**Zeitschrift:** Eclogae Geologicae Helvetiae
**Herausgeber:** Schweizerische Geologische Gesellschaft
**Band:** 90 (1997)
**Heft:** 3

**Artikel:** Catastrophes and climate change : risks and (re-)actions from the viewpoint of an international reinsurer
**Autor:** Berz, Gerhard A.
**DOI:** https://doi.org/10.5169/seals-168168

0012-9402/97/030375-05 $1.50 + 0.20/0
Birkhäuser Verlag, Basel, 1997

Eclogae geol. Helv. 90 (1997) 375–379

# Catastrophes and climate change: Risks and (re-)actions from the viewpoint of an international reinsurer

GERHARD A. BERZ[1]

*Key words:* Natural disasters, climate change, insurance

ABSTRACT

In the last few decades, the international insurance industry has been confronted with a drastic increase in the scope and frequency of great natural disasters. The trend is primarily attributable to the continuing steady growth of the world population and the increasing concentration of people and economic values in urban areas. An additional factor is the global migration of populations and industries into areas such as coastal regions, which are particularly exposed to natural hazards. The natural hazards themselves, on the other hand, have not yet shown a significant trend, in spite of a number of indications.

The present problems of the insurance industry with regard to pricing, capacity and loss reserves will be dramatically aggravated if the greenhouse predictions come true. The shifting of climatic zones and the increasing intensity of convective processes in the atmosphere will probably force up the frequency and severity of windstorms including tornados, hailstorms, floods and storm surges in many parts of the world with serious consequences for all types of property insurance.

Rates will have to be raised and in certain coastal areas or flood plains insurance cover will only be available after considerable restrictions have been imposed, as for example significant deductibles and low liability or loss limits. In areas of high insurance density the loss potential of individual catastrophes can reach a level at which the national and international insurance industries will run into serious capacity problems. Recent disasters showed the disproportionately high participation of reinsurers in extreme disaster losses and the need for more risk transparency if the insurance industry is to fulfil its obligations in an increasingly hostile environment.

ZUSAMMENFASSUNG

In den letzten Jahrzehnten wurde weltweit eine drastische Zunahme der großen Naturkatastrophen registriert. Sie beträgt im Vergleich der letzten 10 Jahre mit den 60er Jahren bei der Anzahl das Vierfache, bei den volkswirtschaftlichen Schäden – inflationsbereinigt – das Achtfache und bei den versicherten Schäden sogar das Fünfzehnfache.

Die wichtigsten Gründe für diesen besorgniserregenden Trend, der auch die Vereinten Nationen zur Einrichtung der «International Decade for Natural Disaster Reduction» (IDNDR) bewegte, liegen bis heute in der zunehmenden Konzentration von Bevölkerung und Werten in Grossstadträumen, überdies häufig in stark naturgefahrenexponierten Regionen, insbesondere den Küstenzonen, aber auch in der Schadenanfälligkeit moderner Industriegesellschaften, die trotz aller Bauvorschriften und technischen Weiterentwicklungen eher größer als kleiner geworden ist.

Gleichzeitig mehren sich die Indizien, dass die sich immer deutlicher abzeichnenden Klimaänderungen bereits heute Einfluss auf die Häufigkeit und Intensität von Elementarschadenereignissen gewinnen. Dies zeigt sich vor allem bei Hitzewellen und Dürren, bei Starkniederschlägen und Überschwemmungen sowie bei den tropischen und außertropischen Stürmen.

Die Versicherungswirtschaft verfügt über eine breite Palette von Instrumenten, mit denen sie sich außerordentlich rasch und effektiv an Änderungen ihres Risikoumfeldes anpassen kann; sie wird deshalb nicht zwangsläufig zu den «Verlierern» der genannten Klima- und Katastrophentrends zählen. Trotzdem bereiten, allen voran, den global agierenden Rückversicherern die noch schwer abzuschätzenden Schadenentwicklungen zunehmende Sorgen, da hier möglicherweise sogar die Grenzen ihrer finanziellen Leistungsfähigkeit erreicht werden. Sie fordern deshalb rasche politische Weichenstellungen für einen umfassenden Klima- und Katastrophenschutz und sind auch selbst bereit, einen substantiellen Beitrag hierzu zu leisten.

## Disaster trend

The loss data on great natural disasters since 1960 (Fig. 1) show a dramatic increase in catastrophe losses in the last few decades – a development that could well see average annual loss burdens from great natural disasters rise to US$ 30–50 billion (in today's values) by the end of the decade. The increase compared to the 1960s, which in the 1980s amounted to a factor of three for economic losses and a factor of five for insured losses, has since escalated to factors of eight and fifteen respectively (Tab. 1). These data are based on "great" natural disasters; the remaining natural loss events, hundreds of which are recorded each year, at least double the overall loss volume.

Without doubt, this rise in losses is caused to a great extent, if not to an overwhelming extent, by increasing economic values and insured liabilities, especially in heavily exposed areas.

[1] Head of Geoscience Research Munich Reinsurance Company, D–80791 Munich

## Great Natural Disasters
1960 - 1995

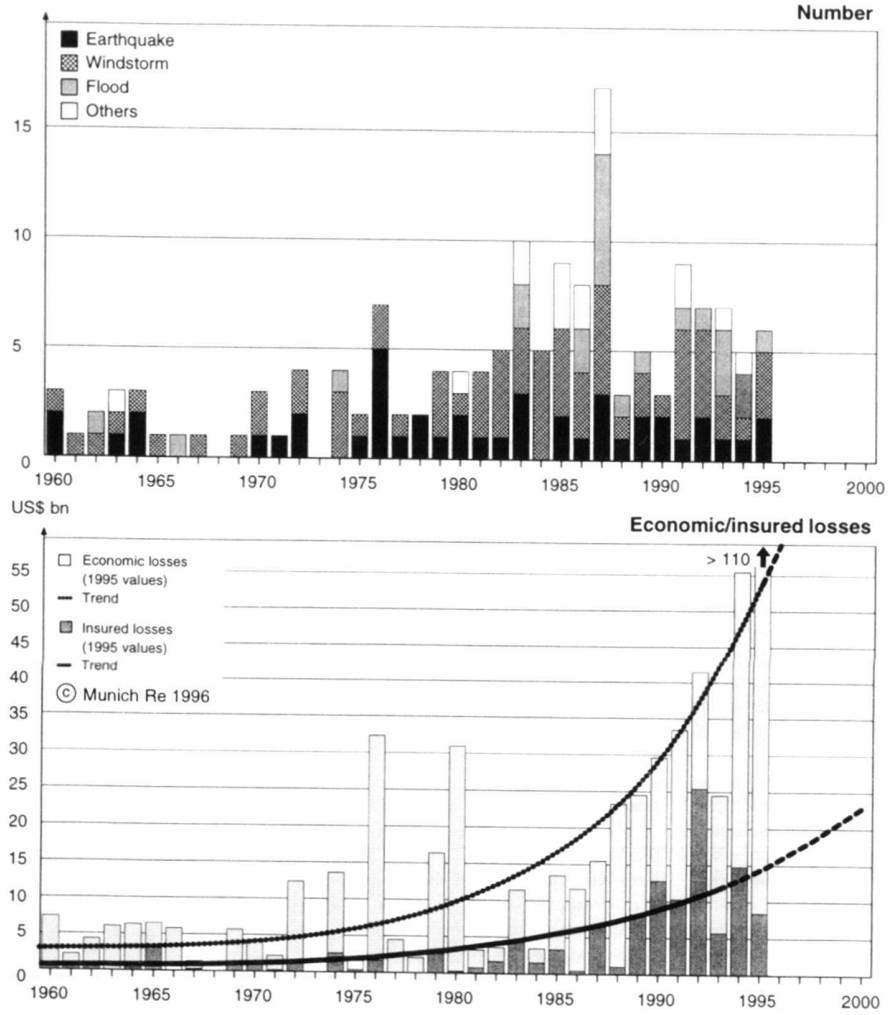



Fig. 1. Great natural disasters have drastically increased in numbers and loss amounts over the last decades. By "great" such disasters are meant which the affected region cannot cope with and, therefore, needs significant national or international assistance. In general such disasters claim hundreds of lives and/or leave hundred of thousands homeless and/or cause economic losses in the hundreds of millions of US-$.

In addition, natural disasters have shown time and again that the loss susceptibility of buildings and infrastructures has rather increased than decreased, in spite of tighter building codes and other developments in technology. This fact has again been illustrated by Hurricane Andrew and the Los Angeles and Kobe earthquakes.

### Climate change facts

At the same time, however, the evidence that emerging climate changes are having an ever greater influence on the frequency and intensity of natural disasters has become stronger. This has been demonstrated by the great windstorm disasters of recent years that have set new loss records almost every year as well as the countless flood, storm, drought and forest-fire disasters that seem to be occurring more often than ever before (Berz 1993).

Some facts about the changes in the atmosphere and on earth:

1. Without doubt the concentration of various climate-affecting trace gases in the atmosphere has risen significantly, which can only be attributed to the increased release of these gases by man. This is especially true for carbon dioxide, which has so far been responsible for about 50% of the man-made greenhouse effect. The other half comes

Tab. 1. Compared with the 60's the last ten years have seen a four-fold number of great natural disasters, eight-fold economic and fifteen-fold insured disaster losses, already adjusted for inflation.

**Great Natural Disasters 1960 - 1996**

| | Decade 1960 - 1969 | Decade 1970 - 1979 | Decade 1980 - 1989 | Last ten years 1987 - 1996 | Factor 80s : 60s | Factor last ten : 60s |
|---|---|---|---|---|---|---|
| Number | 16 | 29 | 70 | 64 | 4.4 | 4.0 |
| Economic losses | 48.4 | 93.0 | 147.6 | 404.4 | 3.0 | 8.4 |
| Insured losses | 6.5 | 10.9 | 29.8 | 98.8 | 4.6 | 15.2 |



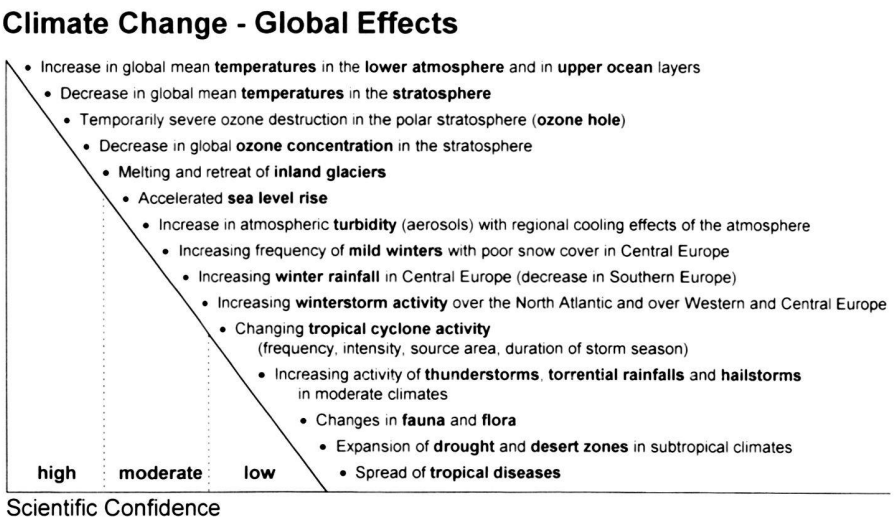
Loss figures in US-$ billion (1996 values)

from the greenhouse gases methane, nitrous oxide, ozone and the CFCs, the chlorofluorocarbons, which are also known as "ozone killers". With their very long life periods all these gases have accumulated in the atmosphere, and have thus increased their concentration appreciably. One important greenhouse gas has to be dealt with separately, namely water vapour.

2. There is no doubt that the ozone content of the stratosphere has steadily decreased in the last few decades. Over the Antarctic some layers have no ozone left whatsoever for certain periods of the year. Densely populated areas of the northern hemisphere are also already showing signs of steady ozone depletion in the stratosphere, which at 10% has not yet assumed any extreme levels. At the same time, a steady increase in low-altitude ozone concentration in all industrial areas has been observed, ozone smog, which occurs in urban areas during periods of intense sunshine.
3. The air is becoming increasingly turbid throughout the world, especially in industrial regions. This is due to aerosols, tiny particles of dust, soot and sand as well as droplets from condensed exhaust gases such as sulphur dioxide, as they diffuse sunlight more strongly and give the atmosphere a "milkier" appearance. At the same time, aerosols assist the condensation of water vapour and the formation of clouds, which then appear whiter. Consequently, more sunlight is reflected back to space from the surface of the clouds and less reaches the earth's surface in heavily industrialized regions.
4. Natural phenomena, such as eruptions of volcanoes, can also temporarily reduce the radiative budget of the lower atmosphere. This was, for example, the case after the eruption of Pinatubo in 1991 in the Philippines. This significantly reduced the short-wave radiation for several years and even the average global temperature temporarily sank by several tenths of a degree Celsius.
5. Extreme melting of mountain glaciers has been observed worldwide, and has already assumed dramatic proportions in certain regions. Since their highest levels in the middle of last century, the Alpine glaciers have lost around 1/3 of their surface and half of their mass.
6. The melting of the glaciers causes the sea level to rise. Added to this is the thermal expansion of the sea water due to rising temperatures. The total rise in the sea level during this century is 10 cm, an amount that may seem low but does give cause for concern when it is seen as a sign of what is to come in the future.
7. The global rise in temperature of approximately 0.5 degrees also appears harmless at first even if the last decade produced the highest temperatures since worldwide meteorological records began 130 years ago. It is only when one considers that the differences between the glacial and interglacial periods were on average only 5 degrees that the real significance of this warming becomes apparent. Added to this is the fact that the temperature rise in the lower atmosphere contrasts with an even sharper temperature drop in the stratosphere.
8. There is a considerable delay before ocean temperatures follow the temperature rise in the atmosphere. This is because the oceans can store a great deal of warmth and the deep-sea water circulates on a type of huge conveyor belt roughly only once every 1,000 years. Higher ocean temperatures lead to exponentially higher evaporation and to a correspondingly higher water vapour content in the atmosphere. This assists the development of high rainfall intensities and tropical cyclones.
9. The winters in Europe have become milder with the result that the eastern European high-pressure system, which builds up in winter over the large snow-covered surfaces of Europe, has weakened on average and retreated eastwards. It seems plausible to assume that it will lose more and more of its blocking effect on the low-pressure systems approaching from the Atlantic, which are now able to penetrate more frequently and further eastwards and hit Europe with their hurricane-force winds, as was the case in January/February 1990.
10. Many other changes have affected the earth, such as the expansion of deserts and the increase in droughts on the edge of these areas, remarkable changes in flora and fauna – from increased wintering of former migratory birds in our latitudes to forests dying – and not least the increase in tropical diseases outside the areas where they are normally found. Climate change is usually only one of the many reasons for the numerous changes that are taking place in environmental and living conditions (see also Tab. 2).

The decisive question is not whether this long list of evidence is conclusive but whether the climate data and computer climate models can provide enough information to allow sufficient time to assess future changes and develop the appropriate adjustment and preventive strategies. The risk of error will remain great for the foreseeable future. It is therefore all the more important that the strategies themselves can be adjusted and do not lead down any blind alleys. Successful from the very outset are so-called "no-regret" strategies such as the reduction of fuel consumption for cars or the reduction of energy

Tab. 2. Climate change will lead to a large number of effects, many of which are of economic significance. The table lists some according to their scientific confidence.




consumption in general, as (even if the relevance to climate is lower than expected) they result in desirable savings and are also very useful to demonstrate to the Third World the industrialized countries' sense of responsibility.

### Climate change predictions

But what sort of future do climatologists predict? The most reliable forecasts seem to be those made by the "Intergovernmental Panel on Climate Change" (IPCC), as the many climatologists from all over the world that work together in this group are much less likely to make fundamental errors in their statements than individual scientists, who often have quite contradictory opinions. These conflicting opinions should not in any way be dismissed, as they often quite rightly take issue with factors in the forecasts with a considerable degree of uncertainty. Unfortunately, however, they also serve to provide decision makers in the political and economical worlds with convenient and at this present time most welcome excuses for a failure to act or a failure of policies.

The IPCC reports of 1990 and 1995 (IPCC 1995) extrapolate future development on the basis of various scenarios, of which the most plausible "the business as usual scenario", is considered the worst possible case. But is this really true? In view of the rising economic trends in the most heavily populated regions of the Third World, should it not be expected that the release of greenhouse gases will rise even more quickly in the future than has so far been the case? If this is true, the expected doubling of the carbon dioxide concentration by the middle of next century could well be too optimistic. There also has to be a large question mark over the assumed growth rates of the other greenhouse gases.

According to the IPCC, the average global temperature will have risen by several degrees by the end of the next century. The area of uncertainty ranges from about 1.5 to 4 degrees. This means an average global rise in temperature of 0.3 degrees per decade and thus represents a significant acceleration over the 0.5 degrees in 100 years observed so far. The acceleration is so great that many ecosystems will probably not be able to adjust quickly enough.

The above-mentioned thermal slowness of the oceans and the buffer effect of the increase in snowfall in the Antarctic will cause the sea level to rise slightly more slowly than the previously assumed level of approximately 65 ± 30 cm in 100 years. This will be partly caused by the continuing dramatic melting of inland glaciers in most mountainous regions of the world. Equally important is the increase in humidity as a result of increased evaporation, as this has a decisive influence on precipitation and convective processes. We can therefore not only expect more torrential rain, flash floods and mudflows but also more thunderstorms, hailstorms, lightning and tornadoes. Tropical cyclones are, according to recent evaluations, not likely to increase in intensity or frequency but may extend their seasons and areas of occurrence. Extratropical storms, i.e. winter storms, are likely to become more severe and, as explained above, penetrate further inland. In conjunction with the rise in sea level, increased windstorm activity will result in a sharp increase in the risk of storm surges for many coastal areas (Berz & Conrad 1994). Table 2 summarizes all these effects.

As climatic history can show us, a warmer global climate generally means more precipitation. In the long term the mid-latitude and subpolar regions will profit from this while the areas which presently form the breadbaskets of the world will suffer from more frequent droughts. Even if the rising $CO_2$ content of the atmosphere improves growth conditions for most plants and their water requirements fall, this will be outweighed in many countries by the negative effects on agricul-

ture, chiefly due to the exacerbated effect of heat and aridity. The winners will be those countries that can adapt their agriculture most quickly to the changing conditions, and these are obviously the highly developed countries, while the less developed ones will fall further and further behind.

However, not all effects have to be negative. For example, many countries in the mid-latitude and subpolar regions of the world will be able to radically reduce their heating costs and the risk of frost will also be greatly diminished. Against this, other regions will see summertime energy consumption for air-conditioning systems rise significantly and more frequent heatwaves will cause additional damage.

### Insurance industry

Confident in its exceptional ability to adjust to changing risk circumstances, the insurance industry could now adopt the attitude that it is not really affected by climate change. However, one must strongly warn against such an attitude. It is to be feared that climate change will produce in nearly all regions of the world new extreme values of many insurance-relevant parameters that will lead to natural disasters of unprecedented severity and frequency. This will cause capacity problems in national and international insurance markets that are much more serious than those experienced in the last few years. The whole future of this class of business in certain regions could be at stake if the development of this problem is misjudged. And premium income would also lag behind loss development in this case (Tab. 3).

On the other hand, it is possible for the insurance industry to protect itself adequately against the effects of climate change and at the same time make a significant contribution to implementing measures to protect the climate. No other sector of the economy has such effective instruments for encouraging risk reduction. However, this can only work if the insurance industry can have its clients and the authorities as useful partners on its side. If, for example, insurers can convince their clients that substantial deductibles in natural hazards insurance are of benefit to both sides because they relieve insurers from the great number of minor losses, which can be more effectively remedied by clients, and because they substantially reduce the price of cover, clients will then be more willing to take measures that prevent or minimize losses. If, on the other hand, the insurance industry looks at the growing loss potential and decides to exclude certain perils or risk areas from cover or severely restrict the scope of cover, then the pressure will inevitably grow on authorities to take measures to improve risks or to tackle the cause of losses or even to transfer the risk to the government.

It would, however, be wrong if the insurance industry were to take on the state's role of penalizing or rewarding environmentally-damaging or environmentally-friendly conduct on the part of its clients. This cannot be the task of the insurance industry even if it were in its interests with regard to the correlation between environmental losses and natural disasters.

Tab. 3. Climate change may affect the insurance industry in a number of ways. This makes appropriate and speedy (re-)actions necessary.

***Climate change may have significant impacts on the insurance industry:***

- Increase in weather variability
- New extreme values in certain regions
- New exposures
- More frequent and larger natural disasters
- Greater claims potential
- Poorer claims experience
- Lagging premium adjustment
- Rising demand for cover of natural hazards

### Conclusions

Mankind is carrying out a huge experiment with the earth's climate, over which it has so far had practically no control and the outcome of which is still very much open. It could, however, dramatically affect mankind's living conditions in the future. As much as people can still argue today about the future development of climate change and in particular the effects it will have, this very high level of uncertainty is itself a great cause for concern. Even if the caution we are now showing proves to be unfounded, we have no choice if we are to behave responsibly towards later generations.

REFERENCES


BERZ, G. 1992: Global Warming and the Insurance Industry. Interdisciplinary Sc. Rev. 18, 120–125.

BERZ, G. & CONRAD, K. 1994: Stormy Weather: The Mounting Windstorm Risk and Consequences for the Insurance Industry. Ecodecision 12, 65–68.

IPCC 1996: Climate Change 1995: The IPCC Second Assessment Report. Cambridge University Press.



Manuscript received December 30, 1996
Revision accepted April 10, 1997