

# the environment

Natural resources in Switzerland



## *Natural hazards concern everyone*

*How Switzerland is managing risks*



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# “What concerns everyone can only be resolved by everyone”



Image: FOEN

Full protection against natural hazards is not possible. However, Switzerland has learned from the natural disasters of the past and has developed an integrated risk management approach that reduces the risks to an acceptable level. Our response to natural hazards is of a high standard and is recognised internationally. Now, however, we are facing new challenges. Climate change is exacerbating natural hazards: rising temperatures and changes to precipitation patterns are expected to lead to significantly more debris flows, landslides, rockfall processes and floods. It is not just in mountainous areas that the hazards are increasing – Switzerland as a whole needs to adapt to the new scenarios, including more frequent, more intense rainfall, which might also lead to flooding in *your* basement.

Parliament intends to improve protection for the population, and in 2019 it tasked the Federal Council with providing the necessary resources to maintain and improve alert and warning systems. The aim is to develop new generations of storm warnings for today's mobile and digital society, and for people to be able to access, on their mobile device, continually updated, detailed, localised information about selected locations. In addition, there are plans to develop a warning system for mass movement hazards. The FOEN is currently building a warning system for landslides and mud flows that works in a similar way to the avalanche warning system. Using a number of warning levels, it tells people in which areas and with what probability slopes could become unstable because of current saturation levels. Monitoring of landslide areas is also being ramped up. Thanks to satellite radar interferometry (InSAR), it is now possible to monitor a large number of slope movements and to identify new ones. Regular analysis of InSAR data makes it possible to predict landslides in certain cases.

Monitoring, warning systems and protective structures alone are not enough to prevent damage completely. There is also a need for land-use planning measures and personal responsibility, for instance investments in property protection or adapting a building's use to the hazard in question. Everyone – from house owners to tenants, the national railway to power stations, hoteliers to garage owners – can be affected by natural hazards, anywhere in the country. As Friedrich Dürrenmatt once wrote, “What concerns everyone can only be resolved by everyone.” Only if all players take on their responsibility can we avoid new risks and create comparable levels of safety for people, property and vital natural resources throughout Switzerland.

Paul Steffen | Vice Director FOEN

# Natural hazards

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Image: ky

Extreme natural events are a regular occurrence in Switzerland. Every community – whether in the mountains, in the Jura or on the Swiss Plateau – can expect some kind of natural disaster. *The environment* presents five of them, and hears from some of those affected (pp. 12–19). The cover image shows flooding in Val-de-Ruz (NE) in 2019 following a heavy storm. The stream that flows through the villages of Dombresson and Villier rose and burst its banks; the flood waters swept away everything in their path. One person died and the damage cost millions of Swiss francs.

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Laurent Gillieron

## Introduction

# Switzerland at a glance

Due to its geography and climate, densely populated Switzerland is often affected by water-related hazards such as floods or debris flows, landslides, rockfalls and avalanches. Strong earthquakes are rare, but, as history shows, they can occur and represent one of the biggest risks. Due to population growth, the expansion of settlements and infrastructure, the rise in mobility, and the effects of climate change (e.g. extreme precipitation events), risks due to natural hazards are increasing. **Text:** Dorothea Wabbels

Switzerland lies in a temperate climate zone at the heart of Western Europe, bordering on France, Germany, Austria, Liechtenstein and Italy. Its territory totals 41,285 square kilometres (km<sup>2</sup>), of which almost two thirds are located in the Alpine region. The intensively developed residential and economic zone is concentrated on the relatively flat Swiss Plateau, which accounts for just 23 percent of the country's territory. Nestled between the Jura Mountains in the North West and the foothills of the Alps in the South, this plain, which ranges from 50 to 100 kilometres in width, extends in a north-easterly direction from Lake Geneva to Lake Constance.

The hazard situation in Alpine Switzerland is influenced by the significant differences in altitude over a small area, and relatively high precipitation volumes compared with the rest of Western Europe. Temperature increases due to climate change are also higher compared with the rest of Europe.

### Densely populated Swiss Plateau

Switzerland's population of around 8.6 million people is concentrated in the lowlands. In addition to the industrial production centres, most important service operations, as well as the main road, rail and aviation infrastructure, all the major cities, i.e. Geneva, Lausanne, Bern, Lucerne, Zurich and Basel, are located there. With a population density of more than 350 people per km<sup>2</sup>, the Swiss Plateau is one of the most densely populated areas in Europe.

### High levels of runoff

Due to the prevailing westerly winds and the country's proximity to the Atlantic Ocean, the Mediterranean Sea and the North Sea, a lot of humid air is blown towards the Alps. Rain fronts often accumulate for days in front of this meteorological barrier, giving Switzerland above-average annual precipitation volumes of around 1,460 litres per square metre (m<sup>2</sup>). A good two thirds of this, i.e. almost 1,000 litres per m<sup>2</sup>, is discharged to other countries through an intricate network of streams and rivers. Mean water runoff in Switzerland is almost four times higher than in the rest of Europe and the world. A total of 40 billion cubic metres of water flow into the Mediterranean, the North Sea and the Black Sea via the main rivers, i.e. the Rhine, Rhone, Ticino (via the Po) and Inn (via the Danube). This explains Switzerland's crucial role as a water reservoir for Western Europe.

### Almost countrywide flood risk

Due to the extensive network of watercourses, the combined length of which totals around 65,000 kilometres, and due to the extreme differences in altitude of up to 4,000 metres over a relatively small area between the Alps and the Swiss Plateau, floods can occur almost everywhere in Switzerland. Moreover, the steepness of the terrain exacerbates erosion and therefore the risk posed by landslides and debris flows. Warmer periods, when the seasonal snow and glacier melt in the Alpine region coincide with intensive storms or orographic precipitation,



Val-de-Ruz (NE) in June 2019: the stream burst its banks and the flood waters swept away everything in their path.

Image: ky

are particularly critical. In this situation, rivers and lakes often break their banks and flood the valley plains.

#### **Wide range of hazards**

However, the mountain regions are significantly more vulnerable to gravitational natural hazards than the Swiss Plateau. Heavy snowfall and unfavourably structured snow cover create a risk of avalanches at high altitudes, while heavy rainfall during the warmer seasons can trigger landslides and debris flows. Rockfalls and landslides can also put both settlements and important transport routes at risk, as demonstrated, for example, by the blocking of the Gotthard motorway, a key trans-Alpine road axis between Northern and Southern Europe, in 2006, or the disastrous rock avalanche and debris flow in 2017 at Piz Cengalo (Bondo) in Grisons. The above-average climate warming in the Alpine region and the resulting thawing of the permafrost and retreat of the glaciers will cause greater volumes of loose material to be mobilised in the future; a development, which represents an additional threat to settlements, transport routes and other infrastructure. Longer periods of drought also increase the risk of forest fires, particularly in the south of Switzerland. Overall, climate change is expected to increase the intensity of precipitation and storms, prompting the need for more measures to limit the extent of the damage caused by floods, hail and severe storms. Earthquakes tend to be a rare occurrence in Switzerland, however,

when they do occur they have the greatest potential to cause damage.

#### **Shared responsibility**

Every person and institution bears risks from natural hazards – both for themselves and for society. In addition, people influence the level of risk through their actions. As such, we are all stakeholders when it comes to dealing with natural hazards – albeit in different roles.

The FOEN is responsible for strategic management with regard to natural hazard prevention tasks, and provides financial and technical support to the cantons. It is up to the cantons to decide whether to organise these tasks centrally, or to delegate some of them to the communes, of which there are 2,255 in Switzerland (as of 1.1.2020).

Given the nature of climate change and increased development in hazardous zones, the challenge lies in maintaining existing levels of safety and in avoiding new unacceptable risks. In a small country such as Switzerland, the task of dealing with these major challenges and protecting against natural hazards is and will remain a shared responsibility.

## Increasing risks

## Anywhere at any time

It is not just in Switzerland's mountainous regions and near lakes and rivers that people are confronted with natural hazards, but all over the country. Because of urban development and climate change, the risks are increasing all the time, despite all the protection efforts. It is only by joining forces that the risks can be kept to a tolerable level for society. **Text:** Nicolas Gattlen

Extreme natural events are a regular occurrence in Switzerland. We remember, for instance, the rock avalanche and debris flow in Bondo (GR) in 2017, the winter storm Lothar in 1999 and 100-year floods, like those of August 2005. However, the threat of hazards is not restricted to mountainous regions and areas near lakes and rivers. Every part of Switzerland is exposed to natural hazards and anyone could be affected. Data collected by the Federal Institute for Forest, Snow and Landscape Research (WSL), for instance, shows that in the past 45 years, four out of five Swiss communes have suffered damage as a result of debris flows or flooding. Landslides affected two in five communes in the same period.

*Around 20 percent of the population lives in zones that could be affected by flooding.*

**Up to 100 billion Swiss francs**

In Switzerland, earthquakes are the natural hazard with the largest potential for damage. The authorities estimate that an earthquake like the one that occurred in Basel in 1356, with an estimated magnitude of 6.6, would leave up to 2,000 people dead, 5,000 seriously injured and 20,000 with minor injuries, and would cause material damage costing 50 to 100 billion Swiss francs. Although powerful earthquakes are rare in Switzerland, history and

research nevertheless show that they can still occur at any time and in any part of the country. A major earthquake (magnitude 6 or more) can be expected in any part of Switzerland every 50 to 150 years. However, the risk is highest in Valais, followed by Basel, Grisons and the Rhine Valley in St Gallen.

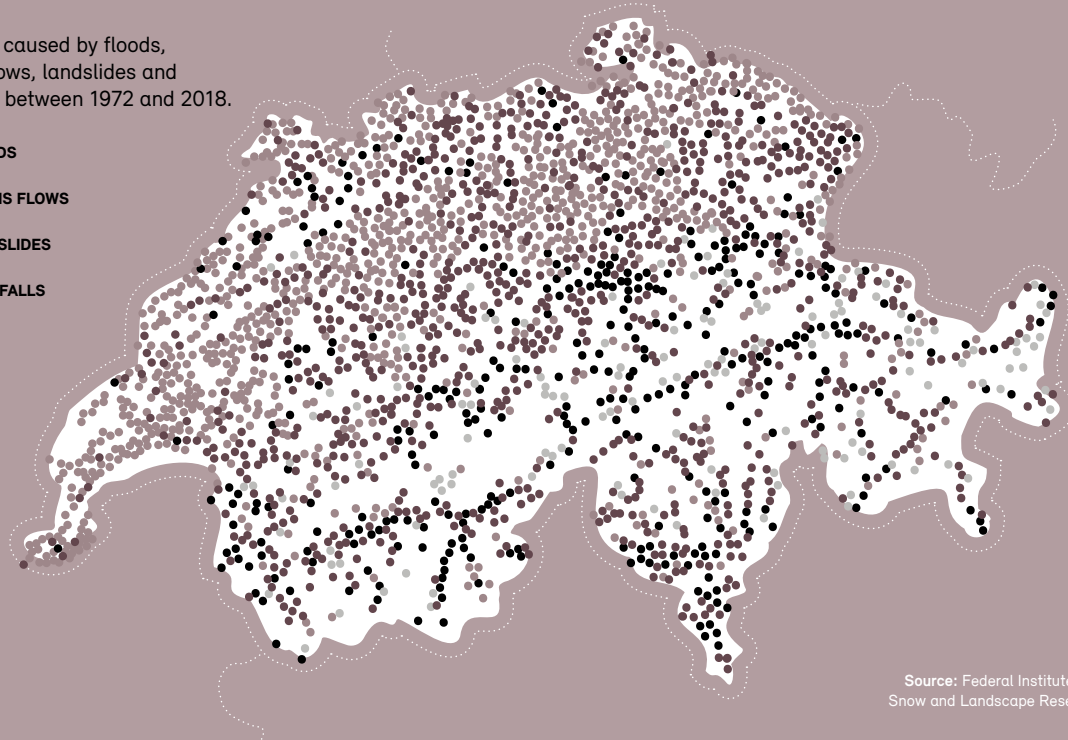
Heavy rainfall can also cause considerable damage anywhere in the country. This was seen in July 2017 in Zofingen (AG), where a three-hour storm left many basements, garages, gardens and underpasses submerged. Although the River Wigger burst its banks in some places, it was not the primary culprit. Rather, the huge volume of water was unable to drain away because of the ground being partially sealed. The surface runoff risk map shows that around two thirds of buildings could be affected by heavy rainfall. Surface runoff accounts for up to 50 percent of flood damage following heavy rainfall, and costs around 140 million Swiss francs per year. Rivers, streams and lakes bursting their banks cause the rest of the flood damage.

Switzerland is a densely populated country with a large number of rivers and lakes, so the flood risks are considerable: around 20 percent of the population lives in zones that could be affected by flooding. And these regions are home to 30 percent of the country's workplaces and 25 percent of its material assets. The main risks are in the agglomerations. Between 1972 and 2018, floods, debris flows, landslides, rockfall processes accounted for around 305 million Swiss francs of damage per year on average. Over 90 percent of material damage is caused by flooding and debris flows, and just

# THE WHOLE OF SWITZERLAND IS AFFECTED

Damage caused by floods, debris flows, landslides and rockfalls between 1972 and 2018.

- FLOODS
- DEBRIS FLOWS
- LANDSLIDES
- ROCKFALLS



Source: Federal Institute for Forest, Snow and Landscape Research (WSL)

under 10 percent by landslides. Material damage caused by avalanches, rockfall processes is low by comparison. However, rockfall processes, landslides and avalanches often lead to loss of life.

### More frequent and more intense

We can expect floods, debris flows, landslides and rockfall processes to become more frequent as a result of climate change. It is not just the frequency of natural hazards that is expected to increase, however, but also their intensity. Higher winter precipitation levels and the simultaneous rise in the snow line are increasing the risk of flooding in the winter months. Because of the expected increase in frequency and intensity of heavy rainfall, there is also likely to be a higher risk of flooding and, in particular, of damage caused by surface runoff at other times of the year as well. At the same time, Switzerland is facing more frequent forest fires and drought periods in the summer months when there is low rainfall. Higher temperatures are driving glacier melt in the mountains

and thawing the permafrost, which is leading to a destabilisation of rocky mountainsides and scree slopes. In general, the hazard situation will change and intensify according to the season and region. In addition, the risks from natural hazards are aggravated by more intensive land-use and the

*Over 90 percent of material damage is caused by flooding and debris flows, and just under 10 percent by landslides.*

spread of settlements in hazardous zones. Building and infrastructure assets are constantly increasing in value, partly because of more expensive construction methods and larger dwellings. Sophisticated protective structures alone are not enough

to prevent damage completely. In order to achieve and maintain an acceptable level of safety in the long term, there is also a need for risk-based land-use planning and for all stakeholders to work together. In Switzerland, natural hazard protection and emergency response management are joint tasks shared by the federal government, the cantons, the communes, insurance companies and private individuals. On the following pages we show which tasks are performed by which agents,

and what contribution individuals can make to natural hazard protection.

*Link to article*

[www.bafu.admin.ch/mag2020-2-01](http://www.bafu.admin.ch/mag2020-2-01)

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## Switzerland's global involvement

In the years 2008 to 2018, the Red Cross recorded 3,750 natural disasters worldwide. Around two billion people were affected by the incidents and more than 700,000 lost their lives. Damage costing over 145 billion US dollars was caused each year. And the disaster risks will increase in future because of climate change, the destruction of the environment, population growth and poorly planned urbanisation. Switzerland has a great deal of experience in dealing with natural hazards and pursues a holistic approach to reducing risks – an approach that it also brings to bear in international committees and conferences, such as the Global Platform for Disaster Risk Reduction. This is the platform that regularly reviews progress in implementing the UN's Sendai Framework for Disaster

Risk Reduction and discusses new ideas for dealing with risks.

Disaster risk reduction is also a key part of the programmes of the Swiss Agency for Development and Cooperation (SDC) because natural disasters can destroy decades of development progress in one fell swoop. The SDC is also able to call on the FOEN's experience and expertise in prevention and protection projects. For instance, the FOEN has carried out training sessions in Bolivia on hazard and risk assessment. In Jordan, it is currently assessing how a national flood hazard and risk-mapping programme could be implemented, and in China it is supporting implementation of an integrated risk management approach in a large torrent drainage basin.





Image: Heike Grasser | Ex-Press | FOEN

## Matthias Buchecker

is a scientist working at the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL). His research focuses on the social science of landscape development, the landscaping of lakes and rivers, and natural hazards. Together with Elisabeth Maidl and Benjamin Wiederkehr, Matthias Buchecker conducted the national population survey on living with natural hazards.

### Risk awareness

# *“People who buy sandbags should not be branded as over-cautious”*

Social scientist Matthias Buchecker explains in an interview how we perceive natural hazards in our day-to-day lives, why we underestimate certain risks and why people in Switzerland need to take more responsibility for their own protection. **Interviewer:** Nicolas Gattlen

**People who live in Switzerland are exposed to a range of natural hazards. A survey that you conducted shows that people’s subjective assessments do not match the actual risk. Is this due to a lack of knowledge?**

Matthias Buchecker: In recent years, research has moved away from assuming that people have too little knowledge or awareness. This suggests they are not aware of the risks or are unable to identify them. Of course, there are differences in awareness levels, but a more important aspect is the difference in values. What we researchers see as a risk, others may see as only one aspect of an option. Spending the holidays in a chalet in the red hazard zone, for instance, may be risky, but it also offers a chance to experience the great outdoors. Therefore it is always about weighing up opportunities and risks.

**Risks are difficult for laypeople to assess. How can they weigh them up objectively?**

It is indeed difficult, partly because there is no shared understanding of the concept of risk. For us scientists, risk means the probability of quantifiable damage. The general public associates risk with responsibility, so they assess risks differently – mainly in terms of manageability, familiarity and long-term consequences. For instance, nuclear energy is seen as much more risky than smoking,

*“Spending the holidays in a chalet in the red hazard zone may be risky, but it also offers a chance to experience the great outdoors.”*

## A reminder for those with short memories

Although floods sometimes cause major damage and have a serious impact on those directly affected by them, they are quickly forgotten and usually disappear from the collective memory in just a few years. The Mobiliar Lab for Natural Risks at Bern University has therefore set up a website ([ueberschwemmungsgedaechtnis.ch](http://ueberschwemmungsgedaechtnis.ch)) as a “collective aide-memoire”. The website puts pictures (engravings, watercolours, etc.) and photos of floods from all over Switzerland in the public domain. Users can search by location and by time period. The oldest picture currently available dates back to 1572. The website operators are calling on the population to upload their own photos of flooding to the website and

to keep adding to the collection. The “collective flood memory” is intended to raise awareness of the threat of flooding. It can also provide the basis for decision-making in flood prevention and alert people to possible protective measures. Pictures are a vivid way of demonstrating the impacts of flooding. Natural disasters (floods, landslides, rockfalls and avalanches) are also being collected by the StorMe database. This is aimed primarily at experts, but the general public can also report incidents. A number of Swiss cantons provide public access to the StorMe register of natural disasters, e.g. via their geoportals.

even though a very rare nuclear disaster causes fewer fatalities and less damage than smoking causes around the world each year.

**According to this argument, the avalanche risk is likely to be underestimated as well, since Switzerland has a long tradition of managing this type of risk – unlike severe earthquakes, for example, which are rare here and with which the Swiss are not familiar.**

Avalanches are a hazard that we believe we have largely under control. They are perceived as a risk only when they affect our livelihoods. For instance, if a valley has to be closed because of avalanches, it could deter tourists. It is more difficult to ascertain the long-term consequences of earthquakes. We tend to think of one-off damage that can be repaired. Moreover, severe earthquakes are so rare in Switzerland that it is difficult for people to grasp the risk.

**When I read that the probability of a major earthquake happening in my region next year is 1 percent, it does not keep me awake at night.**

But if you extrapolate that for your lifetime, it gives a very different picture. Then, the probability of you

experiencing a major earthquake rises to between 40 and 60 percent. That should give you pause for thought!

**Nevertheless, the risk remains abstract because I have never experienced a severe or even medium earthquake, and none of my family or friends have suffered because of one. How important is personal experience? And what is the impact of media coverage?**

Sensational media reports in particular have little impact on risk awareness. Instead, they tend to prompt a fascination with the natural disaster and encourage a belief that it can not affect us: it is something that happens to “other unfortunate people”. However, someone who experiences it for themselves develops a stronger awareness of the hazard and is more prepared to take precautions. And it is not just personal experience that has an impact – experience within the community is also effective, especially in rural areas with high levels of social integration. People also remember extreme events for longer in these places. Events can sometimes remain in the collective memory for decades, whereas personal recollection does not usually stretch back more than 15 years.

**At the same time, however, we know that even people who have had dramatic experiences often rebuild their homes in the same place.**

A person's home is closely linked to their identity: people want to feel safe and in command. There is no place for hazards. There is also a lot of prestige and social status attached to a home. People do not like to admit that they have to bow to nature.

**So a high risk awareness does not necessarily lead to logical action?**

No. That is something we see with gambling too. Every gambler knows that the probability of losing is very high – but they still gamble. If other values are more important, probabilities become less relevant.

**It is interesting that in your survey a large majority say they would rather invest in safety than suffer losses as a result of natural hazards. They are also aware of their personal responsibility to do something about their own protection. But at the same time, they are astonishingly passive. How do you explain this discrepancy?**

One reason is that people trust the protective measures implemented by the authorities and emergency services. And good insurance cover also discourages many people from doing something about their own protection. Moreover, a majority of them are convinced that the cost outweighs the benefit. Without a doubt though, people's lack of knowledge and their perception that their own efforts will not have much impact contribute to their passive approach.

**What is the most effective way to communicate the necessary knowledge?**

It is vital that the community understands and discusses the relevance of preventive measures for natural hazards as an issue that affects everyone. Someone who buys sandbags should not have to worry about being branded as over-cautious. Taking precautions should be seen as setting an example. Hazard maps would be a good basis for discussion.

Exhibitions, competitions and guided tours to see traces of past incidents can also strengthen a community's awareness of natural hazards and encourage people to take preventive action.

**Protection against natural hazards is seen as particularly relevant in places where an incident has recently occurred. In places where nothing has happened for a long time, if at all, people see protection as less important compared with other concerns and interests. How is it possible to get local communities talking about natural hazard protection despite this?**

By linking the issue with the community's main concerns. This could be, for example, tourism in the region, or the future management of local resources such as water, land or forests. These kinds of integrated approaches are particularly important with regard to climate change, which will require comprehensive and expensive protective measures.

*Link to article*  
[www.bafu.admin.ch/mag2020-2-02](http://www.bafu.admin.ch/mag2020-2-02)

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Image: Ephraim Bieri | Ex-Press | FOEN

**Romy Biner-Hauser** has been the mayor of Zermatt since 2017. She is the first female mayor in the history of the world-famous resort. Trained in PR, she also works in the hotel industry.

*“Anyone following the international media might have thought Zermatt was facing a disaster. I was astonished by how wide the gap can be between self-image and public image. Although we were cut off from the outside world, we were not lacking for anything. Some people were frightened though. When it snows that hard and you are restricted in what you can do, it causes uncertainty for visitors. But I grew up here and experienced similar situations many times when I was younger.”*



Image: ky

Natural hazard

# Avalanche

At the beginning of 2018, Zermatt (VS) was repeatedly cut off from the outside world because of avalanches. Both the road and the railway line between Zermatt and Täsch were closed. Locals and around 13,000 tourists were trapped in the town and airlifts were arranged by helicopter.



Image: ky

Natural hazard

# Debris flow

In the evening of 11 August 2019, heavy storms caused the River Losentze in the village of Chamoson (VS) to overflow its banks. A car carrying two people was swept away by the debris flow. They are still missing.

**Guy Monnet** works in Chamoson's technical service department. His home overlooks the Losentze, which regularly brings debris flows through the village.



Image: Ephraim Bieri | Ex-Press | FOEN

*“It all happened incredibly fast, but we locals know that this small river can swell to a raging torrent in just a quarter of an hour following a big storm. From our house, I can see a pedestrian bridge that crosses the Losentze. People always go and stand there to get a close-up view of the spectacle. When the debris flow started there were tourists standing on the bridge. I immediately ran down there to warn them. The river regularly runs high, but I’ve never seen a debris flow as big as that before.”*



Alessandro Wellig works for the Grisons police and, as chief rescue officer of the Swiss alpine rescue centre in San Bernardino (GR), is responsible for Val Mesolcina and Val Calanca.

Image: Ephraim Bieri | Ex-Press | FOEN

*“That was a tragic accident; the herdswoman was just incredibly unlucky. If she had been standing only two or three steps to the side, she would not have been hurt. There have been more rockfalls in the mountains generally in recent years. We know which regions are affected, and when we are out and about in those areas we are more careful. It is hard to say whether this increased frequency is chance or a consequence of climate change. But I definitely have the feeling myself that more rock is coming down.”*





Image: ky

Natural hazard

# Rockfall

At 2.30am on 26 July 2013, 130,000 cubic metres of rock fell on the del Lago alpine meadow in Val Mesolcina in Grisons. A herdsman standing by the alpine hut was hit by a rock and died. Seventeen participants and leaders of a youth camp were evacuated unharmed.



Image: ky

Natural hazard

# Landslide

It has been known for decades that the ground in Brienz/Brinzauls (GR) and on the local mountain is moving, and in recent years the rate of creep has increased. The measuring points in the village are now moving downhill by more than a metre per year, and those on the rock ledge above the village are travelling more than four metres per year. The church tower leans precariously to one side.

**Georgin Bonifazi** grew up in Brienz/Brinzauls, a village with a population of 100. He is a father of four, and a farmer – like his father before him. Much of the Bonifazis' land is located in the landslide area.



Image: Ephraim Bieri | Ex-Press | FOEN

*“Two years ago we built a new house here in Brienz because our children want to keep the farm going. The house is deliberately made of wood so that it will not be affected as much by the moving subsoil. Our entire existence is up here. If we had to leave Brienz, it would be a disaster for us. The critical area is constantly being monitored by lots of different instruments, so we’re not exactly in fear of our lives. Otherwise we would have to pack our bags immediately.”*

## Risk analyses

*“We were like detectives”*

Zurich lies in the middle of the Sihl flood zone, so damage can be expected in the event of flooding.

But where is this damage likely to occur and how severe will it be? And how can it be minimised?

We go on a tour of the city with two experts. **Text:** Christian Schmidt

Traffic is flowing in front of Zurich central station. Dörte Aller, an experienced risk manager, and Matthias Oplatka, head of the construction section at the cantonal Office of Waste, Water, Energy and Air (AWEL) of the Canton of Zurich, are ready to take us on a tour. Aller starts by telling us, “After this tour, you will see the city in a new light.” She is right.

**Flooding underground**

We dive into the underground world of Zurich central station. Standing in the midst of the commuter flow, Oplatka explains, “In Zurich, flooding primarily takes place underground. We expect no more than half a metre of water on the surface in most areas, so floods here don’t appear as dramatic as

out of action, even for just one week?” Zurich central station is used by half a million people every day.

So how can this risk be managed? How can it be assessed and evaluated? How can it be reduced? These are questions that Aller and Oplatka have been exploring with other experts and stakeholders since the floods of 2005, when the city almost suffered a catastrophe. That was reason enough to investigate the risks and develop solutions.

We walk through the ShopVille underground shopping centre. Aller recalls the start of the project: “We surveyed the city, which meant exploring it by computer and on foot. We were like detectives. The task was to assess the consequences of a potential flood and to find out which factors most affect the risk. Is it the frequency of floods, the size of the affected area and its use, or the vulnerability of the buildings and installations?” The Sihl not only poses a risk to 3,000 buildings, but also to the city’s infrastructure. “There are countless utility centres, server rooms, and heating and ventilation systems below ground level”, says Oplatka. “If water enters the basements, it becomes dangerous and expensive.”

We return to the surface and walk along Löwenstrasse. “What do you notice?” Aller asks the journalists. “Well – nothing, really.” But there is one small detail: some of the front doors are two steps higher than street level. Oplatka says, “Many of these houses were built soon after 1910, when the memory of the flood was still fresh.” Two steps are enough, he explains, but in the meantime people have forgotten how sensible such simple measures can be.

*“Flood protection is teamwork and only works if discussions are ongoing.”*

Matthias Oplatka | AWEL

they do in Bern’s Matte district.” Aller adds, “During the last major flood in Zurich, in 1910, people were still driving horse-drawn vehicles through the flooded streets. Today, the consequences would be much worse. What would happen if the station was

# HAZARD IS NOT THE SAME AS RISK

In which areas are people, the environment, property or cultural assets exposed to serious risk? Looking exclusively at the hazard map (left) can lead to wrong conclusions: even in areas where the hazard level is low (yellow), the risk can be high, if it is an area that is used intensively. It is the combination of frequency and intensity of the hazard, the assets affected and the vulnerability to damage that determines the extent of the risk. For example, in Zurich there is a medium level of hazard

along the Kolbenhofbach (brown circle, left) because frequent floods can be expected with a low depth of flooding. The affected assets are few, so the estimated risk is small, or even zero. Along the River Sihl (purple circle, right), the hazard is low because flooding is expected to happen only rarely or very rarely. However, because of the large number of high-value, vulnerable assets in this area (including in the basements), the risk is medium to high.

**FLOOD HAZARD LEVELS**  
(COMBINATION OF FREQUENCY AND INTENSITY)



- Significant hazard
- Residual hazard
- Medium hazard
- No hazard
- Low hazard

**FLOOD RISK**  
(COMBINATION OF HAZARD, ASSETS AND VULNERABILITY)



- High
- Low
- Medium
- Zero

Source: AWEL

And how costly can the damage be? “Very costly”, says Oplatka. “For the kind of flood that occurs every couple of hundred years we would have to expect costs of over 6.7 billion Swiss francs.” But it is not possible to put a figure on all damage, such as interruptions to business operations or damage to the environment, which could amount to several times the estimated figure. The choice of protective measures has to take all the risks into account. “This is why it is important to involve all stakeholders early on”, explains Oplatka, “from the

various authorities to the affected businesses. That is how we create awareness and understanding, with laypeople and experts exchanging ideas.”

## How much risk should we accept?

We stop at the Gessnerallee car park by the river. Next to the exit, three metres below ground level and therefore at risk of flooding, there is a meeting room. “We made a point of holding meetings there”, says Aller. “It creates awareness of the risk. We learnt to change the focus of the discussions.

## Hazard information

The federal government has tasked the cantons with the production of hazard maps, which they must take into account in their planning for urban development and land-use planning. At the same time, the hazard maps are important for raising awareness among the population. Individuals can check the flood hazard level for their area on the relevant page of the FOEN website or on the canton's geoportal. A guide to reading the hazard maps can be found on the website of the PLANAT, National Platform for Natural Hazards ([planat.ch](http://planat.ch)). The new surface runoff risk map went online in summer 2018,

showing the flow routes in the event of heavy rainfall ([bafu.admin.ch/surface-runoff](http://bafu.admin.ch/surface-runoff)). A comprehensive overview of all acute hazards – from forest fires to earthquakes and floods – can be found on the Natural Hazards Portal ([naturgefahren.ch](http://naturgefahren.ch)) or the MeteoSwiss app. In the event of a natural incident, the authorities issue alerts, warnings and information on the Alertswiss app run by the Federal Office for Civil Protection (FOCP). Experts and emergency response personnel can also access the GIN shared natural hazards information platform ([gin.admin.ch](http://gin.admin.ch)).

Instead of just focusing on minimising the risk, we are now considering how much risk we can accept.” If we wanted zero risk, some parts of the city should never have been developed. The aim here, according to Aller, is to find an acceptable balance. “That is an intensive process”, she adds.

*“Instead of just focusing on minimising the risk, we are now considering how much risk we can accept.”*

Dörte Aller | Risk Manager

We cross the river via the Gessnerbrücke bridge. Oplatka points to the water. Today, it is flowing calmly under the tracks of Zurich central station. But the Sihl can be wild. As Oplatka says, “Driftwood, cars and construction containers that have been swept away by floodwater can block the space under the bridges. If that happens, this area ends up underwater.” To minimise the frequency with which this situation occurs, the canton has introduced a number of measures to tame the Sihl. However, there is still a residual risk.

Our final stop is Europaallee with its soaring new skyscrapers. Oplatka points to paving slabs arranged around a light well next to one of the buildings. The next time there is a flood – whenever that might be – a mobile guard will be installed here. “Will those responsible still know how it works?” Oplatka asks. A permanent shield is more effective, because no one needs to do anything about it in the heat of the moment. Aller adds, “For all types of measures, one needs to check what impact they have and how reliable they are. Every measure has its use and it is important to know its contribution to risk reduction.”

One of the most important realisations for Oplatka since the floods of 2005 is that to manage risks successfully, everyone involved must be aware of the risk. Flood protection is teamwork, he says, and only works if discussions are ongoing.

*Link to article*  
[www.bafu.admin.ch/mag2020-2-03](http://www.bafu.admin.ch/mag2020-2-03)

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## Monitoring

## The Valais pioneers

Climate change is exacerbating the threat of natural hazards. In the Saas Valley in Valais, experience clearly shows the importance of monitoring hazardous processes for the safety of people, towns, villages and transport routes. A forward-looking land-use plan is also important – not just in Valais, but everywhere. **Text:** Lukas Denzler

The landscape of the Saas Valley and its communes of Eisten, Saas-Balen, Saas-Grund, Saas-Fee and Saas-Almagell is dominated by steep mountain-sides. The locals have lived with natural hazards for generations. They try to protect themselves, but climate change is exacerbating the risk to towns

*“A systematic decoupling of usage and hazard areas is an option that is often not explored seriously enough.”*

Reto Baumann | FOEN

and villages, roads and tourist facilities. Back in 2010, the communes of the Saas Valley carried out a case study on adapting to climate change – with a focus on natural hazards. Glacier retreat is the most striking change in this area; changes to the soil and rocks are less obvious but are key factors in erosion, rockfalls and rock avalanches.

### Dangerous temperature changes

Norbert Carlen works for the Canton of Valais as a natural hazards engineer, with responsibility for the Saas Valley. He says that dramatic temperature changes, with hot and cold periods occurring within a short period of time, are becoming more frequent. “The freezing and thawing processes increase

the risk of rockfalls and rock avalanches”, he explains. Moreover, as the glaciers retreat, they leave behind areas of loose material. In combination with heavy rainfall or sudden flows of water from the glaciers, this can lead to unpredictable debris flows.

As head of the regional security service in the Saas Valley, Urs Andenmatten keeps a close eye on weather patterns. The Common Information Platform for Natural Hazards (GIN) operated by the federal government is very helpful for assessing risks. Natural hazard experts in the cantons and communes can consult the GIN platform for current measurement and monitoring data, forecasts and warnings. According to Andenmatten, rockfalls primarily occur in the spring after the snow melts, but can also occur in summer and autumn after heavy rain. “These days, when we have to close the cantonal road, it is more often because of rockfalls than because of the risk of avalanches”, he says. In response to the changing situation, 3,800 metres of rockfall nets have been installed in recent years.

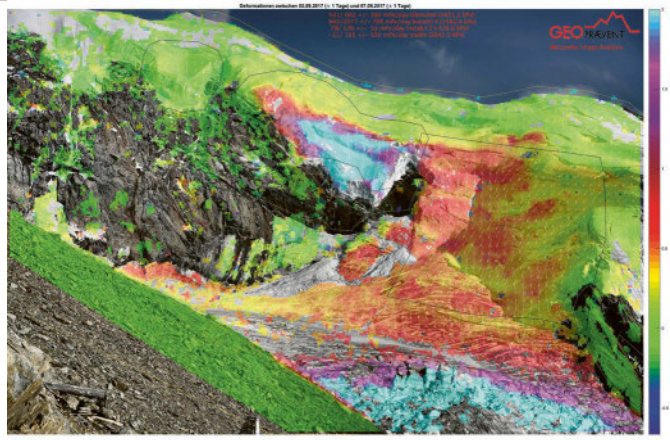
### Warnings of glacial ice avalanches

The Trift glacier above Saas-Grund has attracted lots of attention in recent years. In summer 2014, there were increasing incidents of ice breaking off the glacier. Since there was a risk of more ice breaking off, a monitoring system was set up in October 2014 with radar equipment, GPS points and a camera. When the situation calmed down again, a much cheaper monitoring camera was

# THE ICE AVALANCHE THAT WAS EXPECTED



Photo of the Trift glacier taken by the deformation camera in summer 2017 before the big ice avalanche on 10 September 2017. The unstable glacier area is in the centre of the photo.



Deformation analysis of 7 September 2017 (three days before the ice avalanche), calculated using special image analysis algorithms. Purple areas indicate large movements (approx. 40 cm/day) and light blue areas show very large movements (approx. 50 cm/day).

Source: Geopraevent

installed; this provides high-resolution images each hour when visibility is good. In September 2017, the cracks became wider and communal and cantonal officials decided to resume radar monitoring immediately.

The measurements indicated that ice would soon break off again, so the crisis team evacuated over 200 people. Only a few hours later, early one Sunday morning, the dreaded glacier collapse occurred, but without causing any real damage (see graphic above). The cost of radar monitoring is generally between 300 and 500 Swiss francs per day. In the case of the Trift glacier, the canton covered around half of the costs, and the mountain transport companies also contributed. “The commune had to pay around 35 percent of the monitoring costs”, says Saas-Grund mayor Bruno Ruppen.

In the meantime, glacier activity has calmed down again, but the cameras are still running. In summer 2019 there were two more minor incidents of ice breaking off. Based on an analysis of the

images, officials had closed the hiking trail to Saas-Almagell for half a day as a precaution. The communes are responsible for maintaining some 300 kilometres of hiking trails in the Saas Valley.

Path closures because of rockfalls are quite frequent. Safety boss Urs Andenmatten makes an initial assessment when an event occurs. In the case of a major event, an assessment is carried out by a geologist from the canton. Two years ago, for instance, the hiking trail from Grächen to Saas-Fee was closed for a few weeks after the snow melt. It is important, Andenmatten explains, to put up clear information at the starting points of trails so that hikers do not suddenly find themselves in front of a barrier with no option but to turn back (see box on page 26).

The Gruben glacier on the Fletschhorn and the lakes in the glacier forefield above Saas-Balen also pose a risk. Urs Andenmatten checks the lake outlets every spring and autumn. The outlet of the lake by the glacier itself was dredged a few years



ago to prevent the lake expanding too much. There is also a risk that heavy rainfall could dislodge debris in the glacier forefield and cause a debris flow that could reach Saas-Balen. Discussions are currently ongoing to decide how to reduce the risk along the Fellbach river.

*“These days, when we have to close the cantonal road, it is more often because of the risk of rockfalls than because of the risk of avalanches.”*

Urs Andenmatten | Saas Valley Security Service

#### **Automatic remote monitoring**

There are around 80 potentially hazardous glaciers in Valais. Three of them – the Trift glacier and the Weisshorn and Bis glaciers in the Matter Valley – are being closely monitored. Glacier monitoring is integrated in the canton-wide monitoring system for natural hazards. Experts in private engineering companies monitor and interpret the transmitted data on an ongoing basis. The cantonal office for

forests, river works and landscape runs an automated remote monitoring system comprising hydrological and meteorological measuring stations, cameras and radar equipment, as well as sensors installed on site to record rock and earth movements.

According to Hugo Raetzo of the FOEN’s Hazard Prevention Division, the way the Canton of Valais uses and harnesses its monitoring systems is “pioneering work”. The canton is also involved in the pilot project on adapting to climate change. At the moment, experts are looking at the consequences of warmer temperatures for the permafrost, and with hazards arising from thawing rock faces. Unlike protective structures and protection forests, measuring and monitoring instruments cannot prevent damage. But they can save lives when used in combination with organisational measures, such as evacuation and closures. As Hugo Raetzo explains, “With hazards like glacial ice avalanches and rock avalanches, which simply cannot be prevented by technical means, often the only options left to minimise damage are monitoring and warning systems.”

#### **Moving out of hazard zones**

In the medium term, however, it makes sense to avoid using hazard zones, where possible. “A systematic decoupling of use restrictions and

### **Better monitoring with satellite images**

Radar satellite monitoring offers new possibilities for monitoring mass movement processes. The FOEN is able to use images from the Interferometric Synthetic Aperture Radar (InSAR), which are produced by the Sentinel satellites of the European Space Agency (ESA). With this data it is possible to carry out wide-area assessments that can also reveal slow or incipient slope movements. The FOEN tested the capabilities of satellite monitoring in pilot projects in

the area around the Aletsch glacier and in the Saas Valley. Now, thanks to a motion passed by the National Council and the Council of States, and to the Federal Council Decree of June 2019, the financial resources needed to cover the running costs and further development of natural hazard warning systems are also secure. This means in particular that it will be possible to close gaps in the monitoring of mass movement processes.

## Climate change and hiking trails

Many mountain and Alpine hiking trails run just under the permafrost zone and will be exposed to more rockfall processes or debris flows in future. The Federal Act on Footpaths and Hiking Trails stipulates that the cantons must take care of path upkeep, signage and safety. The responsible authorities therefore also have a duty of care and information. However, certain hazards, such as unexpected rockfalls, cannot be ruled out. As a basic principle, hikers bear a high level of personal responsibility, which increases with the difficulty of the trail.

The pilot programme on adapting to climate change, led by the FOEN, is currently investigating the impacts of future natural hazards on hiking trails, their planning, construction and maintenance, as well as on organisation and processes. The aim of the Safe Hiking 2040 project is to supply those responsible with technical principles and operational frameworks so that they can continue to ensure maximum levels of safety in the future.

hazardous areas is an option that is often not explored seriously enough”, says Reto Baumann of the FOEN’s Hazard Prevention Division. And it is not just a matter of considering the next few years – protective structures and technical systems have to be maintained on an ongoing basis. That costs money, and maintaining them could become a burden for future generations. Decoupling usage from hazard zones is therefore sometimes the most sustainable solution. The FOEN’s brochure entitled *Raumnutzung und Naturgefahren (Land-use and natural hazards)*, published in 2017, provides examples of where and how this strategy has been successful.

For example, in Weggis (LU), five properties have been successfully removed because of a serious risk of rockfalls. In Guttannen (BE) too, a property and a barn have been taken down because of the risk of debris flows. In Preonzo (TI), the canton relocated several industrial and business operations that were directly below an unstable mountainside. And in Nax and Sitten in Valais, several buildings that were located in a high risk zone have been dismantled and moved.

Ten years ago, the communes in the Saas Valley turned their gaze to the future with their case study on adapting to climate change. In view of advancing impacts of climate change, the challenge is to

keep finding the right balance between protecting against and avoiding natural hazards. “When assessing hazard zones, we always take into account new conditions, some of which are the result of climate change”, says natural hazards engineer Norbert Carlen. If new red zones have to be defined on the hazard map and if they include as yet undeveloped land in the building zone, that land will have to be dezoned.

*Link to article*

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Flood protection in Delémont (JU)

## *When a river becomes a community project*

In 2007, the River Sorne burst its banks, causing damage worth millions of Swiss francs in Delémont. Since then, the town has taken numerous steps to prevent flooding. However, the Delémont Marée Basse project is not just about flood protection – it is a community project. **Text:** Cornélia de Preux

The summer of floods in 2007 is one that the people of Delémont (JU) will not forget in a hurry. Extremely heavy rainfall on 8 and 9 August caused the River Sorne to rise rapidly and burst its banks. The entire Morépoint district flooded, submerging basements, underground car parks and other underground areas, and causing damage costing 10 million Swiss francs.

*“Instead of focusing exclusively on flood protection, we saw opportunities to improve people’s quality of life.”*

Cédric Neukomm | Local authority engineer in Delémont

Today, there is no longer any visible trace of the disaster in Morépoint. And thanks to the Delémont Marée Basse (DMB) project, many things have changed. The River Sorne winds its way peacefully between trees and shrubs and islands of shingle and greenery. It is now twice the width it used to be: 40 metres wide instead of 20. The revitalisation work has created a natural environment that offers habitats and nesting sites for numerous animal and bird species. The area is close to the town centre and attracts large numbers of visitors, including

schools, which use it as an open-air science lab. The new town park has play areas, recreational zones and space for various events.

### **Recognising the opportunities**

“In the Delémont Marée Basse project we are ensuring safety, while taking account of the need for revitalisation and creating a bonus for the local people: direct access to the river”, says Cédric Neukomm, a local authority engineer in Delémont. “The floods of 2007 were a shock. But instead of focusing exclusively on flood protection, we saw opportunities to improve people’s quality of life.”

David Siffert, who works in the FOEN’s Flood Protection Section, was a local authority engineer in Delémont from 2009 to 2018. He recalls that the most urgent problems had to be tackled immediately and the authorities built two embankments at the most at-risk sites, some distance from the river. For the DMB project work, the town was divided into three sectors: the En Dozière natural habitats sector, the Morépoint district and the town centre. Work on the construction site, which covered more than three kilometres, began in 2010.

### **More space for the river**

The first environmental measures were implemented in the En Dozière sector, where more space was created for the river. This also increased the flow, which was particularly beneficial to the fish. Open spaces connected to the river and dry meadows



The old riverbank in Delémont's Morépont district has been enlarged, creating habitats and nesting sites for numerous animal and bird species.

Image: Markus Forte | Ex-Press | FOEN

## A whole town on board

Around 70 percent of the 15 million Swiss francs needed for the work on the Delémont Marée Basse project is being provided by the federal government and the canton. The remaining costs must be borne by the town. Around a quarter will be met by the insurance company Die Mobiliar and by the national railway company SBB, which will both benefit from the flood protection measures. A comprehensive participation process with the local population played a

major part in ensuring that the financing of the revitalisation of the River Sorne met with widespread approval across the whole commune. In 2009, 83 percent of those entitled to vote in Delémont voted in favour of the loan. Nearly 50 representatives of the canton and commune, political parties, the insurance industry, environmental organisations and agriculture were involved in the planning process, along with property owners and the general public.

were created. The campsite acquired a beach and the footpaths were upgraded. These measures were drawn up in a participative process and paved the way for similar initiatives.

The DMB project is impressive, not only because of its environmental and socio-economic components, but also because of its structural measures. These include a structure not far from the town centre that can discharge water onto the railway line that runs between Delémont and Basel if the volume of water exceeds the capacities of the flood defences.

### The town gets a facelift

The centre of Delémont is heavily built-up and the River Sorne has only a limited amount of space here. Work is currently being carried out to deepen the river bed, lower the foundation walls and reinforce their embankment function. These measures are designed to increase the flow capacity by 30 percent. There are also plans to add plants to the side walls and create a footpath. Municipal allotment gardens will be created on the corner of Rue Pré-Guillaume. As in the Morépoint district, the new structures in the town centre have been designed with great care. Architectural competitions were organised to choose designs for all the river crossings, such as the new Collège and Haut Fourneau footbridges. The idea, however, is not only to make the town centre more attractive, but also safe.

In order to reduce the residual risk of flooding and damage to new buildings, all ground floors will be built higher in future and buildings will include protective measures. As local authority engineer Cédric Neukomm explains, the DMB project is holistic and sustainable: "It is holistic because we looked at the main protection measures from every angle to ensure we achieved the greatest benefit for the town for the sum invested. And it is sustainable because the structural measures were agreed in consultation with the population, which made it possible to secure them for the long term."

The project entailed major challenges: first the town had to assess the hazards and risks posed by flooding. The analyses showed that the town could expect damage costing up to 120 million Swiss francs. The project will cost around 15 million Swiss francs. The town's inhabitants were involved in the process at an early stage so that their wishes and needs could be taken into account. And when the project team was set up, they made sure it included people with a range of expertise – in underground engineering, hydraulic engineering, applied ecology, landscaping and public space design.

### Extra benefits for the community

The project is creating plenty of extra benefits for the local population: natural spaces are being enhanced and the River Sorne integrated into the

socio-economic life of the town. It has also led to other projects which, according to David Siffert at the FOEN, “would never have been realised without the DMB”. For instance, the town park in Morépont has been extended and the conditions necessary to develop the Gros-Seuc eco-district, where more than 350 homes are due to be built, have been created. In addition to the main bulk of funds to revitalise the river and the surrounding area, other public loans were also approved and used to finance the discharge channel by the railway line, the footbridges, the town park and other projects.

A further plus of the DMB project is an area of around 15,000 square metres in Morépont that has been reserved for the river and adjoining town park. In the En Dozière sector, a zone previously approved for construction has even been set aside

for nature instead. The works in the town centre are not yet finished. There are still some finishing touches to be made: connecting the built-up areas along the Sorne and improving access to the narrow stretch of the river. These works are due to be completed by 2024 at the latest.

*Link to article*

[www.bafu.admin.ch/mag2020-2-05](http://www.bafu.admin.ch/mag2020-2-05)

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The project is creating plenty of extra benefits for the local population: natural spaces are being enhanced and the River Sorne integrated into the socio-economic life of the town.

**Image:** Markus Forte | Ex-Press | FOEN



## Protecting property

# Is your building properly protected?

Earthquakes, floods, rockfall processes, debris flows and avalanches can cause massive damage to buildings and endanger human life. Damage can be prevented at relatively little expense. **Text:** Lucienne Rey

The mess took the young owners unawares: no sooner had they moved into their new house in Rain (LU) than they had to clear out the basement again – and dispose of everything that had been destroyed. Heavy rain had caused a layer of water, which was only a few centimetres deep but covering an entire field, to run down the slope and into the basement of the new building, through lightwells and down the basement steps. Around 130,000 Swiss francs of damage was caused to the building. Added to this was the cost of the ruined furniture, which came to around 80,000 Swiss francs.

**Disastrous surface runoff**

What came as a surprise to the homeowners was not completely unexpected for Antoine Magnollay, who works in the FOEN's Flood Protection Section. Surface runoff is a widespread, frequent occurrence: "30 to 50 percent of damage caused by flooding is

due to surface runoff", he says. It may look less spectacular than a river that has burst its banks, but the effects are just as devastating. The good news is that the problem can be largely controlled at relatively little expense.

A valuable tool for tackling surface runoff is the surface runoff risk map, which has been available for the whole of Switzerland since 2018. It shows the areas that might be at risk from runoff after heavy downpours. The Canton of Lucerne helped develop and test the map, which went live there in 2016. "The map shows the natural topography and illustrates where the water will flow", says Markus Wigger from the Lucerne cantonal building insurance company. Building experts use the runoff map in conjunction with the hazard maps (for floods, landslides, rockfall processes and avalanches) to work out if there is any risk of flooding for construction projects and to suggest possible protective measures. For a building project, this could mean planning corridors to divert or channel off water in a controlled manner. "It is certainly possible to design this kind of landscape attractively so that it also benefits biodiversity", Markus Wigger explains. Provided they are planned in good time, the costs for such measures are negligible and are definitely much lower than clean-up costs once damage has occurred.

When the planning application for the housing estate in Rain was submitted in 2015, the surface runoff map was not yet ready. The protective measures implemented after the event cost 12,000 Swiss francs – a fraction of the costs caused by the floods. A permanent flood kerb along the plot



Earthquake-resistant housing project on the Hanroarea site in Liestal (BL).

**Image:** oak GmbH architects

## Help with protective measures

People who want to secure a building against gravitational natural disasters such as floods, avalanches and debris flows may be eligible for support from the public authorities. A number of cantons provide financial assistance and will cover between 20 and 50 percent of the costs of protecting existing properties. For a building to be eligible, the insurance company must have checked and approved the planned measures.

An interactive map at [schutz-vor-naturgefahren.ch/bauherr/unterstuetzung/fachstellen.html](http://schutz-vor-naturgefahren.ch/bauherr/unterstuetzung/fachstellen.html) (in German and French) shows the specialist departments that can help in each canton. Some insurance companies also offer financial support. There are currently no grants available for measures to protect against earthquakes.

boundary now stops any surface water and diverts it past the housing estate. The low concrete wall is barely noticeable, does not impair the appearance or function of the building or plot and allows the residents to sleep easy during heavy downpours.

When it comes to protecting buildings from the destructive effects of earthquakes, the protective measures for new buildings generally have little impact on the appearance of a property or on the budget – provided earthquake protection is included in the plans from the beginning, in close collaboration with the architects and the engineering company. “Expenditure on earthquake-resistant provisions in new builds accounts for no more than one percent of the total building costs”, says Friederike Braune from the FOEN’s Prevention of Major Accidents and Earthquake Mitigation Section, who has published numerous information sheets and guidelines on this topic.

Since 2003, new buildings in Switzerland must take account of earthquake impacts. Existing buildings have to be checked for earthquake safety and, if it is found to be insufficient, they must be upgraded accordingly. Earthquakes can occur anywhere in Switzerland, although very powerful earthquakes, like those that occur in Italy, are less common. Up to 1,500 earthquakes are registered in Switzerland each year. According to the Swiss Seismological Service (SED), 20 to 30 of these – those with a magnitude of 2.5 or more – can be felt by the population.

The new housing project on the Hanroreal site in Liestal (BL) demonstrates that earthquake-resistant construction does not require trade-offs in terms of aesthetics or the choice of materials. A gently curved long house with 40 apartments was even built with a construction material not commonly used in apartment buildings: the walls are timber frames with composite wood panels clamped to each side. This sheathing gives the building the desired static properties. Division walls, which run through all floors of the building, give it the necessary stability. The outer wall, a facade perforated with numerous small windows, balconies and apartment entrances, is particularly innovative. “In standard architecture, wall elements without openings act as buttresses against wind and earthquake effects”, explains Martin Geiser, an earthquake engineering professor who researches the earthquake behaviour of timber buildings at Bern University of Applied Sciences (BFH). “The perforated facade is reinforced around the windows so that the entire wall now acts as a buttress and not just the elements without openings”, says Geiser, who tested the stability of the new wall in the BFH laboratory in Biel.

### Attractive protection

In the case of existing properties, deficits in earthquake resistance can often be tackled when repairs and conversion work are carried out. In Geneva, a project to add additional floors to a 1950s





In Geneva, a project to add additional floors to the 1950s Sécheron apartment block was seen as an opportunity to improve the earthquake protection of the entire building.

Image: Joël Tettamanti

apartment block was seen as an opportunity to improve the earthquake protection of the entire building (see photo). Firstly, a fine metal frame placed on top of the existing brickwork minimises the additional weight of the three new storeys. On the courtyard and street side of the building, frames of glued-laminated timber were anchored onto the existing walls to stabilise the structure of the entire building and protect it against the impacts of earthquakes.

“When adding extra floors to the apartment building, we were not only able to extend its life and improve the quality of the space, but also increase the earthquake protection”, says Giovanni Accardo, the contracted construction engineer from INGENI SA. The building was praised during an award ceremony by the Swiss Foundation for Structural Dynamics and Seismic Engineering – and it shows that even with existing buildings, if project managers work together closely, it is

possible to combine attractive architecture with earthquake protection.

*Link to article*  
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## Insurance companies

## *Emergency funds for residual risk*

Switzerland also counts on insurance companies in dealing with natural hazards. Insurance firms step in when damage occurs despite all the precautions taken. Solidarity between policyholders and regions is key here.

Damage caused by earthquakes is an exception – there is no insurance cover for this type of hazard. **Text:** Kaspar Meuli

We are talking about money. Large sums of money. The storm of August 2005, for instance, caused record damage costing over 3 billion Swiss francs. On average, floods, debris flows, landslides and rockfalls cause damage worth 305 million Swiss francs per year. But we are also talking about suffering. Since 1945, over 700 people in Switzerland have lost their lives because of the above mentioned natural hazards and avalanches.

Thanks to more effective protective structures, forward-looking land-use planning, tighter building regulations and well-organised emergency planning, it has been possible to avert much suffering and damage over the past few decades. “Switzerland is doing everything possible in terms of planning, technical, organisational and financial measures to reduce the risks to a tolerable level”, says Roberto Loat, a natural hazards specialist at the FOEN. The residual risks are covered by the insurance companies – with the exception of damage caused by earthquakes. Alain Marti, deputy director of the Union of Cantonal Building Insurance Companies (VKG) explains, “Insurance is not a substitute for other measures. We are part of the integrated risk management approach that Switzerland has been pursuing for 30 years.”

### **A new philosophy**

The term risk management signals a fundamental shift in Switzerland’s approach to dealing with natural disasters. The trigger was the 100-year flood of 1987, which burst dams and submerged the entire Reuss plain. “Before this event, people believed they could control the threat with maximum

quantities of steel and concrete”, says Roberto Loat. “But it is now clear that we have to be more sustainable in dealing with natural hazards.” What is needed is a way of dealing with risks that includes planning and organisational measures, rather than just technical protective structures.

Responsibility for natural hazard protection has to be shared by a large number of organisations and individuals. In this philosophy, homeowners, architects and builders have a role to play alongside the authorities – and so do the insurance companies. “The public and private insurance companies have been working closely with the public administration for years”, Alain Marti stresses. “We coordinate our measures.” One result of this joint approach is the surface runoff risk map that was completed in 2018 (see *Protecting property article* on page 31).

Switzerland is proud of its financial safety net for natural disasters, which is the only one of its kind in the world. Its natural hazard insurance is based on the concept of solidarity, which is the only way for people in particularly high-risk areas to access affordable insurance cover. The principle is that everyone pays the same amount and because the risk is spread over a very large number of policyholders, the premiums are low. The Swiss Insurance Association (SIA) explains this fundamental principle in a brochure as follows: “The risks of natural hazards in Switzerland are unevenly distributed – the Swiss Plateau is more likely to suffer from floods, hail or storms, while mountainous areas are more at risk of rockfall processes, landslides and avalanches. However, because natural

## The exception: earthquakes

The fact that Switzerland could experience earthquakes is something the public is barely aware of. Even less well known is the fact that earthquake damage is not covered by building insurance – with the exception of the canton of Zurich, which offers limited insurance cover against earthquakes. In 1978, 18 cantonal building insurance organisations joined forces to form a Swiss pool for earthquake insurance.

The pool is endowed with 2 billion Swiss francs (the total value of insured buildings in Switzerland is 2,000 billion Swiss francs) and functions as a relief organisation for the participating cantons. The attempt to introduce mandatory nationwide insurance for earthquakes has repeatedly failed to receive the support it needs in Parliament. This means that earthquake damage can still only be insured against privately.

hazard insurance covers nine different types of hazard, all private and corporate policyholders benefit from it equally.”

Natural hazard insurance is not a personal choice in Switzerland – it is mandatory for homeowners. Nineteen cantons also specify the insurance company to be used: the non-profit cantonal building insurance organisations. The situation is different in the cantons of Geneva, Uri, Schwyz, Ticino, Appenzell Innerrhoden, Valais and Obwalden. Here, damage to buildings is covered by private insurance companies, but premium levels are prescribed by the federal government. It is important to know that natural hazard insurance only covers damage to buildings. If third parties suffer losses – for instance if tiles are ripped off a roof in a storm and damage a car – it is the homeowners who are liable. Special building liability insurance policies are available to cover this risk.

### Insurance companies: more prevention

The insurance companies do not limit themselves to settling claims, however. As part of the integrated risk management approach, they are increasingly involved in prevention as well. “In view of climate change, our role in this area will continue to increase”, explains Gunthard Niederbäumer, head of indemnity insurance and reinsurance at the SIA. He explains that climate change will alter the hazard situation. “Through our involvement in prevention we want to work with our partners to strengthen Switzerland’s resilience”, he adds. The prevention measures include providing advice

to homeowners – with tips on installing storm-resistant shutters or protecting basement windows against surface runoff – and offering financial incentives. The cantonal building insurance organisations alone invest around 80 million Swiss francs per year in property protection measures. Some insurance companies are involved in prevention at an even earlier stage. The Zurich insurance company, for instance, offers its customers a “natural hazard radar” that they can use to carry out “an informed site and property analysis”. The Helvetia insurance company supports tree planting in protection forests (170,000 trees have been planted in 16 regions since 2011), and the Mobiliar insurance company finances a research centre at Bern University: the Mobiliar Lab for Natural Risks. Among other things, the lab conducts research into the vulnerability of buildings and the basic principles of warning systems.

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## Emergency response

## *Keeping feet dry in Bern's Matte district*

Bern has learned its lessons from past floods: flood damage can be limited by improved emergency response planning, warnings and intervention. However, a residual risk remains. **Text:** Selma Junele

On screen, we watch as a thick, grey-black sludge containing branches and entire tree trunks collects in front of the Schwellenmätteli restaurant. Franz Märki, Head of Communications at Bern's municipal fire service, is showing us video footage from the night of 7 June 2015. At the time, the River Aare was already carrying a large volume of water, with around 350 m<sup>3</sup> flowing out of Lake Thun per second. That is still below the critical 400 m<sup>3</sup> that would cause the Aare to burst its banks in Bern (if no other measures were taken), but the calculation does not include the River Zulg,

which joins the Aare northwest of Thun. For a short while, this river was flowing at a rate of 230 m<sup>3</sup> per second – and carrying a large amount of driftwood.

The driftwood collected in the Tych, a canal in Bern's central Matte district that supplies water to the Matte power station. It blocked the river flow and caused the water levels to rise dramatically – until the two weir elements were removed by a mobile crane. Then the mass of driftwood slowly started to move away and the situation was resolved within minutes.

The civil defence service informs residents of Bern's Matte district about flooding.

**Image:** Bern fire service



### A delicate decision

Unlike in a classic flood situation, which often develops over days, in the case of the Zulg, the authorities have only two hours in which to respond: that is how long the flood waters take to reach Bern. In this short time, they have to fetch the mobile crane and assemble it, and the situation

*“Emergency response plans must not lie around gathering dust. They have to be put into practice and updated.”*

Markus Müller | FOEN

upstream has to be carefully monitored because the decision to remove the weir elements is a delicate one. Once they have been removed, they can only be reinstalled when the water level is extremely low, which often means waiting until the following winter. And without the weir elements, the Matte power station can not produce electricity. This means that in an emergency, the fire service’s emergency response officer has to weigh up electricity production against flood protection – and only remove the weir elements if other measures, such as fishing the driftwood out of the water piece by piece, are not effective enough.

The fact that the night of 7 June 2015 ended well is no coincidence. It is a consequence of lessons learned from the floods of 1999 and 2005. In the event analyses, the city identified the weak points in each case and then developed emergency response documents that define very precisely for each situation, which measures are to be taken and who is responsible for what. For “flooding with driftwood” events, the weir system in Matte was identified as a weak point.

Another weak point was found during the event analysis conducted by the Federal Office for Civil Protection (FOCP). Commissioned by Federal Councillor Samuel Schmid following the 100-year flood

of 2005, this analysis concluded that the warning and alert systems could be improved. Much has been done since then. In order to coordinate and improve their warning systems, the FOEN, the Federal Office of Meteorology and Climatology (MeteoSwiss), the FOCP, the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL), the Institute for Snow and Avalanche Research (SLF) and the Swiss Seismological Service (SED) have joined forces to form the Steering Committee on Intervention in Natural Hazards (LAINAT). Following the revision of the Ordinance on Issuing Warnings and Raising the Alarm, the FOEN was given the task of issuing warnings of floods and associated landslides, as well as forest fires. Although the FOEN was already active in these areas, it had only been providing a service for the cantons. Now it has much broader responsibilities: in the event of a hazardous situation in one of these categories, the FOEN issues warnings to the cantons and the population. The monitoring networks and forecasting models that provide the basis for the warnings are being improved all the time.

Bern has also improved its warning system. Since the 2005 event, residents in at-risk districts can opt to receive an SMS text warning when there is a risk of flooding. This gives them time to clear their basements or move their cars to safety. The city of Bern uses information supplied by the federal government and the canton for its SMS warnings and flood management.

### Not a “dead document”

Flood protection is a joint responsibility that requires collaboration at all three levels of government (federal, cantonal and communal). Depending on the emergency, the fire service, police and civil defence service can be mobilised. The communes face a particularly tough challenge. The natural hazard maps provide the basic information regarding potential threats. And with knowledge about the hazards comes a moral duty to prepare to tackle natural disasters. The FOEN and the FOCP are supporting the communes with a new emergency

## Be prepared for emergencies

In the event of a natural disaster, you must always follow the instructions of the local authorities. If necessary, you can call the emergency services on 112. In addition, you can keep informed of the situation via the radio, TV, apps and the Internet, and pay attention to warnings and alerts. Information on the current natural hazard situation can be found on the naturgefahren.ch website. Alerts, warnings and information on different hazards can be found on alertswiss.ch or the alertswiss app.

In general, there are a number of simple recommended measures you can take to prepare for a natural hazard event (see also naturgefahren.ch / Dealing with natural hazards / General recommendations for action). Specifically, you should:

- find out about the general risk potential where you live and at your place of work (the cantonal hazard maps provide details)
- keep the main emergency telephone numbers somewhere handy
- set up emergency supplies (in the event of a natural disaster, supplies of food, electricity and water cannot always be guaranteed)
- keep a medical kit at home
- check buildings at least once a year for any damage and see that antennas, solar power, satellite dishes, shutters and awnings are firmly attached, and check the stability of porches and canopies
- check what reasonable measures can be taken to protect the building against the natural hazard
- check your insurance cover and adjust it if necessary.

response planning guide for gravitational natural hazards. The tool, which explicitly covers floods, is due to be published in 2020. It is designed to help communes that do not yet have emergency response planning in place to optimise their disaster preparedness. The federal government also provides financial support for the cantons to take appropriate measures. Markus Müller, who works in the FOEN's Risk Management Section, warns: "Emergency response planning must not become dead documents that lie around gathering dust. They have to be put into practice and updated. We can learn from the experiences, which in turn leads us to make improvements to the plan and sometimes even to implement additional structural or planning measures." Asked about the guide, Alain Sahli, head of planning and emergency response at Protection and Rescue Bern, the city's centre of excellence for emergency services, says: "Of course, we will study it closely and check whether and where we need to adapt our emergency response documents." He believes the standard-

isation work that the federal government is doing in this area is important and essential for facilitating collaboration between the various administrative bodies. It is only through standardisation that you can be sure "you're talking about the same thing when you use the same words", he says.

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