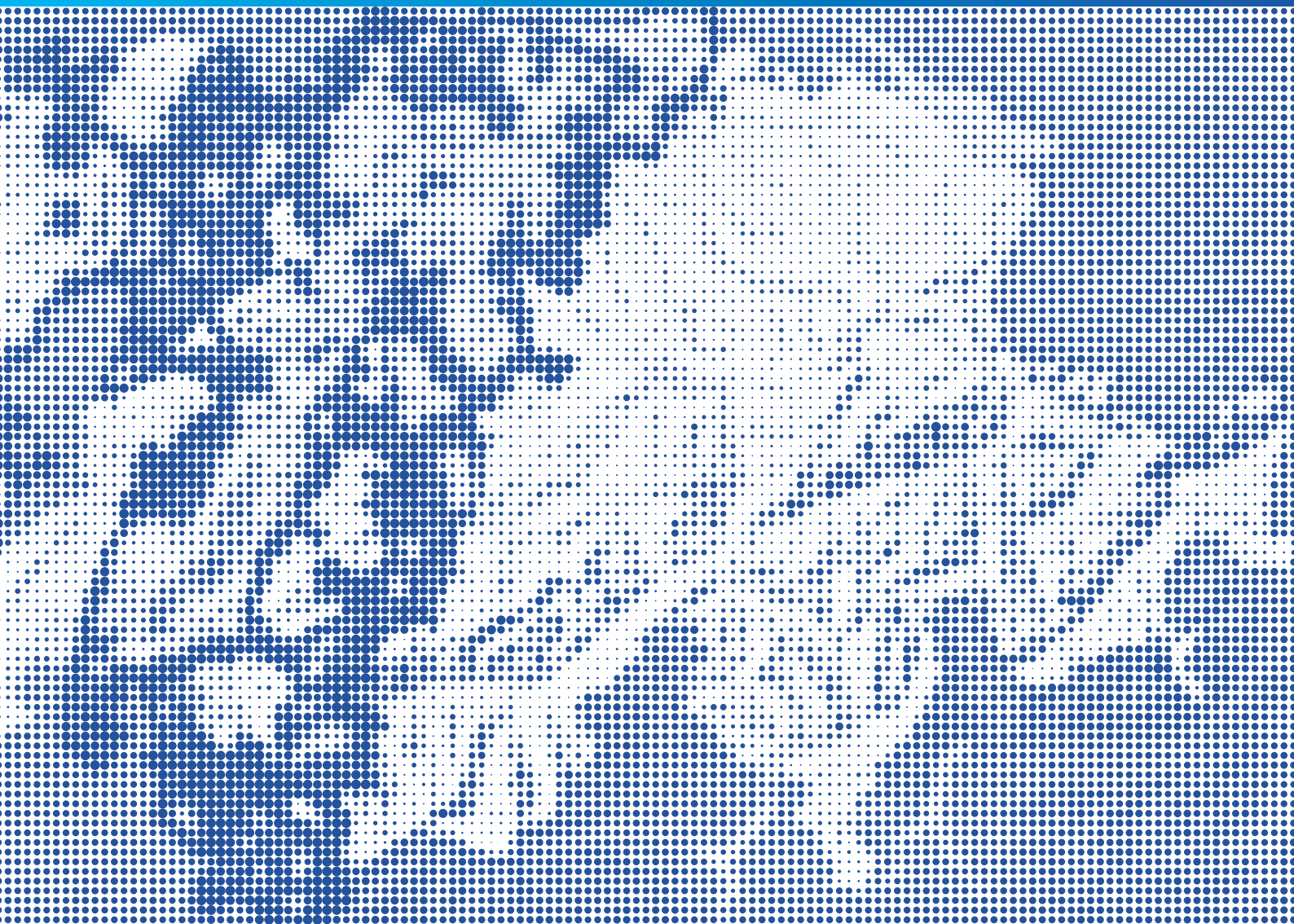
Swiss Re

Floods in Switzerland – an underestimated risk



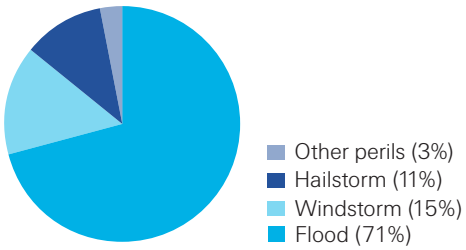
Floods are the most important natural peril in Switzerland. And Swiss Re's new probabilistic model makes one thing clear: it would not take much for the magnitude of flood damage to exceed that of the August 2005 flood event. The entire insurance industry is affected, and the private insurers are potentially even more at threat than the state-owned buildings insurers. Socio-economic and climatic changes are set to reinforce the trend towards ever bigger losses.

Flood losses are significant

In recent decades, Switzerland has been hit by a wide range of natural catastrophes. Floods, hailstorms, windstorms and avalanches caused economic losses of differing proportions, the lion's share of which was borne by the insurance industry.

But how was the claims burden from natural catastrophes in Switzerland over the last 40 years distributed in terms of the perils involved? Flood losses accounted for 71% of the claims burden, while losses from windstorms and hailstorms made up 15% and 11% respectively (Figure 1). This claims experience leaves no doubt that floods are the most significant natural peril facing the Swiss insurance market.

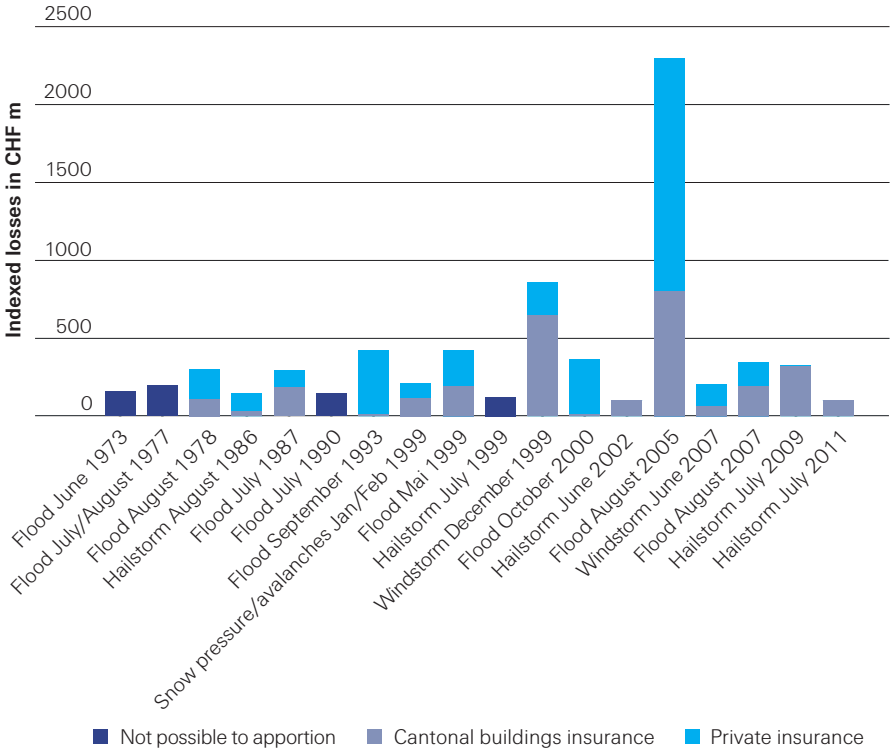
Figure 1: Losses from selected natural-peril events over the period 1973 to 2011, broken down into flood, windstorm, hailstorm and other perils (source: Swiss Re sigma DB).



The flood catastrophe of August 2005 generated losses of CHF 2.3 billion, making it the largest insured loss in Switzerland in the last 40 years (Figure 2). The main areas affected by the catastrophe were the Alpine foothills, and Central and Eastern Switzerland. But Western Switzerland and Ticino have also had their fair share of floods in the past, as the flood events of October 2000 and September 1993 demonstrate.

Figure 2: Indexed insured losses from selected natural-peril events in Switzerland between 1973 and 2011 (source: Swiss Re sigma DB). The indexing is based on the increase in insured values.

Selected natural-peril events in Switzerland for the period 1973–2011



The events shown in Figures 1 and 2 are based on the data stored in Swiss Re's *sigma* natural catastrophe database. Selected major loss events in Switzerland between 1973 and 2011 were analysed, with the focus being placed on the insured losses paid by the private insurance industry and the cantonal buildings insurers. The loss figures were indexed on the basis of the increase in insured values and contain only the insured damage to property and associated business interruption losses. Neither damage to infrastructure nor other economic losses were included.

The dual insurance system in Switzerland

Cantonal buildings insurers

Cantonal buildings insurers (CBIs) exist in 19 Swiss cantons. The owners of buildings located in those cantons are legally obliged to take out insurance with the cantonal insurer against fire and natural perils (ie flood, windstorm, hailstorm, avalanche, snow pressure, rockslide, falling rocks and landslide).

Private insurers

In the so-called GUSTAVO cantons – ie in the cantons of Geneva, Uri, Schwyz, Ticino, Appenzell Innerrhoden, Valais and Obwalden – and in the Principality of Liechtenstein, damage to buildings is insured with private insurance companies. Building contents is covered by private insurers across the whole of Switzerland, with the exception of the cantons of Vaud and Nidwalden.

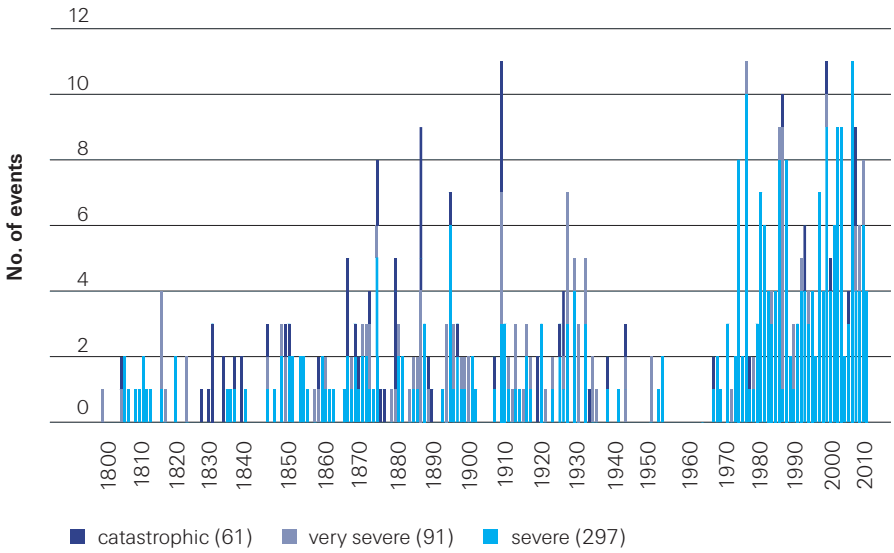
The Restaurant Rössli near Unteraegeri (Canton of Zug) flooded after the heavy rainfall at the end of August 2005.

More development – greater loss potential

Looking back at the last 200 years, we can discern alternating active and passive flood phases, each generally lasting for several decades. Figure 3 shows the number of flood events since 1800. Based on their respective total loss amounts in today's money, the events are classified as being either "severe," "very severe" or "catastrophic" in accordance with the definition by G. Röthlisberger (Unwetterschäden in der Schweiz [Severe weather damage in Switzerland], Berichte der Eidgenössischen Forschungsanstalt für Wald, Schnee und Landschaft, No. 346, 1998). Severe events correspond to a loss amount of CHF 2–20 million, very severe ones to CHF 20–100 million, while catastrophic ones are those exceeding a loss amount of CHF 100 million. The chart reveals that, since the mid-1970s, we have been in an active period with an above-average number of flood events.

In addition to these active and passive phases, settlement trends play a key role, especially in the period since World War II. While areas subject to flooding became better protected during this period, more and more land was developed for building purposes. There has been a marked increase in the amount of property located in areas traditionally exposed to flooding, only in Central Switzerland, but also in the more mountainous cantons. This means that if a flood is severe enough to breach dykes and overcome other flood protection measures, its effects quickly amount to catastrophic proportions because much more property is at risk.

Figure 3: Number of flood events in Switzerland since 1800 (A. Gees, University of Berne – until 1996; thereafter figures kept by Swiss Re). The events are classified in accordance with G. Röthlisberger (Unwetterschäden in der Schweiz [Severe weather damage in Switzerland], Berichte der Eidgenössischen Forschungsanstalt für Wald, Schnee und Landschaft, No. 346, 1998).



Floating debris and wreckage tend to accumulate at bridges and other bottlenecks during extreme flood events and, by obstructing the flow of water, can lead to unexpected high claims. Swiss Army soldiers clear driftwood from the promenade in Berne's Mattenquartier in August 2005.

When historical data is not enough: Swiss Re's flood model for Switzerland

Our urban world has been changing at breakneck speed in recent decades. Whether for residential, commercial or industrial purposes, the amount of land that is built on has expanded vigorously year on year. This trend means that historical data is of only limited use in preparing hazard analyses, especially from a long-term perspective. The past gives us an indication of the frequency and general location of floods, but in order to forecast their potential loss burdens, we need to take into account the protection measures, the geography and the current value of the property located in the exposed regions. The probabilistic models already in widespread use in the insurance industry are well suited to this purpose. Thanks to these models, it is possible to make clear statements on the real exposure.

Only a few years ago, it was impossible to develop probabilistic models for flood damage, but the advent of digital terrain models and high-performance computers have changed that.

If such models are combined with the claims data described earlier, it becomes possible to make predictions for extreme events with long return periods (RP). Swiss Re's current estimate of the potential for property damage (including business interruption losses) through flooding in Switzerland is for a loss amount of CHF 4.4 billion every 100 years, CHF 6.7 billion every 200 years and CHF 7.8 billion every 250 years (see Table 1). These figures include neither policyholder deductibles nor the event limits set by private insurers. However, they do take into account special factors such as sediment deposits, floating debris, contamination, eg through escaping oil, as well as the claims inflation triggered by the huge demand for repair work, etc.[1] In Switzerland, policyholder deductibles have only a very slight impact in the event of large flood events, reducing the total loss only by a single-digit percentage figure.

The August 2005 event was far removed from a worst case scenario.

It is evident from the simulations that, with damage totalling CHF 2.3 billion, the event of August 2005 was far removed from a worst-case scenario. According to the Swiss Re flood model, a loss of this magnitude has a return period of just 45 years. This figure – or rather the event set from the model – is based on the assumption that the current frequency of events will continue (see Figure 3).

Over long return periods, flooding is clearly the biggest natural-peril threat in Switzerland compared with windstorm and hailstorm. According to Swiss Re's probabilistic windstorm and hailstorm models for Switzerland, the 100-year flood loss is almost twice as large as the 100-year windstorm loss. The difference between 100-year flood and 100-year hailstorm events is greater by a factor of three, and these factors are higher still for longer return periods.

Table 1: Modelled insured property losses due to floods for different return periods, in CHF billion.

RP/years	Modelled losses/CHF bn
100	4.4
200	6.7
250	7.8

[1] The deductible is that portion of a loss that policyholders have to bear themselves. Owing to the dual insurance system – part state, part private – in place in Switzerland, there is much variation in the conditions governing deductibles. The deductible for natural-peril losses under household insurance, for instance, is CHF 500 if the policyholder is privately insured. In the case of buildings insurance, deductibles vary enormously depending on the cantonal buildings insurer or private insurer providing the cover.

Scenario for Zurich

The flood zones for the greater Zurich metropolitan area (Figure 4) clearly show the size of the geographical extent of the property exposed to extreme flood events. The shaded zones are those with an average return period of between 50 and 500 years. The return periods refer to specific locations and should not be confused with the return periods for loss events mentioned earlier.[2]

Figure 4: Hazard zones with 50-year (dark blue), 100-year (mid-blue), 250-year (light-blue) and 500-year (buff) return periods for the greater Zurich metropolitan area (source: Swiss Re CatNet, www.swissre.com/catnet).

After a flood catastrophe in the city centre of Zurich was narrowly averted in 2005, the Zurich cantonal authorities decided to improve flood protection measures. To this end, a detailed flood scenario for the Sihl River was compiled for the city of Zurich in cooperation with the cantonal buildings insurer and other experts. The potential economic loss (excluding business interruption losses) of an extreme flood event such as the one that occurred in 1846 is estimated at over CHF 5 billion for Zurich alone. As such an extreme flood event would not only affect Zurich, but would also impact on large parts of Switzerland, the total loss could well be many times that amount.

From experience we know that over 50% of the damage caused by floods in Central Switzerland is insured. In other words, an insured loss of almost CHF 8 billion, such as Swiss Re expects to occur once every 250 years, is well within the realm of possibility. Against this backdrop, it is hardly surprising that the cantonal experts spoke of the loss potential having been grossly underestimated until now.

[2] The official hazard map of the canton of Zurich shows less extensive areas exposed to flooding. This more conservative perspective was corrected by calibrating the statistical models against past losses.

Who foots the bill for insured flood losses?

Whether – and to what extent – private insurers or the cantonal buildings insurers have to pay for flood damage in Switzerland depends on where the catastrophe occurs. For instance, private insurers covered around 65% of the damage caused by the August 2005 floods, but bore almost the entire loss in the flood events of October 2000 and September 1993, as there are no cantonal buildings insurers where the damage occurred – in the cantons of Ticino and Valais.

The Swiss Re flood model allows the different geographical distributions of the portfolios to be quantified.

Comparing the portfolios of individual insurance companies, we see varying exposures to flood losses. These can be quantified using the Swiss Re flood model and are mainly attributable to the different geographical distributions of the portfolios. If we look only at the events of the last ten years, including the major loss event of 2005, we might draw the hasty conclusion that portfolios with heavy exposure to Central Switzerland are more at risk from flood losses than those with more even exposure to the whole of Switzerland. However, the Swiss Re model includes all possible flood scenarios, and it is clear that portfolios with heavy exposure to property in Southern and Western Switzerland are as much at risk as portfolios with greater exposure to Central Switzerland.

Houses destroyed, debris, mud and boulders in the streets: a mudslide caused by heavy downpours led to major losses in Schlans, Canton of Graubünden, in November 2002.

Flood models for forward-looking risk management

Growing urbanisation and urban sprawl coupled with improved flood protection will almost inevitably result in higher losses when a flood catastrophe does occur. Should these protection measures fail in the event of a flood catastrophe, it will almost certainly mean higher losses than would have been the case before the flood protection was put in place and greater development occurred. The expected decrease in the frequency of flood events to be achieved through greater protection measures will do little to alter that.

In Switzerland, this method of assessing flood risks is still in its infancy.

The insurance industry in Switzerland would do well to focus on flood risk when preparing hazard analyses. Socio-economic and climatic changes are set to reinforce the trend toward ever bigger flood losses, serving to accentuate this necessity even more. Any risk management techniques based solely on current claims experience will grossly underestimate the flood hazard.

From the insurance industry's standpoint, the use of a model decisively improves risk management as it enables insurers to make consistent assumptions when assessing both the size of losses and expected annual loss burdens. It reveals the severe financial burden the insurance industry will have to bear as a result of such extremely rare cases. Thus, the use of a model prompts insurers to begin searching for solutions today, rather than after such loss events occur.

In Switzerland, this method of assessing flood risks is still in its infancy. The Swiss Re model is an important step in the right direction and delivers valuable pointers for state-of-the-art risk management.

Swiss Re developed its flood model in house. A team of natural-peril experts in Switzerland, the US and India is responsible for the project. In addition to enhanced transparency, the advantage of such an in-house model is that it enables the latest scientific findings and the company's own global experience to be combined and integrated in the model on an ongoing basis. Apart from its flood model, Swiss Re has also developed earthquake, windstorm and hailstorm models, all of which it utilises for its own risk management purposes.

Fire-fighters from Buchs provide help in Weesen (Canton of St. Gallen), which was hit by the devastating floods on 23 August 2005.

The flood model for Switzerland presented here draws on Swiss Re's many years of research into and experience of flood modelling. The model fundamentally comprises three main components, the hazard map, the probabilistic event set and the vulnerability curves.

The hazard map, which was compiled in conjunction with the Swiss Federal Office for the Environment, can be accessed via the latter's website.[3] It contains flood zones with return periods of 50, 100, 250 and 500 years. These zones were compiled with the aid of a digital terrain model, taking as parameters the horizontal and vertical distance of a point in the terrain from a body of water as well as the size of the relevant catchment area.

The second component of the model is the probabilistic event set. This is based on the flow volumes measured at 180 survey stations across the whole of Switzerland. The maximum monthly flow volume was measured at these stations between 1979 and 2008. Drawing on these flow patterns and their spatial correlation, it is possible to generate new events with the same statistical characteristics. The event set used comprises 120 000 monthly maximum flow volumes and thus covers a period of 10 000 years.

The hazard map and event set are used to simulate the water level at any given point. With the aid of vulnerability curves, the third component of the model, it is possible to calculate the expected damage to a particular property. The vulnerability curves are based on both loss analyses of past events and the assessments and estimates of Swiss Re experts. The model also factors in flood protection measures.

[3] http://www.bafu.admin.ch/naturgefahren/01916/06598/index.html?lang=de

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