important driver of future economic disaster damage (Barthel & Neumayer, 2012).*

# When will Anthropogenic Climate Change Signals be Detected in US Tropical Cyclone Loss Data?



And the answer is?

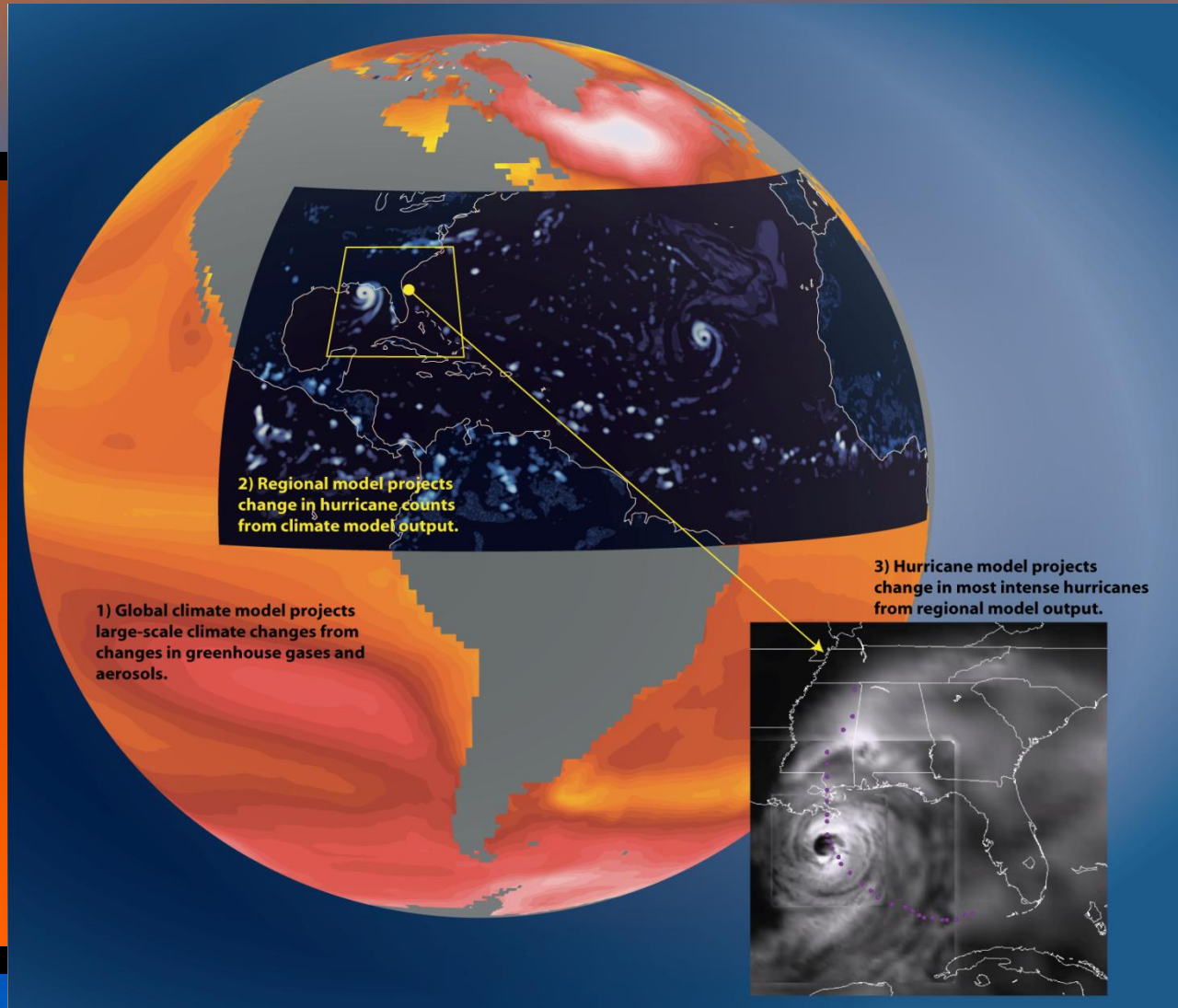
**260 years!**

**Range: 120 – 550 years**

Crompton, R. P., Pielke Jr, R. A., and K. J. McAneney (2011) Emergence time scales for detection of anthropogenic climate change in US tropical cyclone loss data. *Environ. Res. Lett.* 6, 4pp.



# Projected Anthropogenic Climate Change Influence on Atlantic Basin TCs

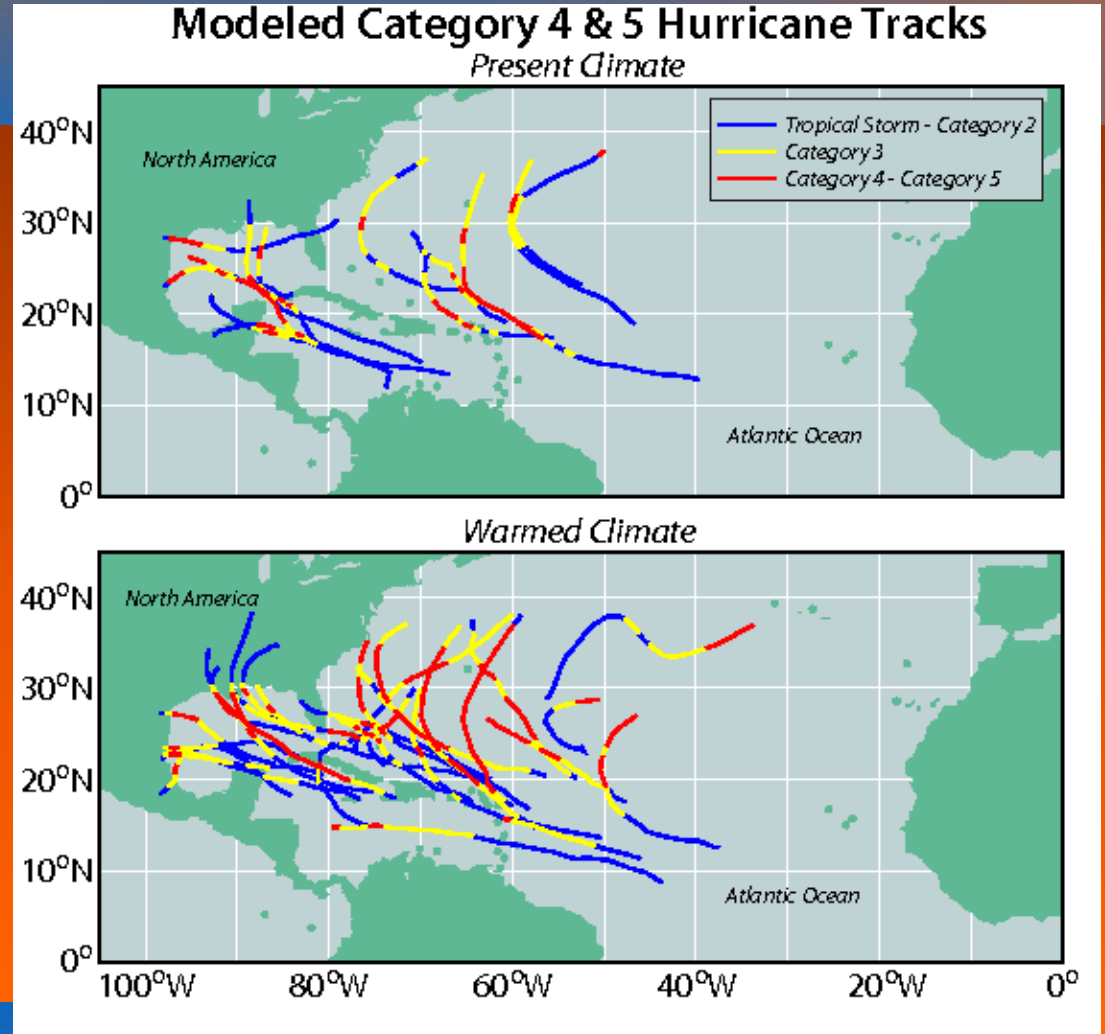


# Projected Anthropogenic Climate Change Influence on Cat 4 and 5 Hurricanes

Tracks for all storms reaching category 4 or 5 intensity, for the control and the warmed 18-model ensemble conditions (CMIP3).

Projected increase:  
81% increase in 80 years

Emergence time scale:  
≈ 60 years



# Projected Anthropogenic Climate Change Influence on Atlantic Basin TCs

	Projected percent changes over 80 years (warm vs. control)				
Saffir-Simpson Storm Category	CMIP3 ensemble	GFDL CM2.1	MRI	MPI	HadCM3
Tropical	-13	+4	-16	-14	-14
1	-52	-40	-45	-48	-66
2	-17	-15	-28	-36	-53
3	-45	+9	-34	-51	-64
4	+83	+100	+72	+17	-56
5	+200	+400	+800	+100	0

(Source: Bender et al. (2010))

# Normalised Atlantic Hurricane Damage

(year 2005 societal conditions)

Saffir-Simpson Storm Category (at landfall)	Count	Count per year	Percent of total loss	Av. loss (USD \$bn)	St. dev. losses (USD \$bn)
Tropical	57	0.54	2.0	0.4	1.0
1	44	0.42	5.0	1.2	3.7
2	34	0.32	7.4	2.4	2.6
3	53	0.50	35.6	7.3	13.3
4	14	0.13	42.5	33.2	41.7
5	3	0.03	7.4	27.1	28.2

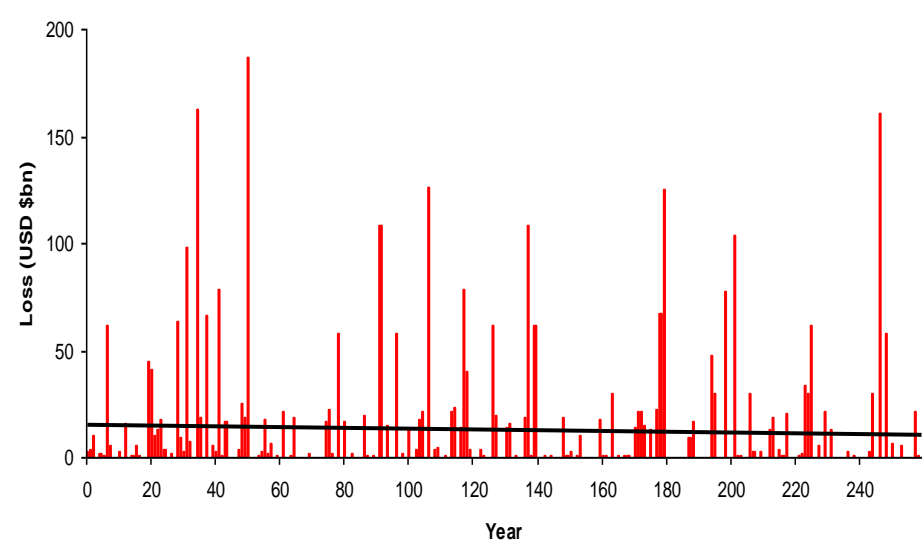
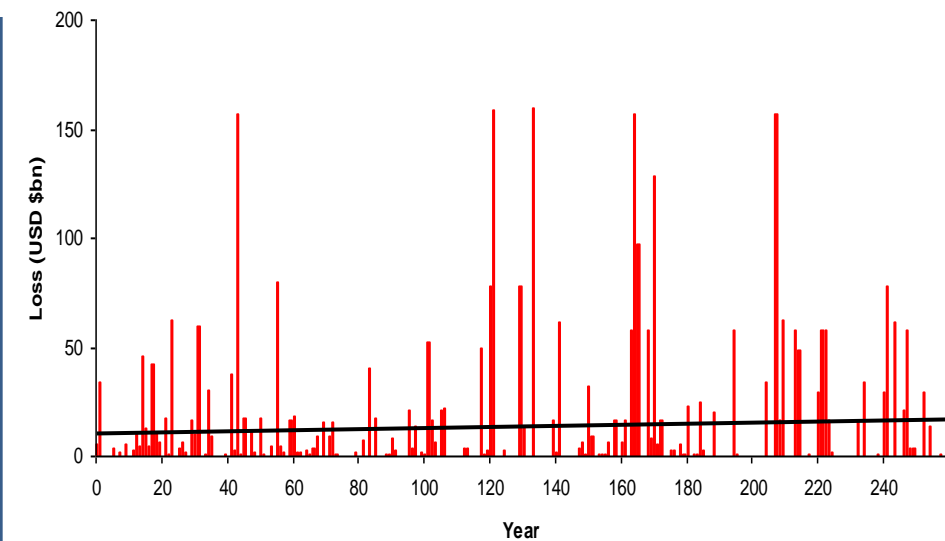
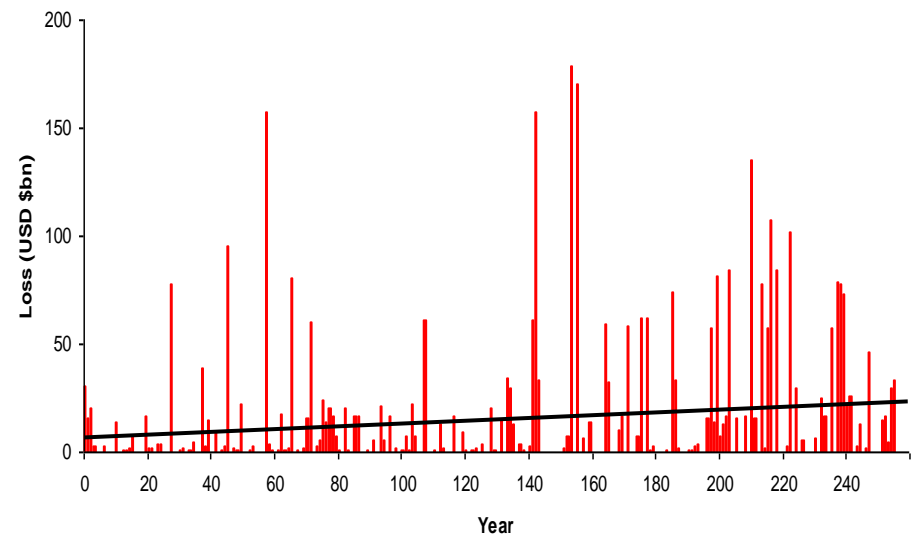
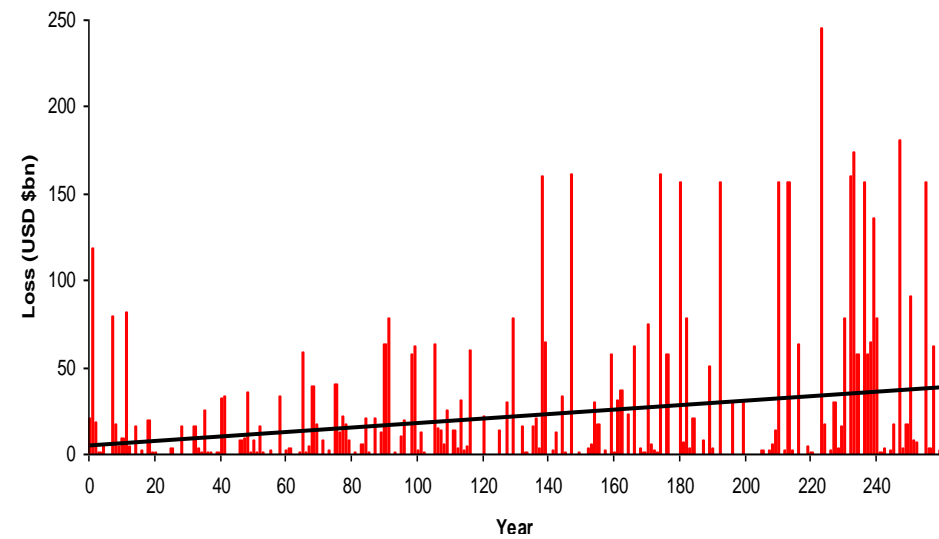
# Emergence Time Scale Inputs

	Damage		Projected percent changes over 80 years (warm vs. control)	Change in damage potential after 80 years (%)
Saffir-Simpson Storm Category	Count per year	Percent of total (1)	CMIP3 ensemble (2)	(1) × (2)
Tropical	0.54	2.0	-13	-0.3
1	0.42	5.0	-52	-2.6
2	0.32	7.4	-17	-1.3
3	0.50	35.6	-45	-16.0
4	0.13	42.5	+83	+35.3
5	0.03	7.4	+200	+14.9
				<b>+30</b>

(Source: Crompton et al. (2011))



# Synthetic Loss Time Series (260 years, CMIP3)



# And the answer is?

# 260 years!

Range: 120 – 550 years

Crompton, R. P., Pielke Jr, R. A., and K. J. McAneney. (2011) Emergence time scales for detection of anthropogenic climate change in US tropical cyclone loss data. *Environ. Res. Lett.* 6, 4pp.

And with updated CMIP5/RCP4.5  
data - - -

**Emergence Timescale for basin-wide  
activity of Cat 4 & 5 hurricanes**

**70 → 110 years**

**Emergence Timescale for losses**

**260 → 360 years!**

# So the Climate Change problem in terms of extreme weather is...

- Long term
- Uncertain
  - trajectory of warming
  - influence on severe weather activity
  - impact of severe weather at the local level
- Impossible yet to resolve increased risk of extreme weather on an annual basis
  - With premiums set annually difficult to see how insurers can be preferentially impacted

# So again why are Disaster Losses rising?

*In many ways the trends [in losses] seem paradoxical. After all, most natural disasters occur in areas of known high risk such as barrier islands, flood plains, and fault lines. . . . the economic incentives for responsible land use have been stifled by legislated insurance rates and federal aid programs that effectively subsidize development in hazardous areas.*

(van der Vink et al. (1998))



# Australia: Coastal Development

**Gold Coast Main  
Beach circa 1970**



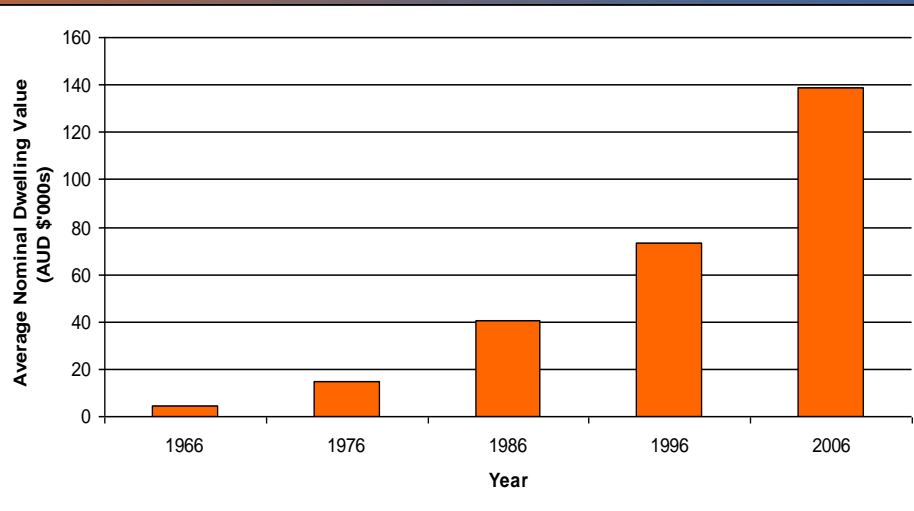
Local Studies Library, Gold Coast City Council

**Gold Coast Main  
Beach 2003**



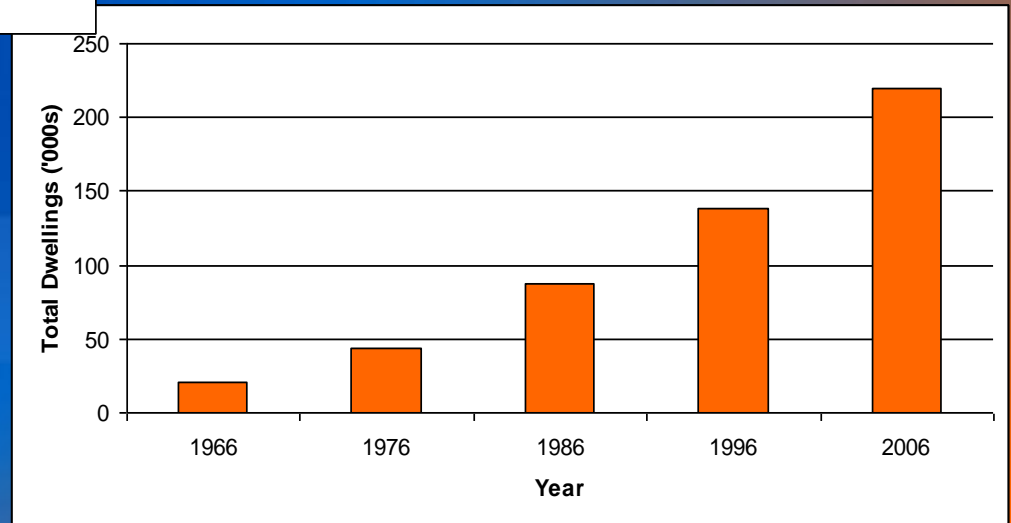
Local Studies Library, Gold Coast City Council

# Development on the Gold Coast – Tweed Heads

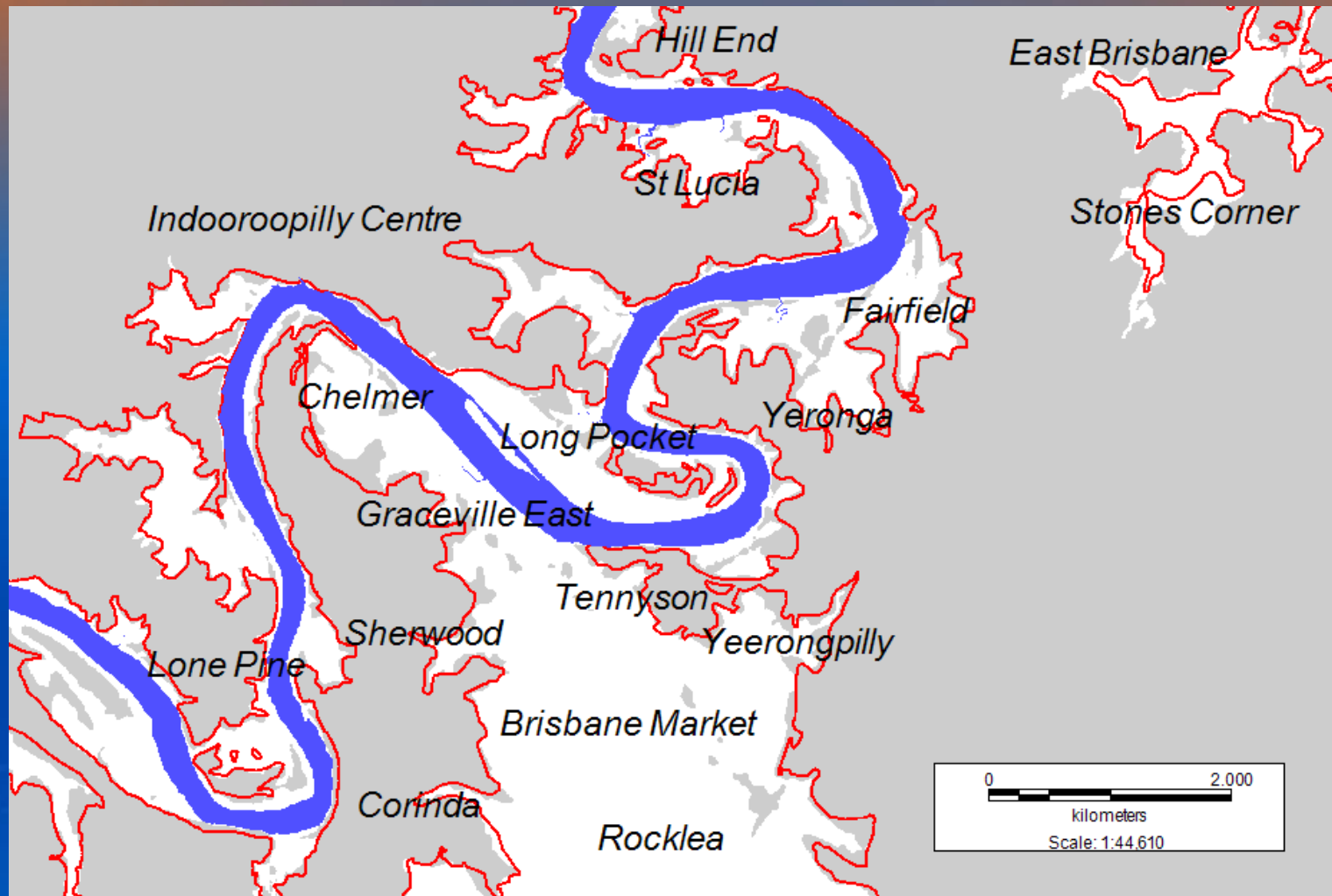


Cost per Dwelling

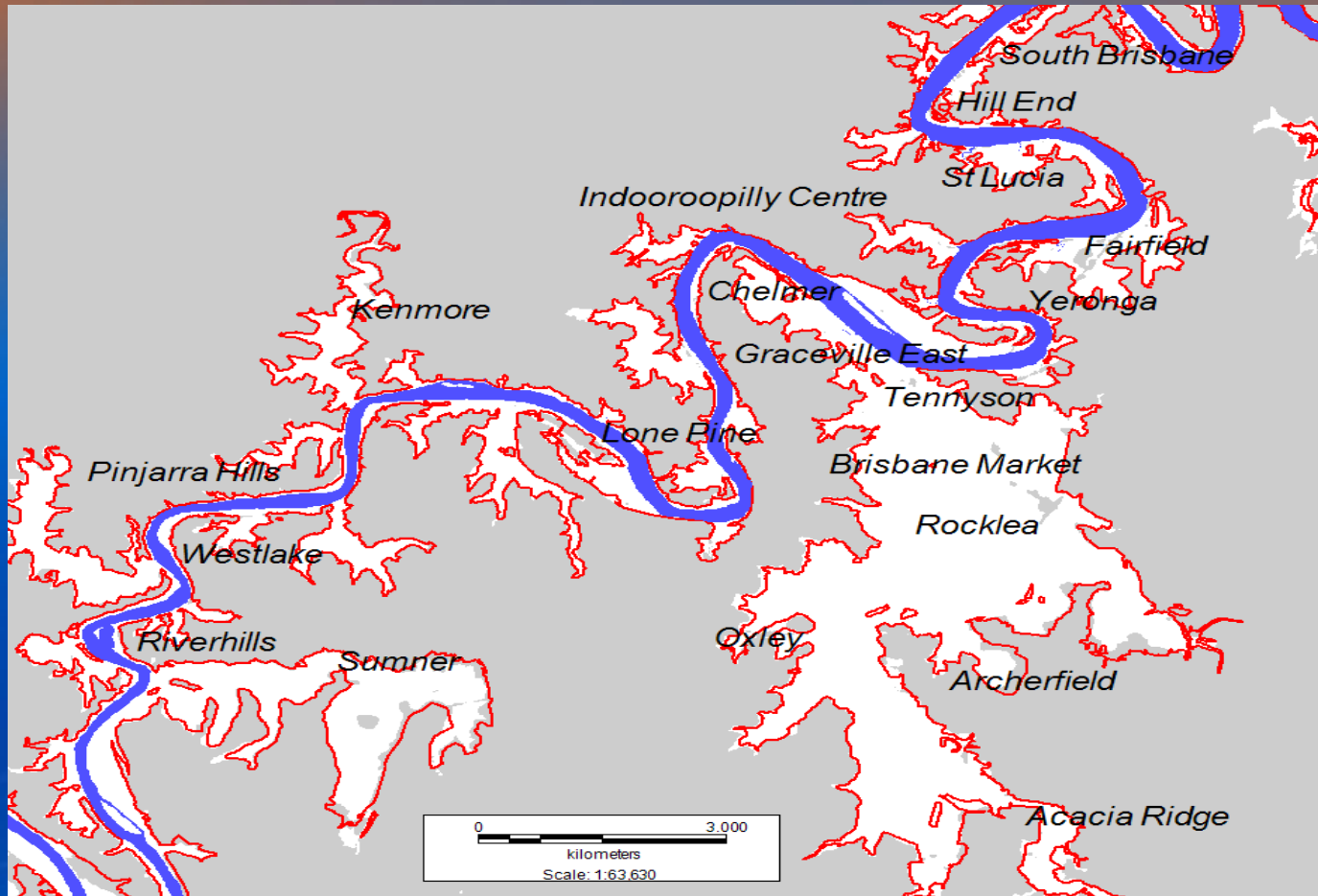
Number of Dwellings



# Comparison: 1974 vs 2011



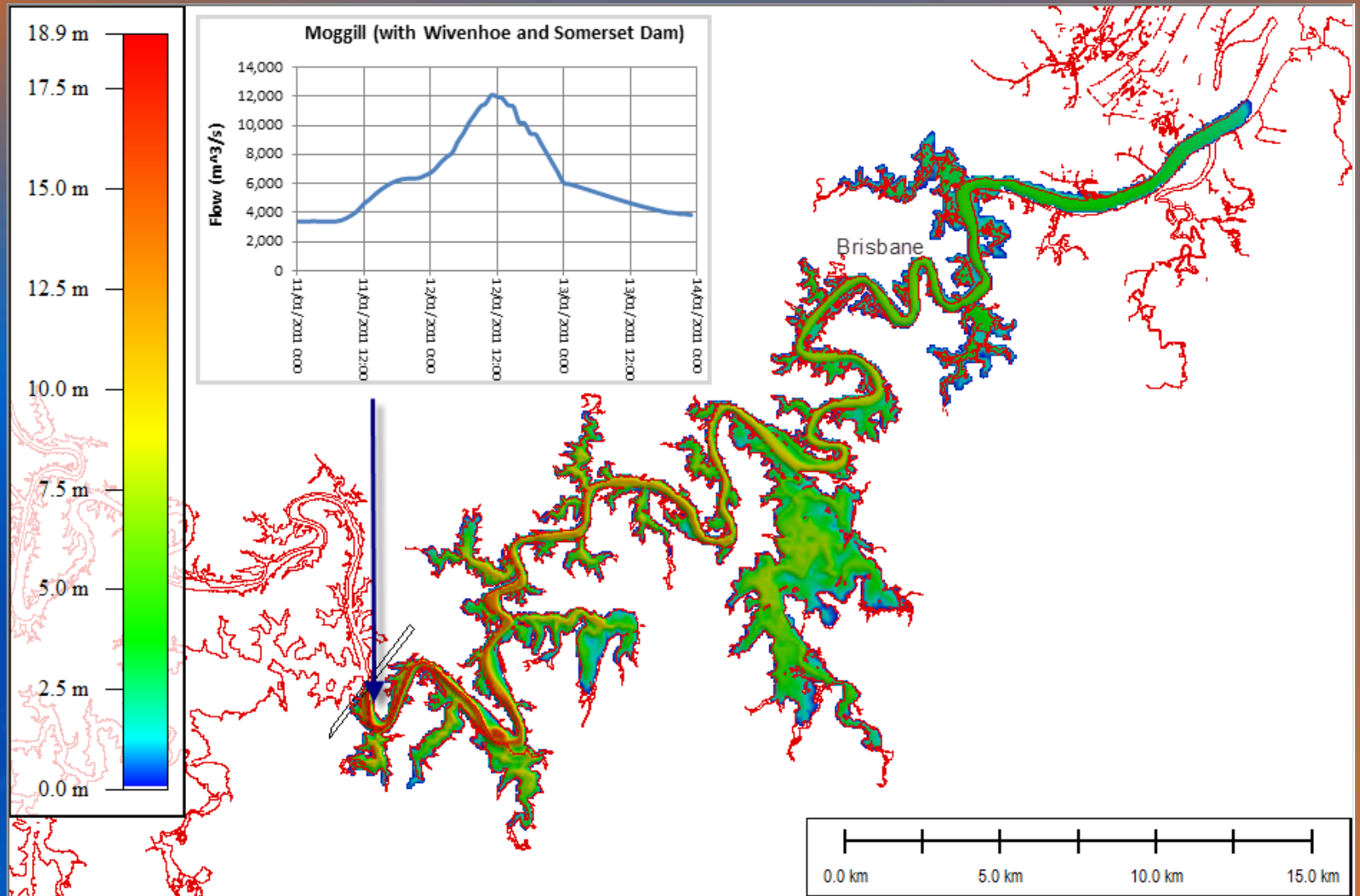
# National Flood Information Database vs 2011 Brisbane Floods



***Comparison between modelled flood extent in NFID (white areas) and the 2011 Brisbane Flood inundation extent (red polygon)***



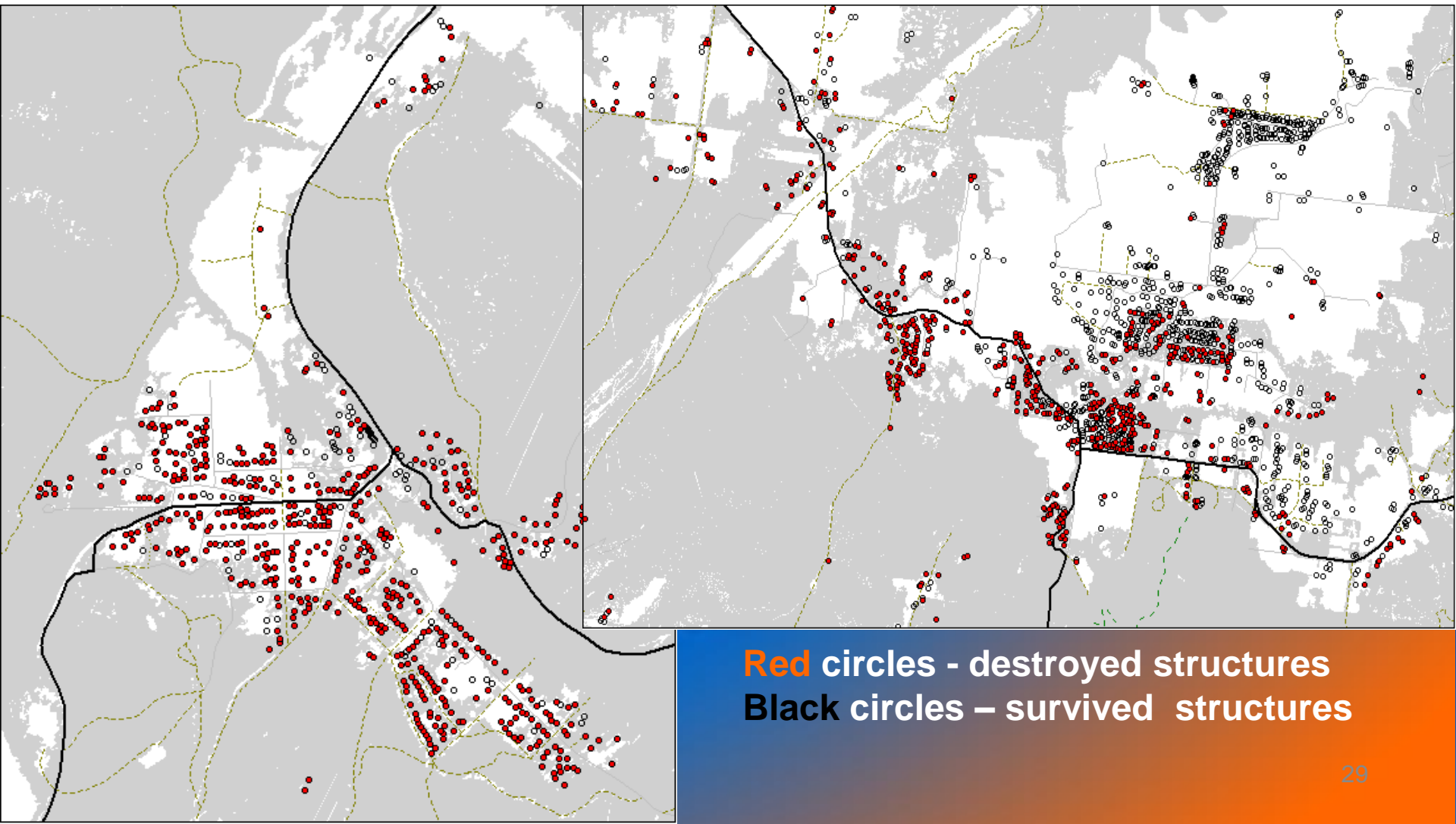
# Flood inundation modelling: water depth and flood extent (Brisbane)





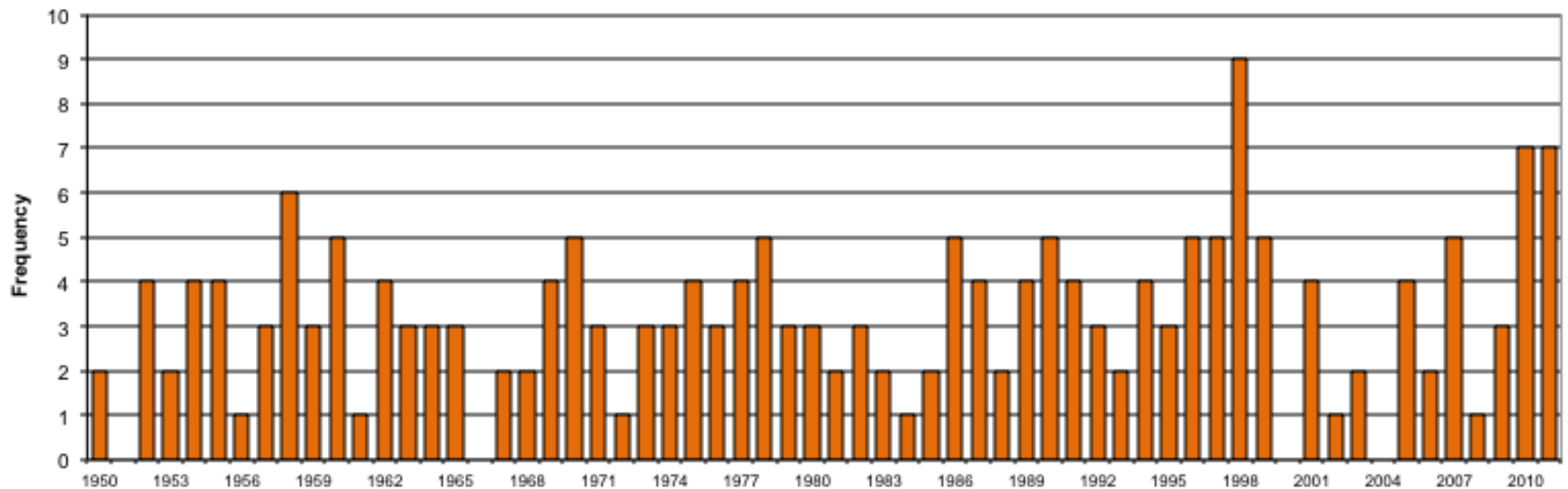
## Marysville and Kinglake 2009

- 25% of all homes destroyed were within 1 m of the bush
- 60% of all homes destroyed were within 10 m



# Frequency of Normalised Losses > 50HE

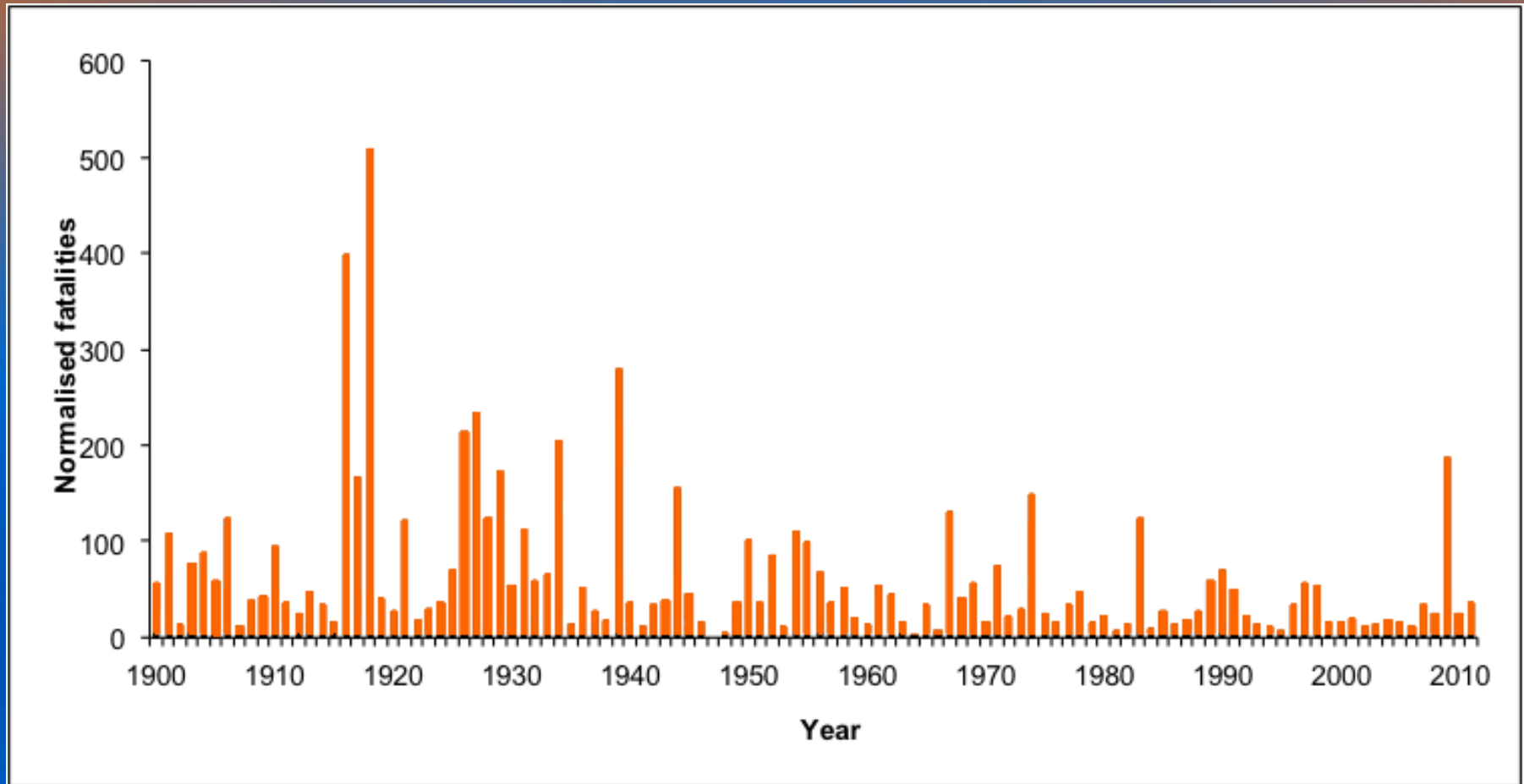
Frequency of events with normalised HE>50, by year



$$\text{Frequency} = -33.7460905 + 0.0186598 (\text{year})$$

Slope *not significant*,  $p = 0.142005$

# Fatalities from natural perils normalised by population



perils include in alphabetical order: bushfires, earthquake, flood, grassfire, wind gust, hail, landslide, lightning, rain, tornado and tropical cyclone

# Summary

- Losses are increasing due to increasing exposure and wealth in dangerous areas
- Emergence time scale of ACC signals in US hurricane losses between 120 and 550 years!
- Wrongly conflating disasters with climate change is to take your eyes off the ball
- Where and how we build is the key to reducing future natural disaster losses
- Good underwriting must reflect the real risk

# Is this important?

- Wrongly attributing disasters to climate change provides
  - wrongly conflates mitigating greenhouse gas emissions with disaster losses - eliminating CO<sub>2</sub> emissions will not stop natural disasters
  - likely to lead to poor policy options
  - easy ammunition for sceptics and discredits science
- The data is what it is – the truth has to be worth something
- Reducing disaster losses requires better land planning decisions and will require hard decisions that we have mostly avoided 'til now

# “Death is something that only happens to other people”

- In Victoria, almost everyone knew the fire conditions on Black Saturday were going to be dreadful, but this didn't change behaviour
- After 2011 Queensland and Victorian floods, few victims intend to build more resilient structures
- Studies show that people:
  - discount low probability events and
  - over-confident of their ability to cope when impacted
- Reducing risks of natural disasters will require some compulsion: needs to be applied at state and local government level because they have responsibility for land development
- Improved building standards works well in tropical cyclone-prone areas



# Planning for future disasters

Good American land planning principles are based upon  
*“property owners’ right to build what they want, and the  
government’s obligation to bail them out afterward.”*

*(Washington Post: September 21, 2005)*



# Politics!

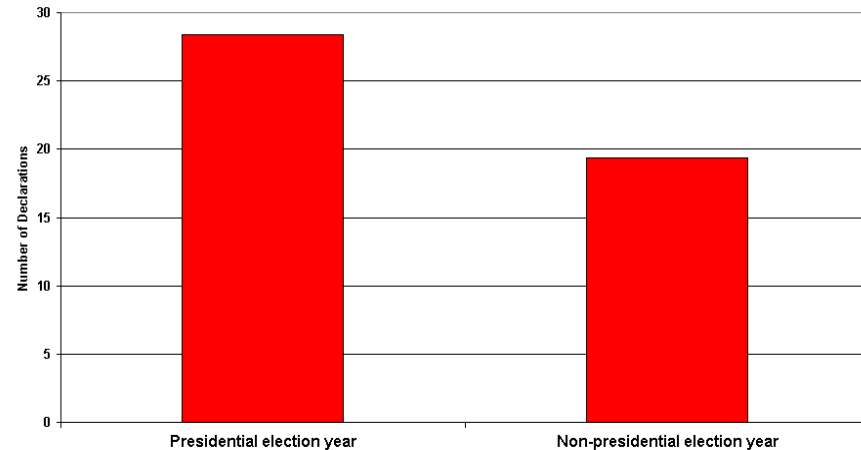
The Stern report, citing Muir-Wood, said:

“New analysis based on insurance industry data has shown that weather-related catastrophe losses have increased by 2% each year since the 1970s over and above changes in wealth, inflation and population growth/movement.

“If this trend continued or intensified with rising global temperatures, losses from extreme weather could reach 0.5%-1% of world GDP by the middle of the century.”

Muir-Wood said his research showed no such thing and accused Stern of “going far beyond what was an acceptable extrapolation of the evidence”.

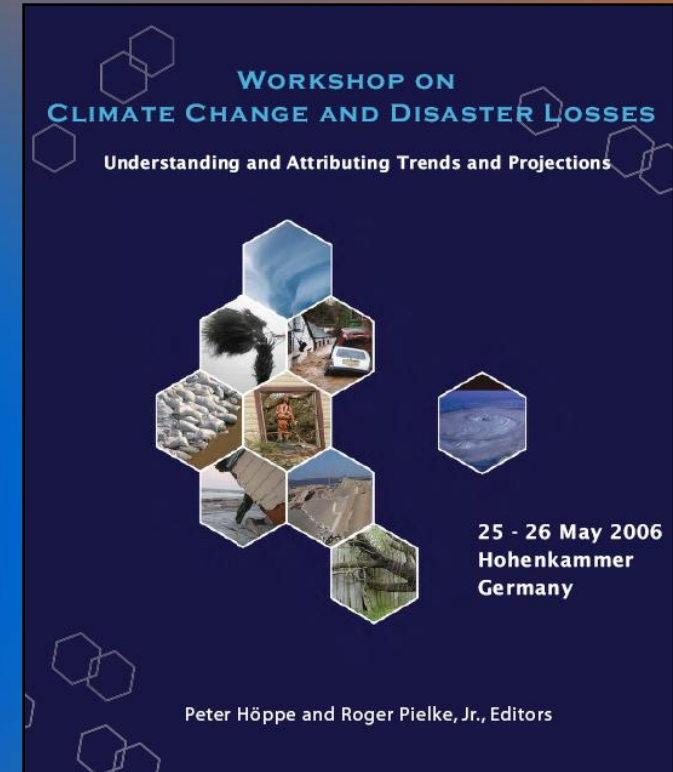
Presidential Disaster Declarations: Annual Average  
Accounting for Precipitation and Damage



“Our climate is changing. And while the increase in extreme weather we have experienced in New York City and around the world may or may not be the result of it, the risk that it may be — given the devastation it is wreaking — should be enough to compel all elected leaders to take immediate action.” **Mayor Bloomberg in his endorsement of Obama.**

# Hohenkammer Workshop May, 2006

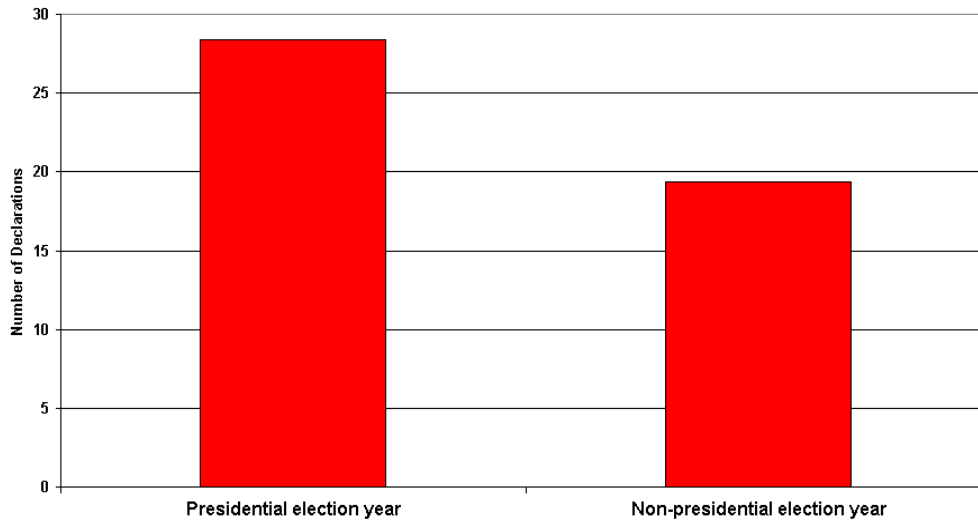
- Analyses of long-term records of disaster losses indicate that societal change and economic development are the principal factors responsible for the documented increasing losses to date.
- Because of issues related to data quality, the stochastic nature of extreme event impacts, length of time series, and various societal factors present in the disaster loss record, it is still not possible to determine the portion of the increase in damages that might be attributed to climate change due to GHG emissions
- In the near future the quantitative link (attribution) of trends in storm and flood losses to climate changes related to GHG emissions is unlikely to be answered unequivocally.





# Politics!

Presidential Disaster Declarations: Annual Average  
Accounting for Precipitation and Damage



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