

When studying decision making, we should not expect to learn the right answers. We should expect to learn the right questions.

What are the Chances of an Avalanche Happening

What are the Consequences of the Avalanche

What is the Capability of the Team to Deal with a Poor Outcome

Learn From Each Tour Regardless of How Well it Went

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❄️

AIARE RISK MANAGEMENT FRAMEWORK

CHECKLISTS

Each Season

PREPARE

- ❑ Continue your avalanche education
- ❑ Practice avalanche rescue
- ❑ Track the season's conditions
- ❑ Investigate trip options

Each Backcountry Day

PLAN YOUR TRIP

- ❑ Assemble Your Group
- ❑ Anticipate The Hazard
- ❑ Plan Your Route
- ❑ Discuss an Emergency Plan

TRIP

RIDE SAFELY

- ❑ Conduct A Departure Check
- ❑ Monitor Conditions Along Your Route
- ❑ Check In With The Group & Reassess Your Plan
- ❑ Recognize Avalanche Signs
- ❑ Use Terrain To Reduce Your Risk

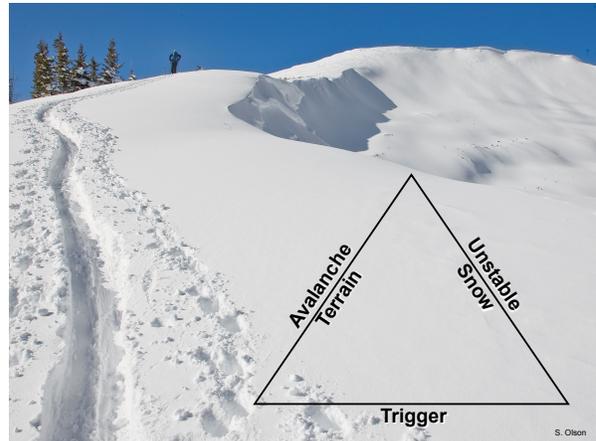
TEAMWORK

- ❑ Travel together. Decide together.
- ❑ Listen to every voice.
- ❑ Challenge Assumptions.
- ❑ Respect any veto.

DEBRIEF THE DAY

- ❑ Summarize Conditions
- ❑ Review Today's Decisions
- ❑ Improve Today's Plan

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SNOW

What are the Chances of an Avalanche Happening

Different Avalanche Problems



Creation Of The Mountain Snowpack

Snow comes in a variety of shapes and sizes

It falls to the ground at different times and under varying weather conditions

The result is not a uniform blanket, but a series of layers which may or may not have similar properties.



It is layers with differing characteristics, that are the source of avalanches.

Layering From Direct Weather

Direct weather effects play a role in changing the layers at or near the surface. The main players are:

- Wind
- Rain
- Temperature
- Sun
- Humidity?

Wind Crust

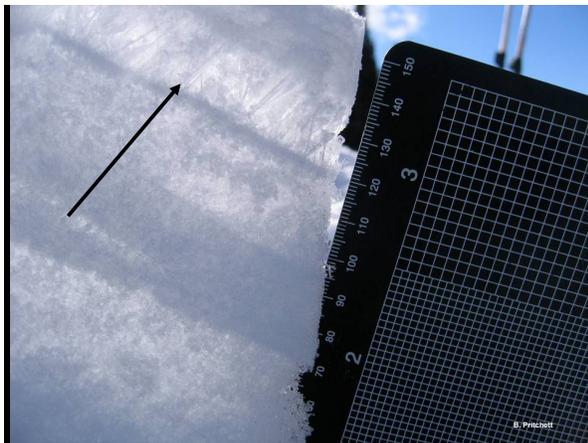


Wind Crust



Rain, Sun or Temperature Crust

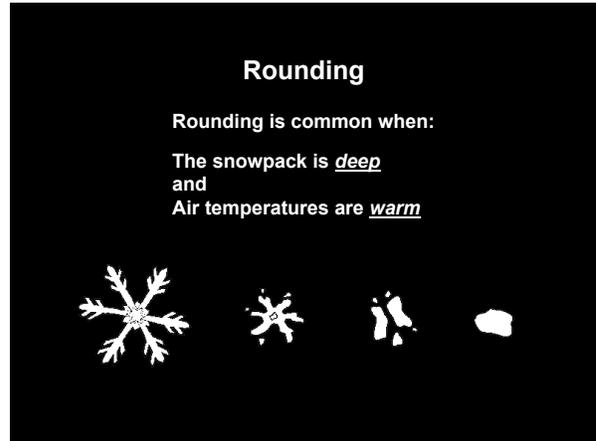
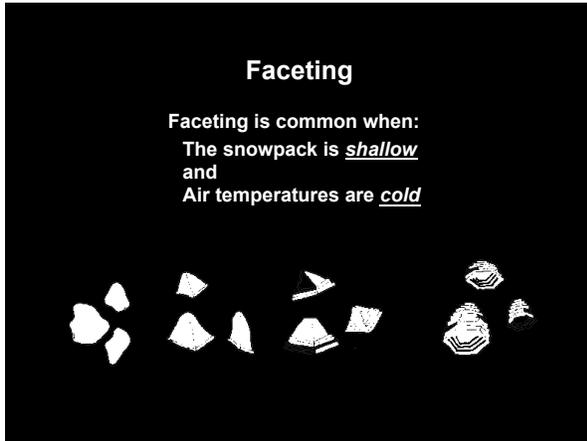




Layering From Indirect Weather

The major factors that influence metamorphism deep in the snowpack are:

- Air temperature
- Snowpack depth



Snow Climates

	Maritime	Continental	Infermountain
Precipitation	High Rate Large Accum.	Low Rate Small Accum.	Mod-High Rate Med-Large Acc.
Wind Transport	Much pre storm Much in-storm Little post-storm	Little pre Some-much in Much post	Little-some pre Some-much in Some post
Temperatures	Warm	Cold	Cool
Depth/Distribution	Deep, uniform	Shallow, variable	Shallow - mod, var. early winter. Deep - uniform later
Layering	Uniform Rounded	Strong over weak Faceted	Variable, faceted early More uniform, rounded later
Temperatures	Warm	Cold	Cool
Avalanches	"Direct action"	"Delayed action."	Direct and delayed
Avalanche Danger	Quick to rise Quick to fall	Slow to rise Often very slow to fall	Quick to rise Often slow to fall early winter. Quicker to fall late season.

Snow Climates

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Non-Persistent:

- Strengthen quickly
- Observable over hours or days

Persistent:

- Strengthen slowly (weeks to months)
- Don't bond readily to bed surface or slab

Grain Types: Persistent

- Depth Hoar
- Surface Hoar
- Facets
- Graupel

Often associated with a continental climate

Deep Slab Tutorial

Bruce Tremper
Utah Avalanche Center

North American Public Avalanche Danger Scale
Avalanche danger is determined by the likelihood, size and distribution of avalanches.

Danger Level	Travel Advice	Likelihood of Avalanches	Avalanche Size and Distribution
5 Extreme	Avoid all avalanche terrain.	Natural and human-triggered avalanches certain.	Large to very large avalanches in many areas.
4 High	Very dangerous avalanche conditions. Travel in avalanche terrain not recommended.	Natural avalanches likely; human-triggered avalanches very likely.	Large avalanches in many areas; or very large avalanches in specific areas.
3 Considerable	Dangerous avalanche conditions. Careful snowpack evaluation, cautious route-finding and conservative decision-making essential.	Natural avalanches possible; human-triggered avalanches likely.	Small avalanches in many areas; or large avalanches in specific areas; or very large avalanches in isolated areas.
2 Moderate	Heightened avalanche conditions on specific terrain features. Evaluate snow and terrain carefully; identify features of concern.	Natural avalanches unlikely; human-triggered avalanches possible.	Small avalanches in specific areas; or large avalanches in isolated areas.
1 Low	Generally safe avalanche conditions. Watch for unstable snow on isolated terrain features.	Natural and human-triggered avalanches unlikely.	Small avalanches in isolated areas or extreme terrain.

Safe backcountry travel requires training and experience. You control your own risk by choosing where, when and how you travel.

Danger Rating

The avalanche danger is **CONSIDERABLE (Level 3)** on all aspects and elevations except for south through west aspects below treeline, where the danger is **MODERATE (Level 2)**.

Avalanche Problem #1

PERSISTENT SLAB	LIKELIHOOD OF TRIGGERING	AVALANCHE SIZE	Trend

Persistent slabs in the upper snowpack exist on most aspects and at all elevations. Last week's storm snow is sitting on facets, surface hoar and crusts that formed earlier in January. Deeper persistent slabs can be found on northwest through east facing slopes and in isolated areas at high elevations.

Avalanche Problem #2

WIND SLAB	LIKELIHOOD OF TRIGGERING	AVALANCHE SIZE	Trend

Steady winds accompanying last week's storm created wind slabs on leeward and cross-loaded slopes. Use extra caution below ridge-tops on north through east through south aspects. Northwest winds continued to load above treeline slopes yesterday.

Weather Forecast

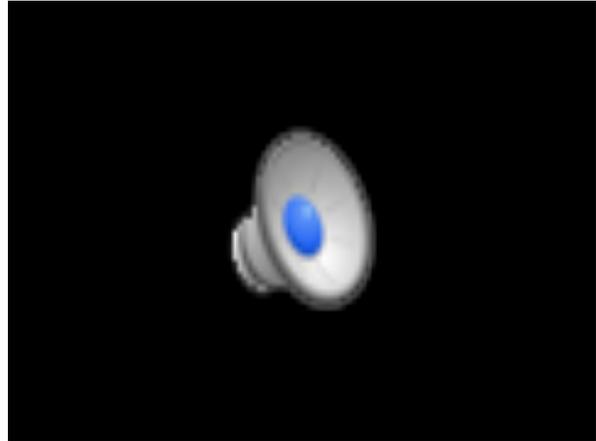
Today: Mostly clear, west winds 5-15 mph and a high near 32.

Tonight: Clear, west winds 5-15 mph and a low of 15.

Tomorrow: Partly cloudy, west winds 5-15 mph and a high of 28.

Weather Outlook

Dry and mild weather continues under a westerly flow. Tomorrow will be cooler and cloudier as a weak cold front moves through the state. More dry and mild conditions return for Thursday. A low pressure storm system brings a change to the weather pattern for Friday and the weekend. There is some snow in the forecast, but the models are still sorting out the details.



Size

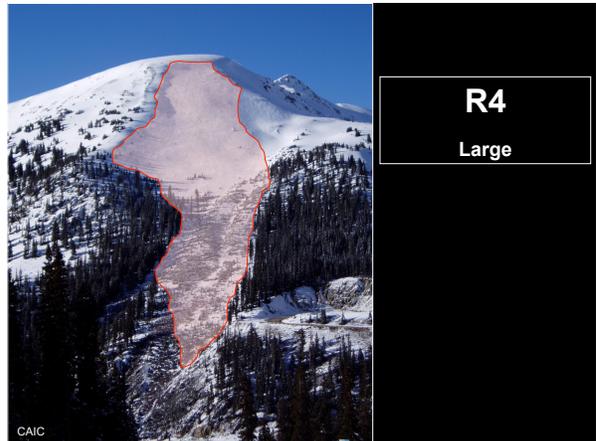
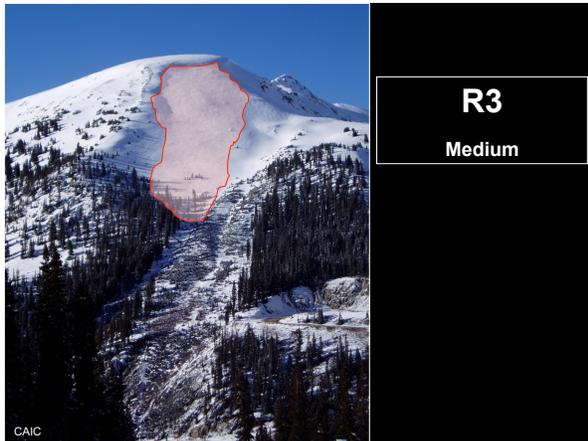
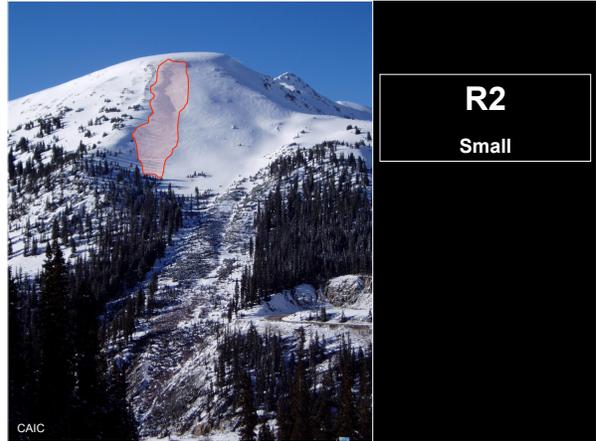
What are the Consequences of the Avalanche

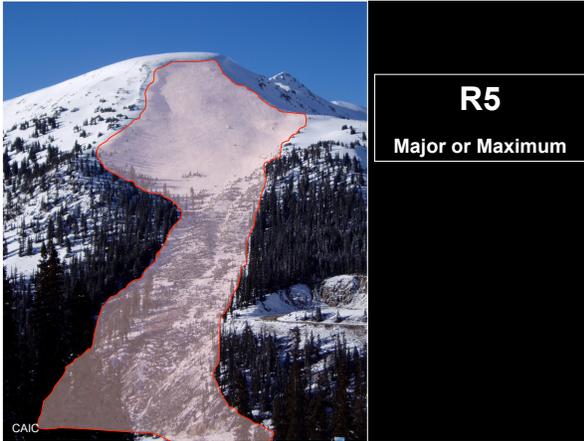
Size - Relative to the Path

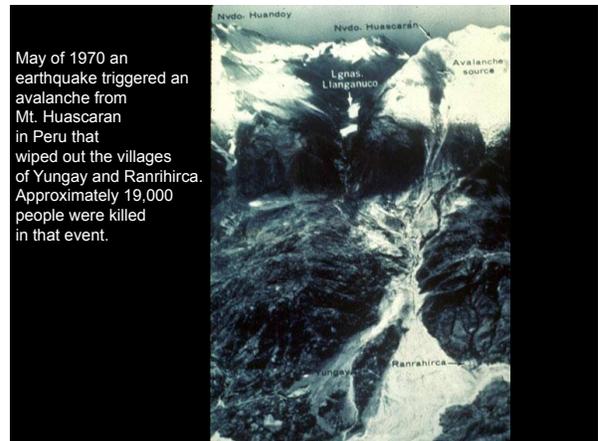
Accounts for:

- Horizontal Extent
- Vertical Depth of Fracture
- Volume
- Runout Distance

CAIC







Terrain

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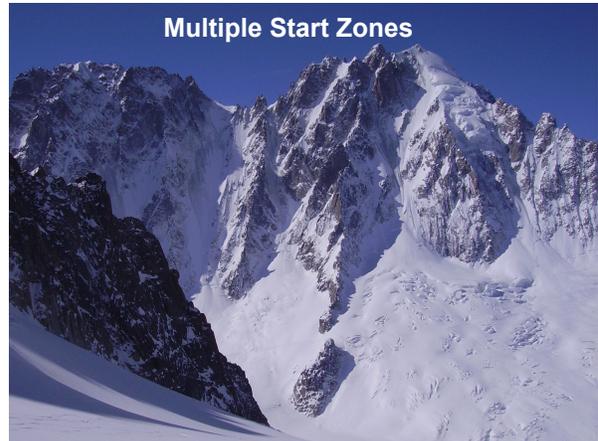
Recognizing Terrain
And
Seeing the Hazard

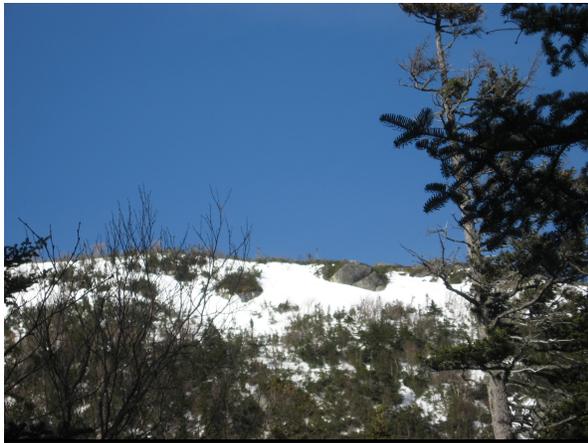
L. Kennen

“Classic” Avalanche Path

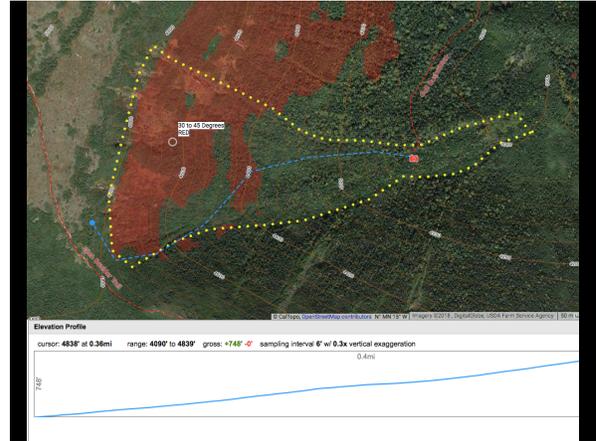
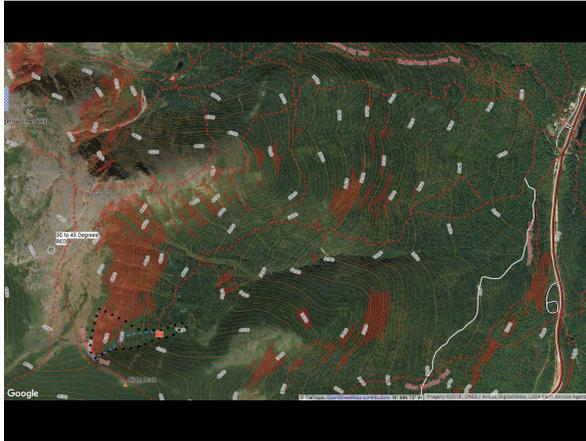


Multiple Start Zones





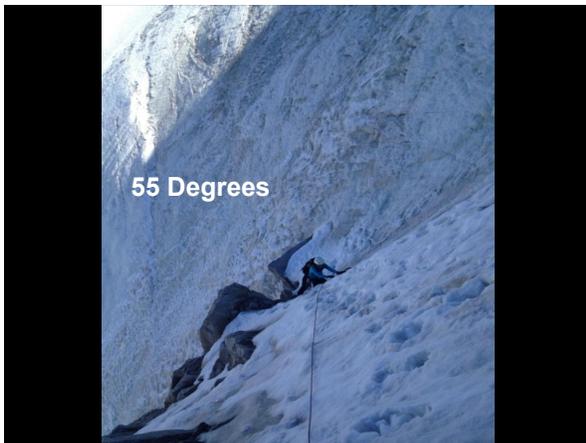


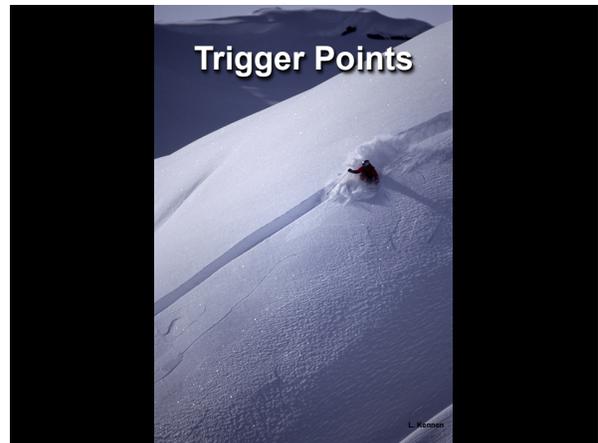


Start Zone Angle

- 0° – 25° Infrequent wet snow avalanches and slush flows. ●
- 25° – 30° Infrequent slabs in unstable conditions. Those that do occur tend to be large. ●
- 30° – 35° Slabs in very unstable conditions. ◆
- 35° – 45° Slab avalanches of all sizes and with most frequency. ◆◆
- 45° - 55° Frequent smaller slabs and sluffs. ⊘
- 55° - 90° Avalanches are rare. Frequent sluffs reduce slabs.





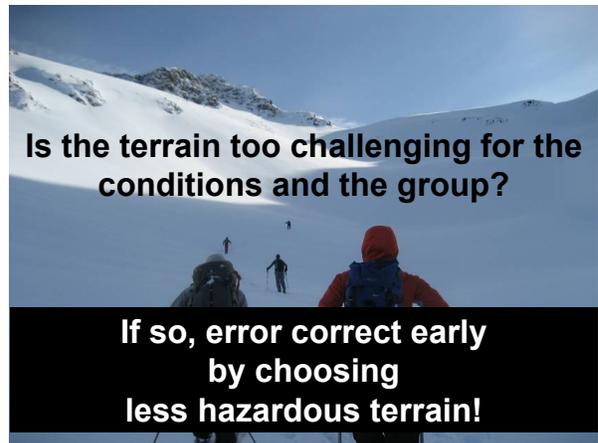


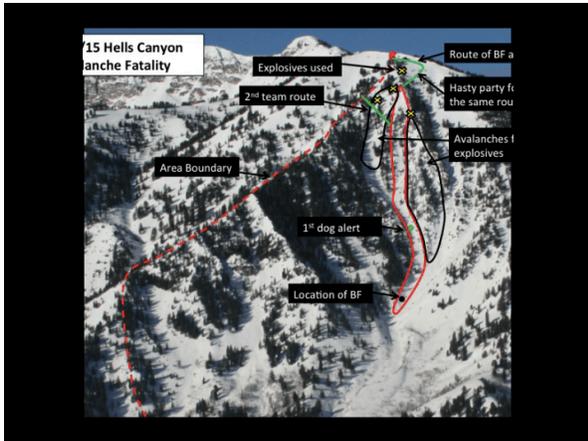
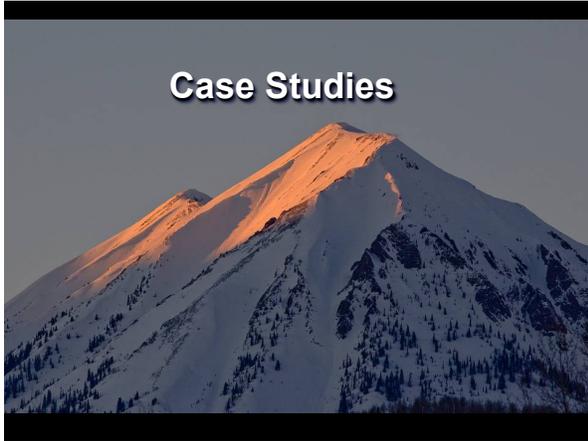


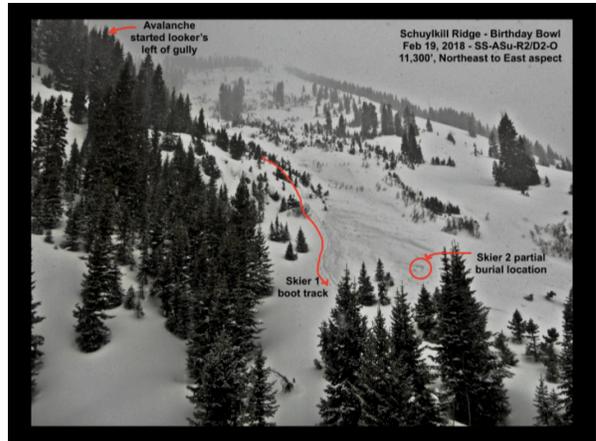
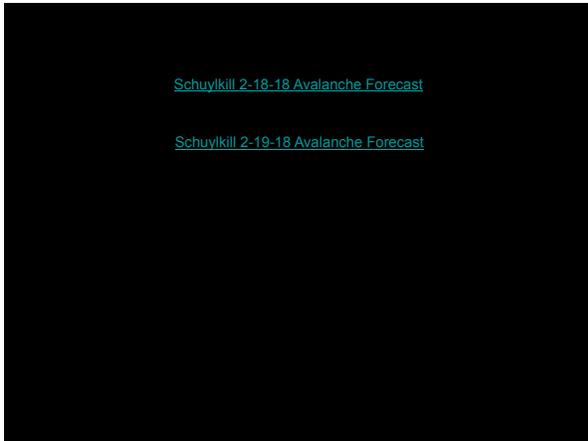
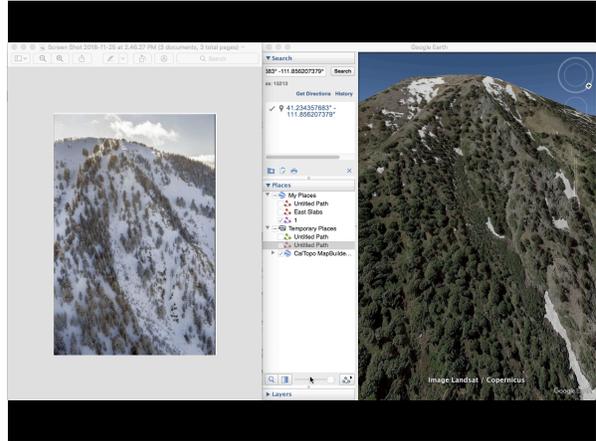


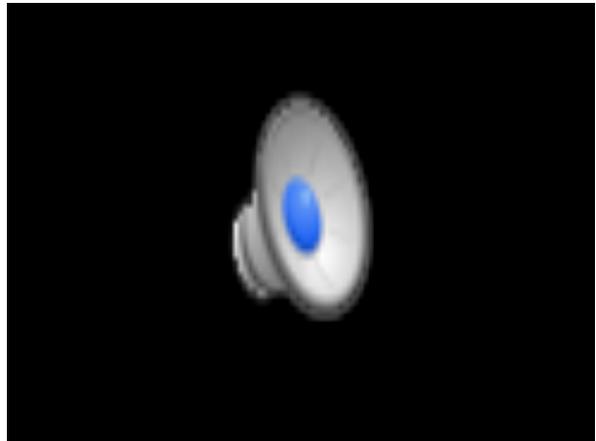
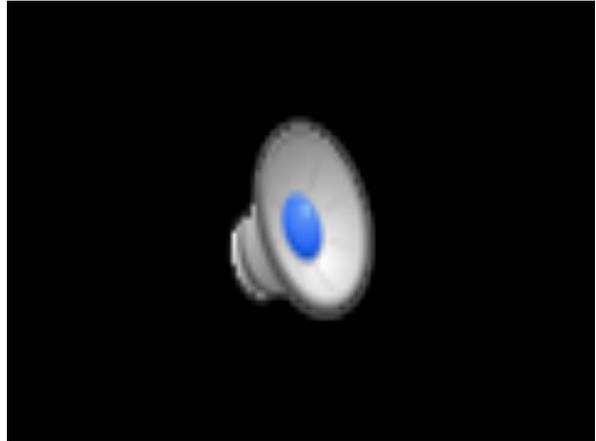
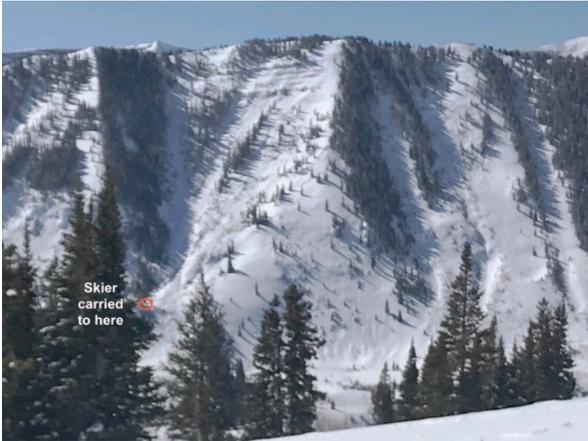












Avalanche Triggers

Common Natural Triggers

- New Snow
- Wind Driven Snow
- Cornice Fall
- Temperature Changes
- Thawing
- Sun
- Rain

Avalanche Triggers

Common Human Triggers

- Skiing
- Snowboarding
- Snowmobiling
- Explosives

Observe

- Weather
- Snow
- Avalanche Activity

Observe Weather



Weather

1. Builds or creates the snowpack layers
2. Triggers avalanches
3. Limits visibility
4. Stresses YOU physically and mentally

Weather

When was the last storm of 1 foot or more?

What is the precipitation type and rate

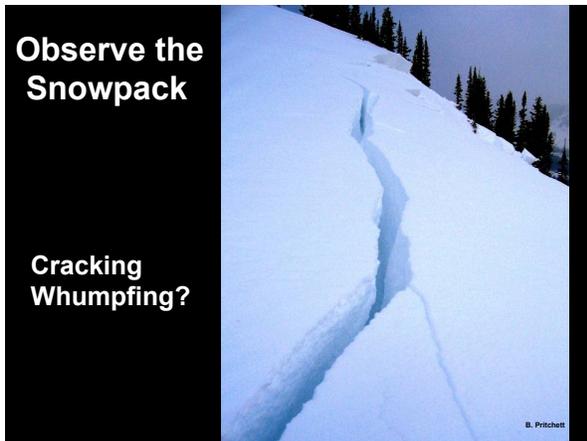
Weather

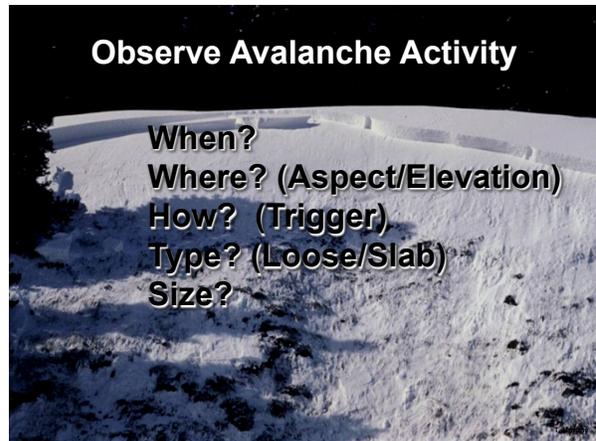
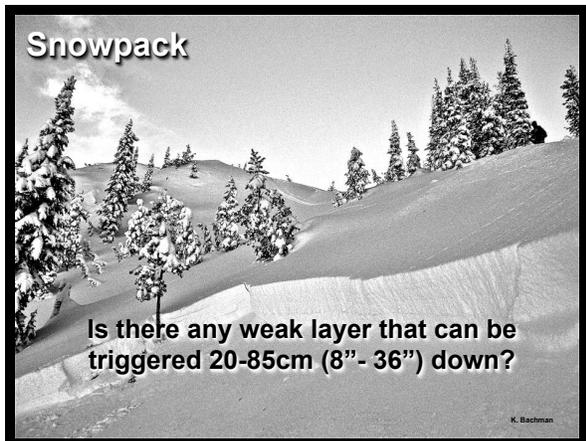
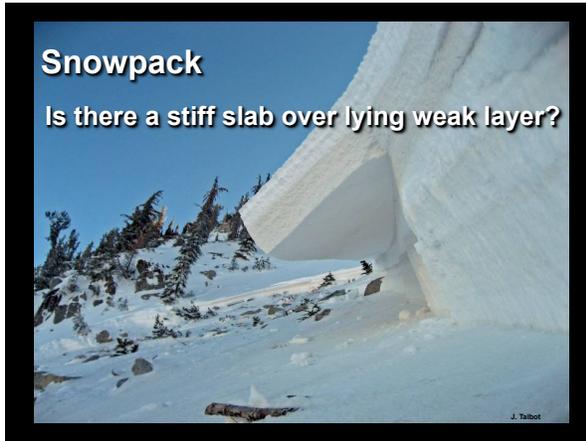
Rain

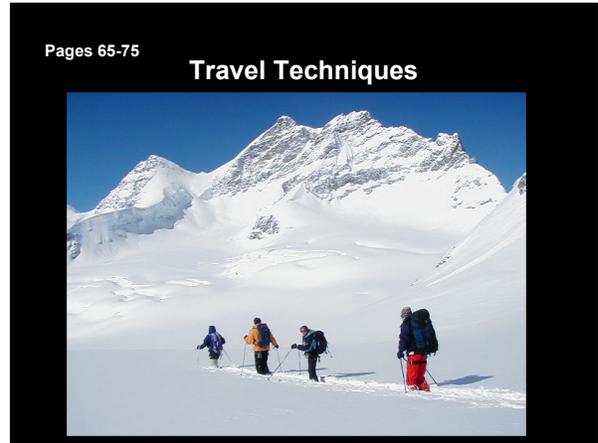
K. Fitch

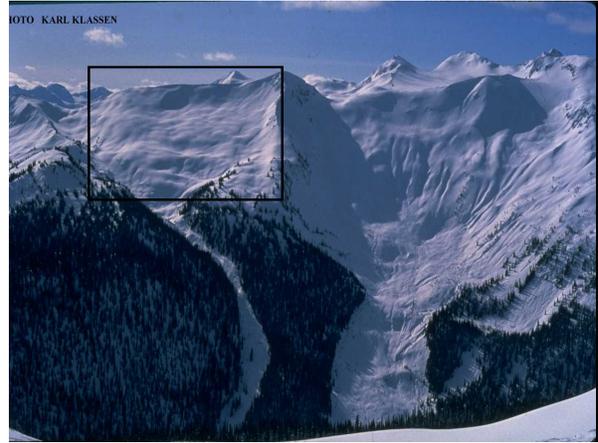
Weather

Blowing Snow











American Institute for
Avalanche Research and Education

Group Management Principles

- Do not travel alone
- Stay in contact
- Keep in touch
- Adjust pace to the slowest person
- Maintain pace
- Take breaks
- Communicate clearly



DECISION MAKING & BIAS

Implicit Bias

The bias in judgment and/or behavior that results from subtle cognitive processes that often operate at a level below conscious awareness and without intentional control.



Analysis of Your Situation

- When
- Why
- How
- Where

Decision Making & Bias

When

Time of year

- Early season/shallow snow pack
- Mid-winter moderate thickness cold snow pack
- Late season mature warm snow pack

Did the plan get hatched

- Long range based on your schedule
- Short-term based on conditions
- Spontaneous

Decision Making & Bias

Why

- Day off
- Vacation
- I need to get away
- Friends asked me, why not
- Good conditions, work can wait

Decision Making & Bias

How

- Short drive
- Long drive
- Pretty far I need to stay over
- Flying
- Long hike

Decision Making & Bias

Where

- Mini Golf
ski trail no avalanche hazard
- Simple Terrain
some avalanche terrain but small and not very hazardous
- Challenging Terrain
you'll be in it but the paths are distinct, not overly steep, consequences can be fatal but there are lower hazard options nearby
- Complex Terrain
big terrain with multiple overlapping paths, big consequences and limited options for safer travel

Decision Making & Bias

Your Knowledge Base

- Area
- Weather
- Snow
- Movement Skills

Decision Making & Bias

Area

- Know it well I've been there in every season and have skied it frequently
- Have some experience with the area I've been there but it's still new
- Never Been there but I've studied maps and guidebooks extensively and have GPS coordinates etc.
- What's the name of the place, could you send me a pin for the trailhead?

Decision Making & Bias

Weather

- I'm a meteorologist
- I've look at mountain forecasts, weather maps of the appropriate elevations/MB, lapse rate and remote observation sites that include temperature, precipitation and wind.
- I've got a weather app on my phone and I have been looking at the area's current conditions and forecast for the last couple of days.
- On the drive up I heard a forecast while I was listening to the alternative rock station

Decision Making & Bias

Snow

- I'm a forecaster
- I've been following the avalanche forecast throughout the season watching trends and have a pretty good picture of how the snowpack has been formed and metamorphosing.
- I've been reading the forecast the last three days and I understand it pretty well.
- I'm going to read it when I get to the area.

Decision Making & Risk

Movement skill

- Expert skier and in good cardio shape
- Expert skier but I've been taking lifts a lot lately
- I win running races in my age group but I'm just an OK skier but new to the backcountry
- I can hike OK but like to take my time new to this outdoor stuff
- I get winded going up stairs and haven't skied since college



Group Skill and Composition

Group Skill and Composition

- All professional
- Strong group with a good solid equivalent skill base 3 to 5 people
- Mixed group of good friends 3-5 people
- Mixed group of strangers or small group of friends in a larger group of people (meet-up)
- Organized club group with distinct leaders
- Guided group with 1 person under contract to be in charge.



Common Errors

Easy or Hard Access What is Your Commitment

- I spent a long time/money to get here so I need to ski
- I just left the ski area so it must be safe.
- This is the only way down without going back up.

Common Errors

Losing Focus on the Decision Making Process

- Having way too much fun
- Weather conditions are uncomfortable. It's cold, windy and/or wet; *let's get going.*

Common Errors

Negative Feedback Loop

- Yesterday we skied conservatively and nothing happened so we can notch it up today.
- The bad conditions have been around awhile and there haven't been any avalanche accidents it must be better than we think.
- Long Term: I've never been caught in an avalanche so I make good decisions.

Common Errors

Group Dynamics

- Mismatched in skill.
- Disorganized
- Poor communication/strangers thrown together.
- Splitting up unwittingly or without good planning.

Common Errors

Terrain Miscalculation

- Familiarity (breeds contempt?)
- Too difficult for the group or one person in the group.
- Good snow or hero snow making the terrain seem lower angled than it really is.
- Not seeing the severity of the consequences, confined runout zones are hard to see or trees/rocks that look to far away to hit.

Common Errors

Expert Halo

- Deferring safety to a leader without really knowing that leader's true skill.
- Not speaking up due to shyness or discomfort even though you may know more about the current situation.
- Thinking someone else is thinking through decision when in reality everyone is "following".

Common Errors

Information Overload Confirmation Bias

- If you want to see good conditions you will find evidence to support that wish.
- Reported good conditions or forecasts can keep you from seeing reality if they are wrong.
- Using fancy words, concept and processes to justify a bad decision or find and focus on a positive sign.

Common Errors

Losing Focus on Changing Weather Conditions that are Stressing the Snow

- Weather is getting good this is sweet (too warm?)
- Snow is falling I'm getting wet, *let's get going.*
- Slope is going into the shade and it's getting late, *let's get going.*

Common Errors

Underestimating the Uncertainty

- When I first started I was confused and scared
- The more I learned I felt like I had a handle on the hazard and was confident about my decisions
- The more experienced I got after my courses I became more conservative, unsure and concerned.



Assessing the Risk

What Factors Affect Your Ability to Assess the Risk?

Snow

- Early Season
- Shallow

Weather

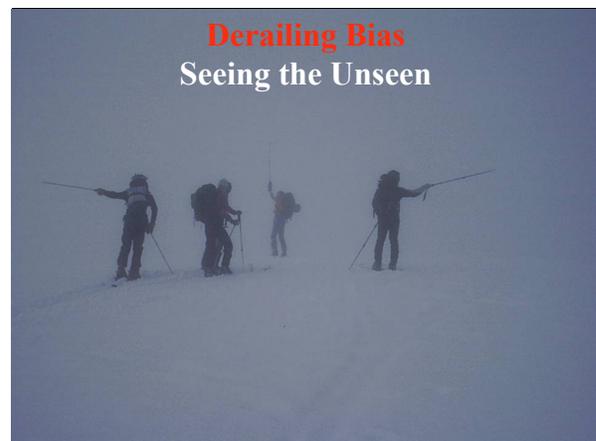
- Visibility
- Cold or Wind

Group

- Large (difficult to communicate)
- Not cohesive (communication, organization)
- No leadership (too much expertise, not enough expertise, expertise not taking charge)
- Just feels disorganized/dysfunctional
- Competition vibe

Motivation

- Are you being blinded by the investment in time or money to get where you are and damn it you're going to ski? Want to show a friend or partner a good time?



Detailing Bias

Know You Are Bias

- Be introspective
- Understand your situation and how that can effect how you see things.

Detailing Bias

Debrief the Trip

- In risky situations, not all good decision lead to good outcomes, and not all bad decisions lead to bad outcomes.
- Could things have been done better?
- Did you get away with something?
- Use your previous debriefings to recognize current potential poor decisions before you carry them out. Try not to repeat mistakes. Have I been in a situation like this before? When I debriefed it what did I say I should have done?

Detailing Bias

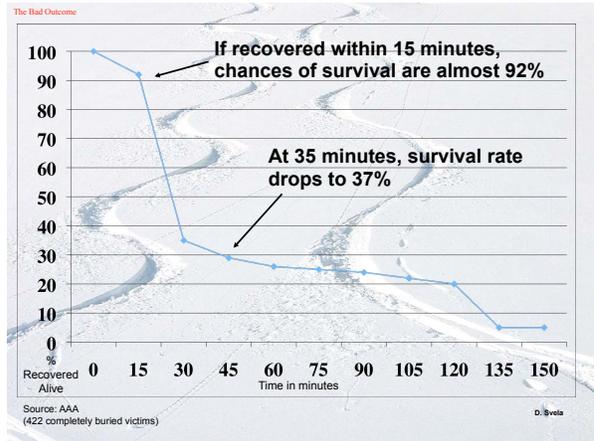
Pre-mortem

Imagine how the accident report that describes the situation you are in would sound if an accident did occur. Write it in your head, give yourself the 20/20 hindsight by projecting yourself into the future where a bad outcome has already occurred.



No Time To Waste

If you survive the fall but end up buried you have 15 minutes — for your friends to find you and dig you out!



The Gear Is Not Enough

- Training in rescue is critical
- Practicing beacon search is not rescue training
- Modern beacons are easy, rescue is hard!!!!

The Bad Outcome

You Cannot Rescue Someone that Does
Not Survive the Fall or that is Buried
More Than 6 Feet Deep

The Bad Outcome

“Of course you’ll hurt me. But this is the very condition of
existence. To become spring, means accepting the risk of
winter. To become present, means accepting the risk of
absence.”

— [Antoine de Saint-Exupéry](#)