Rising natural catastrophe losses – what is the role of climate change?

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Abstract

For more than 30 years Munich Re scientists have been analysing natural hazards throughout the world. Munich Re's NatCatSERVICE now has records of more than 22,000 single natural events having caused damages. Analyses of these data show very clearly that natural catastrophes have increased dramatically and are causing more and more damage. Inflation-adjusted economic and insured losses from these great natural catastrophes have risen to nearly US$ 180 bn in economic losses and around US$ 90 bn in insured losses in the record year of 2005. As the upward trend in numbers of natural catastrophes is mainly due to weather-related events such as windstorms and floods and is not apparent in the same way for events with geophysical causes such as earthquakes, tsunamis, and volcanic eruptions, there is some justification for assuming that this trend is the result of changes in the atmosphere, most probably global warming. Our analyses of the hurricane frequency in recent decades, taking into account the natural climate cycles (Multidecadal Atlantic Oscillation), indicates that current activity of strong hurricanes (SS 3 to 5) is higher than in any other previous period; this suggests an impact from global warming. Evidence for a significant impact of climate change in several sectors is undoubted. In the economy, climate change is no longer seen exclusively as a financial risk, but it also has been stated as offering a great opportunity.

Keywords: Natural catastrophes, climate change, rise in losses, risks and opportunities, insurance industry

1 Rising natural catastrophes and economic losses

In recent years, there have been increasing signs that the steady advance of global warming is progressively affecting the frequency and intensity of natural catastrophes. The following examples confirm that there has been a notable increase in such events over the past few years.

- The hundred-year flood in the Elbe region in the summer of 2002;
- The 450-year event of the hot summer of 2003, which caused more than 35,000 heat deaths in Europe;
- The record damages of the 2004 hurricane season;
- Japan's 2004 typhoon season, with an unprecedented ten landfalls;
- The first ever South Atlantic hurricane in March 2004, with damages in Brazil;
- India's highest 24-hour precipitation amount: 944 mm in Mumbai on 26 July 2005;
- 2005 the largest number of tropical cyclones (28) and hurricanes (15) in a single North Atlantic season since the beginning of records (1851);
- The 2005 hurricane season included the strongest (Wilma – core pressure: 882 hPa), fourth strongest (Rita), and sixth strongest (Katrina) hurricanes on record;
- Hurricane Katrina was the costliest single event of all times, with economic losses of over US$ 125 bn and insured losses of approximately US$ 60 bn;
- In October 2005, Hurricane Vince formed close to Madeira, subsequently reaching the northernmost and easternmost point of any tropical cyclone;
- In November 2005, tropical storm Delta became the first tropical storm ever to reach the Canary Isles;
- Larry, the strongest tropical storm (cyclone) recorded, reached the Australian coast in March 2006:
- Kyrill (January 2007) caused the second largest losses in Europe due to a winter storm;
- The flood series in the United Kingdom (June-July 2007) resulted in the largest flood loss ever in the UK.

Munich Re's Geo Risks Research unit has been researching loss events caused by natural hazards around the globe for over 30 years. These events are documented in the NatCatSERVICE database, which has been fed with data on all the major historic natural catastrophes. Munich Re's NatCatSERVICE now contains details of more than 23,000 individual events. The analyses undertaken by Geo Risks Research provide the most accurate estimate possible of the insured values exposed to natural hazards such as windstorm, flood and earthquake with a view to Munich Re's business.

The data analyses clearly show a dramatic increase in natural catastrophes around the globe, with ever-growing losses. The trend curve indicating the number of great natural catastrophes worldwide (involving thousands of fatalities, billiondollar losses) reveals an increase from two per year at the beginning of the 1950s to around seven at the present time (Fig. 1).

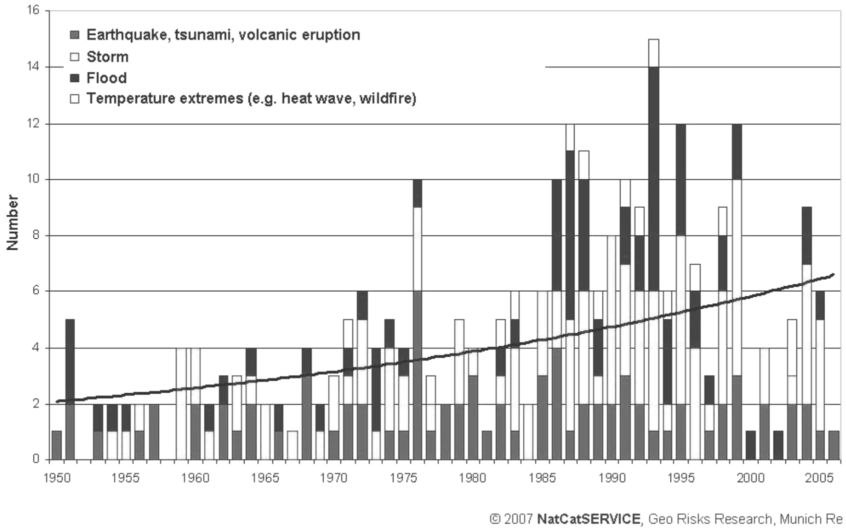

Fig. 1. Great Natural Disasters 1950–2006 (Number of events)

Economic and insured losses resulting from great weather disasters have risen even more sharply in real terms. In 2005, a record year, economic losses were as high as nearly US$ 180 bn and insured losses around US$ 90 bn (Fig. 2).

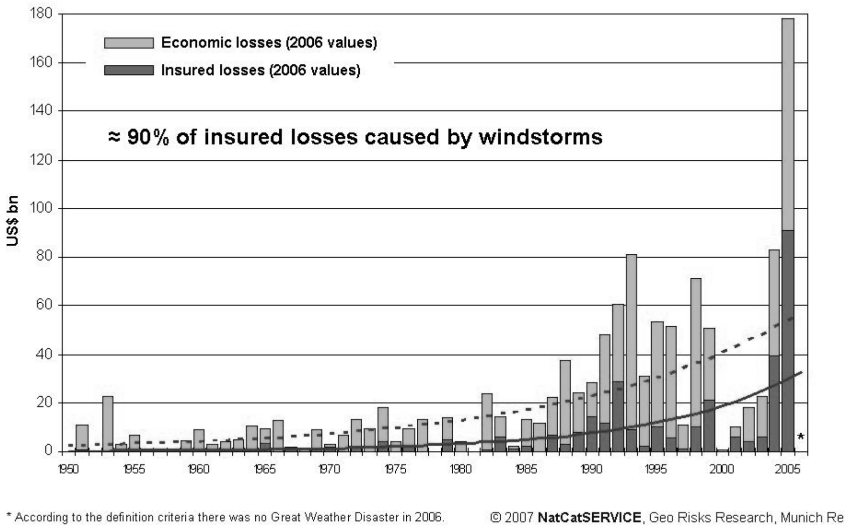

Fig. 2. Great Weather Disasters 1950–2006 (Overall and insured losses)

The main reasons for the sharp increase in losses from major, weather-related catastrophes are population growth, the settlement and industrialisation of regions with high exposure levels and the fact that modern technologies are more prone to loss. The state of Florida in the USA, which has always had a high hurricane exposure, is a good illustration of the way that socio-economic factors can act as natural catastrophe loss drivers. The population has grown from three million in 1950 to the current 18 million. The number of tourists visiting Florida each year recently passed the 80 million mark. It is clear, taking into account the increase in prosperity, that present-day hurricane losses in Florida are liable to be a multiple of those of a few decades ago.

Following 2005's record figures, the insurance industry reported relatively few large natural catastrophe losses in 2006. At the end of December 2006, economic losses from all loss occurrences amounted to US$ 45 bn and insured losses US$ 15 bn, less than one-sixth of the previous year's figure. The loss balance would have been higher had it not been for the fortuitous absence of severe North Atlantic hurricanes.

Only three Atlantic tropical cyclones caused losses in 2006, compared with 17 in the previous year. The lower level of hurricane activity was due to exceptional meteorological circumstances: dust particles carried from the Sahara to the hurricane breeding grounds absorbed solar radiation, thus warming the surrounding layer of air at medium altitude. The effect was to stabilise atmospheric stratification and hinder the formation of hurricanes, particularly during August. From October onwards, the El Niño phenomenon in the Pacific had a curbing effect. However, during September, in the absence of either El Niño or the Sahara dust factor, there were four hurricanes, which corresponds with expectations. A number of storms were steered away into the Atlantic by the dominant configuration of pressure systems without reaching the mainland, and so did not cause damage. This clearly shows that 2006 constitutes no more than a temporary respite in the general increase in weather-related natural catastrophes.

2 Increasing scientific evidence for anthropogenic causes

As the rise in the number of natural catastrophes is largely attributable to weather-related events like windstorms and floods (see Fig. 1), with no evidence of a similar increase in geophysical events such as earthquakes, tsunamis, and volcanic eruptions, there is some justification in assuming that anthropogenic changes in the atmosphere, and climate change in particular, play a decisive role. There has been more and more evidence to support this hypothesis in recent years:

- Analyses of air bubbles trapped in ice cores drawn from deep layers in the Antarctic ice suggest that the concentration of carbon dioxide, the principal greenhouse gas, over the past 650,000 years has never been even remotely close to the current 382 ppm (Siegenthaler et al. 2005).

- The ten warmest years on record since 1856, when systematic readings were first taken, have all been in the twelve-year period 1995–2006 (WMO 2007). The warmest year to date was 1998.

The fourth status report of the Intergovernmental Panel on Climate Change (IPCC 2007) regards the link between global warming and the greater frequency and intensity of extreme weather events as significant. The report finds, with more than 66% probability, that climate change already produces more heatwaves, heavy precipitation, drought and intense tropical storms and that the trend is rising. The expected rise in global average temperatures of up to 6.4°C by the end of the century, depending on emission and climate model, significantly increases the probability of record temperatures. Higher temperatures also enable air to hold more water vapour, thus increasing precipitation potential. Combined with more pronounced convection processes, in which warm air rises to form clouds, this results in more frequent and more extreme intense precipitation events. Even now, such events are responsible for a large proportion of flood losses. As a result of the milder winters now typical of central Europe, there has been a reduction in the snow cover over which stable, cold high-pressure systems used to form a barrier against low-pressure systems coming in from the Atlantic. This barrier now tends to be weak or to be pushed eastwards so that devastating winter storm series like those of 1990 and 1999 can no longer be considered exceptional, as also evidenced recently by Kyrill in January 2007. The wind readings of a number of representative German weather stations have shown a definite increase in number of storm days over the past three decades. At Düsseldorf Airport, for instance, the figure has risen from about 20 to 35 a year (Otte 2000).

In recent years, an increasing number of scientific publications have indicated that there is a causal link between climate change and the frequency and intensity of weather-related natural catastrophes:

- According to British scientists, it is more than 90% probable that the influence of human activity has at least doubled the risk of a heatwave like the one that hit Europe in 2003 (Stott et al. 2004).
- Hurricane models which take account of climate change show that, by 2050, maximum hurricane speeds will have increased by an average of 0.5 on the Saffir-Simpson Scale and the associated precipitation volume will have gone up by 18% (Knutson and Tuleya 2004).
- Publications by Emanuel (2005) and Webster et al. (2005) indicate a 50% increase in the duration and intensity of tropical storms in the North Atlantic and Northwest Pacific since 1970. This trend is expected to continue.
- The surface temperature of the world's oceans in the tropical cyclone breeding grounds has already increased by an average of 0.5°C as a result of climate change (Barnett et al. 2005; Santer et al. 2006).
- The only explanation for the increased intensity of tropical storms in the six ocean basins is the steady rise in sea surface temperatures over the last 35 years (Webster et al. 2006).

- Climate models show that winter storm losses will have more than doubled by 2085 in some European countries due to the effects of climate change (Schwierz et al. 2007).

Geo Risks Research has undertaken hurricane frequency analyses over the past few decades which take into account natural climate cycles (the Atlantic Multidecadal Oscillation, AMO). These indicate that the higher frequency and intensity of Atlantic tropical cyclones in recent years could be due to both the natural cycle (the current warm phase, which started in 1995) and global warming.

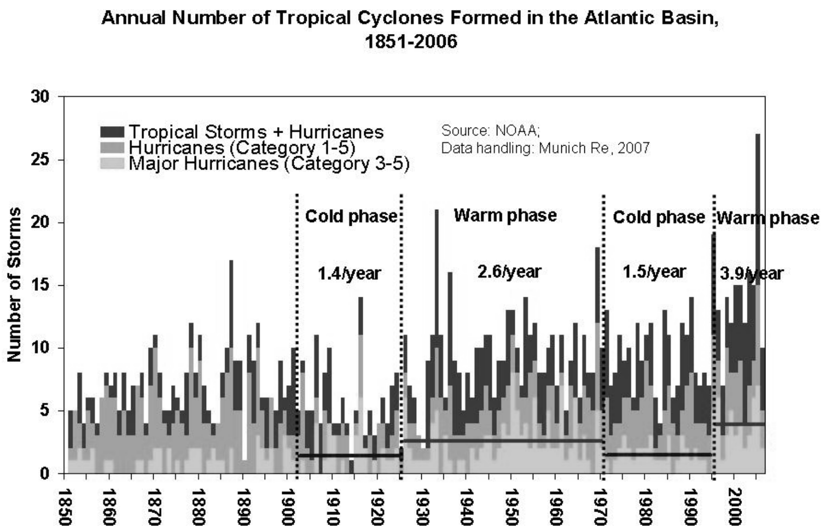

Fig. 3. Climate variability and hurricane activity

Figure 3 clearly shows that, on average, the number of destructive major hurricanes is significantly higher in the warm phases of the AMO than in the cold phases. This supports the theory that hurricanes form over very warm sea surfaces. However, it is also true that storm frequencies during the current warm phase (from 1995 onwards) have been much higher than in the previous warm phase in the middle of the last century. The difference can no longer be explained by natural fluctuation; it can only be due to global warming.

The analysis presented in Fig. 4 shows very clearly that sea surface temperatures which have already increased as a proven consequence of anthropogenic climate change have a considerable impact on hurricane losses. The graph shows the relationship between average annual USA hurricane losses and deviation in sea surface temperatures from the long-term average for the relevant season. The conclusion: the higher the temperature, the greater the loss.

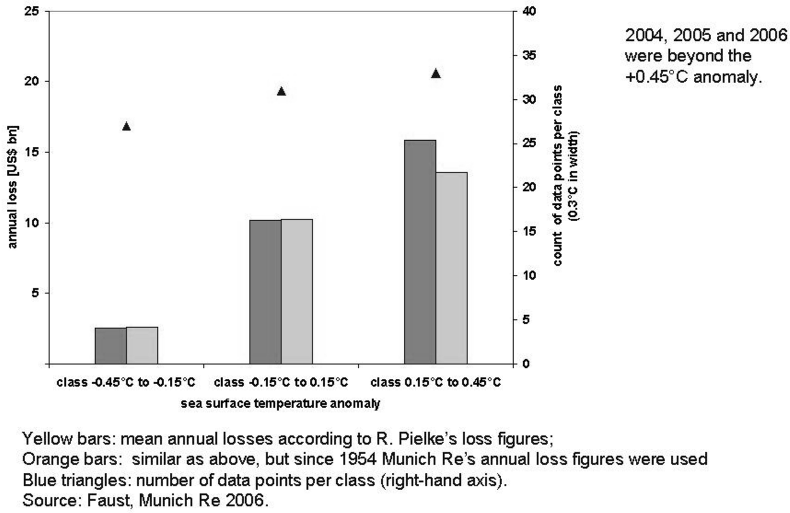

Fig. 4. Mean annual normalized US hurricane losses in dependence on SST-anomalies

Even apparently anomalous events such as the unusually abundant snow in Europe during the winter of 2005 and the warm start to the winter of 2006 are in keeping with the scientific characteristics of climate change. As well as an increase in weather extremes and a general trend towards warmer winters, there is also likely to be greater variation in weather patterns.

Now that a number of changes have already happened and some of the predictions for the coming decades have already been seen, the key issue is no longer if and when there will be conclusive proof of anthropogenic climate change. The crux of the matter is whether the existing climate data and climate models can provide sufficient pointers for us to estimate future changes with reasonable accuracy and formulate adaptation and prevention strategies in good time. The insurance industry's natural catastrophe risk models have already been adjusted in the light of the latest findings. For instance, they now incorporate sea temperatures that remain above the long-term average due to the ongoing cyclical warm phase in the North Atlantic; the effects of this warm phase are reinforced by global warming. We can also expect the above-average water temperatures to increase further the intensities and probably also the number of cyclones.

3 Consequences for the insurance industry

Even before publication of the recent study by the well-known British economist Sir Nicholas Stern (2007) it was clear that climate change is not just an ecological problem; it is also an economic issue. If damage costs continue to rise, this also affects industry and primarily, of course, insurance companies.

Climate change affects the insurance industry in a number of ways:

- As extreme events increase in number and severity, loss frequencies and amounts grow correspondingly.
- Loss volatility increases.
- New exposures arise (e.g. hurricanes in the South and Northeast Atlantic).
- Unprecedented extremes are encountered (the strongest hurricane on record occurred in 2005).
- Premium adjustments have tended to lag behind rising claims, at least in the past.

Despite unfavourable loss trends, the insurance industry continues to offer a wide range of natural hazard covers whilst trying, at the same time, to encourage its clients to focus more on loss prevention. It is also making strenuous efforts to control its own loss potentials with the help of modern geoscientific methods. It is still difficult, however, to predict in quantitative terms the effects that future climate changes will have on the frequency and intensity of extreme weather events.

Munich Re in agreement with IPCC believes that the number of severe, weather-related natural catastrophes will increase in the long term as a result of continuing climate change. This, combined with the trend towards higher value concentrations in exposed areas, will increase loss potentials.

In order to at least slow down the rate of climate change – it is already too late to stop it – the emphasis needs above all to be on so-called no-regret or win-win strategies, such as reductions in energy consumption. Even if such strategies were to have less impact on the climate than expected, they would nevertheless help to conserve resources (including financial resources) and show that the industrial world was aware of its responsibility towards the Third World. To adopt such strategies, which are based on the precautionary principle, is to remain on the safe side and ensure winners all round.

Where the economy is concerned, climate change signifies opportunities as well as risks. It opens up many avenues for industry to develop low-emission, more climate-friendly technologies, or capture carbon dioxide released in the combustion process and store it underground (CO_2 sequestration), for example. It provides opportunities for insurers to develop new insurance products. One of Munich Re's new products is based on the Clean Development Mechanism introduced by the Kyoto Protocol. This mechanism enables investors from industrial countries to improve their climate balance sheet by investing in sustainable projects in the developing world. However, many would-be investors are deterred by the risks involved. In response, Munich Re has introduced the new Kyoto Multi Risk Policy.

The insurance industry has tremendous potential for promoting climate protection and climate change adaptation, and thus positively influencing future losses, by taking account of such issues in its products, investments, sponsoring activities, and communications. This has long been a Munich Re commitment. Munich Re's representatives share their knowledge at the annual world climate conferences (COP). The Munich Re initiated Munich Climate Insurance Initiative unites scientists, NGOs and the World Bank in an effort to find new insurance solutions designed to help above all poorer countries, which have no or limited access to the insurance market, to offset losses due to climate change. A number of Munich Re publications address the issue of climate change, for example "Weather catastrophes and climate change" (published by PG Verlag, Munich) and the Group has also produced "Winds of Change", a strategy game, in conjunction with the European Climate Forum. Munich Re is one of the signatories of the common statement of the Global Roundtable on Climate Change (GRoCC) on the need for climate protection as signed by 85 global companies, NGOs and scientific institutes on 20 February 2007 in New York City.

The objective of Munich Re's long-standing commitment is to help raise awareness of the risks posed by climate change and to prepare corresponding measures. Climate change, a global problem with decidedly adverse long-term consequences, clearly requires action based on international consensus. Regrettably, the results of last autumn's climate summit in Nairobi were disappointing.

There is every sign that the consequences of global warming are already evident, not least in Germany where this year's (2006/2007) warmest winter since records started is in line with climate model forecasts. Mild winters create ideal conditions for severe storms such as winter storm Kyrill, which swept across Europe in January causing losses running into billions of dollars, primarily in Germany and the United Kingdom. Kyrill also stood out because of its duration. It produced gale-force winds (over 63 km/h) that lasted for more than 24 hours in some places. Insured losses from Franz, another January winter storm which preceded Kyrill, amounted to several hundred million dollars.

In December 2007, Munich Re had already warned of the higher windstorm risk due to the unusually warm winter, and Kyrill confirmed this forecast. Although warm winters do not only result from climate change and warm weather does not necessarily produce severe winter storms, it is nonetheless true that the last winter has been a foretaste of the future climate and its extreme weather events.

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