Natural Disaster Losses & Anthropogenic Climate Change

Forecasting, Warning & DRR Strategies in the Mitigation of TC Impact in a Multi-hazard Environment
Macao, November, 2013

Professor John McAneney
Risk Frontiers, Macquarie University, Sydney

Overview

Natural disaster losses are increasing….

- Factors responsible for this trend to date?
- When will anthropogenic climate change (ACC) signals be detected in loss data?
- Implications of these timescales
- Disaster Risk Reduction

Climate Change & Disaster Losses

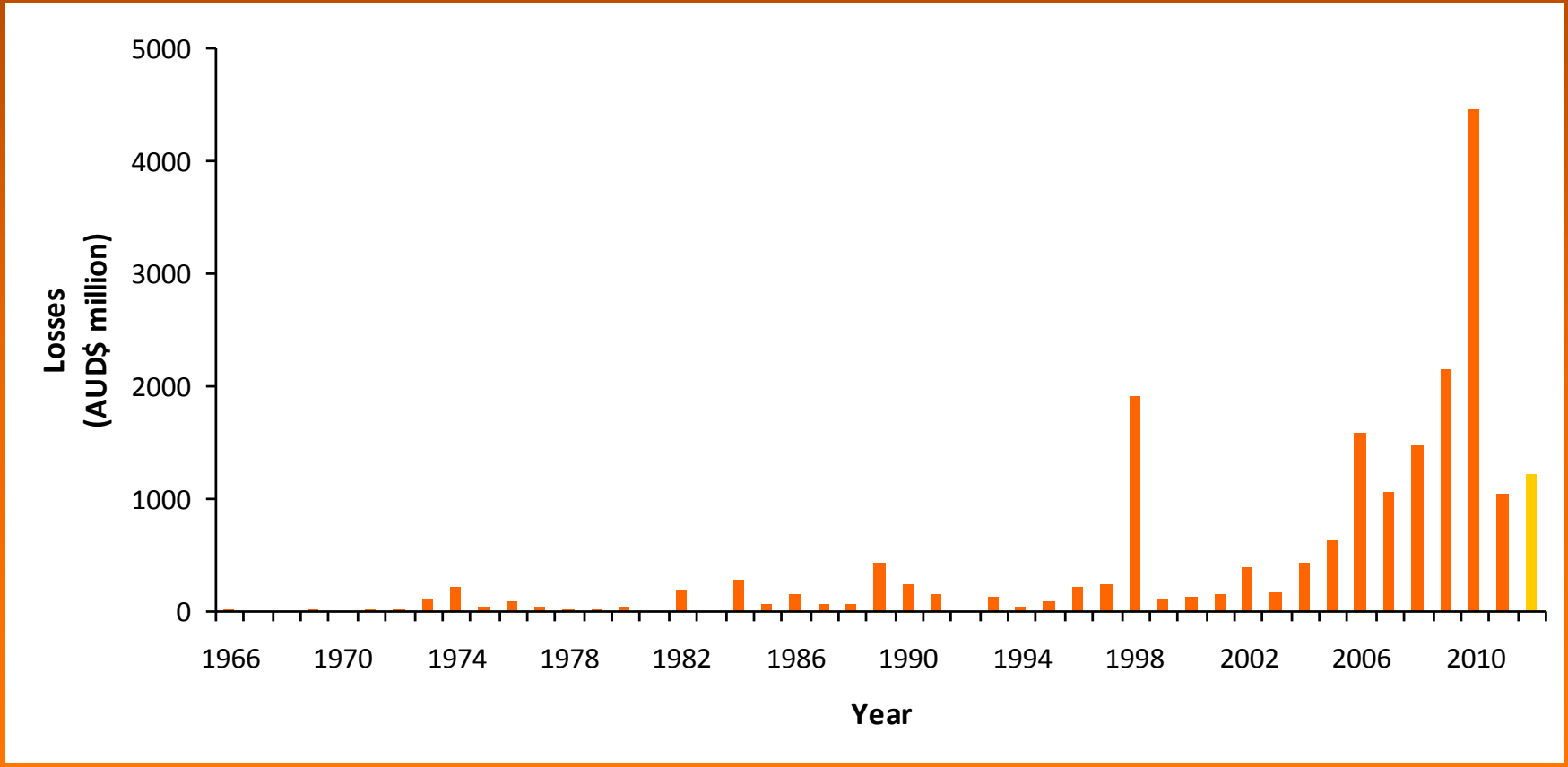
"Long-term trends in economic disaster losses adjusted for wealth and population increases have not been attributed to climate change, but a role for climate change has not been excluded (medium evidence, high agreement)."

IPCC SREX Report

March 2012

Annual Australian Weather Losses

(Insurance Council of Australia Disaster List)



Source: Crompton 2011 (updated)

Australia: Coastal Development

Gold Coast Main Beach
circa 1970

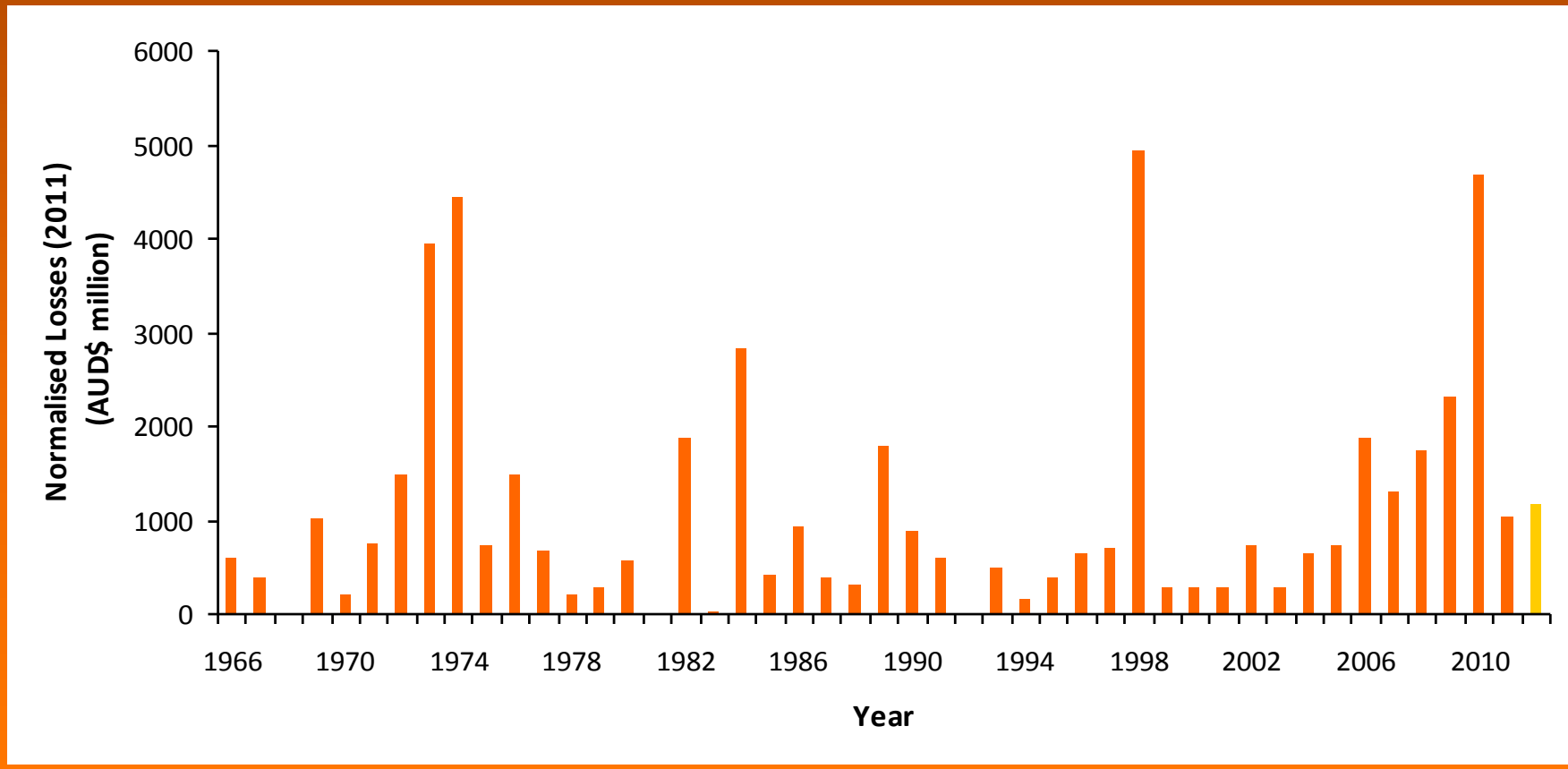
Local Studies Library, Gold Coast City Council

Gold Coast Main Beach
2003

Local Studies Library, Gold Coast City Council

Normalised Australian Weather Losses

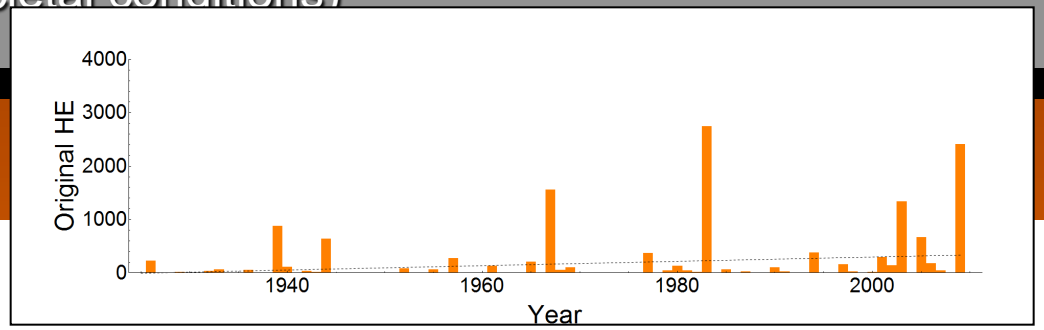
(year 2011/12 societal conditions)

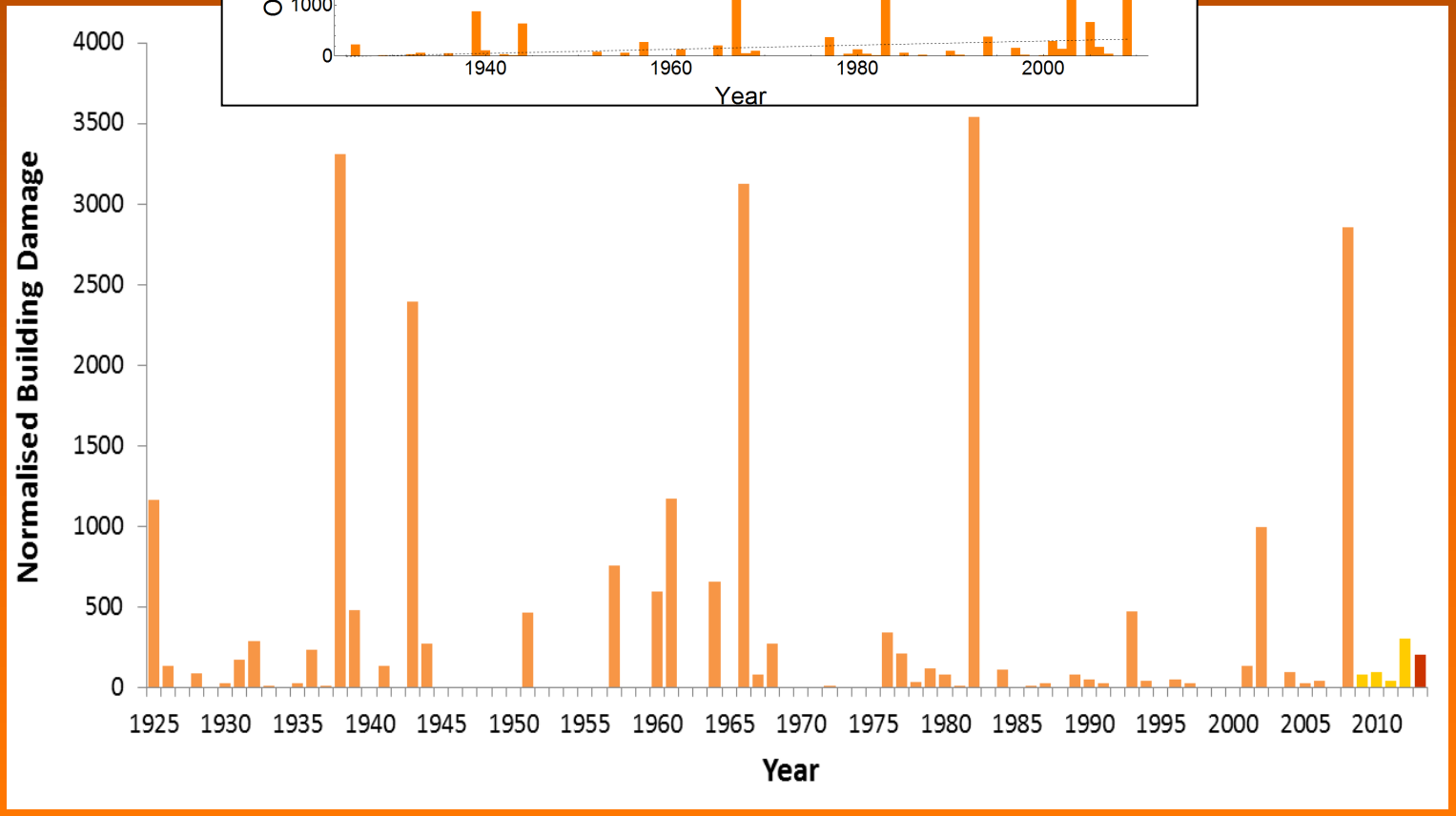


Source: Crompton 2011 (updated)

Normalised Australian Bushfire Damage

(year 2008/09 societal conditions)

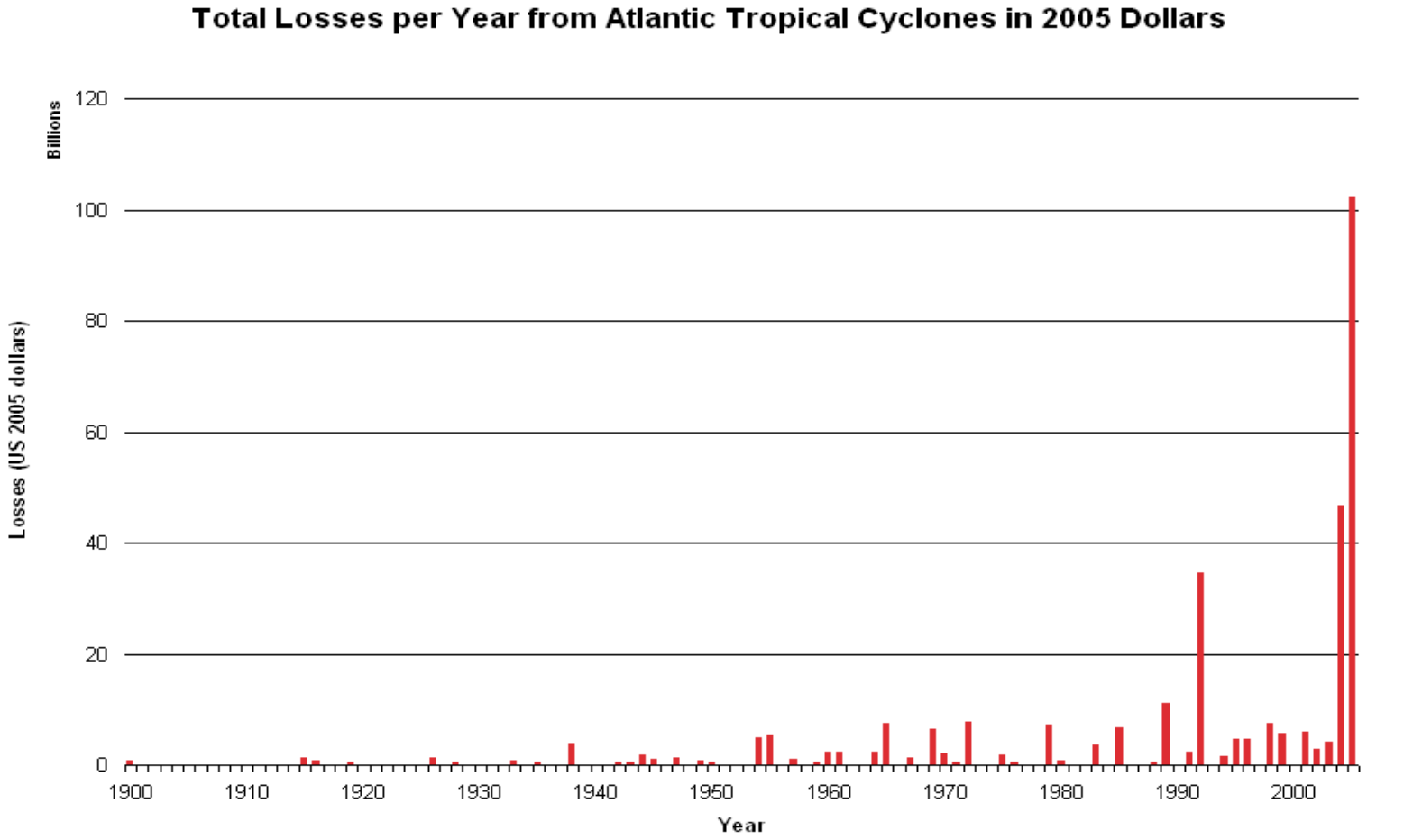




Source: Crompton et al. 2010

Annual Atlantic Hurricane Damage

(only adjusted for inflation)



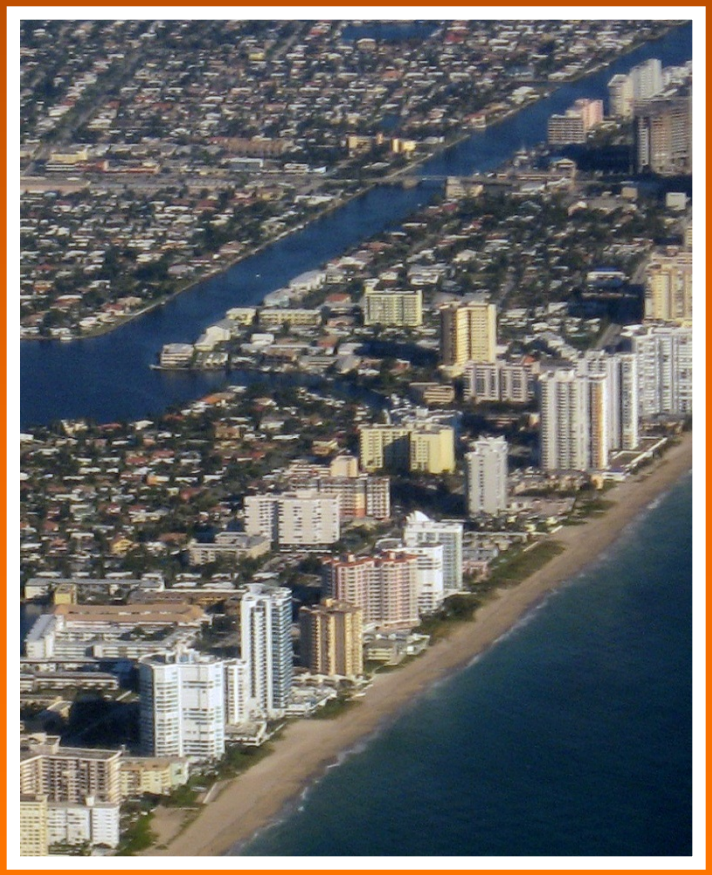
Source: Pielke et al. 2008

USA: Coastal Development

Miami Beach 1926

Wendler Collection

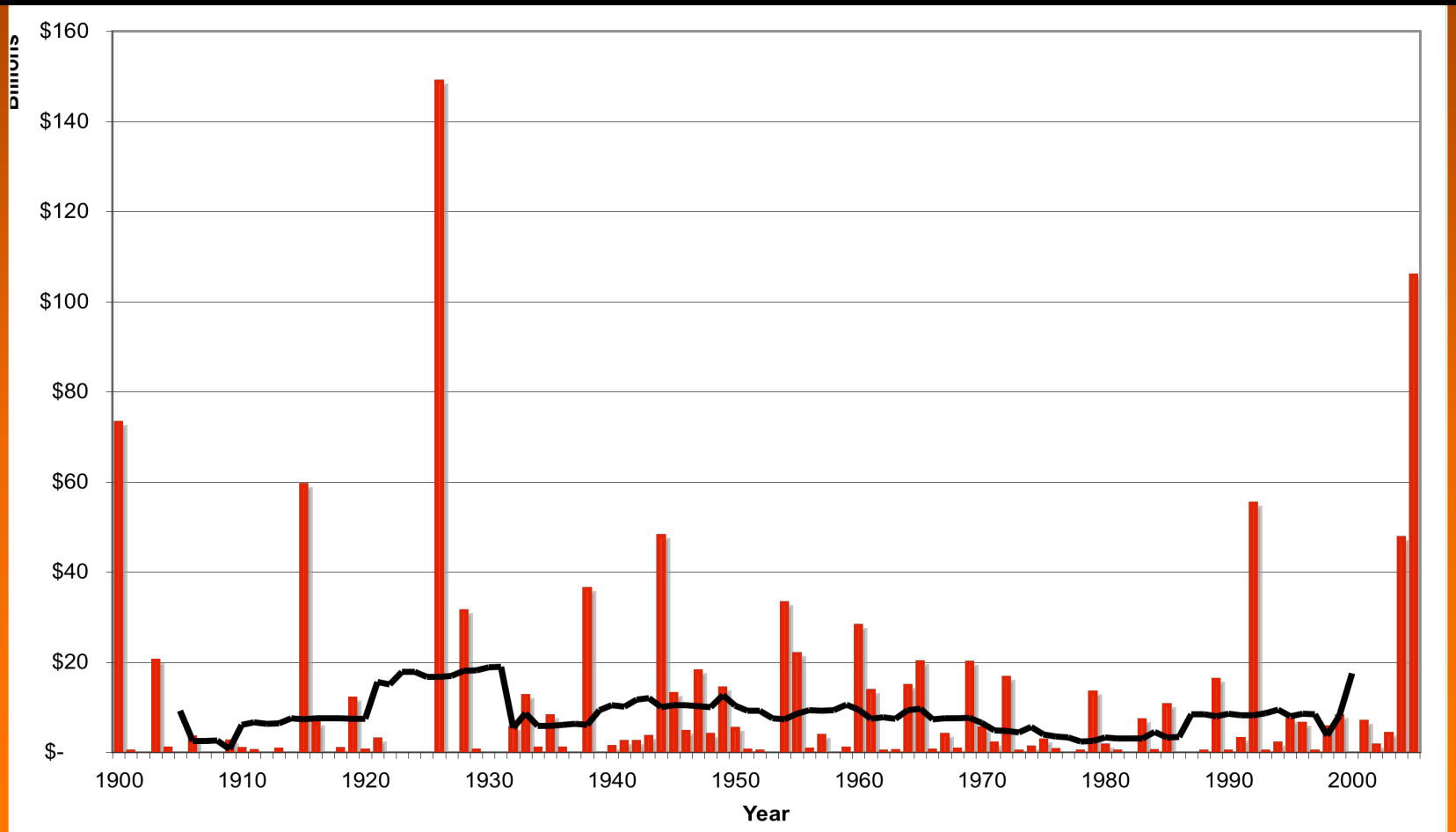
Miami Beach 2006



Joel Gratz © 2006

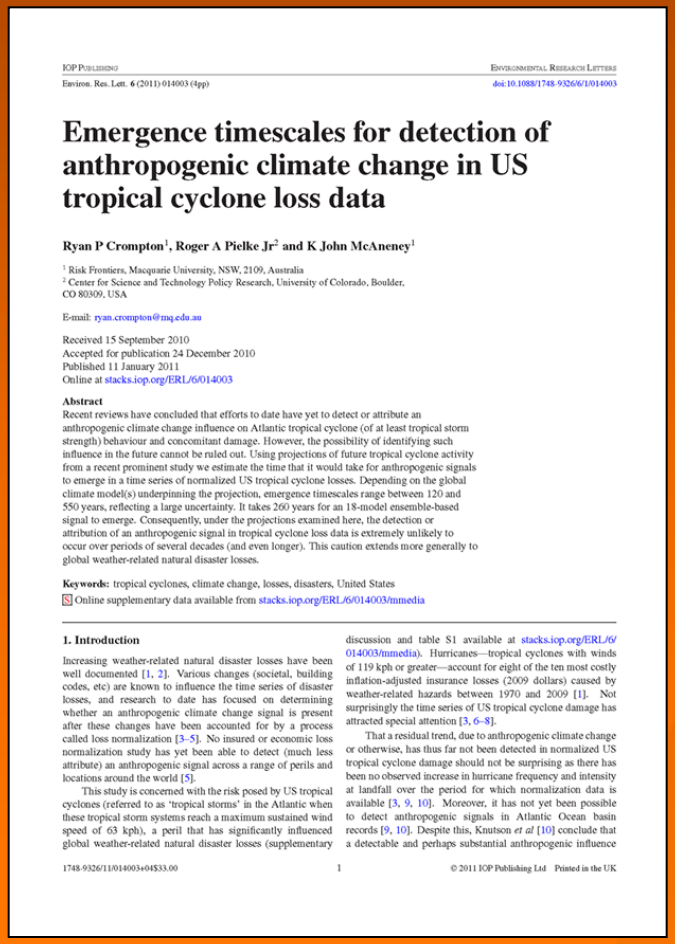
Normalised Atlantic Hurricane Damage

(year 2005 societal conditions)



Source: Pielke et al. 2008

When will Anthropogenic Climate Change Signals be Detected in US TC Loss Data?



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Emergence timescales for detection of anthropogenic climate change in US tropical cyclone loss data

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Abstract
Recent reviews have concluded that efforts to date have yet to detect or attribute an anthropogenic climate change influence on Atlantic tropical cyclone (of at least tropical storm strength) behaviour and concomitant damage. However, the possibility of identifying such influence in the future cannot be ruled out. Using projections of future tropical cyclone activity from a recent prominent study we estimate the time that it would take for anthropogenic signals to emerge in a time series of normalized US tropical cyclone losses. Depending on the global climate model(s) underpinning the projection, emergence timescales range between 120 and 550 years, reflecting a large uncertainty. It takes 260 years for an 18-model ensemble-based signal to emerge. Consequently, under the projections examined here, the detection or attribution of an anthropogenic signal in tropical cyclone loss data is extremely unlikely to occur over periods of several decades (and even longer). This caution extends more generally to global weather-related natural disaster losses.

Keywords: tropical cyclones, climate change, losses, disasters, United States
S Online supplementary data available from stacks.iop.org/ERL/6/014003/mmedia

1. Introduction

Increasing weather-related natural disaster losses have been well documented [1, 2]. Various changes (societal, building codes, etc) are known to influence the time series of disaster losses, and research to date has focused on determining whether an anthropogenic climate change signal is present after these changes have been accounted for by a process called loss normalization [3–5]. No insured or economic loss normalization study has yet been able to detect (much less attribute) an anthropogenic signal across a range of perils and locations around the world [5].

This study is concerned with the risk posed by US tropical cyclones (referred to as 'tropical storms' in the Atlantic when these tropical storm systems reach a maximum sustained wind speed of 63 kph), a peril that has significantly influenced global weather-related natural disaster losses (supplementary discussion and table S1 available at stacks.iop.org/ERL/6/014003/mmedia). Hurricanes—tropical cyclones with winds of 119 kph or greater—account for eight of the ten most costly inflation-adjusted insurance losses (2009 dollars) caused by weather-related hazards between 1970 and 2009 [1]. Not surprisingly the time series of US tropical cyclone damage has attracted special attention [3, 6–8].

That a residual trend, due to anthropogenic climate change or otherwise, has thus far not been detected in normalized US tropical cyclone damage should not be surprising as there has been no observed increase in hurricane frequency and intensity at landfall over the period for which normalization data is available [3, 9, 10]. Moreover, it has not yet been possible to detect anthropogenic signals in Atlantic Ocean basin records [9, 10]. Despite this, Knutson *et al* [10] conclude that a detectable and perhaps substantial anthropogenic influence

The Central Question:

Given a specific projection of future changes to TC behaviour, when would we expect to detect a trend in loss data as a consequence of those changes?

Signal Detection in US TC Loss Data

- Start with projected ACC influence on Atlantic basin TCs
  - Bender et al. 2010
- Apply in context of US TC loss data
  - Pielke et al. 2008
- Emergence timescale methodology
  - Crompton et al. 2011

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	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

Results

260 years!

Range: 120 – 550 years

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

IPCC on Climate Change & Disaster Losses

SREX Report 2012

"In many regions, the main drivers of future increases in economic losses due to some climate extremes will be socioeconomic in nature (medium confidence, … medium agreement, limited evidence)."

"Some studies indicate that the expected changes in exposure are much larger than the effects of climate change … which is particularly true for tropical and extratropical storms."

AR5 Chapter 2

"Current datasets indicate no significant observed trends in global tropical cyclone frequency over the past century … No robust trends in annual numbers of tropical storms, hurricanes and major hurricanes counts … identified over the past 100 years in the North Atlantic basin"

Disaster Risk Reduction

- Vulnerability reduction measures can offset some of the exposure growth pressure on losses
  - e.g. bldg standards, land use planning etc
- Many homeowners, private businesses & public-sector organisations fail to voluntarily adopt cost-effective measures
- Governments should consider large realistic disaster scenarios and use these to focus disaster risk reduction priorities

Conclusions

- Socio-economic factors are main drivers of increasing trend in disaster losses around the world and likely to remain the case for a long time in many regions
- Stategies for climate change adaption must recognise wide uncertainties in terms of future trajectory of extreme weather events like tropical cyclones
- Short & long term benefits from addressing societal vulnerability
- Relaistic disaster scenarios