

1.6. Extreme events from the human standpoint

1.6.1. Influence on risks and losses

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In the natural sciences, natural events are assessed on the basis of physical parameters. From a human standpoint, however, the question of losses dominates. Losses arise from a conflict between forms of land use and natural processes. In Switzerland, the extent and frequency of the losses is influenced at present much more by anthropogenic factors such as changes of use and economic growth than by the comparatively slow process of climate change.

Risk

While the term danger signifies the likelihood of suffering losses, the term risk includes both the potential losses and the probability of their occurrence. A high level of risk is usually understood to mean large-scale losses at very low probability of occurrence. For natural dangers at the local level (e.g. floods, avalanches, landslides and rock falls), whilst the likelihood of their occurrence remains uncertain, the extent of the losses can usually be satisfactorily assessed. Where the risk of atmospheric warming is concerned, the situation is precisely the reverse. Here, the likelihood of occurrence is very high and the extent of losses very uncertain or unknown.

Losses as a result of dynamic factors

Losses result from a conflict between a natural event and anthropogenic land use. The more intensive the arising impact, and the more vulnerable and valuable the land use, the greater the

losses. The question of human influence on the natural event itself is treated in Chapter 1.6.2.

For losses to occur, the natural dangers involved must accord with certain criteria. As an example, the chain of interactions leading to losses through floods is shown in Fig. 12. Since there are many different dynamic influences active along the road from the precipitation to the losses, it is not possible to find a direct relationship between the size of losses and the size of the natural event. Climate change affects the hydrological risk factors, i.e. particularly the meteorological input and the condition of the catchment area. Interventions in the catchment area (e.g. retention measures) or in the river bed (e.g. raising of the runoff rate), may diminish the danger of flooding. However, such interventions may also amplify the danger through the creation of obstacles (e.g. bridges), as shown by the examples of Poschiavo (1987) and Brigue (1993). Classical protection structures are intended to prevent flooding. How-

ever, they do not provide complete protection, as shown by the floods of 1987, 1993, 1999 and 2000. Relying on the effectiveness of the protection measures, structures were erected for decades in risk areas, thereby increasing the loss potential (cf. Chapter 1.6.3).

The loss potential may also be reduced without altering the form of land use. The Cities of Cologne, Regensburg and Passau are examples of how economic growth is



possible in areas subject to frequent flooding, provided that the form of use and building structures are designed to take the hazard into account. When an event occurs, losses can be prevented or limited by emergency measures. Thus, for example, in October 2000 the River Kelchbach in Naters could be kept within its banks by provisional measures of the fire brigade.¹

A positive example of the interaction of different prevention measures is provided by the avalanche winter of 1999.² The land area affected and the number of avalanches are comparable to those during the winter of 1951, so that the two events may be regarded as similar. Despite the significantly larger number of buildings erected since 1951, and despite the larger number of persons, cars and roads, the number of deaths declined from 98 to 17, and the number of buildings damaged from 1300 to 720. Thus today's higher damage potential was more than compensated for by combined protection policies involving avalanche barriers, implementation of hazard zones, alarm systems and emergency measures.

Human factors

Economic growth is a significant cause of increased losses. In Switzerland, some 40 billion CHF are invested each year in buildings and civil engineering. Built-up areas are expanding continually (urban areas, roads and tracks), though not quite so fast as in the 1970s (Tab. 2). The average dwelling space per inhabitant is growing by almost one square meter per year. Owing to the additional assets created, though

Table 2 Annual increase in residential areas (in ha) in Switzerland.⁴

Period	Residential area	Roads	Tracks	Total
1972–83	+1220	+1000	+680	+2900
1978–89	+1685	+250	+470	+2400
1984–95	+1620	+130	+350	+2100

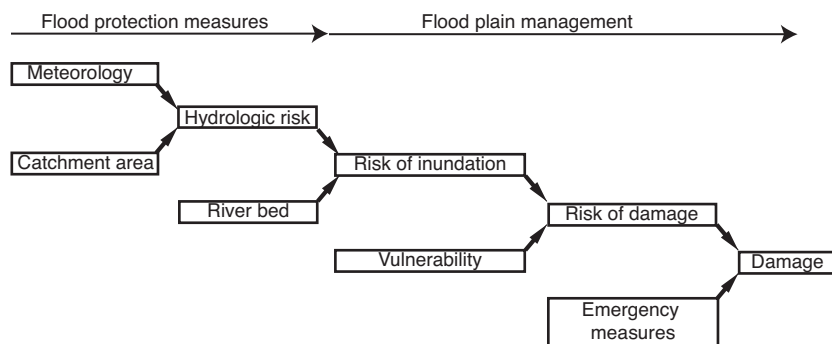


Fig. 12 Causal chain for flood damage.³ The process leading from the precipitation event to the damage involves many dynamic parameters. The intensity of the natural event cannot therefore be derived from the damage occurring.

the natural hazards have remained unchanged, the losses incurred are increasing.

The influence of economic growth on the losses incurred may be excluded by the choice of a suitable reference parameter, for example the gross domestic product or the total insured assets. In 1868, heavy floods affected Switzerland causing material losses of 14 million CHF in the currency in circulation at the time (Fig. 13). In connection with the floods of 1987, the losses amounted to 1200 million CHF.⁵ However, when seen in relationship to the strength of the national economy, the losses in 1868 were very much more severe. Stated in relation to the national income, the losses incurred in 1987 corresponded to a production of 2.2 days for the whole of Switzerland, and those in 1868 of 4 to 6 days. Fig. 13 shows how the losses in the various economic sectors have changed between these two years.

However, economic growth cannot entirely explain the changes in the pattern of losses. In 1994 and 1999, losses were incurred due to flooding in the Reuss valley in the Canton of Aargau. The average losses per building rose between 1994 and 1999 from 4500 to 9200 CHF (based on 61 and 87 buildings respectively in 12 communes). The reasons may be traced to the increased vulnerability of assets and reduced tolerance to losses on the part of the population.

Natural catastrophes overburden local communities

From the standpoint of natural science, natural events are assessed on the basis of their physical characteristics, for example peak discharge in the case of flooding, volume in the case of rock ava-

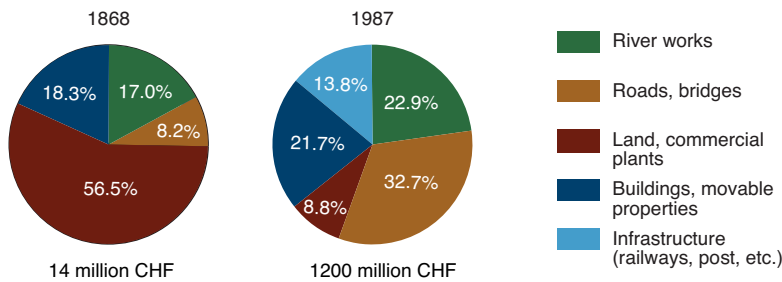


Fig. 13 In 1868, serious floods caused material losses of 14 million CHF in the currency of the day (or at least 1400 million CHF at today's prices). The floods in 1987 caused losses of 1200 million CHF. In the course of social development, not only the extent but also the type of damage alters.⁵

lanches and range of area affected in the case of snow avalanches. From the human standpoint, the losses predominate. The catastrophe statistics cite the number of mortalities, the extent of material losses and the triggering event, but – with the exception of earthquakes – contain no information on the intensity of events. Thus, for example, in the heavy storms of October 2000 in Valais, the debris flow in the village of Fully, with a volume of approx. 350000 m³, devastated agricultural land and cultures. In Gondo, an earth flow with a volume of almost 10 000 m³ was held back by a barrier intended for protection against rock fall, which could not withstand the pressure and then collapsed. Ten houses were destroyed and 13 persons lost their lives.¹ The losses incurred in Fully will soon be forgotten. By contrast, Gondo entered the statistics as a natural catastrophe.

According to the civil-defence definition, a catastrophe is an event that exceeds the capacity of the local population to deal with it (cf. Chapter 1.1). Therefore the extent of material losses does not provide a clear picture of the severity of a catastrophe. In 1997, the village stream devastated the village of Sachseln causing losses of some 100 million CHF. This was a natural catastrophe, and the media published detailed reports. By contrast, losses of some 70 million CHF caused a year later by a hail storm in the Canton of Lucerne were hardly noticed. In the latter case, the losses were distributed among a larger community, so that no-one's livelihood was endangered. As in the comparison of losses due to floods in 1868 and 1987, these must be seen in relationship to the economic capacity of the communities affected. Seen from this standpoint, and despite the rising losses, Switzerland may be said to have become safer in comparison to previous centuries.

A significant motor of change leading to higher losses, and to more frequent catastrophes, may be traced to the concentration processes in the business sector. The increasing intermeshing of industry, the reduction of stocks and the concentration of production at a few sites have led to a shift in the risk profile, as shown schematically in Fig. 14. Though the total risk (represented by areas F1 and F2

in Fig. 14) remains constant, the number and extent of the catastrophes increases for system B.

This situation is made worse by the cost consciousness associated with economic calculations. In weighing up the 'certain' costs of risk-reducing measures against the 'possible' costs of the losses, which may be incurred, the risk is – at least verbally – accepted. Thus although it is known that Lake Maggiore overflows its banks at more or less regular intervals, the shore area is intensively used owing to its attractiveness, but unfortunately in a way that takes no account of the hazard. Thus in October 2000, the insured losses to buildings and moveable property amounted to 160 million CHF, i.e. almost as much as in Valais (180 million CHF). However, in Valais the losses occurred at unexpected places, and the dynamic effects of the debris flows and raging water made self protection more difficult. Precisely the same areas (i.e. Upper Valais and Lake Maggiore) had already been hit by heavy storms in 1993. In Valais, the lessons had been learned, and by virtue of the protection structures that were already in place, and with the help of a careful hazard analysis using mobile equipment, the resulting losses could be reduced. At Lake Maggiore, no precautionary measures were apparent, and the material losses were significantly higher than in 1993. It seems here that the risk is generally accepted.

Climate change as additional factor of uncertainty

The extent and frequency of losses are influenced much more heavily by the dynamic changes in the economy than by the process of climate change (that, till now, has taken place comparatively slowly). In deciding on the use to which a site is to be put, the opportunities and

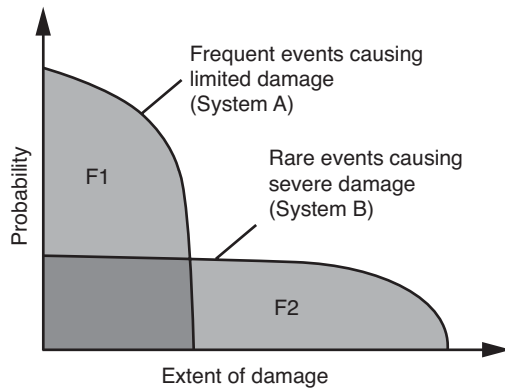


Fig. 14 Change in the risk profile. As a result of concentration processes in industry and commerce, the tendency is for events with limited damage and high probability (system A) to shift to less frequent events with much higher damage (system B).⁶

risks are weighed up, whereby personal or historical experience plays a major part in assessing the risk. Short-term cost benefits are given greater weight than existing natural hazards, or those that may arise in the future.

Natural catastrophes tend to occur when in vulnerable areas the intensity of the impact of the event significantly exceeds the customary level, or when new dangers arise at locations

previously regarded as secure. This represents perhaps the greatest danger of climate change, since thereby the system is altered. In a sensitive system such as the Alpine region, small changes may have very large effects. The opposite effect, namely that certain locations become more secure, is hardly of economic benefit, since these are either not utilised or have already been secured by protective structures.

- 1 BWG, Hochwasser 2000, Ereignisanalyse. Bundesamt für Wasser und Geologie, Bern, 248 S., 2002.
- 2 SLF, Der Lawinenwinter 1999 – Ereignisanalyse. Eidg. Institut für Schnee- und Lawinenforschung, Davos, 588 S., 2000.
- 3 IKSR, Kriterien für die Erstellung von Hochwassergefahren- und Hochwasserrisikokarten. Internationale Kommission zum Schutze des Rheins, Koblenz, 1999.
- 4 ARE, Landschaft unter Druck, 2. Fortschreibung. Bundesamt für Raumentwicklung, Bern, 48 S., 2001.
- 5 Petrascheck A., Die Hochwasser 1868 und 1987, ein Vergleich. WEL, 81, 1–8, 1989.
- 6 Planat, Bewertung von Naturgefahren, Umgang mit Katastrophenereignissen, Vorstudie. Ernst Basler + Partner AG, Bern, 2000.

1.6.2. Trends in losses from floods, landslides and avalanches

Christoph Hegg and Franziska Schmid

Avalanches, floods and landslides claim human lives and cause material damage in Switzerland every year. There has been no obvious trend in their occurrence over the last 30 years. The trend in the losses depends primarily on the rare extreme events. The extent of the losses may be diminished by protection measures. However, precise quantification of the effectiveness of protection measures is not possible.

Trends in casualties

Avalanches, floods and landslides lead to casualties every year in Switzerland. Over the past 30 years, at least 200 deaths were registered, which amounts to an average of about 7 per year.^{1,2,3} About 60% of these are attributable to avalanches and 40% to floods and landslides. These figures do not include the well over 600 casualties occurring in connection with tourist activities outside of the so-called secure areas. This figure includes casualties to cross-country skiers and others skiing outside the secure areas (approx. 20 per year) and the 21 victims of the canyoning accident in Saxetbach on 27 July 1999.

The division of casualties as between avalanches, floods and landslides in the last 30 years varies considerably and shows no obvious trend (Fig. 15). Rather, the years with very high losses are clearly distinguished from the remainder. Thus in 2000, for example, storms claimed a total of 20 victims, 13 of these in Gondo. Luckily, there were no such extreme events in other years. Over 30 years ago, the number of victims claimed by extreme events had been significantly higher than more recently. In the avalanche winter of 1951, 98 victims were claimed, and in the floods of 1868, 50 persons were killed. Other natural catastrophes, for example the rock avalanche in Goldau in 1806, which engulfed 500 persons, can lead to significantly higher casualties.

Trends in total financial losses

The financial losses caused by extreme events can be assessed by various means. The damage to insured objects (as discussed in Chapter 1.6.3) offers a possible basis for this. However, public authorities in Switzerland do not usually insure their property, so that these figures do not provide a complete picture of the total losses incurred in any particular case. In the following therefore, variations in the total direct losses over the last 30 years in the case of floods and landslides are discussed. The data are taken from the storm damage database of the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL), which among other data contains systematic estimates of the incurred losses. In addition to data from local authorities and insurances, the estimates are based on a review of all newspaper articles published in Switzerland on this theme.¹ Indirect damage such as loss of business through blocked access roads was not included, as this is hardly ascertainable.



The yearly losses shown in Fig. 16 deviate by more than 2 orders of magnitude. This is mainly attributable to the fact that the major part of the losses is caused by extreme events. Thus the 5 largest events over the last 30 years (07.08.78, 24.08.87, 24.09.93, 15.05.99, 15.10.00) were responsible for over two-thirds of total financial losses. Only one-third of the losses are attributable to the remaining just over 1300 events. Thus the trend in the losses depends primarily on that of the rare extreme events. At present, little is known of the causes and distribution of these. In most cases, they result from exceptional precipitation events.

The graph for accumulated losses since 1972 displays no marked trend (i.e. neither upwards nor downwards) in the losses due to floods and landslides. Both at the beginning and at the end of the time interval shown, a larger number of events causing particularly high damage are seen. This information is insufficient to derive trends for longer periods, or to identify weaker trends, since these are masked by the large scatter (cf. Chapter 1.4).

The magnitude of the losses resulting from an exceptional precipitation event depends on numerous factors and incidental circumstances. Moreover, the influence of protection measures cannot be neglected. An impressive example of this is provided by the dam in Visp, which was raised following the floods in September 1993 at a cost of only a few 100 000 CHF. In October 2000, the dam protected extensive industrial installations from flooding, avoiding losses that would probably have run into the billions. Had the maximum water level

in the Rhone been only a few centimetres higher, the installations would have been flooded, showing that there is no linear relationship between the causing event and the losses incurred. Rather, it is characterised by threshold values such as represented, for example, by the height of a dam.

It is not possible to quantify the effects of the protection measures realised over the past

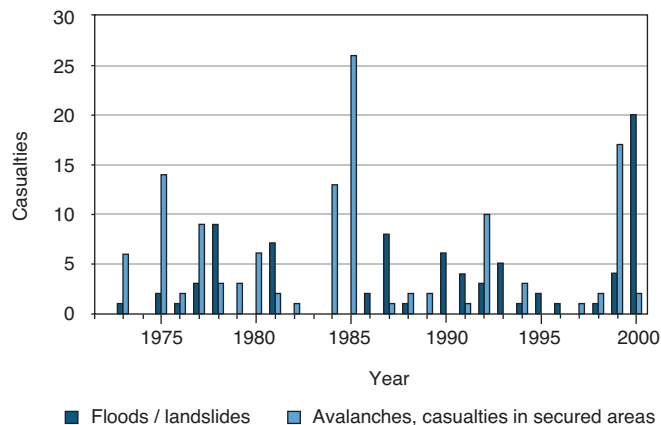


Fig. 15 Number of casualties in Switzerland over the last 30 years caused by avalanches, floods and landslides. The distributions display no obvious trends.

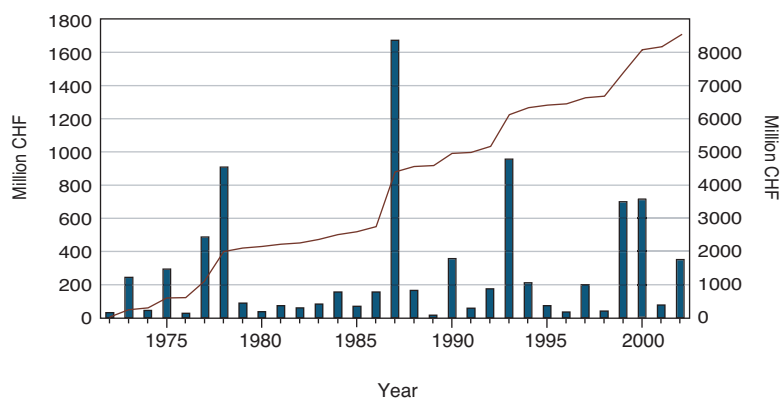


Fig. 16 Direct damage caused by floods and landslides in Switzerland. The columns are referred to the left-hand ordinate and show the annual losses inflation-adjusted to the end of 2000. The curve shows the accumulated total losses since 1972 and is referred to the right-hand ordinate.

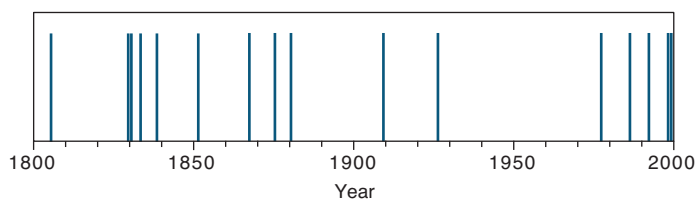


Fig. 17 Flood catastrophes in Switzerland in the last 200 years.

few decades, or in previous centuries, on the extent of the losses incurred in Switzerland as a whole. These may only be determined for precisely documented individual cases, for example with the aid of cost-benefit analyses, in which factors such as maintenance and the failure of protection measures can also be taken into account. It is therefore hardly possible to predict how an increase in heavy precipitation in conjunction with these and the other factors mentioned in Chapter 1.6.1 might affect future financial losses.

- 1 Hegg C., D. Gerber und G. Röhliberger, Unwetterschaden-Datenbank der Schweiz. Int. Symposium Interpraevent 2000 – Villach/Österreich. Tagungspublikation, Band 1: 37–48, 2000.
- 2 Röhliberger G., Unwetterschäden in der Schweiz. Eidg. Forschungsanstalt Wald Schnee Landschaft, 346, 51 S., 1998.
- 3 Latenser M., M. Schneebeili und R. Wüthrich, Die neue SLF-Schadenlawinendatenbank. Bündnerwald 51, 1, 35–39, 1998.

1.6.3. Loss trends in elemental loss insurance

Dörte Aller and Ewa Kozłowski

The extent of building losses is not only affected by factors which modify risks and hazards, but also by national economy factors. The evolution of the building losses of the public building insurance companies (PBI) since the beginning of the 1980s shows an increasing variability in the damage events in Switzerland. The exceptional losses of 1999 point out the enormous loss potential of natural hazards.

The evolution of losses from natural hazards is often used as an indicator of climate change. Whilst climate change is certainly an important factor influencing the losses, it is not the only one. The costs of damage are determined not only by risk modifying factors. Economic development also plays a role. (cf. Chapter 1.6.1). The building losses reported by the 19 public building insurance companies (PBI)¹ in Switzerland will be used as an example to discuss the various influencing factors. Building losses resulting from fire have been covered by the PBI since the first half of the 19th century, while elemental losses² were not included until the late 1920s³.

Data availability

Figures for elemental losses on buildings are available from all 19 cantons with a PBI for the last 30 years (Fig. 18). Since it is compulsory to insure all buildings with the respective public building insurance company, virtually all building losses are registered.

The figures exclusively refer to building losses.⁴ To enable a comparison of the statistics of the last 30 years, the building losses are put in relation to the total sum insured. The resulting ratio is called the 'loss quotient'. The total sum insured is regularly adjusted to the index of building costs and, in addition, building valuations are periodically reviewed. Therefore, the use of the loss quotient provides a certain basis for comparison.⁵

Factors influencing the costs of damage

The size of the costs of damage is not only dependent on the extent of

the damage but also on economic factors (Fig. 19). The costs are either insured or have to be paid by the owners themselves.⁶

The extent of the damage depends not only on the severity of the event, since an extreme event does not necessarily result in extensive damage (e.g. if it occurs in an uninhabited area). On the other hand, an event which is only slightly above average can cause extreme damage should it occur in a densely populated area with a large number of sensitive, high value resources (cf. Chapter 1.6.1).

The factors which influence damage may be divided into two categories: those which modify risks and hazards and those which influence costs.

Hazard and risk modifying factors

Hazard and risk modifying factors influence the frequency and extent of the damage. Climate change affects the intensity and return period of natural events.

- The hazard in a particular area resulting from average and severe gravitational events can be limited by protective structures such as dams and snow supporting structures. Where extreme events are con-



cerned, there is always a residual risk (cf. Chapter 1.6.2).

- Action undertaken by fire services before or during an event can limit the extent of the damage.
- The effective damage is influenced by the vulnerability of the building to natural hazards. This includes:
 - building in hazard areas, e.g. in flood plains.
 - the inclusion of vulnerable constructional designs, e.g. low-lying openings in flood plains.
 - inappropriate use of buildings in areas subject to natural hazards (e.g. use of the cellar as a living space in flood plains).
 - use of insufficiently robust material, e.g. illumination domes not designed to withstand hail.

It cannot be denied that the exploitation of exposed areas and the use of more vulnerable building techniques and materials has contributed to the increase in basic loss potential.

Cost modifying factors

These factors modify the extent of the insured losses via commercial and national economic mechanisms such as:

- general insurance conditions, e.g. alteration of the deductible.
- the sum insured, e.g. where this is changed from current market value cover to replacement value cover.
- the behaviour of policyholders, e.g. where a back yard is cleaned by professionals rather than by the owner.

By indexing with the total sum insured – taking inflation and the increase in the value of assets into consideration – the comparability of the long-range data can largely be assured. It is more difficult to take changes in the general insurance conditions and the behaviour of the policyholders into account.

Since it is hardly possible to quantify the various factors individually, no attempt is made here to list them in order of importance.

Long-range data on building losses

In Fig. 20, the loss quotient for the period 1972 – 2002 is shown. The year 1999 stands out immediately. The series of results from 1972 – 1998 (cf. Fig. 18) gives no direct indication of the

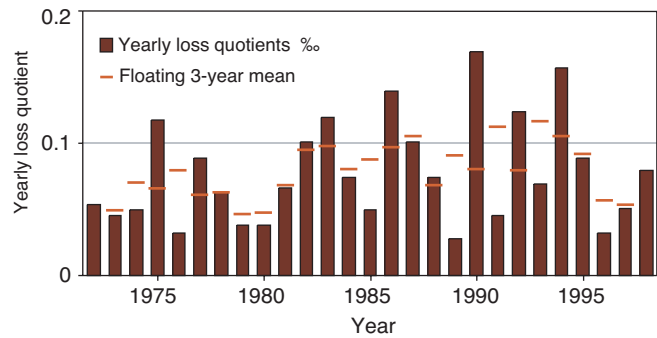


Fig. 18 Yearly loss quotients for building losses of the 19 PBIs⁷ (in % of the sum insured 1972 – 1998)

possibility of a year with such extreme losses. The return period of the losses in 1999 lies between 50 and well over 100 years. This clearly shows the range of the variability of losses and that even more extreme events could occur at any time.

Never before have so many individual losses been registered in the space of a single calendar year than in 1999. Almost 300 000 of a total of nearly 2 million insured buildings suffered damage. In 1999, total building losses of the 19 PBIs amounted to over 1 billion CHF, the total value of all insured buildings being about 1'500 billion CHF.

By spreading these losses over the 19 cantons with PBIs and over the various categories of elemental losses a certain compensating effect can be achieved. Despite this, several exceptional events coincided in 1999, leading to extreme losses over the year:

- avalanches and snow pressure in the spring (approx. 80 million CHF)
- flooding at Ascension and Whitsun (approx. 200 million CHF)
- hailstorm on 5th July 1999 (approx. 80 million CHF)
- storm 'Lothar' on 26th December 1999 (approx. 600 million CHF)

The choice of insurance accounting period – usually corresponding to the calendar year – can also have a substantial influence on annual losses. The damages caused by storm 'Lothar' are a good



Fig. 19 Diagram showing the influence factors which determine costs of damage.

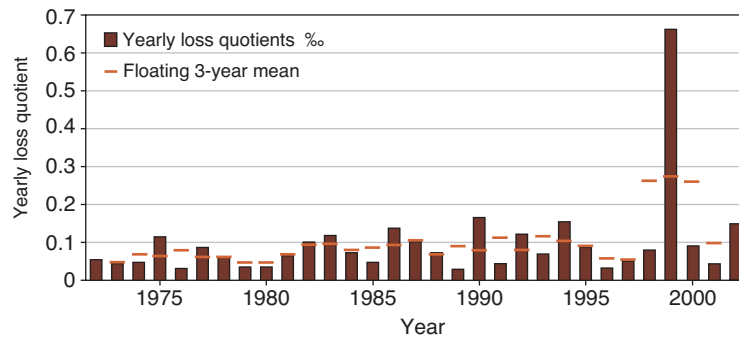


Fig. 20 Yearly loss quotients for building losses of the 19 PBIs⁷ (1972 – 2002). The distances between the grid lines correspond to those in Figure 18 (different scale).

example of this. Had Lothar occurred one week later, the damage would have fallen in the year 2000, lessening the effect on 1999. For this reason, and to reveal the evolution in the losses over 30 years, a ‘floating’ 3-year average was calculated.

Fig. 18 shows a rise at the beginning of the 1980’s. The average loss quotients are somewhat higher after 1981 than in the period from 1972 to 1981. Variability rose during the 1980’s. In the final decade, an even steeper increase in variability is evident.

The role of prevention

Further natural catastrophes must be expected in the future. The responsibility to be carried by individuals and communities in handling the losses must be formulated. In the future, prevention (protection and mitigation) will play an increasingly important role.

The PBIs are extending their prevention activity, which has proven its effectiveness in the domain of fire hazard over several decades, to also include natural hazards⁸. In the case of PBIs, protection means that buildings are constructed taking a certain extent of natural hazards into account. Should a more serious event occur, a well-trained and equipped fire service can help to mitigate the resulting damage. Finally, the compulsory public building insurance, only available through the PBIs, guarantees that all buildings are adequately insured and that losses are fully compensated. The synergies of building protection, organised emergency services and insurance leads to a comprehensive, inexpensive and mutual insurance cover. Therefore, the regulation of elemental loss insurance and prevention is carried out in an exemplary manner by the PBIs in Switzerland compared to European standards.⁹

- 1 Public building insurance companies exist in the following cantons: Zurich, Bern, Luzern, Nidwalden, Glarus, Zug, Freiburg, Solothurn, Basel-Stadt, Basel-Land, Schaffhausen, Appenzell-Ausserrhoden, St. Gallen, Grisons, Aargau, Thurgau, Waadt, Neuenburg, Jura. Cantons without public building insurance companies: Genf, Uri, Schwyz, Ticino, Appenzell-Innerrhoden, Valais, Obwalden.
- 2 Elemental losses: sudden and unexpected damage caused by storm, hail, floods, avalanches, snow pressure, debris flow, landslides, rockfalls, collapsing cliff faces and rock avalanches.
- 3 Wanner C., Vorbeugen – schützen – entschädigen. Die Entstehung der Elementarschadenversicherung in der Schweiz. Lizentiatsarbeit, Historisches Institut der Universität Bern, 2002.
- 4 Building losses: Damage to immovable parts after deducting the excess of the policyholder, excluding losses to furniture and the costs of business interruption.
- 5 The determination of the insured assets and the damage assessment is carried out by trained internal and external building professionals (architects, building engineers, etc.). For this reason, and owing to the almost complete registration of the damage, high data quality is assured.
- 6 In cantons with public building insurance companies, all buildings are insured against elemental losses.
- 7 Losses in cantons without public building insurance companies are not included in the Figure (cf. footnote 1). Thus the floods in Brigue in 1993 and the flooding in Ticino and Valais in October 2002 are not included.
- 8 Kantonale Gebäudeversicherungen, Manifest der Kantonalen Gebäudeversicherungen zur Elementarschadenverhütung, 2001.
- 9 von Ungern-Sternberg T., Gebäudeversicherung in Europa – Die Grenzen des Wettbewerbs. Haupt Verlag, Bern, 178 S., 2002.

1.6.4. Extreme events from the standpoint of the insurance business

Gerry Lemcke

The losses due to natural events fluctuate from year to year. The annual growth in insured losses amounts to approximately 5.2%. Two-thirds of all losses due to natural hazards are of atmospheric origin. Any change in the climate has the potential to alter the frequency and intensity of these events. By application of the precautionary principle and the development of new products, the insurance business is exerting its best efforts to provide adequate cover now and in the future

With its total insured losses¹ of 28.6 billion USD, and incurred losses of 7 billion USD, 1999 was the second most expensive year in the history of the insurance business worldwide, and ranks among the record years subsequent to 1989. In the period 1970-2000, Swiss Re's Sigma statistics show 47 cases of damage with losses extending into the billions. Of these, 33 are attributable to the years 1989-2000. The losses due to natural events are characterised by extraordinary fluctuation (Fig. 21). At an annual average loss quota of 20.2 billion USD since 1989, the standard deviation was 8.2 billion USD. On average, storms contribute 11.0 billion USD, earthquakes 2.0 billion USD and flooding 1.1 billion USD. The remainder is distributed among 'other risks' such as tornados, hailstorms and earthquakes. The growth rate in insured losses due to natural hazards is at present approximately 5.2% per year. If these figures are simply extrapolated over the next 20 years, soci-

ety and the insurance companies will be confronted with annual average insured losses of 60 billion USD in 2020.

The Lothar storm, together with Martin, which is mostly taken in conjunction with it, were reported in the press as records of the century. They claimed 80 human lives, of which 13 occurred in Switzerland, involved losses to the national economy of the order of 12 billion USD and insured losses of some 5.8 billion USD. With the exception of the storm damage in 1990 caused by Daria, Herta, Vivian and Wiebke, losses due to storms of this magnitude have never before occurred. Although regarded from a European perspective, Lothar and Martin were of only average intensity, the fact that these two storms followed one another in short succession brought the European prime insurers to their financial limits. Typically reinsurance programmes are designed to protect against isolated and very seldom events, but not against several successive events of this kind.

In recent years, vulnerability to natural hazards, and thus the potential risks, have drastically increased through demographic movements, technological progress and sozio-economic factors. Today, almost 40% of the world's population lives in coastal regions that are disproportionately vulnerable to natural hazards. Even assuming the risk from natural hazards were to remain constant, the likelihood of incurring



very substantial losses would still increase simply through the growth in insured assets. Over the past decade, the losses to the national economy were some 8 times higher, and the insured losses some 12 times higher, than in the 1960s.² Even though it is widely accepted that the increase in insured assets is mainly responsible for this trend, variations in the frequency and intensity of natural hazards due to climate change cannot be neglected.

Increased risk potential

The phenomenon of extreme events cannot be reduced to physical or statistical quantities. Rather, it results from the intensity and frequency of an event, and the material and immaterial assets involved. From the point of view of the insurance business, it is absolutely essential in assessing extreme events to couple these with the monetary losses incurred. From a humanitarian standpoint, however, this approach must be questioned. It should always be borne in mind that non-insured losses have to be carried by the owner or the community at large. In the developing countries, this may have serious consequences, as in the case of hurricane Mitch, which devastated Honduras in 1998, claiming 9000 human lives.

Some two-thirds of all losses from natural hazards are of atmospheric origin, e.g. caused by storms, flooding or hail. Basically, any change in the climate – i.e. of the global energy content of the atmosphere – has the potential to alter the frequency and intensity of regional – or at least local – climatic events.

Climate change is mostly discussed purely in terms of changes in the long-range average values. In this, it is often overlooked that average values in fact arise from a trend. The following points should therefore be borne in mind:

- Fluctuations in the average value result from fluctuations in the frequency and/or intensity of events. The increase may apply both to 'normal' and infrequent events. Should the probability of occurrence of an extreme event alter, this has a major effect on the magnitude of a hypothetical high-

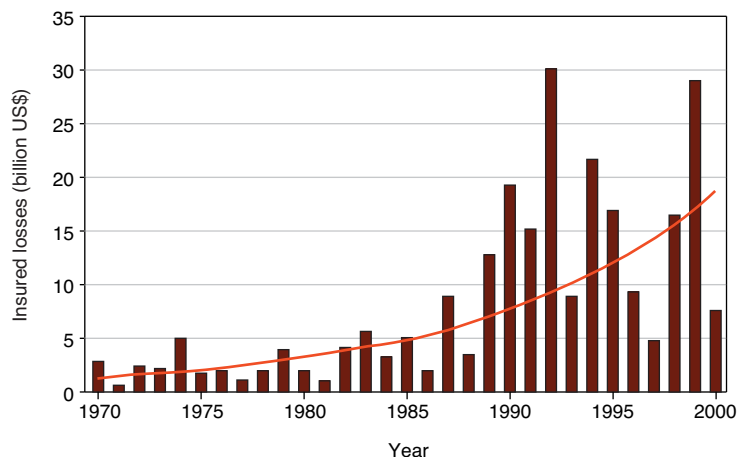


Fig. 21 Insured losses for natural catastrophes between 1970 and 2000 in billion USD at 2000 prices (Swiss Re Sigma statistics, adjusted for inflation).

loss scenario (EML scenario), which is defined in terms of very rare extreme events.

- Where events of average magnitude increase in frequency, this has a direct effect on the so-called basic loss burden: such events absorb a large fraction of the premiums set aside for more seldom natural catastrophes.

Whether, and to what extent, global warming may lead to an intensification of natural hazards and to changes in their frequency is not at present clear. Although the acceleration of the hydrological cycle already appears to be responsible for an increase in heavy precipitation events, there are no clear indications that this may be true for changes in winter storm activity. Nonetheless, it is clear that even a slight increase in the frequency of storms of the magnitude of Lothar would have a major effect on present and future insurance premiums.³

Role and scope of reinsurance

The insurance business is closely following developments in losses, which have risen sharply over the last 10 years. The principal procedures to ensure adequate coverage now and in the future are the application of the precautionary principle, including proactive risk management and risk assessment based on the latest scientific studies, and – in addition to the classical insurance systems – the development of innovative products such as capital market transfer (so-called Cat bonds) and weather derivatives.

Risk management is cast significantly wider

than the provision of technical structures for combating natural hazards. It includes the development of public awareness as a principal element. It is important that the public should become aware of the extent to which present-day technologies and modern lifestyles, in conjunction with the changing climatic conditions, are creating a risk potential that cannot always be carried and absorbed by third parties as at present. Those who wish to build in highly exposed areas subject, for example, to flooding, must either be prepared to carry the higher risk themselves, or to pay a higher insurance premium to cover it, ensuring that the burden is not placed on the community. Where changes affecting the community are concerned, such as an increase in the frequency of floods due to climatic changes, the available capacity must be used to cover large-scale losses, and not the petty losses. At the present cost contribution of the policyholder of 0.2% of the insured sum, the major part of the coverage is absorbed by small and petty losses, which do not represent a threat to individuals' existence.

Risk assessment is an important part of risk management and deals with the application of scientific know-how to the assessment of natural hazards. Probabilistic techniques are used to model natural hazards, the distribution of assets, the geographical distribution and the insurance provisions, and to estimate the occurrence of infrequent events via the loss frequency characteristics with sufficient precision. This also requires a precise record of the location of

exposed assets and their quality, and a complete record of historical events.

Concentrated efforts to further develop the classical insurance models (e.g. non-proportional insurance models and alternative risk transfer) have enabled existing insurance and reinsurance capacities to be constantly expanded. However, there are limits to the extension of classical models, particularly since additional capacity is mainly demanded in areas already displaying a high rate of coverage. This fact militates against the demand for diversification, i.e. risk compensation over space and time, and results in sharply rising premiums, so that the cost of coverage may become exorbitant in certain areas.

Both to protect its own interests and those of policyholders, it is an important task of the insurance business to assess the current and the future direct and indirect consequences of the changing climate. Despite major uncertainties concerning the precise consequences, this must be done at the earliest time. It must be remembered that the development of insurance products to cope with changes in demand, e.g. in the case of floods, requires substantial time expenditure.

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- 1 We are concerned here solely with losses resulting from natural hazards. Man-made extreme events, such as those in the USA on 11 September 2001, are not included.
 - 2 Müncher Rück, Nat Cat Service, 2001.
 - 3 Swiss Re, Despite continued price erosion and overcapacity: Cat markets on the rebound? 1999.