PART I

Chapter 4

Insurance of Atmospheric Perils – Challenges Ahead

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The (re)insurance of damage caused by weather related risks has a long history and is well established in all mature insurance markets. A fundamental characteristic of atmospheric perils like hurricanes or European winter storms is their potential for extreme event loss accumulations. In fact, up to early 2004, the most costly natural catastrophe of all time for the insurance industry was hurricane Andrew in 1992 with total (un-indexed) insured losses of some USD 20 billion. Events of this size occur with very low frequencies and hence only a limited historical record is available. Probabilistic loss models based on state-of-the-art scientific knowledge must be utilised for the risk assessment of such perils. Growing uncertainty due to climate change, the increasing use of alternative risk transfer solutions and the rapidly developing insurance markets of China and India are seen as the key challenges of the near future.

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1. Characteristics of natural hazards insurance

The principle of insurance is quite simple: take all insured losses, add the administrative costs of the insurer (acquisition, claims settlement) and spread this amount evenly over all insured clients. Thus every individual pays a comparatively small amount for the insurance coverage against loss events of possibly livelihood-threatening size.

Conventional insurance perils like "fire" are unpredictable and happen at random. The probability of an individual building suffering a fire loss is very low. In the case of an entire insurance portfolio, however, these losses occur relatively frequently, and both the sum of losses as well as the number of affected policies will be fairly consistent over a given unit of time (e.g. annually). The insurance company will find out quite quickly whether or not the premium level is sufficient to cover the losses and can adjust the premium level if necessary.

While natural catastrophes too are random and unpredictable, the probability of an insurance portfolio being affected by a particular event – such as a major hurricane – can be is extremely low. This means that after years or even decades without notable losses there may suddenly follow a year with an enormous event loss. Therefore, as opposed to fire losses, the natural hazard loss burden will typically fluctuate radically from year to year. As a consequence, an insurer can not rely on the loss history for the calculation of corresponding risk premiums.

In addition to the difficulty of assessing the annual expected loss (AEL) the insurance company faces a second major challenge. Natural catastrophes typically cause losses across vast geographical areas (ranging between 10'000 and 100'000 km^2) and damage numerous individual objects. The term "catastrophe accumulation" is used in the insurance industry to describe this phenomenon. The sum of all individual losses – i.e. the event loss – can reach enormous proportions, even multiples of the entire annual premium income of an insurance company. A precise estimate of the size of such potential extreme event losses (often referred to as "estimated maximum loss" or "EML") is a vital precondition for the economic survival of the company. The claims arising from the event must be backed by corresponding loss reserves or by means of risk transfer (e.g. reinsurance).

Furthermore, the natural hazard risk can vary enormously over short distances. Attention must therefore be paid, not only to the extreme fluctuations in the annual loss burden and the danger of catastrophe accumulation but also to the geographic factors. In fire insurance, while market, sector and structural factors play a role in determining an adequate premium, the location of the building is not of crucial importance: ultimately

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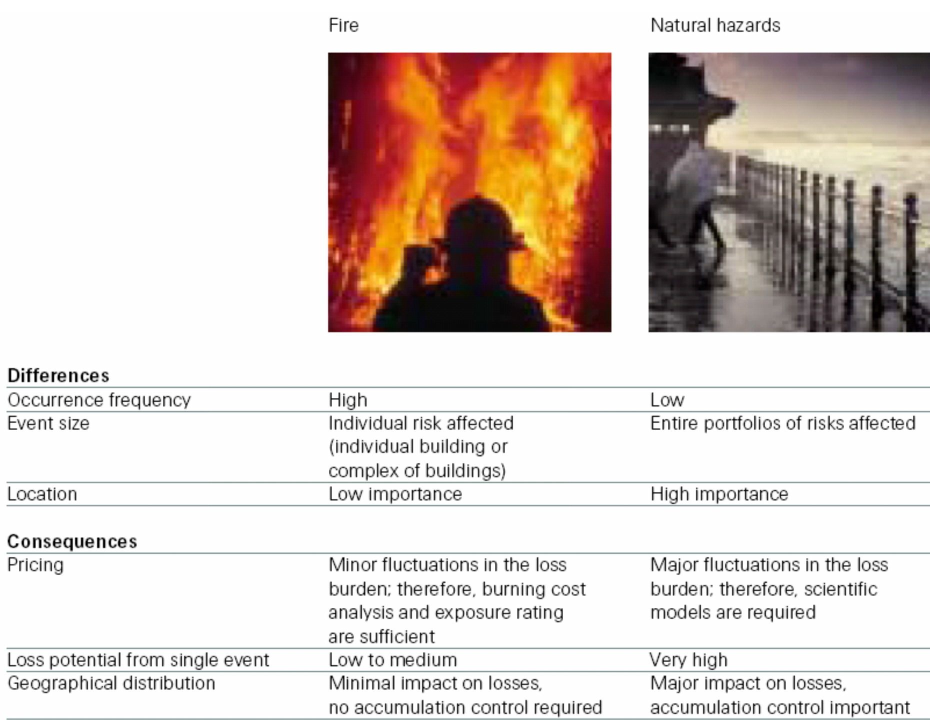
it is irrelevant for the insurer whether a warehouse is located in Florida or in California. In natural hazards insurance however, the location of the insured object becomes a vital consideration: whilst hurricanes represent a major threat in Florida during the summer months, the population of California – though spared this particular hazard – faces the risk of highly destructive earthquakes.

When assessing natural hazard risks, all of the special factors previously mentioned must be borne in mind (Figure 4.1). It is impossible to arrive at a reliable estimation of average and extreme loss burdens on the basis of a few years' data. Rather, probabilistic loss models based on state-of-the-art scientific knowledge are employed to achieve this end. Substantial progress has been made in assessing natural hazard loss potential over the past decade – not least due to the tremendous increase in computer power. Today several commercial providers, brokers and reinsurers have developed software tools for modelling natural hazard insurance losses.

Figure 4.1. Summary of the most important differences between fire and natural hazard insurance and their consequences.



	Fire	Natural hazards
Differences		
Occurrence frequency	High	Low
Event size	Individual risk affected (individual building or complex of buildings)	Entire portfolios of risks affected
Location	Low importance	High importance
Consequences		
Pricing	Minor fluctuations in the loss burden; therefore, burning cost analysis and exposure rating are sufficient	Major fluctuations in the loss burden; therefore, scientific models are required
Loss potential from single event	Low to medium	Very high
Geographical distribution	Minimal impact on losses, no accumulation control required	Major impact on losses, accumulation control important

2. Recent developments and challenges ahead

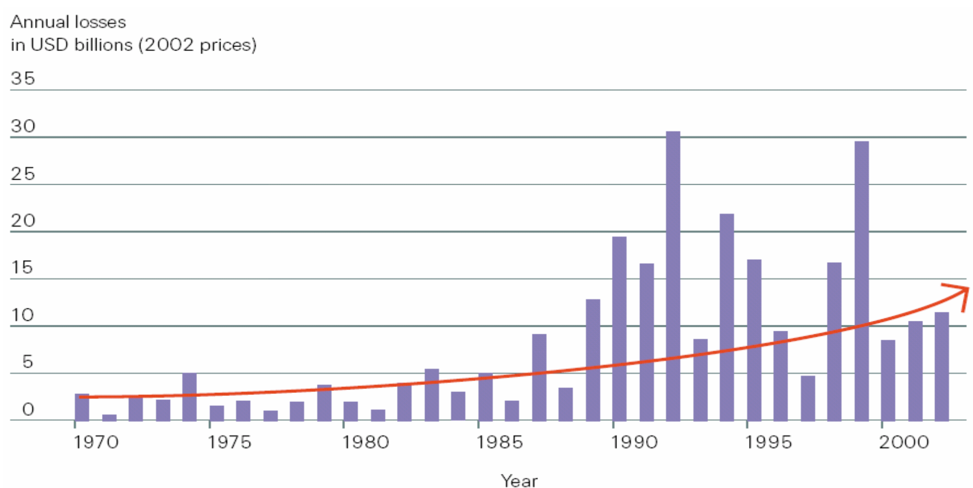
The (re)insurance of damage caused by weather related risks has a long history and is well established in all mature insurance markets. In fact, the very birth of the insurance industry is connected to weather related hazards. When medieval traders insured their ships against "not arriving at the target port", then one important reason for a loss apart from piracy and fire must certainly have been adverse weather conditions. Despite this long history, the development of weather related risk management is far from over. Some key issues arising over of the next few years are discussed in the following section.

2.1. Climate change

In spite of huge annual fluctuations, a clear trend emerges from insurance loss statistics of the past 30 years. These indicate that insurance losses caused by natural catastrophes have risen dramatically (Figure 4.2). This increase is principally a result of higher population densities, widening insurance coverage, an increase in the density of high valued property in high-risk areas and the high vulnerability of some modern materials and technologies[1]. Given that these trends have been constant, it is assumed that natural hazard losses will continue to rise. However, the fact that losses are on the increase should not necessarily lead us to conclude that the number and/or intensity of natural catastrophes per se has increased.

Yet, a growing body of scientific research would seem to support the view that the frequency and intensity of certain natural catastrophes can be expected to rise beyond the normal cyclical fluctuations. Temperature measurements indicate that, overall, the earth's lower atmosphere has warmed up over the past hundred years. A large proportion of this temperature increase is, in all probability, attributable to human activities. In particular, greenhouse gas emissions such as carbon dioxide (CO_2), produced through the combustion of fossil fuels, are thought to be responsible for global warming. Due to the physical characteristics of the atmosphere, it is highly probable that a global temperature increase will lead to an intensification of the hydrological cycle. Global climate models predict increased and more frequent seasonal precipitation in various regions of the world[2]. The fear is that this might lead to more frequent and/or more extreme flood events and a general increase in temperature might also aggravate storm activity.

Figure 4.2. Development of insured losses attributable to natural hazards over the past.



All probabilistic risk assessment models available are benchmarked against historical hazard activity in one way or another. Currently there does not seem to be enough conclusive scientific evidence to justify a deviation from the historic basis. However, as the leaders of the insurance industry observe and partly sponsor scientific research in this area, it is not beyond reason to assume that probabilistic loss models will be adjusted once a change in hazard activity becomes noted. This can be illustrated by two recent examples:

In March 2004 a fierce storm hit the coast of southern Brazil, killing at least three persons and damaging thousands of houses. Based on historical experience the southern Atlantic has been considered as free of hurricanes and meteorologists had an intense debate about whether or not this storm can be classified a "hurricane". However, irrespective of the true internal structure of this storm, insurance companies will rethink their South Atlantic risk assessment if more of these events occur in the next few years.

Half a year later Hurricane Jeanne, with winds of up to 190 km/h, made landfall in Florida, making it only the second time in recorded history that a US state was affected by four hurricanes in one season - the first being Texas in 1886. Should the next few years yield again such a high concentrations of land-falling hurricanes, then loss model developers will certainly re-evaluate their current assumptions. Whilst annual expected losses may remain unchanged, an increase in model uncertainty would lead to a more conservative risk perception.

2.2. Alternative risk transfer solutions

Insurance-linked securities (ILS) are seen as an effective way of increasing insurance capacity, especially for highly improbable low-frequency, high-severity natural catastrophe events. Since its inception in 1996, the market for ILS has witnessed worldwide issuance in excess of USD 9.5 billion. The largest number of the securities issued has been in the form of catastrophe bonds (cat bonds)[3]. The market for cat bonds was first developed in the wake of reinsurance capacity shortage following two major catastrophic events, Hurricane Andrew in 1992 and the Northridge earthquake of 1994. Cat bonds increased the ability of insurers to continue providing insurance protection by transferring the risk to investors. Initially considered "esoteric", cat bonds have gained wide acceptance reflecting their attractiveness to both sponsors and investors. For insurers, reinsurers and an increasing number of corporations, cat bonds provide multi-year protection against natural catastrophes with no counterparty credit risk. To investors cat bonds offer the potential to diversify and reduce their portfolio risk, since cat bond defaults are essentially uncorrelated with defaults of most other securities. While initial growth expectations of this alternative risk transfer option have not been entirely met, a steady increase is expected for the near future.

In contrast to cat bonds, which essentially substitute conventional reinsurance under certain preconditions, so called “weather derivates” are basically a new risk transfer product involving atmospheric conditions. For many companies weather related losses can have a major impact on earnings. Weather derivates are an effective means of reducing this risk of volatility and hence function as a cash flow insurance against “adverse” weather conditions. Depending on the industry looked at, “adverse” weather may be cold summers (e.g. ice cream manufacturer) or warm winters (energy provider) or dry winters (ski resort) and so on. The number of transactions as well as the notional value of this type of “insurance” has seen a steep rise in the past few years, led by the US market and followed by growing demand from European and Asian customers.

2.3. Emerging insurance markets of China and India[4]

Among the emerging markets, China and India have been drawing intense attention over the past few years due to their remarkable economic growth and due to the opening up of their previously protectionist insurance markets. China and India are the most populous countries in the world, together being home to 2.35 billion people, more than one-third of the world’s total population. Premiums written have seen an annual increase of 17.9% and 10.9% over the past decade in the Chinese and Indian insurance market respectively. The bulk premium income in non-life insurance is

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attributable to fire and motor policies covering mainly commercial and industrial customers with personal lines remaining still at an embryonic stage.

China and India are both prone to natural catastrophes, with tropical cyclones a prominent risk. Furthermore the two countries both have areas that are among the most hazardous hail storm exposed regions. Between 1994 and 2003, these two markets accounted for 25% of the global economic losses from natural catastrophes. With respect to insured losses however, the contribution of these adverse events was minimal, amounting to less than 1% of global insurance losses over this period. It is clear that the continuing development of these markets will trigger a demand for more accurate probabilistic risk assessment models over the next few years.

Notes

1 S*igma* No. 2/2003: "Natural perils and man-made disasters in 2002", Swiss Re.

2 IPCC(Intergovernmental Panel on Climate Change), Third Assessment Report, 2001.

3 "Insurance-linked securities", Swiss Re Publication, 2003.

4 Information of this section taken from "Exploiting the growth potential of emerging insurance markets – China and India in the spotlight", *sigma* 5/2004, Swiss Re.

Annex 1

List of Speakers and Presentations at the Conference*

Session 1 - Insurability of catastrophic risks

- Economics of catastrophe risk insurance, *Christian Gollier (University of Toulouse).*
- Insurability of terrorism risk: challenges and perspectives, *Howard Kunreuther and Erwann Michel-Kerjan (Wharton School, University of Pennsylvania).*
- Industrial, technological and other catastrophes, *Christian Lahnstein (Munich Re).*
- Recent trends in the catastrophe risk insurance/reinsurance market, *Patrick Murphy O'Connor (Benfield).*
- Role of the reinsurance industry in the management of weather related risks, *Peter Zimmerli (Swiss Re).*
- Issues and options in the management of terrorism risk through insurance, *Robert Reville (Rand Corporation).*
- Current state of the coverage for war and terrorism risks - including NBC - in the aviation sector, *Eugene Hoeven (IATA)*
- Free market solutions for terrorism risks coverage, *Ben Garston (MAP Underwriting and Lloyd's Terrorism Panel).*

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* Power point presentations summarising papers included in this publication as well as other presentations made at the conference are available on the OECD Insurance homepage: http://www.oecd.org/daf/insurance.

- Improving insurability and affordability: the role of insurance in hazard identification, risk assessment, risk prevention and mitigation for industrial/chemical accidents, *Satyananda Mishra, IAS, Disaster Management Institute, Bhopal - Government of Madhya Pradesh, India).*

Session 2 - Financial market solutions to manage catastrophic risks

- International financing solutions to catastrophic risk exposures, *Torben Juul Andersen (Copenhagen Business School).*
- The use of risk linked securities to manage catastrophic risks, including terrorism, *Christian Mumenthaler (Swiss Re).*
- Current challenges in terrorism risk securitization, *Gordon Woo (RMS).*
- Financing catastrophic risks in non-OECD countries: challenges and perspectives, *Reinhard Mechler (IIASA).*
- Current market trends for catastrophe bonds and risk kinked securities, *Christopher McGhee (MMC Securities, Guy Carpenter).*
- The potential for new risk transfer instruments to cover terrorism risks, *Michele David (The Bond Market Association).*
- Rating agency's perspective on catastrophe bonds and risk linked securities, *Rodrigo Araya (Moody's).*

Session 3 - Role of governments and development of public-private partnerships for catastrophe risk management

- Role of governments in natural catastrophe risk management and financing in OECD countries, *Paul K. Freeman (University of Denver).*
- Catastrophe insurance programs in emerging countries: field experience, *Eugene Gurenko (World Bank, Financial Sector Operations and Policy Department).*
- Potential role for governments in terrorism coverage, *Dwight Jaffee (Haas School of Business, UC Berkeley).*
- Public-private partnerships to cover terrorism risks in OECD countries, *John Cooke (International Economic Relations Consultant, London).*

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- Role of the US government in the prevention and mitigation of terrorism risks, *Robert Liscouski (Infrastructure Protection Office, Department of Homeland Security, USA).*
- Disaster risk management policy in Japan, *Kazuhiro Kawachimaru (NIPPONKOA Insurance Company Ltd).*
- The Spanish experience in the management of extraordinary risks, including terrorism, *Ignacio Machetti (Consorcio de Compensación de Seguros).*
- A stakeholder approach for developing a public-private partnership: the Hungarian case*, Reinhard Mechler (IIASA).*
- Disaster risk management policy in China, *Yuanchang Zheng and Jianguo Mu (Department of Disaster and Social Relief, Ministry of Civil Affairs).*
- The French experience in natural catastrophe risk management, *Suzanne Vallet (Caisse Centrale de Réassurance).*
- Earthquake risk management policy in Indonesia, *Werner Bugl (PT Asuransi, MAIPARK Indonesia)*.
- Disaster risk management policy in Mexico, *Carlos Bayo Martinez (FONDEN).*
- Disaster risk management policy in the Philippines, *Ronald I. Flores (Department of National Defense, Office of Civil Defense, National Disasters Coordinating Council).*
- Disaster management in India, *D. Madan (Under Secretary, National Disaster Management Division, Ministry of Home Affairs, Government of India).*
- Management of extraordinary risks, including terrorism, in India: achievements and perspectives, *C. S. Rao (Indian Insurance Regulatory and Development Authority).*

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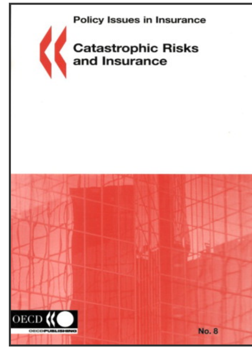

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