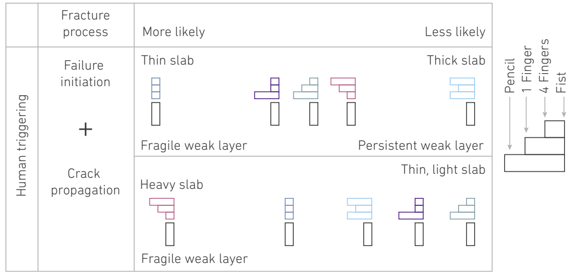
SNOW PIT INTERPRETATION

SLAB AND WEAK LAYER INTERPLAY

Snow instability is closely tied to specific snowpack properties. In snow pits these properties can be observed. Triggering a weak layer below a thick slab is harder than if the slab is shallow. However, thick slabs are usually heavy and thus, tend to propagate cracks more easily. The slab layering (colors) has a more subtle influence on the fracture processes and on triggering. The five different profile types illustrate the influence.



LEMONS

The lemons describe the structural instability of the layers we found in the snow pit. Distinct weak layers count many lemons – science tells us. Three properties at layer interface and three properties of the softer one of the two layers next to it (i.e. the potential weak layer) are considered.

PROPERTIES AT THE INTERFACE

Large difference in grain size (≥ 1 mm) / Large difference in hand hardness index (≥ 2 levels) / Layer interface less than 1 m below the snow surface.

PROPERTIES OF THE WEAK LAYER

Large grains (≥ 1 mm) / very soft layer (hand hardness index: 1, fist) / Persistent grain types: depth hoar, surface hoar or (rounding) faceted crystals (□, ⊟, ∨, ∧)

INTERPRETATION of the lemon counts at an interface

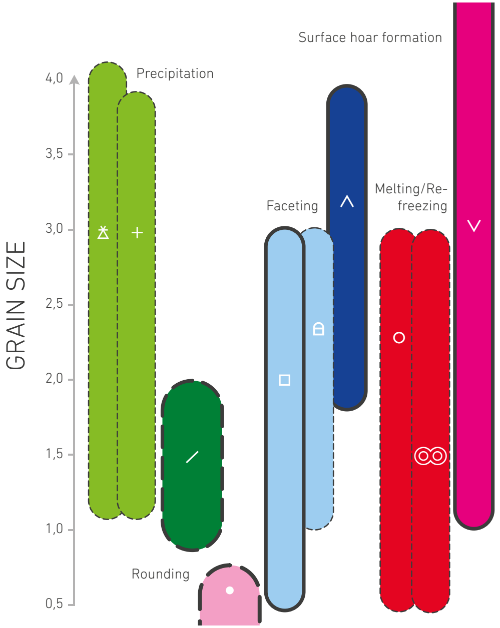
5 – 6 lemons: very likely a critical weakness
3 – 4 lemons: possibly a critical weakness
0 – 2 lemons: no distinct weak layer

ASSESSING SNOW INSTABILITY

Stability test results and weak layer characteristics (Lemons) can be combined to assess instability. Poor, if 2 of the 3 criteria are met:

✓RB ≤ 3;
✓RB whole block release
✓On a weak layer with ≥ 5 lemons

GRAIN TYPES AND THEIR CHARACTERISTIC SIZE

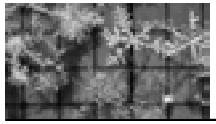
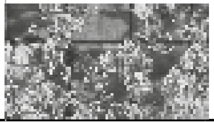
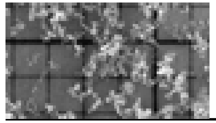
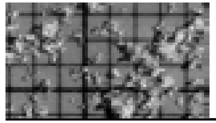
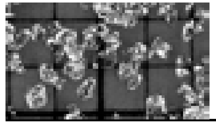
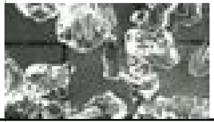
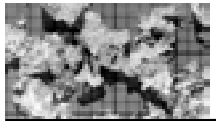
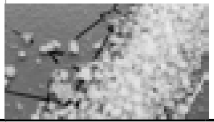
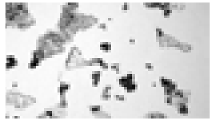


Snow layers form at the snow surface when snow crystals (+ / Ѫ) fall during storms or when water vapor is deposited from the ambient air (∨). Depending on snow temperature conditions deposited crystals evolve due to faceting, or rounding or melt (○). Facets (□, ⊟), depth hoar (∧) and surface hoar (∨) are common in weak layers. Decomposing (⟋) or small rounded particles (●) often form slabs.

WINTERJOURNAL

ORTOVOX

GRAIN SHAPE AND TYPICAL SIZES

	Symbol		Symbol
PRECIPITATION PARTICLES: 1 – 4 mm 	+	MELT FORMS 0,5 – 3 mm 	○
FRAGMENTED PARTICLES: 1 – 2 mm 	⟋	MELT-FREEZE CRUST 0,5 – 3 mm	∞
ROUNDED GRAINS: 0,2 – 0,5 mm 	●	ICE LAYER Individual grains are not visible.	▬
FACETED CRYSTALS 0,5 – 3 mm 	□	ROUNDING FACETED PARTICLES 1–3 mm 	⊟
DEPTH HOAR 2 – 5 mm 	∧	GRAUPEL 1 – 5 mm 	Ѫ
SURFACE HOAR 1 – 10 mm 	∨	NOTATION OF GRAIN SIZE 1st Number = mean size of all grains 2nd Number = mean size of largest grains	

AVALANCHE SIZE

1 SMALL AVALANCHE

Stops in slope, harmless. Fall hazard?

2 MEDIUM AVALANCHE

Reaches base of slope, could bury or kill a person.

3 LARGE AVALANCHE

Traverses flat terrain, could break a few trees.

4 VERY LARGE AVALANCHE

Runs for > 1km, could destroy an area of forest.

5 EXTREME AVALANCHE

Reaches the valley, could devastate the landscape.

SLOPE ANGLE CLASSES

MODERATE ANGLES: < 30°
STEEP: from 30°
VERY STEEP: from 35°
EXTREME TERRAIN: from 40°

HAND HARD-NESS [K]

1: very soft, fist
2: soft, 4 Fingers
3: medium, 1 Finger
4: hard, pencil
5: very hard, knife blade
6: Ice

LIQUID WATER CONTENT [ϴ]

1: dry, snow temperature below 0 °C
2: moist, snow temperature at 0 °C
3: wet, water visible with magnifier
4: very wet, water can be pressed out
5: slush, snow is soaked with water

OBSERVATIONS

AVALANCHE OBSERVATIONS

- Location (coordinates), time, elevation of start and runout zones, aspect, slope angle
- Avalanche size, slab width and depth (measured vertically), length of the avalanche
- Slab, loose snow or glide-snow avalanche
- Dry or wet (snow in starting zone)
- Triggered naturally, artificially (e.g. person or explosives) or remotely
- Failure layer within new snow, drifted snow or old snow

IMPORTANCE

Field observations add value to avalanche forecasts and support local danger assessment. Some observations require digging a snow pit, others come for free.
▸ cf. page 44, "Snowpack properties and stability estimates"

RELEVANCE OF FIELD OBSERVATIONS

- A snow pit gives insight into the snowpack layering. Snow instability can be assessed if combined with stability tests.
- Snow pit data is site-specific. Extrapolation is limited by spatial variability and only possible from pit locations representative of the general conditions.
- To assess the local avalanche danger, snow pit data is combined with all other field observations (e.g. signs of instability, snow drifts).

SNOW PIT LOCATION

Select the pit location based on safety and snowpack conditions.

- Safety
  - stay below 30° in critical situations
  - choose short slope with gentle runout
  - avoid terrain traps
- Snowpack:
  - Representative layering (e.g. avoid thick snow drifts)
  - Rather unfavorable layering (▸ Avalanche problem, p.70)
  - Below-average snow depth (▸ often weaker)
  - Undisturbed snow cover (e.g. avoid tracked terrain)
  - Uniform snow distribution (▸ check by probing)
  - Steep slope except in critical situations

▸ cf. page 46, "Snowpack observations"

RECOMMENDATIONS

TRAVEL ADVICE, FREQUENCY, FATALITY RATE
Avoid all avalanche terrain. Very rarely forecast. Around 1% of avalanche fatalities.
Less trained recreationists stay on open ski runs and trails. Avoid steep terrain and runout zones. Forecast only for a few days throughout the winter. Around 10 % of avalanche fatalities.
Less trained recreationists should stay on open ski runs and trails. Careful snowpack evaluation, cautious route-selection and conservative decision making is essential, in particular on steep slopes that fit the danger description. Forecast for around 30 % of the winter season. Around 50 % of avalanche fatalities.
Identify features of concern. Route-finding requires care, in particular on steep slopes that fit the danger description. Add margin of safety with persistent weak layer problem. Forecast for around 50 % of the winter season. Around 30 % of avalanche fatalities.
Watch for unstable snow on isolated terrain features and fall hazards. Travel one at a time in extreme terrain. Forecast for around 20 % of the winter season. Around 5 % of avalanche fatalities.

RATING THE CRUX SLOPES

Answering the detailed questions will guide you through the risk evaluation process. To assess the risk you will need to combine the ratings for the likelihood of triggering and the ones for the possible consequences of release.

LIKELIHOOD OF TRIGGERING G

- Failure initiation: Is failure initiation unlikely? Are there weak layers? Can we trigger along the intended route or at grouping spots?
- Crack propagation: Is crack propagation unlikely? What is the slab(thickness)? Did the weak layer have time to strengthen?
- Tracks: Has the slope been skied much? Skiing is a stability test and triggering is less likely on tracked slopes. Skier traffic increases variability which can stop crack formation. Be careful with persistent weak layers.
- Other hazards: Is the group threatened by additional hazards? Natural release? Seracs? Crevasses? Other people?

POSSIBLE CONSEQUENCES OF RELEASE K

- Slope size: Is the slope rather large? Would release mean serious burial? It may depend on where you ski or climb the slope.
- Release volume: How much snow is going to move? Release width and possible crown thickness? Larger slides tend to be more harmful.
- Terrain traps: Are there terrain traps that increase the consequences of being caught? Cliffs, trees, rocks in the runout? Gullies or unfavorably shaped runout terrain?
- Safe spots: Can we avoid multiple burials? Is only one person exposed at a time? Is the group near to help in case of a burial.

WINTER JOURNAL

Benjamin Reuter, Chris Semmel

DECISION MAKING AND REPORTING

Supported by ORTOVOX

TRIP PLANNING WITH G K M R

AVALANCHE AND WEATHER FORECAST

1. Danger level
2. Avalanche problem
3. Avalanche prone locations
4. Detailed hazard description
5. Current weather and trends
6. Snow cover information

Select the mountain range (1–2)

Select the terrain (2–6)

TOOLS: Avalanche and weather forecast, topographic map, automatic weather station and snow cover data, pictures, slope maps etc.

IDENTIFYING THE HAZARD — G

- Identify cruxes (▸ "Crux finder" on p.6)
- Assess local conditions (▸ Example on p.10, local data preferred)
- Estimate the likelihood of triggering at the crux:
  - ▸ Simple approach: based on slope angle classes in the „crux check" on p.7
  - ▸ Detailed rating: example on p.11 (back cover folds out)

ANTICIPATING THE CONSEQUENCES — K

- Estimate the consequences of a release: Slope size? Release volume? Terrain traps? Safe grouping spots?
  - ▸ Simple: rate consequences with the „crux check" on p.7
  - ▸ Detailed: follow the example on p.11 (back cover folds out)

CONSIDERING MITIGATION — M

- Group management (e.g. spreading out)
- Alternative plans or by-passes? Alternative objectives?

ASSESSING THE RISK — R

- Does the selected terrain fit the conditions?
  - ▸ Simple: follow the „crux check" on p.7 to obtain a risk estimate
  - ▸ Detailed: Weigh Hazard ‹› Consequences (p.11)
- Is the trip within the group's comfort zone?

COMMUNICATION

- Present the intended trip and alternative plans
- Communicate the schedule
- Check and prepare gear

CRUX FINDER

1. Any steep slope (≥30°) is potential avalanche terrain. Select all steep slopes along and above your intended route as cruxes.
2. Slopes that do not fit the description of avalanche prone locations (as mentioned in the avalanche forecast) can be dropped from the cruxes. Extreme terrain (≥40°) always represents a crux and requires detailed evaluation.
3. The slopes above your route that you don't cross can be dropped from the cruxes, too, if remote triggering and natural release can be ruled out based on the avalanche problem. The exposure on the remaining slopes can be estimated with a simplified topographical model.

Remote triggering is typical with persistent weak layers or new snow problems. In these cases, slopes above the intended route need to be considered. If snow drifts (or wind slabs) are the only problem, remote triggering is rather rare. Remote triggering of wet slabs is rare. Avalanche forecasts usually address the frequency of natural avalanches if it is relevant.

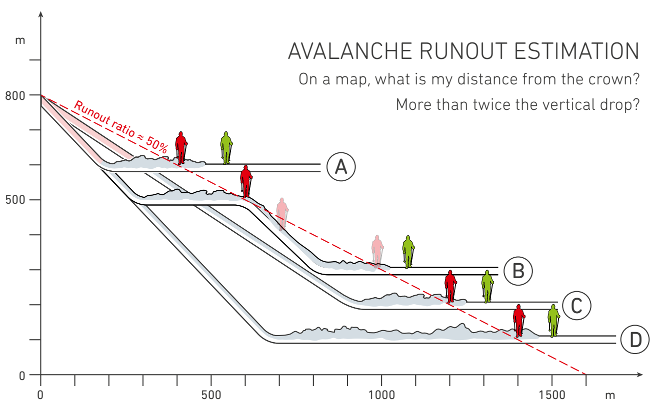


FIGURE: A typical skier-triggered avalanche runs twice as many horizontal meters as it drops vertically, i.e. the runout ratio is 50%. The sketched avalanches stop roughly where the runout ratio intersects the terrain. The expected runout reaches the red figures, the green ones are likely outside. In case B, the avalanche will rather not cross the first step in the terrain.

CRUX CHECK

A RISK EVALUATION TOOL

APPROACH FOR A BASIC RISK CHECK DURING TRIP PLANNING:

- There is greater likelihood of triggering with increasing slope angle. For a rough hazard rating, pick the slope angle class that is appropriate for the crux slope : 30 – 34°, 35 – 39°, ≥ 40°.
- Unfavorable terrain can increase the consequences of avalanche release. Answering the 4 questions shows how serious the consequences would be (back cover folds out).
- The right column tells you if a crux slope is «critical» by combining the hazard rating and the consequences

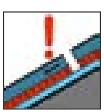
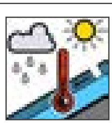
RECOMMENDATIONS:

- Trips with «critical» crux slopes are not recommended if alternative routes are lacking.
- Preparing lower risk alternatives is particularly encouraged if skier triggering or natural release is expected.

	G	LIKELIHOOD OF TRIGGER-ING	+K	CONSEQUENCES	=R	RISK
SLOPES IDENTIFIED WITH THE "CRUX FINDER"	≥ 40°	Slopes steeper than 39°	☐ Sizeable slope? ☐ Large release volume? ☐ Terrain traps? ☐ No safe spots?		Extreme terrain is always considered a critical crux.	
	≥ 35°	Slope angle 35° — 39°	☐ Sizeable slope? ☐ Large release volume? ☐ Terrain traps? ☐ No safe spots?		With 1 or more checks the crux is critical.	
	≥ 30°	Hang-neigung 30° — 34°	☐ Sizeable slope? ☐ Large release volume? ☐ Terrain traps? ☐ No safe spots?		With 2 or more checks the crux is critical.	
	< 30°	Runout zones? (▸ S. 06)				

PLAN AHEAD

Advanced trip planning includes estimating local avalanche conditions and rating the crux slopes (▸ examples on p.10 and 11). Both steps, combine local information to eventually identify hazard locations before we get to the crux. Even if local conditions are unique, patterns exist: Avalanche forecasters use the following «avalanche problem types» (p. 74) to communicate the characteristics of an avalanche problem. The five types guide us on how to deal with the problem.

PROBLEM TYPE	HAZARD LOCATIONS	SIGNS	HOW PRONOUNCED	SOLUTION
 **Active during storms**, **heals quickly**.	Often widespread. More pronounced at higher elevations.	Critical amount of new snow. Natural release common.	Surface before storm? Sintering?	Hard to mitigate. Be patient for a day or two.
 **Variable distribution**	Often in alpine areas, close to ridges.	Signs of drifting snow. Recent releases and cracks common.	Age and distribution of snow drifts?	Skilled route-finding to avoid features of concern.
 **Dangerous size**, **remote triggering**	Avoid areas with shallow snowpack. Watch for terrain changes.	Weak snowpack, whumpf sounds, shooting cracks, remote triggering typical.	Depth and distribution of weak layer?	Know the layering, dig snow pits. Add margin of safety.
 **Natural release**, **damage potential**	Aspect and elevation time dependent.	Wet snowpack, deep skier penetration, natural release.	Where and since when is the snowpack wet?	Prepare schedule. Return in time.

DECISION MAKING AT THE CRUX WITH G K M R

AT THE CHECKPOINT BEFORE THE CRUX

- Slope description (Aspect, Angle, Elevation, Size, Shape)
- Recall trip planning: Are conditions as expected?

IDENTIFYING THE HAZARD — G

- Assess local conditions in the area: Avalanche problem? Likelihood of triggering? (▸ Example on p.10, use current observations)
- Estimate the likelihood of triggering at the crux: Initiation? Propagation? Tracks? Other hazards? (▸ example on p.11 with help on p.86)

ANTICIPATING THE CONSEQUENCES — K

Estimate the consequences of a release: Slope size? Release volume? Terrain traps? Safe grouping spots?

(▸ example on p.11 with help on p.86)

CONSIDERING MITIGATION — M

We can mitigate our risk at the crux by reducing

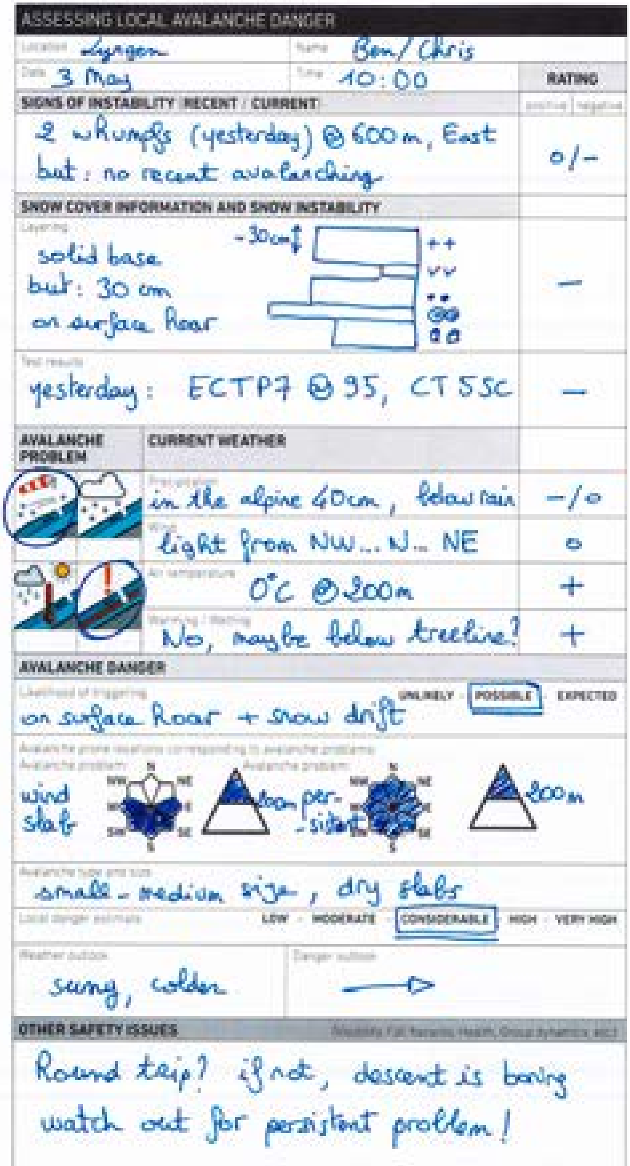
- The likelihood of triggering (e.g. spreading out) and/or
- The consequences of release (e.g. avoiding a terrain trap).

ASSESSING THE RISK — R

- Weigh hazard <> consequences (p.11)
- Do we accept the risk?

No ▸ Change mitigation measures, look at alternatives or bail.
Yes ▸ Communicate risk evaluation and organize the group.

- Human factors: Peer pressure? Own goals? Group dynamics?



ASSESSING LOCAL AVALANCHE DANGER

Location: Lyngen	Name: Ben/Chris	
Date: 3 May	Time: 10:00	RATING
SIGNS OF INSTABILITY RECENT / CURRENT		positive / negative
2 whumpfs (yesterday) @ 600 m, East but: no recent avalanching		o/–
SNOW COVER INFORMATION AND SNOW INSTABILITY		
Layering: solid base but: 30 cm on surface hoar (-30cm)		–
Test results: yesterday: ECTP7 @ 95, CT 5SC		–
AVALANCHE PROBLEM	**CURRENT WEATHER**	
	Precipitation: in the alpine 40cm, below rain	–/o
	Wind: light from NW... N... NE	o
	Air temperature: 0°C @ 200m	+
	Warming / Wetting: No, maybe below treeline?	+
AVALANCHE DANGER		
Likelihood of triggering: on surface hoar + snow drift	UNLIKELY · POSSIBLE · EXPECTED	
Avalanche prone locations corresponding to avalanche problems: Avalanche problem: wind slab; Avalanche problem: persistent slab; 200m		
Avalanche type and size: small - medium size, dry slabs		
Local danger estimate:	LOW · MODERATE · CONSIDERABLE · HIGH · VERY HIGH	
Weather outlook: sunny, colder	Danger outlook: →	
OTHER SAFETY ISSUES (Visibility, Fall hazards, Health, Group dynamics, etc.)		
Round trip? if not, descent is boring watch out for persistent problem!		

RATING THE CRUX SLOPES (EXAMPLE)

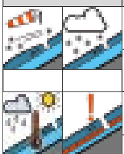
TRIP: Lone peak DATE 11 Jan 2018 TEAM: Daredevils

SHORT FACTS				LIKELIHOOD OF TRIGGERING				CONSEQUENCES				MITIGATION MEASURES	RISK
LOCATION	ELEVATION	ASPECT	SLOPE ANGLE	FAILURE INITIATION?	CRACK PROPAGATION?	TRACKS?	OTHER HAZARDS?	SLOPE SIZE?	RELEASE VOLUME?	TERRAIN TRAPS?	SAFE SPOTS?	NOTES	EVALUATE
Direttissima	2560 m	S	>35°	Trigger fresh snow?	Tracked before storm	Many	other teams!	120 m	Down 30 cm	Smooth runout	Only at the foot	1 skier on slope, watch other teams	
				-	+	+	-	-	o	+	-		
Chicken run	2975 m	NE	ca. 33°	Deep weak layer	possible	none	none	60 m	1 m slab!	Canyon	Below rocks	Ski 1 by 1, left limit	
				o	-	o	+	o	-	-	+		
Kingline	3050 m	W	ca. 31°	stubborn	unlikely	sure	none	80 m	Little snow	Cliff below	several	1 by 1, slow, watch for drop	
				+	+	+	+	-	+	-	+		

ASSESSING LOCAL AVALANCHE DANGER

Location	Name	
Date	Time	**RATING**

SIGNS OF INSTABILITY (RECENT / CURRENT)	positive	negative
SNOW COVER INFORMATION AND SNOW INSTABILITY		
Layering		
Test results		

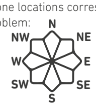
AVALANCHE PROBLEM	**CURRENT WEATHER**	
	Precipitation	
	Wind	
	Air temperature	
	Warming / Wetting	

AVALANCHE DANGER

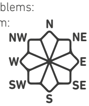
Likelihood of triggering — **UNLIKELY – POSSIBLE – EXPECTED**

Avalanche prone locations corresponding to avalanche problems:

Avalanche problem:



Avalanche problem:



Avalanche type and size

Local danger estimate — **LOW – MODERATE – CONSIDERABLE – HIGH – VERY HIGH**

Weather outlook	Danger outlook

OTHER SAFETY ISSUES (Visibility, Fall hazards, Health, Group dynamics, etc.)

RATING THE CRUX SLOPES

TRIP: DATE: TEAM:

	SHORT FACTS			**LIKELIHOOD OF TRIGGERING**				**CONSEQUENCES**				**MITIGATION MEASURES**	**RISK**
LOCATION	ELEVATION	ASPECT	SLOPE ANGLE	FAILURE INITIATION?	CRACK PROPAGATION?	TRACKS?	OTHER HAZARDS?	SLOPE SIZE?	RELEASE VOLUME?	TERRAIN TRAPS?	SAFE SPOTS?	NOTES	EVALUATE

ASSESSING LOCAL AVALANCHE DANGER

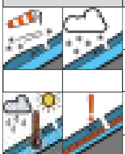
Location	Name	
Date	Time	**RATING**

SIGNS OF INSTABILITY (RECENT / CURRENT)	positive	negative

SNOW COVER INFORMATION AND SNOW INSTABILITY

Layering

Test results

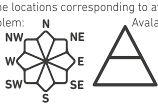
AVALANCHE PROBLEM	**CURRENT WEATHER**
	Precipitation
	Wind
	Air temperature
	Warming / Wetting

AVALANCHE DANGER

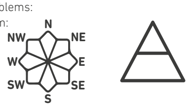
Likelihood of triggering **UNLIKELY – POSSIBLE – EXPECTED**

Avalanche prone locations corresponding to avalanche problems:

Avalanche problem:



Avalanche problem:



Avalanche type and size

Local danger estimate **LOW – MODERATE – CONSIDERABLE – HIGH – VERY HIGH**

Weather outlook	Danger outlook

OTHER SAFETY ISSUES (Visibility, Fall hazards, Health, Group dynamics, etc.)

RATING THE CRUX SLOPES

TRIP: DATE: TEAM:

	SHORT FACTS			LIKELIHOOD OF TRIGGERING				CONSEQUENCES				MITIGATION MEASURES	RISK
LOCATION	ELEVATION	ASPECT	SLOPE ANGLE	FAILURE INITIATION?	CRACK PROPAGATION?	TRACKS?	OTHER HAZARDS?	SLOPE SIZE?	RELEASE VOLUME?	TERRAIN TRAPS?	SAFE SPOTS?	NOTES	EVALUATE

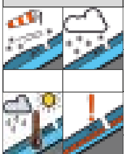
ASSESSING LOCAL AVALANCHE DANGER

Location	Name	
Date	Time	**RATING**
SIGNS OF INSTABILITY (RECENT / CURRENT)		positive / negative

SNOW COVER INFORMATION AND SNOW INSTABILITY

Layering

Test results

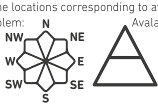
AVALANCHE PROBLEM	**CURRENT WEATHER**
	Precipitation
	Wind
	Air temperature
	Warming / Wetting

AVALANCHE DANGER

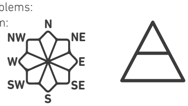
Likelihood of triggering **UNLIKELY – POSSIBLE – EXPECTED**

Avalanche prone locations corresponding to avalanche problems:

Avalanche problem:



Avalanche problem:



Avalanche type and size

Local danger estimate **LOW – MODERATE – CONSIDERABLE – HIGH – VERY HIGH**

Weather outlook	Danger outlook

OTHER SAFETY ISSUES (Visibility, Fall hazards, Health, Group dynamics, etc.)

RATING THE CRUX SLOPES

TRIP: DATE: TEAM:

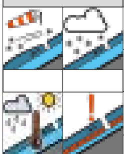
SHORT FACTS				LIKELIHOOD OF TRIGGERING				CONSEQUENCES				MITIGATION MEASURES	RISK
LOCATION	ELEVATION	ASPECT	SLOPE ANGLE	FAILURE INITIATION?	CRACK PROPAGATION?	TRACKS?	OTHER HAZARDS?	SLOPE SIZE?	RELEASE VOLUME?	TERRAIN TRAPS?	SAFE SPOTS?	NOTES	EVALUATE

ASSESSING LOCAL AVALANCHE DANGER

Location	Name	
Date	Time	**RATING**

SIGNS OF INSTABILITY (RECENT / CURRENT)	positive	negative

SNOW COVER INFORMATION AND SNOW INSTABILITY	
Layering	
Test results	

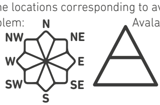
AVALANCHE PROBLEM	**CURRENT WEATHER**	
	Precipitation	
	Wind	
	Air temperature	
	Warming / Wetting	

AVALANCHE DANGER

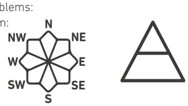
Likelihood of triggering **UNLIKELY – POSSIBLE – EXPECTED**

Avalanche prone locations corresponding to avalanche problems:

Avalanche problem:



Avalanche problem:



Avalanche type and size

Local danger estimate **LOW – MODERATE – CONSIDERABLE – HIGH – VERY HIGH**

Weather outlook	Danger outlook

OTHER SAFETY ISSUES (Visibility, Fall hazards, Health, Group dynamics, etc.)

RATING THE CRUX SLOPES

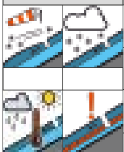
TRIP: DATE: TEAM:

	SHORT FACTS			LIKELIHOOD OF TRIGGERING				CONSEQUENCES				MITIGATION MEASURES	RISK
LOCATION	ELEVATION	ASPECT	SLOPE ANGLE	FAILURE INITIATION?	CRACK PROPAGATION?	TRACKS?	OTHER HAZARDS?	SLOPE SIZE?	RELEASE VOLUME?	TERRAIN TRAPS?	SAFE SPOTS?	NOTES	EVALUATE

ASSESSING LOCAL AVALANCHE DANGER

Location	Name	
Date	Time	**RATING**

SIGNS OF INSTABILITY (RECENT / CURRENT)	positive	negative
SNOW COVER INFORMATION AND SNOW INSTABILITY		
Layering		
Test results		

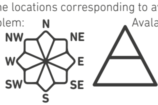
AVALANCHE PROBLEM	**CURRENT WEATHER**	
	Precipitation	
	Wind	
	Air temperature	
	Warming / Wetting	

AVALANCHE DANGER

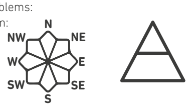
Likelihood of triggering **UNLIKELY – POSSIBLE – EXPECTED**

Avalanche prone locations corresponding to avalanche problems:

Avalanche problem:



Avalanche problem:



Avalanche type and size

Local danger estimate **LOW – MODERATE – CONSIDERABLE – HIGH – VERY HIGH**

Weather outlook	Danger outlook

OTHER SAFETY ISSUES (Visibility, Fall hazards, Health, Group dynamics, etc.)

RATING THE CRUX SLOPES

TRIP: DATE: TEAM:

	SHORT FACTS			LIKELIHOOD OF TRIGGERING				CONSEQUENCES				MITIGATION MEASURES	RISK
LOCATION	ELEVATION	ASPECT	SLOPE ANGLE	FAILURE INITIATION?	CRACK PROPAGATION?	TRACKS?	OTHER HAZARDS?	SLOPE SIZE?	RELEASE VOLUME?	TERRAIN TRAPS?	SAFE SPOTS?	NOTES	EVALUATE

ASSESSING LOCAL AVALANCHE DANGER

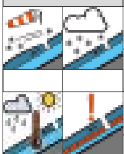
Location	Name	
Date	Time	**RATING**

SIGNS OF INSTABILITY (RECENT / CURRENT)	positive	negative

SNOW COVER INFORMATION AND SNOW INSTABILITY

Layering

Test results

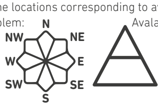
AVALANCHE PROBLEM	**CURRENT WEATHER**
	Precipitation
	Wind
	Air temperature
	Warming / Wetting

AVALANCHE DANGER

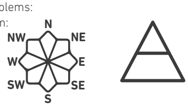
Likelihood of triggering **UNLIKELY – POSSIBLE – EXPECTED**

Avalanche prone locations corresponding to avalanche problems:

Avalanche problem:



Avalanche problem:



Avalanche type and size

Local danger estimate **LOW – MODERATE – CONSIDERABLE – HIGH – VERY HIGH**

Weather outlook	Danger outlook

OTHER SAFETY ISSUES (Visibility, Fall hazards, Health, Group dynamics, etc.)

RATING THE CRUX SLOPES

TRIP: DATE: TEAM:

	SHORT FACTS			LIKELIHOOD OF TRIGGERING				CONSEQUENCES				MITIGATION MEASURES	RISK
LOCATION	ELEVATION	ASPECT	SLOPE ANGLE	FAILURE INITIATION?	CRACK PROPAGATION?	TRACKS?	OTHER HAZARDS?	SLOPE SIZE?	RELEASE VOLUME?	TERRAIN TRAPS?	SAFE SPOTS?	NOTES	EVALUATE

ASSESSING LOCAL AVALANCHE DANGER

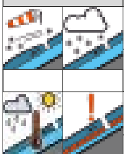
Location	Name	
Date	Time	**RATING**

SIGNS OF INSTABILITY (RECENT / CURRENT) — positive | negative

SNOW COVER INFORMATION AND SNOW INSTABILITY

Layering

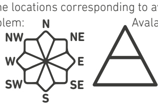
Test results

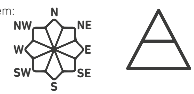
AVALANCHE PROBLEM	**CURRENT WEATHER**
	Precipitation
	Wind
	Air temperature
	Warming / Wetting

AVALANCHE DANGER

Likelihood of triggering — **UNLIKELY – POSSIBLE – EXPECTED**

Avalanche prone locations corresponding to avalanche problems:

Avalanche problem: 

Avalanche problem: 

Avalanche type and size

Local danger estimate — **LOW – MODERATE – CONSIDERABLE – HIGH – VERY HIGH**

Weather outlook	Danger outlook

OTHER SAFETY ISSUES (Visibility, Fall hazards, Health, Group dynamics, etc.)

RATING THE CRUX SLOPES

TRIP: DATE: TEAM:

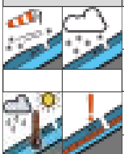
SHORT FACTS				LIKELIHOOD OF TRIGGERING				CONSEQUENCES				MITIGATION MEASURES	RISK
LOCATION	ELEVATION	ASPECT	SLOPE ANGLE	FAILURE INITIATION?	CRACK PROPAGATION?	TRACKS?	OTHER HAZARDS?	SLOPE SIZE?	RELEASE VOLUME?	TERRAIN TRAPS?	SAFE SPOTS?	NOTES	EVALUATE

ASSESSING LOCAL AVALANCHE DANGER

Location	Name	
Date	Time	**RATING**

SIGNS OF INSTABILITY (RECENT / CURRENT)	positive	negative

SNOW COVER INFORMATION AND SNOW INSTABILITY	
Layering	
Test results	

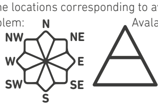
AVALANCHE PROBLEM	**CURRENT WEATHER**	
	Precipitation	
	Wind	
	Air temperature	
	Warming / Wetting	

AVALANCHE DANGER

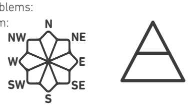
Likelihood of triggering **UNLIKELY – POSSIBLE – EXPECTED**

Avalanche prone locations corresponding to avalanche problems:

Avalanche problem:



Avalanche problem:



Avalanche type and size

Local danger estimate **LOW – MODERATE – CONSIDERABLE – HIGH – VERY HIGH**

Weather outlook	Danger outlook

OTHER SAFETY ISSUES (Visibility, Fall hazards, Health, Group dynamics, etc.)

RATING THE CRUX SLOPES

TRIP: DATE: TEAM:

	SHORT FACTS			LIKELIHOOD OF TRIGGERING				CONSEQUENCES				MITIGATION MEASURES	RISK
LOCATION	ELEVATION	ASPECT	SLOPE ANGLE	FAILURE INITIATION?	CRACK PROPAGATION?	TRACKS?	OTHER HAZARDS?	SLOPE SIZE?	RELEASE VOLUME?	TERRAIN TRAPS?	SAFE SPOTS?	NOTES	EVALUATE

ASSESSING LOCAL AVALANCHE DANGER

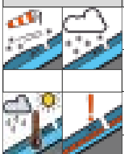
Location	Name	
Date	Time	**RATING**

SIGNS OF INSTABILITY (RECENT / CURRENT) — positive | negative

SNOW COVER INFORMATION AND SNOW INSTABILITY

Layering

Test results

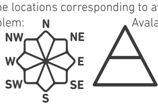
AVALANCHE PROBLEM	**CURRENT WEATHER**
	Precipitation
	Wind
	Air temperature
	Warming / Wetting

AVALANCHE DANGER

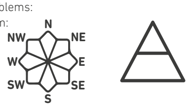
Likelihood of triggering — **UNLIKELY – POSSIBLE – EXPECTED**

Avalanche prone locations corresponding to avalanche problems:

Avalanche problem:



Avalanche problem:



Avalanche type and size

Local danger estimate — **LOW – MODERATE – CONSIDERABLE – HIGH – VERY HIGH**

Weather outlook	Danger outlook

OTHER SAFETY ISSUES (Visibility, Fall hazards, Health, Group dynamics, etc.)

RATING THE CRUX SLOPES

TRIP: DATE: TEAM:

	SHORT FACTS			LIKELIHOOD OF TRIGGERING				CONSEQUENCES				MITIGATION MEASURES	RISK
LOCATION	ELEVATION	ASPECT	SLOPE ANGLE	FAILURE INITIATION?	CRACK PROPAGATION?	TRACKS?	OTHER HAZARDS?	SLOPE SIZE?	RELEASE VOLUME?	TERRAIN TRAPS?	SAFE SPOTS?	NOTES	EVALUATE

ASSESSING LOCAL AVALANCHE DANGER

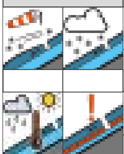
Location	Name	
Date	Time	**RATING**

SIGNS OF INSTABILITY (**RECENT** / **CURRENT**)	positive	negative

SNOW COVER INFORMATION AND SNOW INSTABILITY

Layering

Test results

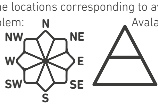
AVALANCHE PROBLEM	**CURRENT WEATHER**	
	Precipitation	
	Wind	
	Air temperature	
	Warming / Wetting	

AVALANCHE DANGER

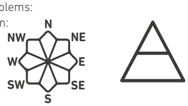
Likelihood of triggering **UNLIKELY – POSSIBLE – EXPECTED**

Avalanche prone locations corresponding to avalanche problems:

Avalanche problem:



Avalanche problem:



Avalanche type and size

Local danger estimate **LOW – MODERATE – CONSIDERABLE – HIGH – VERY HIGH**

Weather outlook	Danger outlook

OTHER SAFETY ISSUES (Visibility, Fall hazards, Health, Group dynamics, etc.)

RATING THE CRUX SLOPES

TRIP: DATE: TEAM:

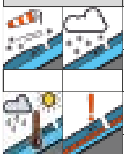
	SHORT FACTS			LIKELIHOOD OF TRIGGERING				CONSEQUENCES				MITIGATION MEASURES	RISK
LOCATION	ELEVATION	ASPECT	SLOPE ANGLE	FAILURE INITIATION?	CRACK PROPAGATION?	TRACKS?	OTHER HAZARDS?	SLOPE SIZE?	RELEASE VOLUME?	TERRAIN TRAPS?	SAFE SPOTS?	NOTES	EVALUATE

ASSESSING LOCAL AVALANCHE DANGER

Location	Name	
Date	Time	**RATING**

SIGNS OF INSTABILITY (RECENT / CURRENT)	positive	negative

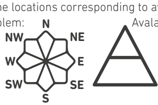
SNOW COVER INFORMATION AND SNOW INSTABILITY	
Layering	
Test results	

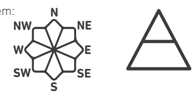
AVALANCHE PROBLEM	**CURRENT WEATHER**	
	Precipitation	
	Wind	
	Air temperature	
	Warming / Wetting	

AVALANCHE DANGER

Likelihood of triggering **UNLIKELY – POSSIBLE – EXPECTED**

Avalanche prone locations corresponding to avalanche problems:

Avalanche problem: 

Avalanche problem: 

Avalanche type and size

Local danger estimate **LOW – MODERATE – CONSIDERABLE – HIGH – VERY HIGH**

Weather outlook	Danger outlook

OTHER SAFETY ISSUES (Visibility, Fall hazards, Health, Group dynamics, etc.)

RATING THE CRUX SLOPES

TRIP: DATE: TEAM:

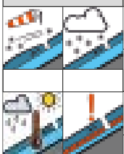
SHORT FACTS				LIKELIHOOD OF TRIGGERING				CONSEQUENCES				MITIGATION MEASURES	RISK
LOCATION	ELEVATION	ASPECT	SLOPE ANGLE	FAILURE INITIATION?	CRACK PROPAGATION?	TRACKS?	OTHER HAZARDS?	SLOPE SIZE?	RELEASE VOLUME?	TERRAIN TRAPS?	SAFE SPOTS?	NOTES	EVALUATE

ASSESSING LOCAL AVALANCHE DANGER

Location	Name	
Date	Time	**RATING**

SIGNS OF INSTABILITY (**RECENT** / **CURRENT**)	positive	negative

SNOW COVER INFORMATION AND SNOW INSTABILITY	
Layering	
Test results	

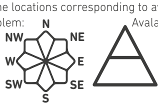
AVALANCHE PROBLEM	**CURRENT WEATHER**	
	Precipitation	
	Wind	
	Air temperature	
	Warming / Wetting	

AVALANCHE DANGER

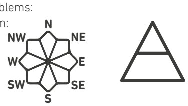
Likelihood of triggering — **UNLIKELY** – **POSSIBLE** – **EXPECTED**

Avalanche prone locations corresponding to avalanche problems:

Avalanche problem:



Avalanche problem:



Avalanche type and size

Local danger estimate — **LOW** – **MODERATE** – **CONSIDERABLE** – **HIGH** – **VERY HIGH**

Weather outlook	Danger outlook

OTHER SAFETY ISSUES (Visibility, Fall hazards, Health, Group dynamics, etc.)

RATING THE CRUX SLOPES

TRIP: DATE: TEAM:

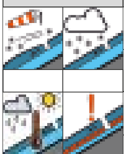
	SHORT FACTS			**LIKELIHOOD OF TRIGGERING**				**CONSEQUENCES**				**MITIGATION MEASURES**	**RISK**
LOCATION	ELEVATION	ASPECT	SLOPE ANGLE	FAILURE INITIATION?	CRACK PROPAGATION?	TRACKS?	OTHER HAZARDS?	SLOPE SIZE?	RELEASE VOLUME?	TERRAIN TRAPS?	SAFE SPOTS?	NOTES	EVALUATE

ASSESSING LOCAL AVALANCHE DANGER

Location	Name	
Date	Time	**RATING**

SIGNS OF INSTABILITY (RECENT / CURRENT)	positive	negative

SNOW COVER INFORMATION AND SNOW INSTABILITY	
Layering	
Test results	

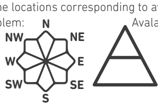
AVALANCHE PROBLEM	**CURRENT WEATHER**	
	Precipitation	
	Wind	
	Air temperature	
	Warming / Wetting	

AVALANCHE DANGER

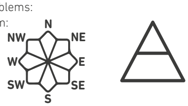
Likelihood of triggering **UNLIKELY – POSSIBLE – EXPECTED**

Avalanche prone locations corresponding to avalanche problems:

Avalanche problem:



Avalanche problem:



Avalanche type and size

Local danger estimate **LOW – MODERATE – CONSIDERABLE – HIGH – VERY HIGH**

Weather outlook	Danger outlook

OTHER SAFETY ISSUES (Visibility, Fall hazards, Health, Group dynamics, etc.)

RATING THE CRUX SLOPES

TRIP: DATE: TEAM:

	SHORT FACTS			LIKELIHOOD OF TRIGGERING				CONSEQUENCES				MITIGATION MEASURES	RISK
LOCATION	ELEVATION	ASPECT	SLOPE ANGLE	FAILURE INITIATION?	CRACK PROPAGATION?	TRACKS?	OTHER HAZARDS?	SLOPE SIZE?	RELEASE VOLUME?	TERRAIN TRAPS?	SAFE SPOTS?	NOTES	EVALUATE

ASSESSING LOCAL AVALANCHE DANGER

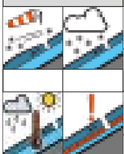
Location	Name	
Date	Time	**RATING**

SIGNS OF INSTABILITY (RECENT / CURRENT)	positive	negative

SNOW COVER INFORMATION AND SNOW INSTABILITY

Layering

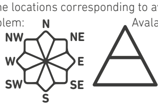
Test results

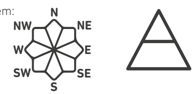
AVALANCHE PROBLEM	**CURRENT WEATHER**	
	Precipitation	
	Wind	
	Air temperature	
	Warming / Wetting	

AVALANCHE DANGER

Likelihood of triggering **UNLIKELY – POSSIBLE – EXPECTED**

Avalanche prone locations corresponding to avalanche problems:

Avalanche problem: 

Avalanche problem: 

Avalanche type and size

Local danger estimate **LOW – MODERATE – CONSIDERABLE – HIGH – VERY HIGH**

Weather outlook	Danger outlook

OTHER SAFETY ISSUES (Visibility, Fall hazards, Health, Group dynamics, etc.)

RATING THE CRUX SLOPES

TRIP: DATE: TEAM:

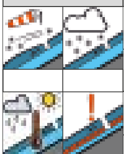
	SHORT FACTS			LIKELIHOOD OF TRIGGERING				CONSEQUENCES				MITIGATION MEASURES	RISK
LOCATION	ELEVATION	ASPECT	SLOPE ANGLE	FAILURE INITIATION?	CRACK PROPAGATION?	TRACKS?	OTHER HAZARDS?	SLOPE SIZE?	RELEASE VOLUME?	TERRAIN TRAPS?	SAFE SPOTS?	NOTES	EVALUATE

ASSESSING LOCAL AVALANCHE DANGER

Location	Name	
Date	Time	**RATING**

SIGNS OF INSTABILITY (RECENT / CURRENT)	positive	negative

SNOW COVER INFORMATION AND SNOW INSTABILITY	
Layering	
Test results	

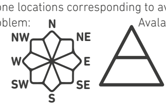
AVALANCHE PROBLEM	**CURRENT WEATHER**	
	Precipitation	
	Wind	
	Air temperature	
	Warming / Wetting	

AVALANCHE DANGER

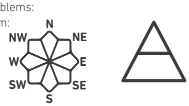
Likelihood of triggering **UNLIKELY – POSSIBLE – EXPECTED**

Avalanche prone locations corresponding to avalanche problems:

Avalanche problem:



Avalanche problem:



Avalanche type and size

Local danger estimate **LOW – MODERATE – CONSIDERABLE – HIGH – VERY HIGH**

Weather outlook	Danger outlook

OTHER SAFETY ISSUES (Visibility, Fall hazards, Health, Group dynamics, etc.)

RATING THE CRUX SLOPES

TRIP: DATE: TEAM:

	SHORT FACTS			LIKELIHOOD OF TRIGGERING				CONSEQUENCES				MITIGATION MEASURES	RISK
LOCATION	ELEVATION	ASPECT	SLOPE ANGLE	FAILURE INITIATION?	CRACK PROPAGATION?	TRACKS?	OTHER HAZARDS?	SLOPE SIZE?	RELEASE VOLUME?	TERRAIN TRAPS?	SAFE SPOTS?	NOTES	EVALUATE

ASSESSING LOCAL AVALANCHE DANGER

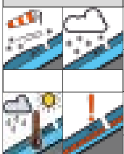
Location	Name	
Date	Time	**RATING**

SIGNS OF INSTABILITY (RECENT / CURRENT)	positive	negative

SNOW COVER INFORMATION AND SNOW INSTABILITY

Layering

Test results

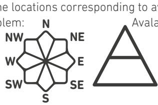
AVALANCHE PROBLEM	**CURRENT WEATHER**
	Precipitation
	Wind
	Air temperature
	Warming / Wetting

AVALANCHE DANGER

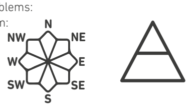
Likelihood of triggering **UNLIKELY – POSSIBLE – EXPECTED**

Avalanche prone locations corresponding to avalanche problems:

Avalanche problem:



Avalanche problem:



Avalanche type and size

Local danger estimate **LOW – MODERATE – CONSIDERABLE – HIGH – VERY HIGH**

Weather outlook	Danger outlook

OTHER SAFETY ISSUES (Visibility, Fall hazards, Health, Group dynamics, etc.)

RATING THE CRUX SLOPES

TRIP: DATE: TEAM:

SHORT FACTS				LIKELIHOOD OF TRIGGERING				CONSEQUENCES				MITIGATION MEASURES	RISK
LOCATION	ELEVATION	ASPECT	SLOPE ANGLE	FAILURE INITIATION?	CRACK PROPAGATION?	TRACKS?	OTHER HAZARDS?	SLOPE SIZE?	RELEASE VOLUME?	TERRAIN TRAPS?	SAFE SPOTS?	NOTES	EVALUATE

SNOWPACK ANALYSIS AND SNOW INSTABILITY

The following observations help to complete the snow cover information provided in the avalanche forecast. They are useful in particular with persistent weak layer problems or when signs of instability are rare.

SIMPLE OBSERVATIONS:
Check the penetration depth or use the ski pole test to learn about slab densification and possible thick weak layers along your route. Ski cut small rolls to test their stability.

SNOWPACK OBSERVATIONS ▸ page 45

CLUES FOR SNOWPACK EVALUATION

- Weak layers form readily if the snowpack is thin and temperatures are low.
- Average stability is better with lots of snow than with little snow.
- A series of thick layers that are similar is better than many thin layers that are different.
- Today's snow surface can be tomorrow's weak layer.

SNOW INSTABILITY – DEFINITION AND CLUES

Failure initiation and crack propagation contribute equally to slope instability. Low stability means that weak layers are likely to fail and cracks will propagate to release the slab that sits on top.

THE SNOWPACK LAYERING IS UNFAVORABLE, IF

- well-bonded layers sit on top of
- softer layers with large grains that are buried
- no deeper than 1 m in the snowpack

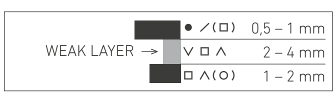


Illustration of an unfavorable layering

STABILITY TEST RESULTS ARE UNFAVORABLE, IF

- clean fractures cross the test column
- during the first loading steps.

SNOWPACK OBSERVATIONS

Single stability test results correctly predict slope stability in only 60 – 80 % of the cases. For a better guess, we combine snow profile data with the test results in a snow pit that allows process-based thinking and extrapolation. Knowing the avalanche problem, we may tell how it formed and where it persists. The Rutschblock is the most reliable test. Two smaller column tests, such as the ECT, have similar predictive power, if conflicting results are regarded as "unstable".

		SNOW INSTABILITY		
OBSERVATIONS	**LAYE-RING**	**FAILURE INITIATION**	**CRACK PROPAGATION**	**▸ PAGE**
Snow pit	yes	no	no	46
Snow pit & lemons	yes	partly	partly	Book cover
Rutschblock (2 × 1.5 m)	yes	yes	yes	50
CT (30 × 30 cm)	yes	yes	partly	47
ECT (90 × 30 cm)	yes	(yes)	yes	49
PST	no	no	yes	52

TABLE: Snowpack observations and interpretation for snow instability assessment. The information on failure initiation or crack propagation we get can be limited in some cases.

INTERPRETATION – SLOPE STABILITY
Avalanche release can be described with probabilities at best. Spatial variability and different scales challenge slope stability evaluation.

To estimate the likelihood of triggering …

- Combine test results and snowpack layering.
- Combine the results with other available information.
- Focus your rating on the negative results.
- Compare your results with the general avalanche conditions.
- Allow for a wider margin of safety in case of conflicting results.

LAYOUT FOR SNOWPACK OBSERVATIONS

A snow pit combines a snow profile with stability tests to assess snow instability. Process-based thinking builds on this information.

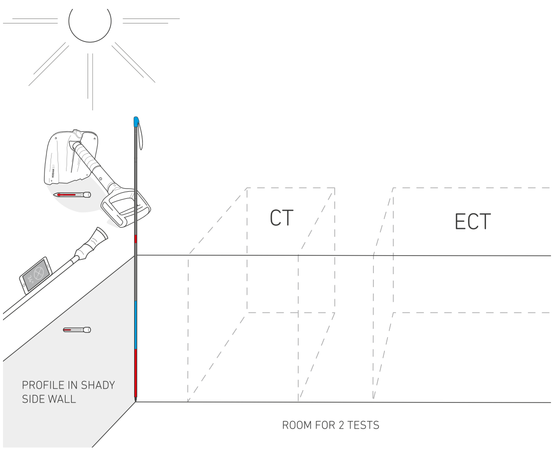


FIGURE: Snow pit with snow profile on the side wall which is in the shade. Tests are done adjacent at the front of the pit.

ADVICE:

- Look for representative locations with rather unfavorable layering (▸ p.2, front cover inside)
- Interpret own observations in the light of the general conditions in the area (▸ p.45)

SNOW PIT PROCEDURES

- Select suitable snow pit location (▸ p. 02, front cover inside)
- Record location and current weather (▸ p. 53)
- Dig snow pit that probe is in the corner (▸ figure)
- Measure snow surface temperature in the shade of the shovel (▸ figure)
- Continue snow temperature measurements (10 cm intervals), while:
- Recording layer properties starting at the top (to about 1 m depth, or to well below the weak layer, ▸ p.53)

- Perform stability tests adjacent to probe
- Find weak layer in snow profile and record the test results
- Track down the layers you may have missed in the pit

HINT: Doing a CT at the beginning can help find the weakness and set the focus right.

COLUMN / COMPRESSION TEST (CT)

PROCEDURE AND SCORES

To do a CT isolate a 30 cm by 30 cm column of snow. Use the shovel to dig out the front and side walls. Isolate the back with the saw. Place a shovel blade on top of the column and progressively load it by tapping. When a layer fails, remove the fractured, upper part of the column to determine the fracture type. Continue testing on the remaining column.

FAILURE OCCURS:

... during isolation .... # 0

... while tapping ten times dropping the hand from the wrist .... # 1 – 10

... while tapping ten times dropping the forearm from the elbow........ # 11 – 20

... while tapping ten times dropping the arm from the shoulder .... # 21 – 30

FRACTURE TYPE

SUDDEN **P**LANAR	The fracture is clean, sudden and the fractured part comes off easily.
SUDDEN **C**OLLAPSE	The fracture appears suddenly and comes with visible settlement.
RESISTANT **P**LANAR	More than one tap is needed to propagate the fracture across the entire column. The fracture may appear suddenly, but the fractured part does not come off easily.
PROGR. **C**OMPRESSION	Diffuse fracture in a vertical region of one to several cm.
BREAK	The fracture is irregular.

NOTATION

Start with CT, then add the number of taps until fracture. After @ comes the depth of the failure in the profile (measured from the ground), then comes the fracture type.

EXAMPLE

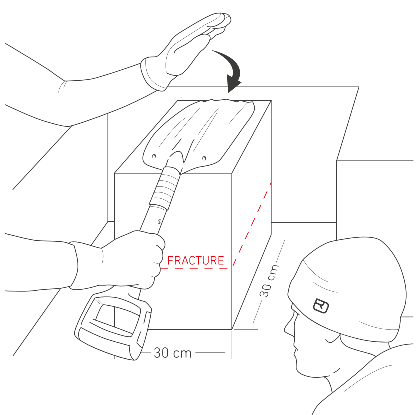
Failure occurs at the 2nd tap from the elbow (tap #12). The layer at 63 cm in the profile visually collapsed: CT 12 @ 63 cm SC.

CT INTERPRETATION IN VIEW OF SNOW INSTABILITY
(**GREEN**, **YELLOW**: **RATHER GOOD**; **RED**: **POOR**):

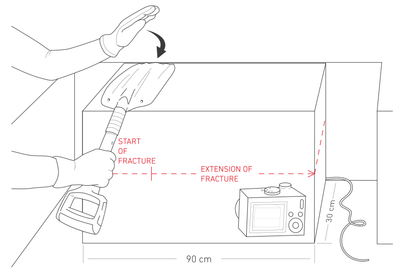
	SNOW INSTABILITY ESTIMATION	
CT RESULT	**FAILURE INITIATION LIKELY**	**CRACK PROPAGATION LIKELY**
CT < 14, SP or SC	yes	yes
CT < 14, RP or PC or B	yes	no
CT ≥ 14, SP or SC	no	yes
CT ≥ 14, RP or PC or B	no	no
CT 31 (no fracture)	no	no

FIGURE

Closely watch the front to spot the onset of fracture while the column is loaded.



EXTENDED COLUMN TEST (ECT)



FIGURE

After isolation the column is loaded on either side by tapping on the shovel blade. Recording a movie can help to locate the onset of crack propagation.

PROCEDURE AND SCORE

To do an ECT isolate a column 90 cm wide (across-slope) and with 30 cm side length (up-slope). Use the shovel to dig out the front and side walls. With a cord isolate the back of the ECT. Place a shovel blade on top of the column and load it by tapping until a failure initiates below the shovel. Remove the fractured part once the fracture has crossed the column. Continue testing the remaining column. Remove the cord when finished.

FAILURE OCCURS:

... during isolation .... # 0

... while tapping ten times dropping the hand from the wrist .... # 1 – 10

... while tapping ten times dropping the forearm from the elbow .... # 11 – 20

... while tapping ten times dropping the arm from the shoulder.......... # 21 – 30

FRACTURE TYPE

- **P**ropagation, the initial failure under the shovel propagates across the column immediately or at the following tap.
- **N**o propagation – the crack neither propagates immediately nor at the following tap
- No fracture (**X**) – no fracture observed until tap 30.

NOTATION

Start with ECT and the fracture type, then add the number of taps until a failure initiated. After @ comes the depth of the failure in the profile (measured from the ground).

EXAMPLES

- Failure occurs at tap 5 in a layer at 36 cm in the profile; the crack crosses the column at once: ECTP 5 @ 36 cm.
- A crack forms at tap 24 in the layer at 75 cm in the profile, but only at the next tap it crosses the column: ECTP 24 @ 75 cm.
- Tap 27 initiates failure in the layer at 12 cm in the profile, which does not propagate until tap 30: ECTN 27 @12 cm.
- While isolating the column the layer at 63 cm fails: ECTP 0 @ 63 cm.
- No fracture observed until finished with tap 30: ECTX.

ECT INTERPRETATION IN VIEW OF SNOW INSTABILITY
(**GREEN**, **YELLOW**: **RATHER GOOD**, **RED**: **POOR**):

	SNOW INSTABILITY ESTIMATION	
ECT RESULT	**FAILURE INITIATION LIKELY**	**CRACK PROPAGATION LIKELY**
ECT P ... @ [cm]	yes	yes
ECT N ... @ [cm]	yes	no
ECT X	no	no

RUTSCHBLOCK (RB)

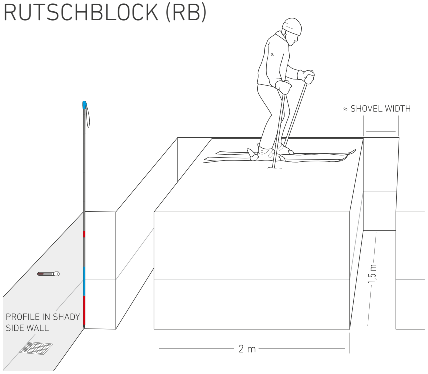


FIGURE: Finding failure layers in the profile is easier when tests are done adjacent. The person steps on the Rutschblock in the upper third.

PROCEDURE AND SCORE
Isolate a block of 2 m width (across-slope) and 1.5 m side length (up-slope). Use the shovel to dig out the front and side walls. With a cord isolate the back of the block. The block is then loaded by a person with the following steps until failure.

THE BLOCK FAILS

1 while digging or cutting

2 while stepping onto the block with skis

3 while three times dropping from straight legs to bent knees

4 on first jump with skis from above

5 on second or third jump with skis from above

6 on first jump without skis from above

7 no release

RELEASE TYPE

- Whole block release
- Partial (e.g. the part below the skis releases)

NOTATION

Start with RB, then record the score. After @ comes the depth of the failure in the profile (measured from the ground). Then, add the release type which is key for interpretation.

EXAMPLE

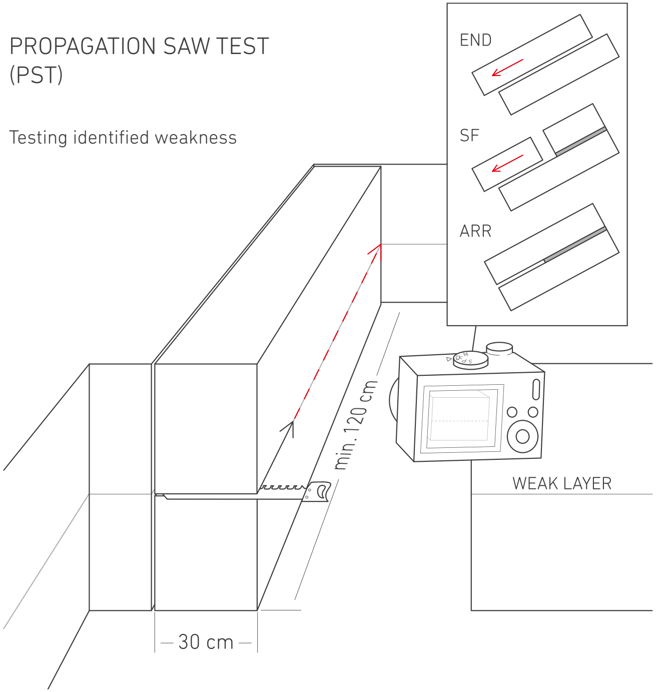
The block failed on the first jump with skis from above on the layer at 70 cm in the profile. At the back of the block you could verify that the whole block moved downhill slightly: RB 4 @70 whole block

RB INTERPRETATION IN VIEW OF SNOW INSTABILITY
(**GREEN**: **GOOD**; **YELLOW**: **FAIR**, **RED**: **POOR**):

	SNOW INSTABILITY ESTIMATION	
RB RESULT	**FAILURE INITIATION LIKELY**	**CRACK PROPAGATION LIKELY**
RB ≤ 3, whole block	yes	yes
RB ≤ 3, partial	yes	no
RB > 3, whole block	no	yes
RB > 3, partial	no	no

PROPAGATION SAW TEST (PST)

Testing identified weakness



NOTATION

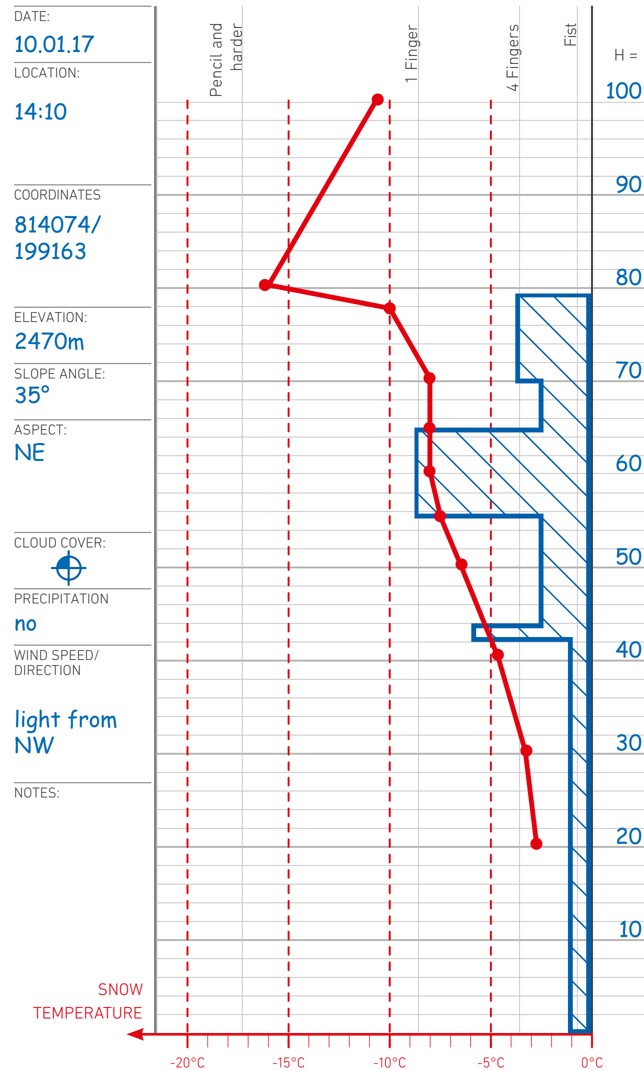
PST	Critical crack length	/	Column length	END / SF / ARR	@	Weak layer depth in profile

EXAMPLE

The weak layer is located at 95 cm in the profile. After saw cutting the weak layer for 15 cm the crack runs the remaining 135 cm to the end of the column: PST 15/150 END @ 95 cm

	SNOW INSTABILITY ESTIMATION	
PST RESULT	**FAILURE INITIATION LIKELY**	**CRACK PROPAGATION LIKELY**
PST...END	N/A	yes
PST...SF (slab fracture)	N/A	no
PST...ARR (arrest)	N/A	no

SNOW PROFILE (EXAMPLE)



SNOW PROFILE

DATE:

LOCATION:

COORDINATES:

ELEVATION:

SLOPE ANGLE:

ASPECT:

CLOUD COVER:

PRECIPITATION:

WIND SPEED/
DIRECTION

NOTES:

Pencil and harder

1 Finger

4 Fingers

Fist

H =

SNOW
TEMPERATURE

-20°C

-15°C

-10°C

-5°C

0°C

SNOW PROFILE

Snow depth	Wetness	Grain type	Grain size	Hand hardness	Depth	Temps.
cm	θ	F	mm	K	cm	°C

TEST RESULTS

SNOW PROFILE

DATE:

LOCATION:

COORDINATES:

ELEVATION:

SLOPE ANGLE:

ASPECT:

CLOUD COVER:

PRECIPITATION:

WIND SPEED/ DIRECTION

NOTES:

Pencil and harder

1 Finger

4 Fingers

Fist

H =

SNOW TEMPERATURE

-20°C -15°C -10°C -5°C 0°C

SNOW PROFILE

Snow depth	Wetness	Grain type	Grain size	Hand hardness	Depth	Temps.
cm	θ	F	mm	K	cm	°C

TEST RESULTS

SNOW PROFILE

DATE:

LOCATION:

COORDINATES:

ELEVATION:

SLOPE ANGLE:

ASPECT:

CLOUD COVER:

PRECIPITATION:

WIND SPEED/
DIRECTION

NOTES:

Pencil and harder | 1 Finger | 4 Fingers | Fist | H =

SNOW
TEMPERATURE

-20°C | -15°C | -10°C | -5°C | 0°C

SNOW PROFILE

Snow depth	Wetness	Grain type	Grain size	Hand hardness	Depth	Temps.
cm	θ	F	mm	K	cm	°C

TEST RESULTS

SNOW PROFILE

DATE:

LOCATION:

COORDINATES:

ELEVATION:

SLOPE ANGLE:

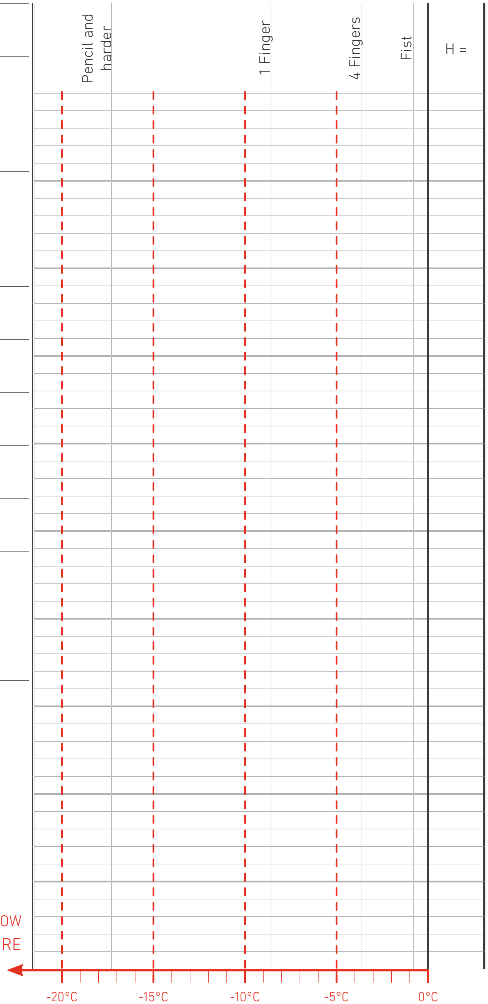
ASPECT:

CLOUD COVER:

PRECIPITATION:

WIND SPEED/
DIRECTION

NOTES:



SNOW PROFILE

Snow depth	Wetness	Grain type	Grain size	Hand hardness	Depth	Temps.
cm	θ	F	mm	K	cm	°C

TEST RESULTS

SNOW PROFILE

DATE:

LOCATION:

COORDINATES:

ELEVATION:

SLOPE ANGLE:

ASPECT:

CLOUD COVER:

PRECIPITATION:

WIND SPEED/
DIRECTION

NOTES:

Pencil and harder | 1 Finger | 4 Fingers | Fist | H =

SNOW
TEMPERATURE

-20°C | -15°C | -10°C | -5°C | 0°C

SNOW PROFILE

Snow depth	Wetness	Grain type	Grain size	Hand hardness	Depth	Temps.
cm	θ	F	mm	K	cm	°C

TEST RESULTS

SNOW PROFILE

DATE:

LOCATION:

COORDINATES:

ELEVATION:

SLOPE ANGLE:

ASPECT:

CLOUD COVER:

PRECIPITATION:

WIND SPEED/ DIRECTION

NOTES:

Pencil and harder | 1 Finger | 4 Fingers | Fist | H =

SNOW TEMPERATURE

-20°C | -15°C | -10°C | -5°C | 0°C

SNOW PROFILE

Snow depth	Wetness	Grain type	Grain size	Hand hardness	Depth	Temps.
cm	θ	F	mm	K	cm	°C

TEST RESULTS

SNOW PROFILE

DATE:

LOCATION:

COORDINATES:

ELEVATION:

SLOPE ANGLE:

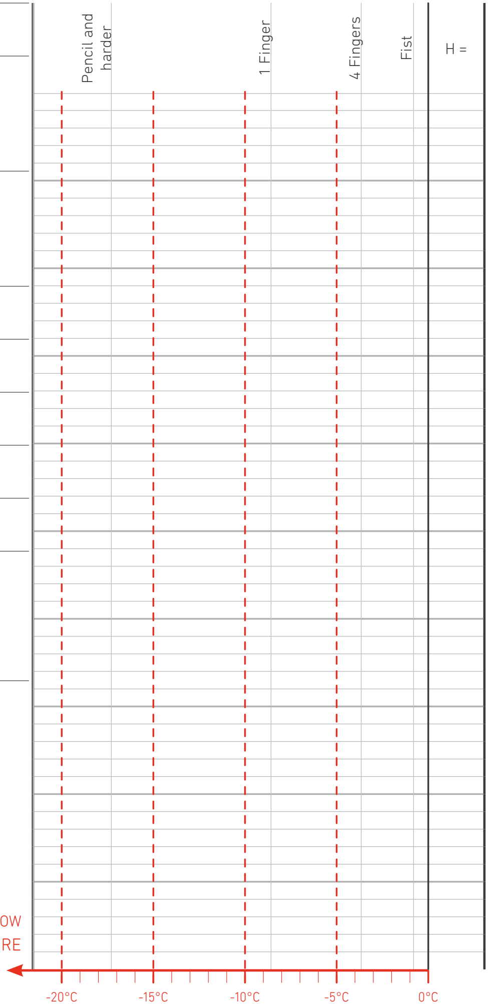
ASPECT:

CLOUD COVER:

PRECIPITATION:

WIND SPEED/
DIRECTION

NOTES:



SNOW PROFILE

Snow depth	Wetness	Grain type	Grain size	Hand hardness	Depth	Temps.
cm	θ	F	mm	K	cm	°C

TEST RESULTS

SNOW PROFILE

DATE:

LOCATION:

COORDINATES:

ELEVATION:

SLOPE ANGLE:

ASPECT:

CLOUD COVER:

PRECIPITATION:

WIND SPEED/
DIRECTION

NOTES:

Pencil and harder	1 Finger	4 Fingers	Fist	H =

SNOW
TEMPERATURE

-20°C -15°C -10°C -5°C 0°C

SNOW PROFILE

Snow depth	Wetness	Grain type	Grain size	Hand hardness	Depth	Temps.
cm	θ	F	mm	K	cm	°C

TEST RESULTS

SNOW PROFILE

DATE:

LOCATION:

COORDINATES:

ELEVATION:

SLOPE ANGLE:

ASPECT:

CLOUD COVER:

PRECIPITATION:

WIND SPEED/
DIRECTION

NOTES:

Pencil and harder | 1 Finger | 4 Fingers | Fist | H =

SNOW
TEMPERATURE

-20°C | -15°C | -10°C | -5°C | 0°C

SNOW PROFILE

Snow depth	Wetness	Grain type	Grain size	Hand hardness	Depth	Temps.
cm	θ	F	mm	K	cm	°C

TEST RESULTS

SNOW PROFILE

DATE:

LOCATION:

COORDINATES:

ELEVATION:

SLOPE ANGLE:

ASPECT:

CLOUD COVER:

PRECIPITATION:

WIND SPEED/ DIRECTION

NOTES:

SNOW TEMPERATURE

SNOW PROFILE

Snow depth	Wetness	Grain type	Grain size	Hand hardness	Depth	Temps.
cm	θ	F	mm	K	cm	°C

TEST RESULTS

FIVE CLASSIC TYPES OF AVALANCHE PROBLEMS

Five typical avalanche problems are described by the European Avalanche Warning Services EAWS as they recur during the season. These patterns guide our process-based thinking in avalanche terrain and help to find out, for instance, where weak layers formed.

Every type of avalanche problem has a typical distribution in the field. Wind slabs tend to form on sheltered terrain behind ridges. Typically , their distribution is different from the location of faceted weak layers, for example. Such grains develop during temperature gradient metamorphism and readily form in a shallow snowpack which is often found along smooth ridges. Moreover, triggering mechanisms vary between avalanche problems. Remote triggering is typical of persistent weak layer problems. Wet snow problems often show high natural activity.

In many cases our behavior derives from the avalanche problem – rather than from the danger level which sits on top of the information pyramid. The following description of classic avalanche problems helps to ask the relevant questions in a particular situation. This way we hope to find the answer to how an avalanche can form in the current conditions. Has a slab formed? Is the weak layer active? Can a skier initiate a fracture and would the crack propagate?

1. NEW SNOW

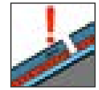
The avalanche problem is related to current or the most recent snowfall. The amount of new snow plays a dominant role as it represents an additional load on the snowpack, but may also form a temporary weaknesses itself. The critical amount of new snow depends on snow temperature, wind and the characteristics of the snow surface prior to the storm.

EXPECTED AVALANCHES	• Dry-snow slab avalanches • Dry loose snow avalanches • Natural and human triggered avalanches
WHERE TO FIND IT?	
SPATIAL DISTRIBUTION	Wide-spread; often found on all aspects.
WEAK LAYER DEPTH	Often at the interface between the storm snow and the old snow surface. Sometimes within the layers of new snow
LINKED PROBLEMS	• Wind slabs: wind reduces critical amount of new snow, thick slabs may form and release earlier • Persistent weak layers: the load of the new snow can re-activate older weak layers
HOW TO TRIGGER?	
RELEASE MECHANISM	• Dry-snow slab avalanches: Additional load due to snowfall on an existing weak layer or on a new weak layer within the new snow • Dry loose snow avalanches: Lack of cohesion between the new snow particles
WHEN RELEVANT?	
DURATION	During snowfall and up to a few days after.
HOW TO DEAL WITH?	
PROBLEM IDENTIFICATION	The new snow problem is fairly easy to recognize since it affects most of the terrain. Consider critical amount of new snow and recent avalanche activity.
TRAVEL ADVICE	• Dry-snow slab avalanches: Wait for weak layer to adjust to the load (sintering). This depends on the type of weak layer. • Dry loose snow avalanches: Fall hazard is more important than burial.
RELEVANT QUESTIONS	Critical amount of new snow? Spatial distribution of unfavorable snow surfaces prior to storm? Re-activation of persistent weak layer?

2. WIND SLABS

The avalanche problem is related to wind-drifted snow, i.e. when wind moves snow around. This happens during storms, but also in dry periods with strong enough winds to pick up snow from the ground. The newly formed layers add additional load to the existing snowpack, but they can also form a weakness.

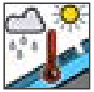
EXPECTED AVALANCHES	• Dry-snow slab avalanches • Natural and human triggered avalanches
WHERE TO FIND IT?	
SPATIAL DISTRIBUTION	Highly variable, but typically found on sheltered aspects such as in gullies or bowls. Also close to distinct changes in the terrain such as behind ridgelines. More common above treeline.
WEAK LAYER DEPTH	Often at the interface between the wind slab and the old snow surface. Sometimes within wind slab layers due to varying wind speed.
LINKED PROBLEMS	• Fresh snow: more snow available due to storm • Persistent weak layers: the load of the wind slab can re-activate older weak layers.
HOW TO TRIGGER?	
RELEASE MECHANISM	Wind-drifted snow adds additional load on a weak layer and builds a slab that is particularly prone to support crack propagation.
WHEN RELEVANT?	
DURATION	Wind slabs can form quickly. The problem persists while snow is blown up to a few days at most, depending on snow temperature.
HOW TO DEAL WITH IT?	
PROBLEM IDENTIFICATION	Unless covered by new snow or during periods of poor visibility wind slabs can be located from characteristic wind signs such as dunes or sastrugies. Age of wind signs and presence of weak layers are often hard to tell later. Typical clues: snowdrifts, all signs of instability.
TRAVEL ADVICE	Avoid wind slabs in steep terrain.
RELEVANT QUESTIONS	Location of wind slabs? Visibility? Snow surface prior to blowing snow event? Age of snow drifts? Re-activation of persistent weak layer?



3. PERSISTENT WEAK LAYERS

The avalanche problem is related to the presence of one or more persistent weak layers in the snowpack. These weak layers typically include faceted crystals, depth hoar or surface hoar crystals.

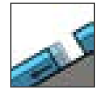
EXPECTED AVALANCHES	• Dry-snow slab avalanches • Human triggered avalanches; natural avalanches usually occur in combination with other problems.
WHERE TO FIND IT?	
SPATIAL DISTRIBUTION	Widespread to isolated. Can be found on all aspects, but more frequently on shady, wind sheltered slopes or in shallow areas.
WEAK LAYER DEPTH	In the old snowpack, often deeply buried.
LINKED PROBLEMS	• New snow or wind slabs: deep weak layers are re-activated when recent new snow or wind slabs add load to the slab. • Wet snow: water infiltration re-activates deep weak layers.
HOW TO TRIGGER?	
RELEASE MECHANISM	Avalanche release when (skier) loading exceeds the strength of the weak layer. Deeper weak layers are harder to trigger. Often sustained crack propagation. Remote triggering typical.
WHEN RELEVANT?	
DURATION	Weak layers can persist for weeks to months; possibly during most of the season. Possible re-activation in spring.
HOW TO DEAL WITH IT?	
PROBLEM IDENTIFICATION	Persistent weak layers are very challenging to recognize. Signs of instability such as whumpfs are typical but not necessarily present. Stability tests can be helpful to detect the persistent weak layers. Information on snowpack history is critical and reference to the public forecast is important. Crack propagation over long distances is common and remote triggering is possible.
TRAVEL ADVICE	Avoid large slopes with bad consequences. Consider past local weather and snow cover processes. Be cautious in areas with a shallow snowpack. Add margin of safety. This problem causes the majority of recreational fatalities.
RELEVANT QUESTIONS	Hazard locations? Weak layer depth? Failure initiation and crack propagation?



4. WET SNOW

This avalanche problem relates to liquid water that weakens the snowpack. Water infiltrates the snowpack following melting or rain. Water weakens interfaces or reduces the strength of existing weak layers.

EXPECTED AVALANCHES	• Wet-snow slab avalanches • Wet loose snow avalanches • Almost exclusively natural avalanches
WHERE TO FIND?	
SPATIAL DISTRIBUTION	When melting due to solar radiation is the main cause, distribution of the problem is mostly depending on aspect. The elevation is mainly depending on air temperature and humidity. All aspects are affected in the event of rain on snow.
WEAK LAYER DEPTH	Depending on wetness; deeper with ongoing wetting.
LINKED PROBLEMS	Persistent weak layers: water infiltration re-activates deep (possibly dormant) weak layers
HOW TO TRIGGER?	
RELEASE MECHANISM	• Wet-snow slab avalanches: Infiltrating water may reach existing weak layers. Water may pond at interfaces between layers with different grain size or hardness. Natural release often due to reduced weak layer strength. Rain is an additional load on the snowpack and weakens rapidly, in particular fresh snow. • Wet loose snow avalanches: Loss of cohesion between snow crystals.
WHEN RELEVANT?	
DURATION	• Hours, when rapid warming / rain reduces stability • Days, when deeper layers get wet due to ongoing warming • Deeper weak layers become critical when they get wet for the first time, i.e. when the snow temperature reaches 0 °C • Natural avalanches can become more likely later in the day, if daytime warming causes wetting
HOW TO DEAL WITH IT?	
PROBLEM IDENTIFICATION	Precursors for natural wet-snow slab avalanche activity are often onset of rain, snowballing, pin wheeling and small wet slabs or loose wet avalanches. Deep foot-penetration can indicate advanced wetting.
TRAVEL ADVICE	If night-time freezing has formed a crust that supports skiers conditions are favorable. Lack of cooling, e.g. during overcast nights, does not ease the problem. Good timing is key.
RELEVANT QUESTIONS	First time wetting? Advance of wetting? Planned trip works with warming conditions? Runout-zones?

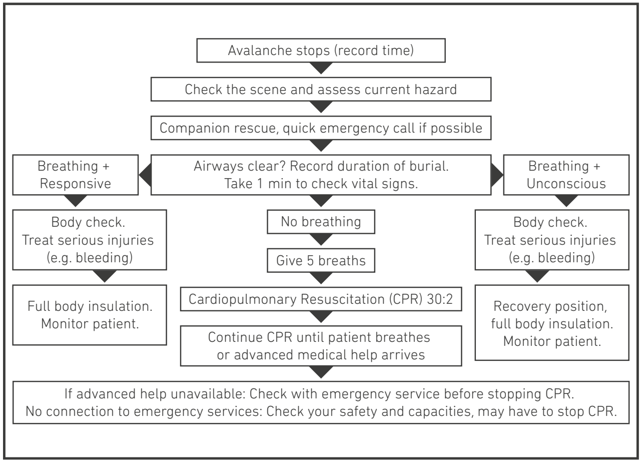


5. GLIDING SNOW

The entire snowpack is gliding on the ground, typically on smooth ground such as grass or rock slabs. High activity is typically related to a thick snowpack with no or only few layers. Glide snow avalanches occur in a cold, dry snowpack, but also in a warm wet snowpack. The release of a glide-snow avalanche is difficult to predict, although in many cases glide cracks open prior to release.

EXPECTED AVALANCHES	• Glide-snow avalanches; cold dry or wet snowpack • Almost exclusively natural avalanches. Human and artificial triggering is unlikely.
WHERE TO FIND?	
SPATIAL DISTRIBUTION	Primarily on smooth ground and on slopes of any aspect, but more often on south-facing slopes.
WEAK LAYER DEPTH	Interface between the ground and overlaying snowpack
LINKED PROBLEMS	Wet snow problems: warm glide-snow avalanches can become slightly more likely during day-time warming.
HOW TO TRIGGER?	
RELEASE MECHANISM	Glide-snow avalanches are caused by a loss of adhesion at the snow-ground interface.
WHEN RELEVANT?	
DURATION	Days to months; occasionally during entire winter-season. The release can occur at any time during the day. In spring, warm glide-snow avalanches occur mostly during the second part of the day.
HOW TO DEAL WITH IT?	
PROBLEM IDENTIFICATION	With the presence of glide cracks the problem can often be localized; however, the presence of glide cracks does not indicate imminent avalanche release, which is nearly impossible to predict. Avalanche release without pre-existing glide cracks is also common.
TRAVEL ADVICE	Avoid areas close to glide cracks
RELEVANT QUESTIONS	Where are glide crack? When did they open? Adjust route-finding?

ASSIST FIRST AID AT AN AVALANCHE ACCIDENT



MOUNTAIN RESCUE AND EMERGENCY SERVICES	
D: **112** (**EMERGENCY SERVICE**) Consider Alpenverein Aktiv app (transfers GPS data)	**A**: **140** (**MOUNTAIN RESCUE SERVICE**) Consider Notfall Tirol app (transfers GPS data)
I: **118** (**EMERGENCY SERVICE**) South Tyrol and Trentino: **112**	**F**: **112** (**EMERGENCY SERVICE**), 15 SAMU PGHM Chamonix: 04 50 53 16 89 PGHM Briançon: 04 92 22 22 22
CH: **1414** (**REGA**), In Valais: 144, consider using the REGA app Foreign SIM cards and at the border: +41 333 333 333 Consider using UEPAA app (transfers GPS data)	**SLOVENIA**: 112 **NORWAY**: 113, mobile phones call: 911, coast guard: 120 **SWEDEN** 112 **ICELAND** 112 **SPAIN** 112 or 061 **UK** 999 or 112 **USA** / **CANADA**: 911 **NEW ZEALAND** 111

DEALING WITH AN AVALANCHE ACCIDENT

- **CHECK THE SCENE AND CALL RESCUE**
  - Assess current hazard
  - Call rescue (unless partly buried person)
- **FIND AND EXTRICATE BURIED PERSONS**
  - Eye and beacon search
  - Maybe move patients
- **FIRST AID**
  Simple medical treatment until advanced medical help arrives
- **CALL RESCUE** (**IF STILL NEEDED**)
  - Follow professional advice
  - Maybe send members to find signal or call help
- **TAKE CARE**
  - Stay with the group after the rescue
  - Be attentive to the group
- **RECORD CHAIN OF EVENTS**
  Take notes, sketch up the scene, take pitures
- **CONSULT PROFESSIONAL CRISIS MANAGEMENT**
  Crisis management passes on information, calls expert witness, provides legal advice and arranges for psychological care. VDBS members call the accident line.

ACCIDENT LINE FOR VDBS MEMBERS:

+49 (0)89 20 80 17 115

VDBS REPRESENTATIVES: +49 8046. 188 61 12
C. SEMMEL: +49 1525. 148 39 39
R. TAGLINGER: +43 660. 480 78 76

PERSONAL NUMBERS TO CALL:

The probability of avalanche release and the distribution of hazard locations characterize the degree of avalanche danger. In some situations the avalanche size can tip the scales against a higher/lower level. A variety of situations is described with the same danger level.

EAWS

DISTRIBUTION OF HAZARD LOCATIONS / PROBABILITY OF AVALANCHE RELEASE	Generally only with high additional load				Primarily with high additional loads (in some cases with low additional loads)				Possible with low additional loads				Likely with low additional loads			
Avalanche Size	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Limited number of hazard locations*	1	1	1	1	1	1	2	3	1	1	2	3				
	1				**1**				**1**							
Hazard locations on some slopes *	1	2	2	3	1	2	2	3	1	2	3	4	2	3	3	4
	2				**2**				**3**				**3**			
Hazard locations on many slopes *	1	2	2	3	2	2	3	4	2	3	3	4	3	4	4	4
	2				**2**				**3**				**4**			
Hazard locations on many/most slopes **									3	4	4	4	3	4	4	4
									4				**4**			
Hazard locations in level and sloping terrain													4	4	5	5
													5			

*) locations can be described in the forecast, typically with aspect, elevation and/or terrain characteristics

**) Hazard locations are numerous and their distribution is not well known to be specific.

and / or

	Natural release of size 2 avalanches possible	Natural release of size 3, in some cases size 4 avalanches possible	Natural release of many size 3, in several cases size 4 avalanches likely	Natural release of numerous size 4, often size 5 avalanches likely
Limited number of hazard locations*	**1**	**2**		
Hazard locations on some slopes *	**2**	**3**	**3**	
Hazard locations on many slopes *	**2**	**3**	**4**	**4**
Hazard locations on many/most slopes **	**3**	**4**	**4**	**5**
Hazard locations in level and sloping terrain		**4**	**5**	**5**

The EAWS Matrix derives from the "Bavarian" Matrix and is a proposal to include the avalanche size in the description of the danger level. (Version 12/2017)

IMPRINT:

The authors are grateful to Jürg Schweizer and Neige Calonne for commenting and proof-reading.

REFERENCES:

EAWS, 2017: «Glossar» www.avalanches.org

Plattner und Wurtl, 2015: „Winter Journal", upGround.

SLF, 2018: «Avalanche Bulletin Interpretation Guide» www.slf.ch

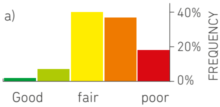
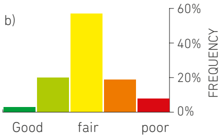
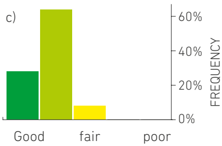
SLF, 2016: "Caution Avalanches!"

Schweizer et al., 2016: "Avalanche Release 101", ISSW Breckenridge 2016.

Reuter and Semmel, 2018: "Backcountry risk assessment (...)", ISSW Innsbruck 2018.

Techel et al, 2016: «Extended Column Test (...)», ISSW Breckenridge 2016.

Out of ink or filled all the sheets?
Get templates online

	CHARACTERISTICS	
DANGER LEVEL	LIKELIHOOD OF TRIGGERING, HAZARD LOCATIONS, AVALANCHE SIZE	DISTRIBUTION OF SNOW INSTABILITY
5 VERY HIGH	Many very large and extreme natural avalanches are expected; they can reach the valley floor.	The snowpack is weak in general.
 **4** HIGH	Triggering is likely, even with low additional loads, on many steep slopes. Many large and very large natural avalanches can be expected. Whumpf sounds and shooting cracks are common. Remote triggering is typical.	Most steep slopes have a weak snowpack.
 **3** CONSIDERABLE	Triggering is possible, even with low additional loads, particularly on the steep slopes indicated in the forecast. Some large and in isolated cases very large natural avalanches are possible. Whumpf sounds and shooting cracks are typical. Remote triggering is possible.	Many steep slopes have a rather weak snowpack. 
 **2** MODERATE	Triggering is generally possible from high additional loads, in rare cases from low additional loads, particularly on the steep slopes indicated in the forecast. Natural avalanches are unlikely. Signs of instability are rare.	Some steep slopes have a rather weak snowpack, the rest is fairly stable. 
 **1** LOW	Triggering is generally possible only from high additional loads in isolated areas in very steep, extreme terrain. ONatural avalanches are unlikely. No signs of instability.	The snowpack is stable in general. 

Figures a – c: Observed distributions of snow instability on steep slopes (Schweizer et al. 2003)