Climate Change & Insurance: What Regulators Need to Know

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

Climate Change is about Risk Management, But the Dice are Loaded

State of the Science: Fingerprints

The Scientific Consensus
http://www.ipcc.ch

Intergovernmental Panel on Climate Change
TAR - 1300 Authors; 1100 Reviewers
Unanimously adopted by 100+ nations (including U.S.)
Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global mean sea level.”

http://www.ipcc.ch
The Primary Human Influence is Fossil Fuels Combustion

(Second is Deforestation)

Fingerprints... Temperature, Sea Level, Snow


Attribution

Our models predict history very well, so we are confident in their ability to project future impacts


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

Moutinho and Schwartzman, 2005

September 2006 Temperature Anomalies
(with respect to a 1961-1990 base period)
National Climatic Data Center/NOAA


IPCC (2007) Projections of Future Changes in Climate

Best estimate for low scenario (B1) is 1.8°C (likely range is 1.1°C to 2.9°C), and for high scenario (A1FI) is 4.0°C (likely range is 2.4°C to 6.4°C).

Fingerprints

Hurricane Destructiveness Rising

Fingerprints.... Torrential Rain

Fingerprints.... Floods

Regions of observed disproportionate changes in heavy (95th %-ile) and very heavy (99th %-ile) precipitation

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

**Fingerprints: Drought**

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

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


**Fingerprints: Wildfire**


The trend has been sharply upward everywhere; CO2 feedback is significant.

Source: Millennium Ecosystem Assessment

**Fingerprints: Loss of Ice & Snow Cover**

Loss of 1 million sq. miles by 2007 = 10x U.K.

- 7%/year decline (summer)
- "Darkens" Earth's surface
- "Freshens" oceans; can stall essential circulation patterns

Source: James McCarthy, Harvard

**Change in Recurrence of 100-year Droughts**

Source: IPCC 4th Assessment (2007), Ch 3

**The Northwest Passage is Open**

Source: NASA

Harvard Expedition to North Pole... free water ....

Source: James McCarthy, Harvard
Larsen-B Ice Shelf

Jan 31 2002

Larsen B Ice Shelf

Feb 17

Feb 23

March 5

1255 square miles [24x San Francisco]

655 foot thick [4.3 Lake Tahoe]

720 billion tons

Subsequent 8x increase in outflow glacier speed

Fingerprints ... Glaciers & frozen ground are receding

Area of seasonally frozen ground in the northern hemisphere has decreased by 7% from 1901 to 2002

Accelerating since early 1990s

**Disappearing Glaciers**

Muir Glacier, photographed by William O. Field on 13 August 1941 (left) and by Bruce F. Molnia on 31 August 2004 (right). During this period, the glacier retreated more than twelve kilometers (seven miles) and thinned by more than 800 meters (875 yards).

Source: National Snow and Ice Data Center

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

(Source: Harvard University)

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**Correlation of Disease Clusters with the 1997-1998 El Nino Weather Extremes**

(Source: Epstein, Harvard Medical School, Science)

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**Overwhelming Correlations**

IPCC Synthesis of Scientific Literature on Observed Changes 1970-2004

577 studies reviewed

- 765 observed **physical** changes (94% consistent with warming)
- 28,671 observed **biological** changes (90% consistent with warming)


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**The Consensus**

- Human-induced climate change is here: we've been studying this for over a century
- The climate consensus, is about as good as it ever gets in science.
  - It's about like that for human evolution or the health consequences of tobacco smoke
- One can quibble with specific points, but not with the systematic observed pattern of evidence
- Uncertainties are explicit; and are shrinking
- Unaccounted factors are likely to eventually reveal an even worse problem
- No alternate theory has been advanced
IPCC (2007) Consensus on Future Extremes Events

- Warmer & more frequent hot days & nights
- Heat waves/waves
- Heavy precipitation
- Drought
- Increased Cyclones/Hurricane
- High seas, Storm surge


Impacts of Future Events @ 3-5°C warming (IPCC 2007)

<table>
<thead>
<tr>
<th>Water</th>
<th>Decreasing availability of water resources due to increased stress.</th>
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<tbody>
<tr>
<td>Ecosystems</td>
<td>- Significant extinctions of species.</td>
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<td>- Widespread coral mortality.</td>
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<td></td>
<td>- Change in species range.</td>
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<td>Food</td>
<td>- Impacts on subsistence farmers and fishing.</td>
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<td>- Decreased productivity of cereal crops.</td>
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<td>Coasts</td>
<td>- Millions more people experience coastal flooding.</td>
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<td>- 30% of coastal wetlands lost.</td>
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<tr>
<td>Health</td>
<td>- Increased malnutrition, diarrhoeal, cardio-respiratory, and infectious disease.</td>
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<td></td>
<td>- Rising morbidity &amp; mortality: heat waves, flood, droughts.</td>
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<td>- Changed disease distributions.</td>
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<td>- Substantial burden on health services.</td>
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Open Questions

- Not the existence of human-induced climate change, or lack thereof, but rather:
  - How much?
  - How fast?
  - Smooth versus abrupt change
  - Feedbacks
    - Positive
    - Negative
  - Geography of impacts; downscaling
  - Gaps in models (especially cryosphere)
  - Attribution of Impacts
  - Society’s ability to adapt
  - Costs of mitigation and adaptation
  - Policy pathways

Donuts Exist Despite the Holes

Source: Krispy Creme

Risks for Insurers

World Insurance Market

$4 Trillion in 2006

Source: Swiss Re, Sigma, NAIC
“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

CEA Report: July 2007

• CEA is trade association of 33 European insurance associations, representing 94% of premiums in region

• Strong concern about climate change, and need for proactive steps

F&C Investments Statement: September 2007

• F&C is asset manager with $200 billion under management.

• Concerned about climate-sensitivity of their investments in insurers.

Insurance Regulators (via NAIC Taskforce) 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
Nebraska Insurance Commissioner

Climate Change: Intersection with Insurance

Insurers are....
– integrators
– risk assessors
– risk managers
– adaptive capacity
– vulnerable
– selective
– potential part of solution

Anticipated Losses

• Property damage
• Mold/moisture
• Forest products
• Agricultural losses
• Fisheries
• Business interruption
• Roadway

• Injury
• Infectious diseases
• Heat stress
• Respiratory
• Pollutant releases
• Food poisoning
• Mental health
• Nutrition/water

• Products
• Negligence
• Nuisance
• Fiduciary
• Tort / BI
• Environmental
• Roadway liability insurance
Also in play....
• Surplus lines
• Residual Markets
• Self insurers (captives, RRGs, etc)
• Insurance alternatives (e.g. Takaful)
• ART (alternative risk transfer)
• and... public-sector insurance programs (flood, crop,...)

Disasters Look Different Through an Insurance “Lens”

Aggregated Global Impacts: 1980-2004

Risk is OK; Excessive Volatility is Not
The ratio of losses to premium revenues is increasing

Non-climate factors play a role, but...
• Trends consistent with observed change
• Why are non-weather losses growing more slowly?
• Would have been even worse without prevention efforts

Insured Losses from Natural Hazards Are Less Predictable than Conventional Losses (% of total in Central Europe: 1983-2002)


Source: Swiss Re 2002

CATs Profoundly Influence Profitability

Notes: All economic values inflation-adjusted to 2004 levels. Losses from Munich Re NatCat Service; premiums from Swiss Re, Sigma.

Values for 2005 are LBNL estimates.
Changes in Extremes

Source: IPCC, Third Assessment Report

Extremes Shift More Than Avg’s.


Rare Extremes Cause Most of the Damages & Insured Losses

The European heat wave of Summer 2003


Small-scale and Indirect Events & Consequences Often Overlooked

Events
- Insect infestations
- Drought
- hail
- Heat waves
- Ice Storms
- Lightning
- Sea-level rise
- Thunderstorms
- Torrential rains
- Wildfire
- Winterstorms

Greater combined impacts than CATs in an average year

Consequences
- Blackouts
- Coastal erosion
- Crop/fishery damages
- Equipment breakdown
- Eroded air quality
- Eroded water quality
- Flooding
- Health impacts
- Mudslides
- Property loss
- Sinkholes/Subsidence
- Weather-related vehicle accidents

Temperature-Related Insurance Loss Experience

Subsidence claims increase with drought: UK 1975-1999

Source: Association of British Insurers

Temperature-Related Insurance Loss Experience

Lightning-related claims accelerate with temperature

Each symbol represents a lightning storm event

Source: Hartford Steam Boiler Inspection and Insurance Co.
U.S. Power Outages

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

Permafrost Disintegration
Settlement of several meters is possible

Emerging Risk: Liability

- General
- Environmental
- D&O
- Product
- Political Risk
- Vehicle

Shareholder Resolutions Link Business Atmosphere to Climate Change Liability

2000-2006 Data: ISS 2007
2007 Data (as of 02.06.07): Ceres 2007
Challenges to the Standards of Insurability

• Risks measurable, costs predictable, affordable
• Risks diversified, e.g. geographically
• Correlations understood
• Maximum losses manageable (not jeopardizing insurer solvency)
• Adverse selection (purchase of insurance only by those most at-risk) and moral hazard (complacency due to presence of insurance) must be managed

Availability & Affordability

• Exodus of insurers from coasts (and elsewhere)
• Quiet “hollowing out” of insurance

• Customers “going Bare”: 9 utilities (10% of membership) left in OIL Mutual Ins. Co. May 2007
  – Paid $100 million in fees to leave
  – CEO says “It was a stunning blow”

• RAND Report on commercial insurance in FL
  – In 2005: one insured paid $250k for $38m coverage
  – In 2006: paid $940k for $5m coverage, i.e. a ~29-fold bump in the “cost of risk”

Summary: Reasons for Concern

• Underwriting
• Models
• Claims-handling
• Capital
• Operations
• Investments
• Competition
• Contraction
• Shareholders
• Reputation
• Regulation
• Liability
• Insurability

Managing Risks & Capturing Opportunities
From Risk ... to Opportunity

The insurance sector has a key role to play in helping to mitigate the effects of climate change ... and by developing new products and solutions that can support emerging greenhouse-gas and renewable energy markets.

-Marsh & McLennan

Ceres Report: 24 strategies; ~310 examples; ~160 insurers

Cutting U.S. Emissions in Half with Climate-Stabilization “Wedges”

US Electric Sector CO2 Emissions

Today 2050

Source: Electric Power Research Institute

More Business!

Wide Range of Activities

Understanding the Climate Change Problem: modeling

- Efforts underway:
  - AIG
  - Lloyds
  - Munich Re
  - Swiss Re
  - Willis
  - RMS

Expected increase in annual windstorm loss in Europe

Swiss Re
Understanding the Climate Change Problem: land-use pln’g

Promoting Loss Prevention: 
Building Codes

- 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

Promoting Loss Prevention: 
Wetlands Restoration

- Tokio Marine & Nichido has reforested 7,500 acres of mangroves in Indonesia, Thailand, Philippines, Myanmar and Vietnam. 5,000 more acres in progress

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

Innovative Products

- Fireman’s Fund: first-ever “Green-Buildings Insurance”
  - 5% premium credits for green features
  - Rebuild green after loss

- Lloyds of London (Naturesave): personal lines; commercial lines
  - 10 percent of premiums donated to environmental projects
  - Environmental performance surveys offered to policyholders

Innovative Products

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

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

Innovative Products

- Energy Performance Insurance
  - Lloyds (and others): Energy Savings Insurance
  - Munich Re: Geothermal exploration risk insurance
Innovative Products
• Insurance Australia Group offering on-line automobile carbon-offset service for customers


Innovative Products
• Allianz, AXA, Cooperative: Carbon-neutral car and travel insurance

Carbon Offset and Risk-Management Services
• AIG, Marsh, others offering carbon project risk-management consulting services; insurance


Carbon Trading and Risk-Management Services
• Swiss Re:
  – Contingent-Cap Forward for Emissions Reduction Trades (cost risk hedge)
  – Carbon credit price volatility product
  – Carbon-delivery insurance

Aligning Terms & Conditions with Risk-reducing Behavior
• Insurance discounts of up to 40% for low mileage:
  – GMAC
  – Progressive
  – Norwich Union
  – Polis Direct
  – Rheinland
  – Versicherungen
  – Aioi
  – Axa
  – Pay-per-K
  – Hollard
  – Gerling
  – Unigard

10K policies in Europe as of 2007.
$700M revenues projected by 2010

General Motors Acceptance Corporation (GMAC) PAYD discount schedule.

Investment in Solutions
• AIG Atlantic Station
  – brownfields redevelopment
  – 8 million square feet LEED registered

Some use GPS → stolen-vehicle recovery; avoids reporting fraud
Building Awareness & Formulation of Public Policy

Additional signatories as of 17 Sept 2007: ACE, Amlin, ARK, Beazley, BIBA, Chaucer, Diagonal Underwriting, Equity Group, Hardy’s Underwriting, Higgins Legal & General, Markel, Munich Re, Motorists Mutual, OBE European Operations, RSA, RMS, Standard Life Insurance, Swiss Life, Swiss Re, TSB, Unum, UNUM, XL, Zurich

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

Building Awareness & Formulation of Public Policy

- American Insurance Association - Endorsing public transportation; reduced speed limits; telecommuting based on win-win benefits to insurers
- Association of British Insurers advising City of London on land-use planning and flood defenses

Announced Sept 17, 2007. 38 insurers and trade allies:

“We will 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.”

Leading by Example

- Carbon Neutrality
  - Munich Re (DE)
  - Folksam (SE)
  - Aviva (UK)
  - Royal Sun Alliance (UK)
  - FP Marine (HK)

Swiss Re’s “Gherkin” building (London)

Swiss Re’s “Gherkin” building (London)

Carbon Risk Disclosure

Insurers responding to global survey ($41 T under management):
AIG, Aon, Marsh & McLennan, MBIA, Safeco, St. Paul Travelers, Unum Provident, Munich Re, others...

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

Insurer Emissions Vary by 7x!

Median value is greater than global per-capita emissions from transportation or housing.

Risks Are Also Associated with Responses to Climate Change

- Emissions reductions: supply- and demand-side
  - Green buildings
  - Nuclear power
  - Hydrogen energy
  - Renewable energy
  - Carbon capture & storage
  - Carbon offsets/trading
- Comparative risk assessments needed
Carbon Capture & Storage (CCS)

- Lake Nyos - 1986 (Cameroon): Natural CO₂ leak killed 1800 people, 3500 farm animals

Win-Win Solutions

- Arkwright Mutual (now part of FM Global): replaced fire-hazardous halogen "torchieres" with compact fluorescent alternatives at Northeastern University student housing + seminars for risk managers

Roles for Regulators (1 of 2)

- Follow the science.
- Motivate insurers to collect more/better data.
- Raise the standards of practice for catastrophe modeling; open-source model.
- Obtain better disclosure of climate risks.
- Promote climate-friendly products and services.
- Enable actuarial pricing with sensitivity to affordability.

Roles for Regulators (2 of 2)

- Focus on improved building codes and beyond
- Promote partnerships with policyholders for loss mitigation, e.g. financing upgrades.
- Safeguard surplus by encouraging prudent investments.
- Encourage insurers to minimize their carbon footprint.
- Communicate industry priorities to governments.
- Ensure validity and quality of insurer climate initiatives, claims.

Thank You

http://insurance.lbl.gov
Aligning Terms & Conditions with Risk-reducing Behavior

- **Travelers** offers 10% premium discount to drivers of hybrids
- **Swiss Re** - seeking D&O disclosure from insureds

Investment in Solutions

- **Swiss Re**: $xxx million venture fund
- **Gerling**: Sustainable Development Project operates a $100 million initiative including venture capital
- **Allianz**: has invested 10 million euros in the European Carbon Fund; plans to increase investments in renewable energy by 300 to 500 million euros will invest between $350 and $600 million in renewable energy

Building Awareness & Formulation of Public Policy

- **Swiss Re** has run full-page adds on climate change in major insurance trade journals for several years

Fingerprints.... Storms

- Climate change is affecting storm tracks, winds and temperature patterns
- Human-induced forcing has likely contributed

Summary: Reasons for Concern

- Actuarial - losses in all lines (core business)
  - increased variability
  - unexpected correlation
  - affordability/availability
  - potential for abrupt change
  - CAT model deficiencies
  - difficult to function post-loss
  - data "blindspots"
- Contraction
- Competitive risk
- Regulatory risk
- Reputation risk
- Own Liability
- Assets & share prices are weather-sensitive; Ratings
- Macroeconomic downturn