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 1200 backcountry ski tours in Switzerland. Coverage of further regions within the Alps is under construction. The algorithm is based on the Quantitative Reduction Method (QRM). 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, in the morning and in the evening. 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 sources are used in Skitourenguru:

- **The digital 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 several 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 Quantitative Reduction Method (QRM)** combines terrain characteristics with data of the avalanche bulletin. The QRM does not deliver in all cases accurate values, but always gives a reference point.

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 evaluated.

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 several thousands of 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 terrain combined into QRM). 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 Meine erste Skitour (my first backcountry ski tour). **The focus of Skitourenguru is on 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 one of the five regions throughout the Alps you get to a disclaimer. If you accept the disclaimer, you will get to the **Route Overview**. 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). Based on your search criteria, the list of suggested routes is updated. 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 route. Similar to a traffic light, it is divided into three Risk-Categories:

Symbol	Values	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 potential avalanche terrain. 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 during 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 QRM 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 "considerable".

Tab. 1: Definition of Risk-Categories

2 Select Route

2.1 Entry Point

Skitourenguru divides the Alps into five regions:

1. Switzerland
2. Eastern Alps (incl. Bavaria und South Tyrol)
3. France
4. Northwest-Italy
5. Northeast-Italy

Each region has a status:

1. **Full Operation** (light blue): The service is available. Risk-indicators are calculated once or twice per day.
2. **Test Operation** (light gray): The service is not available. Even though risk-indicators are calculated daily, they are not reliable for different reasons.
3. **Demo Operation** (dark gray): The service is not available. Normally risk-indicators are not calculated. In case risk-indicators are calculated, they are not reliable for different reasons. Particularly in Summer, when no avalanche bulletin is available, the regions are set to Demo Operation.
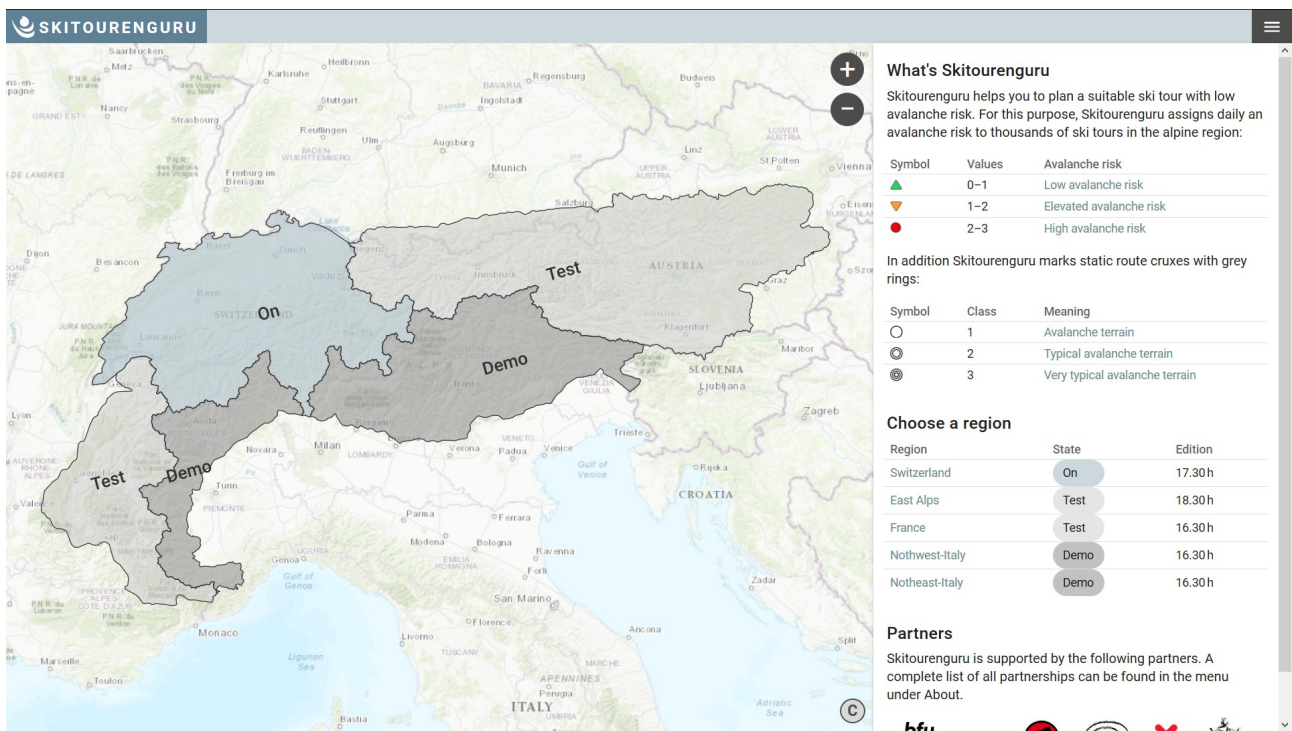

Fig. 1: Five regions throughout the Alps

Select your desired region via a click into the table on the right or on the map (see Figure 1). This will show the disclaimer. It explains with easy words the purpose and limitations of Skitourenguru. If you accept the disclaimer via a click on "Yes" at the bottom of the text, you will see the **Route Overview**.

2.2 Route Overview

With the help of six filter criteria (see top left in Figure 2) you can define which type of backcountry ski tours you are looking for. Apart from the **difficulty**, the main criteria is the **avalanche risk**.
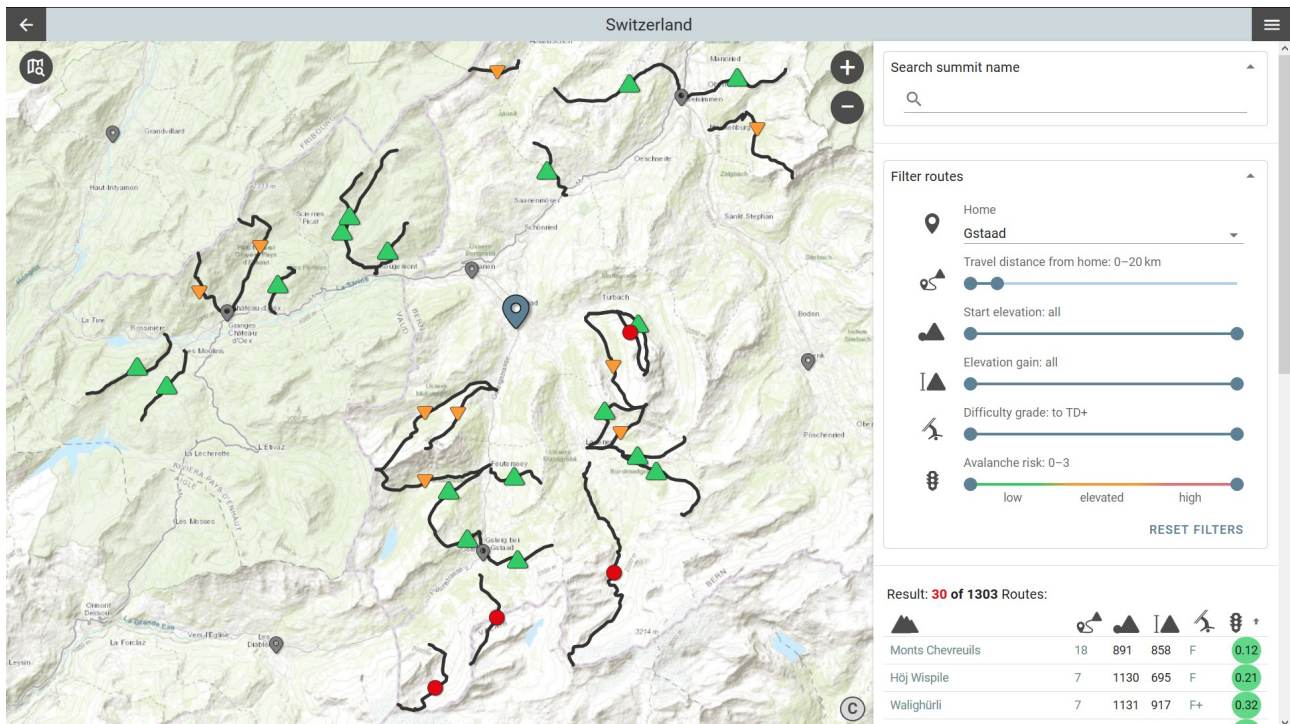

Fig. 2: Route Overview

Each time you change one of the filter criteria, the table (see bottom right in Figure 2) is automatically updated. The map on the left only shows routes that match the filter criteria.

The routes in the table are 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, some 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 table to the right, you will see the route details (see Chapter 3). Alternatively you can select the route via a click on the map.

3 Route Detailed View

3.1 Structure

When you select the route via the table or 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 right column you find **meta data of your route**. The lower part shows the most important **information of the avalanche bulletin**. The left side contains the map with the route.

3.2 Meta data of a Route

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

1.   Risk-Indicator (decimal number between 0...3).
2.   Difficulty.

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.
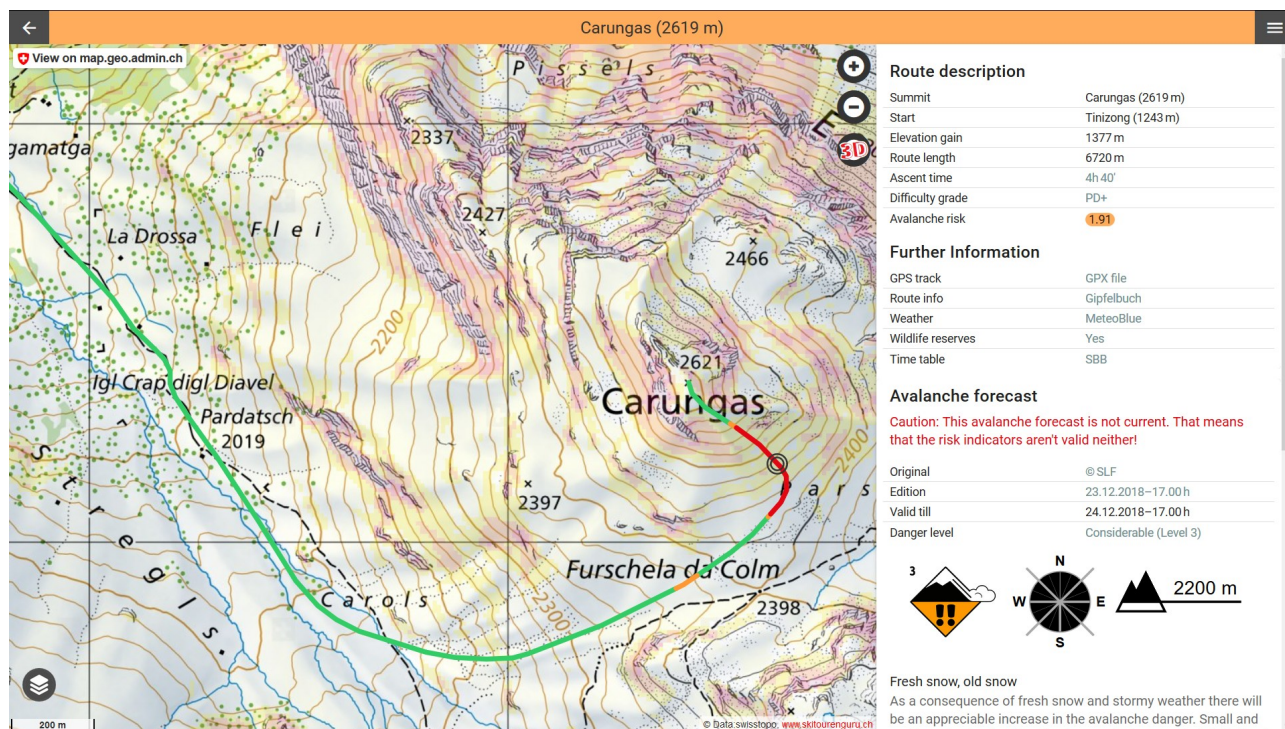

Figure 4: Detailed view for the route Carungas

3.3 Avalanche Bulletin

Skitourenguru displays the relevant information of the avalanche bulletin. If a route is located in the border zone of two danger areas, the area with the higher danger level, respectively the more extended avalanche prone locations, is displayed. 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 are intended to encourage discussion of the content of the avalanche bulletin.

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

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In spring time situations, when the avalanche warning service publishes two avalanche bulletins (one for the morning and one for the afternoon), a corresponding remark appears. The remark 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 understand the factors that make up 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 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 4 the danger level "considerable" is especially applicable to elevations above 2200m 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 describes the current avalanche problems. The example in Figure 4 especially points out a **fresh snow problem** and an **old snow 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 Route

In the detailed view the colored route is shown on a topographic map. Sections with low risk are marked "green", with elevated risk "orange" and those with high risk are marked "red". You can see at a glance where the potential **cruxes** might be. You need to keep in mind that the Skitourenguru algorithm calculates the risk profile only based on terrain, danger level and avalanche prone locations. Thus, cruxes cannot be marked comprehensively.

Apart from the selected route, you also see neighboring routes. 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 **static cruxes**, **web-cams** and route corridors. By clicking on the respective symbol, you find additional information.

3.5 Static Cruxes

The avalanche bulletin is highly generalized (only valid for large regions) as well as relatively uncertain. Regarding a specific slope, the communicated danger level can deviate by one (or more) from the "real danger level". The "real danger level" of a specific slope remains unknown. Skitourenguru marks critical locations depending on the avalanche bulletin and the terrain in green, orange or red. Especially for danger levels "low" or "moderate" critical locations are often marked in green. This is problematic when the "real danger level" is higher than expected. Thus, Skitourenguru marks potential cruxes with grey circles. The color gray shall indicate that the mark is static and not dynamic. It remains always unchanged independent from the avalanche bulletin.

Cruxes are only shown in the context of avalanche risk and are not considering alpine technical difficulties. Following symbols exist:
- One gray circle: Avalanche terrain (class 1)
- Two gray circles: Typical avalanche terrain (class 2)
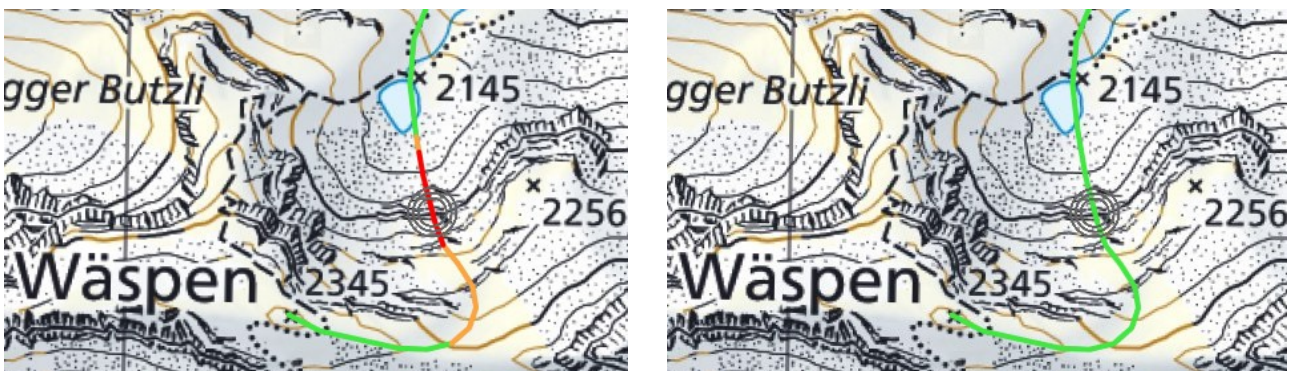- Three gray circles: Very typical avalanche terrain (class 3)

Fig. 4: Cruxes close to summit Wäspen (Uri) with moderate risk level (left) and low risk level (right)

Cruxes are valid for the marked location as well as the route passages before and after.

What is the purpose of the cruxes?
The identification of cruxes is an important step during ski tour planning. Skitourenguru helps with the gray circles to identify such cruxes. However you are requested keep a critical view on those cruxes. Did the algorithm really mark all cruxes? The map, which shows slope angles, can help you. One part of the ski tour planning is intended to plan what to do, when the crux cannot be mastered without unacceptable risks. Turning back is always an obvious answer. Since you now know the cruxes, you can conduct an individual risk assessment of the respective crux when reaching the zone. Be careful: Such an inspection requires a good avalanche knowledge and experience with the alpine winter terrain. Even if you gained a lot of experience, there can be situation, which you cannot easily assess. Turn back in case of doubt.

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.
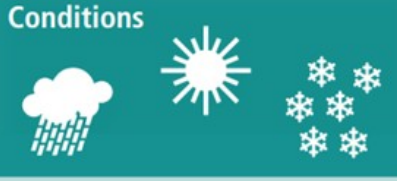
1. TRIP PLANNING

Trip destination with alternatives and schedule.

Conditions

- Avalanche bulletin (forecast)
- Weather forecast
- Info on planned trip from the online community (with caution)
- Time of the day / season
- Other info

Terrain

- Plan route on a topo map 1:25'000, incl. alternatives
- Ski touring guidebook and skitouring map
- Identify cruxes and assess options
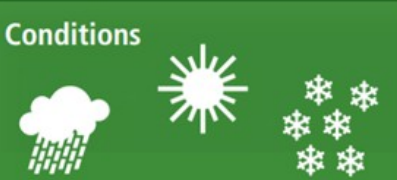- Info from locals

Human factors

- Who is coming along?
- How many people?
- Responsibility
- Participants' wishes and expectations
- Skills and fitness of participants / leader
- Equipment
- Timelines

2. LOCAL EVALUATION

Beliefs and conceptions = reality? Stay aware throughout the entire day, revise trip planning if necessary.

Conditions

- Look for warning signs
- Current weather, tendency
- Avalanche problems? Or is the avalanche situation favourable?
- Is the current avalanche situation similar to what is described in the bulletin?
- Visibility

Terrain

- View into cruxes
- Possible critical areas
- Route choice and possible alternatives
- Existing tracks

Human factors

- Transceiver check
- Check equipment
- Physical and mental state (personal, group)
- Timelines realistic?
- Heuristic traps
- Who else is out there?
- Encourage feedback culture
- Group dynamic processes

3. INDIVIDUAL SLOPE

Final risk assessment, trail selection, travel techniques or avoidance

Conditions

- Avalanche problems in the slope? How severe are they? Or is the current avalanche situation favourable?
- Visibility
- Frequently traveled
- Other dangers (glacier, cornice, etc.)

Terrain

- Steepness
- Aspect and elevation (favourable / unfavourable)
- Shape of terrain
- Slope dimensions
- Possible consequences / terrain trap
- Trail selection

Human Factors

- Mental state (group, personal)
- Facts ↔ Feelings
- Tactics (spreading out, riding one at a time, regrouping at «islands of safety»)
- Communication
- Leadership/discipline

Fig. 5: 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. You are now using your planning activities on promising candidates and don't waste it on 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 (SAC Tour Portal, Alpenverein Aktiv, Gipfelbuch, Hikr or Camp2Camp) and guide books provide additional route information.
2. Select a possible route from Skitourenguru. Review it critically and reflect whether the track is appropriate for the assumed 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 a reduction method. 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 proven avalanche experts are often not able to carry out 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 reduction method say about this single slope?

The result of the reduction method 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 reduction method.
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 is processed. Both, data and processes, are subject to uncertainties, leading to a restricted validity of the results.

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

5.2 Digital Elevation Model and Landcover

Digital Elevation Model
Skitourenguru works with country specific digital elevation models. Usually these have a resolution of 10 meters.

Surface Covering
For the risk moderation in forests, Skitourenguru uses usually forest density data from ESA.

Which data is used for which region is made transparent under Data Basis.

5.3 Routes

Skitourenguru digitizes the backcountry ski tours with state-of-the-art techniques and high quality base data. Topographic maps, ortofotos, slope angle and avalanche terrain maps as well as GPS tracks are considered.

The applied process (digitization, validation) is described in the document Routenanlage (route digitization). 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. Strictly 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 the respective region. The bulletin underlies several uncertainties:

- The avalanche services of Europe publish one to two times per day a **forecast** of the avalanche danger during the winter season. 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).
- 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 Quantitative Reduction Method (QRM).
QRM combines information of the avalanche terrain and the avalanche bulletin to a daily updated risk map (see figure 6).
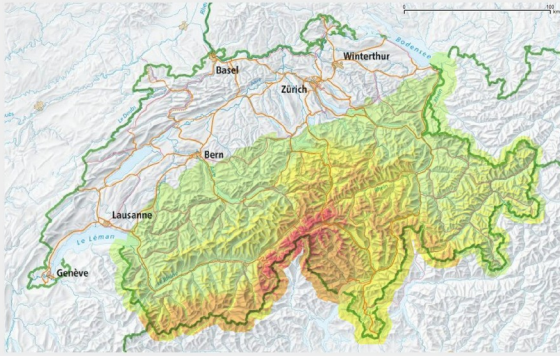
Avalanche Terrain:
An avalanche terrain map describes for each point in the area how prone it is to trigger an avalanche. Four classes are distinguished:
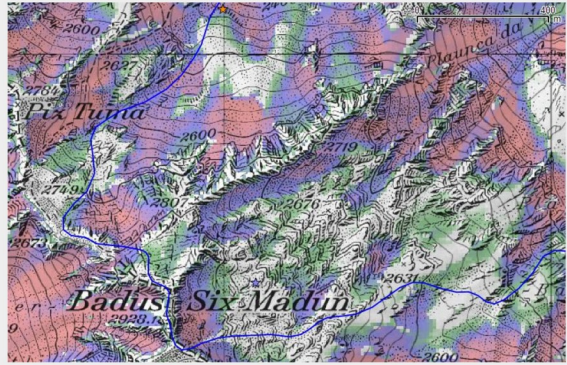1. Transparent: No avalanche terrain
2. Green: Untypical avalanche terrain
3. Blue: Typical avalanche terrain
4. Red: Very typical avalanche terrain

The calculation of an avalanche terrain map is complex. Generally four criteria are considered: Slope form, slope size, slope angle and forest density. Further details are shown under avalanche terrain.
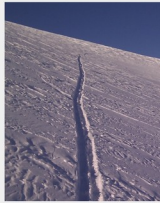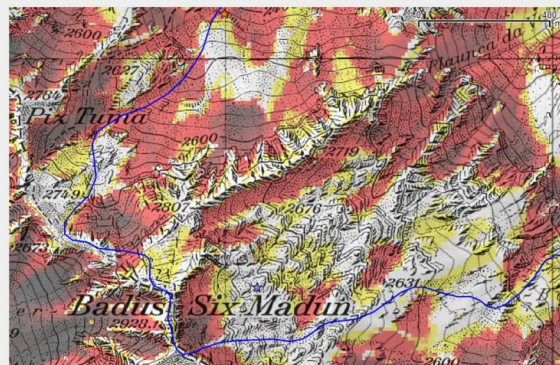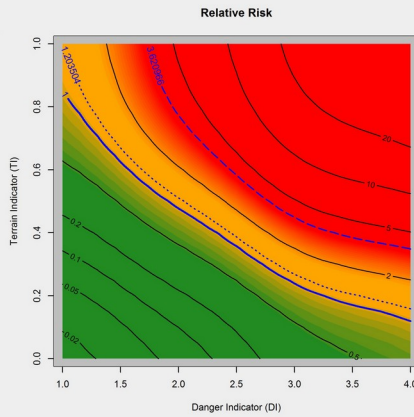
Fig. 6: Model

Avalanche Bulletin:
Primarily the danger level is used. Outside of the avalanche prone locations (critical expositions and critical elevations) the danger level is decreased by one. To avoid leaps, the danger is smoothed at regional borders, at critical elevations and as well at places where the slope exposure changes.

QRM:
In contrast to former reduction methods, QRM is based on data. QRM was calculated with the help of 1700 avalanche accidents in combination with GPS tracks of real actual ski tours.

The daily updated risk map is not published, it is used as intermediate result for the last three steps.
1. Every 10 meters, a point is marked on the route. Thanks to the daily updated risk map, the risk is known for these points.
2. The combination of the single point risks, leads to the total route risk for a deadly avalanche accident on the route as a whole. The average total route risk is 1:100'000. Depending on the avalanche bulletin and the terrain, the value can vary from 1:100 (very high risk) to 1:10'000'000 (very low risk).
3. In the last step, a Risk-Indicator is derived from the total route risk. It shows, whether the route has a low (green), increased (orange) or high (red) risk.

Every mode has uncertainties. In regards to QRM four problems need to be mentioned:
- The rule that outside of avalanche prone locations the risk level is reduced by one, is not based on a strong scientific basis.
- Due to a lack of scientific knowledge the smoothing of the danger level at border areas must be based on assumptions.
- Every avalanche terrain classification is necessarily based on a series of assumptions.
- How well the collection of the GPS tracks represents the actual ski touring behaviour of the community is difficult to be answered.

Errors can occur during the implementation of the algorithm. This is the version V2.2 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 QRM, or a defect in the calculation. Is the algorithm thus dangerous? Presumably not, since Skitourenguru applies a clearly defined methodology more consequently than the average backcountry skier during the own planning. 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 assessment.	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 feedback to review their own assessments.	Its well known, that experienced mountaineers are not really safer then novices. Experiences and knowledge are typically used to take more risk 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 many reasons. The availability of new tools (avalanche beacon, 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. Alpine clubs 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 possible trap: independent from the actual skills of your guide, you never know exactly with whom you are actually dealing. However, 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:

- K. Winkler / H.P. Brehm / J. Haltmeier: Bergsport Winter - Technik, Taktik, Sicherheit, 2018.
- 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.
- 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 Alpine clubs, 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.
Whatever you learn about avalanches, a book or an avalanche course doesn't make an avalanche expert out of you.