www.skitourenguru.ch

The planning platform helps you to choose a backcountry ski tour with low avalanche risk.

Introduction

Introduction “Skitourenguru”

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Preface

Spending time in the mountains always comes with a certain amount of risk. Approximately 150 persons die each year in Switzerland during some kind of activities in the mountains; among which 20 are due to avalanches. It is why venturing off secured routes and slopes is classified as a risky sport by SUVA. A tool is needed that predicts avalanches; however, such a tool **does not exist** and won't exist in the foreseeable future. Skitourenguru cannot achieve this goal, but it can help you plan your trip. There is no way around the importance of trip planning, continued assessment along the way and the necessity to accept the remaining risk. Skitourenguru is helpful for selecting and planning your trip at home (first phase of the 3x3-Rule, see Chapter 4). Nevertheless, on location and while evaluating a single slope, the assessment of Skitourenguru becomes less important. Whether or not you use Skitourenguru, planning and conducting a ski tour requires the education and skills of an alpine sportsperson.

1 In a Nutshell

1.1 What is Skitourenguru?

Skitourenguru offers an automated avalanche risk assessment for approximately 900 backcountry ski tours in Switzerland. The according algorithm is based on the Graphical Reduction Method (GRM). Skitourenguru calculates for each point of a route the avalanche risk by combining a digital elevation model with the current avalanche bulletin. Subsequently, the results are aggregated to a single **Risk-Indicator** (see Chapter 1.5). This Risk-Indicator shows, similar to a traffic light, whether the route is of low risk (green), an elevated risk (orange) or high risk (red). The calculation is updated twice a day, at 8:30am and 17:30pm. People tend to shorten the trip planning or they miss important aspects. In contrast, Skitourenguru is reliable and diligent. Skitourenguru delivers reproducible and consistent results.

The following data elements are used in Skitourenguru:

- **The elevation model** is very accurate. Apart from glaciers, it is hardly ever a cause of false calculations.
- **The forest coverage** is very accurate. Whether the forest actually has a protective effect depends on different factors.
- **The avalanche bulletin** is just a forecast and by nature it can be wrong. In those cases, the result of Skitourenguru will also be wrong.
- **The Graphical Reduction Method (GRM)** combines the slope angle with the danger level of the avalanche bulletin. The GRM does not deliver in all cases accurate values, but always gives a reference point. The GRM is considered the best available tool.

Despite these uncertainties, Skitourenguru offers an excellent opportunity to quickly select an appropriate trip. The result of Skitourenguru must never be the sole criteria to enter a slope. However, the same applies for a route that would have been manually selected and planned.

1.2 What is the value of Skitourenguru?

The foundation of modern avalanche assessments is the 3x3-Rule (Assessment and Decision Framework) of Werner Munter. It divides a trip into the three phases of **Trip Planning**, **Local Evaluation** and **Individual Slope**. In each phase, the three factors **Conditions**, **Terrain** and **Human Factors** have to be considered.

Avalanche courses usually start with the exercise to plan a specific route, but who provides the initial route suggestion? The instructor? At home you won't have an instructor. Even those who know "their" mountains well, will have difficulties to remember 1000 routes and make a rational selection.
This is where Skitourenguru steps in with a customized list of ski tours that show a low avalanche risk based on current knowledge (avalanche bulletin and elevation model combined into GRM). Now it is up to you to select one (or more) routes from the list and plan those in detail.
When the backcountry ski tour is progressing, knowledge regarding snow, weather, terrain and people increases. With the additional knowledge, the result of the planning becomes less important and is replaced by a differentiated risk evaluation of every single slope. Such an evaluation requires experience and formation.

1.3 Who is the audience for Skitourenguru?

Skitourenguru targets backcountry skiers and snowboarders who know avalanche theory and actively practice avalanche awareness. Winter sport enthusiasts need to be able to cope with the challenges of the alpine terrain during winter. Novices shall read the article my first ski tour. **The focus of Skitourenguru is backcountry skiers and backcountry snowboarders**. The service explicitly does not target snowshoe walkers or free-riders. These two disciplines usually take place in a different context, which is not covered reliably by the algorithm of Skitourenguru. Furthermore, secured routes exist for these sports.

1.4 How do I get quickly to the Routes?

Via a mouse click on Skitouren (backcountry ski tours) you get to a disclaimer. If you accept the disclaimer, you will get to a search dialog window. You can select the ski tour you are looking for via six filter criteria. Apart from the **difficulty**, the main criteria is the **Risk-Indicator**. This is a decimal number between 0 and 3 and is separated into three categories (see Chapter 1.5). After clicking on “Suche...” (Search), a list of recommended routes is shown. Now you can refine your search or display the details of a particular route.

1.5 Risk-Indicator

Twice a day Skitourenguru calculates a Risk-Indicator for each of the 900 routes. Similar to a traffic light, it is divided into three Risk-Categories:

Symbol	Value	Definition according to GRM	Interpretation
	0..1	**Low risk** Generally safe if no warning signs are present.	**Green means the backcountry ski tour can be considered for planning, however, a further critical assessment must be undertaken.** Attention: Skitourenguru shall never be the sole source for a Yes/No decision in a potential avalanche area. Why does green not mean that the route can be undertaken unseen? Avalanche risk assessment in the 3x3-Rule (see Chapter 4) is based on filters. While a NO means a NO-go decision, a YES is only a preliminary decision that requires further evaluation of the subsequent filters.
	1..2	**Elevated risk** Caution! Experience required! • Assess avalanche problems, weigh up pros and cons with respect to the avalanche risk on the individual slope. • Smart route selection and good travel habits are essential. • Risk reduction measures. • Inexperienced riders should avoid this area. • Training and experience required.	**Orange means that only experienced individuals can continue the assessment.** They need to be able to identify and weigh avalanche risk factors. Thus, experience is required to even continue the planning. Orange does not indicate, whether the further evaluation leads to a YES or NO. A NO should be the most likely scenario. Also for experts, orange is not s “free ticket”. Remember the quote by André Roche: “*Expert, be cautious! The avalanche does not know that you are an expert.*”
	2..3	**High risk** Travel in avalanche terrain is not recommended.	**Red usually means NO!** Does red mean an avalanche would actually occur on this route? Maybe and maybe not. The GRM can only provide a basic calculation whether the risk is high or low. Red sections of tours show typical characteristics that apply for avalanche accidents: e.g. the combination of a very steep slope, avalanche prone locations and the avalanche danger level is “considerable”.

Table 1: Definition of Risk-Categories

2 Select Route

2.1 Entry Point

A click on Skitouren (backcountry tours) shows the disclaimer. It explains with easy words the purpose and limitation of Skitourenguru. If you accept the disclaimer, you will see a search menu. You can search routes in three ways:

1. Search Request
2. Select Route via Map
3. Select Area via Map

Skitourenguru favors the first option (Search Request). You will be directed to routes with “low avalanche risk” while fulfilling your request.

2.2 Search Request

With the help of six filter criteria (see Figure 1) you can define which type of backcountry ski tours you are looking for. Apart from the **difficulty**, the main criteria is the **Risk-Category**.

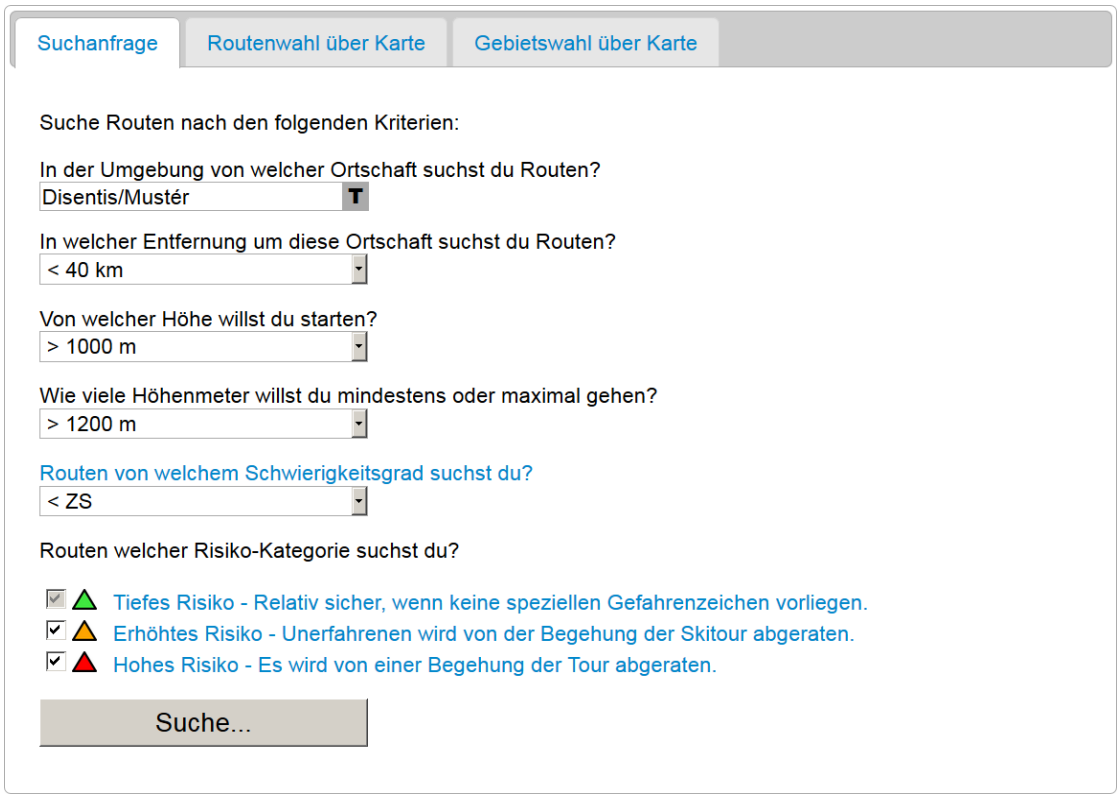

Figure 1: Search request

Your entries are stored in cookies and are retained between searches. Difficulty and Risk-Category, however, are always reset to their default values. The default values stimulate the search of routes with low difficulty and with low avalanche risk. Nevertheless, it remains possible to view other routes any time. However, you must be aware that you expose yourself to a higher and potentially unacceptable risk.
Once you click on “Suche...“ (Search), a table is displayed with routes that fit your search criteria (see Figure 2). You can use the table header to change the search criteria, which leads to a longer or shorter list. The column on the right side displays the Risk-Indicator as a decimal number between 0 and 3. The routes are automatically sorted by the Risk-Indicator in ascending order. Via a click on the table header, you can also sort by a different column (e.g. alphabetically by summit). In the example, six routes show a green Risk-Indicator. The “green routes” are the recommended pre-selection for your trip planning. Once you click on an entry in the first column, you will see the route details (see Chapter 3).

Gipfel	Gipfelhöhe	Start	Starthöhe	Höhendifferenz	Anreisedistanz	Schwierigkeit	Risiko
13 / 625	m		> 1000 m	> 1200 m	< 40 km	< ZS	Alle
Fil da Rueun	2346	Valsins	1138	1209	28	L	0.42
Piz Titschal	2534	St. Martin	1344	1201	23	L	0.70
Piz Dadens	2764	Brigels	1285	1502	21	WS	0.89
Chrüzlistock	2703	Rueras	1447	1256	12	WS+	0.93
Piz Val Gronda	2813	Giraniga	1268	1545	23	WS+	0.95
Piz Pazzola	2576	Platta	1373	1204	7	WS	0.99
Oberalpstock	3317	Sedrun	1441	1876	9	ZS-	1.05
Piz Maler	2784	Sedrun	1400	1471	10	WS+	1.42
Piz Giuv	3081	Dieni	1455	1627	12	ZS-	1.45
Winterhorn	2656	Hospental	1452	1204	35	WS	1.61
Piz Ravetsch	2997	Oberalppass	2032	1234	21	WS-	1.94
Piz Maler	2784	Rueras	1397	1408	11	ZS-	1.97
Piz Cristallina	3116	Fuorns	1455	1687	9	ZS-	2.68

Figure 1: Sorted table of routes

2.3 Select Route via Map

Instead of searching via filter criteria, you can also look up routes on the map. You can move and zoom the map with your mouse. All routes are marked with a colored triangle according to their Risk-Category. If you want to know more about a specific route, click on the respective triangle and then on “Zur Detail-Routenplanung…” (To the route details).

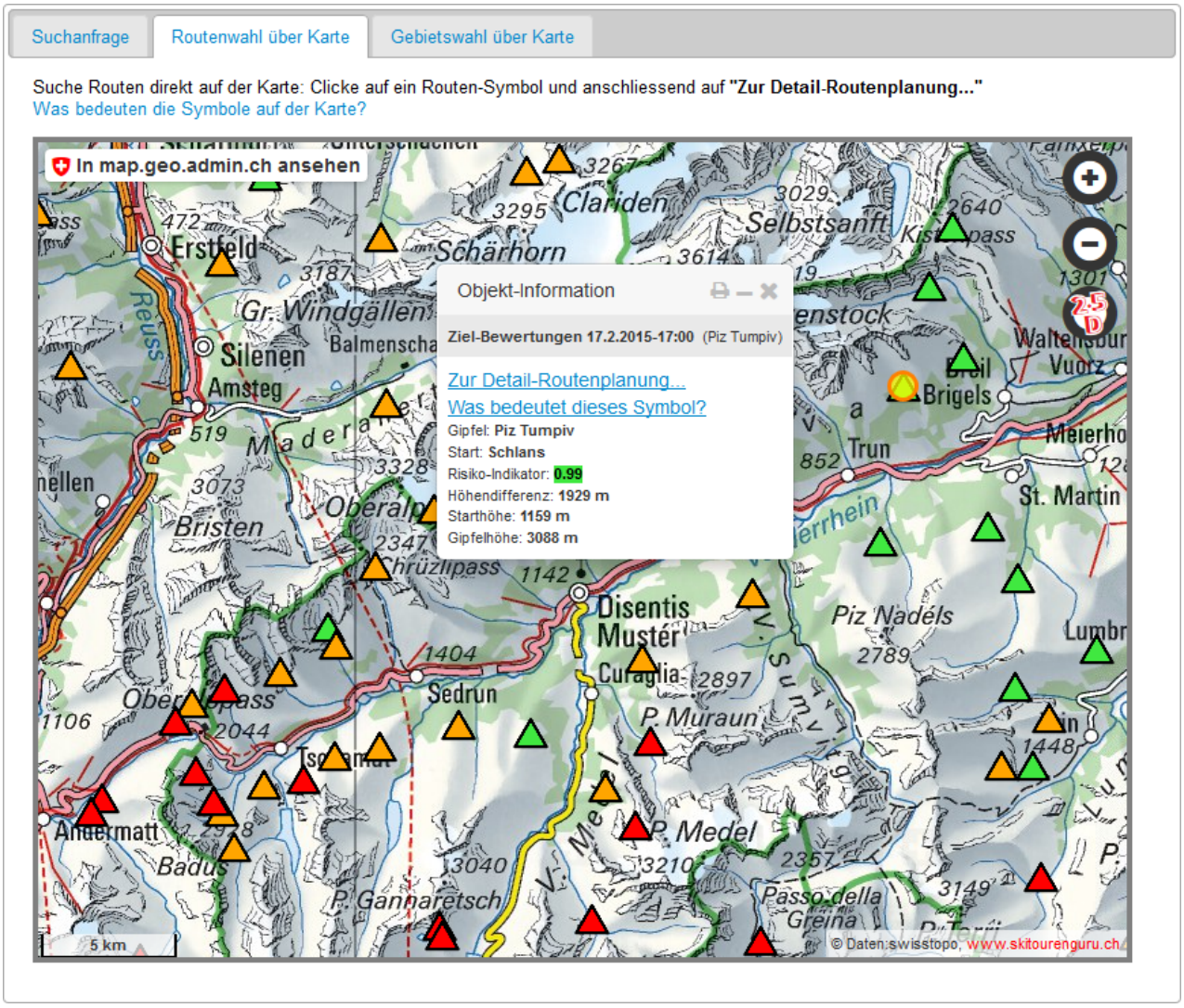

Figure 2: Route selection via the map

2.4 Select Area via Map

If you know exactly which area you are interested in, you can also choose the third option “Gebietswahl über Karte” (Select Area via Map). Switzerland is divided into 128 districts. When you select one of the districts, all routes of the respective district are shown. In order to get to the detailed view of a specific route, you need to click on one of the triangles.

2.5 Search of a specific Summit

If you are searching for a specific summit (e.g. Mutteristock). This is the easiest way:

1. Go to “Suchanfrage” (Search Request): see Chapter 2.2.
2. Set the filter criteria to display **all routes**. A click on “Suche...“ (Search) will display the table.
3. A click on the far left column will sort the routes alphabetically by their summit name.
4. Now you can either manually search for M like Mutteristock or you use the search function of your browser (Win: Ctrl-F, Mac: Apple-F).

3 Detailed View of a Route

3.1 Structure

Whether you do a search request or choose your route through the map, you will always end up in the detailed view of a single route. The route view summarizes the information required for your planning according to the 3x3-Rule (see Chapter 4). In the upper part of the left column you find the **meta-data of the route**. The lower part shows the most important **information of the avalanche bulletin**. The right side contains the Swisstopo map with the route.

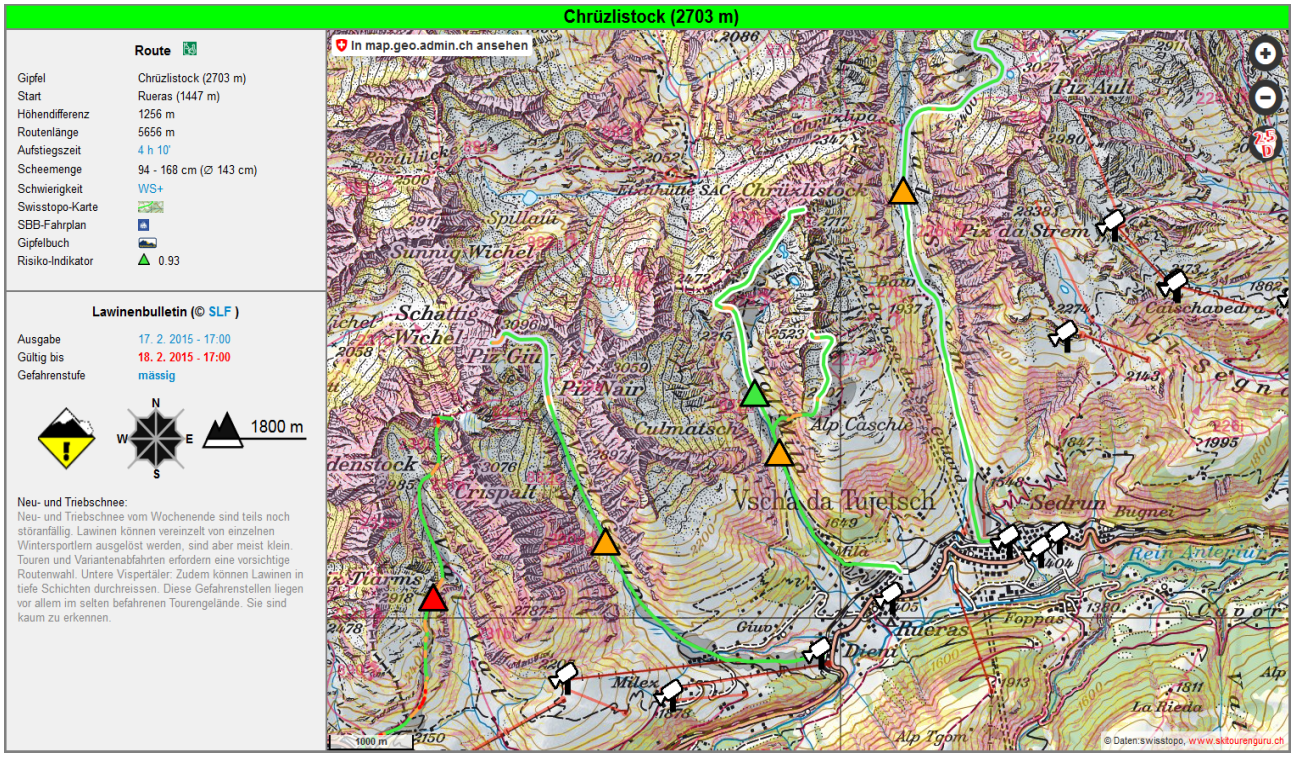

Figure 3: Detailed view for the route Chrüzlistock

3.2 Meta-data of a Route

Apart from route characteristics (elevation gain, length, ascent duration), three indicators are of importance:

1. Risk-Indicator (decimal number between 0...3).
2. Difficulty.
3. Approximate snow depth at the starting point, on the summit and in average.

If you like to know more about a given field, click on the respective symbol. This is especially useful for the difficulty. It is important that you are aware of the actual meaning of the difficulty rating.

3.3 Avalanche Bulletin

Skitourenguru displays the relevant information of the avalanche bulletin. If a route is located in the middle of two danger areas, the area with the higher danger level, respectively the more extended avalanche prone locations, is considered. These information fragments have the following two purposes:

1. The information fragments make transparent which data has been used as input for the Skitourenguru algorithm.
2. The information fragments can promote an active consideration of the avalanche bulletin content by the users.

A click on the date of the avalanche bulletin brings you to the original bulletin of the SLF. The original bulletin contains additional information regarding the snowpack and weather.

In spring time situations, when SLF publishes two avalanche bulletins (one for the morning and one for the afternoon), a thermometer appears.

This symbol indicates that the Skitourenguru Risk-Indicator was calculated based on the morning bulletin. Therefore, the Risk-Indicators are **only valid for the morning hours**.

The key information of the avalanche bulletin is the **danger level** valid for a specific **danger area**. It is important that you are aware which factors influence the danger level:

1. The **snowpack stability**, which is mainly defined by the firmness of the individual snow layers and the likelihood of a crack propagation.
2. The **likelihood of avalanche triggering**, which is dependent on the snowpack stability and can be increased by human influence.
3. The spatial dispersion of **critical slope spots**.
4. The **size and type** of expected **avalanches**.

Usually, the avalanche bulletin describes terrain features, which are especially dangerous (avalanche prone locations). In the example in Figure 3 the danger level “considerable” is especially applicable to elevations above 1800m and to all aspects. It’s a common practice to decrease the danger level in areas that are not explicitly mentioned. This rule of thumb has shown to be useful, but has exceptions like any rule. Skitourenguru applies it outside of transition areas.

The danger description of the avalanche bulletin usually displays specific avalanche problems. The example in Figure 3 points to a **new snow problem** and a **wind slab problem**. While during the planning of a backcountry tour the main focus is on the danger level, in the single slopes attention shifts to the actual avalanche problems. However, in the single slopes you are challenged to correct and extend the avalanche bulletin with your own observations.

3.4 Map

Each route appears on the Swisstopo map on the right side with its risk profile. Sections with low risk are “green”, with elevated risk “orange” and those with high risk are “red”. You can see at a glance where the potential cruxes in regards to avalanches might be. You need to keep in mind that the Skitourenguru algorithm calculates the risk profile only based on terrain, danger level, avalanche prone locations and a word analysis of the descriptions in the avalanche bulletin. Further influencing factors cannot be considered. Thus, cruxes cannot be marked comprehensively.

Apart from the selected route, you also see neighboring routes in case they are located in the same district. For technical reasons, it is only possible to show routes of one district at a time. If you want to change to a different route, click on the respective triangle. The colored triangle is always located in the middle of the route (between start and end point of the route). If triangles for two different routes overlap, separate them by zooming in.

The more familiar you get with Skitourenguru, the more information you will see. Especially interesting are the **snow depth**, the **web-cams** and the route corridors. By clicking on the respective symbol, you find additional information.

4 3x3-Rule (Assessment and Decision Framework)

The basis of each modern avalanche awareness is the 3x3-Rule from Werner Munter. In this model, the trip is divided into the three phases of **Trip Planning**, **Local Evaluation** and **Individual Slope**. In each phase the three factors **Conditions**, **Terrain** and **Human factor** have to be assessed.

Skitourenguru is used as an aid for the tour selection and therefore is part of the trip planning phase. All further application of the 3x3-Rule is still mandatory. The following chapters offers a brief introduction for each phase. See Chapter 7 for a comprehensive list of sources regarding the 3x3-Rule.

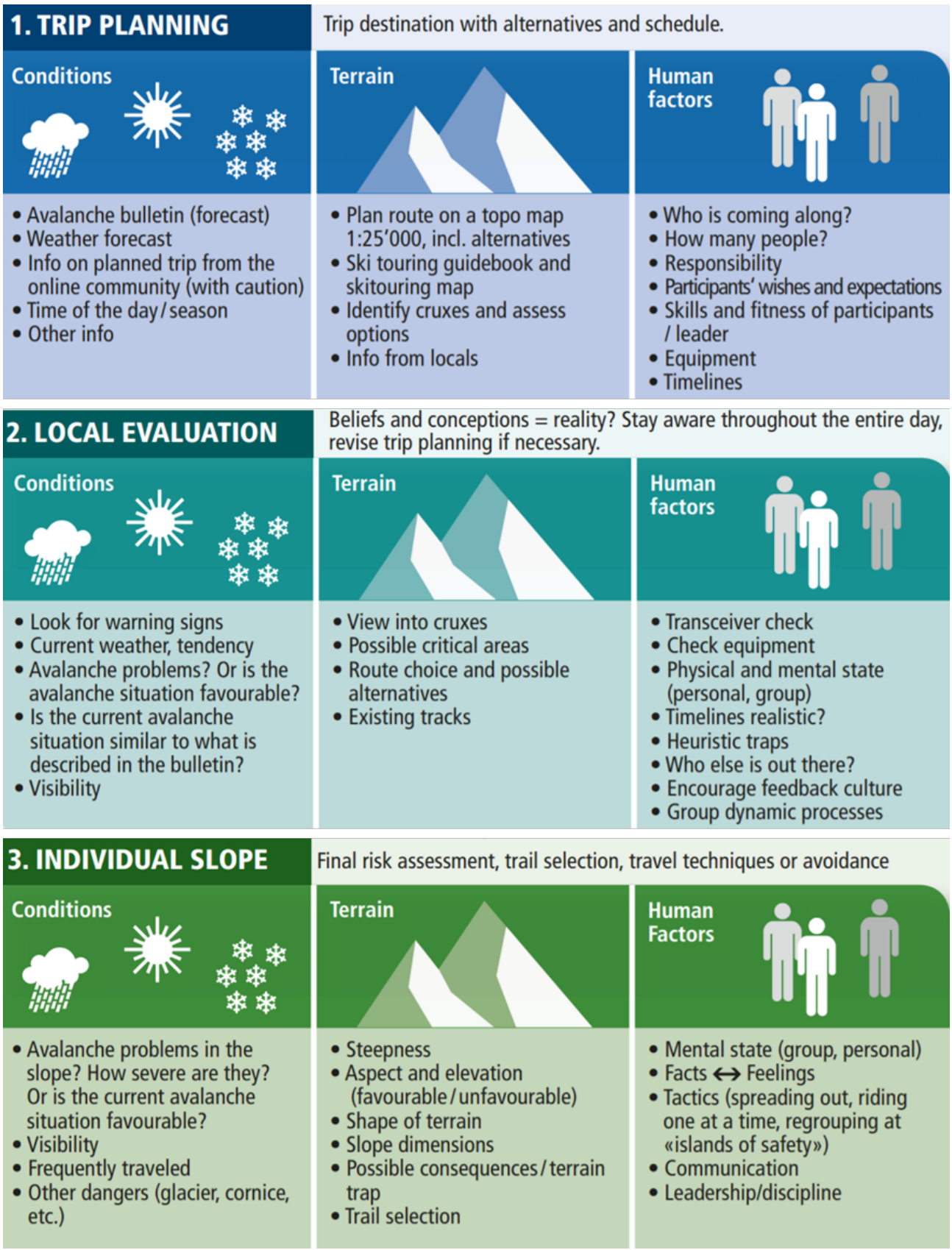

Figure 4: 3x3-Rule (extract from leaflet „Caution Avalanches!“)

4.1 Trip Planning (Phase 1)

Thanks to Skitourenguru, you can begin the tour planning phase with a pre-selection of routes. If you have only selected “green” routes, these ski tours show a “low avalanche risk” according to current level of knowledge. Now you can invest your planning effort with the various options and you won’t lose time with lame ducks. After the planning, you will select one of the options.

1. First, get an overview of the current **weather** and **avalanche** situation according to the weather forecast and the avalanche bulletin. Web portals (Gipfelbuch, Hikr or Camp2Camp) and guide books (SAC) provide additional route information.
2. Select a possible route from Skitourenguru. Review it critically and reflect whether the track is appropriate for the expected conditions.
3. Identify the most important cruxes (regarding avalanche risk). Mark them with a circle and compare them with those identified by Skitourenguru. Check the cruxes by manually applying the GRM. During the trip you will have to assess the avalanche risk for each single crux.
4. Define for each crux what you will do (eg. turn back or take an alternative route) if you come to the conclusion that the place is tricky or that an appropriate assessment is not possible.

The route selection must be a good fit for the group. Who is joining? What are the skills of the group and what are their needs? This step is also about selecting a route with a difficulty suiting to the group. By visualizing your group, you can finally define a time plan.

For the tour planning you can also refer to WhiteRisk, the Trainings- and Planning-Platform of SLF.

4.2 Local Evaluation (Phase 2)

This phase begins with your journey to the starting point and continues until the end of the trip. Throughout the trip, you should continuously collect information and check, whether the new information fits into your expectations. The following questions are especially important to focus on:

1. How is the weather changing?
2. Are there warning signs: Whumpf sounds, triggered avalanches or old avalanches?
3. How does the snow “feel” when you make a new trace? Do you break through the snow with your skies?
4. How many previous traces exist?
5. Who else is on tour?

If the actual conditions are worse than assumed during your trip planning, you need to redo your planning based on the new information. Dependent on the result of the assessment, it might be required to search for an alternative or return.

4.3 Individual Slope (Phase 3)

Prior to each crux, you evaluate the individual slope. At this stage, a sound level of self-reflection is required. Even designated avalanche experts are often not able to conduct an appropriate assessment of the individual slope. Are you able? The following questions are in focus:

1. Which avalanche problems are predominant? In order to be able to answer this question, you need to know the five avalanche problems in theory and practice.
2. How serious are the avalanche problems right now in the current slope?
3. Is it required to correct the danger assessment provided by the avalanche bulletin?

Above questions must be answered taking into account a comprehensive terrain analysis:

1. How favorable or unfavorable is the steepness, aspect, elevation and shape of the terrain?
2. What are possible consequences of a triggered avalanche? What are the dimensions of the slope? Are there any terrain traps (high burying depths) further down? Is there a danger of falling as result of an avalanche?
3. What does the GRM say about this single slope?

The result of GRM remains your reference point during the assessment of the individual slope. You need to be able to provide good reasons, before you enter a crux, which is “red” according to the GRM.
Under certain circumstances you might gain some additional margin by applying appropriate measures (optimal tracking, safety distances, relief distances). Take into account the condition of your group and the presence of other persons, when assessing an individual slope.

The questions are vague so the answers are thus vague as well. Due to the uncertainties during the assessment, you may be tempted to be guided by your wishes and interests. At this point, a good self-reflection is required before proceeding.

5 Basics

5.1 Overview

A model is a simplified version of reality. In order to understand what a model is capable of, it is important to know how the model is set up and which data gets processed. Figure 5 shows out of which data (blue) and processes (red) the Risk-Indicators (green) are calculated. Both, data and processes, are subject to uncertainties, leading to a restricted validity of the results.

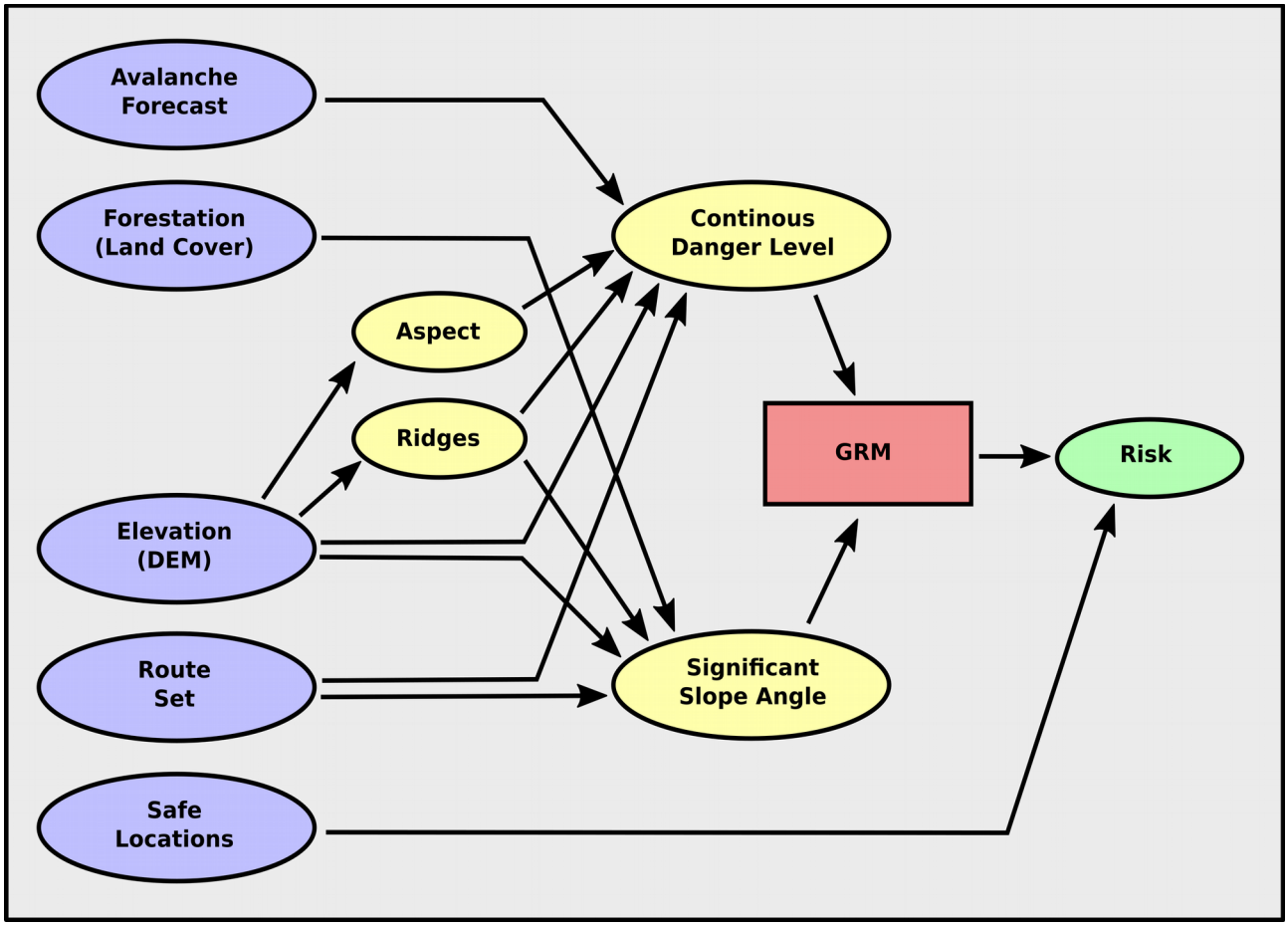

Figure 5: Data flow model of Skitourenguru

In the following chapters the calculation basics of the Risk-Indicators are described as comprehensively as possible, giving you an understanding of Skitourenguru's limits.

5.2 Digital Elevation Model and Landcover

Digital Elevation Model
Skitourenguru works with the digital elevation model swissALTI3D (resolution 10 m) from Swisstopo. With an excellent vertical accuracy of 1-2 m, the digital elevation model is not source of concern. Swisstopo also offers elevation models with higher resolution (2 m and 5 m). However, the added value is limited since slight terrain modulations are anyway smoothed by the snow pack.

Surface Covering
For the risk moderation in forests, Skitourenguru depends on the topographical landscape model swissTLM3D of Swisstopo. In mountain areas, swissTLM3D is usually still based on the old topographical landscape model VECTOR25. The latter has a horizontal accuracy of 3-8 m. For the present application that's more than sufficient.

5.3 Routes

Skitourenguru digitizes the backcountry ski tours with state-of-the-art techniques and high quality base data. The applied process (digitization, validation) is described in the document Routenanlage (route tracking). Even though the routes have been digitized with best effort, they can be suboptimal or in single cases even wrong. The routes underlie the following constraints:

- Routes and corridors can contain defects. Technically speaking, an ideal route can only be defined on site.
- Skitourenguru uses for each route a static track. In reality, the ideal track can change depending on the conditions.
- A route can contain passages which need to be passed by foot. Such passages cannot be indicated, since neither the conditions, nor the skills of the individuals are known.
- A difficulty is assigned to each route. The difficulty is subjective and thus, might be wrong.
- The Risk-Indicators are only valid if the route is ascended and descended as shown on the map.

Skitourenguru appreciates feedback regarding suboptimal or even wrong routes and difficulties. If the feedback is reasonable, routes will be updated accordingly.

5.4 Avalanche Bulletin

The calculation of Skitourenguru is based on the most recently published avalanche bulletin of SLF. The bulletin underlies several uncertainties:

- In the winter season SLF publishes a **forecast** of the avalanche danger twice daily. Remember, every forecast contains a level of uncertainty. Since the data of the avalanche bulletin is used as input for the Skitourenguru algorithm, the nature of Skitourenguru's assessment is also **a forecast**.
- The avalanche bulletin is highly generalized. Therefore, its' information applies to large areas and not to individual slopes. The high generalization level leads to a fuzziness of Skitourenguru's results.
- Skitourenguru extracts the following elements from the avalanche bulletin: danger areas, danger levels and avalanche prone locations (critical elevations and critical aspects).
- The textual danger description is used to fine-tune the danger level. Fine-tuning only applies to the danger level 2 (moderate) and 3 (considerable). In single cases, the fine-tuning of the danger level can harm the original values of the avalanche bulletin. All other qualitative information of the description texts cannot be used at this point.
- Other information regarding the snow and avalanche conditions are not considered by Skitourenguru.
- Skitourenguru takes precautions to extract the data accurately from the avalanche bulletin. However, Skitourenguru cannot guarantee that the extraction is always accurate.

5.5 Model

Skitourenguru calculates the final Risk-Indicators applying a specific calculation model. This model is based in its essence on the Graphical Reduction Method (GRM). The model was extended in three points:

1. Risk moderation on ridges and backs.
2. Risk moderation in forests and in forest surroundings.
3. Risk moderation on so-called "Safe Locations".

A strong scientific evidence of the **concrete definition of GRM** does not exist. Neither a theoretical, nor an empirical. One of the few studies that undertook a statistical validation of the Elementary Reduction Method got published by Christian Pfeifer in Natural Hazards (2008).

The GRM also leaves room for interpretation. This refers especially to three problems: Where in the terrain the slope angle has to be recorded? How to treat intermediate danger levels between two danger levels? How to derive the final Risk-Indicator from a risk profile? These questions show how imprecisely the GRM is defined. While each individual can make different assumptions, Skitourenguru must explicitly define and implement them. Skitourenguru seeks to define plausible assumptions and makes them as transparent as possible. Please refer to Hintergrund (background).

- The GRM shows a significant leap between the danger levels "moderate" and "considerable". This leap is a result of a footnote: At danger level "considerable", the steepest point in the entire slope needs to be taken into account. At danger level "moderate", the steepest point needs to be looked up at the "vicinity of the track". From the perspective of a sensitivity analysis, such non-linearities are not desired.
- According to experts' opinions, the GRM is useful for the avalanche problem "new snow". For the avalanche problem "old snow" it's useful, but the GRM has to be applied defensively. For the avalanche problem "wind-drifted snow" it's of limited use. For the avalanche problem "wet snow", the GRM is considered to be inapplicable. However the avalanche bulletin information regarding the actual avalanche problems is highly generalized and uncertain. Anyway, even for avalanche problems that do not favor the application of the GRM, at the time of writing, there is no better tool available then the GRM. Take into account, that **Skitourenguru does not make use of the actual avalanche problem.**
- GRM focuses on slope angles. No further terrain characteristics, e.g. slope dimension or terrain shape (e.g. convex, concave), are considered. However, for the model V2.0 it is planned to perform a more sophisticated terrain analysis (refer to ATES).

- The model does not take into account other risks than avalanche risks. Mountaineering comes with a bunch of additional risks: falling, locking, crevasse, ice-fall, rock-fall, exhaustion and other health risks. All of these risks need to be appropriately considered during the planning of a ski tour.

Errors can occur during the implementation of an algorithm. This is version V1.2 (Build 2539) of Skitourenguru. The software has been thoroughly tested, nevertheless it can contain bugs.

6 Opportunities and Risks

Any technical innovation offers opportunities and bears risks. Whether the opportunities outweigh the risks is a difficult question, which cannot be fully answered at this time.

Skitourenguru may create false Risk-Indicators. For example, due to a wrong avalanche bulletin, deficiencies of the GRM, or a defect in the calculation. Is the algorithm thus dangerous? Presumably not, since Skitourenguru is expected to apply the GRM more consequently than the average backcountry skier. The thoughtless application of the algorithm is considered more dangerous than the algorithm itself. As for any other technical innovation you should learn how to apply Skitourenguru. The possibility to get to a tour recommendation with few mouse clicks shall never replace a sound trip planning and guidance. The Risk-Indicator does not relieve us from critically reviewing the conditions and decisions during the trip. Skitourenguru can increase the safety only when it is correctly applied.

Topic	Opportunity	Risk
Steering Effect	Winter sports enthusiasts are pointed to “low risk“ backcountry ski tours. Routes in the lower risk segment are more fault tolerant. Thus, Skitourenguru has the potential to create a positive steering effect. This can be an important contribution to accident prevention.	The risk exists that novices get dragged into the individual trip planning and guidance. This can be a problem when novices do not have the required skills.
Communication	Skitourenguru offers a unique opportunity to sensibilize the audience regarding avalanche risks.	Due to the documented uncertainties (see chapter 5) there will be always “erroneous results”. Underestimated Risk-Indicators can guide individuals on “thin ice”. The communication regarding the value and the limits of Skitourenguru is a challenge.
Learning Potential	Services like Skitourenguru have a high potential to bring individuals closer to an advanced avalanche awareness. By providing reference values, users get an orientation to review their own assessments.	Its well known, that experienced mountaineers are not really safer then novices. Experiences and knowledge are typically used to enter more critical terrain and not to reduce the accident risk.
Planning	The planning effort gets focused on promising route candidates.	It remains a general open question to which extent the audience is willing to plan a backcountry tour according to the current avalanche doctrine.

Table 2 Opportunities and Risks

Off-piste winter sport is popular. More than 1 million ski tours are executed in Switzerland every year. The ski touring scene is changing quickly. Ski touring fits well into a society which strives for performance and adventure. These dynamics are driven by a collection of reasons. The availability of new tools (avalanche transceiver, smartphone, avalanche bulletin, GPS, guide books, avalanche airbag) is only one of the reasons. Most likely the aspirations, dreams and needs of the people are more relevant. Considering these dynamics, **openness** and **curiosity** towards new technical possibilities is a key issue.

7 Avalanche Awareness

7.1 Practical Experience

In order to be able to plan and conduct independent backcountry ski tours, you need practical experience. You can gain experience by joining groups. SAC and commercial providers (see below) offer organized backcountry ski tours and snowboard tours. Of course, you can also hire a mountain guide or you can make your first adventures with a well-organized avalanche course.

Whichever group you join, it will be led by a formal or informal **guide**. This is the first problem: independent from the actual skills of your guide, you never know exactly with whom you are actually dealing. Regardless, you entrust your life to a certain extent with this person. History shows that professional mountain guides and formed backcountry tour guides have often been involved in avalanche accidents.

The solution to this dilemma is communication! Challenge your guide: “Why do we go on this route? What do you think about the triggered avalanches on the other side? Why do we descent this slope, even though the original plan was to take the same way back? Skitourenguru calculates “red” for this route, what makes you certain that this route is nevertheless safe?” You might get on the guide’s bad side, however, important discussions may also result from your questions.

Trust is nice, but whom do you actually trust? Daniel Kaneman writes in Thinking, Fast and Slow: *"The confidence that people have in their intuitions is not a reliable guide to their validity. In other words, do not trust anyone - including yourself - to tell you how much you should trust their judgment.”*

7.2 Avalanche Awareness

Though theoretical know-how about avalanches is never sufficient, it is certainly a required precondition to plan and conduct independently backcountry ski tours. The following five books are the **ideal approach** to gain theoretical knowledge:

- P. Descamps / O. Moret: Avalanches - Comment réduire le risque, 2016.
- W. Munter: 3 x 3 Lawinen - Risiko Management im Wintersport, 2014.
- S. Harvey / J. Schweizer / H. Rhyner: Lawinenkunde, 2013.
- K. Winkler / H.P. Brehm / J. Haltmeier: Bergsport Winter - Technik, Taktik, Sicherheit, 2012.
- M. Wicky / D. Marbacher / M. Müller / E. Wassermann: Lawinen und Risikomanagement, 2011.

In case you do not want to spend time ordering books, you can start immediately with the following links:

- WhiteRisk: The training- and planning-platform of SLF (starting at 29 sFr. per year).
- About the Avalanche Bulletin of the SLF.
- Caution Avalanches!: Avalanche awareness leaflet. It defines the currently applicable avalanche doctrine of Switzerland and is especially useful as supporting material for courses.

A good avalanche course can ideally combine theoretical knowledge with practical experience. Apart from SAC, also some commercial providers offer courses ranging from a trial day to a multi-day avalanche course:

- Bächli Bergsport offers a low-threasholded program of backcountry ski and snowboard tours.
- Mammut Alpine School, Bergpunkt, Berg und Tal, Höhenfieber belong to the large Swiss alpine schools.

When you select a course, be sure that not only avalanche rescue but also avalanche awareness are included.
Independent from what you learn, a book or course will not make an expert out of you.