CLIMATE CHANGE

RISKS, POLITICS AND OPPORTUNITIES

October 2009

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Many slides with kind permission of Lloyd's….

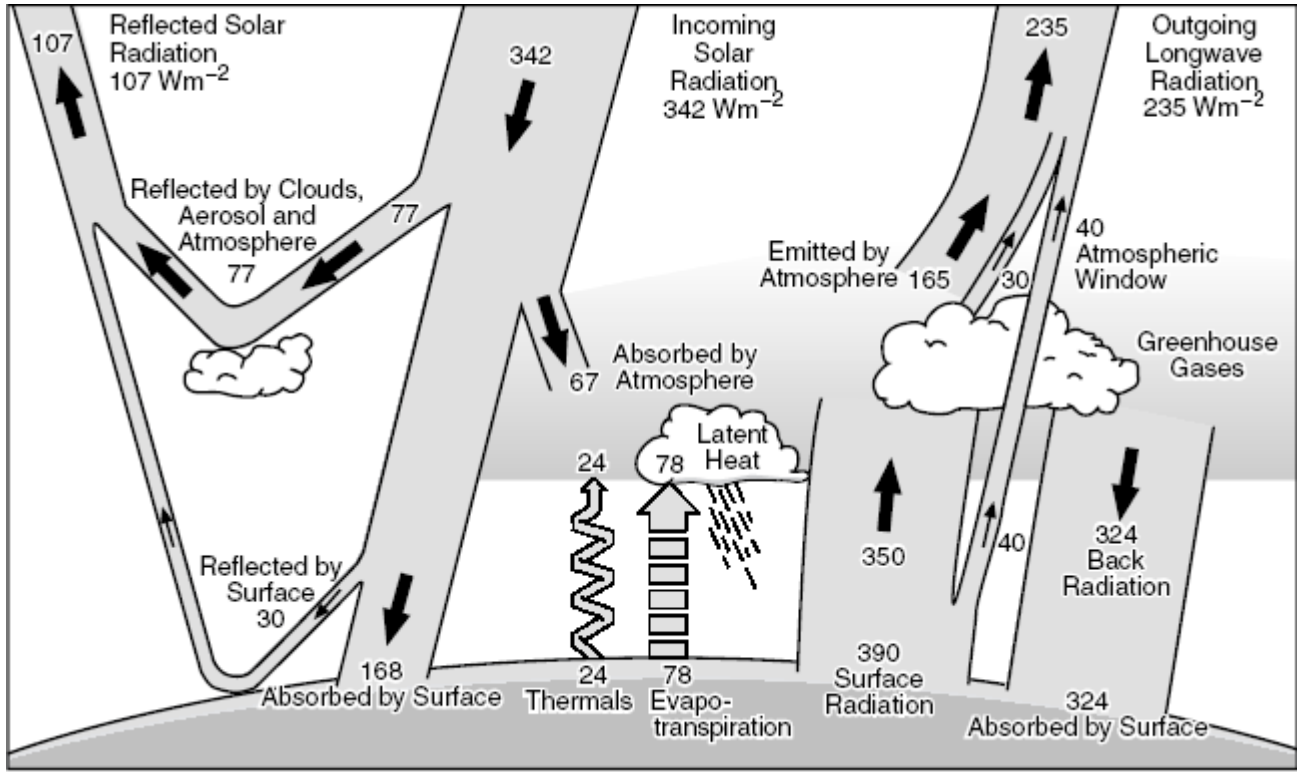
However, the views expressed in this presentation are my own and do not necessarily reflect those of my employer or the UK actuarial profession.

Agenda

- Happening, Man-made, Mostly CO2
- Extremes, past lessons, future warnings
- Impacts, Big Picture
- Impacts, Actuaries
- Copenhagen - COP15
- Insurance industry response

HAPPENING
MAN-MADE
MOSTLY CO_2

Greenhouse effect



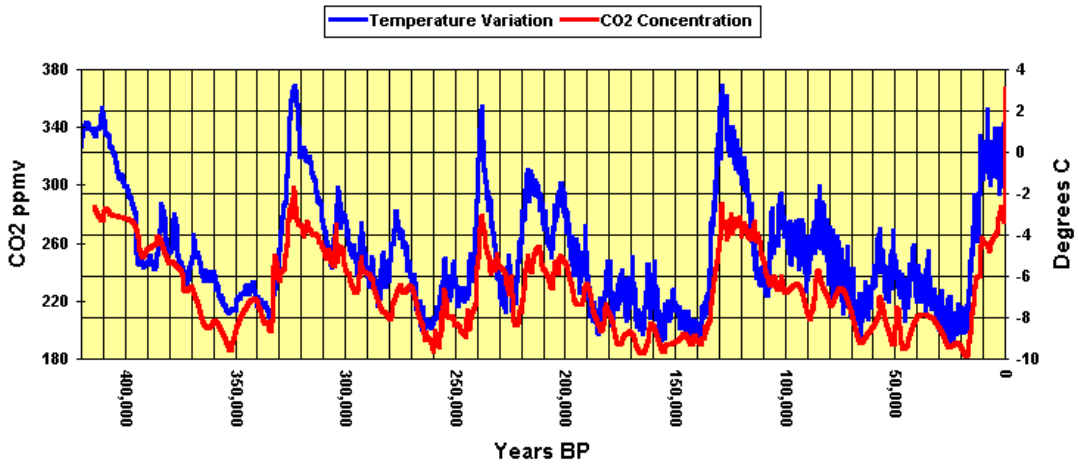
Source: Kiehl and Trenberth, 1997:

Greenhouse gasses

Greenhouse gases	Chemical formula	Pre-industrial concentration	Concentration in 1994	Atmospheric lifetime (years)***	Anthropogenic sources	Global warming potential (GWP) *
Carbon-dioxide	CO_2	278 000 ppbv	358 000 ppbv	Variable	Fossil fuel combustion Land use conversion Cement production	1
Methane	CH_4	700 ppbv	1721 ppbv	12,2 +/- 3	Fossil fuels Rice paddies Waste dumps Livestock	21 **
Nitrous oxide	N_2O	275 ppbv	311 ppbv	120	Fertilizer industrial processes combustion	310
CFC-12	CCl_2F_2	0	0,503 ppbv	102	Liquid coolants. Foams	6200-7100 ***
HCFC-22	$CHClF_2$	0	0,105 ppbv	12,1	Liquid coolants	1300-1400 ***
Perfluoromethane	CF_4	0	0,070 ppbv	50 000	Production of aluminium	6 500
Sulphur hexa-fluoride	SF_6	0	0,032 ppbv	3 200	Dielectric fluid	23 900

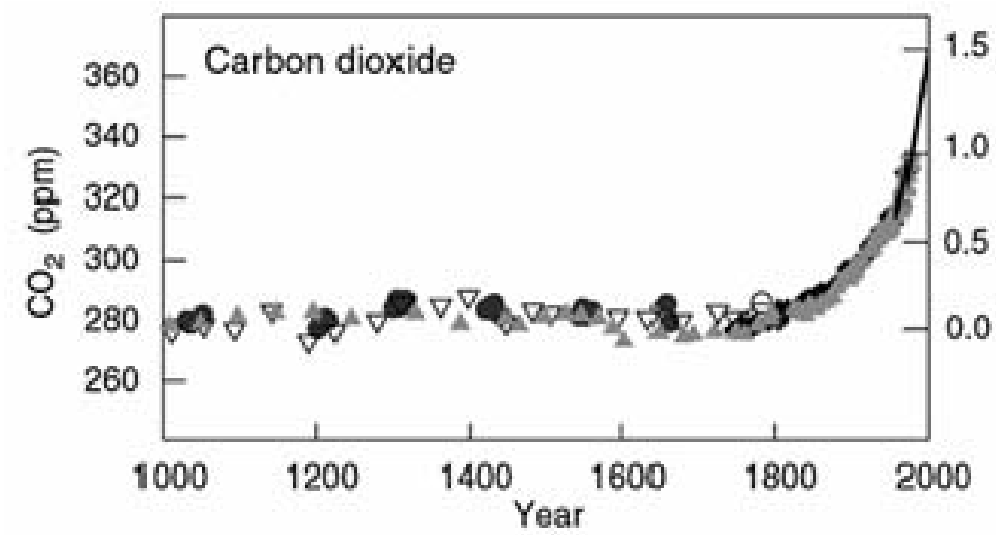
Greenhouse gasses – further back

- 1990s, international team
- 420,000 years of data
- Simultaneous record of:
  - CO_2
  - Oxygen
  - Temperature
  - Methane
- CO_2 and Temperature highly correlated
- 180ppm – 300ppm



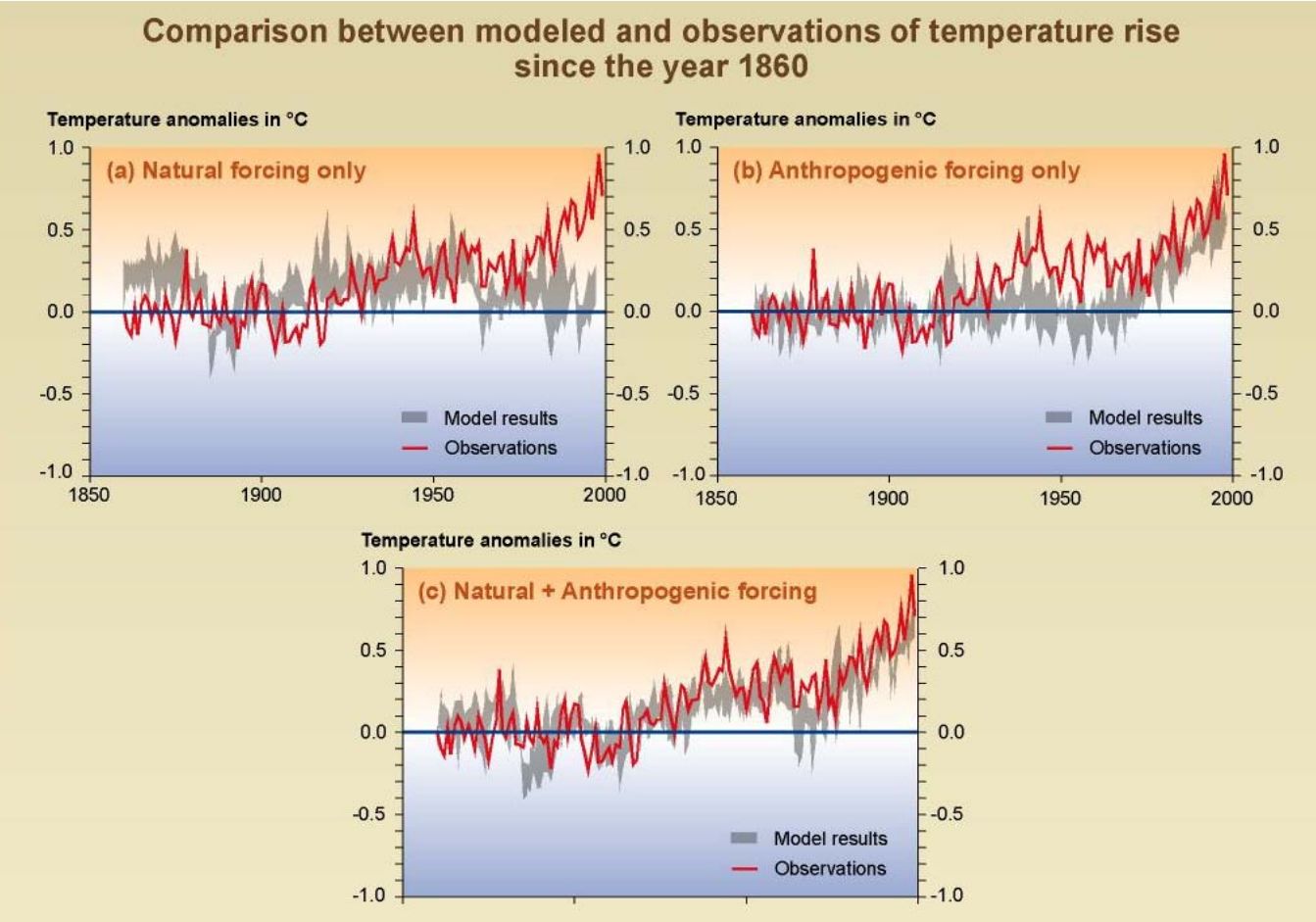
Greenhouse gasses – recent past

- 280ppm to 380ppm in 150 years
- 31% above pre-industrial levels
- Proxy data before 1800
- Anthropogenic (man made)



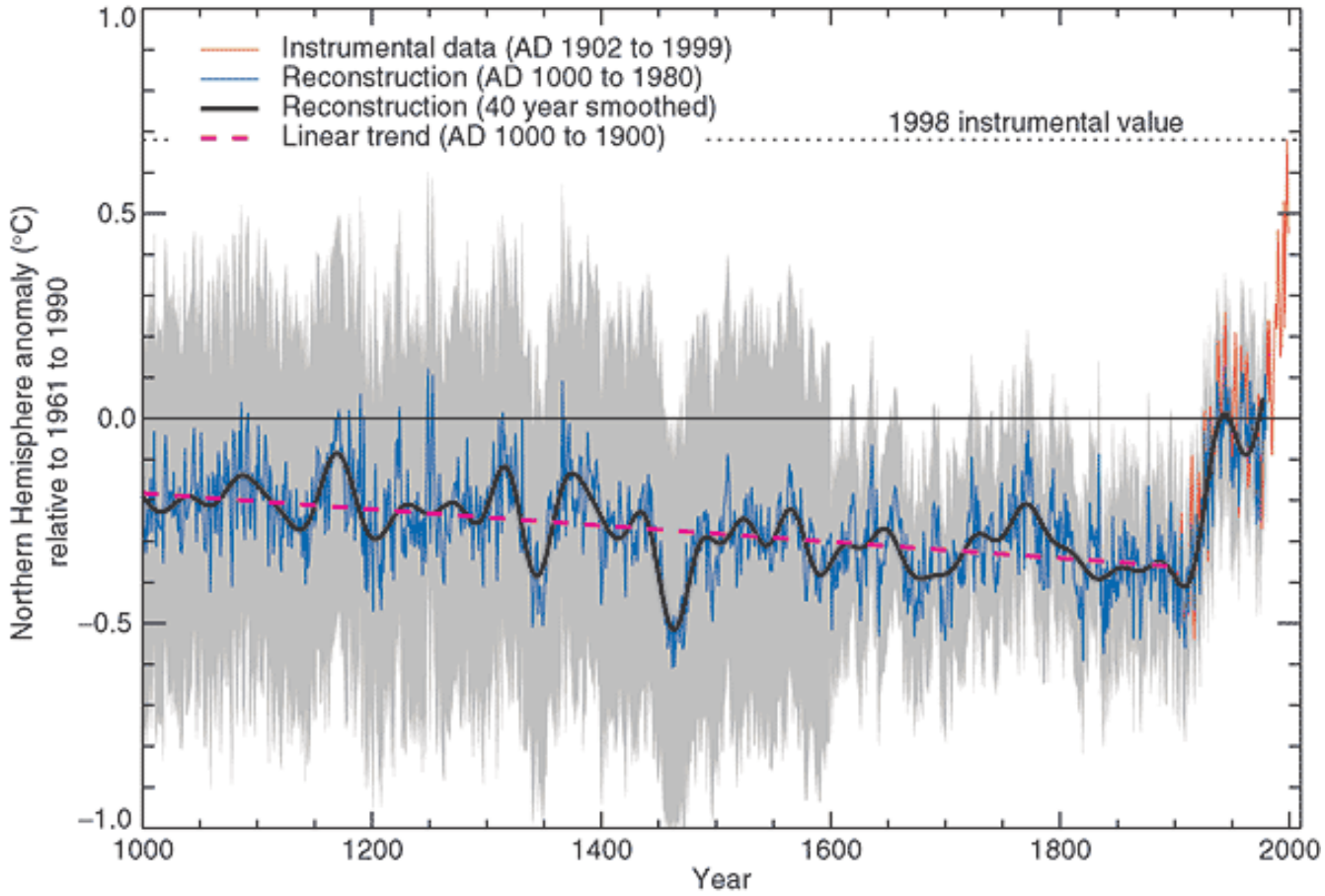
Source: IPCC

Temperature effect – man-made



Source: IPCC

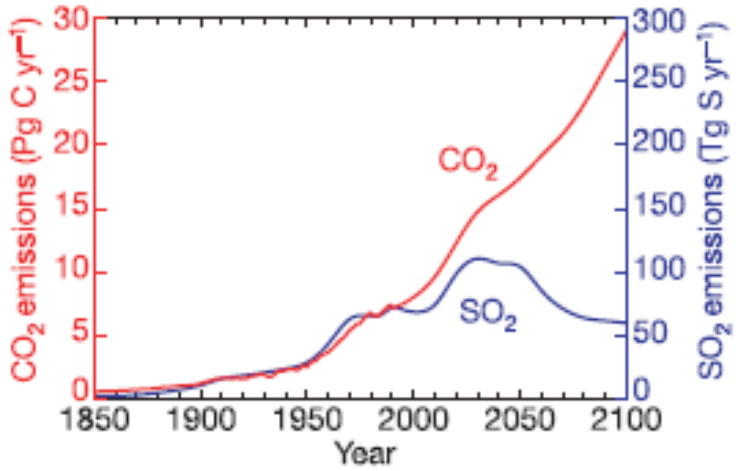
Temperatures – hockey stick



Source: IPCC

Aerosols

- Andreae et al (2005) – nature
- We expect to clean up the atmosphere (reduce SO_2)
- Past rates of temperature growth have been masked.

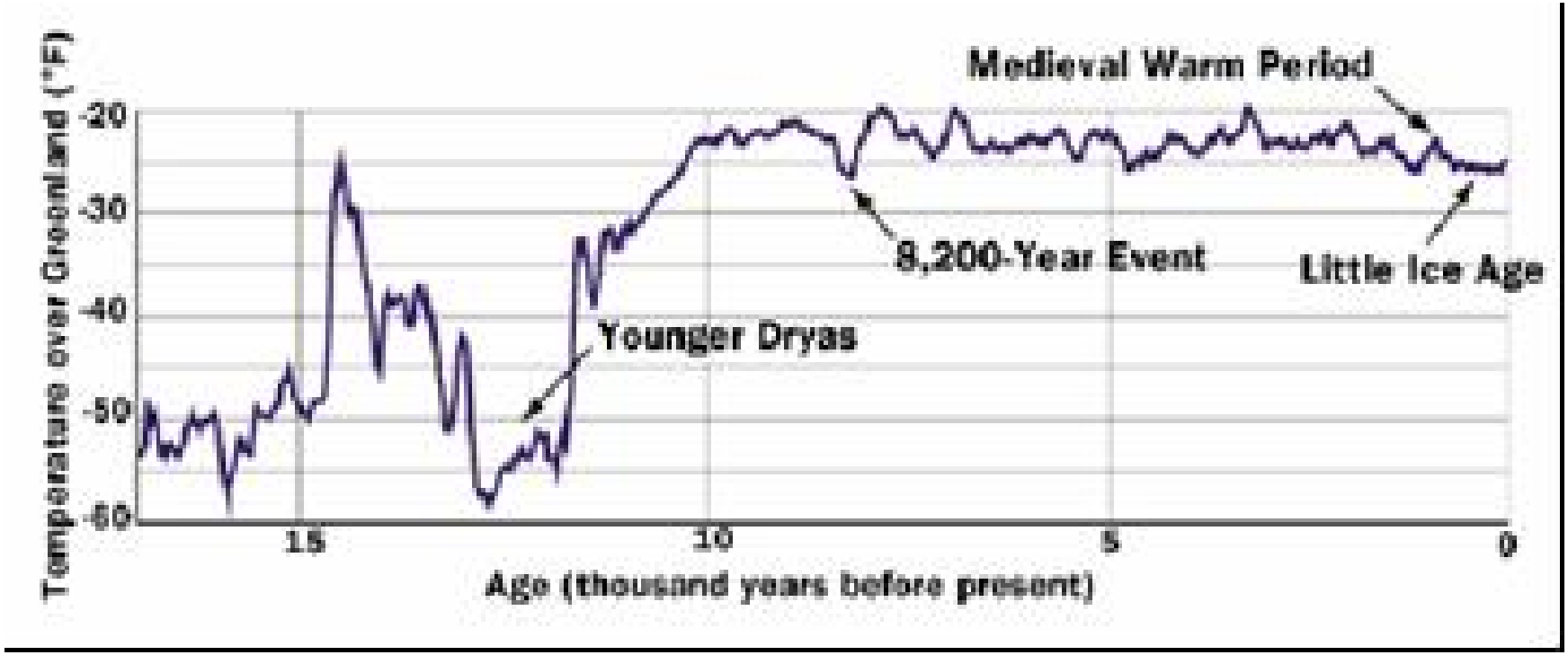


WWW.REALCLIMATE.ORG

EXTREMES

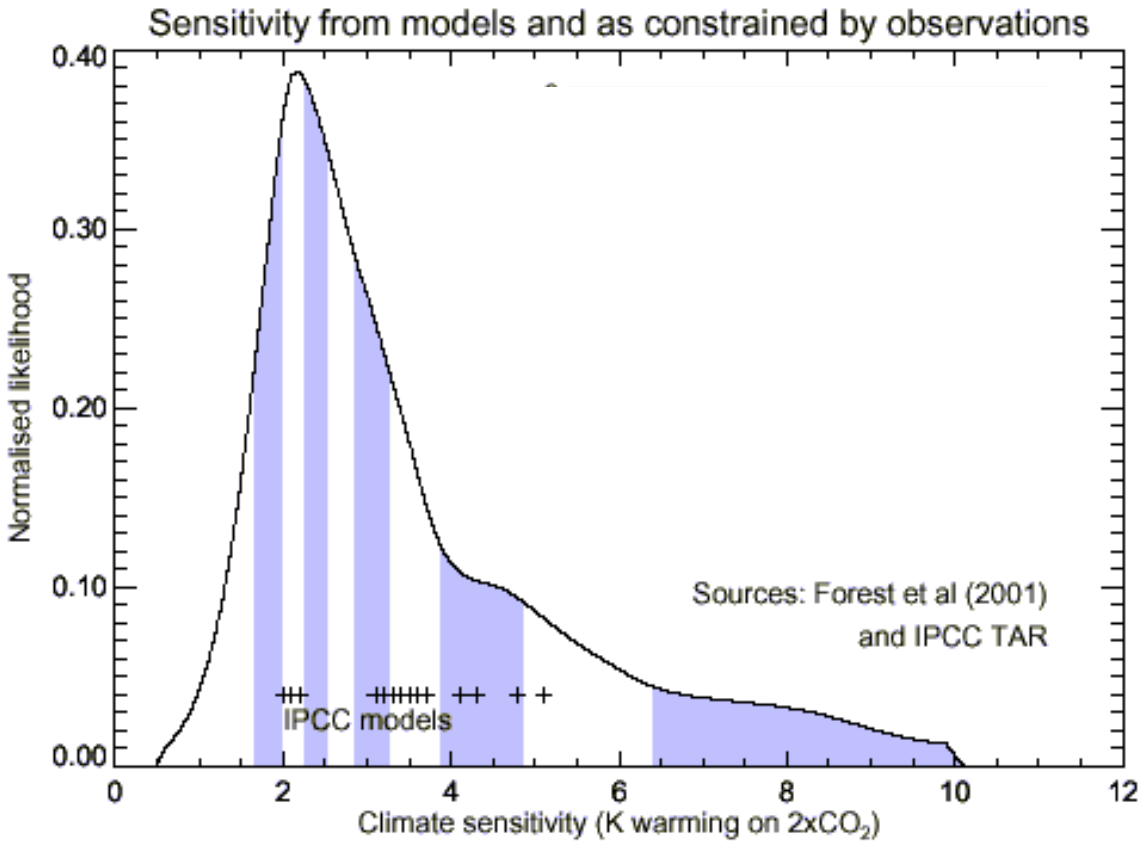
LESSONS FROM THE PAST
A WARNING FOR THE FUTURE

Temperatures



Chaos applies to climate models….

- Parameter and model risk
- Ensembles!
- Robust planning



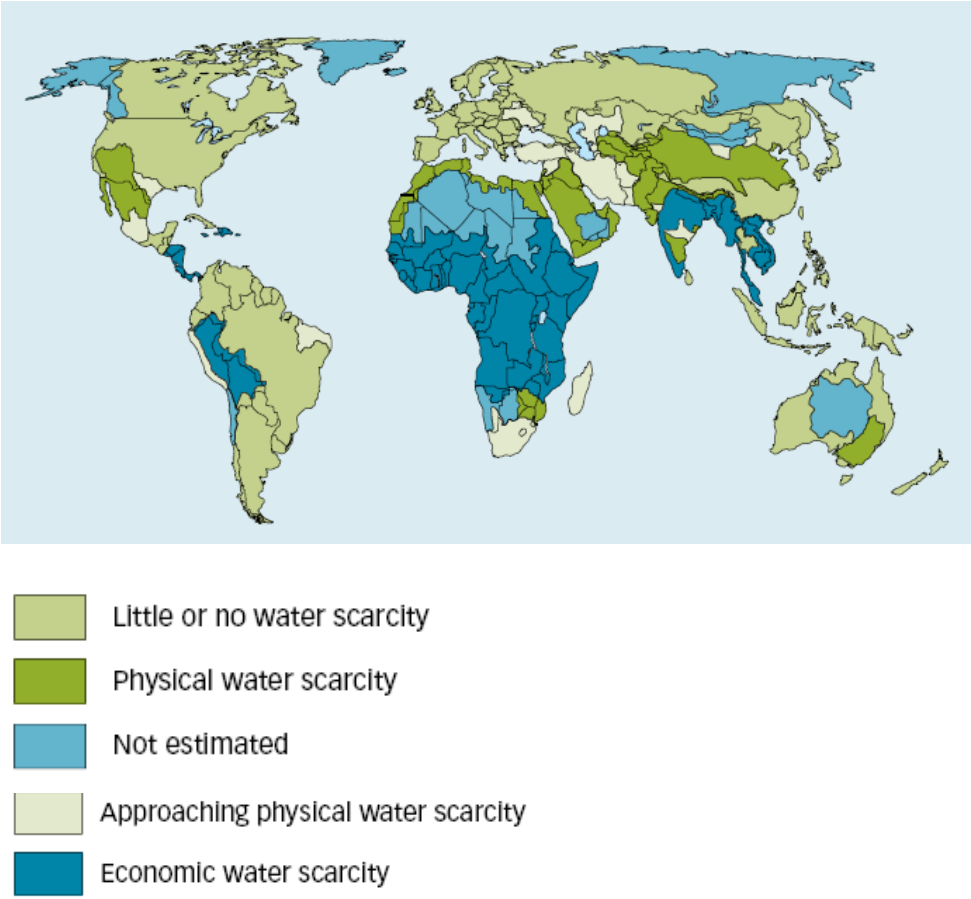
climateprediction.net

IMPACTS BIG PICTURE

SOME SCENARIOS, NOT FORECASTS

Water weapons…

- People typically live where water is; if it moves, they move
- Access to water will be seen as a strategic weapon
- “Building a dam could be seen as an act of aggression”
- Key risks:
  - Nile
  - Tigris/ Euphrates
  - Indus
  - Mekong



Indus

- 1947 Partition of India and Pakistan (both nuclear)
- Indian land contains 5/6 major tributaries (glacier fed)
- Indus water treaty 1960 allocated
  - Majority of flow to Pakistan
  - India gets fixed volume
- ¾ of Pakistan's food grown on irrigated land (otherwise desert), only 10% for india
- Water "weapon" never used by india
- Glaciers feed all six tributaries and are melting (gone by 2035?)
  - => river flow becomes seasonal
  - no water when crops need them (life or death for Pakistan)
  - Similar issue faces: Mekong, Yangtze, Ganges, Brahmaputra, Ganges, Salween

Food facts

- World population 3x in last 60 years
- Green revolution=>
  - Hybrid strains; higher yields, saline resistance
  - 1100% increase in use of fertlisers
  - 300% increase in use of irrigation (fossil water)
- Irrigated land = 15%; but produces 40% of world's food
- Fossil water drilling – uses fossil fuels (and many aquifers almost dry)
- Fertiliser production uses natural gas

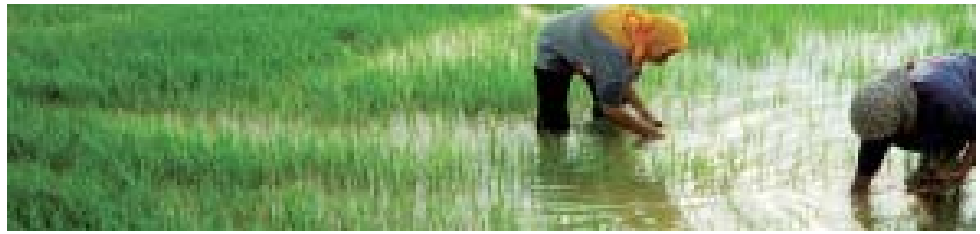
Not as stable as we thought…

- World grain reserve
  - =54 days (cf 116 days 10 years ago)
  - 1973 – last time that low (population 50% of now!)
- India, 2º temp increase => 25% crop decrease
- 50% of UK food is imported
- Solutions?
  - Move down food chain (less meat);
  - New crops (higher yielding; saline resistence)
  - Deals with other food producers (e.g. China with Sudan)
  - More efficiency (drip feeding etc)
- Climate change issues:

  … water

  … storms

  .... sea level rise



We don’t need oil any more…

- Possible to imagine US halving oil consumption in 15 years
  - Fuel efficiency
  - Battery Technology (electricity from clean coal?)
  - 2nd 3rd Gen Bio Fuels
- Implication for oil producing nations profound:
  - Marginalisation of major oil producers in 2 decades?
  - Iran, Arab states, Nigeria, Angola, Venezuela, Russia
  - Unable to support population?

….or maybe we do

- Interpretation of UNCLOS (United Nations Convention on Law of the Sea)
  - What does perpendicular mean?
  - Artur Chilingarov – placed Russian flag on artic seabed
  - Canada reacted by promising new naval bases; and claims the northwest passage is part of their inland waters.
  - Increasing tension between Russia and NATO?

Climate refugees…

- Waves of refugees? Already:
  - Libyan's -> Italy
  - Senegal -> Canary Islands
- Invest in adaptation to make regions viable?
  - Desalination etc
  - Economic cost to developed world
- Or close boarders?
  - Physical barriers/ limitations to travel
  - E.g US/Mexico (Hispanic community in US will react)

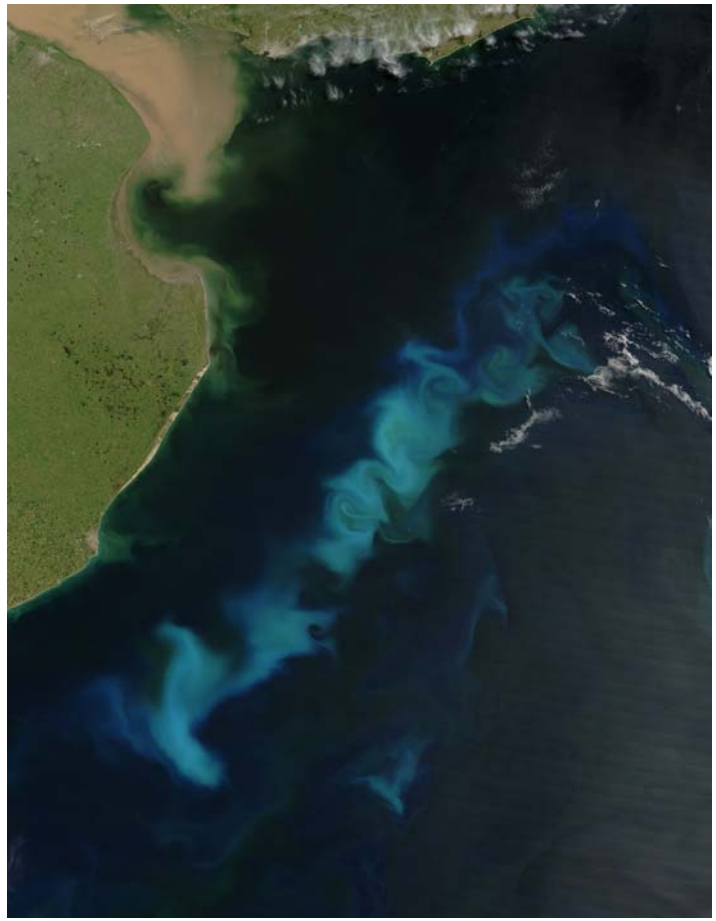
Megacities…

- 2008 was first year more people lived in cities than outside them
- Vulnerable to climate stress (heat, water, flooding etc)
- Ungovernable? (e.g. Mexico city)
- Organised crime (cyber, counterfeiting, fraud)
- Business issues:
  - Utilities unreliable
  - High cost of security for staff/ premises
- Hot bed for extremism

http://en.wikipedia.org/wiki/File:Tokyo_odaiba.jpg

Geoengineering

- Albedo management – reflecting sunlight
  - Cloud brightening
  - Stratospheric particle injection
  - Orbiting space mirrors
- Carbon management –
  - Sequestration
  - Iron ion seeding in pacific
- Not clear if these are insurable….
- Who blames whom if it goes wrong?



IMPACTS ACTUARIES

Public opinion

Hindsight

Morbidity

Physical damage

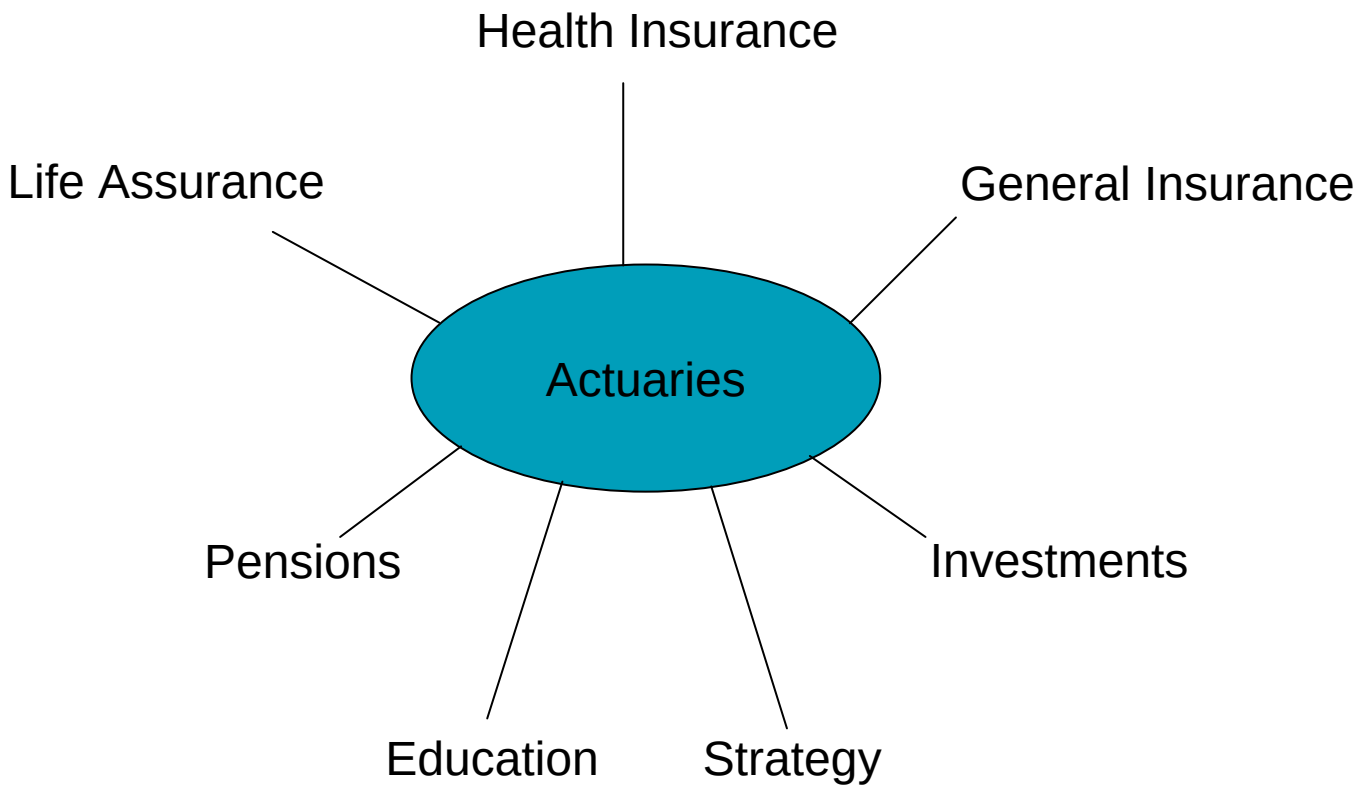
Political Tension

Mortality

Adaptation

Liability?

Financial sense of the future



Economic impacts

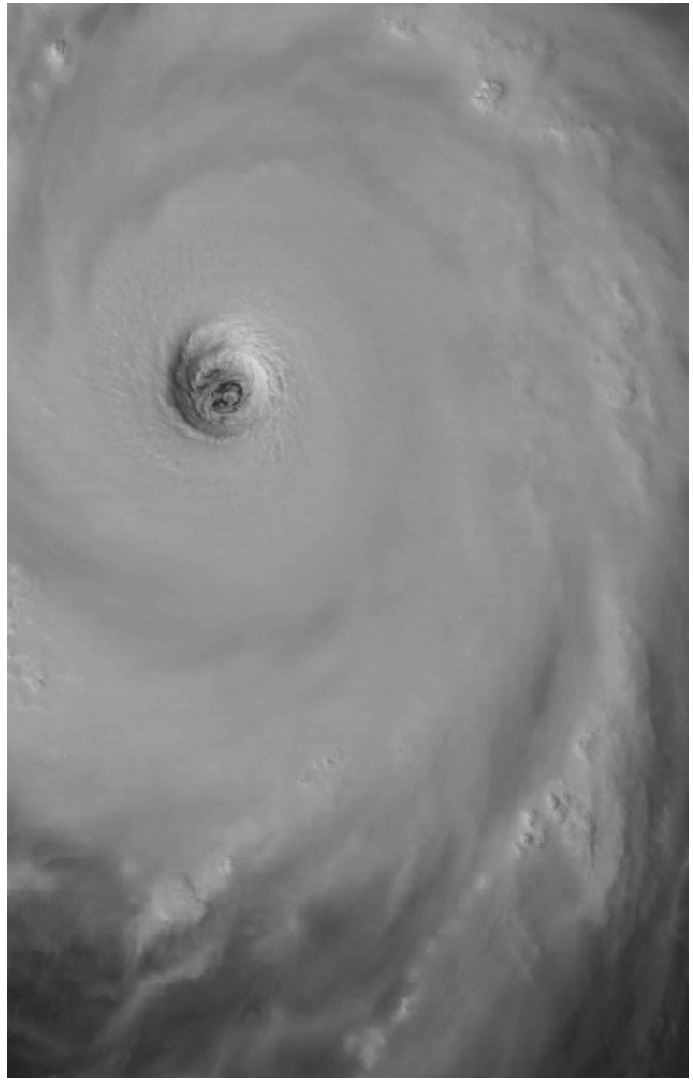
Political Will

Opportunity

Mitigation

Property Damage - Wind

- Climate change
  - Severity/Frequency
  - Changed landfall location
  - Longer hurricane season
- Implication
  - Business opportunity
  - Political interference
  - Insurability?
  - Lloyds RDS
- Example: 2004/2005 Hurricane season



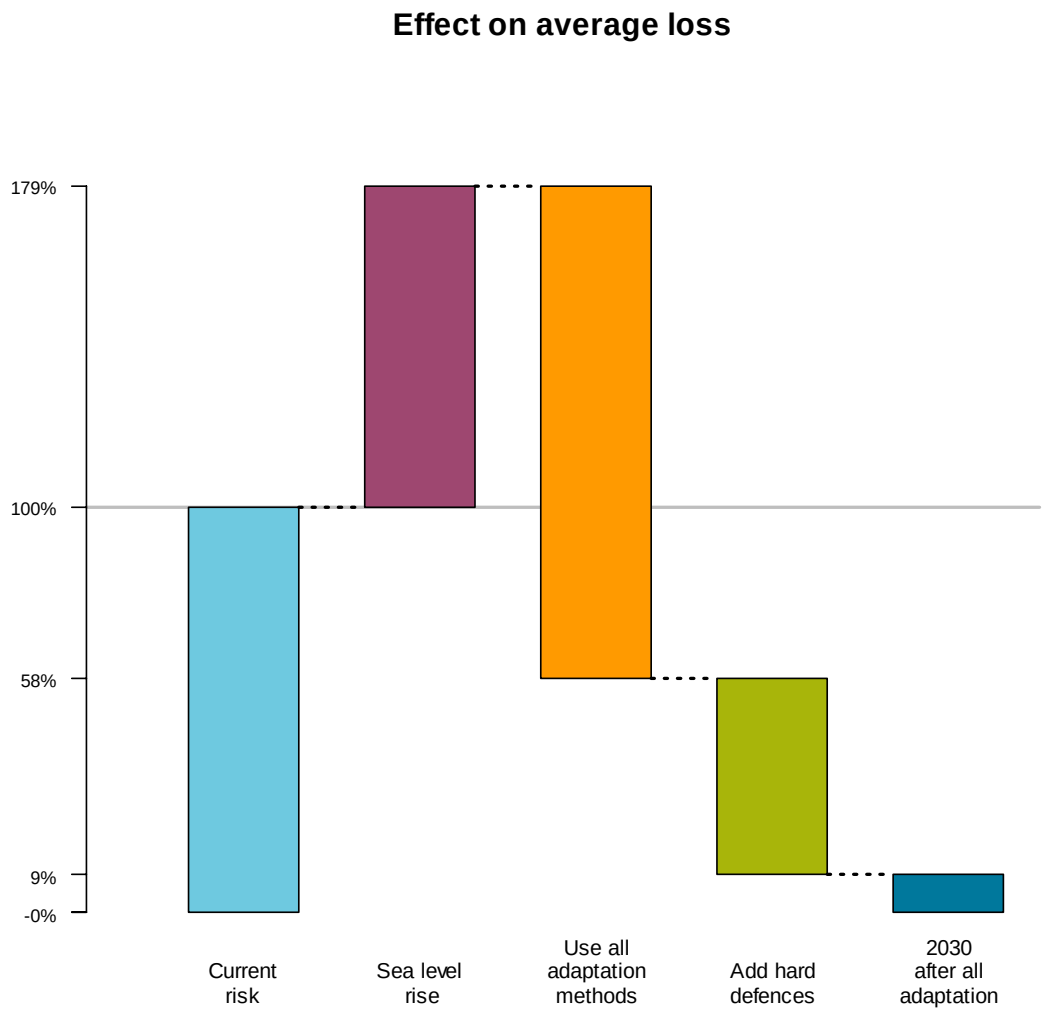
Tropical Storm Grace formed just northeast of the Azores on October 4 out of a previously non-tropical storm. It is **the farthest-northeast-forming tropical storm in the Atlantic in the satellite era**, breaking Vince's record from 2005. It moved rapidly northwards, reaching peak winds of 70 mph (110 km/h) early on October 5 and was **absorbed by a frontal system** late that same day, while **less than 100 miles from the southwestern coast of Ireland**.

Hurricane Vince was an unusual hurricane which developed in the northeastern Atlantic basin. Forming in October during the 2005 Atlantic hurricane season, **the waters over which it developed were considered too cold for tropical development.**

Property damage - Flood

- River flood
  - Saturated ground
  - Stronger Downpours
  - Changed Winter Storm Tracks
- Surface water – Victorian Drains
- Storm surge
  - Higher sea levels
  - Stronger winds

Highlight the impact of adaptation



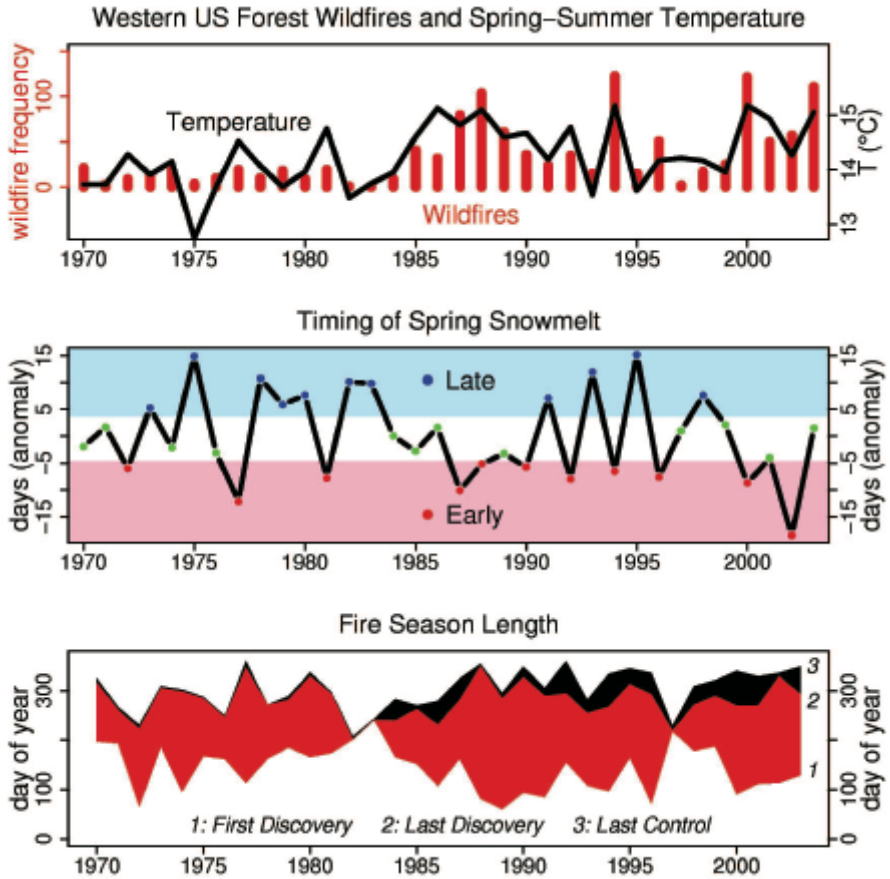
Property damage - Subsidence/ heave

- Drier summers - subsidence
- Wetter winters – heave?
- Need trees for shade….

  …..but they cause the problem!
- Earthquake?

Fire

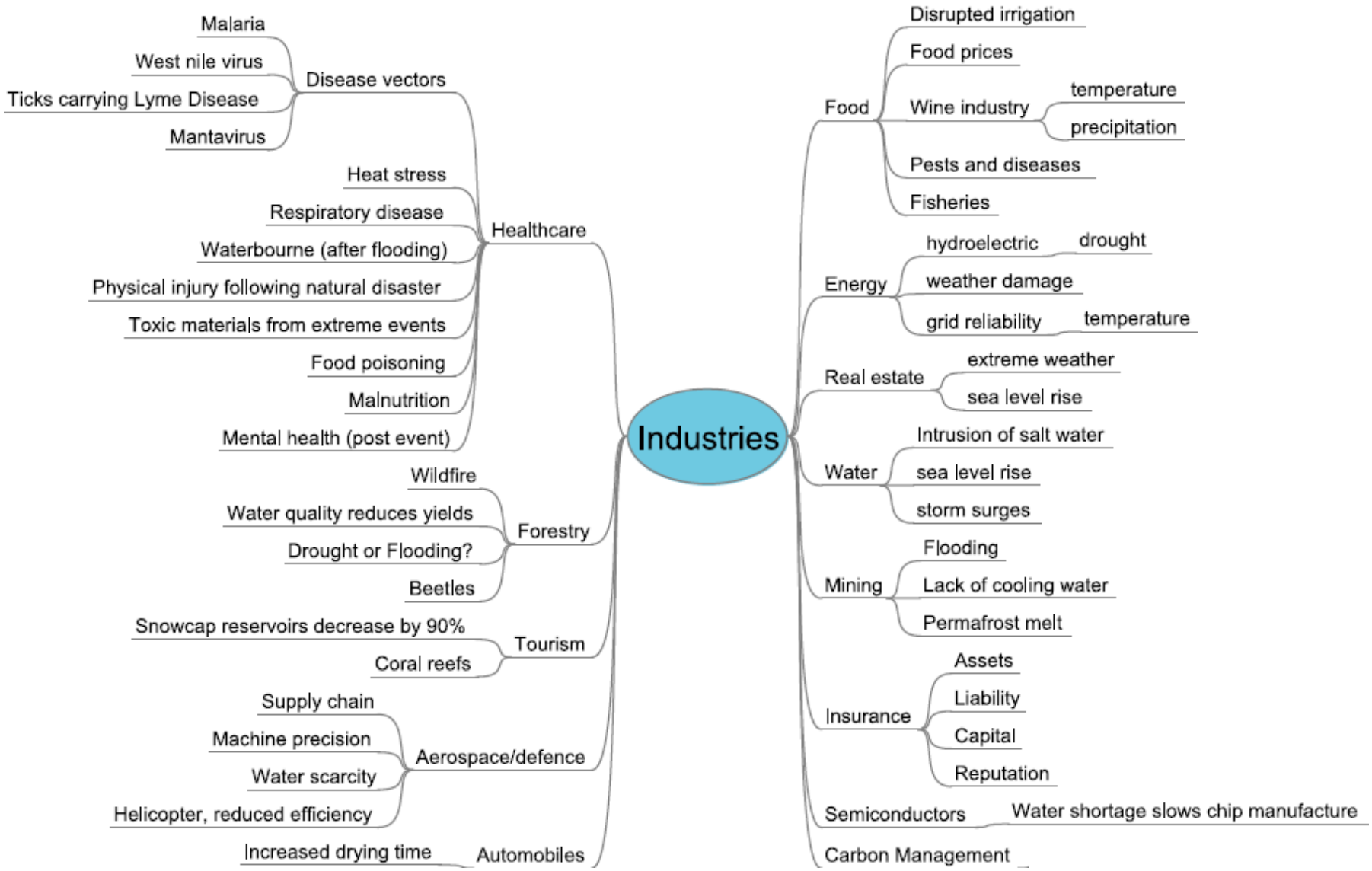
- Fire
  - Longer season
  - Dryer conditions
  - More Lightning
  - E.g. Portugal/ California/ Australia



Source: Westerling et al

http://meteora.ucsd.edu/cap/pdffiles/westerling_fire08.pdf

Lots of affected industries….

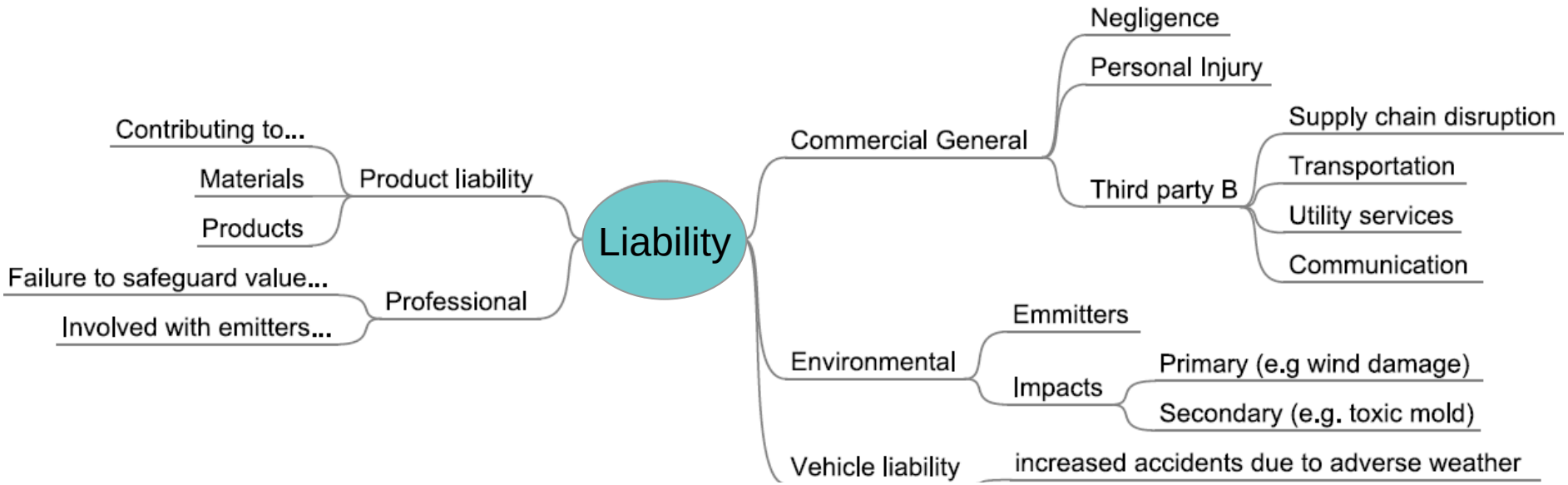


Source: Limiting liability in the greenhouse (UCLA: Ross, Mills, Hecht) & Adaptation Tipping Point (Acclimatise, UKCIP)

Assets – adverse effect

- Equities
  - Future profits lower
  - Sudden price shocks?
  - Some winners? Hedging?
- Bonds
- Property
  - Adapted to future?
  - Resale possible?
- Currency
  - Some countries; political risk

Plenty of liability policies to target….

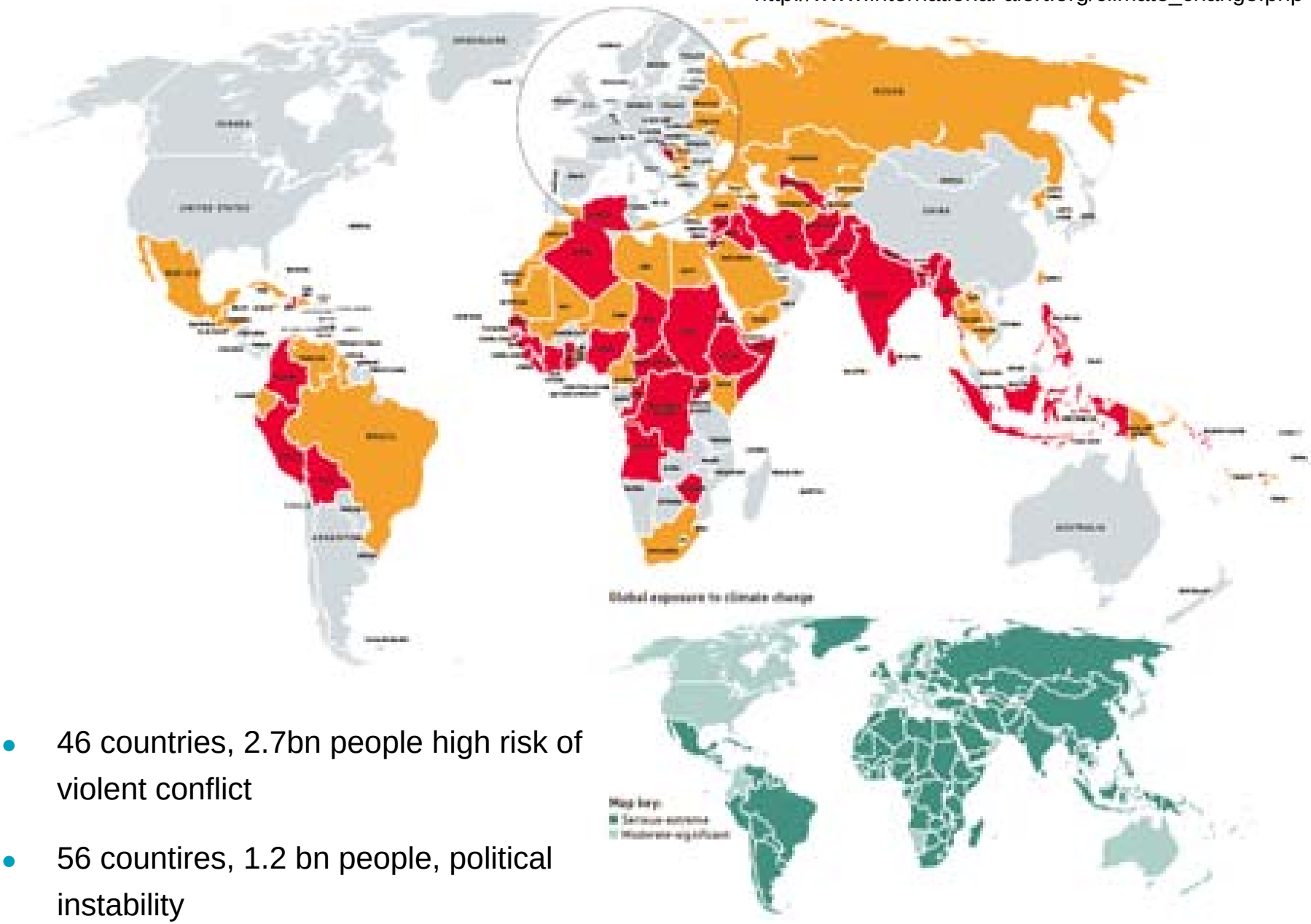


Source: Limiting liability in the greenhouse (UCLA: Ross, Mills, Hecht)

Political Risk

- Covers: Seizure of property, contract frustration etc
- Tensions likely to increase globally
  - Water disputes
  - Energy shortages
  - Loss of land/ migrations

http://www.international-alert.org/climate_change.php



- 46 countries, 2.7bn people high risk of violent conflict
- 56 countires, 1.2 bn people, political instability

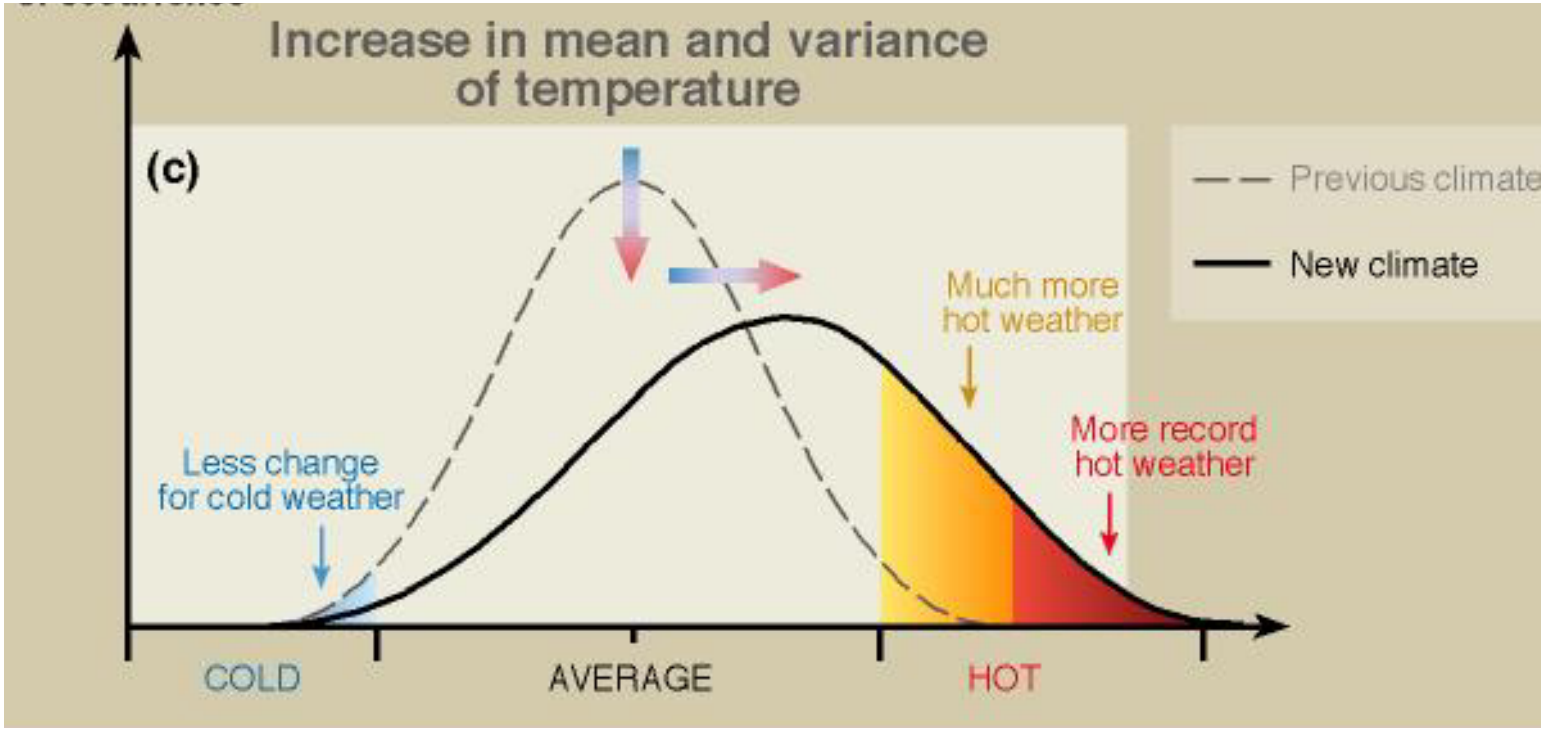
Assets – adverse effect

- Equities
  - Future profits lower
  - Sudden price shocks?
  - Some winners? Hedging?
- Bonds
- Property
  - Adapted to future?
  - Resale possible?
- Currency
  - Some countries; political risk

Longevity

- Summer 2003
  - 1000 excess UK deaths?
  - Can adapt
- Last winter
  - 25,000 “excess deaths” from cold
  - Global warming will reduce these
- Annuity profitability may be lower
- What about our own pension schemes?

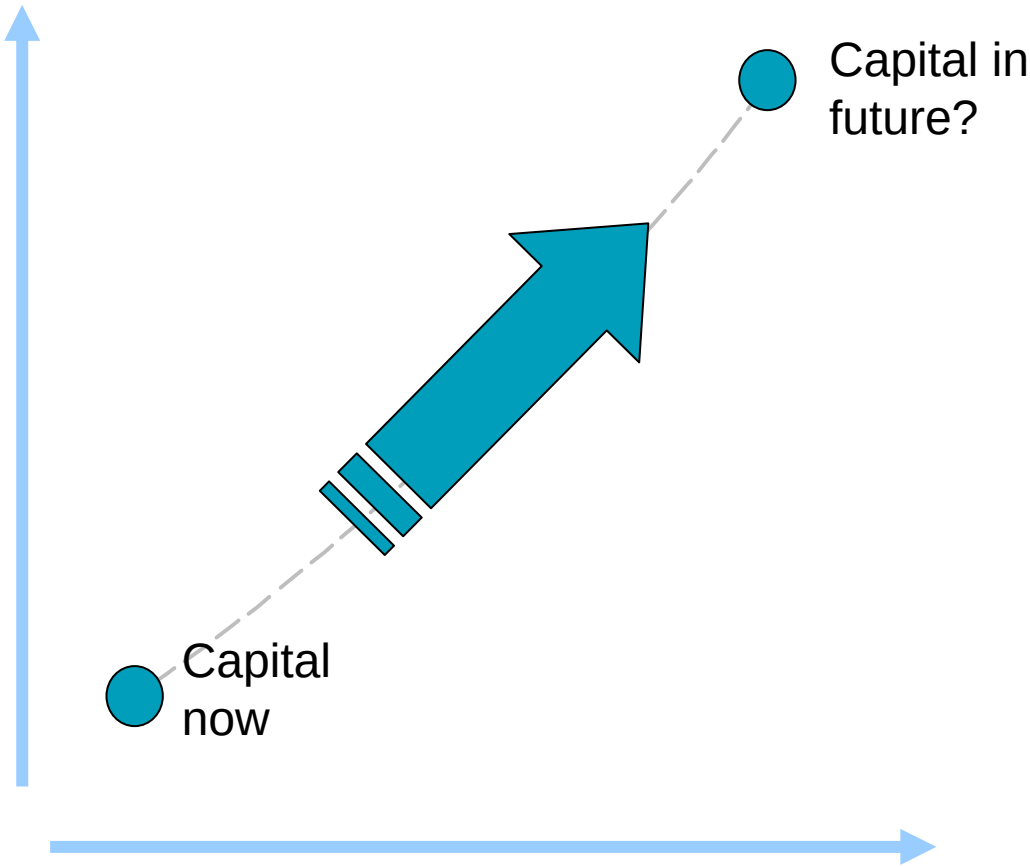
Capital – implication of climate change



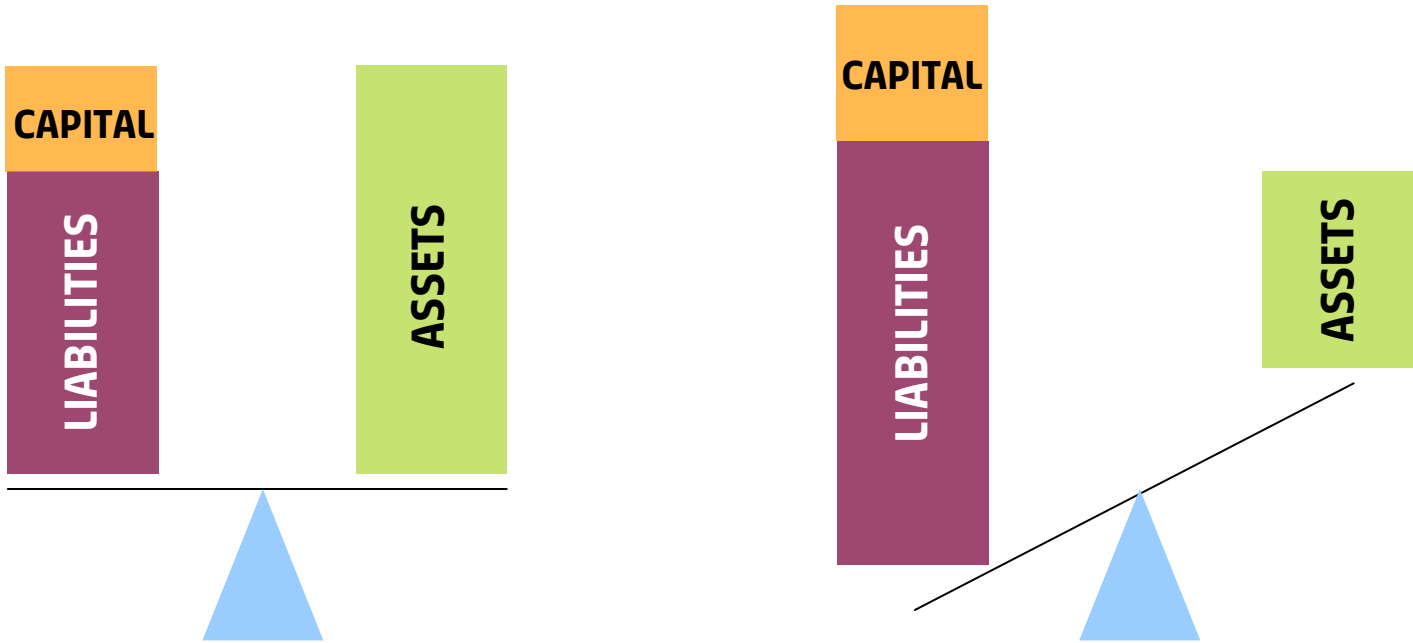
Source: IPCC

Capital – implication of climate change

- More extreme events
  => more capital…
  ….or reduce cover.
- Capital suppliers want an appropriate return…
  ….reduced appetite?
- Premium =
  Expected claims cost
  \+ Cost of capital
- So premiums rise is geared.



Assets/ liabilities/ capital – treble whammy



BEFORE **AFTER**

COPENHAGEN
COP15

UNFCCC – a history

- IPCC 1st report 1990
- Rio Earth summit (1992) - created UNFCCC
- COP1 - Berlin, 1995
- IPCC 2nd report 1995
- COP3 - Kyoto 1997 – “Kyoto protocol”
- IPCC 3rd report 2001
- 2005 – Kyoto protocol ratified and in force
- IPCC 4th report 2007 (800 authors, 2500 expert reviewers)
- COP13 - Bali 2007 – “Bali action plan”
- COP 15 - Copenhagen

ACCREDITATION

Who can participate in COP15 and how?

Basically, there are four ways of becoming accredited and to participate in the COP15 conference. Read more

WHERE TO STAY

Hotels and Accommodation

NHG has been appointed to take care of all hotel reservations for delegations to COP15. Read more

COP15 SCHOLARSHIP AND SPONSORSHIPS

COP15 Climate Scholarship

The Danish Government has decided to establish a "COP15 Climate Scholarship" for money saved pursuant to its policy of

Copenhagen dreaming….

- Copenhagen – last chance for new targets before Kyoto protocol expires
- Goals:
  - a binding global climate agreement, a target for GHGs
  - developed countries take the lead: those contributing most of the problem bear most of the cost
  - newly industrialised and developing countries play a role
  - not restrict growth or competition
  - green job opportunities; retraining
  - long term sustainable land management including forests
  - sustainable development and poverty eradication
  - technology transfer
  - prioritise adaptation with a multiplying effect –e.g. insurance

INSURANCE INDUSTRY RESPONSE

ClimateWise

- Lead in risk analysis
- Inform public policy making
- Support climate awareness amongst our customers
- Incorporate climate change into our investment strategies
- Reduce the environmental impact of our business
- Report and be transparent

ClimateWise Copenhagen statement

- Insurance a vital tool for managing risks
- Ambitious, robust and equitable global deal is required - 40% by 2020, 85% by 2050
- Insurers offer: risk management expertise; risk transfer mechanisms
- Climate change - makes insurance more challenging
- Agreement on scale and structure of financial flows to developing world; mandatory risk reduction plans
- Free access to risk data
- Insurance includes index schemes
- New building regulations to require sustainable rebuilding

ClimateWise

UNIVERSITY OF CAMBRIDGE
PROGRAMME FOR SUSTAINABILITY LEADERSHIP

ジュネーブ協会 京都宣言

Kyoto Statement of The Geneva Association

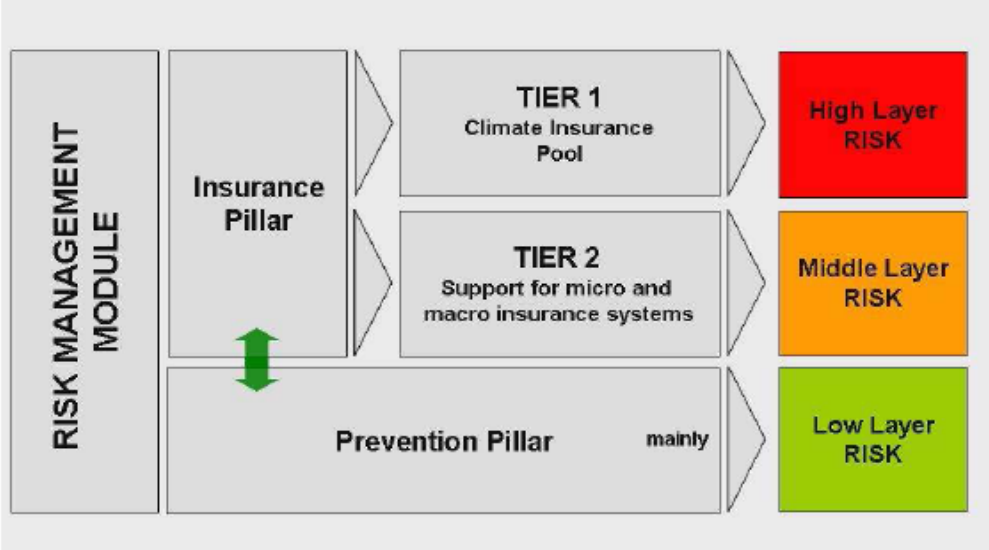
- Enhance research
- Develop products that incentivise carbon reduction
- Invest in low carbon projects
- Implement building codes to encourage sustainable practices
- Free availability of climate data
- etc

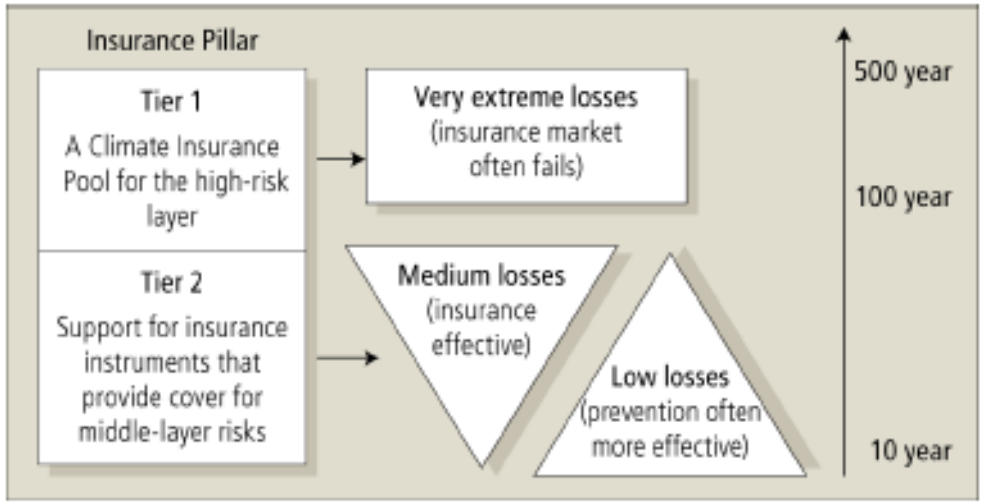
Signed by the CEOs/ Chairmen of:

Munich Re
Allianz
Tokio Marine
Prudential
Axis Capital
Groupama
HSBC Insurance
Generali
SCOR
BUPA

Trygvesta
Axa
Renaissance Re
Landsforsakringar
ING
MAF
Mitsui Sumitomo
ACE
RSA

Swiss Re
XL
Aviva
Swiss Life
Sun Life
Eureko
Hannover Re
Lloyd's
Peoples insurance company of China
And more…..


RISK MANAGEMENT MODULE
Insurance Pillar
TIER 1
Climate Insurance Pool
TIER 2
Support for micro and macro insurance systems
Prevention Pillar
mainly
High Layer RISK
Middle Layer RISK
Low Layer RISK


Insurance Pillar
Tier 1
A Climate Insurance Pool for the high-risk layer
Tier 2
Support for insurance instruments that provide cover for middle-layer risks
Very extreme losses (insurance market often fails)
Medium losses (insurance effective)
Low losses (prevention often more effective)
500 year
100 year
10 year

SUMMARY

In summary…

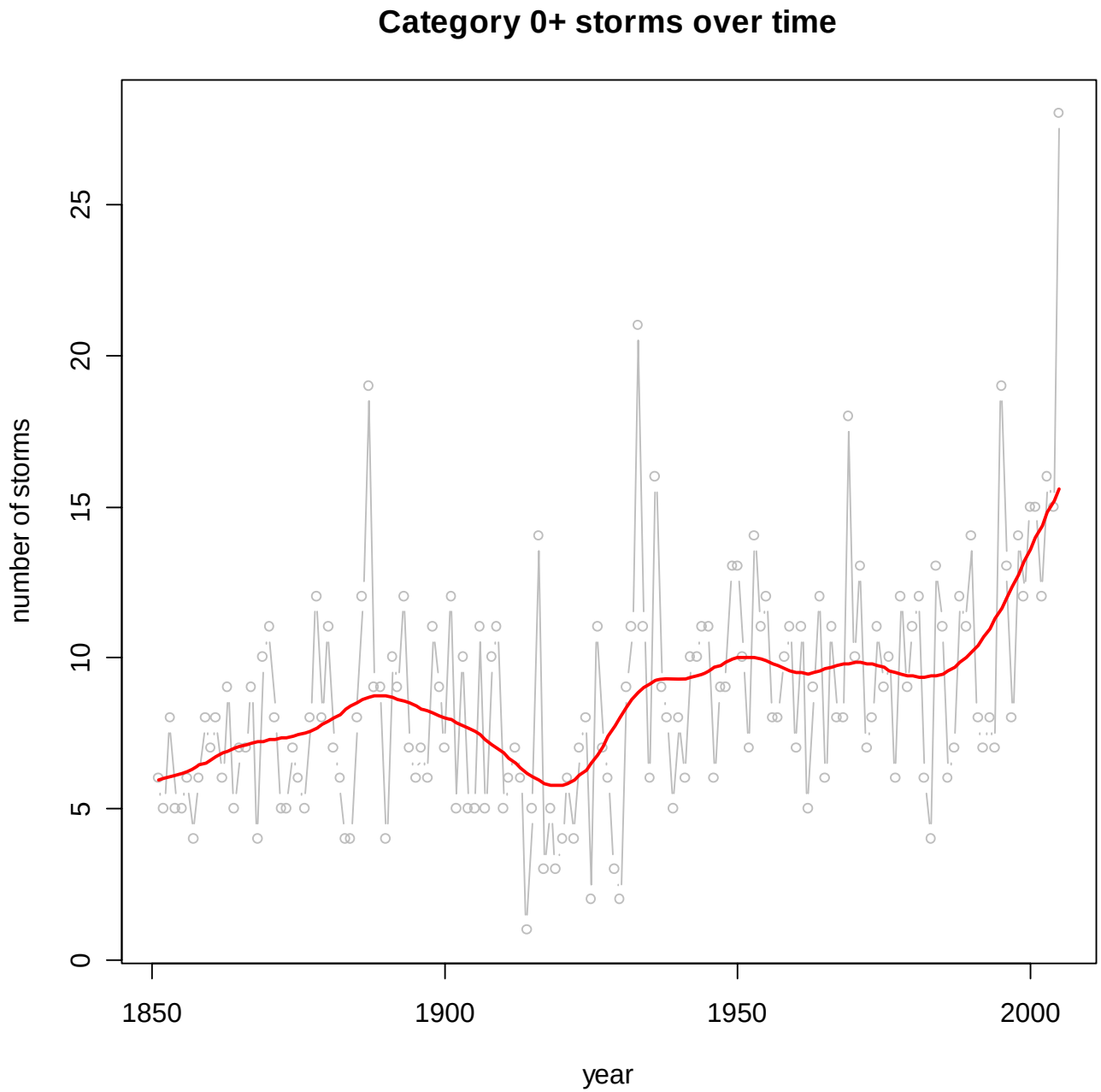
- Don’t panic!
- Evidence is clear
- Much uncertainty remains – terrible extremes are possible
- Impacts will be global; and could severely impact society
- Actuaries will be impacted in all aspects of our work
- Insurers have responded
- Copenhagen may bring opportunities; are we ready to take them?


FIDENTIA

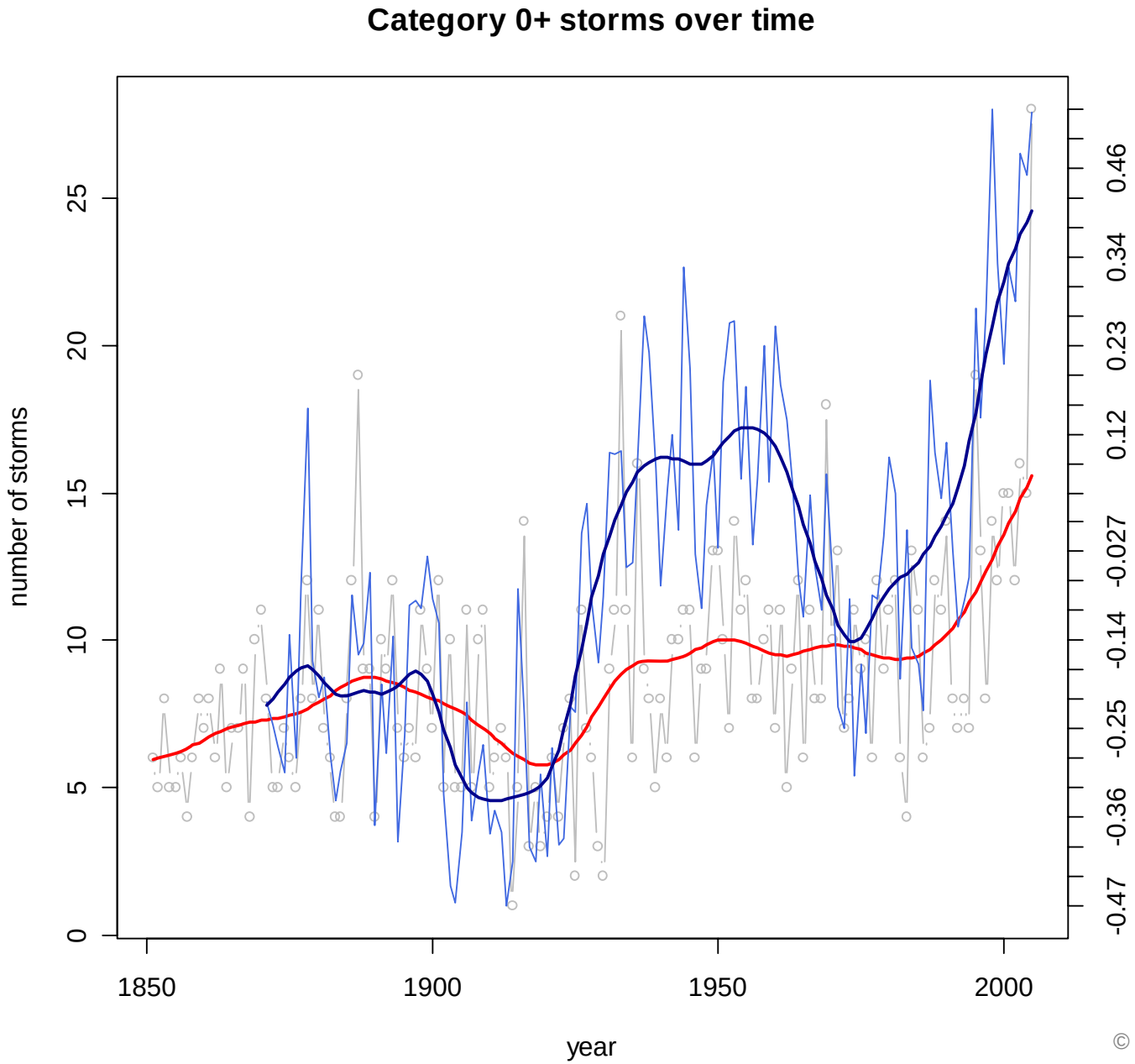
APPENDIX 1

THE HURRICANE DEBATE

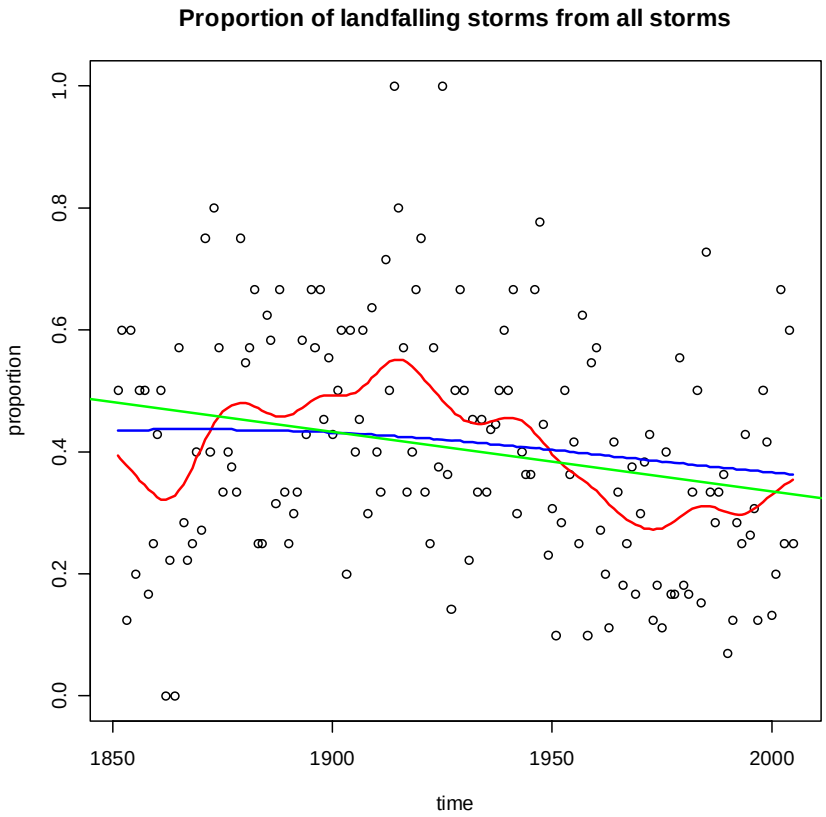
Genesis frequency

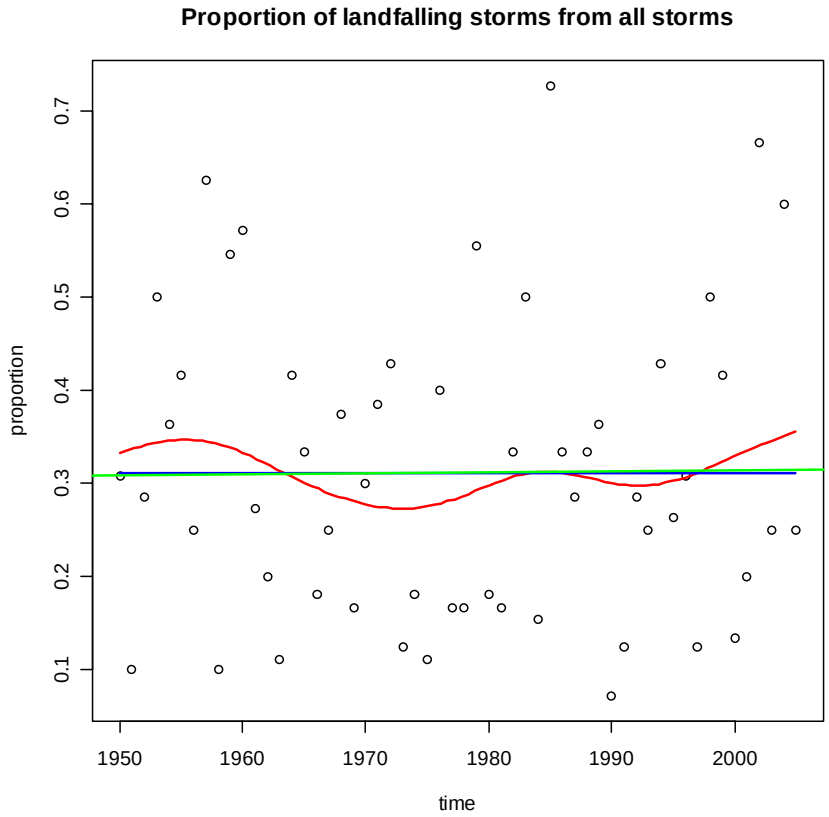


Genesis frequency + AMO

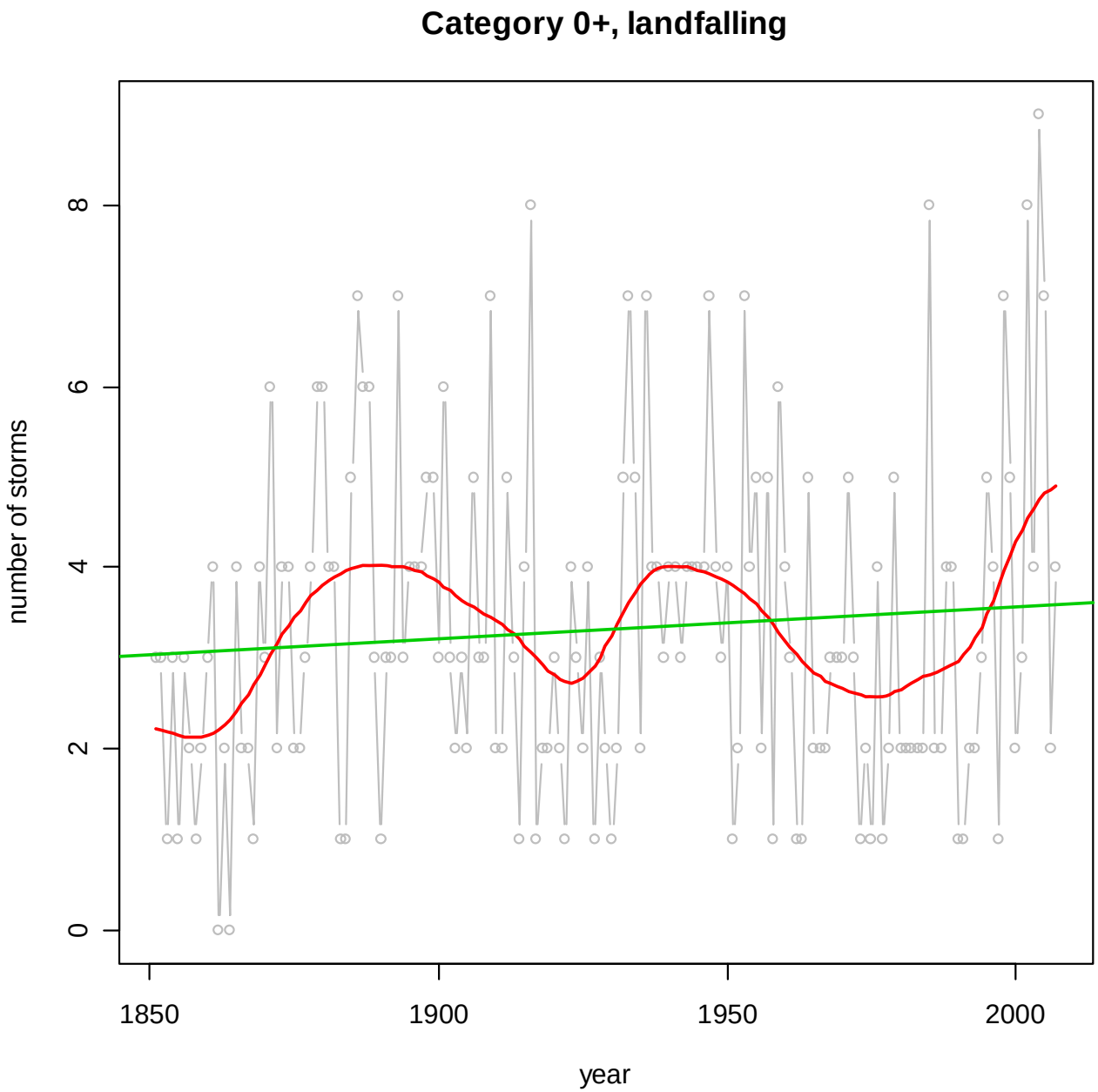


Proportion making landfall

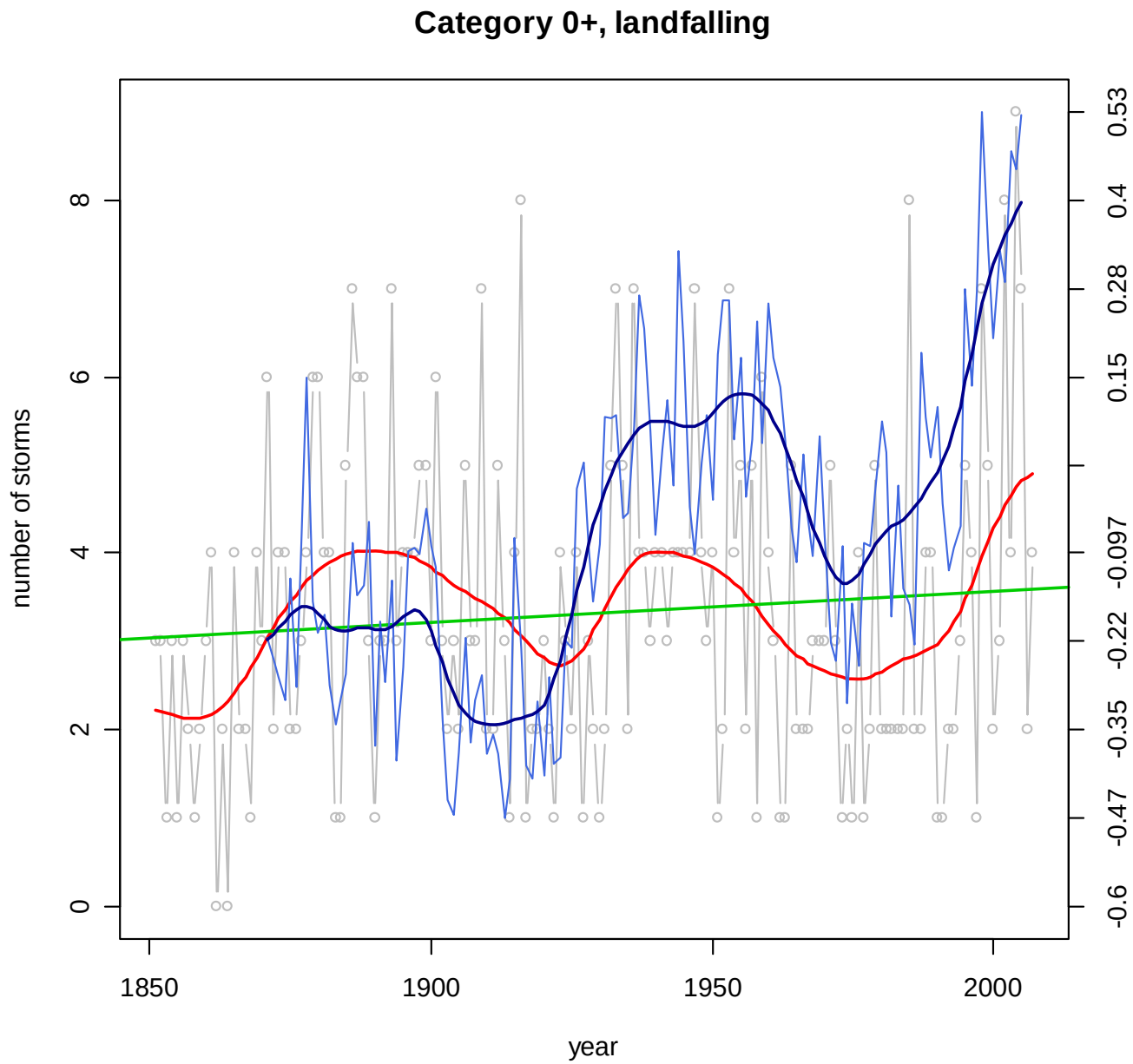




Landfalling storms – all categories



Landfalling storms – all categories +AMO



APPENDIX 2

MORE ON LIABILITY

Enough is known

- *"Uncertainty over climate change is often cited as justification for delay or inaction. Yet* ***there is greater consensus in the scientific community that man-made climate change is underway than on almost any other issue.***" **The adaptation tipping point (Acclimatise and UKCIP)**

- *"Lawyers are beginning to acknowledge that there is now sufficient information available on climate change for companies to take it into account in both strategic and project level decision-making.* ***All decisions and professional advisors that do not take climate change into account may be open to legal challenge****."* **The adaptation tipping point (Acclimatise and UKCIP)**

Growing level of scrutiny/ success…

- *"In late 2006 the SEC took an enforcement action against a major chemical company….it has been speculated that this …may be an indicator of the* ***SEC's growing scrutiny on environmental liability reporting****"* **Limiting liability in the greenhouse (UCLA: Ross, Mills, Hecht)**

- *On the subject of EPA vs Massachusetts "In the US litigation context, the Court's decision is* ***likely to have significant implications*** *for pending and future climate change litigation. Its decision on standing effectively lowers the bar…."* **Freshfields BD May 2007**

- *On the subject of EPA vs Mass "Legal commentary is of the view that this decision will both* ***significantly embolden potential litigants*** *and fundamentally alter US political discourse on climate change… The Court determined that there was now sufficient scientific consensus on the link between anthropogenic CHG emissions and associated harms, the combined effect of which was to create* ***sufficient standing to sue*** *in courts to address climate change"* **Prue Taylor (New Zealand Centre for Environmental Law)**

Ever more disclosure

- *"In the post-Enron environment, where investors are wary of undisclosed risks, there is an* ***ever increasing desire for full disclosure of a company's environmental liability risks****"* **Limiting liability in the greenhouse (UCLA: Ross, Mills, Hecht)**
- *"****Sarbanes Oxley Act of 2002….may render CEOs and CFOs ultimately liable*** *for the accuracy of disclosure of environmental-related liabilities…"* **Limiting liability in the greenhouse (UCLA: Ross, Mills, Hecht)**
- *"The yearly directors' report must contain a business review, and in the case of a quoted company the review* ***must include the main trends and factors*** *likely to affect future development";* **Martineau Johnson (2007)**
- *Proff Liab: "****Central to D&O liability litigation will be disclosure of, or the failure to disclose, material information****"* **Limiting liability in the greenhouse (UCLA: Ross, Mills, Hecht)**

Negligence

- *"A clear example is the tension between increased risk from flooding and the pressing demand for more housing…..**developers run the risk of costly negligence claims if it can be shown they ought to have anticipated and protected against flood risks**. The "reasonable foreseeability" that needs to be proven in establishing negligence becomes easier to assert as the links between climate change and increased incidence and severity of flooding are more regularly drawn"* **Martineau Johnson (2007)**

- *Proff Liab: "One Trigger…would be **breach of the duty of care where [an officer] has not considered climate change in making decisions**"* **Limiting liability in the greenhouse (UCLA: Ross, Mills, Hecht)**

Negligence

- *Proff Liab: "A* ***pension fund fiduciary that failed to consider how global investments would be impacted…would*** *be vulnerable"* **Limiting liability in the greenhouse (UCLA: Ross, Mills, Hecht)**
- *Proff Liab: "Another trigger ..would be…* ***[where] shareholders have filed resolutions …to address climate change risk, and minimal…improvements were made*** *as the business lost value"* **Limiting liability in the greenhouse (UCLA: Ross, Mills, Hecht)**
- *Proff Liab: "…****misrepresentation of climate change impacts or risks could trigger D&O liability****, as a breach of director's duty of good faith"* **Limiting liability in the greenhouse (UCLA: Ross, Mills, Hecht)**

Costs include future harm

- *“Motivations for litigation included compensation for* ***present or future anticipated harm****….”* **Prue Taylor (New Zealand Centre for Environmental Law)**

Legal costs regardless

- *"From insurers' vantage point,* ***liability exposures will of course include legal defence costs, irrespective of whether defendants are ultimately held liable for damages****…."* **Limiting liability in the greenhouse (UCLA: Ross, Mills, Hecht)**