A Method for Risk Analysis of Disasters and Emergencies in Switzerland

Version 1.03

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Preface

The present version of the report on the method for of disasters and ermergencies in Switzerland is aimed at an audience of experts who will be using the method in workshops in this year to assess the likelihood of occurrence and potential effects of hazard scenarios. It describes the framework conditions and approach used in the assessment of hazards and their associated risks.

The report ensures that the hazards are analyzed systematically and in a comparable manner in the workshops and allows interested parties to reproduce their results.

The risk analysis method follows the best practice approach. The first practical application of the method in workshops took place in 2012. The results of the first part of the analysis are documented in the Risk Report 2012 on disasters and emergencies in Switzerland.

Experiences gained in the use of this method during the workshops in 2012 are considered in the version 1.03. Now the method is made available to a broad audience as a basis for carrying out risk analysis in disaster management.

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1 Introduction

1.1 Starting Point

Hazard and risk analyses are crucial elements in preparing for response to disastrous events (e.g., Jachs, 2011). They are part of precautionary planning and are used in training for emergency responders as well as in planning exercises (e.g., FOCP, 2012). They constitute the conceptual basis for disaster management and civil protection.

Such analyses focus on identifying hazards and on the assessment of potential damage arising from an event or development. Another core element is the assessment of the likelihood of occurrence or frequency of an event and the damage associated with it.

Switzerland has already carried out such hazard and risk analyses from a civil protection perspective in the context of the KATANOS (FOCP, 1995) and KATARISK (FOCP, 2003) projects. In both studies, a selection of hazards was analyzed and compared. The analyses concentrated on the effects for the population at large and on outcomes in selected areas.

The national risk analysis of disasters and emergenecies in Switzerland expands the hazard spectrum as well as the spectrum of effects caused by these hazards. It takes into account events and developments and their results for the environment, the economy, and society as well as the resulting outcomes for the population.

The analysis of these hazards is based on a methodology that allows the risks of various hazards to be determined using a consistent approach and to compare them in a reproducible and transparent manner. This comparison between hazards is an important basis for disaster management in civil protection, which is confronted with a wide range of hazards and must use its limited resources in a targeted and efficient manner.

The present report describes the approach used by the national risk analysis in the analysis of hazards and the associated risks.

1.2 Objective and target audience

1.2.1 Objective and purpose

The overarching goal of these efforts is to develop risk-based planning assumptions for organizations involved in the management of disasters and emergencies. The focus is on creating a transparent, comparative overview that can serve as a foundation for prioritization and preparedness planning.

This analysis lays the groundwork for better coordination of planning and development efforts in the field of disaster management in Switzerland. The developed products promote preparations for a more systematic approach in disaster management and foster a more comprehensive risk culture.

For the Risk Report 2012 the following goals were paramount::

- To develop a method for analyzing the risk of disaster and emergency scenarios that would facilitate the integration of a broad spectrum of hazards and allow a comparison between various hazard scenarios.
- To develop, in collaboration with experts and based on existing expertise and researche findings, consistently structured scenarios for disasters and emergencies and determine the risks they hold for Switzerland.
- To structure the approach and method in such a manner as to allow the continuous coordination, updating, and further development of an efficient process of analysis for disasters and emergencies by the FOCP.

1.2.2 Audience

The analysis and products thus developed are aimed at organizations tasked with disaster and emergency management and with planning and preparations for emergency operations. In this preparatory work, crisis management organizations and first responders are usually in touch with various actors from various areas of responsibility and with different areas of expertise. In the case of a disaster or emergency, there is an need for trans-jurisdictional strategic and

operational cooperation at the various administrative levels. In order to facilitate joint preparations, consistently structured planning assumptions that rest on a systematic analysis is crucial. Therefore, cantonal command staffs and the Federal NBCN Crisis Management Board as well as the Critical Infrastructure Protection (CIP) Program or the Security Network Switzerland (Sicherheitsverbund Schweiz, SVS) are among the core audiences of this Risk Report and the products associated with it.

1.2.3 Management process

As part of the national risk analysis of disasters and emergencies in Switzerland, three products are elaborated successively: a hazard catalog, hazard dossiers, and a comparative analysis. Once the products have been developed, they will be reviewed periodically for currency and supplemented accordingly.

- Product hazard catalog

The catalog includes hazards that could occur in Switzerland or which could have significant effects for the country.

- Product hazard dossier

For individual selected hazards in the hazard catalog, information is collated in dossiers. Among other things, the information is required for understanding the hazard and its analysis.

- Comparative analysis of hazard scenarios

For each analyzed hazard, the hazard dossier contains certain hazard scenarios. The scenarios are analyzed and compared with regard to their effects on individuals, the environment, the economy, and society as well as with regard to their likelihood of occurrence. The results of the analysis carried out in 2012 are presented in the risk report 2012 on disasters and emergenies in Switzerland.

The hazard catalog, the hazard dossiers, and the comparative analyses will be regularly reviewed and updated. New information and insights will be taken into account in the individual steps. The analysis should therefore be understood as a process (cf. Fig. 1).

The national risk analysis of disasters and emergencies in Switzerland is carried out in close cooperation with experts from the following areas:

- Federal agencies and Federal Chancellery
- Cantons (mainly civil protection)
- Academia
- Private sector

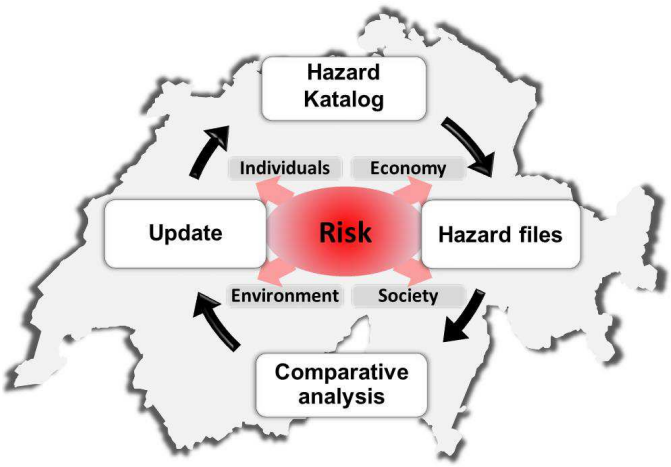

Figure 1 Management process for the risk analysis of disasters and emergencies in Schwitzerland.

2 Products and their development

2.1 Hazard catalog

2.1.1 Content

In a first step, as many as possible of the hazards that might have significant effects in Switzerland are collated in a so-called hazard catalog. These include hazards that have already occurred or might occur in Switzerland, as well as events abroad that might have effects in Switzerland. The hazard catalog constitutes a comprehensive inventory of hazards and is structured in three parts:

- Natural hazards,
- Technical hazards,
- Societal hazards.

The catalog includes hazards that may occur unexpectedly and at very short notice, such as dam ruptures or terrorist attacks. On the other hand, it also lists longer-term developments that may have an effect on Switzerland, such as infectious diseases or fuel shortages.

Wherever possible, examples of events in Switzerland or abroad are cited for each hazard to illustrate what exactly is meant.

In the framework of "Disasters and Emergenies Switzerland", the catalog of hazards is used as the basis for choosing the hazards that are to be analyzed in detail.[1]

2.1.2 Development

The project team of "isasters and Emergenies Switzerland" developed an initial version of the hazard catalog in 2009.

Since then, the project team has been continually updating it together with the responsible authorities in the public administration, academia, and the private sector. Emerging events and developments such as the eruption of Iceland's Mount Eyafjallajökull and the ensuing disruption of air traffic in 2010 are added. Events such as the nuclear accident at Fukushima in 2011 that are already included in the catalog of hazards are taken up as complementary examples.

2.2 Hazard files

2.2.1 Content

A hazard file offers a systematic overview of the hazard. All hazard files apply the same structure.

- Definition
  In order to delimit and bring consistency to the understanding of a given hazard, it is briefly defined. Wherever possible, this definition is based on existing sources (e.g., definitions given in legal texts).
- Examples
  Each file describes examples of previous instances of the hazard in question. These examples cite experiences gathered and provide an idea of the impact that the events had.
- Influencing factors
  This part lists all significant factors that may have an impact on the genesis, the sequence of events, and the extent of damage. This includes information on the source of the hazard, the timing, the place and dimensions, and the course of events.
- Dependencies
  The section on dependencies analyzes the source and the possible consequences of the hazard under investigation. The classification used is based on the "List of Possible Hazards" provided in FOCP (2012a).
- Scenarios
  Three scenarios of varying intensity are shortly outlined for each hazard (cf. 2.2.2). The scenario of "major intensity" is described in more detail. The scenario describes the effects in a differentiated manner; they are also illustrated in a diagram (Fig. 3).

[1] The catalog may also be employed by other users for the selection of hazards or for developing a catalog of their own, e.g., in cantonal hazard analyses or as part of the Critical Infrastructure Protection program.

- Basis and references
  The file lists the most relevant legislative foundations and references for further reading.

2.2.2 Development of hazard files

In the process of elaborating a hazard dossier, the project team develops a draft dossier based on an already developed guideline. Subsequently, the draft is reviewed and validated by the responsible authorities in the public administration, by academics, or by experts in the private sector. Once their changes have been adapted, the project team finalizes the dossier.

2.3 Comparative analysis

2.3.1 Evaluations

The comparative analysis of hazard scenarios is the key product of "Risks Switzerland". It allows risks to be quantified according to consistent criteria and facilitates a comparison between hazards.

In order to conduct such a comparison, the likelihood of occurrence (L) and the effects (E) are determined for each hazard scenario. By multiplying L and E, the risk (R) for the hazard scenario is calculated. The values for L and E are depicted in a risk matrix for each scenario. This matrix facilitates a comparison between the various hazard scenarios.

2.3.2 Development of the method

The following method was developed for the analysis applied in the national risk analyis of disasters and emergencies in Switzerland. It is based on earlier hazard analyses in the area of civil protection, i.e., KATANOS (FOCP, 1995) and KATARISK (FOCP, 2003). In its 1995 publication "KATANOS: Disasters and Emergencies in Switzerland, A Comparative Overview", the Federal Office for Civil Protection (FOCP) for the first time released a hazard analysis from the perspective of civil protection (FOCP, 1995). The focus of the analyses was on the effects for the population and selected areas of natural resources. In 2003, the FOCP reviewed the KATANOS study and developed it further under the title "KATARISK". "KATARISK: Disasters and Emergencies in Switzerland, A Risk Assessment from a Civil Protection Perspective" compared the risks of selected disasters and emergencies with the risks of everyday events (e.g., traffic accidents).

In developing the method for "Disasters and Emergencies Switzerland", the authors took into account not only the experiences gained with hazard analyses for civil protection in Switzerland, but also comparable work in other countries (BBK, 2010; Cabinet Office, 2008, 2010, 2012; Department of Homeland Security, 2011; Ministry of the Interior and Kingdom Relations, 2009). The national risk analysis of disasters and emergencies in Switzerland was also based on international standards and guidelines (ISO/PAS 22399, 2007; European Commission, 2010).

The method for the national risk analysis was developed in cooperation with experts from the public administration, academia, and the private sector.[2] A joint workshop for validating the method was held in December 2011 (FOCP, 2011).

[2] Cf. Appendix 3.

3 Methodology of risk analysis

3.1 General approach

The approach used for assessing risks for the individual hazards and comparing these can be subdivided into the following steps, which will be discussed in detail in sections 3.2 to 3.5:

- develop scenarios for each hazard;
- determine frequency, likelihood of occurrence, or plausibility of the scenarios;
- determine the effects of scenarios according to damage indicators;
- compare hazards and associated risks.

Information on the frequency or likelihood of occurrence and extent of effects of hazards is usually taken from existing basic material and information such as event analyses, statistics, literature, other scenarios, etc. Such information is transposed to the scenarios used in "Disasters and Emergencies Switerzland" and validated by experts.

Wherever information is lacking or there are significant uncertainties as to the extent of effects or the frequency or likelihood of occurrence of scenarios, expert assessments come into play. These assessments take place in group discussions patterned on the Delphi Method. The Delphi Method is a multi-step analysis process: Participants initially submit their assessments. The responses are subsequently evaluated, and participants are informed as to the results of the first round. Participants then discuss the assessment. In this way, the Delphi Method leads to a convergence of assessments and a consolidation of estimated values.

This approach makes it possible to take subjective assessments of hazards and make them as objective as possible. The expert teams are composed according to the existing information gaps. The project team developed a separate guideline for conducting expert Delphi sessions.[3]

3.2 Hazard scenarios

Scenario development is an indispensable instrument for precautionary planning efforts. Describing a hazard using scenarios is fundamental for determining likelihood of occurrence and effects. By developing an exemplary description of a hazard in a scenario, one can anticipate how such an event can develop and what effects an event or development may have. This, in turn, is a way to reveal shortcomings in response and to derive prevention and precaution measures.

The hazard scenarios that are developed in the analysis process provide an overview of how an event would unfold. Scenario descriptions are patterned, as far as possible, on known events, but also take into account potential future developments. However, these descriptions focus on the effects that are expected as part of the scenario in question. The effects on individuals, the environment, the economy, and society can be quantified using damage indicators.[4]

In "characterizing" hazards, three scenarios for each hazard are developed in the analysis process that are distinguished by intensity. This ensures that an appropriate range of possible courses of events are considered in the analysis of hazards.

For each hazard, three scenarios of considerable, great, and extreme intensity, respectively, are differentiated. The intensity of the three scenarios is noticeably higher than that of everyday events (e.g., sporting accidents), and the effects are considerably more significant.

Intensities are defined as follows:

- **Significant**: A scenario that is considerably more severe than an everyday event.
- **Major**: A scenario of great intensity. Nevertheless, considerably more severe occurrences and courses of events are imaginable in Switzerland.
- **Extreme**: A scenario of extreme intensity. Such events are only just imaginable in Switzerland.

[3] Cf. Appendix A2.

[4] For damage indicators, cf. sections 3.4.2 and A1.

The intensity of an event depends on several influencing factors; in the case of the "drought" hazard, for instance, it depends on the spatial expansion or intensity of aridity. "Intensity", for the present purposes, always refers to the occurrence of the hazard in Switzerland.

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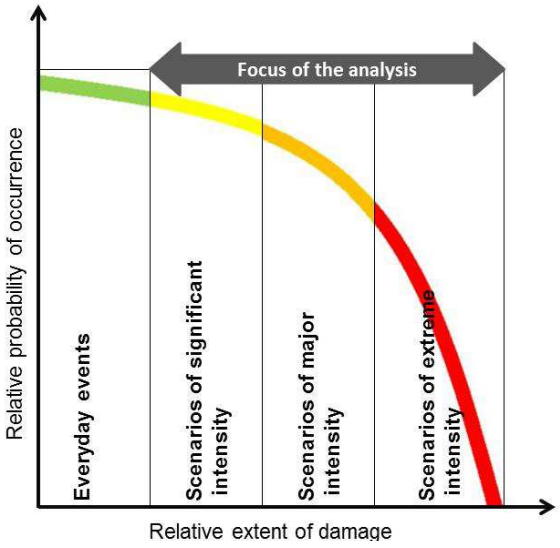

Figure 2 Schematic depiction of the three intensity levels in the frequency/damage extent diagram. The subdivision of the frequency and damage extent axes differs for each hazard.

The areas of considerable, great, and extreme scenarios are further outlined in Fig. 2.

Each of the three scenarios is briefly outlined, based mainly on hazard-specific factors influencing the extent of effects, such as wind speed for storms or duration of a power blackout. In the following, an example of such a description for the "drought" hazard is given (cf. Table 1)

Table 1 Exemplary description of parameters for three scenarios of varying intensity in the case of drought.

Intensity	Parameters based on influencing factors
1 – significant intensity	▪ No preceding drought period ▪ Locally restricted drought over three months in summer ▪ No significant heat ▪ Aridity of soil negligible one month after end of drought
2 – major intensity	▪ Preceding drought period ▪ Nationwide drought in Switzerland over six months ▪ Several heat days, but no sustained heatwave ▪ Aridity of soil negligible three months after end of drought
3 – extreme intensity	▪ Extended preceding drought period ▪ Nationwide constant drought in Switzerland between two consecutive summers ▪ Heatwave lasting several weeks ▪ Aridity of soil negligible 24 months after end of drought

3.3 Frequency, likelihood of occurrence and plausibility

3.3.1 Understanding and differentiation

"Frequency" refers to the number of (expected) events per unit of time. Typically, frequencies are listed by number of events per year (e.g., number of avalanches in Switzerland per year).

"Likelihood" refers to a possible event. It assesses the probability that a given event will indeed materialize. Probability is always expressed as a value between 0 and 1. This corresponds to a value between 0 and 100%.

Therefore, frequency describes the (expected) number of events per time unit, while likelihood describes the possible occurrence of a given event, provided that the conditions for its occurrence are given in this specific case.

Maliciously induced events, e.g., in the context of political events, crime, terrorism, and armed conflict, can not be clearly described in terms of frequency and plausibility due to the fluctuating nature of threat pictures. For such hazards, the plausibility of an event's occurrence within the next ten years is assessed.

Table 2 Classes of frequency and likelihood of occurrence

L-class	Written description	Probability	Once in ... years	Frequency (1/year)
L 8	On average, few events over a human lifespan in Switzerland.	> 30 %	< 30	> $3*10^{-2}$
L 7	On average, one event over a human lifespan in Switzerland.	10 - 30 %	30 - 100	$3*10^{-2}$ - 10^{-2}
L 6	Has occurred in Switzerland before, but possibly already several generations in the past.	3 - 10 %	100 - 300	10^{-2} - $3*10^{-3}$
L 5	May not have occurred in Switzerland yet, but is known to have happened in other countries.	1 - 3 %	300 - 1000	$3*10^{-3}$ - 10^{-3}
L 4	Several known events worldwide.	0.3 - 1 %	1000 - 3000	10^{-3} - $3*10^{-4}$
L 3	Only few known events worldwide.	0.1 - 0.3 %	3000 – 10 000	$3*10^{-4}$ - 10^{-4}
L 2	Only single known events worldwide, but also conceivable in Switzerland.	0.03 - 0.1 %	10 000 – 30 000	10^{-4} - $3*10^{-5}$
L 1	Only single, if any, known events worldwide. Such an occurrence is regarded as very rare even on a global scale, but cannot be fully excluded for Switzerland either.	< 0.03%	> 30000	< $3*10^{-5}$

3.3.2 Assessing frequency and likelihood of occurrence

For natural and technical hazards, the likelihood or frequency of a hazard scenario's materialization is determined as precisely as possible – for example, based on statistics, or on expert assessments where no sufficient data set exists. If a point estimate is not feasible, the likelihood of occurrence or frequency can also be correlated to a logarithmic class. Table 2 provides an overview of the classes used for frequency and likelihood.

3.3.3 Assessing plausibility

For maliciously induced events (e.g., terrorist attacks), a plausibility class is added analogously to the frequency and likelihood classes. The classes are laid out in table 3.

Table 3 Classes for plausibility. These classes describe how plausible the occurrence of a given event in Switzerland is seen to be in the next ten years.

P- class	Plausibility of occurrence in the next ten years
P 8	Relatively plausible
P 7	Rather implausible
P 6	Implausible
P 5	Very implausible
P 4	Most implausible
P 3	Extremely implausible
P 2	Just imaginable
P 1	Hardly imaginable

3.4 Impact

3.4.1 Damage indicators and areas

"Disasters and Emergencies Switzerland" offers a sophisticated overview of significant effects and damage that may be caused by an event. To this end, a set of damage indicators was defined. The indicators were selected, among other criteria, based on the Federal Constitution (FC) and the subjects of protection that it defines. The damage indicators are assigned to the following four damage areas (articles referring to subjects of protection listed in parentheses):

- Individuals (e.g., FC Art. 10, 57, 58, 61)
- Environment (e.g., FC Art. 2, 76-79, 104)
- Economy (e.g., FC Art. 26, 54, 61, 100-102)
- Society (e.g., FC Art. 2, 5, 7-36, 41, 52-53, 57-58, 69, 78)

3.4.2 Damage indicators

The effects of hazard scenarios are measured by applying 12 damage indicators. The analysis of risks is therefore based on a multi-criteria approach.

For each indicator that can be measured in quantitative terms, a unit is defined expressing the extent of effects. For instance, the indicator "asset losses" is expressed in Swiss francs (CHF). Table 4 offers an overview of damage indicators used and the corresponding units. As with likelihood and frequency, the effects designated by the indicators are to be given as point values if possible, e.g., CHF 30 million.

In cases where the effects on indicators cannot be measured in terms of quantitative units, the effects are correlated with a class for extent that is described in qualitative terms. Similarly, the effects on a damage indicator are correlated with a class for extent if the effects are very difficult to gauge.

Table 4: Overview of damage indicators used in the national hazard analysis on disasters and emergencies as well as corresponding articles in the Swiss Federal Constitution.

Damage area	Indicator	Reference in Constitution
Individuals	Fatalities	Art 10, 57, 58, 61, 118
	Casualties/sick people	Art 10, 57, 58, 61, 118
	Individuals in need of assistance	Art 12, 115
Environment	Damaged ecosystems	Art. 74,. 76, 77, 78, 104
Economy	Asset losses and cost of coping	Art. 61
	Reduction of economic performance	Art. 100
Society	Supply shortfalls and disruptions	Art. 102
	Diminished public order and domestic security	Art. 52, 185
	Reputational damage	Art. 54
	Loss of confidence in state/institutions	Preambel, Art. 2, 5
	Reduction of territorial integrity	Art. 58
	Damage to and loss of cultural goods	Art. 2, 69, 78

The values given for extent of damage per indicator amount to a marginal analysis that counts all effects that the event may cause and that would not come about without the event occurring. For many indicators, there is a "base rate" of effects that are brought about by everyday events. Thus, every year, people die in Switzerland due to dehydration or traffic accidents. A scenario must only count those effects that exceed the "base rate" due to the event or development. For heatwaves, for instance, one would count all heat-related deaths minus the ones that would have occurred due to dehydration even in the absence of a pronounced heatwave.

3.4.3 Temporal delimitation of effects taken into consideration

The consequences of various hazards may take effect over widely differing timeframes, depending on the event or development and the damage indicator being considered. For instance, a rockslide may cause direct damage to property within seconds or minutes. However, there are also instances of damage (e.g., diminished revenues from tourism in a valley) that are registered over the course of weeks. In the case of hazards arising from developments (e.g., diseases of affluence), the effects may accumulate over years and even decades. The timeframe for considering effects is defined for each scenario separately.

3.4.4 Description of indicators

In the following, the individual indicators are described. Appendix A1 offers a complete overview of scales that describe extent and define the classes for extent of the individual indicators.

Damage area "Security and Safety of individuals"

The indicators for the damage area relating to individuals register the effects of a hazard on the lives and physical integrity of the general public (I1, I2). They include mental health (I2). I3 relates to the need for assistance caused by a hazard.

I1 deaths [number]

The damage indicator "deaths" relates to all people whose deaths can be directly attributed to the event.

Scale:

A1	A2	A3	A4	A5	A6	A7	A8
≤ 10	11 - 30	31 - 100	101 - 300	301 - 1'000	1'001 - 3'000	3'001 - 10'000	> 10'000

I2 Casualties/Sick persons [number]

The I2 indicator includes the number of people affected by injuries or diseases that can be directly attributed to the event.

The indicator takes into account physical and mental illnesses or injuries connected to the hazard. Three levels are distinguished (cf. Table 5).

The basic units for this indicator are all people affected by injuries or disease due to the event. The three levels of severity outlined above should be assessed accordingly.

Individuals who succumb to their injuries or illness are counted not under this indicator, but under I1 (deaths).

Individuals requiring one-time emergency psychological care but do not suffer from an actual psychological illness are covered by indicator I3 (individuals in need of assistance).

Differing degrees of severity of injuries are aggregated using weighting factors. The factors were derived on the basis of Bickel and Friedrich (2005).

Scale:

A1	A2	A3	A4	A5	A6	A7	A8
≤ 100	101 - 300	301 - 1'000	1'001 - 3'000	3'001 - 10'000	10'001 - 30'000	30'001 - 100'000	> 100'000

Table 5: Levels and conversion factor. The factors were derived on the basis of Bickel and Friedrich (2005).

	Injury	Disease	Factor
major	At least 7-day hospital stay. No permanent physical harm.	Chronic illness, medical care required.	1
medium	One to six days in hospital. No permanent physical harm.	Severe, persistent illness with full recuperation, medical attention required.	0.1
minor	No permanent physical harm; medical attention, but no hospital stay.	Minor illness with full recuperation, medical attention required.	0.003

I3 Individuals in need of assistance [person days]

Indicator I3 covers individuals who must be evacuated, temporarily housed, and/or otherwise cared for before, during, and after an event. This may involve, for instance, housing in emergency shelters; supplying food to people in locations cut off from the outside world; or giving emergency psychological assistance to individuals who are not, however, affected by actual mental illnesses. The duration of assistance required by the directly affected persons is registered. Effects such as shortages and disruptions of supply for large parts of the population are counted not under I3, but under the indicator S1 (supply shortfalls and disruptions).

The unit for assistance required is the person day. This is determined by multiplying the number of people requiring assistance with the duration of impairment in days. The effective duration of assistance required by all individuals is added up. The minimum unit per person is one day. The duration of the requirement for assistance is counted, rather than the period in which assistance services are provided. For instance, one would count the number of days during which the total number of affected people require emergency psychological assistance, rather than the duration for which the members of care-providing organizations have been in action.

The cost of providing support services is accounted for in the indicator Ec1 (asset losses and cost of coping).

Scale:

A1	A2	A3	A4	A5	A6	A7	A8
≤ 200'000	200'001 - 600'000	600'001 - 2 Mio.	> 2 Mio. - 6 Mio.	> 6 Mio. - 20 Mio.	> 20 Mio. - 60 Mio.	> 60 Mio. - 200 Mio.	> 200 Mio.

Damage area "environment"

The indicators for the damage area "environment" express the effects of a hazard on the environment according to the Law relating to the Protection of the Environment (Umweltschutzgesetz, USG). The main effects include water pollution, ground pollution, and changes to the genetic material of organisms or biological diversity.

En1 Damaged ecosystems [area x years]

Indicator En1 measures the size and the duration of an adverse impact on ecosystems (woodlands, agro ecosystems, watercourses, lakes, wetlands etc.) which are seriously damaged and which will recovery very slowly or never.

Effects may be caused, for instance, through chemical or radiological pollution, through contamination by alien invasive species, or through physical damage, such as erosion.

Impacts are damages on ecosystems and/or adverse effects on ecosystem services:

An ecosystem is damaged, e.g. if the natural balance is significantly disturbed or the soil fertility is significantly compromised. For example, heavy chemical pollution of surface waters is measured with the indicator En1. If the water level of a lake significantly drops as a result of drought, but without damaging the flora and the fauna in the medium to long term, this is not considered as damages on the ecosystem system.

The impairment of ecosystem services should be only considered if the restriction will not be covered by other indicators (e.g. their use for leisure and recovery). If the supply of drinking water from surface water is limited for the population as a result of drought, this is detected by the indicator S1. The economic impacts of ecosystem damage are not covered by the indicator En1 but with the economic indicators E1 and / or E2.

The unit for measuring adverse effects is the area x year (km^2 x year). It is calculated by multiplying the affected area with the number of years that the adverse effect lasts. If an area is under the influence of multiple effects, it is only counted once.

The duration of the impairment is the time of the damage to the ecosystem or the restriction of its use (e.g. restrictions of cultivation on agricultural land).

The cycle of different stages of an ecosystems, e.g. succession stages in managed forests, should be taken into account. An ecosystem is regarded as damaged only as long as a condition is obtained in the course of the cycle. E.G. after extensive forest fire in a forest, this is the time until early succession stages have re-established.

Scale:

A1	A2	A3	A4	A5	A6	A7	A8
≤ 150	151 - 450	> 450 - 1'500	> 1'500 - 4'500	> 4'500 - 15'000	> 15'000 - 45'000	> 45'000 - 150'000	> 150'000

Damage area "economy"

Economic effects and damage are counted as asset losses and cost of coping (Ec1) and reduction of economic performance (Ec2).

Ec1 Asset losses and cost of coping [CHF]

Damage indicator Ec1 measures losses to existing assets and the cost of coping.

Assets include both tangible and financial assets.[5,6] This indicator counts all damage to assets even if, for example, insurance companies or the state settle the costs.

Cost of coping includes, for instance, the cost of emergency services, emergency shelters, and provision of care for individuals in need of assistance.

Example – flooding: Flooding causes damage to several buildings and a factory. This runs up costs for pumping out basements and removing rubble and driftwood (cost of coping). The physical damage creates financial losses, since the buildings and equipment are now diminished in value.

Depending on the effects of the hazard, various perspectives can be adopted regarding financial losses:

Macroeconomic: Nationwide cost of coping and damage to national wealth.[7]

Individual or small-scale: Cost of coping and financial losses for individuals or within a spatially limited unit.[8]

Scale:

A1	A2	A3	A4	A5	A6	A7	A8
≤ 50 Mio.	51 - 150 Mio.	> 150 - 500 Mio.	> 500 Mio. - 1.5 Mrd.	> 1.5 Mrd. - 5 Mrd.	> 5 Mrd. - 15 Mrd.	> 15 Mrd. - 50 Mrd.	> 50 Mrd.

[5] Capital assets are also referred to as "real capital", e.g., real estate, manufacturing facilities, household effects, or farm animals. In Switzerland, capital assets include buildings and civil engineering works, machines and equipment, farm animals and crops, and computer programs (cf. FSO indicator T10 "Non-financial net capital stock").
[6] Financial assets may include cash, shares, or pension entitlements. Financial assets consist of the balance between assets and liabilities, cf. SNB "Net financial assets".
[7] Including Switzerland's net assets abroad. This is mainly relevant for hazards that apply uniformly across the country, e.g., rising cost of healthcare due to diseases of affluence.
[8] This is mainly relevant in the case of events of limited area effect, e.g., landslides or accidents involving hazardous material.

Ec2 Reduction of economic performance [CHF]

Damage indicator Ec2 includes indirect economic effects that reduce the creation of value in Switzerland. Thus, while Ec1 (financial losses and cost of coping) relates to the cost of coping and damage to existing assets, Ec2 takes into account the consequences for future value creation.

Example – flooding (cf. example given for Ec1): Due to the damage created by flooding, the affected company has no output for several weeks and therefore suffers loss of income.

Depending on the effects of the hazard, various perspectives can be adopted regarding financial losses:

Macroeconomic: the sum of domestic value creation is used as an indicator of total economic performance. It is quantified in terms of Gross Domestic Product (GDP). Thus, a reduction of economic performance corresponds to a decline in GDP.[9]

Individual or small-scale: Loss of individual economic performance for individuals or within a spatially limited unit.[10]

Scale:

A1	A2	A3	A4	A5	A6	A7	A8
≤ 50 Mio.	51 - 150 Mio.	> 150 - 500 Mio.	> 500 Mio. - 1.5 Mrd.	> 1.5 Mrd. - 5 Mrd.	> 5 Mrd. - 15 Mrd.	> 15 Mrd. - 50 Mrd.	> 50 Mrd.

[9] E.g., in case of a severe earthquake causing a longer-term disruption of most economic activities.
[10] For instance, the discontinuance of distribution for produced goods due to disruption of transportation routes is measured as loss of value creation.

Damage area "society"

The damage area relating to society measures significant disruptions of daily life caused by hazards. On the one hand, these may include the effects on the Swiss population, e.g., through supply shortfalls and disruptions (S1), curtailment of basic rights (S2), or diminished public order and domestic security (S3). On the other hand, it registers the effects on the state: A reputational loss for Switzerland abroad (S4), a loss of confidence in the state or its institutions on the part of the Swiss people (S5), or a reduction of territorial integrity (S6).

S1 Supply shortfalls and disruptions [person days]

This indicator measures breakdowns or severe disruptions to the supply of critical goods and services to the entire population or parts of it. They are grouped into three sets according to their importance.

Supply shortfalls are calculated by multiplying the number of persons affected with the duration of disruption in days. The effective duration of the supply disruption for affected people is added up. Thus, what is calculated is the duration of the actual disruption. For instance, the total time of a power blackout might be calculated, i.e., the sum of outage time, rather than the number of days on which power was disrupted for a few hours each day.

Economic follow-on costs are counted by the indicators Ec1 (asset losses and cost of coping) and Ec2 (reduction of economic performance).

Scale:

A1	A2	A3	A4	A5	A6	A7	A8
≤ 0.5 Mio.	> 0.5 Mio. - 1.5 Mio.	> 1.5 Mio. - 5 Mio.	> 5 Mio. - 15 Mio.	> 15 Mio. - 50 Mio.	> 50 Mio. - 150 Mio.	> 150 Mio. - 500 Mio.	> 500 Mio.

Table 6: Grouping of goods and services according to importance.

Importance	Goods	Services	Factor[11]
critical	Potable water, basic foodstuffs, medicine	Medical emergency services, communication of first responders	1
very important	Electricity, heating, natural gas, clothing, shelter	Ambulant and stationary medical treatment (excluding emergency services), ambulant nursing	0.3
important	Other foodstuffs, fuel	Telephone, IT, TV, transport/traffic (roads, rail, shipping, etc.)	0.1

[11] There is currently no basis for weighting these factors. They will therefore be validated and adapted during practical application of the method.

S2 Diminished public order and domestic security [person days]

This indicator measures how many people living in Switzerland have experienced diminished public order and domestic security, and for how long. This refers to adverse effects from domestic disturbances impinging upon the daily life of the general public. Such adverse effects are measured in person days. The minimum duration per person is one day.

Scale:

A1	A2	A3	A4	A5	A6	A7	A8
≤ 100'000	100'001 - 300'000	300'001 - 1 Mio.	1 Mio. - 3 Mio.	3 Mio. - 10 Mio.	10 Mio. - 30 Mio.	30 Mio. - 100 Mio.	> 100 Mio.

S3 Reputational loss [intensity x duration]

This indicator comprises the intensity and duration of a reputational loss for Switzerland abroad, i.e., an event or development that damages Switzerland's standing and causes the country to be put into question as a partner for bi- and multilateral as well as international agreements.

This indicator takes into account the intensity of the reputational loss and its duration.

Scale:

A1	A2	A3	A4	A5	A6	A7	A8
Damage to reputation lasting only a few days and related to issues of medium importance (e.g., negative coverage in foreign media)	Damage to reputation lasting up to a few weeks and related to issues of medium importance (e.g., negative coverage in foreign media)	Damage to reputation lasting up to a few weeks and related to important issues (e.g., negative coverage in foreign media)	Damage to reputation lasting several weeks and related to important issues, but with minor impact on Switzerland's standing and international cooperation (e.g., temporary expulsion of Swiss diplomat)	Damage to reputation lasting several weeks and related to important issues, with impact on Switzerland's standing and international cooperation (e.g., termination of agreements with Switzerland, temporary expulsion of Swiss ambassador)	Considerable damage to reputation lasting several weeks and related to important issues, with impact on Switzerland's standing and international cooperation (e.g., termination of agreements with Switzerland, expulsion of Swiss ambassador)	Considerable damage to reputation lasting up to several months with visible impact on Switzerland's standing and international cooperation (e.g., political isolation, boycotts)	Lasting, severe damage to reputation, possibly leading to irreversible loss of reputation with far-reaching impact on Switzerland's standing and international cooperation (e.g., political isolation, boycotts)

S4 Loss of confidence in state/institutions [intensity x share of population]

Indicator S5 measures the intensity of a loss of confidence in the state in general and its institutions, as well as the share of the population that is losing confidence. Such institutions may include the executive, legislative, or legal branches of government as well as state and cantonal organizations such as public administrations, the armed forces, or the police.

The intensity of such loss of confidence is described qualitatively (cf. classes for extent). For instance, it includes the question of whether the loss of confidence extends to individual cantonal administrative units or to the federal administration in general.

Scale:

A1	A2	A3	A4	A5	A6	A7	A8
Loss of confidence lasting only a few days and related to issues of medium importance (e.g., very critical coverage in Swiss media)	Loss of confidence lasting up to a few weeks and related to issues of medium importance (e.g., very critical coverage in Swiss media, occasional demonstrations)	Loss of confidence lasting up to a few weeks and related to important issues (e.g., very critical coverage in Swiss media, occasional demonstrations)	Loss of confidence lasting from a few weeks up to several weeks and related to important issues (e.g., strikes, larger demonstrations)	Loss of confidence lasting several weeks and related to important issues (e.g., multiple strikes, occasional mass demonstrations)	General loss of confidence lasting several weeks (e.g., extended strikes in many areas, mass demonstrations all over Switzerland)	General, considerable loss of confidence lasting up to several months (e.g., general strikes)	Lasting, severe or even irreversible loss of general confidence (formation of local or regional groups for self-organization of public life, to the point of vigilante group formation)

S5 Reduction of territorial integrity [intensity x duration]

This indicator describes the intensity of a violation of Swiss territory. The focus is on violations of Swiss airspace and soil.

The indicator comprises various forms of violations of Swiss territory by another state. It takes into account the intensity and duration of this violation.

The extent of effects are only determined starting at Class 4, as only such violations are registered that may lead to a noticeable reduction of territorial integrity or to pronounced inter-state tensions.

Scale:

A1	A2	A3	A4	A5	A6	A7	A8
---	---	---	Short-term, intentional violations of territorial integrity (e.g., civilian or military operations of foreign security forces on Swiss soil)	Short-term, grave violations of territorial integrity (e.g., repeated civilian or military operations of foreign security forces on Swiss soil)	Temporary, grave violation of territorial integrity (e.g., temporary occupation of limited area of Swiss soil)	Temporary, extremely grave violation of territorial integrity (e.g., temporary occupation of considerable area within Switzerland)	Long-lasting, extremely grave violation of territorial integrity (e.g., occupation of significant part of Switzerland)

S6 Damage to and loss of cultural goods [number x significance]

This indicator describes the damage to or loss of Switzerland's cultural goods.

Cultural goods worthy of protection may include movable or non-movable goods of considerable importance to the cultural heritage of nations. Examples include buildings, artwork, monuments, archeological sites, books, manuscripts, scientific collections, archival material, and reproductions of cultural goods. They also include buildings such as museums, libraries, archives, monasteries, and places that may be used to safeguard moveable cultural goods.[12]

A distinction is made between cultural goods of local, regional (B-class objects), or national (A-class objects) significance as well as objects under "enhanced protection" (cf. Federal Commission for the Protection of Cultural Goods, according to the II Protocol to the Hague Convention).

The term "damage" applies to severe detrimental effects that destroy the cultural goods or necessitate high expenditures of time or funds for the restoration of the latter.

"Loss" encompasses misappropriation (theft, robbery) or irreversible destruction (e.g., through fire, explosion, or water).

Scale:

A1	A2	A3	A4	A5	A6	A7	A8
Damage to or loss of individual cultural goods of regional significance	Damage to or loss of cultural goods of regional significance or individual cultural goods of national significance	Damage to or loss of several cultural goods of regional significance and individual cultural goods of national significance	Damage to or loss of several cultural goods of national significance	Damage to or loss of many cultural goods of national significance	Damage to or loss of many cultural goods of national significance and cultural goods under "enhanced protection"	---	---

[12] Cf. Hague Convention for the Protection of Cultural Property in the Event of Armed Conflict (1954), Art. 1.

3.5 Comparison of hazards

3.5.1 Overviews

The key result of the analysis is the comparison of hazards and the risks associated with them. To this end, the extent of damage (E) determined for a given hazard scenario and the likelihood (L) or frequency of its occurrence are depicted in a diagram known as a risk diagram (cf. Fig. 3).

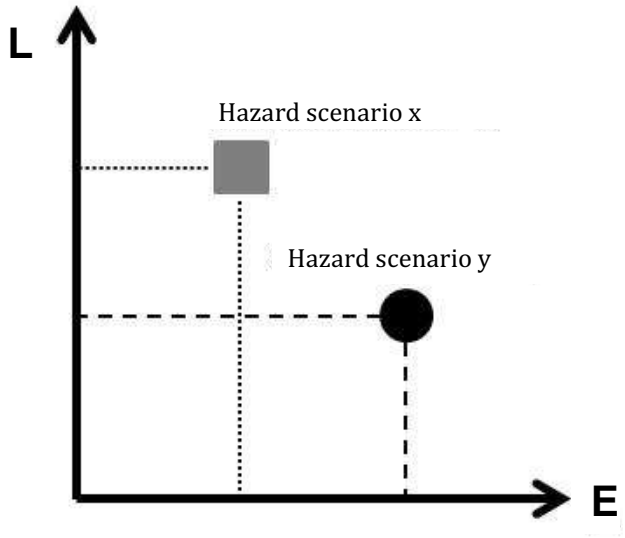

Figure 3: Schematic depiction of hazard scenarios in a risk diagram.

The depiction of hazard scenarios in a matrix makes it possible to compare the extent of effects (E) for various hazard scenarios and their likelihood of occurrence (L) (in Fig. 3, the frequency or plausibility can also be plotted accordingly on the matrix axis). This comparison serves as the basis for prioritizing hazards or assessing risks.

The effects are listed separately for each hazard scenario based on the 13 indicators described above. In order to be able to depict the extent of multiple effects as a single value on the risk matrix, the values of the individual damage indicators must be aggregated (cf. section 3.5.2).

If the risks are calculated in a subsequent step, i.e., when the product of E and L is calculated, the risk aversion is taken into account in the calculations (cf. section 3.5.3).

3.5.2 Aggregating the damage indicators

Only one dimension of an effect can be depicted in a risk matrix. In order to depict the effects measured by the indicators as a single value, the damage must be aggregated for comparison.

To this end, the extent of damage for each indicator is converted into a single unit. Usually, this is done by monetization expressed as cash value, e.g., in CHF. A monetary value is assigned to the unit of each indicator. For the purposes of monetization, the marginal costs are determined for each indicator. The marginal cost for an indicator is the amount of money that society is willing to pay in order to reduce the extent of damage of an indicator by one unit (KATARISK 2003). This willingness to pay may be the result of an environmental economic assessment or a normative societal determination. The aggregated extent of damage is calculated by adding up the effects, expressed as cash value, of an event across all indicators (cf. KATARISK 2003). In this way, the complete extent of damage of an event can be displayed as a value in the matrix.

To facilitate aggregation of non-quantitatively defined indicators, a monetary value is assigned to each class for extent of these indicators. To this end, the mean value determined for the same class for extent under the indicator Ec1 (asset losses and cost of coping) is used.

This monetary value is added up together with the monetary values for extent of the other indicators for a total value. Using this total value, the extent of damage across all damage indicators can be entered into the risk matrix. The classes for extent are displayed on the “extent” axis of the risk matrix.

Table 5: Overview of the values for marginal costs that were used in the 2012 analysis.
*= cf. chapter 3.5.2 Aggregating the damage indicators.

Indicator	Marginal costs per unit
I1 - Fatalities	4 Mio.
I2 - Casualties/sick people	400‘000 CHF
I3 - Individuals in need of assistance	250 CHF
En1 - Damaged ecosystems	11‘500 CHF
Ec1 - Asset losses and cost of coping	1 CHF
Ec2 - Reduction of economic performance	1 CHF
S1 - Supply shortfalls and disruptions	500 CHF
S2 - Diminished public order and domestic security	300 CHF
S3 - Reputational damage	Mean of the corresponding class in Ec1*
S4 - Loss of confidence in state/institutions	Mean of the corresponding class in Ec1*
S5 - Reduction of territorial integrity	Mean of the corresponding class in Ec1*
S6 - Damage to and loss of cultural goods	Mean of the corresponding class in Ec1*

The marginal costs for aggregation in the risk report 2012 are shown in table 5. The values were derived from former works such as KATARISK or publications of PLANAT. If there were no known values of marginal cost for a particular damage indicator their calculation were based on statistics (e.g. the marginal costs for damaged ecosystems) or their values were estimated in relation to know values (e.g. Diminished public order and domestic security)

3.5.3 Risk aversion

Risk aversion is an element of risk assessment with which the extent of damage of major events can be weighted disproportionally strongly in order to depict the particular effects of such events.

If the risk for a hazard scenario is calculated, i.e., the extent of damage is multiplied with the likelihood of occurrence (or frequency or plausibility), the information is lost as to whether the hazard scenario is a scenario with a very high extent of damage and small likelihood of occurrence, or a scenario with a small extent of damage and high likelihood of occurrence. In order to compensate for this loss of information and to take into account the importance of events with very high extent of damage even when studying the calculated risks, allowance is made for risk aversion as an additional assessment factor in the calculation.

The aversion function that is factored into the risk analysis for disasters and emergencies in Switzerland is based on the report “Risikoaversion: Ein Beitrag zur systematischen Risikobeurteilung“ (“Risk aversion: A contribution to systematic risk assessment”, FOCP 2010).

3.6 Dealing with uncertainties

3.6.1 Dealing with uncertainties

Methods of quantitative risk analysis as used for the risk analysis of disasters and emergencies in Switzerland make it possible to determine precise risk values. However, these ultimately only constitute a modeling of reality and accordingly involve uncertainties. These uncertainties must be taken into account when choosing the degree of detail in analyses and in the interpretation of data. The more precisely reality can be depicted during quantification, the better the identified risks will reflect reality.

3.6.2 Uncertainty in data and in data collection methods

The national risk analysis compares well-known hazards, such as flooding, with hazards that are to some extent elusive, such as terrorist attacks. In the former case, empirical values and a statistical basis are often available for establishing the frequency and extent of damage for the hazard scenarios. This is not the case with hazards that are less well understood. Here, any hazard analysis depends much more on assumptions and expert judgments. But even with well-known hazards, expert judgments are inevitable, e.g., in order to determine the extent of certain damage indicators (cf. section 3.4).

To a large extent, careful data collection and awareness of the respective collection methods can help to preclude distortions, resulting in good data quality.

There are various scientific survey methods for data collection (e.g., Delphi Method) that can be used to achieve good results with such estimates. In addition to the survey method, the selection of experts involved in the assessments is also a crucial factor.

Nevertheless, the fact remains that the underlying data are assumptions. Uncertainties concerning the data for a national hazard analysis therefore persist. For instance, the frequency and the extent of damage are particularly difficult to assess for scenarios involving comparatively new hazards or for infrequent scenarios, where statistical data or other empirical values are rare, e.g., for infectious diseases through unknown pathogenic agents. Here, there is no alternative to working with assumptions and approximations.

In dealing with hazards that are subject to change (e.g., due to climate change), empirical values for frequency and extent of damage are only of limited validity. Statements on the future frequency and extent of such hazards must necessarily depend on assumptions.

3.6.3 Uncertainties in modeling

In addition to the uncertainties of data and assumptions, there are further uncertainties involved in the modeling of risks. Comparisons are made between the risks of selected exemplary scenarios for the events related to a specific hazard. The analyst has a certain degree of freedom in designing the unfolding of the scenario, which in turn influences the effects and the likelihood of occurrence. However, since ultimately three scenarios of considerable, great, and extreme intensity are developed for each hazard, the selection of examples for scenarios should balance out possible distortions.

In order to aggregate the effects of a scenario across all indicators, they are converted into monetary units based on marginal costs and multiplied by the risk aversion factor. Both of these factors are designed to reflect societal preferences. The marginal cost rates and risk aversion factors used here may have a crucial effect on the total effect.

3.6.4 Sensitivity analyses

In order to test the robustness of results and to evaluate uncertainties in the model, sensitivity analyses are required. With these analyses, taking into account variation for different marginal costs (cf. section 3.5.2) and risk aversion functions (cf. section 3.5.3), one can determine whether the sequence of hazards is robust in terms of their risk, or whether the result of the comparative analysis depends strongly on society's assessment of the various protected goods and the extent of damage.

4 Sources and methodological basis

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A1 Guidelines for conducting Delphi surveys

The lead team begins by informing participants about the aims of the workshop and the expert assessments to be conducted in the framework of the workshop. Subsequently, the following steps are carried out:

1. The experts (re-) read the example scenario.

Procedure for validating the extent of damage indicators derived from existing data

1. Each suggestion relating to the extent of a damage indicator and/or the likelihood of occurrence/frequency/plausibility that is based on existing data is examined individually by the experts.
2. The moderator collects the individual assessments of the experts.
3. If any expert has concerns about the allocated value, the value is discussed by the group and, if the concerns prove to be justified, is adapted and noted.

Procedure for assessing the extent of damage indicators as well as likelihood of occurrence/frequency/plausibility for which no basic data is available

4. The experts individually estimate the extent of effects for the indicators for which no data is available.
5. The moderator collects the individual estimates and identifies the minimum and maximum estimated values.
6. The experts who contributed these maximum or minimum values explain the deliberations on which their estimates are founded. Subsequently, a moderated discussion is held to establish a value on which the expert group can agree. If no agreement is achieved, the mean value of the estimates is used.
7. For a hazard scenario, the likelihood of occurrence is first estimated individually.
8. The moderator collects the individual estimates and identifies the minimum and maximum estimates.
9. The experts who contributed these maximum or minimum values explain the deliberations on which their estimates are founded. Subsequently, a moderated discussion is held to establish a value on which the expert group can agree. If no agreement is achieved, the mean value of the estimates is used.

A2 Participants of the method validation workshop for the risk analysis of disasters and emergencies in Switzerland

Bohnenblust	Hans	Ernst Basler + Partner
Brem	Stefan	Federal Office for Civil Protection
Brönnimann	Gabriel	Center for Security Studies ETH
Bründl	Michael	Institute for Snow and Avalanche Research
Bruno	Stefano	Federal Office of Police
Bucher	Andreas	Federal Office for Civil Protection
Dunn	Myriam	Center for Security Studies ETH
Egli	Ken	Federal Department of Foreign Affairs
Franz	Andrea	Swissi AG
Habegger	Beat	Swiss Re
Heynen	Nicole	Federal Department of Finance
Holenstein	Matthias	Risk Dialogue Foundation
Holzner	Christian	Federal Office of Energy
Imholz	Hans	Cantonal Police Zurich
Jordi	Martin	Association of Cantonal Fire Insurances
Köppel	Thomas	Federal Intelligence Service
Lateltin	Olivier	Swisstopo
Lauber	Anton	Office for National Economic Supply
Merz	Hans	Ernst Basler + Partner
Mueller	Nicolas	Federal Chancellery
Roos	Dominic	Municipal Police Zurich
Sennhauser	Michel	Kantonaler Führungsstab Thurgau
Suter	Reto	Federal Office for Civil Protection
Werner	Christoph	Federal Office for Civil Protection
Widmer	Susanne	Amt Militär und Bevölkerungsschutz Solothurn

A3 Overview of indicators and classes for extent

Damage area	Indicator		Unit	A1	A2	A3
Persons	P1	Deaths	Number	≤10	11 - 30	31 - 100
	P2	Casualties/sick persons	Number	≤100	101 - 300	301 - 1'000
	P3	Individuals in need of assistance	Person days	≤200'000	200'001 - 600'000	600'001 – 2 million
Environment	En1	Damaged ecosystems	km2 * years	≤150	151 - 450	>450 - 1'500
Economy	Ec1	Asset losses and cost of coping	CHF	≤50 million	51 – 150 million	>150 – 500 million
	Ec2	Reduction of economic performance	CHF	≤50 million	51 – 150 million	>150 – 500 million
Society	S1	Supply shortfalls	Person days	≤0.5 million	>0.5 – 1.5 million	>1.5 million – 5 million
	S2	Diminished public order and domestic security	Person days	≤100'000	100'001 - 300'000	300'001 – 1 million
	S3	Reputational damage	Intensity * duration	Damage to reputation lasting only a few days and related to issues of medium importance (e.g., negative coverage in foreign media)	Damage to reputation lasting up to a few weeks and related to issues of medium importance (e.g., negative coverage in foreign media)	Damage to reputation lasting up to a few weeks and related to important issues (e.g., negative coverage in foreign media)
	S4	Loss of confidence in state/institutions	Intensity * duration	Loss of confidence lasting only a few days and related to issues of medium importance (e.g., very critical coverage in Swiss media)	Loss of confidence lasting up to a few weeks and related to issues of medium importance (e.g., very critical coverage in Swiss media, occasional demonstrations)	Loss of confidence lasting up to a few weeks and related to important issues (e.g., very critical coverage in Swiss media, occasional demonstrations)
	S5	Reduction of territorial integrity	Intensity	---	---	---
	S6	Damage to and loss of cultural goods	Number * importance	Damage to or loss of cultural goods of regional significance or individual cultural goods of national significance	Damage to or loss of several cultural goods of regional significance and individual cultural goods of national significance	Damage to or loss of several cultural goods of national significance or individual goods of international significance

	A4	A5	A6	A7	A8
P1	101 - 300	301 - 1'000	1'001 – 3'000	3'001 - 10'000	>10'000
P2	1'001 - 3'000	3'001 - 10'000	10'001 - 30'000	30'001 - 100'000	>100'000
P3	>2 million – 6 million	>6 million – 20 million	>20 million – 60 million	>60 million – 200 million	>200 million
En1	>1'500 – 4'500	>4'500 - 15'000	>15'000 - 45'000	>45'000 - 150'000	>150'000
Ec1	>500 million – 1.5 billion	>1.5 billion – 5 billion	>5 billion – 15 billion	>15 billion – 50 billion	>50 billion
Ec2	>500 million – 1.5 billion	>1.5 billion – 5 billion	>5 billion – 15 billion	>15 billion – 50 billion	>50 billion
S1	>5 million – 15 million	>15 million – 50 million	>50 million – 150 million	150 million – 500 million	>500 million
S2	1 million – 3 million	3 – 10 million	10 million – 30 million	30 million – 100 million	>100 million
S3	Damage to reputation lasting several weeks and related to important issues, but with minor impact on Switzerland's standing and international cooperation	Damage to reputation lasting several weeks and related to important issues, with impact on Switzerland's standing and international cooperation (e.g., termination of agreements with Switzerland, temporary expulsion of Swiss ambassador)	Considerable damage to reputation lasting several weeks and related to important issues, with impact on Switzerland's standing and international cooperation (e.g., termination of agreements with Switzerland, expulsion of Swiss ambassador	Considerable damage to reputation lasting up to several months with visible impact on Switzerland's standing and international cooperation (e.g., political isolation, boycotts)	Lasting, severe damage to reputation, possibly leading to irreversible loss of reputation with far-reaching impact on Switzerland's standing and international cooperation (e.g., political isolation, boycotts
S4	Loss of confidence lasting from a few weeks up to several weeks and related to important issues (e.g., strikes, larger demonstrations)	Loss of confidence lasting several weeks and related to important issues (e.g., multiple strikes, occasional mass demonstrations)	General loss of confidence lasting several weeks (e.g., extended strikes in many areas, mass demonstrations all over Switzerland)	General, considerable loss of confidence lasting up to several months (e.g., general strikes)	Lasting, severe or even irreversible loss of general confidence (formation of local or regional groups for self-organization of public life, to the point of vigilante group formation)
S5	Short-term, intentional violations of territorial integrity (e.g., civilian or military operations of foreign security forces on Swiss soil)	Short-term, grave violations of territorial integrity (e.g., repeated civilian or military operations of foreign security forces on Swiss soil)	Temporary, grave violation of territorial integrity (e.g., temporary occupation of limited area of Swiss soil)	Temporary, extremely grave violation of territorial integrity (e.g., temporary occupation of considerable area within Switzerland)	Long-lasting, extremely grave violation of territorial integrity (e.g., occupation of significant part of Switzerland
S6	Damage to or loss of many cultural goods of national significance and of individual goods of international significance	Damage to or loss of several cultural goods of international significance	---	---	---