From Risk to Opportunity:
Insurer Responses to Climate Change

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U.S. Department of Energy
Lawrence Berkeley National Laboratory

Casualty Actuarial Society Annual Meeting
Quebec City
June 16, 2008

Our atmosphere is as thin -- in proportion to the Earth's diameter -- as a film of condensation on a steel ball.

Roadmap

- **Why insurance & climate change?**
- **State of knowledge on climate**
  - **fingerprints**
  - **forecasts**
- **Relevance for the insurance community**
  - **changing business environment**
  - **expectations from stakeholders**
  - **emerging risks**
- **Opportunities**

For Insurers, Climate Change is an Emerging Risk to be Managed...

Insurers are....

- messengers
- integrators
- risk assessors
- risk managers

but...

- vulnerable
- flying partly blind
- selective

and....

- part of the solution

Climate Change is Integral to Mainstream Insurance Issues

- Customer retention
- Corporate governance, investor relations, & disclosure
- Balance sheet strength & solvency
- Competitiveness
- Emerging markets
- Reputation & trust
- Modeling weaknesses: Past vs future
- Regulation
- *Insurability*: availability & affordability

The Scientific Consensus

Nobel Peace Prize: 2007

Intergovernmental Panel on Climate Change
~1500 Authors;
1000 Reviewers
Unanimously adopted by 100 + nations (including U.S.)

IPCC Fourth Assessment Report
Co-Recipient of the 2007 NOBEL PEACE PRIZE

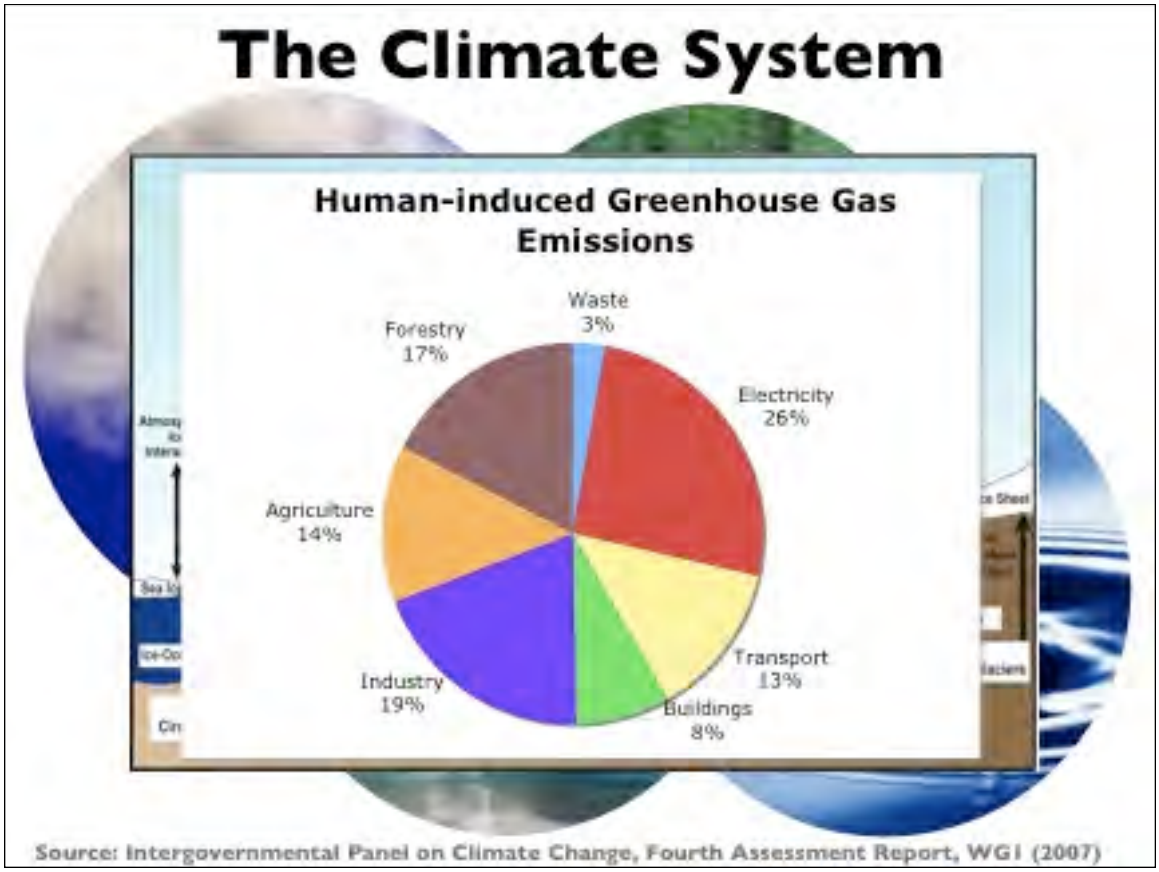
http://www.ipcc.ch

"Warming of the climate system is unequivocal."

- Change is accelerating
- Nearing danger zone
- Solutions possible (and affordable)
- Must adapt *and* reduce emissions

Our Confidence in climate change is about like that of human evolution or health effects of smoking

The Climate System



Source: Intergovernmental Panel on Climate Change, Fourth Assessment Report, WG1 (2007)

Climate Modeling Has Become Far More Precise

1990 FAR

1995 SAR

2000 TAR

2005 AR4

25x improved resolution!

The World in Global Climate Models

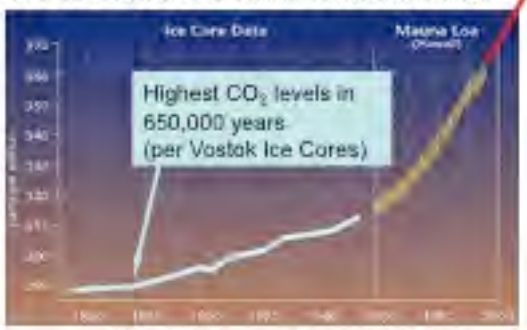
Source: Intergovernmental Panel on Climate Change, Fourth Assessment Report, WG I (2007)

The most important human influence is fossil fuel combustion ...

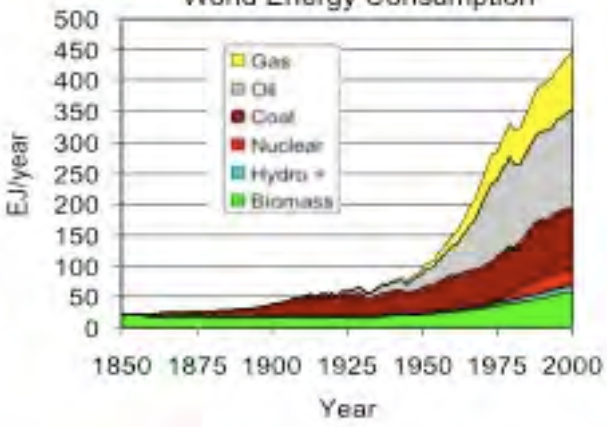
... but there are others

Other GHG's already above highest levels in 650,000 years

World Carbon Dioxide Concentrations



World Energy Consumption

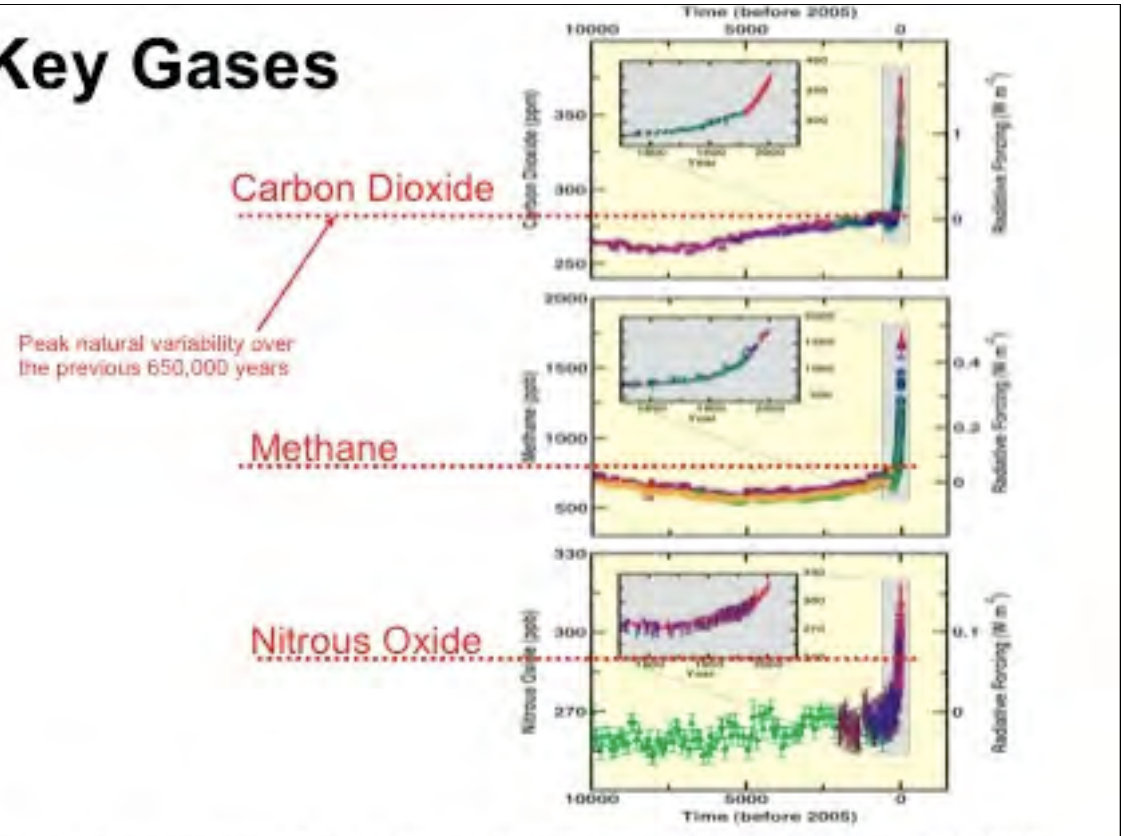


... The second most important human influence is deforestation

Deforestation for soy growing in the state of Mato Grosso, Brazil

Source: Moutinho and Schwartzman, 2005

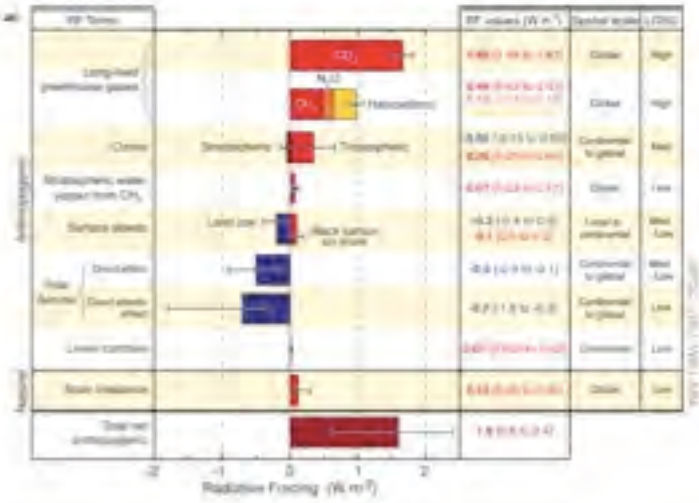
Key Gases



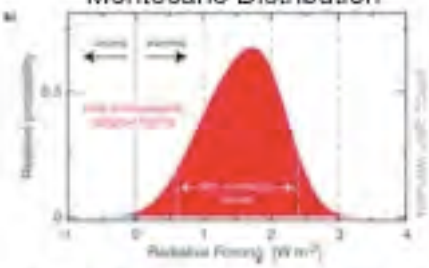
Source: Intergovernmental Panel on Climate Change, Fourth Assessment Report, WG1 (2007)

Net effect of cooling + warming influences...

...is warming



Montecarlo Distribution



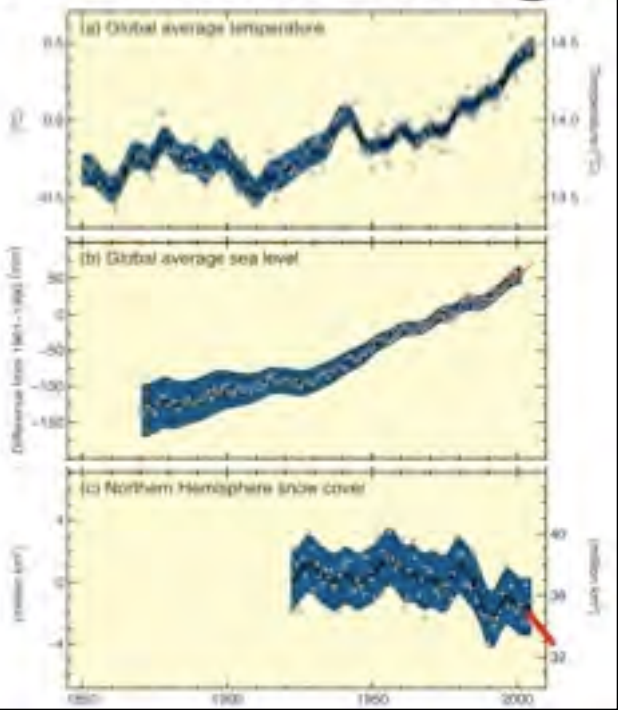
Source: Intergovernmental Panel on Climate Change, Fourth Assessment Report, WG I (2007)

FINGERPRINTS... Recent Indicators of Climate Change

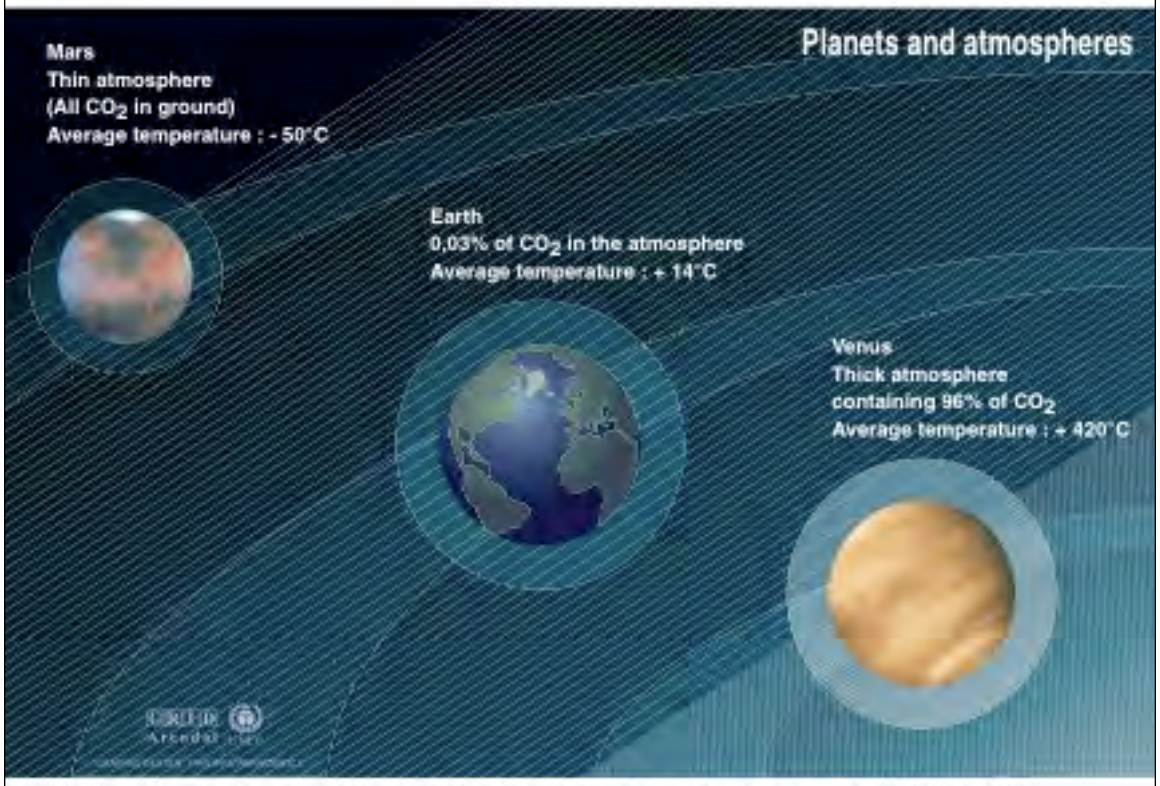
Global average temperature (*accelerating*)

Global average sea level

Northern hemisphere snow cover (*accelerating*)

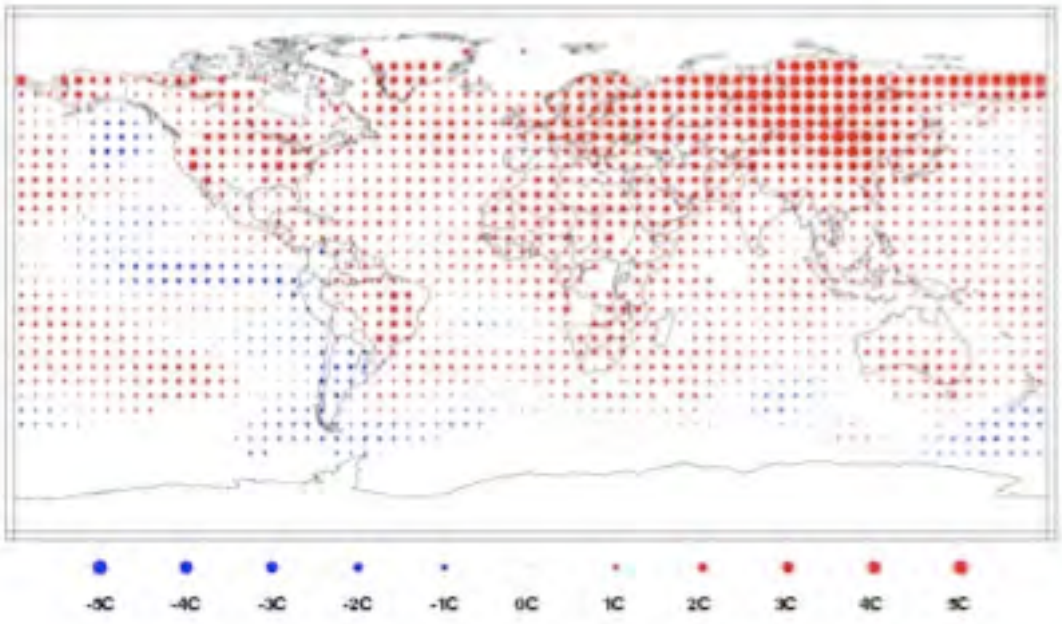


Source: IPCC 4th Assessment (2007)



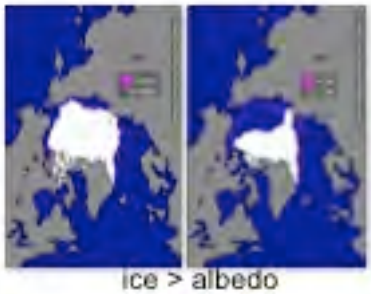
ource: Calvin J. Hamilton. Views of the solar system, www.planetscapes.com; Bill Arnett , The nine planets, a multimedia tour of the solar system, www.seds.org/billa/tnp/ninePlanets.html

Warming during the Industrial Era



Positive Feedbacks

temperature > beetles



ice > albedo

windstorm-downed trees > carbon

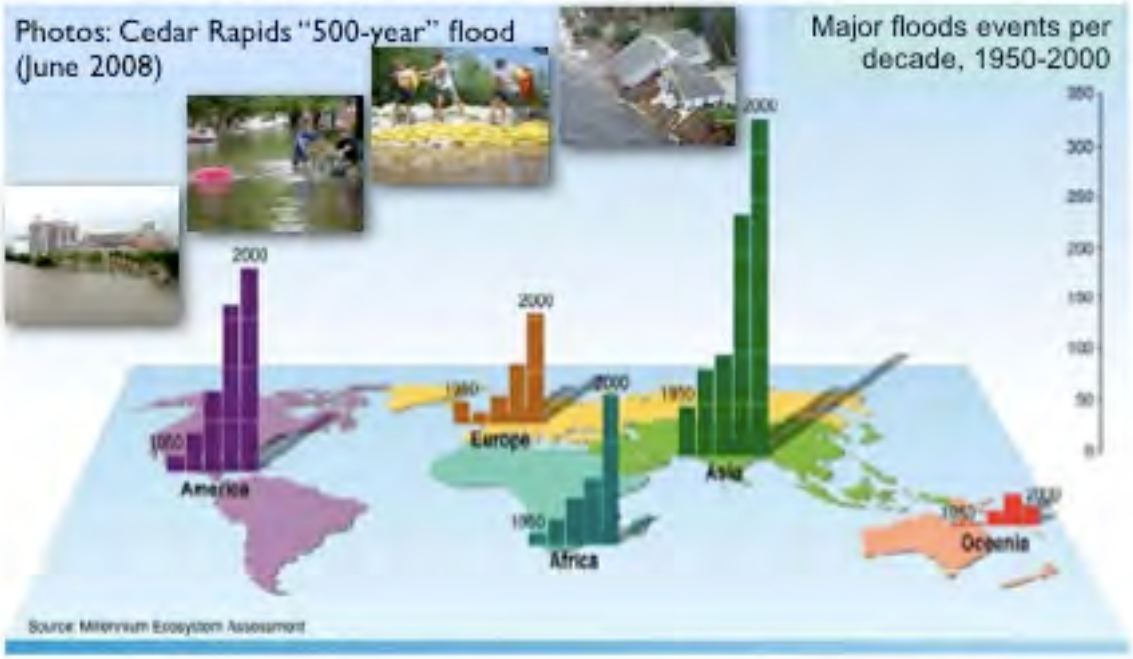
wildfire > carbon

erosion > carbon

permafrost thaw > carbon

Net effect is *accelerated* warming

FINGERPRINTS ... Floods



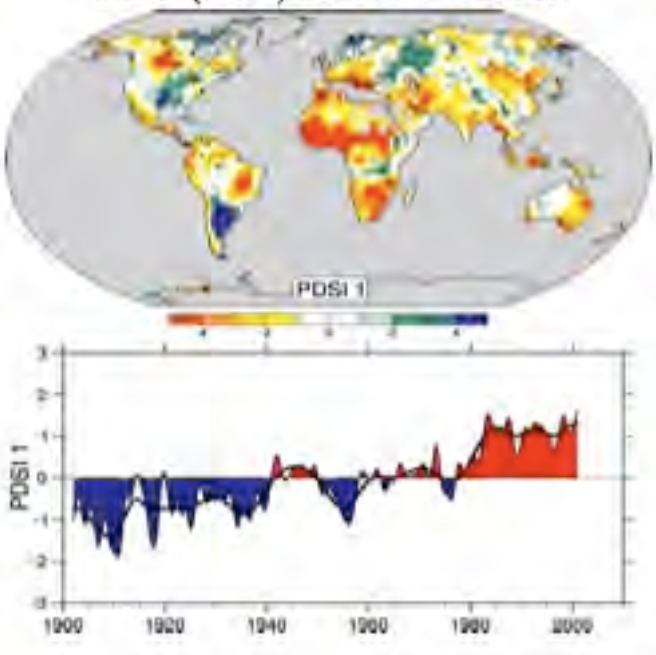
There's a consistent 50-year upward trend in every region except Oceania.

FINGERPRINTS ... Drought

Proportion of land area in extreme drought predicted to increase from 1-3% to 30% by 2090s.

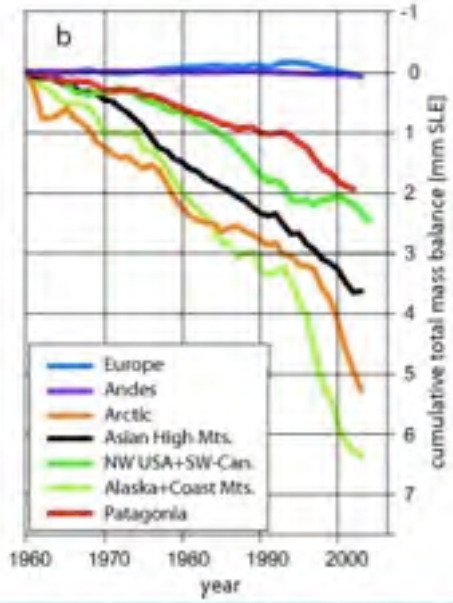
Drought duration expected to increase 6-fold.

Change in Palmer Drought Severity Index (PDSI) for 1900 to 2002



Source: IPCC 4th Assessment (2007)

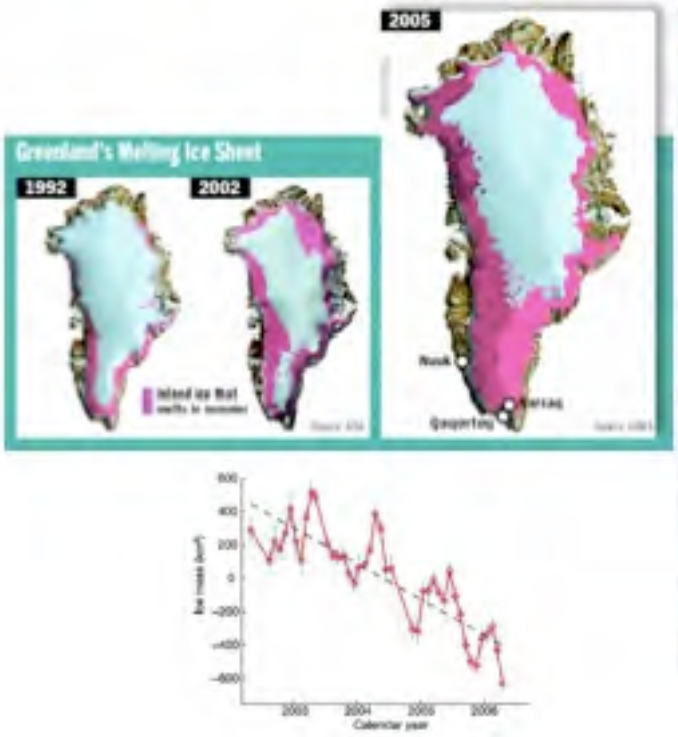
FINGERPRINTS ... Glaciers



Loss *Accelerating* since early 1990s

Source: IPCC 4th Assessment (2007)

FINGERPRINTS... Greenland



Sea-level Rise = 10 feet = half of Greenland melting

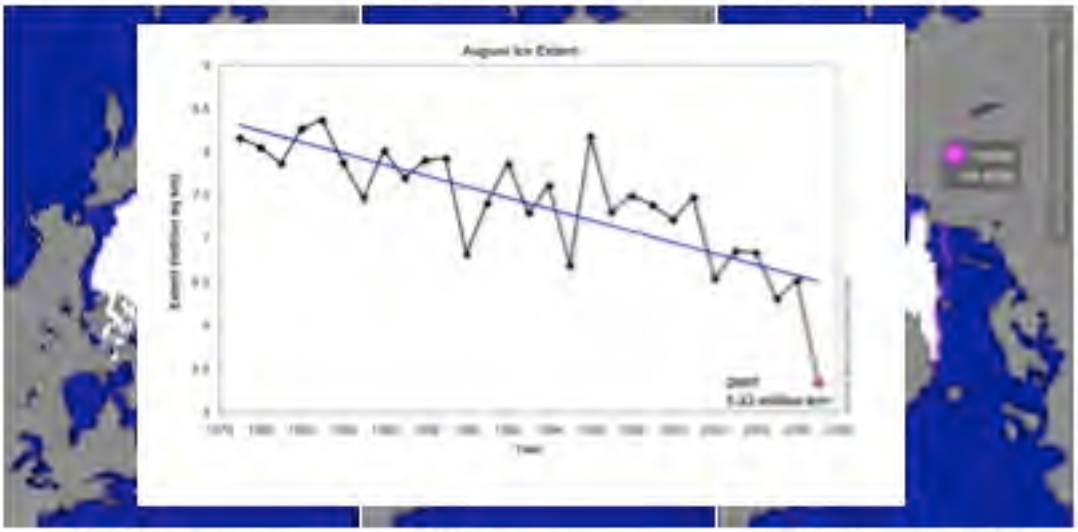
(Source:
Harvard University)

Sea-level Rise = 10 feet = half of Greenland melting

(Source:
Harvard University)

FINGERPRINTS ... Polar ice

Median 1979-2000 | September 21, 2005 | September 16, 2007



6.74 M square km | 5.32 M square km | 4.13 M square km

The difference between median minimum arctic ice coverage and the extent on Sept. 16, 2007 is **equal to the area of Alaska and Texas combined** (2.61 M sq. km or 1 M sq. miles). http://nsidc.org/news/press/2007_seaiceminimum/20070810_index.html

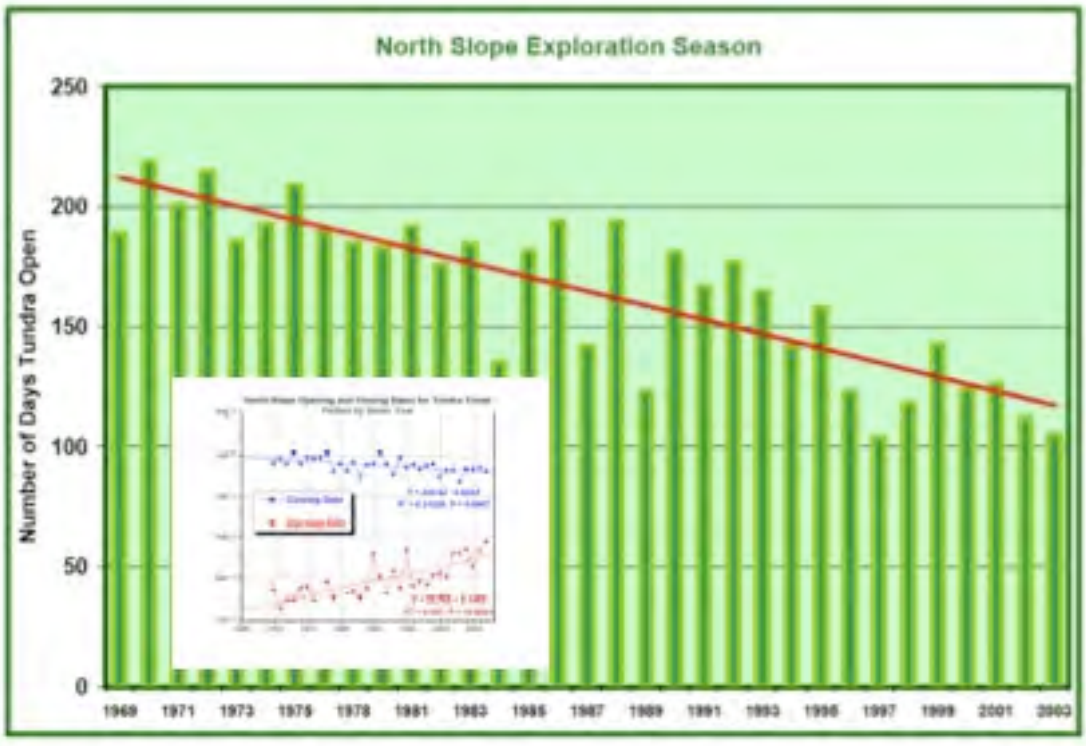
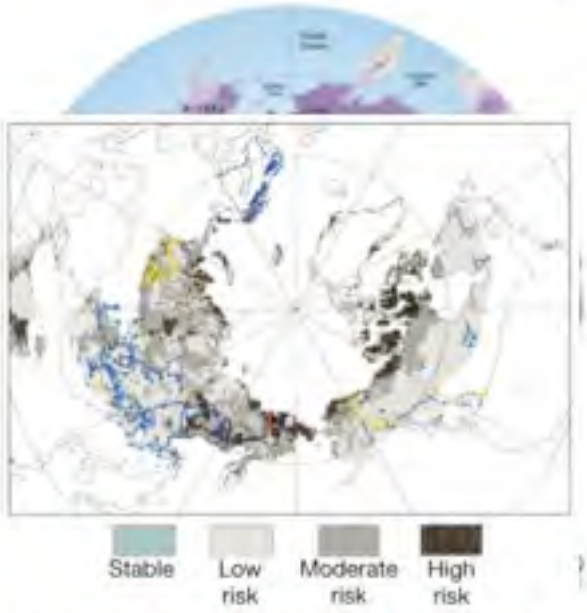


Figure 1- Length of the winter tundra travel season, as determined by the DNR Division of Lands, Northern Regional Office

Permafrost Disintegration

Settlement of *several meters* is possible

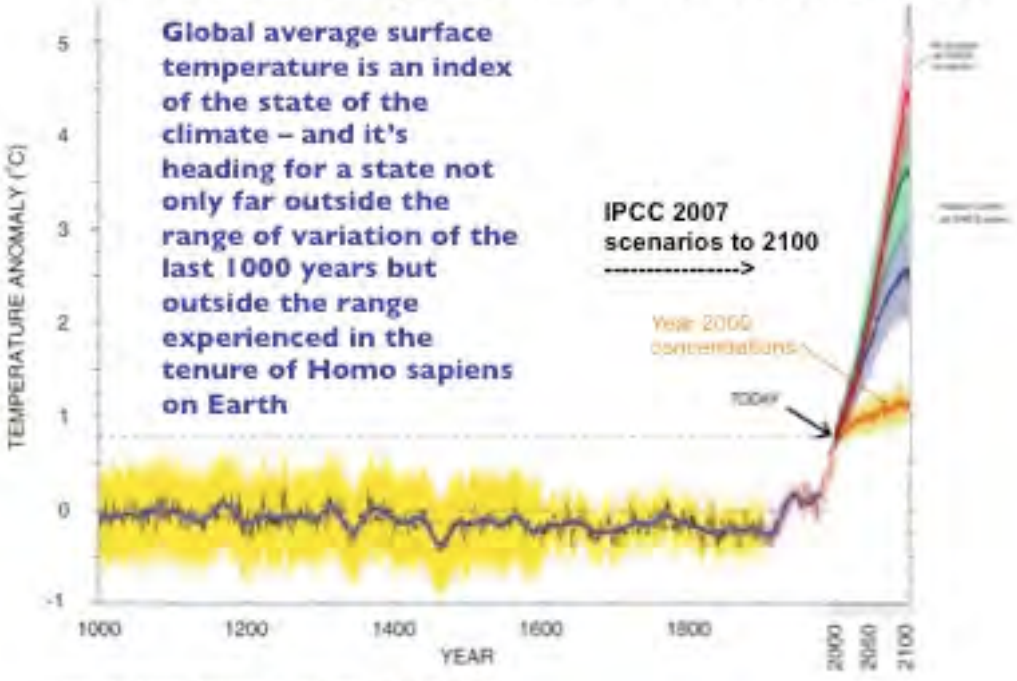


Electric Transmission, Pipelines, Bilbino Nuclear Station

Frederick E. Nelson, Oleg A. Anisimov, Nikolay I. Shiklomanov, Nature 410, 889-890(19 April 2001)

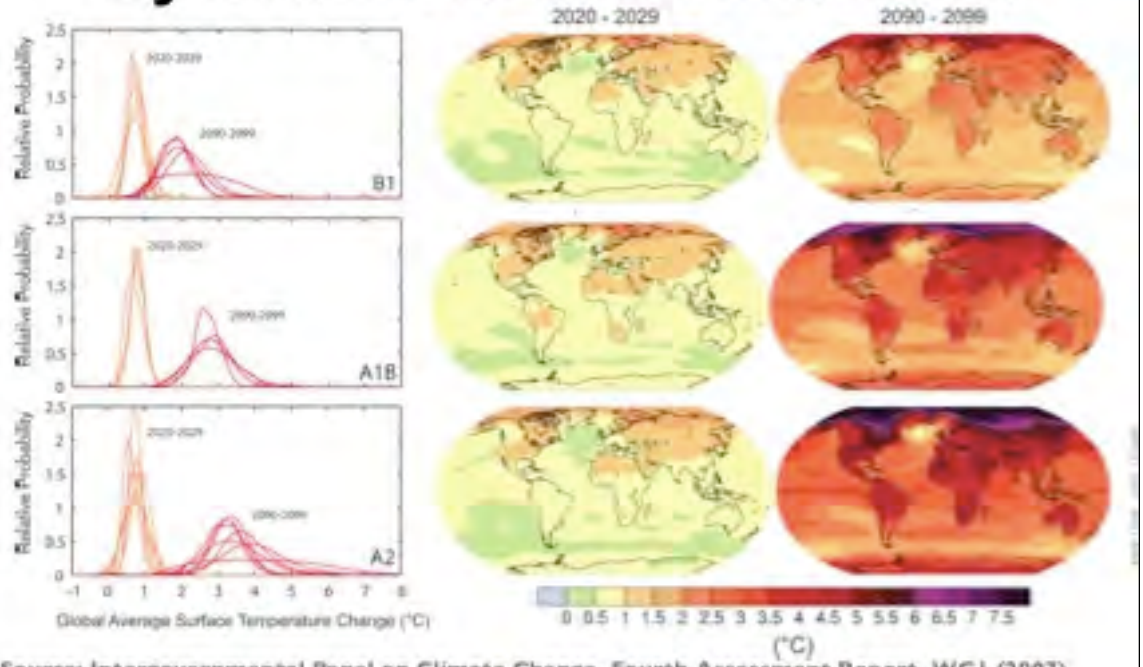
If we don't alter course, we'll end up where we're headed

Global average surface temperature is an index of the state of the climate – and it's heading for a state not only far outside the range of variation of the last 1000 years but outside the range experienced in the tenure of Homo sapiens on Earth



Source: John Holdren, after IPCC (2007)

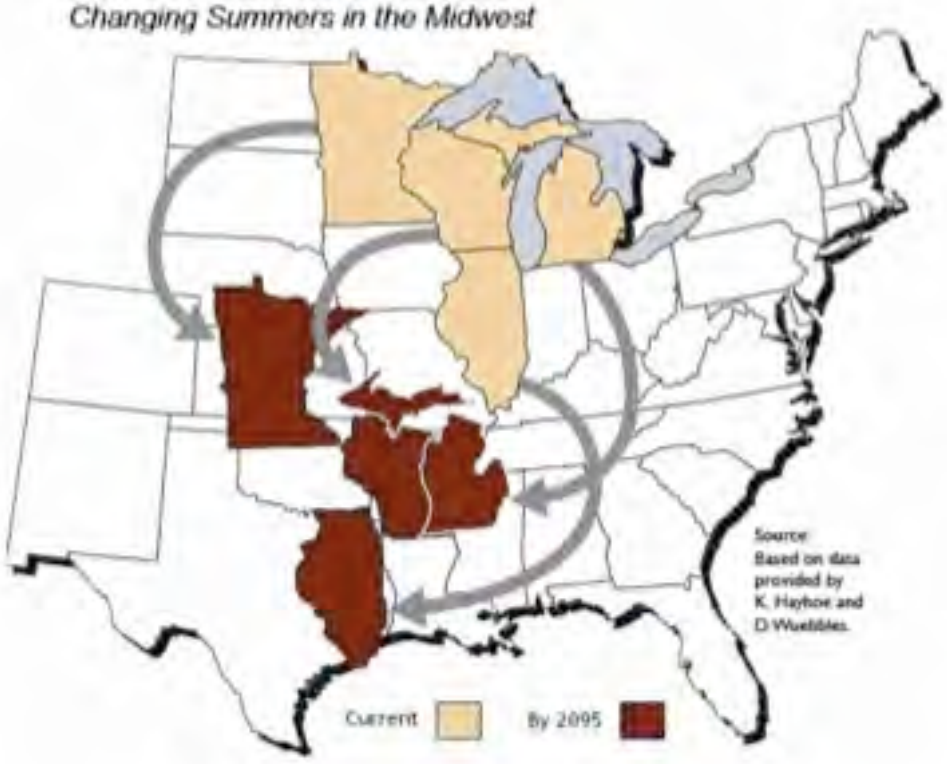
Range of Predicted Warming: By Scenario and Timeframe



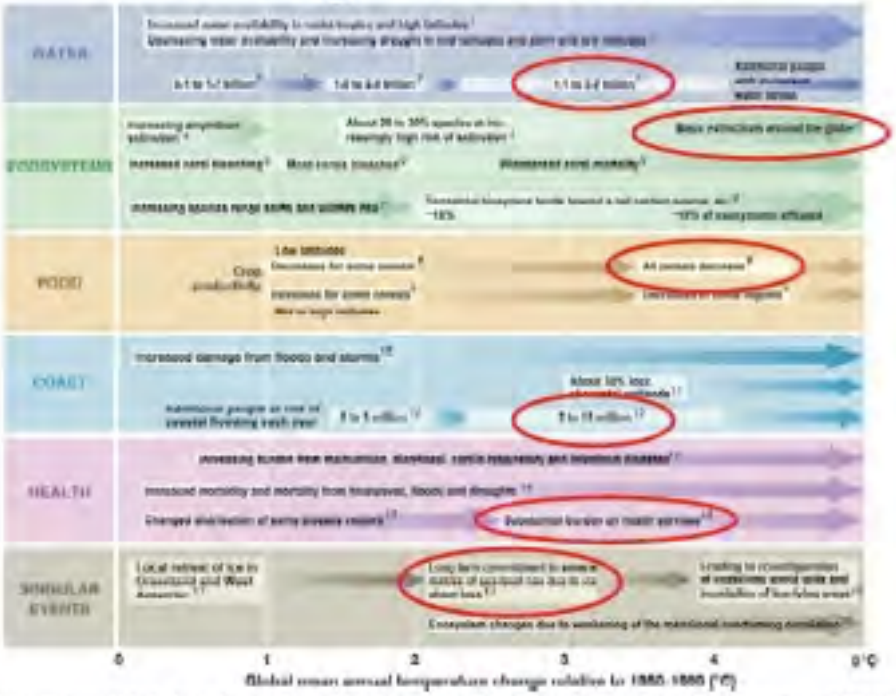
Source: Intergovernmental Panel on Climate Change, Fourth Assessment Report, WG1 (2007)

Climate on the Move:

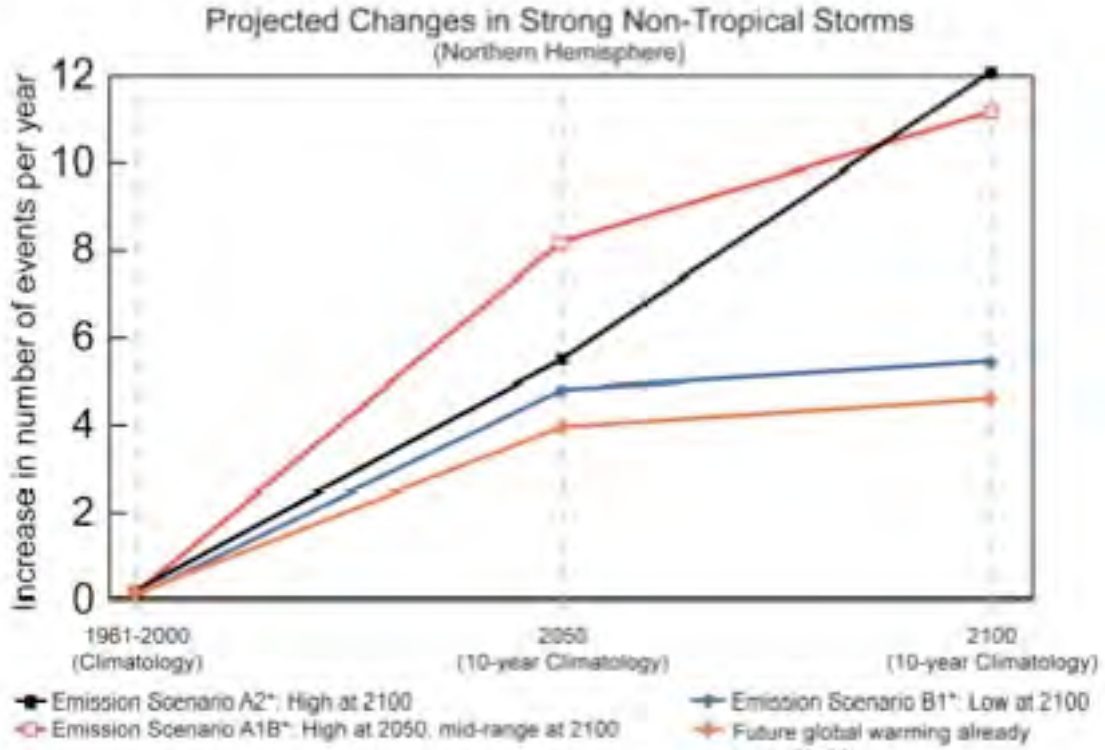
Changing Summers in the Midwest

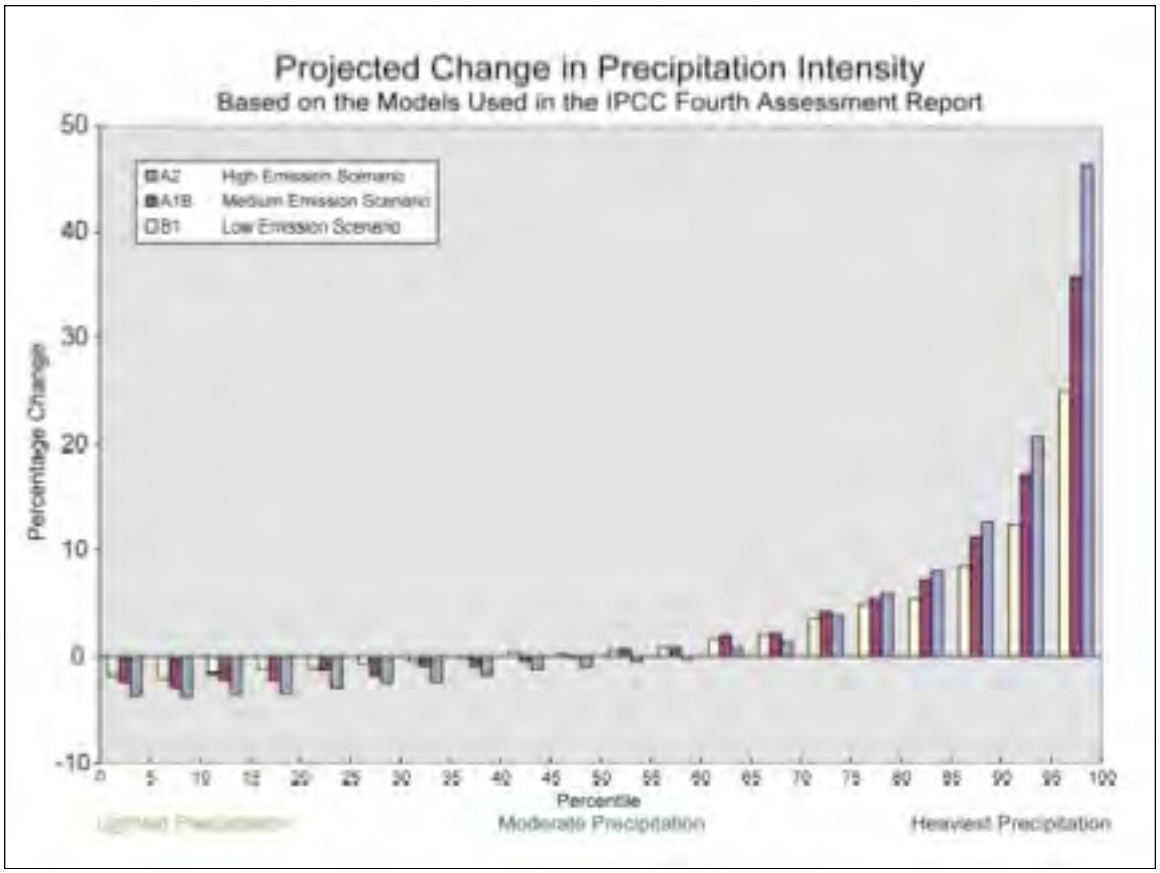


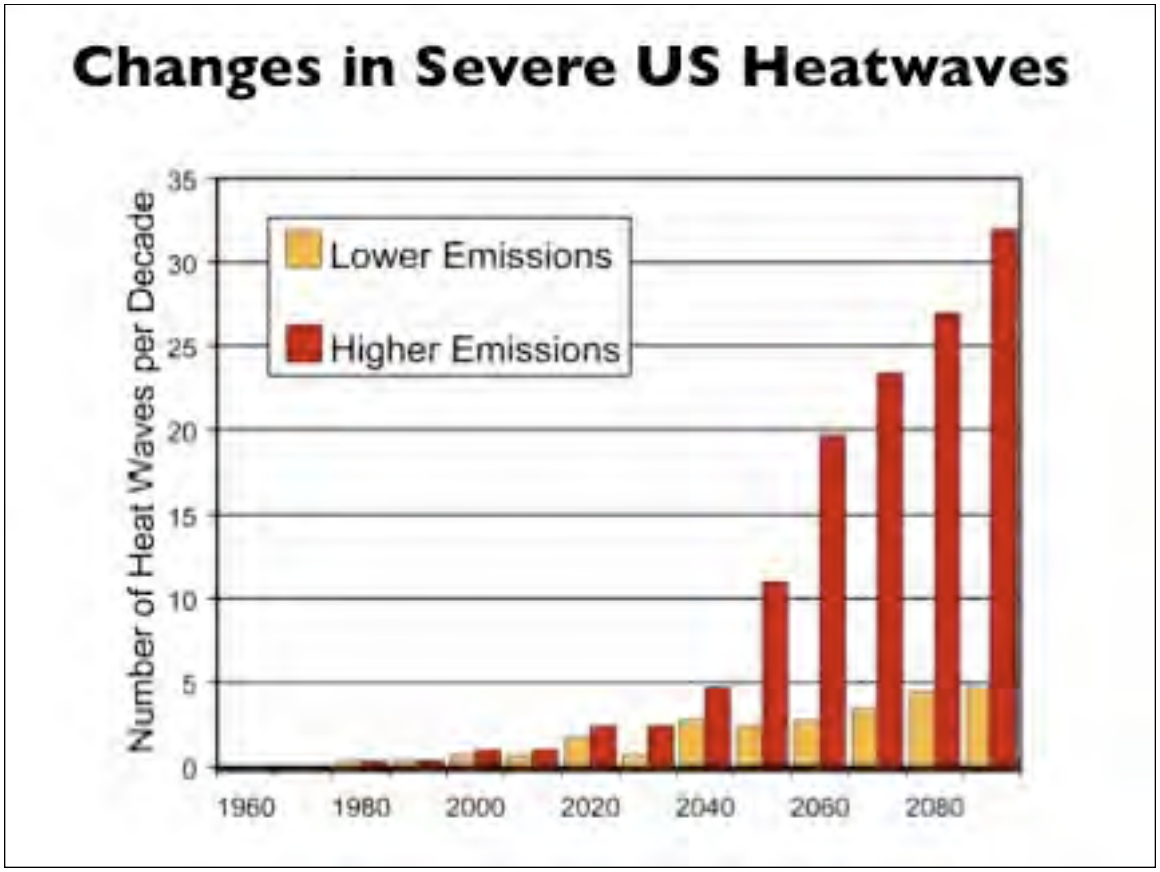
Examples of global impacts projected for changes in climate



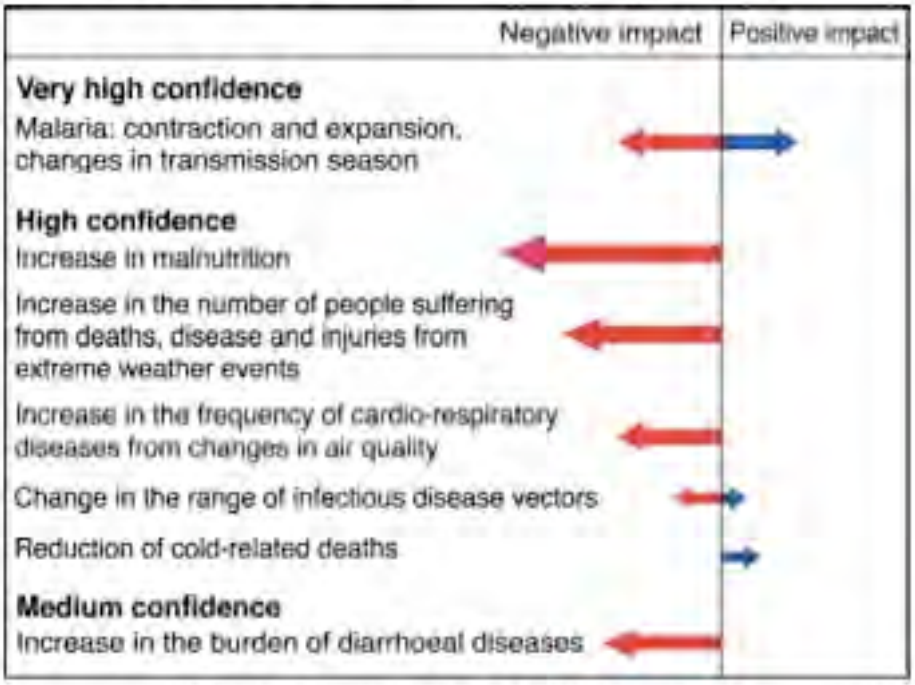
Source: Intergovernmental Panel on Climate Change, AR4-WG2, Technical Summary (2007)




Projected Change in Precipitation Intensity
Based on the Models Used in the IPCC Fourth Assessment Report
A2 High Emission Scenario
A1B Medium Emission Scenario
B1 Low Emission Scenario
Percentage Change
50
40
30
20
10
0
-10
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Percentile
Moderate Precipitation
Heaviest Precipitation


Changes in Severe US Heatwaves
Number of Heat Waves per Decade
Lower Emissions
Higher Emissions
35
30
25
20
15
10
5
0
1960
1980
2000
2020
2040
2060
2080

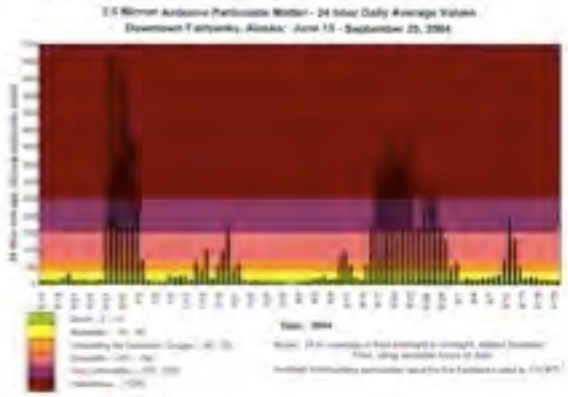
Direction and magnitude of change of selected health impacts



Source: Intergovernmental Panel on Climate Change, AR4-WG2, Technical Summary (2007)

Human Health Impacts

- Injury from disasters
- Respiratory disease
  - Pollen
  - Mold
  - Smoke and particulates
  - Urban air pollution
- Heat stress
- Food poisoning
- Water quality
- Environmental contamination
- Infectious diseases



Fairbanks June 28, 2004 July 6, 2004

WHO estimates 150,000 human mortalities each year due to current climate change

Abrupt Climate Change

Anticipated Insurance Losses

Property

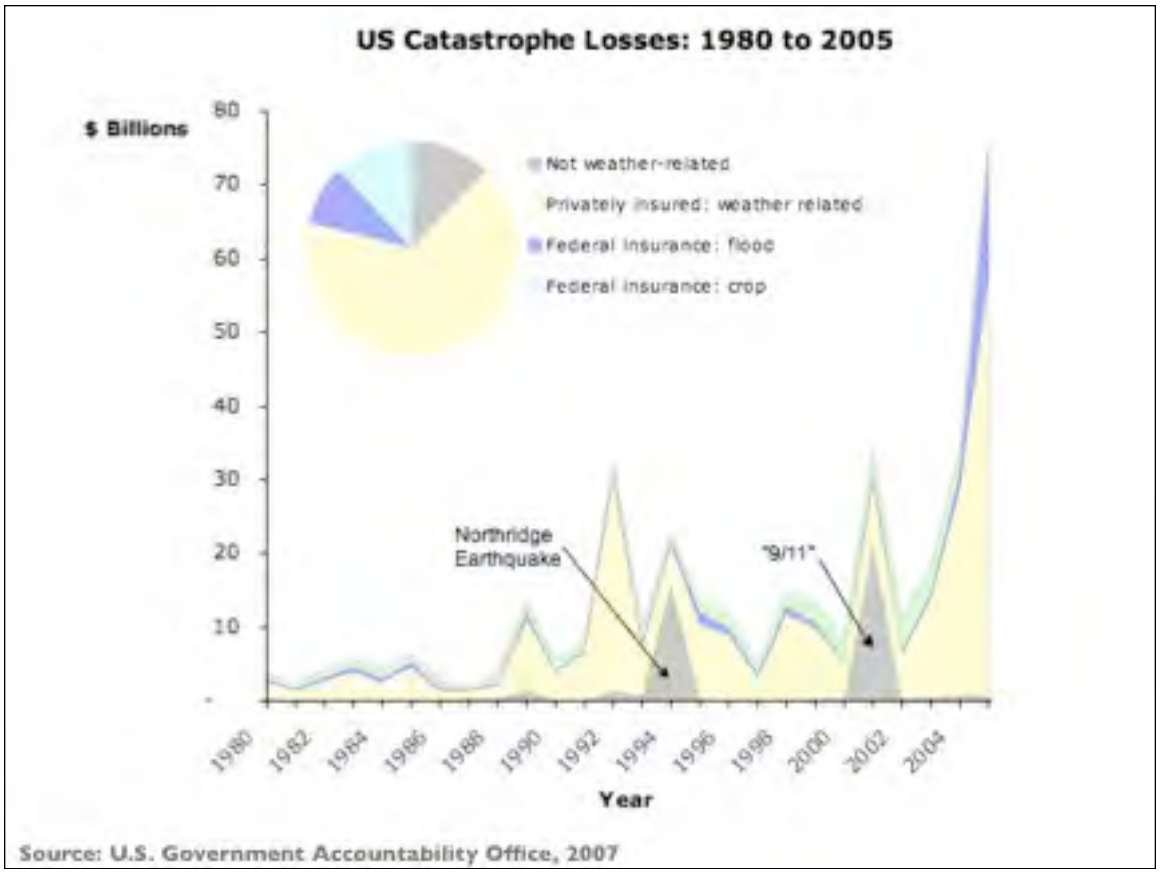
- Property damage
- Marine mishaps
- Mold/moisture
- Forest products
- Agricultural losses
- Fisheries
- Business interruption
- Roadway

Life/Health

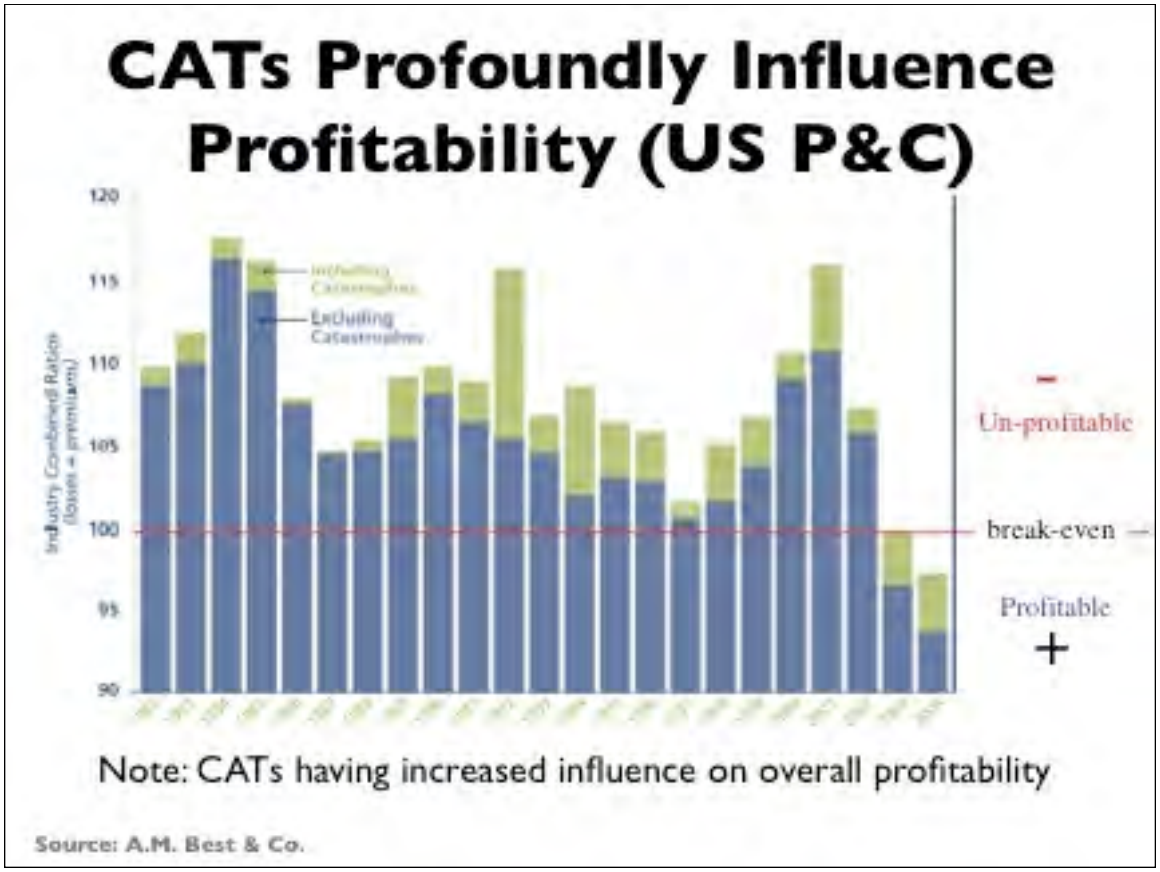
- Injury
- Infectious diseases
- Heat stress
- Respiratory
- Pollution release
- Food poisoning
- Mental health
- Nutrition/water

Liability (Casualty)

- Products
- Negligence
- Nuisance
- Fiduciary
- Tort / BI
- Environmental
- Roadway liability insurance

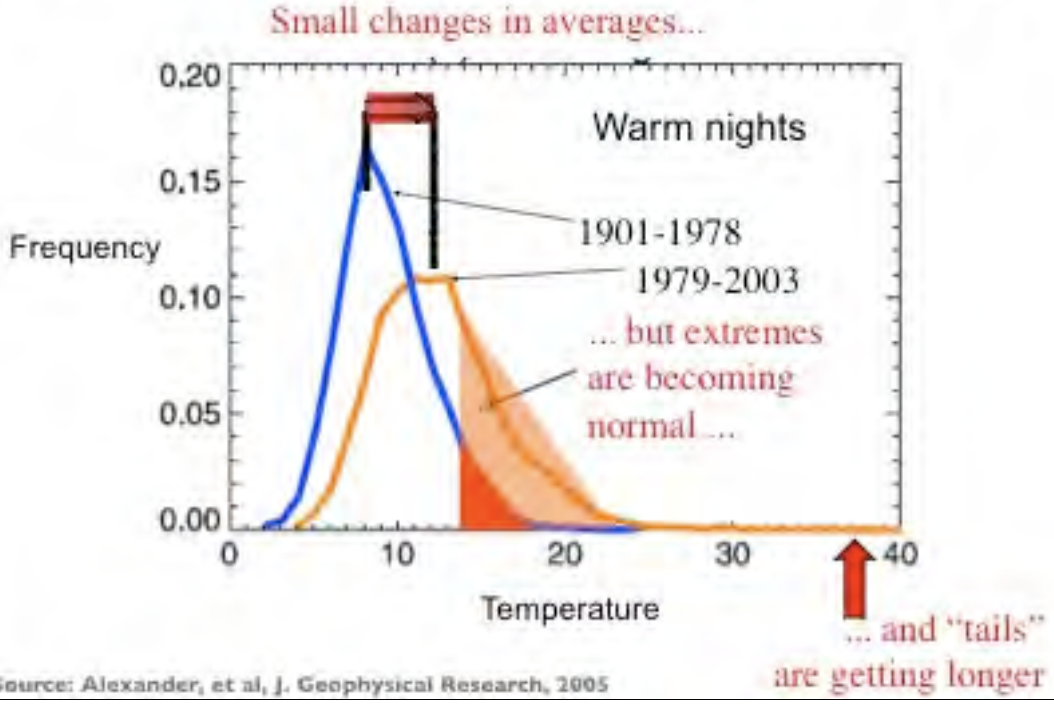


Source: U.S. Government Accountability Office, 2007



Source: A.M. Best & Co.

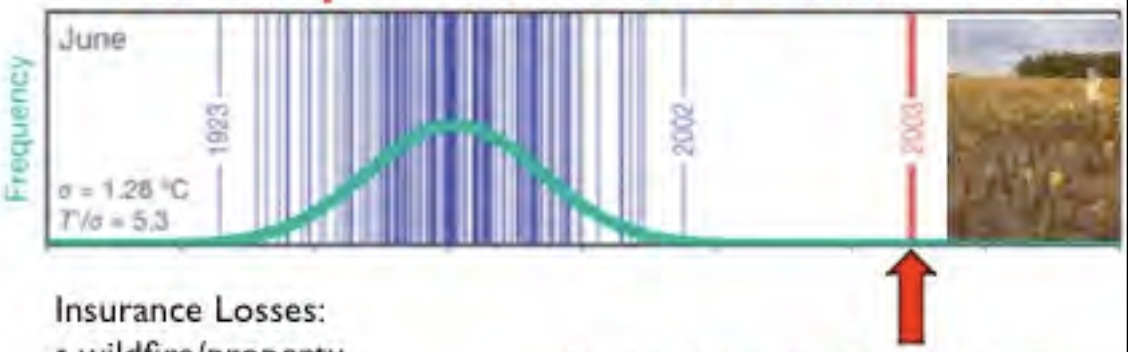
Extremes Shift *More* Than Avg's.



Source: Alexander, et al, J. Geophysical Research, 2005

Rare Extremes Cause Most of the Damages & Insured Losses

The European heat wave of Summer 2003

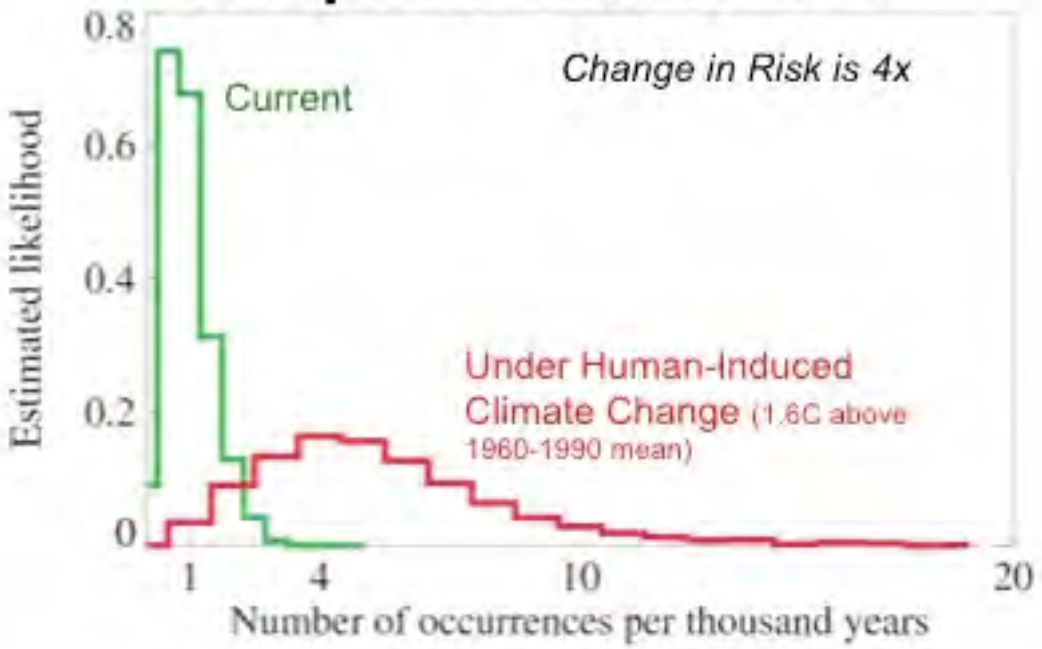


Insurance Losses:
- wildfire/property
- crop
- power sales
- health/mortality

Event was "six-sigmas" outside of norm.
16°F above average in France and Germany
was a 1-in-10,000 event to 1-in-46,000 event

Source: Schar et al, Nature, v. 427, 2004.

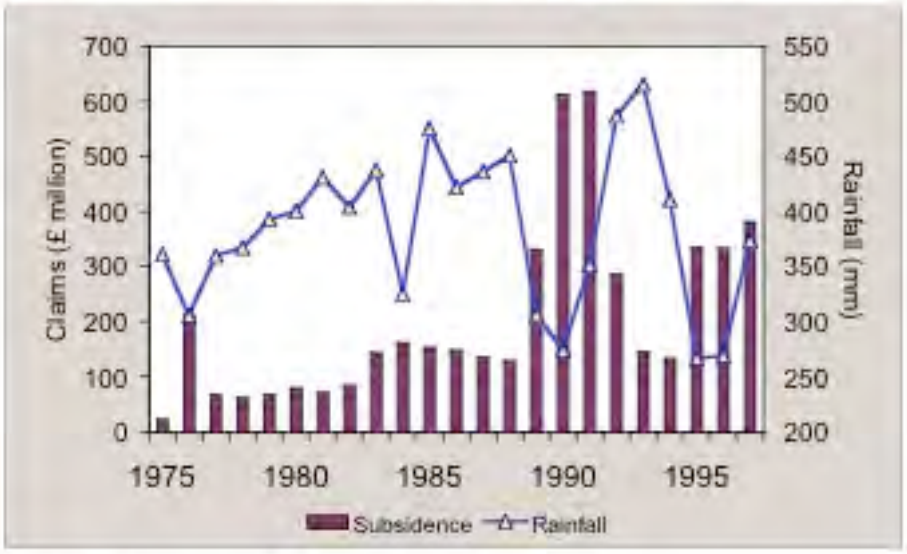
Change in Frequency of Extreme European Heat Waves



Source: IPCC AR4, Corresponds to 1.6C change in mean

Small-scale Losses: Soil Subsidence

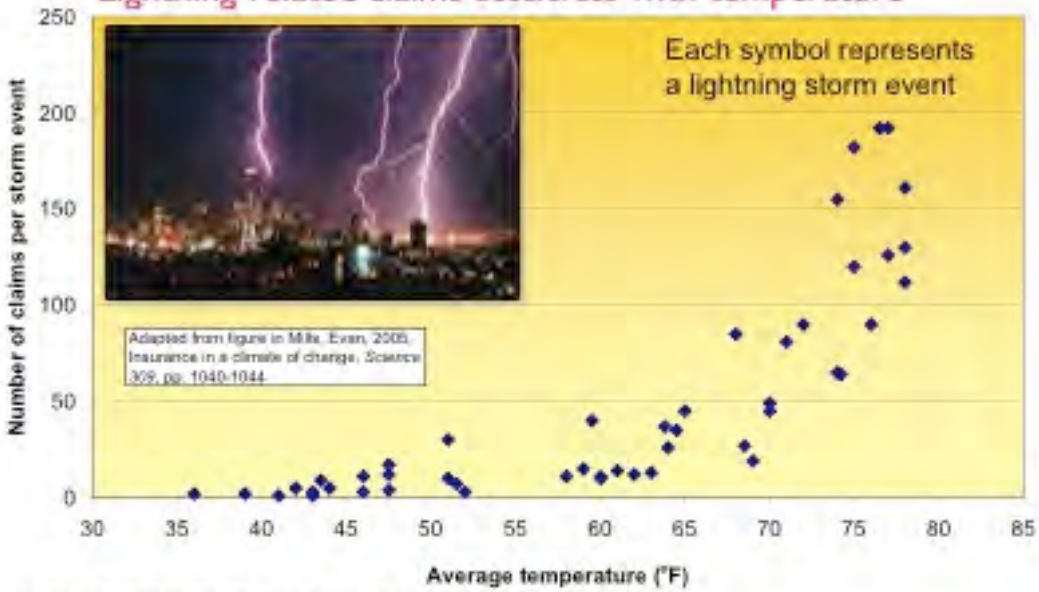
Subsidence claims increase with drought: UK 1975-1999



Source: Association of British Insurers

Small-scale Losses: Lightning

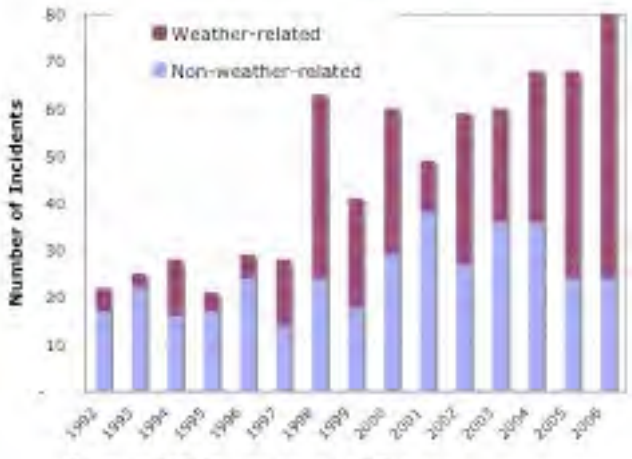
Lightning-related claims *accelerate* with temperature



Source: Hartford Steam Boiler Inspection and Insurance Co.

Small-scale Losses: Power Outages

US Electric Grid Disturbances (1992-2006)
Weather- and Non-Weather-Related
110 million customers effected



Source: US Department of Energy

Power outages were a factor in slowness of draining New Orleans following Hurricane Katrina.

U.S. economy total cost: ~$80B/ year

Average cost to utilities $49 million/ storm; max. $890 million (EEI)

RMS Scenario: $2.7B for NY

Small-scale Losses: Floating Ice

Water Quality: California

Correlated Impacts

Drought stress

Insect Infestation

Wildfire

Mudslide

Emerging Risk: Liability

Oil spill following Hurricane Katrina - *LIFE*

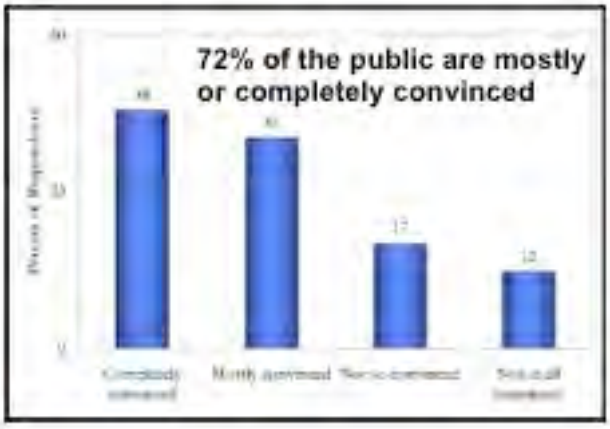
> 30 climate law suits pending as of 1/2008

"We'd be out of our minds if we wrote weather insurance on the opinion global warming would have no effect at all."

Warren Buffett
2006 annual Shareholder meeting

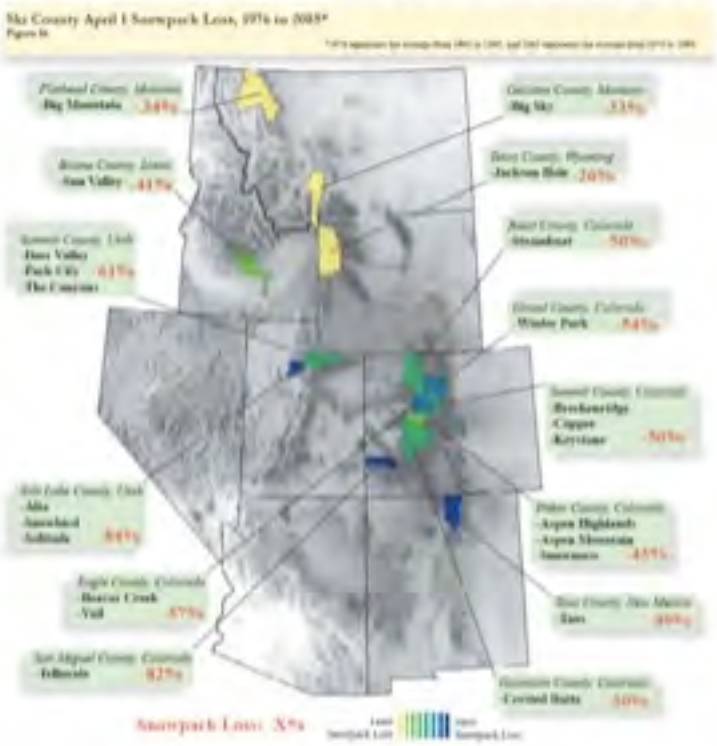
Temperature of Public Opinion

- In 2007, twice as many people believed climate change is here than did in 2004
- But public opinion lags scientific certainty by a *significant* margin



Source: Yale-Gallup Poll (July 2007): http://environment.yale.edu/news/Research/5317/americans-consider-global-warming-an-urgent-threat/

Insurance Customers Impacted



Top Concerns: Survey of 139 Insurance Executives in 21 Countries

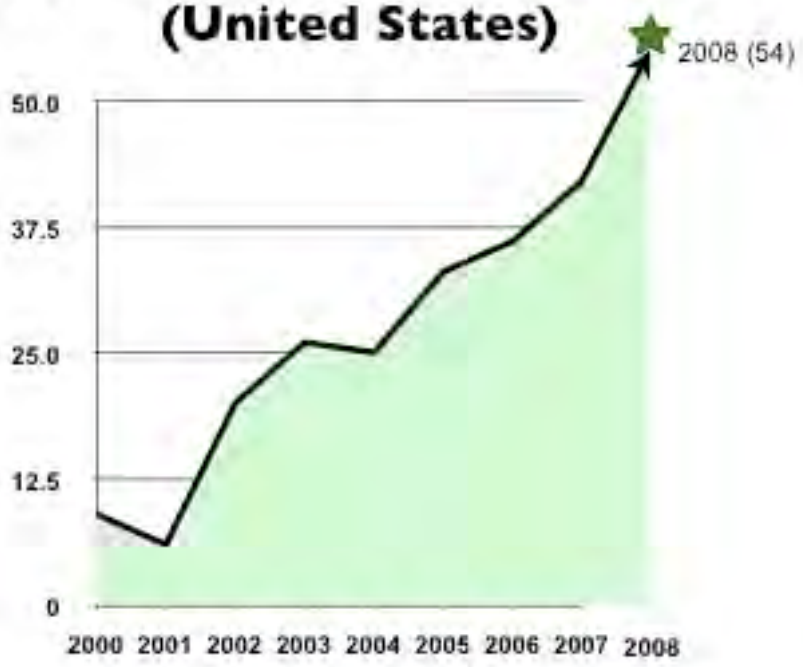
1	Too much regulation	12	Managing technology	23	Corporate governance
2	Natural catastrophes	13	Equity markets	24	Demographic trends
3	Management quality	14	Risk-management techniques	25	Contract wording
4	Climate change	15	Back office	26	Capital availability
5	Managing the cycle	16	Political shocks and pressures	27	Security of reinsurance
6	Distribution channels	17	Pricing new risks	28	Availability of reinsurance
7	Long-tail liabilities	18	Terrorism	29	Business continuation
8	Actuarial assumptions	19	Complex instruments	30	Fraud
9	Longevity assumptions	20	Retail-sales practices	31	Merger mania
10	New types of competitors	21	Pollution	32	Too little regulation
11	Investment performance	22	Interest rates	33	Asbestos

Source: Centre for the Study of Financial Information and PricewaterhouseCoopers survey: 2007

Climate Change is #1 Risk, According to >70 Insurance Industry Analysts

1. ***Climate change***
2. **Demographic shifts in core markets**
3. **Catastrophic events**
4. **Emerging markets**
5. **Regulatory intervention**
6. **Channel distribution**
7. **Integration of technology with operations & strategy**
8. **Securities markets**
9. **Legal risk**
10. **Geopolitical or macro-economic shocks**

Shareholder Climate Resolutions (United States)



Sources: 2000-2006 Data: ISS 2007; 2007 Data (as of 02.06.07); Ceres 2007 & 2008

Carbon Disclosure Project

Annual questionnaire on business risks and opportunities presented by climate change and greenhouse-gas emissions data from the world's largest companies

Run by Institutional Investors:
$57 *Trillion* under management
(major holdings in insurance)

Started in 2000, the CDP now has 385 signatory investors, including Merrill Lynch, Goldman Sachs, Morgan Stanley, AIG Investments, Barclays and HSBC are among current signatories.

Currently polling 3800 companies

Source: https://www.cdproject.net/

Insurance Regulators Recognize the Problem

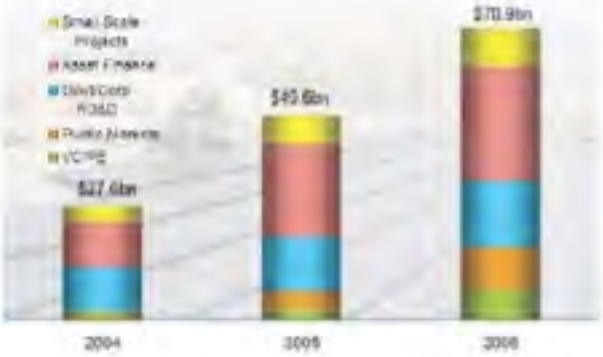
"Global warming is upon us, and it poses unprecedented new threats to the insurance industry and vast segments of society that rely on insurance for peace of mind and financial security."

Michael Kreidler
Washington Insurance Commissioner

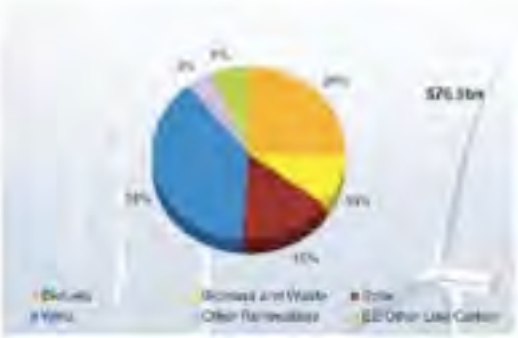
Tim Wagner (deceased)
Nebraska Insurance Commissioner

Global Direct Investment in Sustainable Energy: 2004-2006

Investment by Type



Investment by Technology



* Sylvie Lemmet, Division of Technology, Industry and Economics, UNEP. "Back to the Future: Investing in Clean Energy, Climate Action, p. 138 (2007)

Risks Are Also Associated with Responses *to* Climate Change

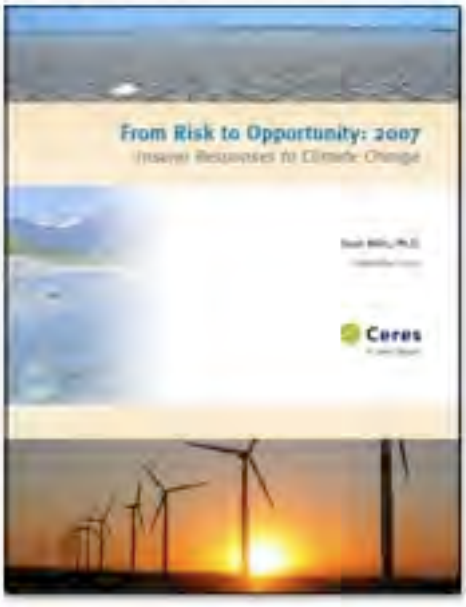
- Green buildings
- Nuclear power
- Renewable energy
- Hydrogen
- Carbon capture & storage
- Carbon offsets/trading
- Geo-engineering
- Adaptation projects

Comparative risk assessments needed

Insurance Paradigm Shift

From Risk ... to Opportunity

30 strategies; 422 examples
~190 parties; 26 countries ... and counting



New Insurer Business Units

AIG "Office of Environment & Climate Change";
"Advanced Energy Solutions"

Allianz "Climate Solutions"

AON "Agri-Fuels Group"

CHUBB "Green Energy Team"

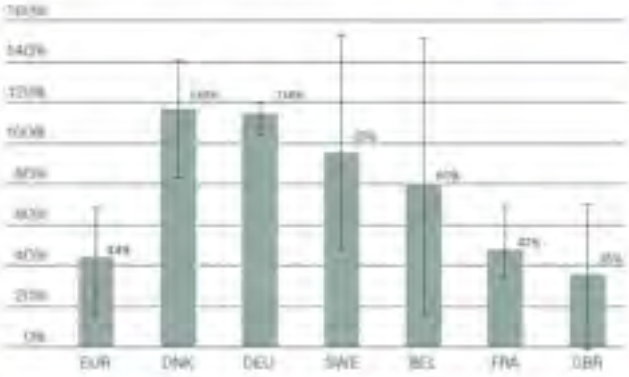
TRAVELERS "Core Business Climate Change Project"

ZURICH "Climate Change Advisory Council"

Understanding the Problem: CAT+Climate Modeling

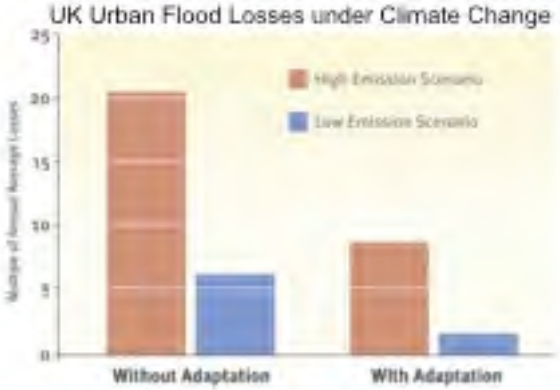
- *Trade Associations*
  - *III [CAT Modeling Forum]*
- *Insurers*
  - *AIG*
  - *Travelers*
  - *Lloyds*
- *Reinsurers*
  - *Swiss Re*
  - *Munich Re*
- *Brokers*
  - *Willis*
- *CAT Modelers*
  - *RMS*
  - *AIR*

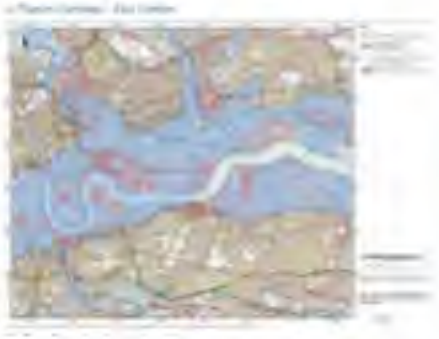
Expected increase in annual loss in Europe — *Swiss Re*



Improved Land-use Planning

Association of British Insurers - modeling studies





CEA Report: 13 of 18 countries have >10% penetration of commercial flood insurance

Source: Modeling results for London. Adapted from Association of British Insurers, "Financial Risks of Climate Change" c: 2080s

Improved Building Practices

- ***FM Global*** - hurricane-resistant building guidelines
- ***Institute for Business and Home Safety's*** "Fortified… for safer living" stds.
  - Wind-resistant rigid foam panel walls and multi-glazed windows
  - Ice-dam resistant
  - Mold resistant
  - Water-resistant insulation

BASF Home - Patterson NJ

- ***Some insurers giving premium credits for compliant homes***

Promoting Loss Prevention: Wetlands Restoration

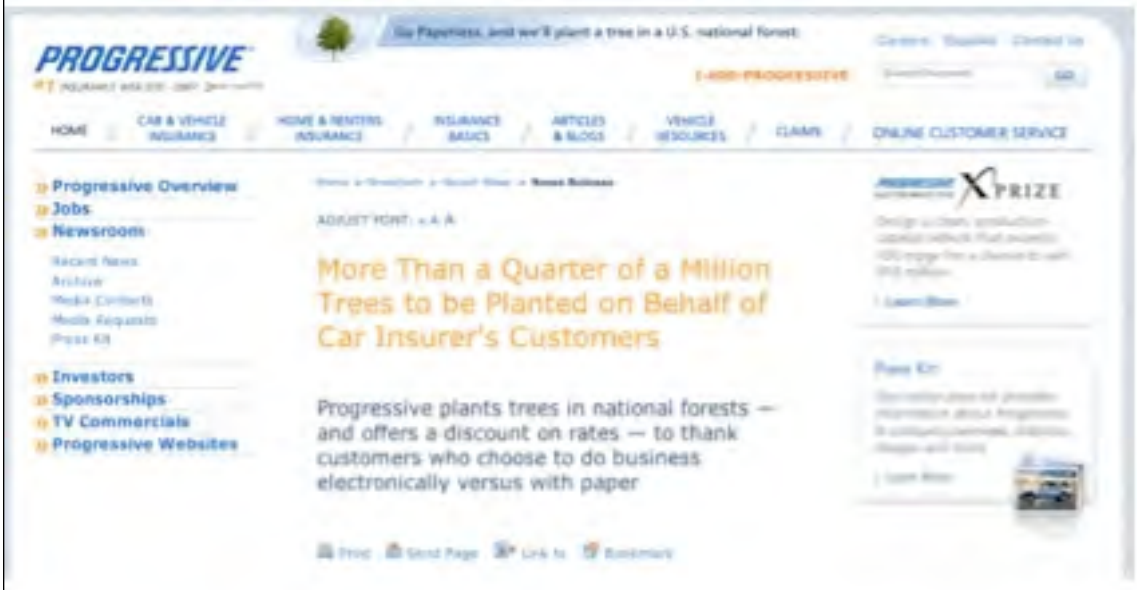
- ***Tokio Marine Nichido:*** has reforested 12,200 acres of mangroves in Indonesia, Thailand, Philippines, Myanmar and Vietnam

Company states that 2005 Tsunami did less damage in these areas

Source: http://www.tokiomarine-nichido.co.jp/english/index.html

Paperless Insurance

- ***Progressive:*** Tree Planting



Co-benefits

Aligning Terms & Conditions with Risk-reducing Behavior

- Insurance discounts of up to 40% for low mileage:
  - *Aioi*
  - *Axa*
  - *GMAC*
  - *Hollard*
  - *Milemeter*
  - *Norwich Union*
  - *Polis Direct*
  - *Progressive*
  - *Rheinland*
  - *Sompo*
  - *Tokio Marine Nichido*
  - *Unigard*
  - *Versicherungen*

250,000 policies in Europe as of 2007; $700M revenues projected by 2010

General Motors Acceptance Corporation (GMAC) PAYD discount schedule:

Miles/year	Discount offered
1 – 2,500 miles	40%
2,501 – 5,000	33%
5,001 – 7,500	28%
7,501 – 10,000	20%
10,001 – 12,500	11%
12,501 – 15,000	5%
15,001 – 99,999	0%

Some use GPS –> stolen-vehicle recovery; avoids reporting fraud

Aligning Terms & Conditions with Risk-reducing Behavior

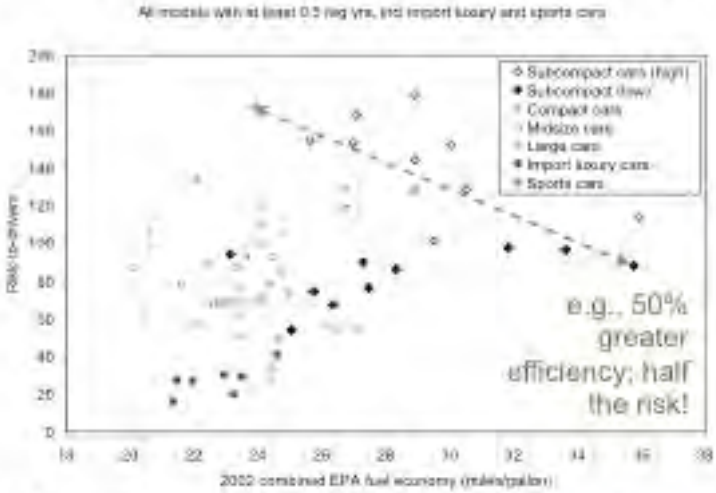
- ***TrygVesta:***
  - Free one-month bus pass while damaged car is being repaired
  - Repair claims will not be paid for cars built before 1989 and with high emissions

Hybrid Discounts

5-15% premium discounts to hybrid drivers

- ***AXA***
- ***Berkshire/GEICO***
- ***Cooperative***
- ***Desjardins General***
- ***Farmers***
- ***Hybernia***
- ***SECURA***
- ***St. Paul-Travelers***

Fuel Economy & Risk



- Risk (driver fatalities/mile) of compact cars is 1/2 to 1/3 that of trucks, and lower than SUVs
- Crossover SUVs have 1/2 the risk of standard SUVs and are 17% more fuel-efficient

Source: Tom Wenzel and Marc Ross, Lawrence Berkeley National Laboratory

Carbon Offsets

- ***Allianz, AXA, Cooperative,***
- ***Insurance Australia Group:***
  Car and travel insurance bundled with offsets

Changing Risk Profiles

Innovative Products

- ***Fireman's Fund***: first-ever U.S. *commercial* "Green-Buildings Insurance"
  - 5% premium credits for existing green features
  - Rebuild to LEED after loss
  - Commissioning
    - ~500 policies sold in first year (2007)
    - Premiums > $35M in '07; Doubling quarterly
- ***AIG (Lexington):*** Commercial, and first-ever U.S. *residential* "Green-Buildings" insurance
  - Rebuilding to LEED (or next-higher LEED level) after loss; LEED design and registration fees
  - Rewards use of EnergyStar-labeled equipment
  - Low-emission materials; IAQ testing
  - Solar "revenue loss" if downtime
- ***AIG Environmental:*** Sustain-a-Build *environmental liability* premium credit for green commercial buildings

Innovative Products for Energy Performance

- ***Energy Production:*** ***Munich Re - geothermal, Sompo - wind, others....***

- ***Demand reduction:*** ***AIG, Zurich and others...***

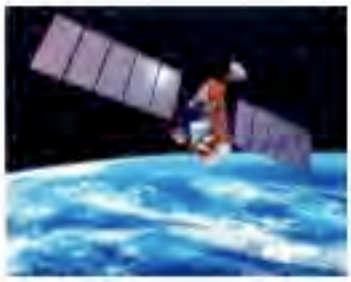
Coverage for Under-served Market Segments

- ***Lockton Risk Services:***
  - group liability coverage for home energy auditors, if members of RESNET

Source: http://www.locktonaffinity.com/RESNET/

Coverage for Under-served Market Segments

- ***Swiss Re:*** Drought/Crop micro-insurance for 400,000 farmers in Ethiopia, Ghana, Kenya, Malawi, Mali, Nigeria, Rwanda, Senegal, Tanzania and Uganda.



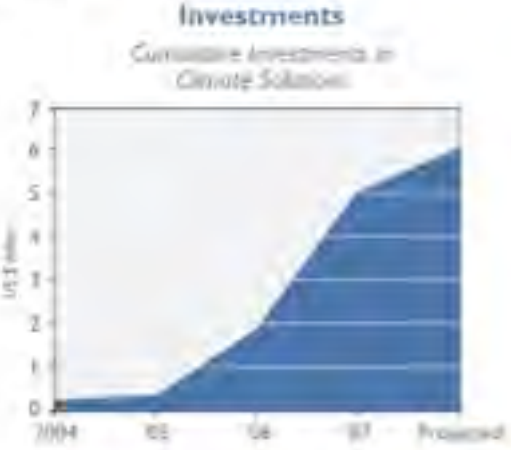
Carbon Risk-Management Services: Project Risk

- ***AIG, Marsh, Zurich, others:*** offering carbon project risk-management consulting services; benchmarking, and insurance

Source: Marsh. 2004. "Responding to Climate Change Risks and Opportunities."

Direct Investment

- ***Allianz:*** $15 million in the European Carbon Fund; plans to invest between $400 and $650 million in renewable energy
- ***Gerling:*** Sustainable Development Project operates a $100 million venture capital fund
- ***ING:*** Green finance - $1.16 billion
- ***Sompo Japan:*** $100 million green fund
- ***Swiss Re:*** $429 million "clean energy" venture fund; $320 million in individual investments



2008 CERA study predicts $7 trillion investment in "clean-energy technologies".

Direct Investment

- ***AIG:*** Atlantic Station
  - Brownfields redevelopment
  - 8 million square feet LEED registered

Among institutional investors, U.S. life insurers hold 22% of all commercial real estate

Financing Emissions-reduction Projects

- ***AIG:*** $300 million lending facility for efficiency and clean energy
- ***Fortis:***
  - Preferential lending rate for energy-efficiency upgrades +10% premium discount
  - $106 million "Green Bank" loans
- ***HSBC:*** $45 million for wind projects in India
- ***Mitsui Sumitomo:*** Loans for building-integrated solar systems
- ***TrygVests:*** $10k financing for "climate-friendly home energy upgrades" after loss.

Funding Innovation

- ***Progressive*** $10-million "X-Prize for Ultra-fuel-efficient cars

Building Awareness & Participating in Public Policy

- ***American Insurance Association:*** endorses public transportation; reduced speed limits; telecommuting based on win-win benefits to insurers
- ***Insurance Institute for Highway Safety:*** supports tightened CAFE standards
- ***Firemen's Fund, IBHS, ICLR:*** have endorsed energy-efficient building codes

Building Awareness & Participating in Public Policy

- ClimateWise announced Sept 17, 2007 -- 41 insurers and trade allies pledged to lead the way in:
  - "Analysing and reducing risks
  - Support climate awareness amongst our customers;
  - Incorporate climate change into our investment strategies
  - Inform and engage in public policy debate
  - And reduce the environmental impact of our businesses."

Source: http://www.climatewise.org.uk/

Additional signatories as of 11 June 2008: ACE, Amlin, ARK, Beazley, BIBA, Catlin, Chaucer, Diagonal Underwriting, Equity Group, Hardy's Underwriting, Heritage, Hiscox, Legal & General, Marketform, Navigators, NFU Mutual, Prudential, QBE European Operations, RJ Kiln, RMS, Spectrum, Standard Life, UNUM, XL

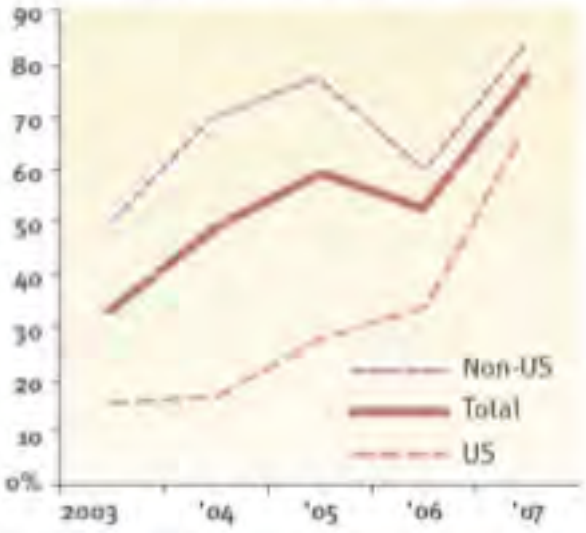
Carbon Risk Disclosure

Carbon Disclosure Project: Annual Global Survey by Institutional Investors ($57 Trillion under management)

113 Insurer responses: 2003-200

- ***AIG, Allstate, Aon, Chubb, Marsh, MBIA, Safeco, St. Paul Travelers, Unum Provident, Munich Re, others...***

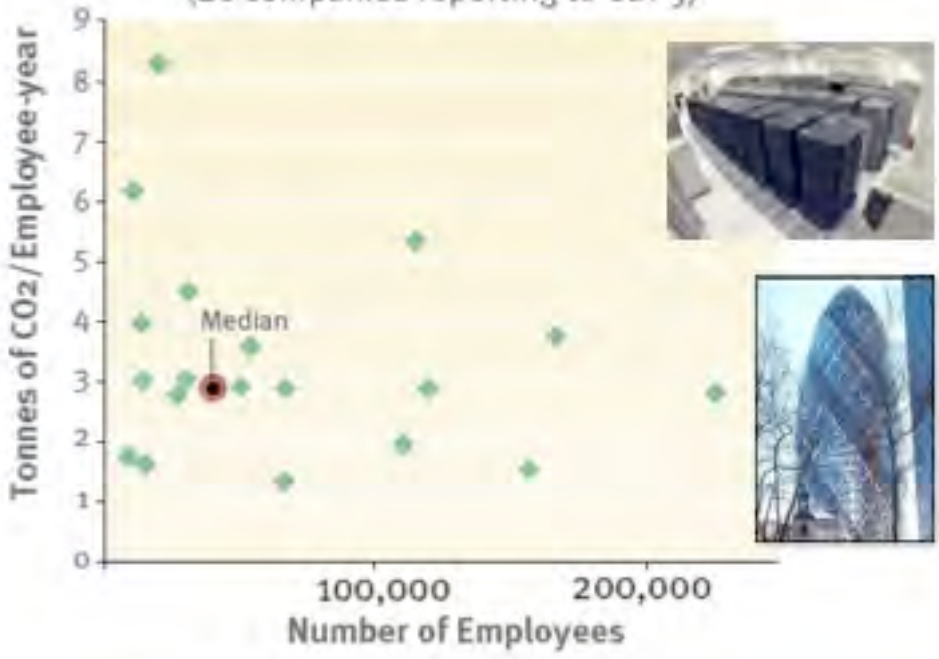
Carbon Disclosure Project
Full Response Rates Over Time



Source: http://www.cdproject.net/

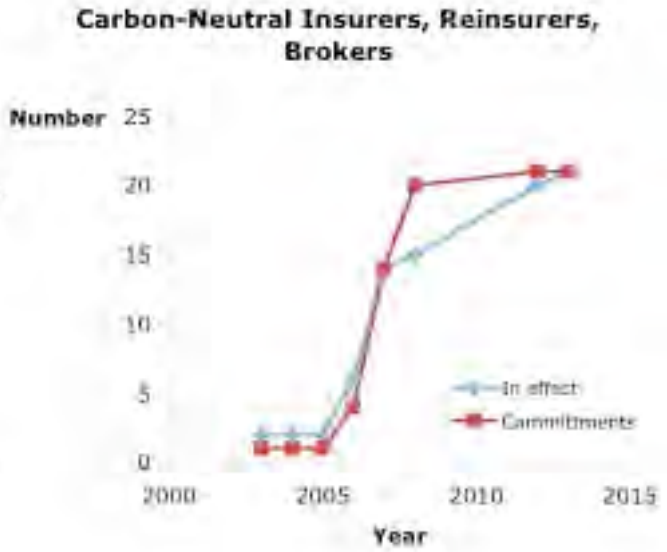
Leading by Example

Insurer CO_2 Emissions Intensity
(20 companies reporting to CDP5)



Carbon-neutral Insurers

- AIG
- Aviva
- Bradford & Bingley
- Folksam
- Fortis
- FP Marine
- HSBC
- Independent Insurance Services
- ING
- Insurance Australia Group
- Munich Re
- Royal & Sun Alliance
- Rutherfoord
- Solar Group
- Specialized Broking Associates
- Storebrand
- Swiss Re
- Tokio Marine Nichido
- Xelector



Untapped Opportunities

- Customer segments: agriculture, commercial auto, shipping, high-tech
- Upgrading after loss: shipping, industrial...
- Value-added services
  - benchmarking or carbon-footprint at renewal
  - climate risk modeling
  - Training: operations, loss control, QA
  - Board coaching (esp. re: liability)
  - Disclosure support
- Tailored products, services for green startups (bonds, letters of credit, etc.)

Roles for Actuaries

1. Help your management make sense of the science and its business implications
2. Understand the risk profiles of climate change responses
3. Push for inclusion of climate change in CAT modeling
4. Participate in the development of innovative products & services

"When the winds of change blow, some build walls ... others build windmills."

- Chinese Proverb

http://insurance.lbl.gov
emills@lbl.gov