Invited Perspectives: "Small country, big challenges – Switzerland's hazard prevention research"

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Switzerland's situation at a glance. Due to its geography and climate, densely populated Switzerland is often affected by water-related hazards such as surface runoff, floods, debris flows, landslides, rockfalls and avalanches. Strong earthquakes are rare, but, as history shows, they do occur and represent one of the biggest risks. Due to population growth, the expansion of settlements and infrastructure, the rise in mobility as well as the effects of climate change, risks ascribable to natural hazards

10 are increasing.

The hazard situation in alpine Switzerland is influenced by significant differences in altitude over short distances and relatively high precipitation volumes. In addition, the increase in temperature caused by climate change is higher, compared to the rest of Western Europe (FOEN 2020a).

Natural hazards concern everyone in Switzerland. Extreme natural events are a regular occurrence in Switzerland. For

15 instance the rock avalanche and debris flow in Bondo, canton Graubünden, in 2017, the winter storm Lothar in 1999 and important floods, like those of August 2005 and August 2007. However, the threat of hazards is not restricted to mountainous regions and along rivers or seashores. Almost every part of Switzerland is exposed to natural hazards and anyone can be affected. Data collected by the Federal Institute for Forest, Snow and Landscape Research (WSL 2021) shows that in the past 49 years, four out of five Swiss communes have suffered damage due to flooding or debris flows (Fig. 1). Landslides affected

20 two in five communes in the same period. Between 1972 and 2020 floods, debris flows, landslides and rockfall processes accounted for around 300 million Swiss francs of damage per year on average.
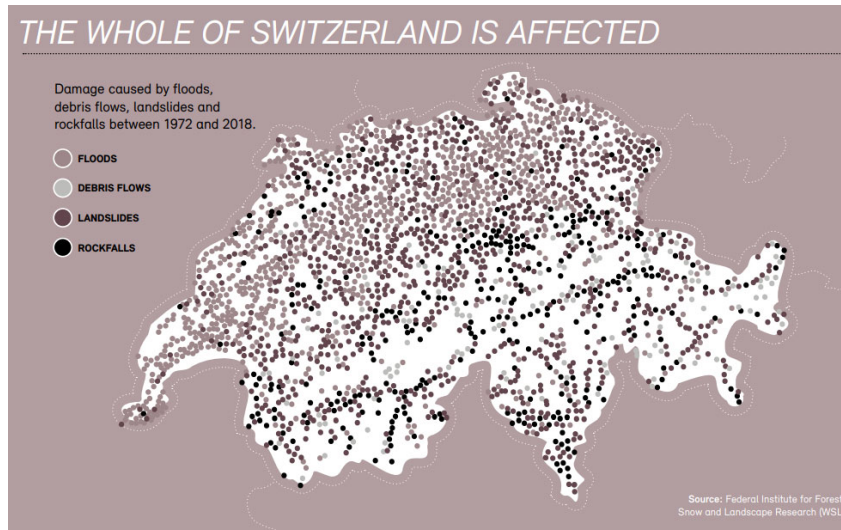
Figure 1: Damage caused by natural hazards in Switzerland. Federal Institute for Forest, Snow and Landscape Research (WSL).

Small country, big challenges. Switzerland has a long tradition concerning fundamental research as well as practice- and
25   implementation-oriented research in hazard prevention and there is an important number of research institutions being active
in this domain. The findings of these research activities will further improve the management of natural hazards and the risks
of events, taking into account environmental aspects, climate change and settlement densification. The « Research Concept
Environment » (FOEN 2020b) describes the implementation of environmental policies in 18 research areas and thus the priority
fields of research from the perspective of the Federal Office For The Environment in the near- and future-term. FOEN's priority
30   themes in hazard prevention for 2021 – 2024 are listed below.

Research priorities in hazard prevention 2021 – 2024

1 Know hazards and risks comprehensively

1.1 Generation of basic scientific knowledge for hazard processes like e.g. lateral erosion of watercourses, hillslope debris flows, rockfall, snow gliding avalanches, impulse waves (tsunamis) and of the influence of climate change on such processes

1.2 Development of methods to record natural hazard processes, e.g. sediment and driftwood transport, to register indirect damages due to natural hazard events and development of methods to assess future hazards and extreme events due to climate change

1.3 Development of a methodology for risk overviews at different spatial scales

1.4 Investigation of the impact of climate change on the risk landscape in Switzerland and analysis of combinations and concatenations of different processes

1.5 Elaboration of fundamentals to quantify the vulnerability and the risk for infrastructural systems in the event of earthquakes and gravitational natural hazards

2 Identify events at an early stage

2.1 Investigation of precipitation thresholds and analysis of the disposition to slope processes in-depth

2.2 Improvement of extreme value statistics

2.3 Improvement of the forecasting and early detection of natural hazards

3 Plan measures integrated and to be robust

3.1 Development of methods for evaluating options for action within the integrated risk management

3.2 Development of new instruments for risk-based land use and their practical implementation in spatial planning

3.3 Analysis of ecological aspects in the implementation of protective measures; addressing of dichotomy of protective function of the forest vs the forest as a habitat for game animals

3.4 Development of methods to assess existing protective structures and to assess robust protective systems; development of models for dynamic loads on structures

4 Search the risk dialogue and observe the impact on society

4.1 Investigation of the social science component in risk perception and communication; conduction of research into the acceptance of measures

4.2 Further development of cost-benefit analysis in integrated risk management; development of methods for quantifying the indirect economic damage after earthquakes and gravitational natural hazards

What concerns everyone can only be resolved by everyone. Complete protection against natural hazards is impossible. However, Switzerland has learned from the natural disasters of the past and developed an integrated risk management to reduce the risks to a reasonable level (PLANAT 2018). Monitoring, warning systems and protective structures alone are not enough

70 to prevent damage. There is also a need for land-use planning measures and personal responsibility, for instance investments in object protection or adapting the usage of certain buildings to a hazard in question. Everyone, from house owners to tenants, from the national railway operators to power providers, from hoteliers to freight carriers, can be affected by natural hazards, anywhere in the country. As the famous Swiss author Friedrich Dürrenmatt once wrote: "What concerns everyone can only be resolved by everyone." Only if all actors concerned take on their responsibility, Switzerland can achieve and maintain an

75 adequate safety for people, property and natural resources throughout the country.

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