CAUTION – AVALANCHES!

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Avalanche formation

Types of avalanches (dry or wet)

Snow slab avalanche

Loose snow avalanche

Terrain
critical steepness: 30° for dry snow slab avalanches (steepest part of starting zone)

30° for dry snow slab avalanches (less than 30° for wet snow avalanches)

Beware of runout zones!

Avalanche formation

Snow slab avalanches
Cohesive snow on top of a weak layer: The slab breaks away as a unit. Dry snow slabs are the most dangerous avalanches for winter recreationists. They are also possible when the surface layers seem to consist of cohesionless powder snow.

Wet snow avalanches
Towards spring the snow cover loses its strength due to gradual soaking: increasing danger of wet snow avalanches.

If the snow surface is distinctly refrozen, following a clear night, mostly favourable conditions prevail before midday. Pay attention after midday and generally at any time when the sky is overcast.

Avalanche danger prevails above all with:
- new snow combined with wind
- rapidly and distinctly rising temperatures
- weak layers within the snow cover

Avalanche hazard evaluation: «3x3»-method

<table>
<thead>
<tr>
<th>Conditions: Weather and Snow</th>
<th>Terrain</th>
<th>Human factors</th>
</tr>
</thead>
</table>
| 1. Trip planning
  Trip with alternatives and time-schedule
  «Which tour is possible?» | Avalanche bulletin
  Weather forecast
  Additional information: from hut warden etc. | Map
  Guide book
  Photographs
  Key passages
  Measure steepness (map 1:25'000)
  Alternatives
  Time-schedule | Who will participate?
  Group size
  Technique and fitness
  Equipment
  Responsibility |
| 2. Assessing the local hazard
  Route selection and alternatives
  «Is anything unexpected?» | Precipitation, critical new snow depth
  Alarm signals
  Wind, wind-driven snow
  Air temperature
  Visibility
  Clouds
  Weather trend
  Snow cover conditions | Is my perception correct?
  Steepness
  Aspect
  What is above/below?
  Near ridge?
  Topography/relief
  Forest | Who is in my group?
  Check of equipment and transceivers
  Who else is travelling?
  Frequently check the physical condition of members and the time-schedule |
| 3. Assessing specific slopes, key passage | Critical new snow depth
  Snow quality
  Recent accumulations of wind-driven snow
  Radiation, temperature
  Visibility
  Frequency and extent of previous skiing activity | Steepness, shape, location (e.g. distance to ridge), size of slope
  Rocky outcrops
  Elevation and aspect
  Danger of fall and of burial
  Detour possibilities | Physical and mental fitness
  Technical ability
  Group size
  Discipline
  Leadership |

The first sunny day after a snowfall period is particularly dangerous.
### Avalanche hazard evaluation

#### Conditions

**New snow + Wind = Danger of slab avalanches**

- Critical new snow depth: at least «considerable» avalanche danger
  - >10 cm when conditions are unfavourable
  - >20 cm when conditions are fair or mixed
  - >30 cm when conditions are favourable

- Favourable: low to moderate winds, air temperature close to 0°C, strongly irregular old snow surface, frequently skied slope
- Unfavourable: high rate of precipitation, strong winds (>50 km/h, roaring wind), low temperature (below -5 to -10°C), smooth old snow surface, rarely skied slope

#### Terrain

**Steeplness**

- Measure the slope angle with an inclination scale on the map (1:25'000). Pay attention to S-shaped terrain profiles: in fact, always steeper.
- During the trip, estimate the inclination of the steepest part of the slope (ca. 20 m x 20 m) or measure it using the poles (or the snowboard).

**Tip: Rule of thumb for steeplness**

- If zig-zags (kick turns) are necessary: > about 30 degrees
- Steep terrain with rocky outcrops: > about 40 degrees
- Also consider steep slopes above and below the route, in particular if ‘considerable’ danger prevails.

**Shape of slope and type of terrain**

- Most accidents happen on steep shady slopes, near the ridge top.
- Hilly ground allows better selection of a safe route.
- Sparse woods do not protect from slab avalanches.
- Ridges are safer than bowls. Ridges are often wind scoured, also offering a favourable old snow surface. Gullies and bowls are often loaded with wind-driven snow, also offering a rather unfavourable old snow surface.

**Tip: Column Test**

- To find weak layers: cut a column of snow about 30 cm x 30 cm. Induce a fracture by gradually loading the top of the column (tapping, hitting). If it does not fail, break it over your leg or let it drop.

#### Temperature

- Take into account previous and expected evolution. Cold temperatures preserve the danger. Warm temperatures have a long term stabilizing effect, in particular repeated warm-cold cycles.
- Rapid, distinct warming towards 0°C favours instability. Solar radiation significantly warms up the surface layers, thereby promoting instability.

#### Human factors

- Many avalanche accidents occurred not because the hazard could not be recognized, but due to subjective elements such as poor judgement and according behaviour. Perception, decision making and behaviour are processes strongly influenced by mental and social factors.

#### Aspect

- Shady slopes are more hazardous than sunny slopes.

#### Size of slope

- How large is the slope? Is the run-out gradual?
- Terrain trap? Risk of deep burial in hole-type terrain features and stream gullies?

#### Class of steepness

- Steepness measured over 100m vertical
Avalanche bulletin

The degree of avalanche danger depends on: the release probability (the natural stability of the snow cover and the effects of human activities), the distribution and frequency of dangerous slopes, the size and type of avalanches (including the thickness of the sliding snow layers).

National bulletin

Structure: General situation, short-term development, forecast of avalanche danger for the following day (degrees of danger, incl. aspect and altitude of the dangerous slopes), tendency for the subsequent days.

Content: Information about snow conditions, and regional avalanche danger for all regions of the Swiss Alps (regional indication, local divergence is possible, transitions are smooth!).

Issue and distribution: Daily after 17.00. Phone: 187 (from outside Switzerland: +41 848 800 187), Fax: 0900 59 20 21 (in German), 0900 59 20 22 (in French), teletext: page 782, wap.slf.ch and with much additional information on the web: http://www.slf.ch

Regional bulletins

For most regions, daily after 08.00, a regional bulletin in graphical form is issued (Fax: 0900 59 20 20, wap.slf.ch, http://www.slf.ch)

Information on the avalanche conditions in adjacent countries: www.lawinen.org

Avalanche danger scale (abbreviated)

<table>
<thead>
<tr>
<th>Degree of danger</th>
<th>Characteristics (release probability, distribution and frequency of dangerous slopes, type of avalanches)</th>
<th>Consequences and recommendations for recreationists outside of controlled ski areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 low gering</td>
<td>Triggering is generally possible only with high additional loads (e.g. groups without intervals) and on very few locations in steep extreme terrain. Only a few sluffs and small natural avalanches are possible. Forecasted for about 20% of the winter season. About 7% of the recreational fatalities.</td>
<td>Generally favourable conditions. Ski one by one on extremely steep slopes. If possible avoid recent accumulations of wind-driven snow on extreme slopes. Beware of the danger of falling and of possibly unfavourable conditions in high alpine terrain.</td>
</tr>
<tr>
<td>2 moderate mäßig</td>
<td>Triggering possible in particular with high additional loads, particularly on the steep slopes indicated in the bulletin. Large natural avalanches not likely. Forecasted for nearly 50% of the winter season. About 34% of the recreational fatalities.</td>
<td>Favourable conditions, for the most part. Routes should be selected with care, in particular on steep slopes of the aspect and altitude indicated in the bulletin. Avoid all extremely steep slopes of the aspect and altitude indicated in the bulletin and recent accumulations of wind-driven snow. Ski one by one and with caution on very steep slopes.</td>
</tr>
<tr>
<td>3 considerable erheblich</td>
<td>Triggering possible even with low additional loads (e.g. single person), particularly on the steep slopes indicated in the bulletin. In some conditions, medium and occasionally large natural avalanches may occur. Frequently alarm signals exist (whumpfs, natural releases). Forecasted for nearly 33% of the winter season. About 47% of the recreational fatalities.</td>
<td>Partly unfavourable conditions. Critical situation. Experience in avalanche hazard assessment and in selecting good routes required. Avoid very steep slopes of the aspect and altitude indicated in the bulletin if possible. Pay attention to remotely triggered avalanches. Proceed with caution on traverses or when travelling into unknown terrain.</td>
</tr>
<tr>
<td>4 high gross</td>
<td>Triggering probable even with low additional loads on many steep slopes of all aspect. In some conditions, many medium and several large natural avalanches are likely. Forecasted for a few days only of the winter season. About 12% of the recreational fatalities.</td>
<td>Unfavourable conditions. Acute Situation. Lines of transport might be endangered. Sound experience in avalanche hazard assessment required. Stay in moderately steep terrain; beware of runout zones. Remotely triggered avalanches are typical, even over large distances.</td>
</tr>
<tr>
<td>5 very high sehr gross</td>
<td>Numerous large natural avalanches are likely, even in moderately steep terrain. Avalanches run to the valley bottom. Rarely forecasted, on average for one day of the winter season. No recreational fatalities.</td>
<td>Very unfavourable conditions. Catastrophic situation. Parts of villages endangered, evacuations might be necessary. Travel in avalanche terrain not recommended.</td>
</tr>
</tbody>
</table>
Decision strategy to assess and reduce the avalanche risk

Connect the degree of avalanche danger with terrain: slope inclination and aspect

Depending on the degree of danger, it is recommended to avoid slopes of a certain steepness and with unfavourable aspect.

The unfavourable aspects are generally shady slopes (change with season!) and/or lee slopes. Aspect and elevation of these particularly unfavourable slopes are usually described in the avalanche bulletin.

If we do not know the conditions, if we can’t make observations, or if the unfavourable slopes are not specified in the bulletin, we assume all slope aspects to be unfavourable. If there is a difference, we may assume a lower danger for the slopes of favourable aspects (typically about one degree lower).

For the slopes of unfavourable aspects, the following is recommended:

Example:
If «moderate» danger is prevailing, it is recommended to avoid extremely steep (>40°) slopes of unfavourable aspects, and to take additional precautionary measures on very steep (35°-40°) slopes.

To determine the slope inclination, the degree of avalanche danger needs to be considered:

- If «low» or «moderate» danger is prevailing, the steepness in the surroundings of the tracks (20m) is relevant. Keep in mind that terrain steeper than 30° in the green domain is still potential avalanche terrain.
- If «considerable» danger is prevailing, the whole slope needs to be considered and its steepest part is relevant.
- If «high» danger is prevailing, we keep away from steep slopes (>30°).

In frequently skied terrain, exceptions from the above recommendations might be acceptable.

Factors increasing the risk
- Recent accumulation of wind driven snow
- Critical depth of new snow
- Snowpack with many different layers
- Substantial warming
- Alarm signals: Recently released avalanches, whumpfs
- Poor visibility
- Large group
- Shock-type loading of snowpack (jump, fall)
- Bowl shaped terrain
- Unfavourable aspect
- Steep slope above, terrain trap: danger of deep burial
- Near ridge
- Steep terrain with rocky outcrops
- Danger of falling

Factors decreasing the risk
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Elementary safety measures (to apply in general)
- Be informed about weather and avalanche conditions, trip planning.
- Inform others about planned route.
- Always set transceiver (rescue beacon) to TRANSMIT (check functioning), carry an avalanche shovel and a probe.
- Constant reassessment of: weather, snow, terrain, human factors, time schedule
- Circumvent recent accumulations of wind-driven snow.
- Consider the variations in temperature depending on the time of the day and the impact of radiation (also on the way to the hut).
- Ski down extremely steep slopes one at a time.

Additional precautionary measures (to apply in particular if alarm signs are present)
- Avoid steep terrain with rocky outcrops and gullies.
- Keep distances between each other (while climbing up at least 10 m, while skiing down keep further apart), or ski down one at a time.
- Define a descent route, ski gently, avoid falls.
- Avoid the steepest part of the slope.
- Stop and regroup on islands of safety.
- In case of fog or bad visibility in steep, unknown terrain: turn back!

About 90% of all avalanche victims have triggered the fatal avalanche themselves.
Avalanche accident – Rescue

If caught
Try to escape out of the avalanche area (rarely possible); let go of ski poles, try to open bindings, pull your knees toward your chest and hold your arms in front of your face.

If not buried
Point last seen at
Entry tracks

Primary search area
(width of search strip for one transceiver: 20–40 m*)

• Watch the avalanche flow and the persons caught (note the point last seen at).
• Gain an overview – think – act. Assess your own safety, avoid further accidents.
• Determine primary search area (in the flowing direction below point last seen at).
• Begin searching immediately with transceiver (turn off transceivers that are not in use) and at the same time search with eyes and ears.
• Alert rescue service.

If transceivers are not available:
• Search with eyes and ears.
• Alert rescue service.
• Systematic repeated improvised probing
(*: Width of search strip and search according to specific transceiver manual)

Avalanche danger = Danger of death

First aid for avalanche victims
• Dig methodically, make a large hole.
• Uncover head and chest as fast as possible, clear the breathing passages, check if there is a breathing cavity in the snow.
• Start artificial respiration (mouth-to-nose), if circulation has stopped, start cardiopulmonary resuscitation simultaneously; continue resuscitation until a medical doctor takes over.
• Prevent further cooling.
• Position the victim according to injury.
• Watch and take care of the victim very carefully.
• Careful evacuation by helicopter

Alarm
Phone
Swiss air rescue (Rega): 1414 (all of Switzerland, except in Valais)
KWRO/OCVS: 144 (Valais)
Police: 117

Radio
161.300 MHz (E-channel)
158.625 MHz (K-channel, police)

Accident report
Who is calling (Name, phone number, location)?
What happened?
Where is the accident location?
When did the accident happen?
How many completely buried victims, helpers?
Weather in the area?

Concise report = Effective help

Air rescue
Do not approach the helicopter before the rotor has stopped. While the rotor is running, only get in and out in the company of a crew member and always stay in eye contact with the pilot.

Keep calm – Fight