

Insurance Sector Vulnerabilities to Climate Change

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Why Link Insurance & Climate Change?

- **Importance**

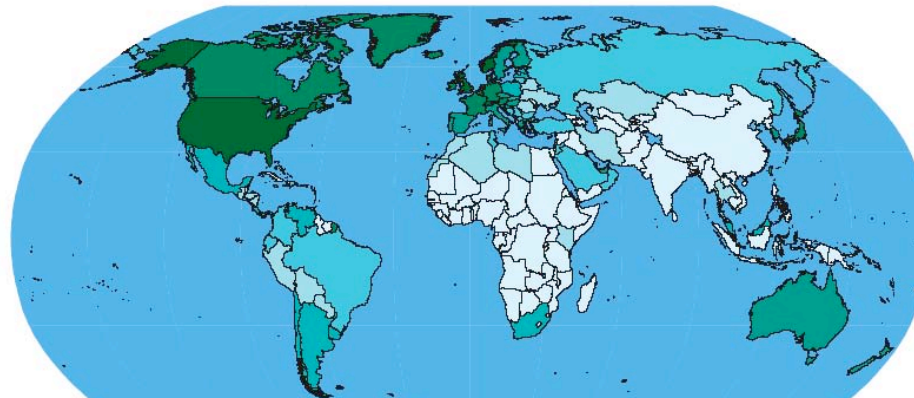
- World's largest industry: \$3 trillion/year in revenues (= 3x "oil")
- Mechanism for risk averaging (financial)
- Mechanism for risk management (physical)
- Provides a global "observing" system
- Complements science

- **Concerns**

- Vulnerability to climate change; dangerously uses past as proxy for future
- Increased losses threaten affordability (more uninsured)
- Health/life risks largely unknown; unaddressed
- Insurability/solvency in question
- Regulation can be obstacle to "doing the right thing"

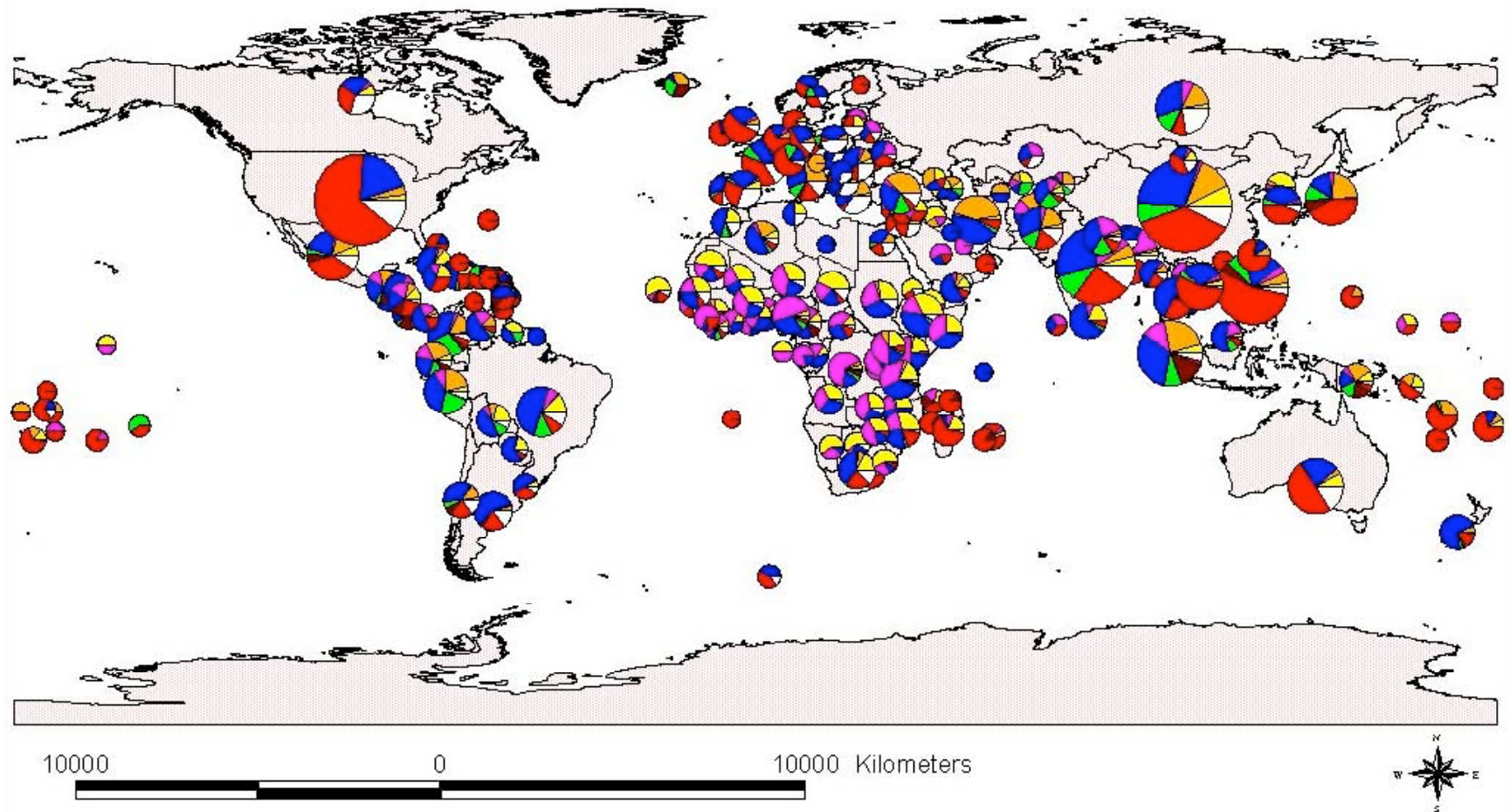
Insurance = Adaptive Capacity

- Major (and growing) means of spreading and managing the risks of extreme weather events -- today covers 20% of all weather-related damages
- Rapidly growing in developing world and economies in transition
- Availability and penetration varies widely

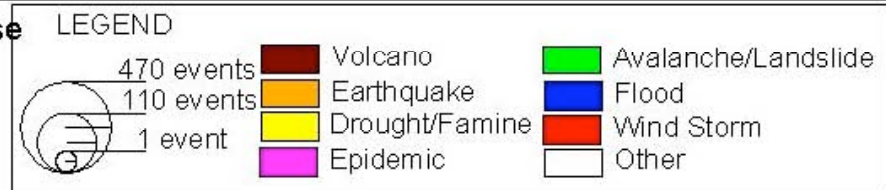


Premiums/capita-year highest in densely shaded areas (\$5-\$1000/capita-y)
Munich Re (2003)

The Type and Scale of Natural Disasters are Distributed Unevenly: 1975 to 2001

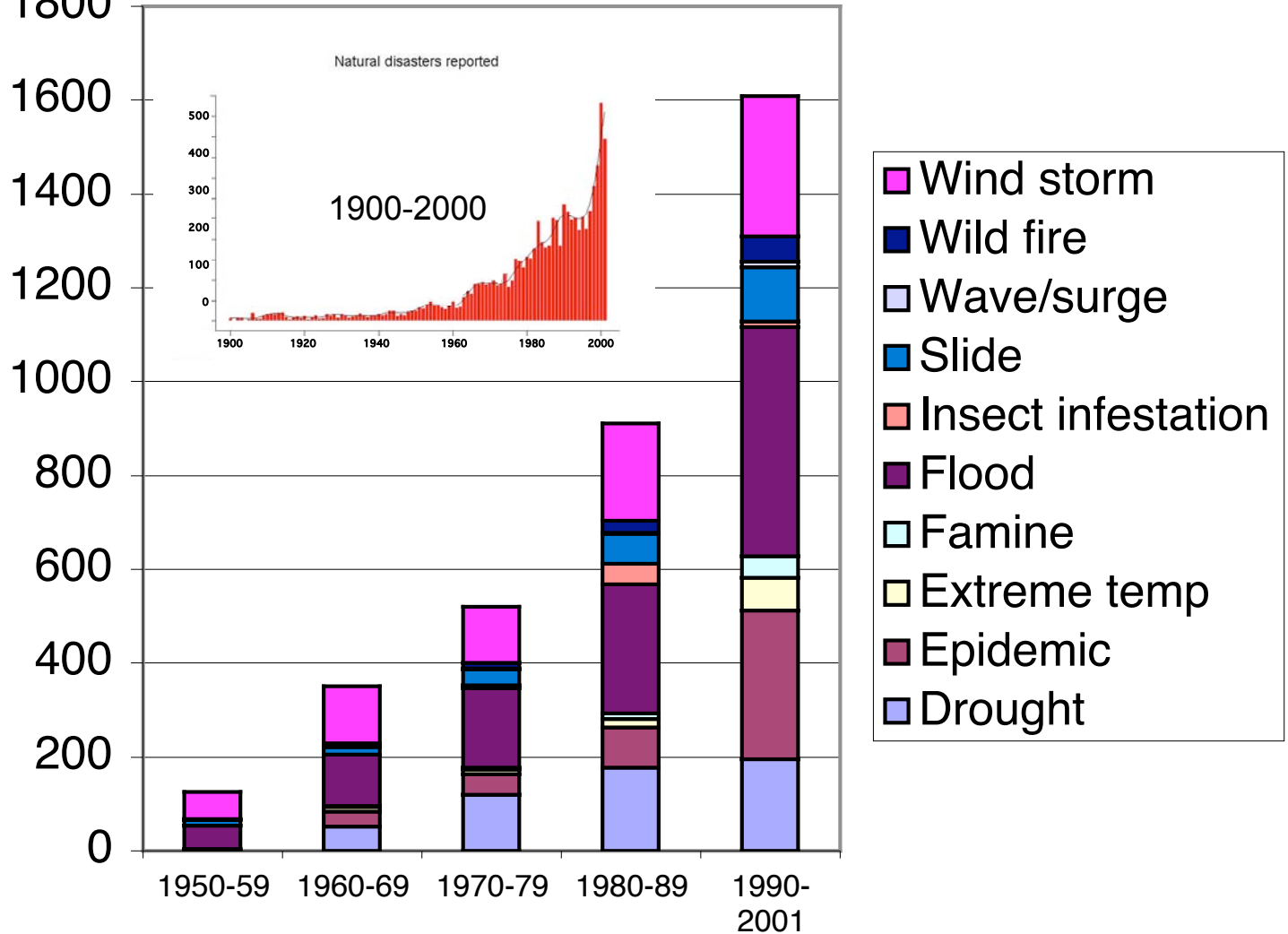


EM-DAT: The OFDA/CRED International Disaster Database
(<http://www.cred.be>; email: cred@epid.ucl.ac.be)



Changing Nature and Structure of Events

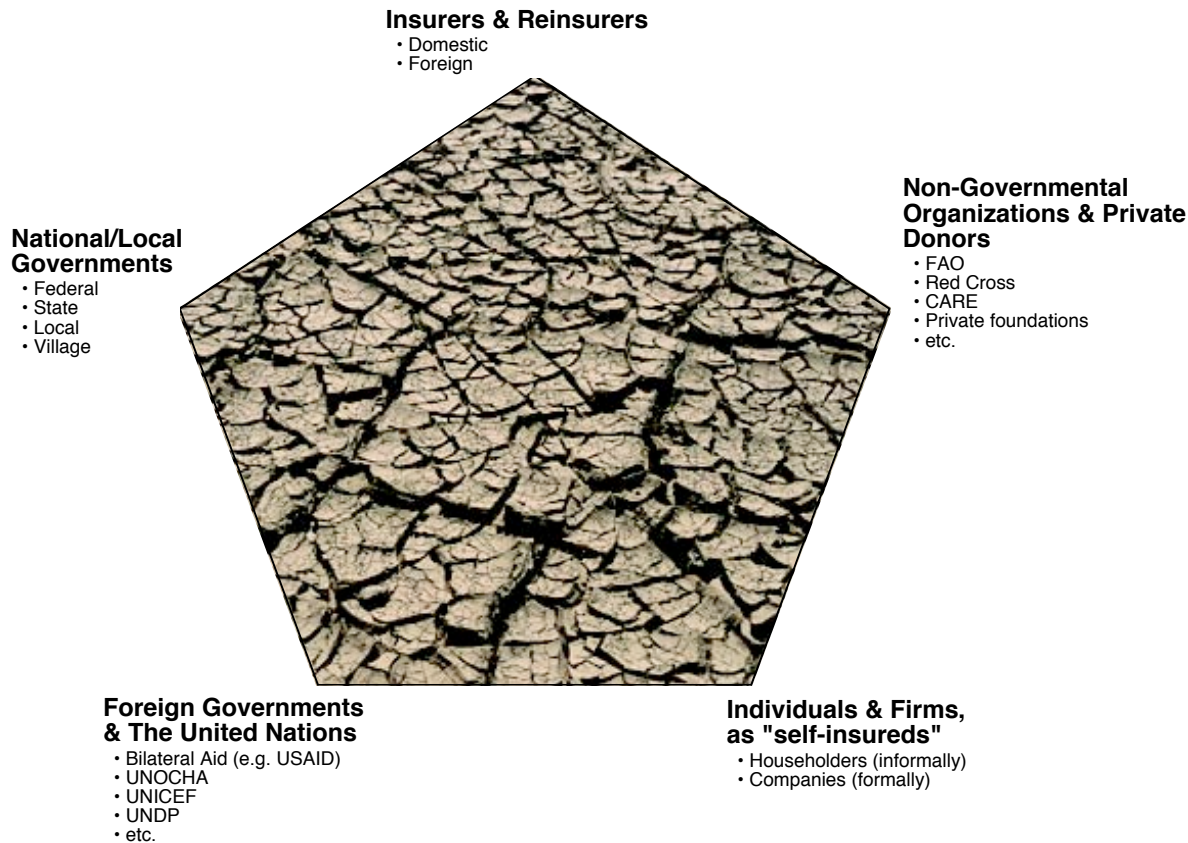
Number of
Events
1800



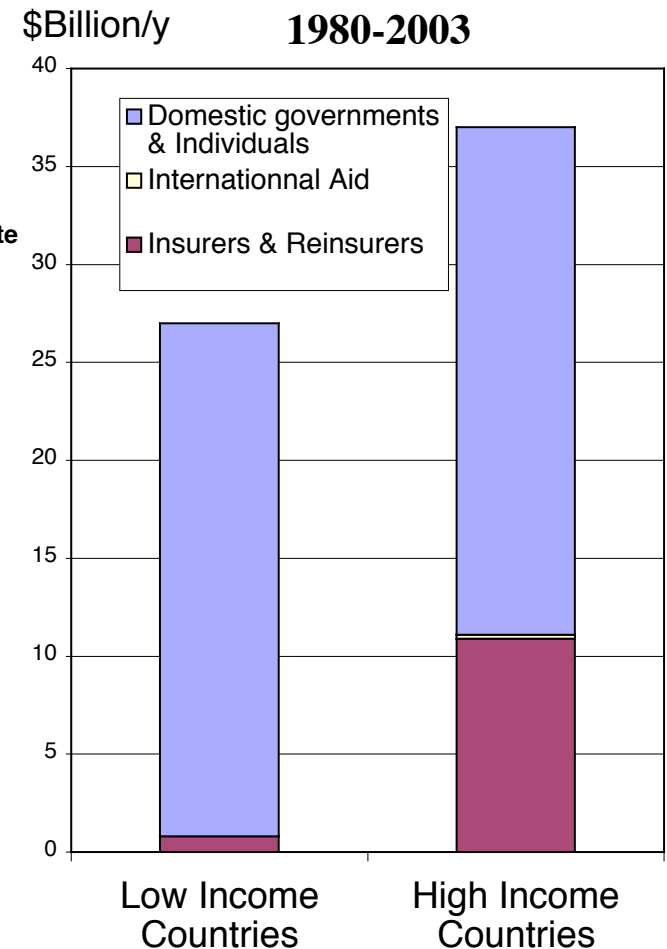
Sources: OFDA / Center for Research in the Epidemiology of Disasters (CRED) Intl database of Disasters

Spreading of Economic Costs

Weather Risks Are Spread in Five Directions

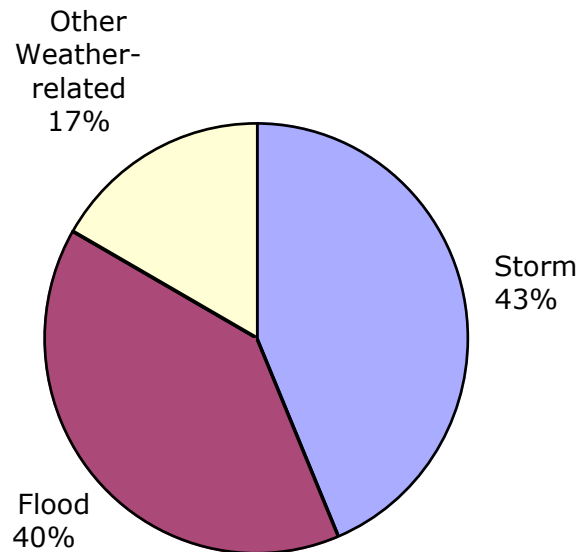


Costs of Weather-Related Natural Disasters

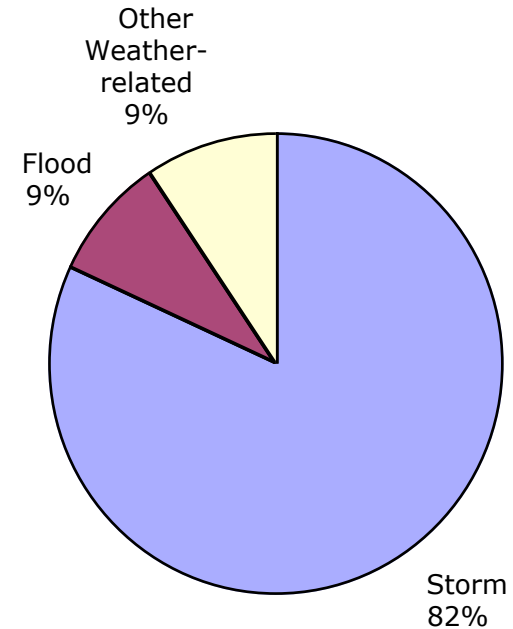


Financial “Lenses”

Total Economic Losses, Weather-Related Natural Disasters: \$707 Billion (1985-1999)



Insured Losses, Weather-Related Natural Disasters: \$141 Billion (1985-1999)



The difference between total and insured losses is taken up by governments, ngo's, self-insurers, and individuals -- insurers *select* risks; don't accept all

Source: Munich Re (2002)

Dynamics of Risks, Uncertainties, and Losses

Natural Phenomenon

(e.g. temperature increase)

Variability/Uncertainty

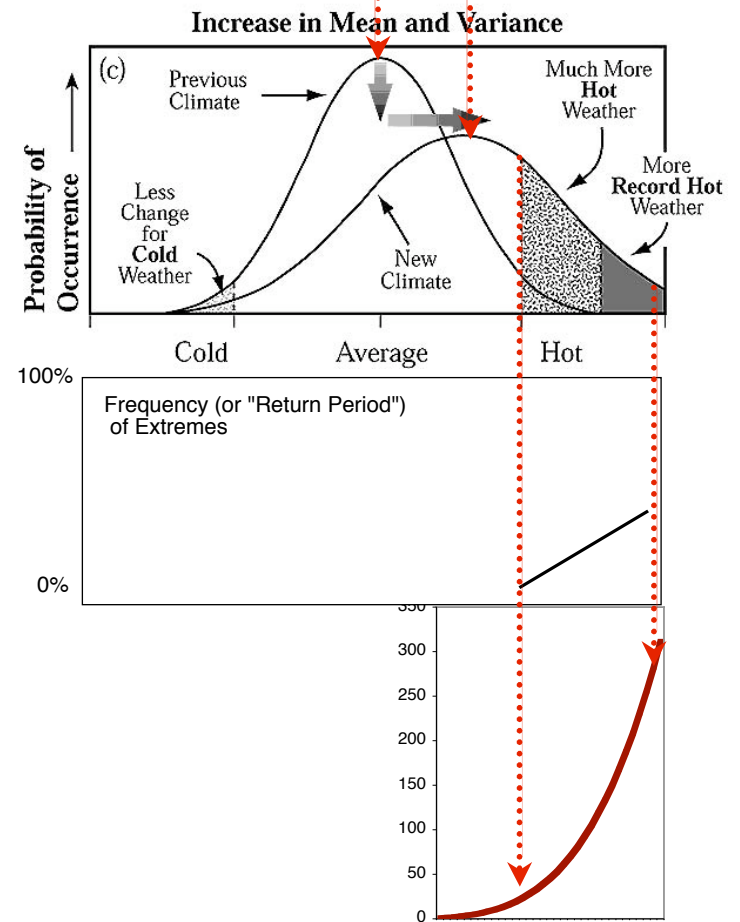
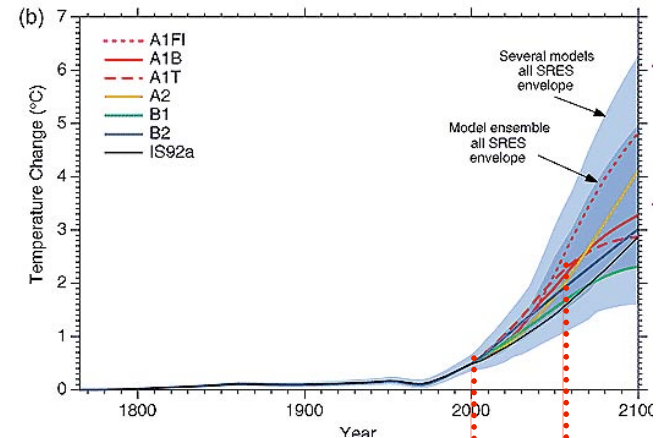
(e.g. heatwaves)

Change in Likelihood of Extreme Event

(e.g. return period)

Impact / Insured Loss

(e.g. loss of life; business interruption, etc.)

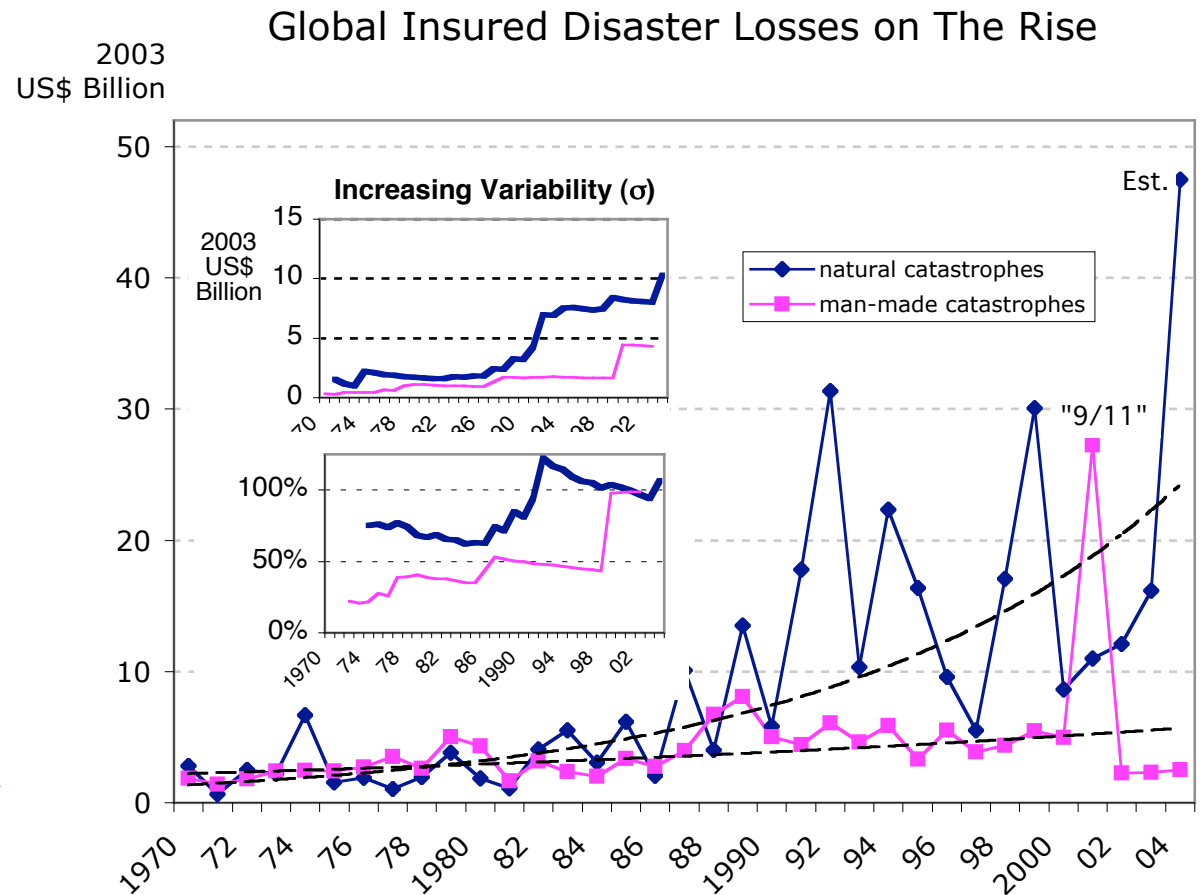


Uncertainty: Physical \Rightarrow Financial

“Catastrophe insurers can't simply extrapolate past experience.”

- Warren Buffett (1992)

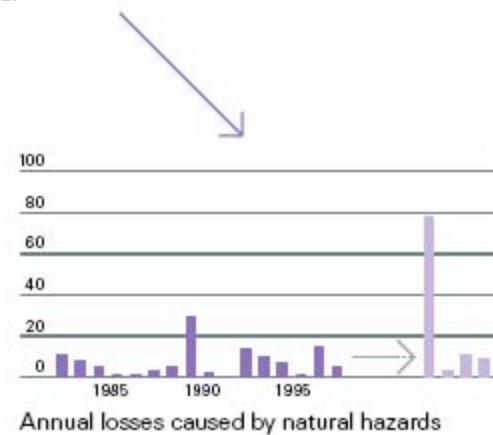
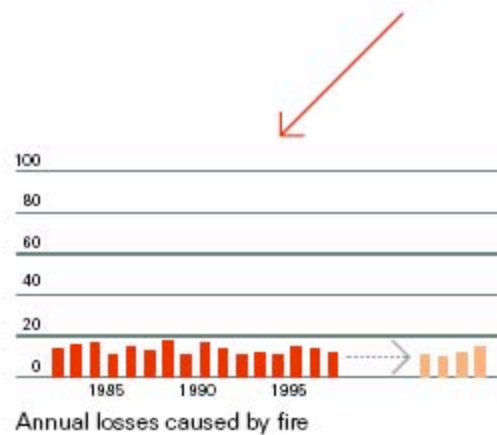
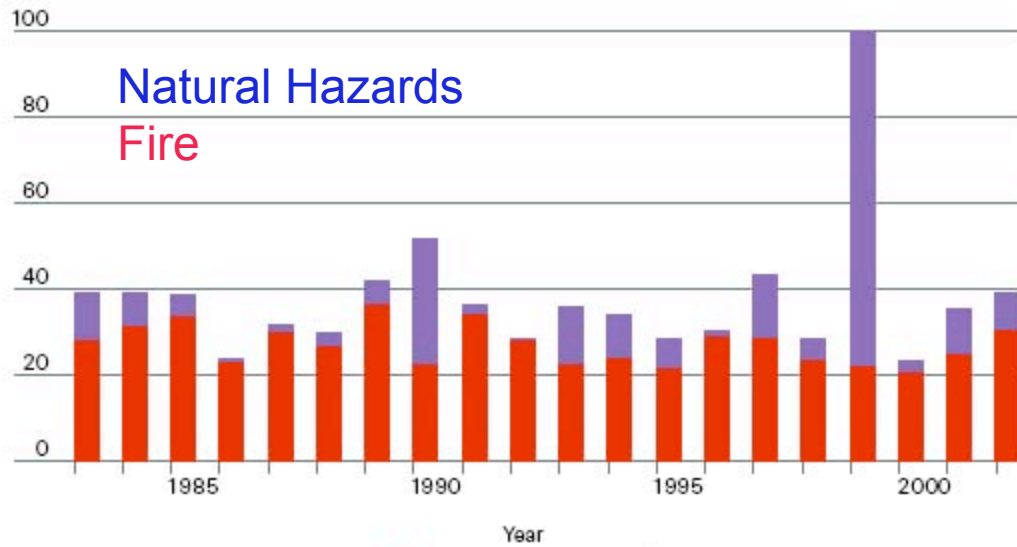
Note: plot shows only large events and excludes health/life losses. Including small-scale events would double these numbers; health-related losses unknown



Source: Swiss Re (*Sigma*)

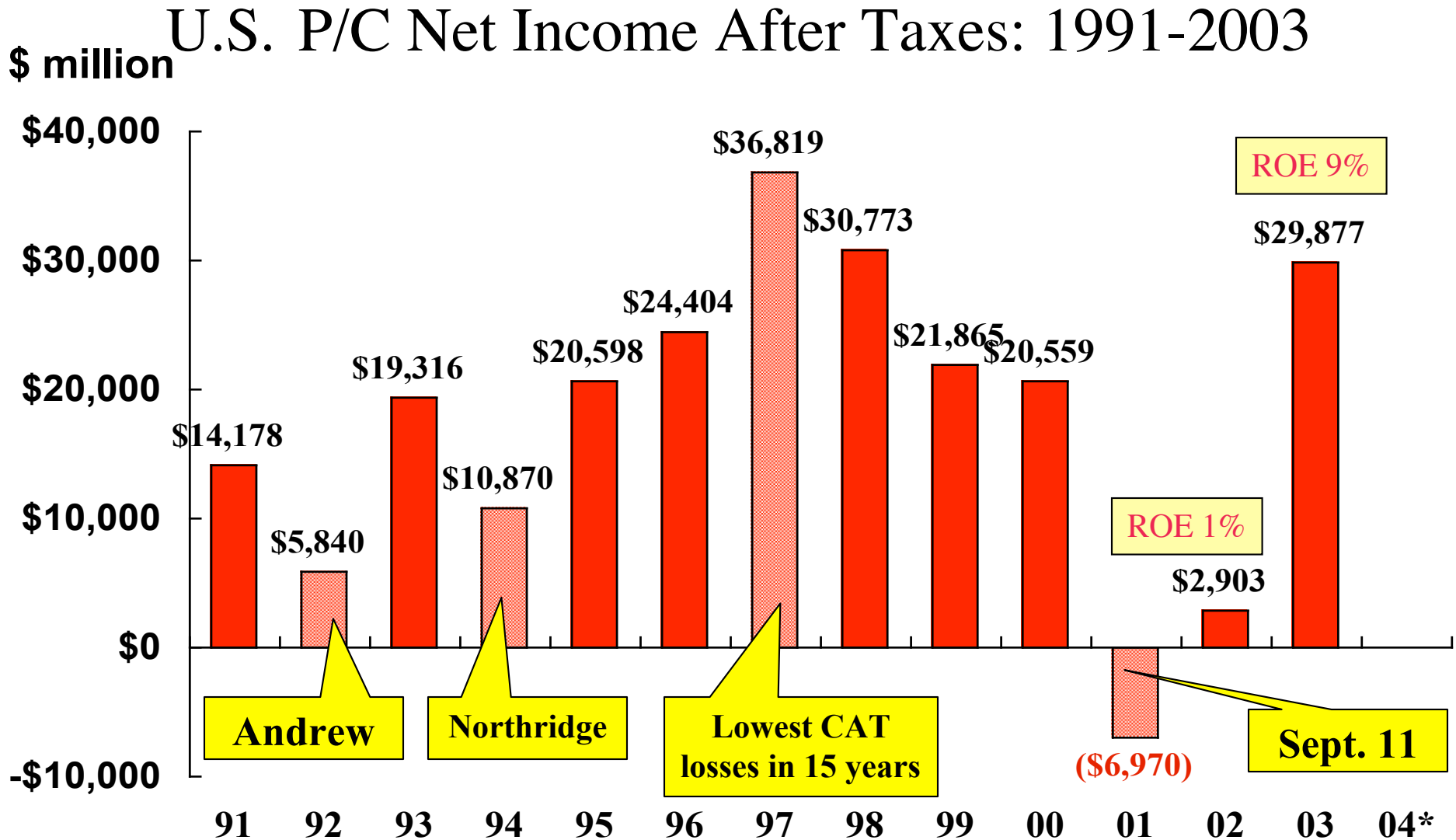
Variability

Loss amount as a percentage of the maximum annual loss



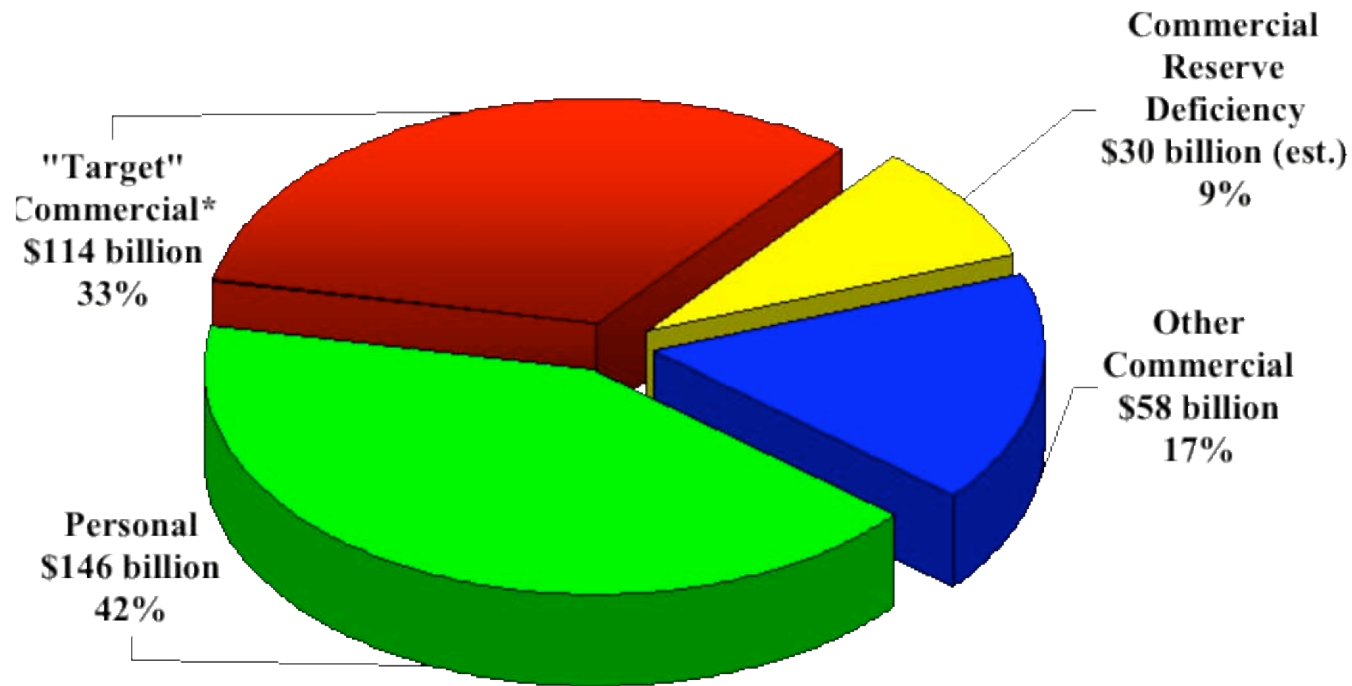
Source: Swiss Re (2002)

“CAT” Losses are Material for Insurers



Sources: A.M. Best, ISO, Insurance Information Institute (Robert Hartwig)

Capital Myth: \$300 Billion Available to Pay Losses



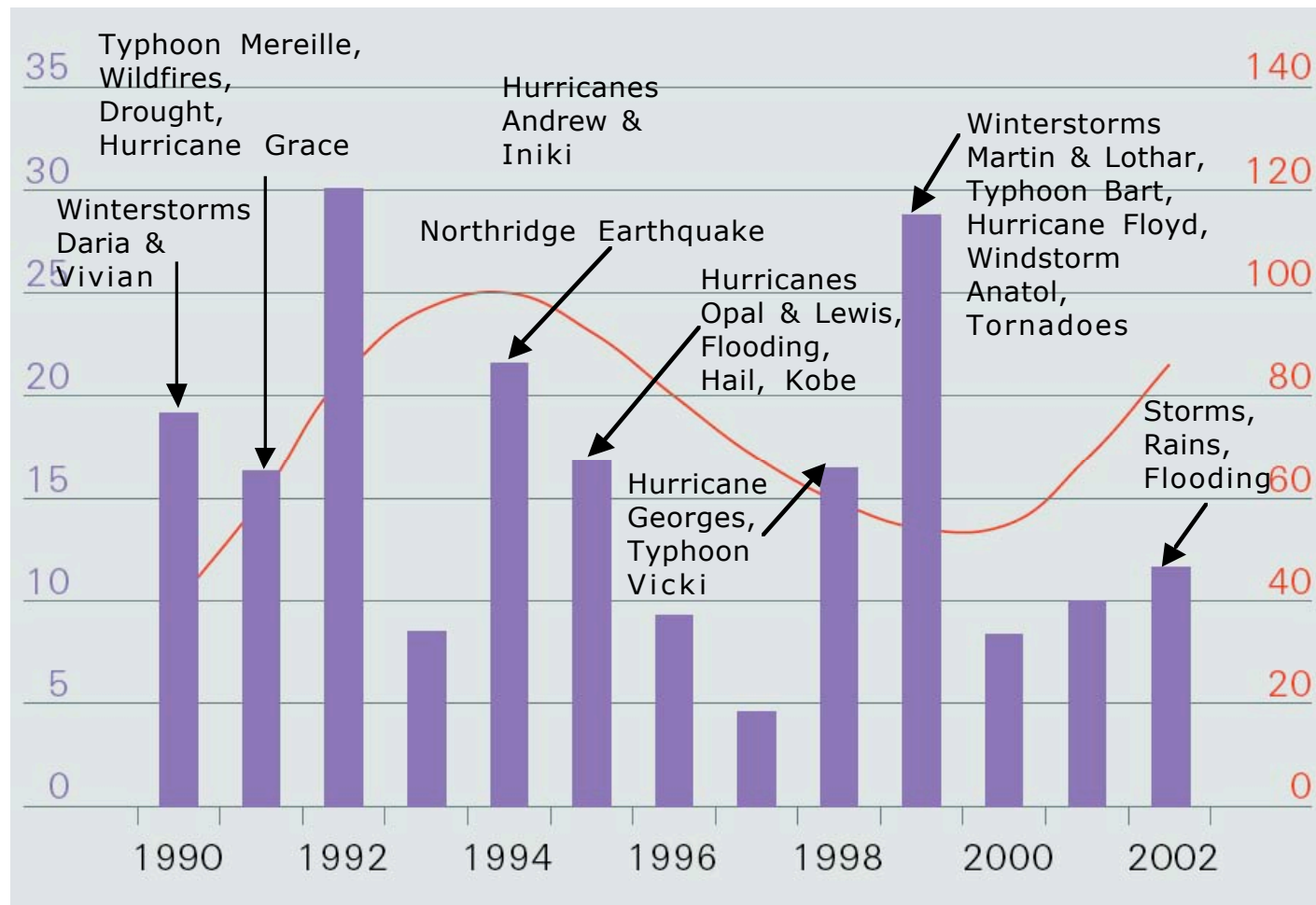
Surplus not pooled across companies. Must also back-up non-disaster related property/casualty claims and non-weather claims (e.g. terrorism). Surplus fluctuates -- sometimes significantly

Source: Insurance Information Institute estimates based on A.M. Best Q.A.R Data. (Robert Hartwig, III)

Reinsurance Pricing Reflects Losses & Uncertainty

Losses (\$B)
(bars)

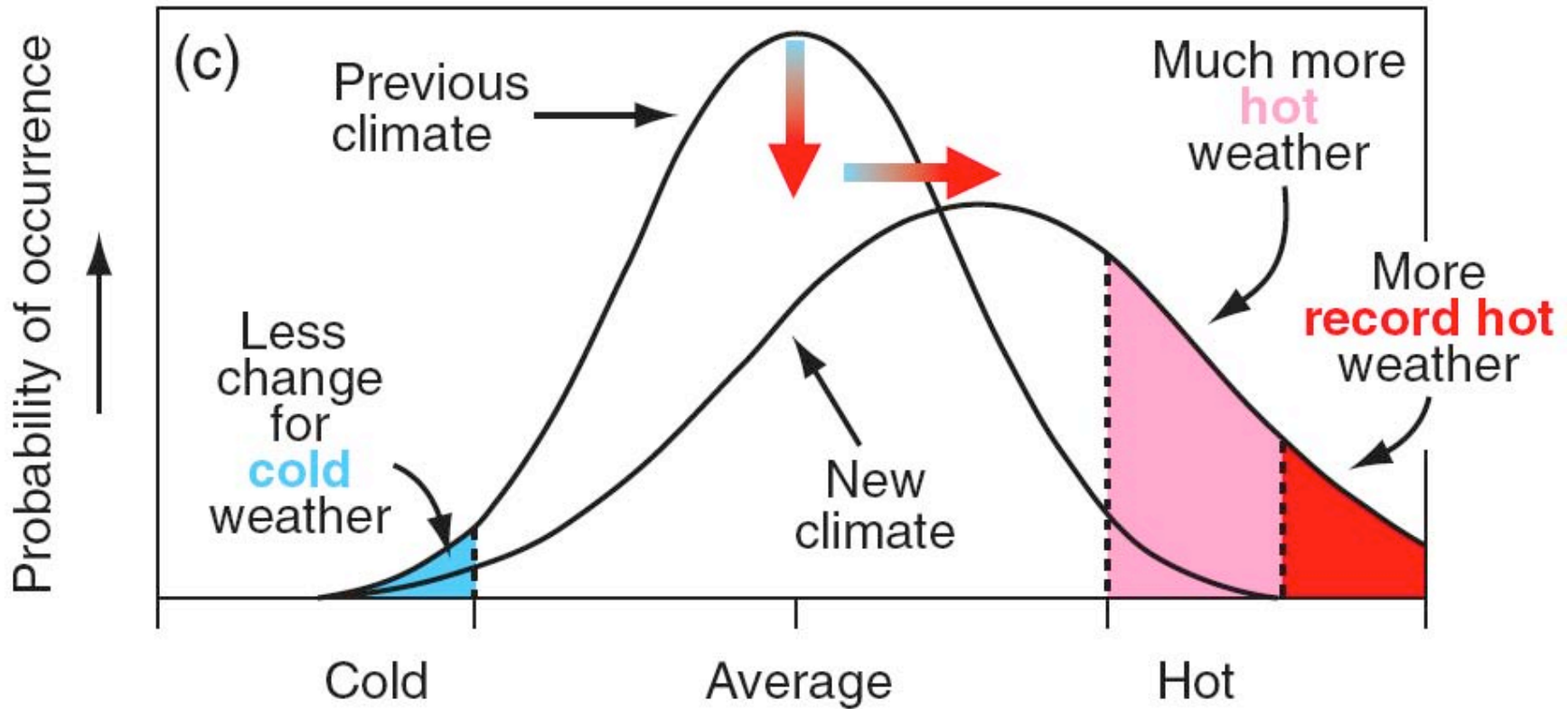
Reinsurance
Price Index
(curve)



Source:
Swiss Re

Changes in Extremes

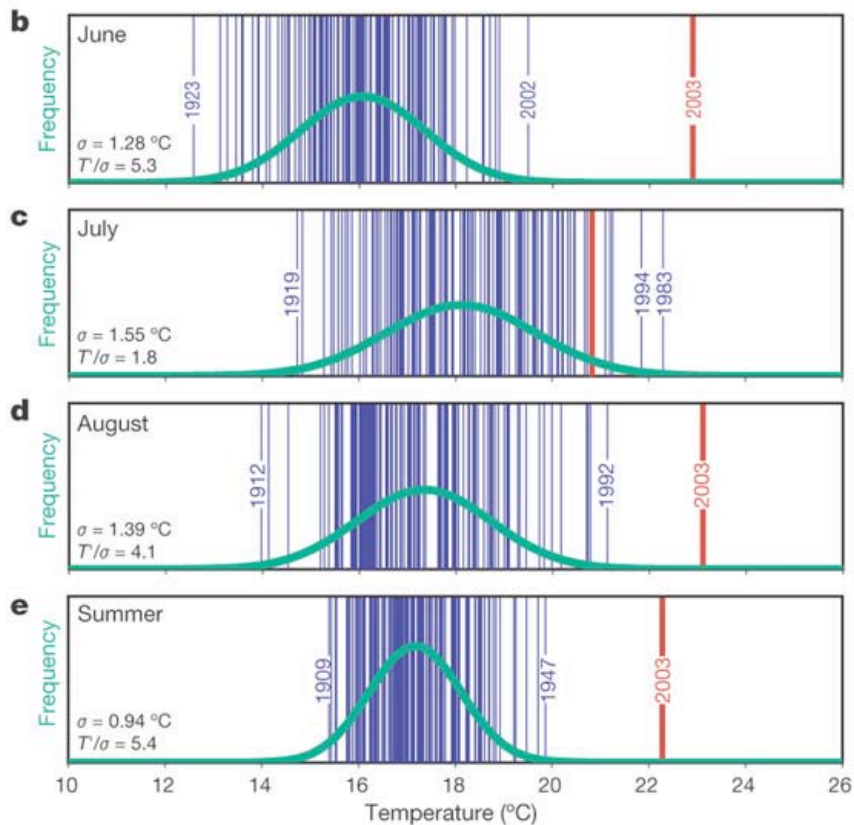
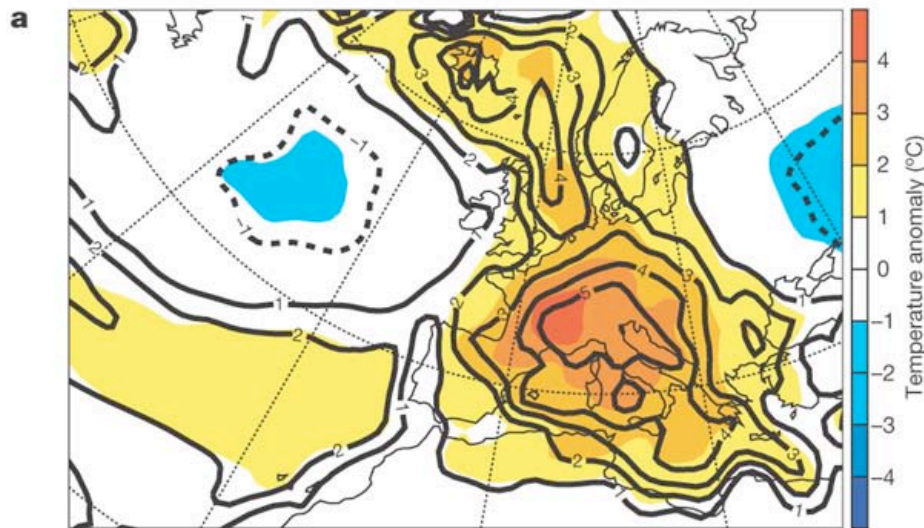
Increase in mean and variance



Example: the 2003 European Heat Wave:

(hottest summer since 1500 AD)

- 22,000-35,000 human fatalities
- \$13.6B in crop losses
- \$1.7B in wildfires in Portugal alone + respiratory illness
- Nuclear power plant curtailment (insufficient cooling water)
- Unhealthy air masses (smog, particulate)



(a) Europe summer temperature anomaly with respect to 1961-1990 mean.

(b-e) Distribution of Swiss monthly and seasonal summer temperatures for 1864-2003.

Green: Fitted Gaussian distribution; Red: 2003

Source: Schar 2004 (*Nature*)

Vulnerabilities: Physical

- Disproportionately increasing damage functions:
 - 4x increase in wind damage for every 2x of wind speed
 - Increase in torrential precipitation: 1-in-100 year flood comes every 15 years
 - 1.4x increase in lightning for 1 deg-C increase in air temperature
 - 4x increase in wildfire damages in some areas under 2xCO₂
 - *Current* warming has led to 2- to 4-times likelihood of extreme heatwaves, e.g. Europe 2003 (increase 100x in next 4 decades)



Vulnerabilities: Financial

- Underwriting
 - profitability/solvency (insufficient reserves)
 - volatility (unpredictability)
 - simultaneity (drought and flood)
 - correlation (drought-wildfire; financial markets)
 - surprise (e.g. Directors & Officers liability)
- Broader Business
 - financial market conditions
 - real estate holdings
- Market Power
 - slowed/shrinking markets (voluntary/involuntary)
 - reputation

Small-scale, Gradual, and Indirect Events Often Overlooked

- **Small-scale**

- Subsidence, Lightning, Hail, Wildfire, Equipment Breakdown

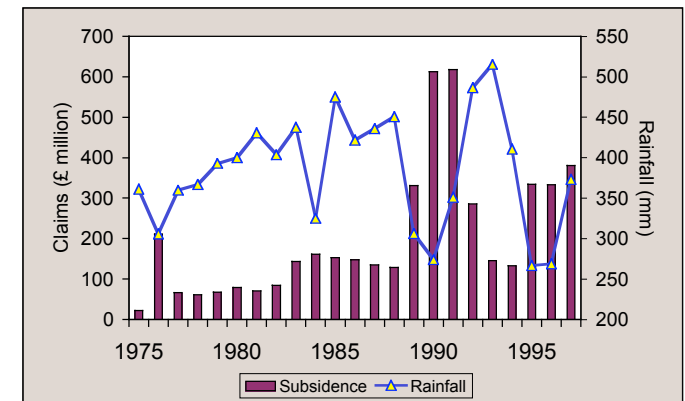
- **Gradual**

- Sea-level rise, Drought, Infectious diseases

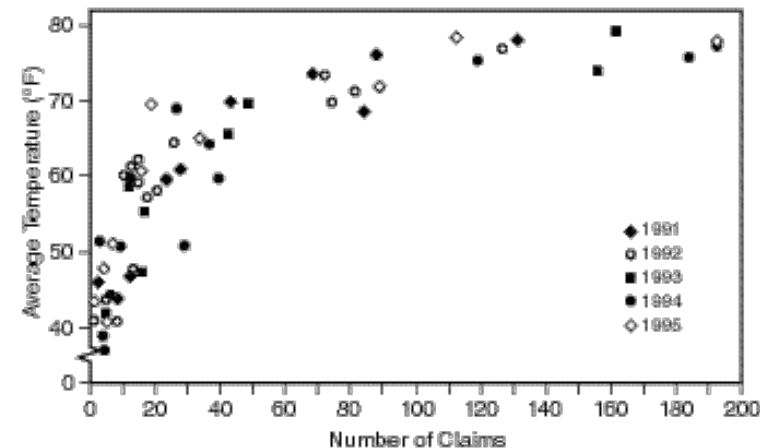
- **Indirect**

- Erosion of water quality
- Erosion of air quality
- Health (human, crops, etc.)
- Amplification of poverty (slows market growth; political risk)

Subsidence claims increase with drought

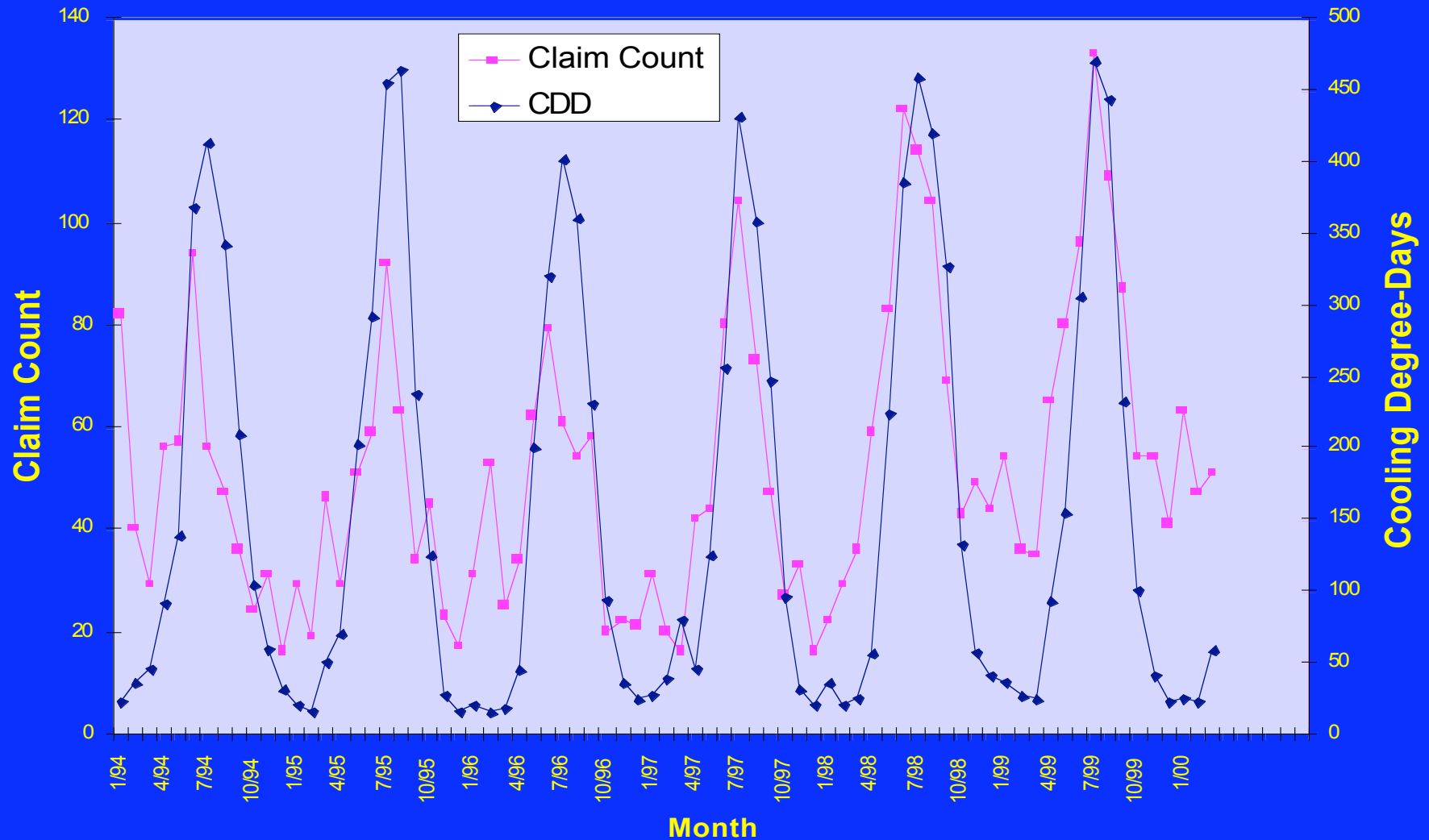


Lightning-related claims increase with temperature



Source: Hartford Steam Boiler Inspection and Insurance Co. claims data (2000). Each symbol represents a lightning storm event.

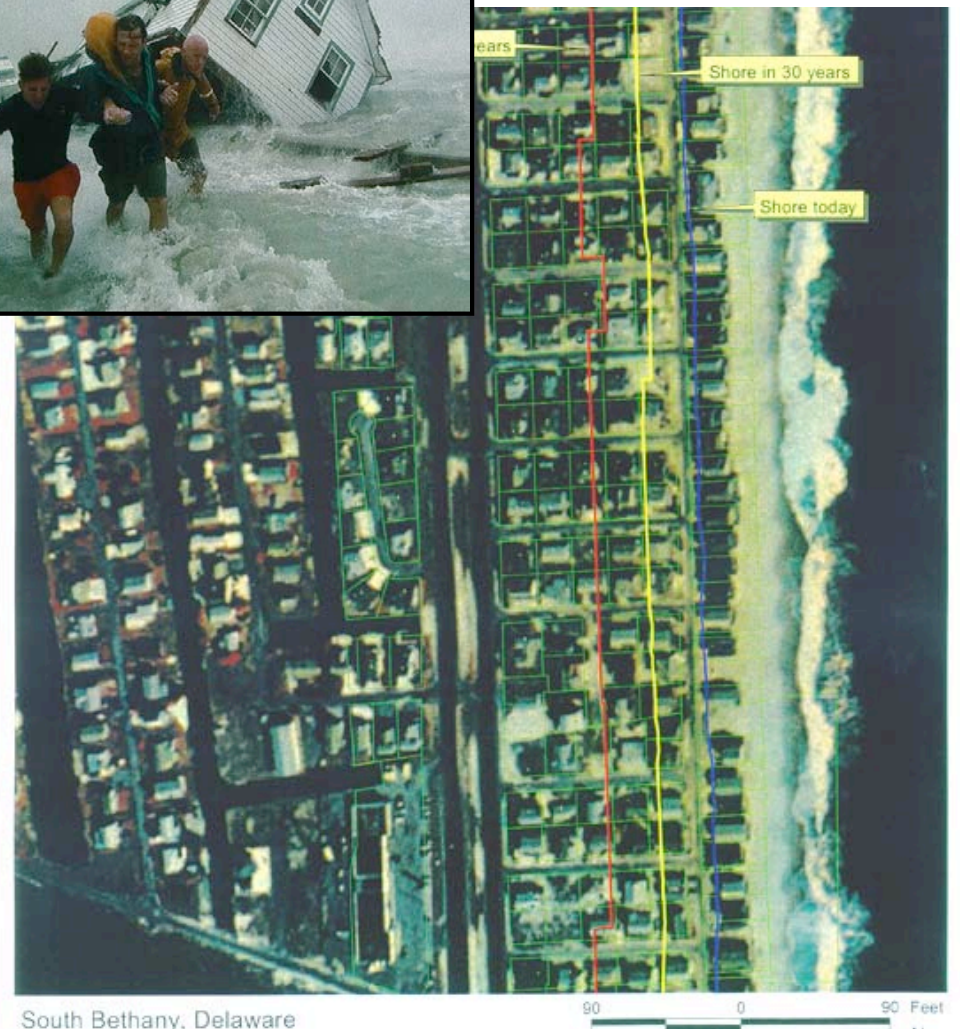
A/C Claims vs Cooling Degree-Days : South East



Source: Hartford Steam Boiler Insurance and Inspection Co, 2001

Sea-level Rise

- Figure: 60-year coastal erosion outlook for South Bethany, Delaware -- 3 rows of homes to be lost
- 25% of homes within 150 yards of current high-tide mark at risk over next 60 years. Water quality. Wetlands.

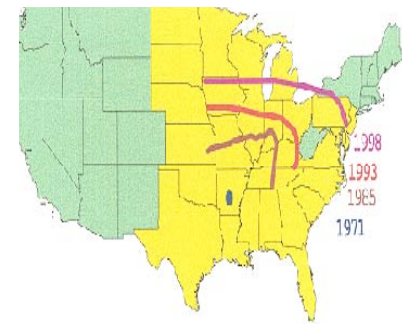


Health

- Heat catastrophes
- Pollen/Mold - health; liability (\$5B)
- New diseases: Nipah virus - highly contagious; lethal in $> 40\%$ of cases
- Insect super-infestations
- Crop diseases
- Coral bleaching - coastal protection; tourism; fresh water salinization



Pine beetle superinfestations



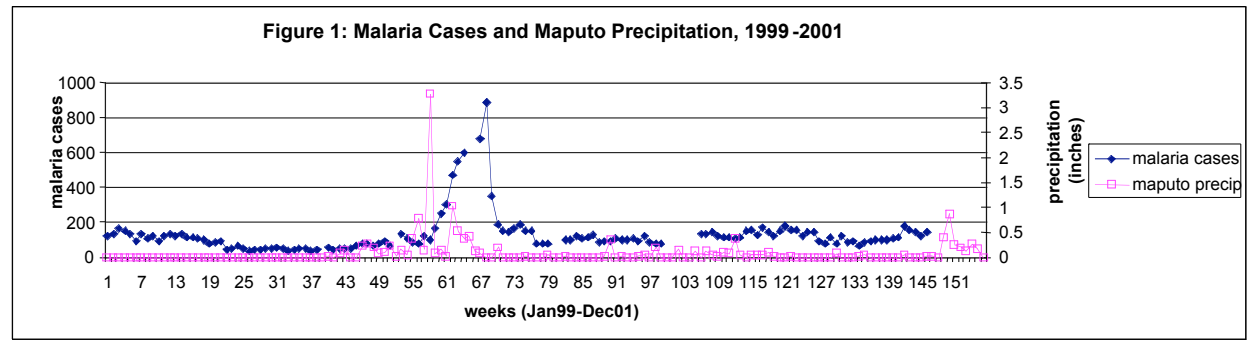
Expanding range of soybean rust: 1971-1998



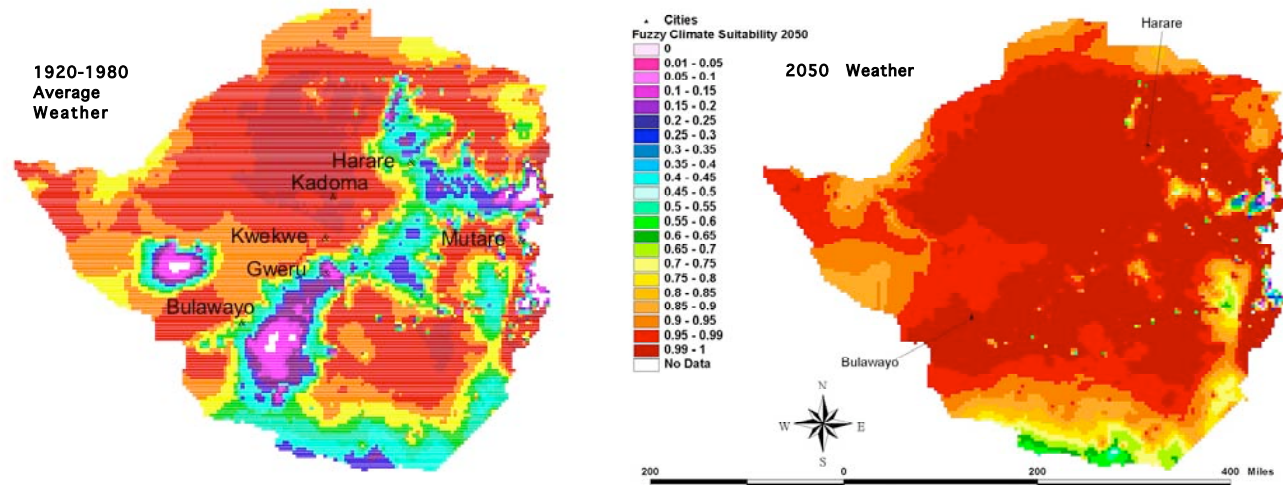
Coral bleaching

Vector-born Diseases: Malaria

- Outbreaks following extreme rainfall events: more of which expected under climate change: Maputo, Mozambique



- Changes in Range: Zimbabwe



Source: Ebi et al (2004)

POLITICAL AND ECONOMIC RISK 2004



- Relevant weather-related risks include: Civil unrest, supply-chain disruption, resource-related conflict, government actions
- Level of risk tied to degree and effectiveness of post-event public-sector efforts

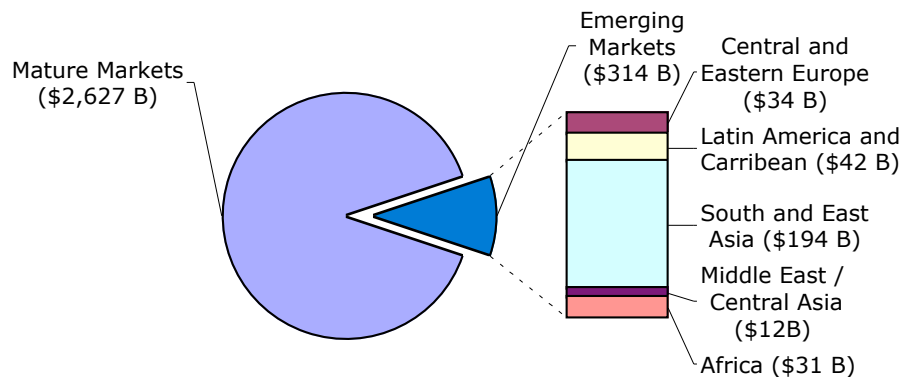
Source: www.aon.com/politicalrisk

Emerging Markets are the Future of Insurance, and are Particularly Vulnerable

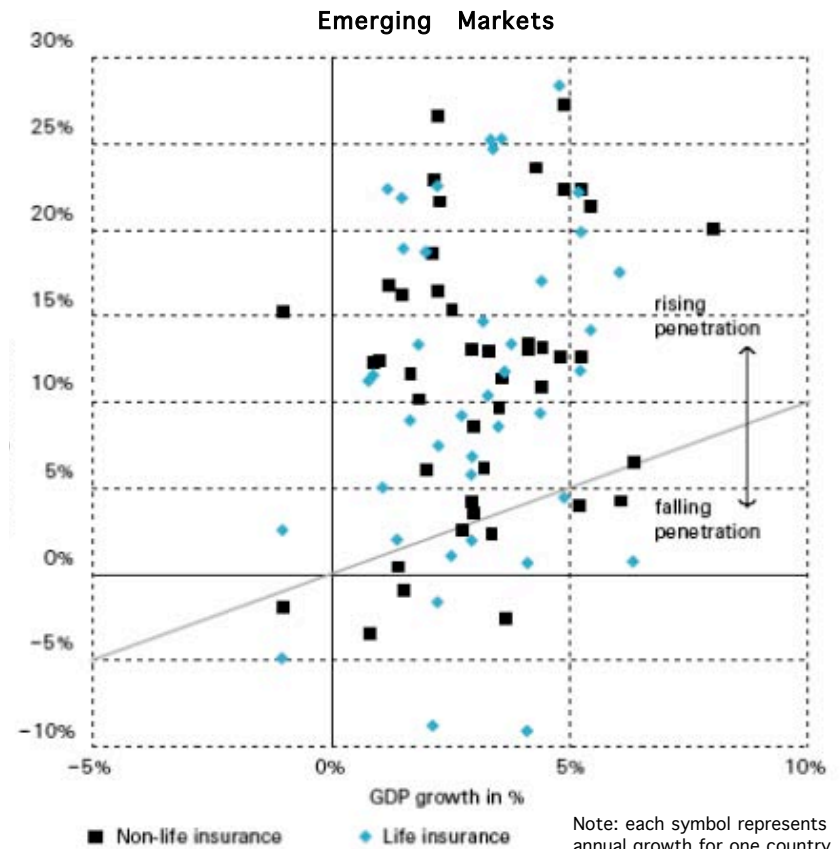
Already over \$300 billion/year in premiums

Demand growing faster than GDP

Eleven Percent of \$2.9 Trillion/year Global Insurance Market is in Developing Countries and Economies in Transition: 2003



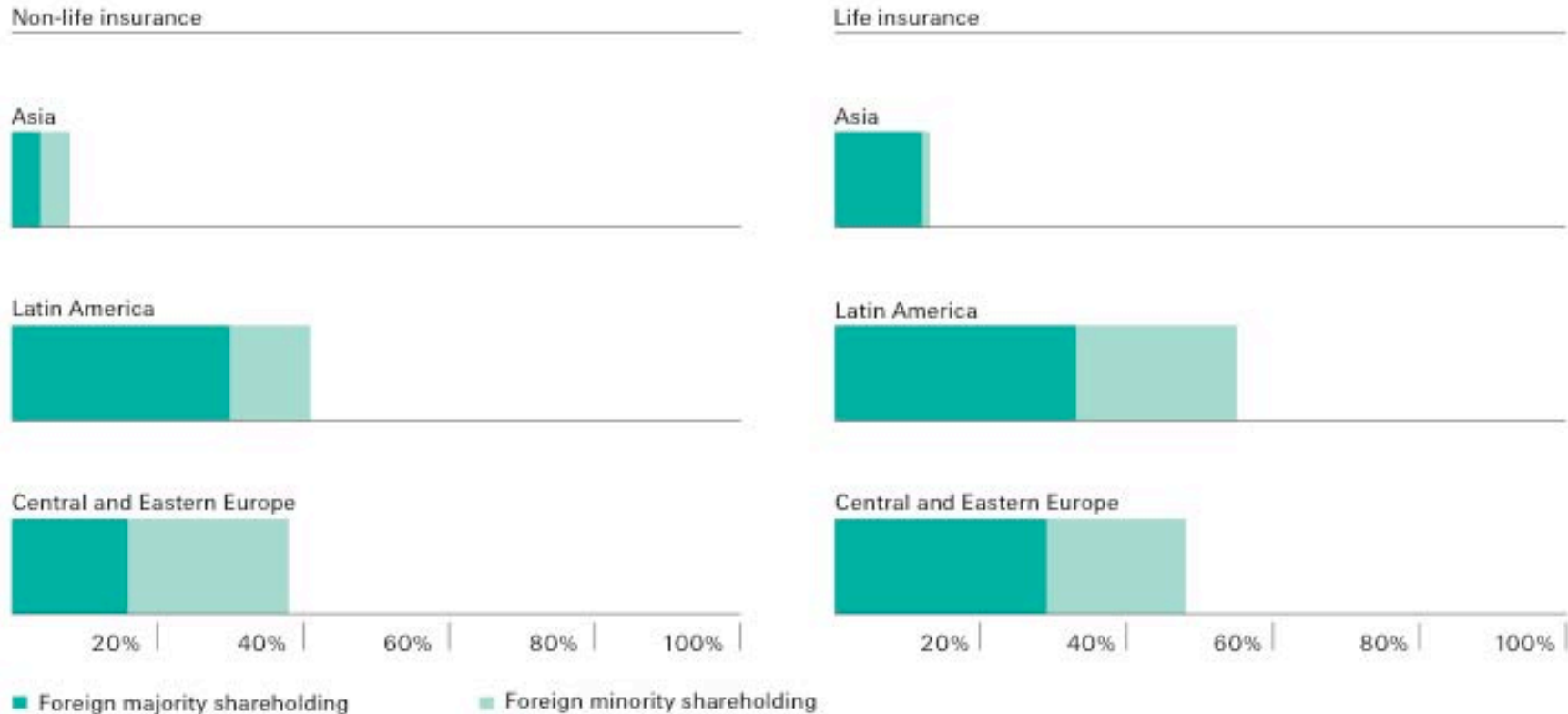
Source: Swiss Re, Economic Research & Consulting, Sigma No. 3/2004 [Swiss Re (2004)]. Includes property/casualty and life/health insurance.



Source: Swiss Re Economic Research & Consulting

Economic Risks Rapidly Becoming Globalized

Foreign Participation in Insurance Ownership: 1998



Source: Swiss Re

Example: Insured losses from the 2004 Tsunami projected to fall between \$5 and \$10 billion

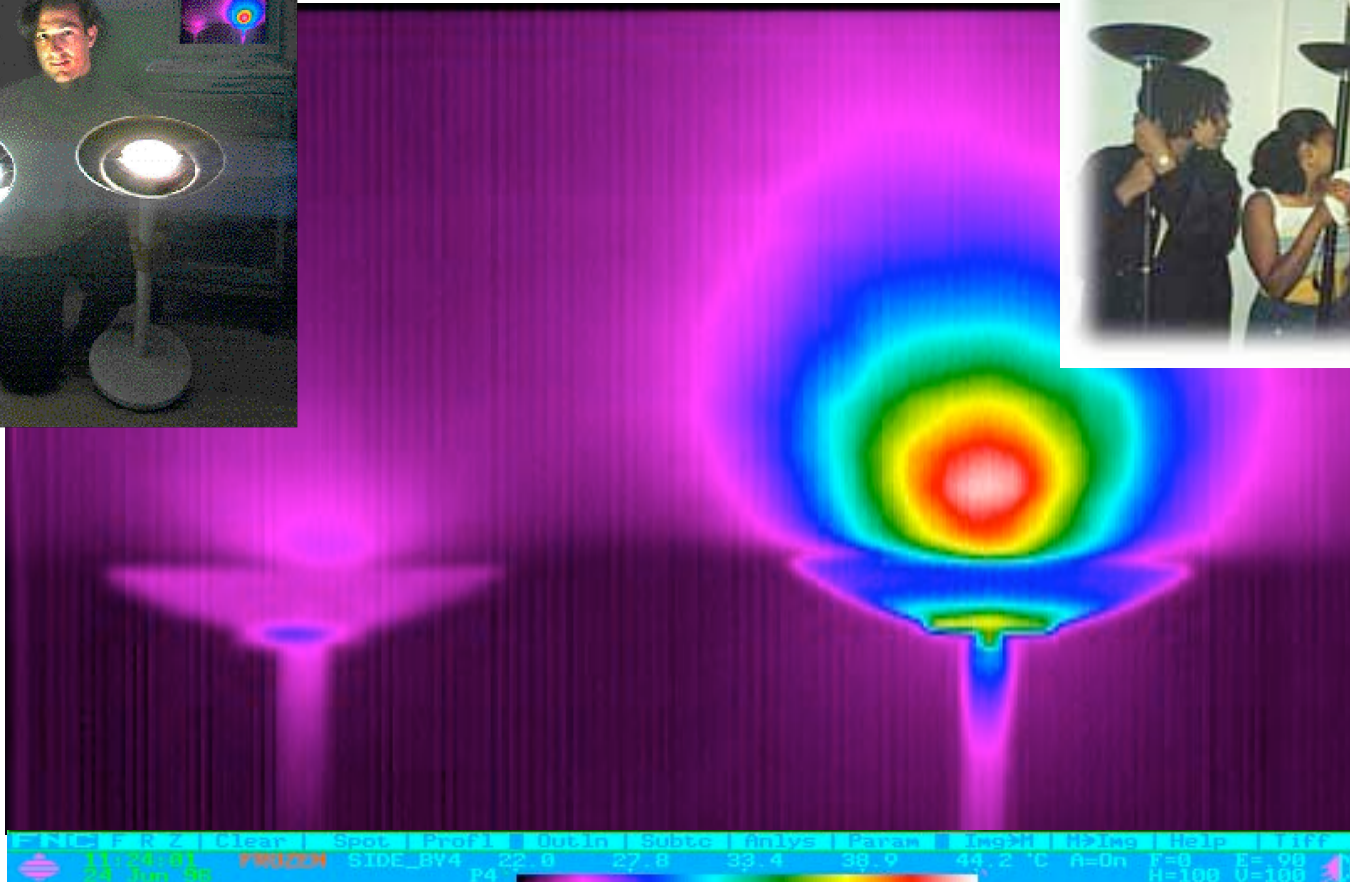
Response Options

- Reactive
 - Higher premiums
 - Higher deductibles
 - Lower limits
 - Exclusions
 - Non-renewal
 - Withdraw from markets
- Proactive
 - Building codes
 - Disaster preparedness; recovery; education
 - Public policy
 - Integrating emissions reduction and risk management
 - Science

--> Insurability is key issue

Integrating Energy Management & Risk Management

Energy-efficient torchiere lights also eliminate significant fire hazard

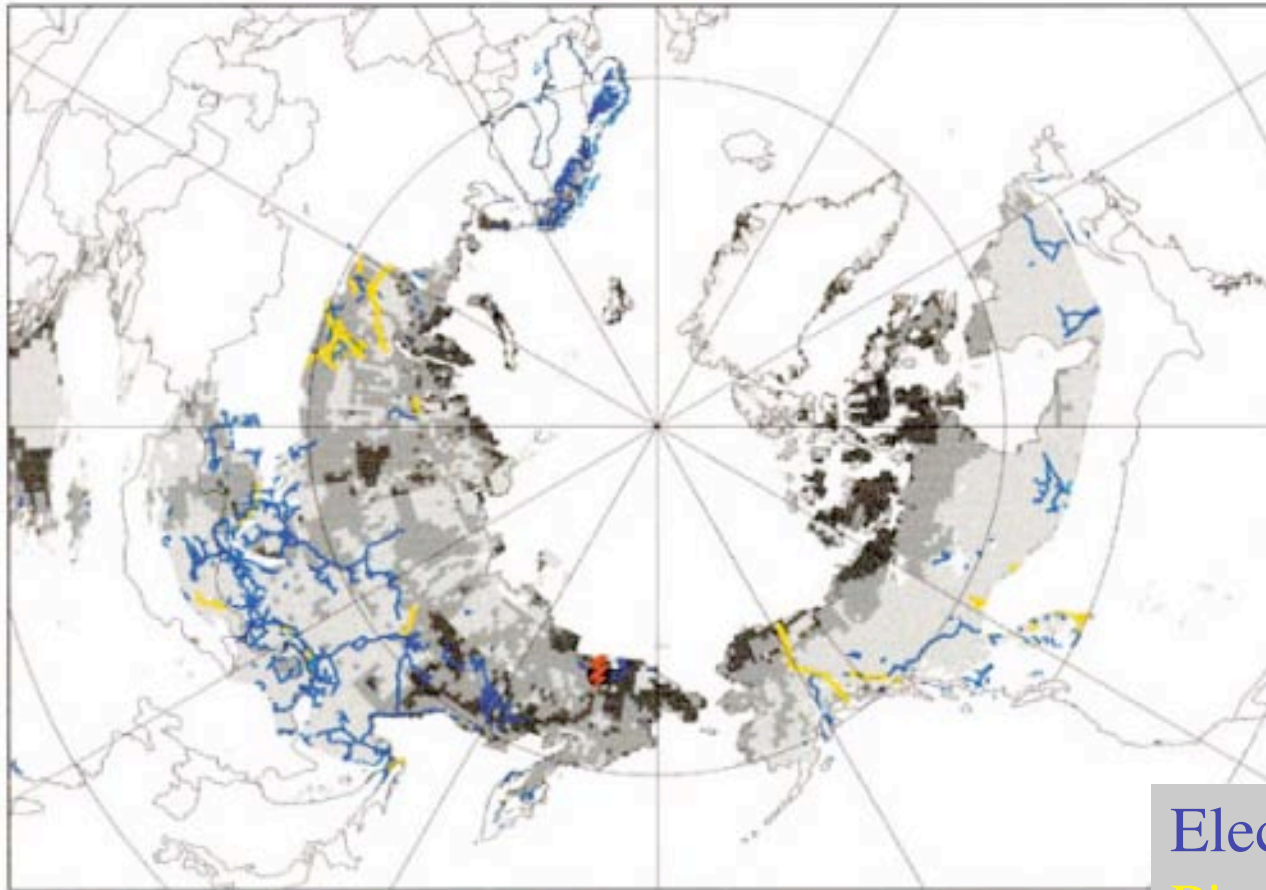


Where Science Meets Society

(Research Needs)

- Insurers have much to offer: historical data, current exposures, actuarial techniques
- No-regrets opportunities for insurers
- Needed: better understanding of the risk management dimensions of sustainable energy technologies
- Integration of historically-based “CAT” modeling with forward-looking climate modeling --> *maintain/increase insurability*

Value of Coupled Models: e.g. Permafrost Melt Hazard Potential



Stable

Low
risk

Moderate
risk

High
risk

Settlement of
several meters is
possible.

Vulnerability:

- Buildings
- River terminals
- Natural gas production
- Pipelines
- Electric transmission
- Roadways/rail

Electrical transmission

Pipelines

Bilbino nuclear station

Nelson, et al. 2001 (*Nature*)

More Information

<http://eetd.lbl.gov/insurance>