

Avalanche Awareness



Central Canadian Rockies, SG



Northern U.S. Rockies, SG

Spencer Gray
Yale Winter School

Overview + Disclaimer

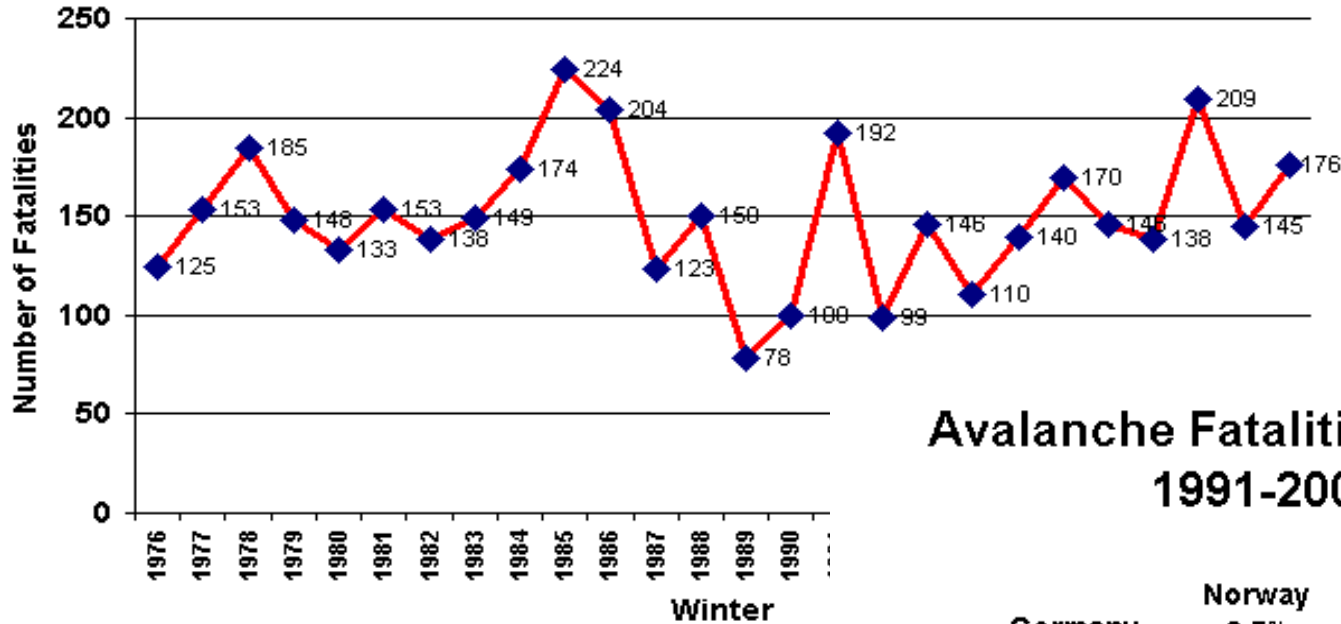
This is a very brief introduction

Learn more:

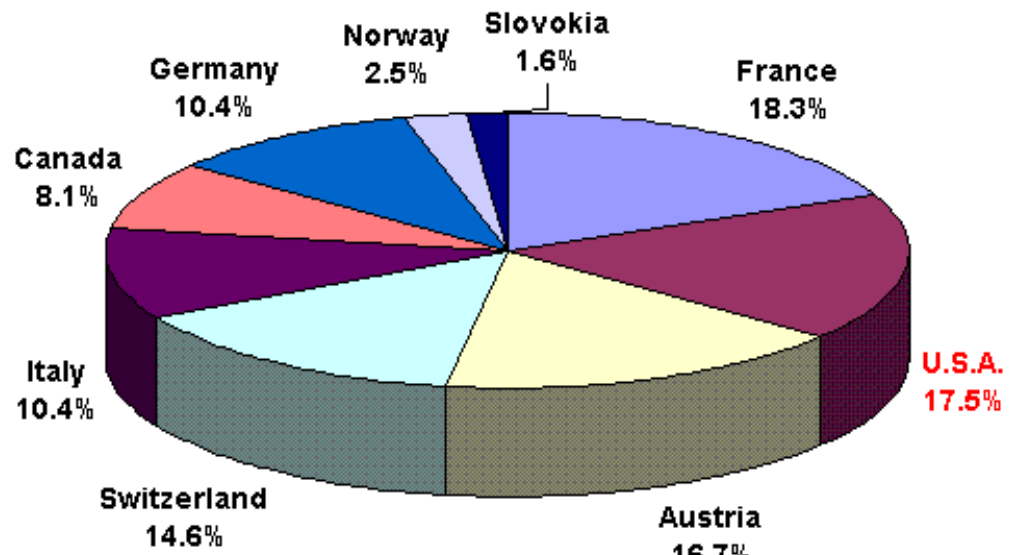
- Take an Avalanche Level I Course
- Read books
- Travel with experienced partners

Scary Statistics

Avalanche Fatalities in IKAR Countries 1976-2001



Avalanche Fatalities by IKAR Country - 1991-2001 (N=1477)



Cause of death:

- ~Two-thirds: asphyxiation
- One quarter: trauma

www.avalanche.org

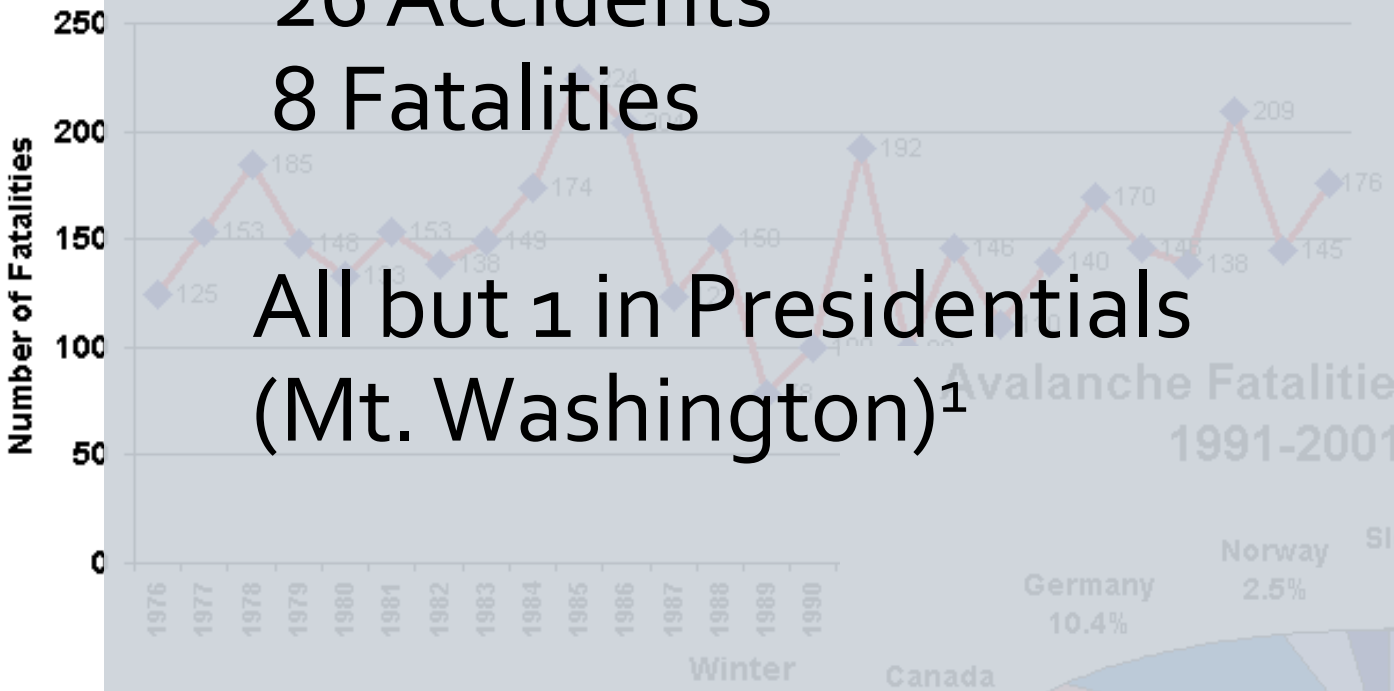
Avalanche Fatalities in IKAR Countries 1976-2001

New Hampshire (1990-2008)

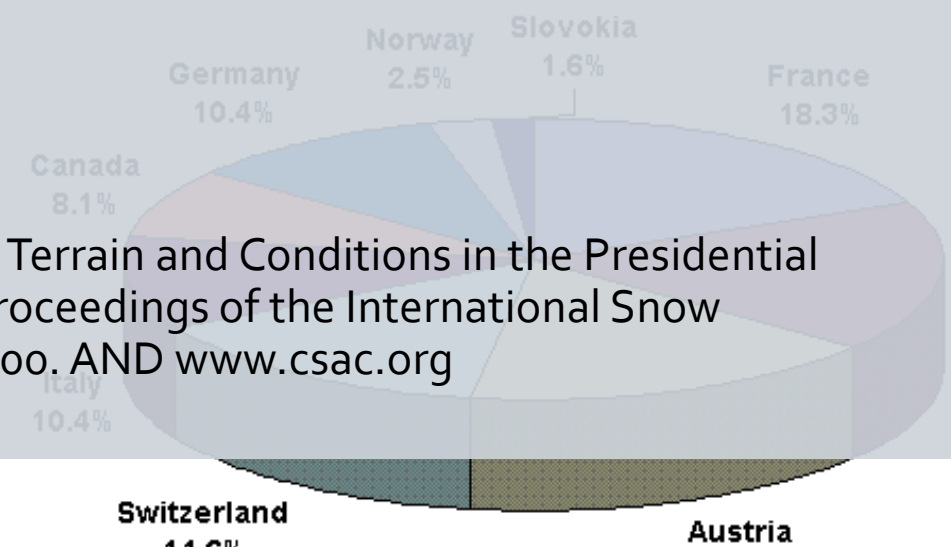
26 Accidents

8 Fatalities

All but 1 in Presidentials
(Mt. Washington)¹



Avalanche Fatalities by IKAR Country - 1991-2001 (N=1477)

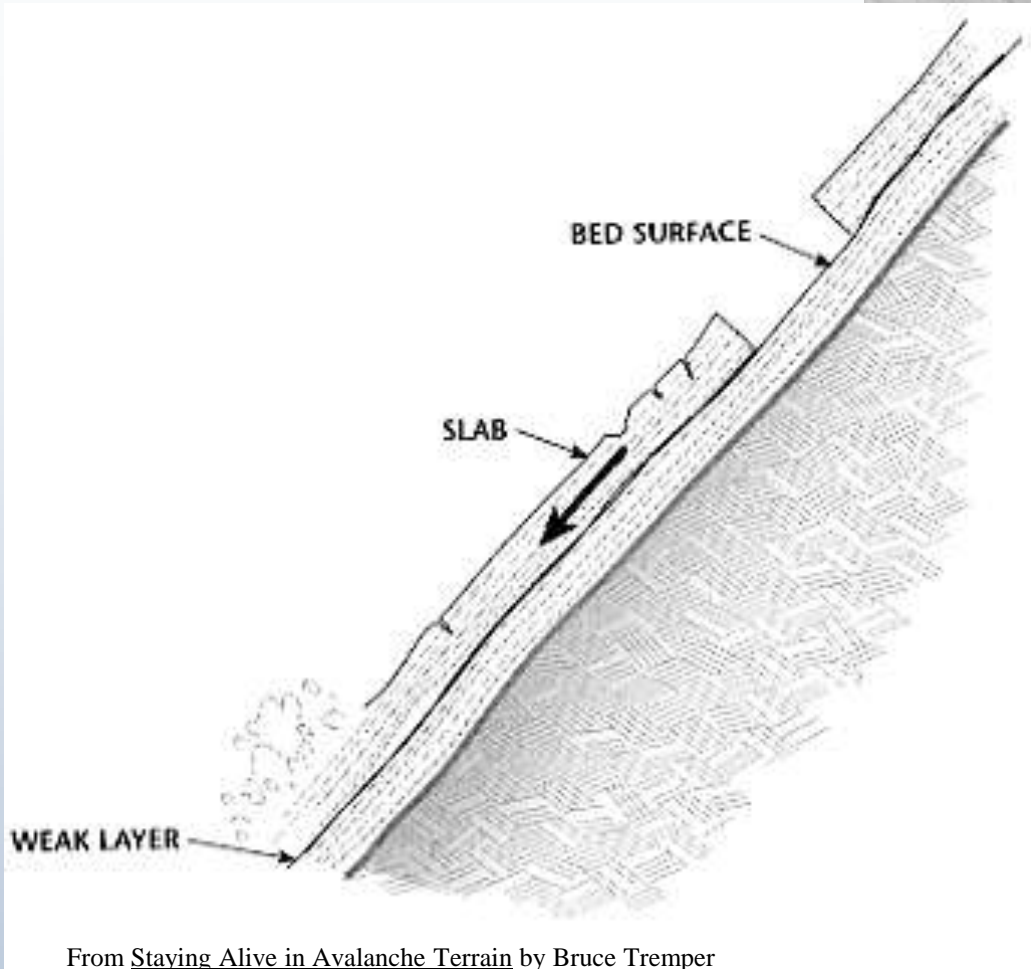
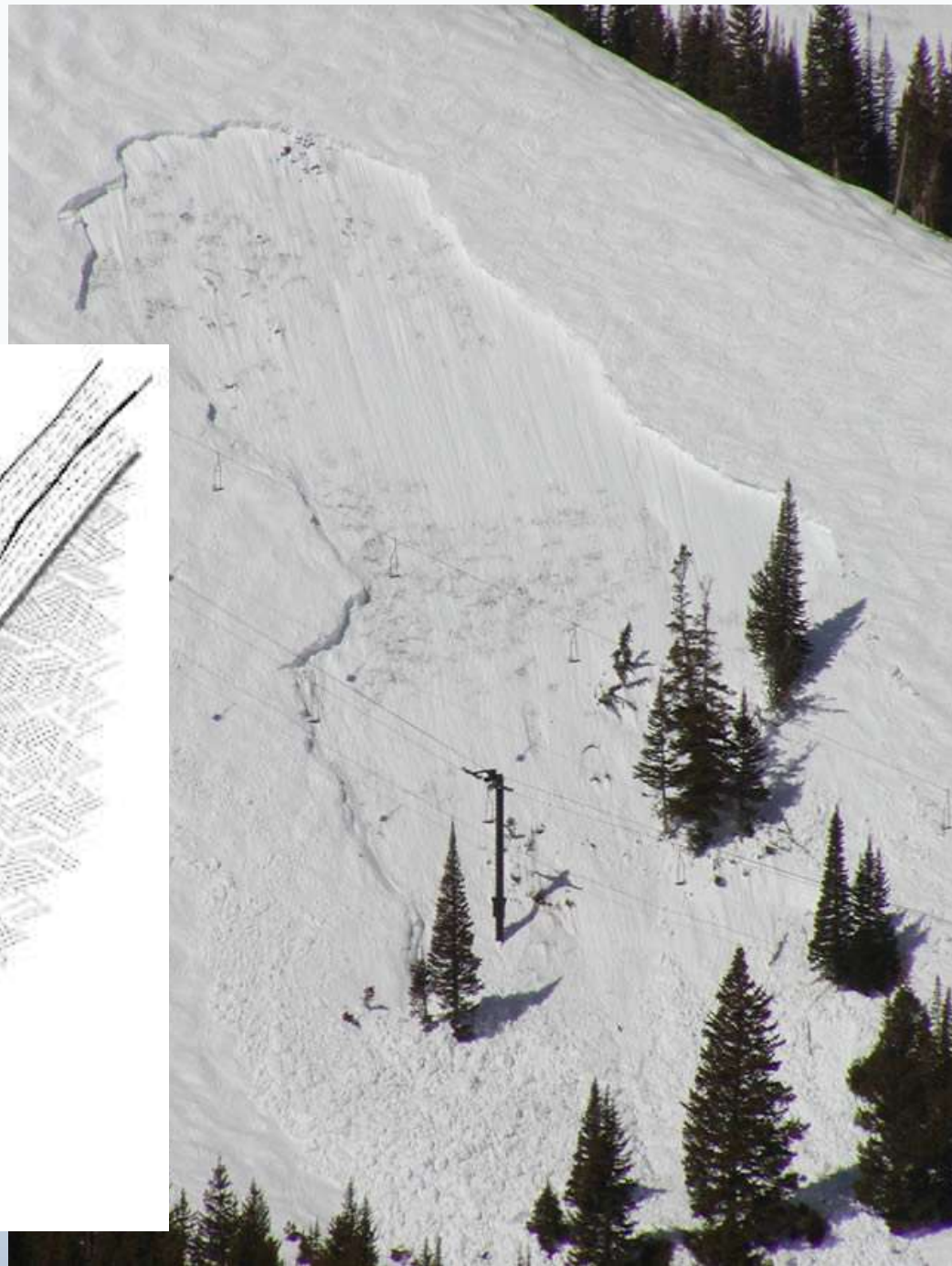


¹Allen, K. U. (2000). Avalanche Terrain and Conditions in the Presidential Range, New Hampshire, US. Proceedings of the International Snow Science Workshop, October 2000. AND www.csac.org

What is an avalanche?

- Mass of ice and snow that breaks from the side of a mountain and slides downward
 - Dry slabs: 60-80 mph in 5 sec
- WHY??
 - Always the same mechanics:
gravity overcomes friction
- Consider slope instability outside of winter
- **Avalanche Eyeballs**

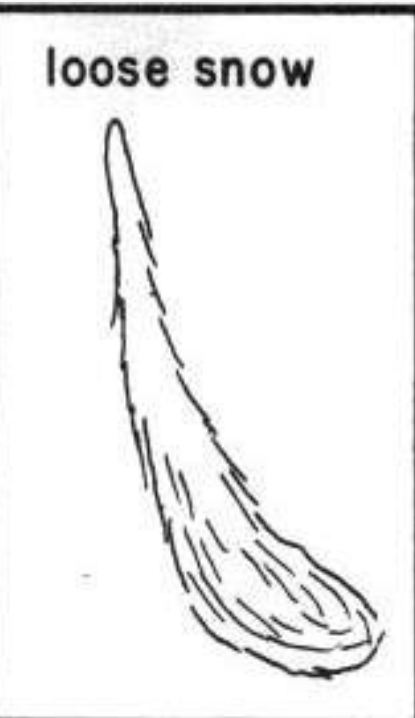
Types: Slab



From [Staying Alive in Avalanche Terrain](#) by Bruce Tremper

In-bounds slide at Park City, From www.avalanche.org

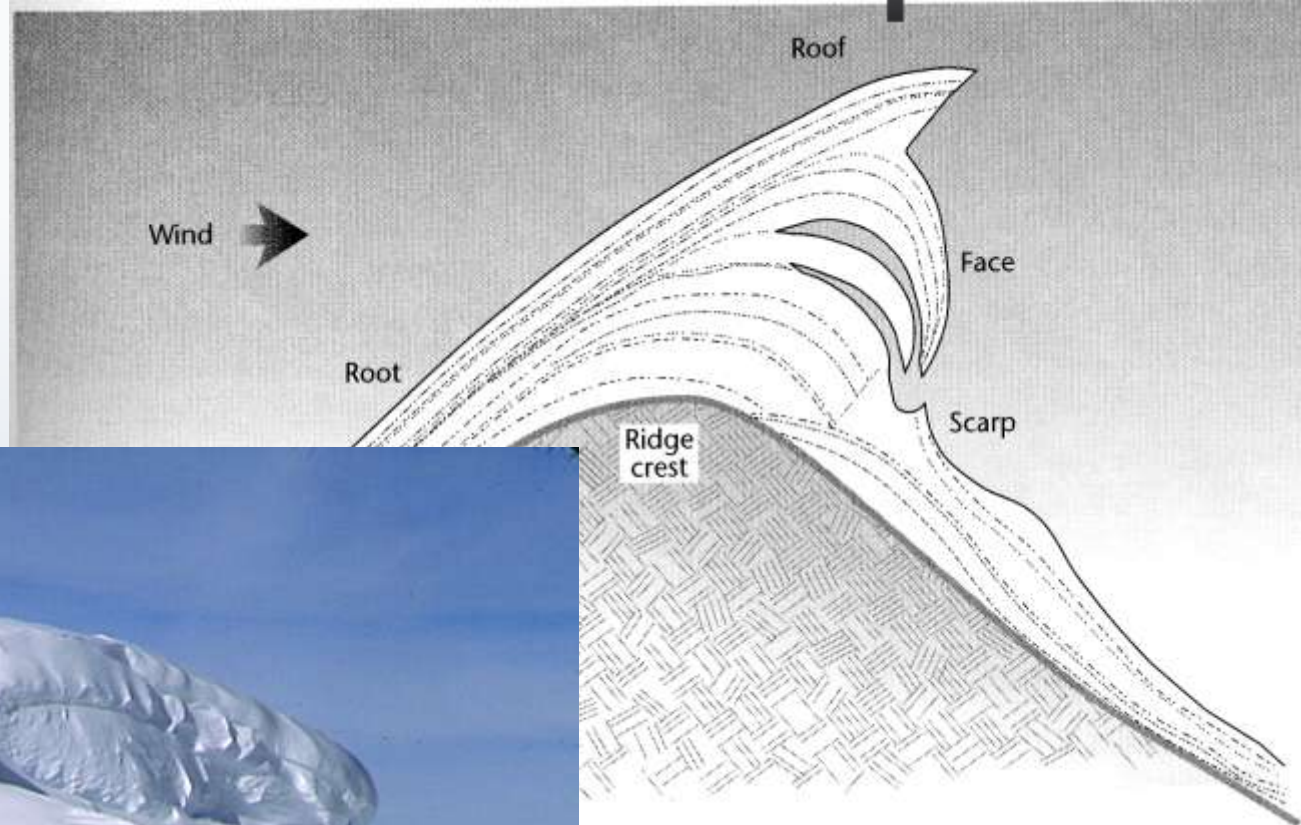
Types: Loose Snow



From www.avalanche.org

Photo by Bryan Palminier

Types: Cornice Collapse



From [Staying Alive in Avalanche Terrain](#) by Bruce Tremper



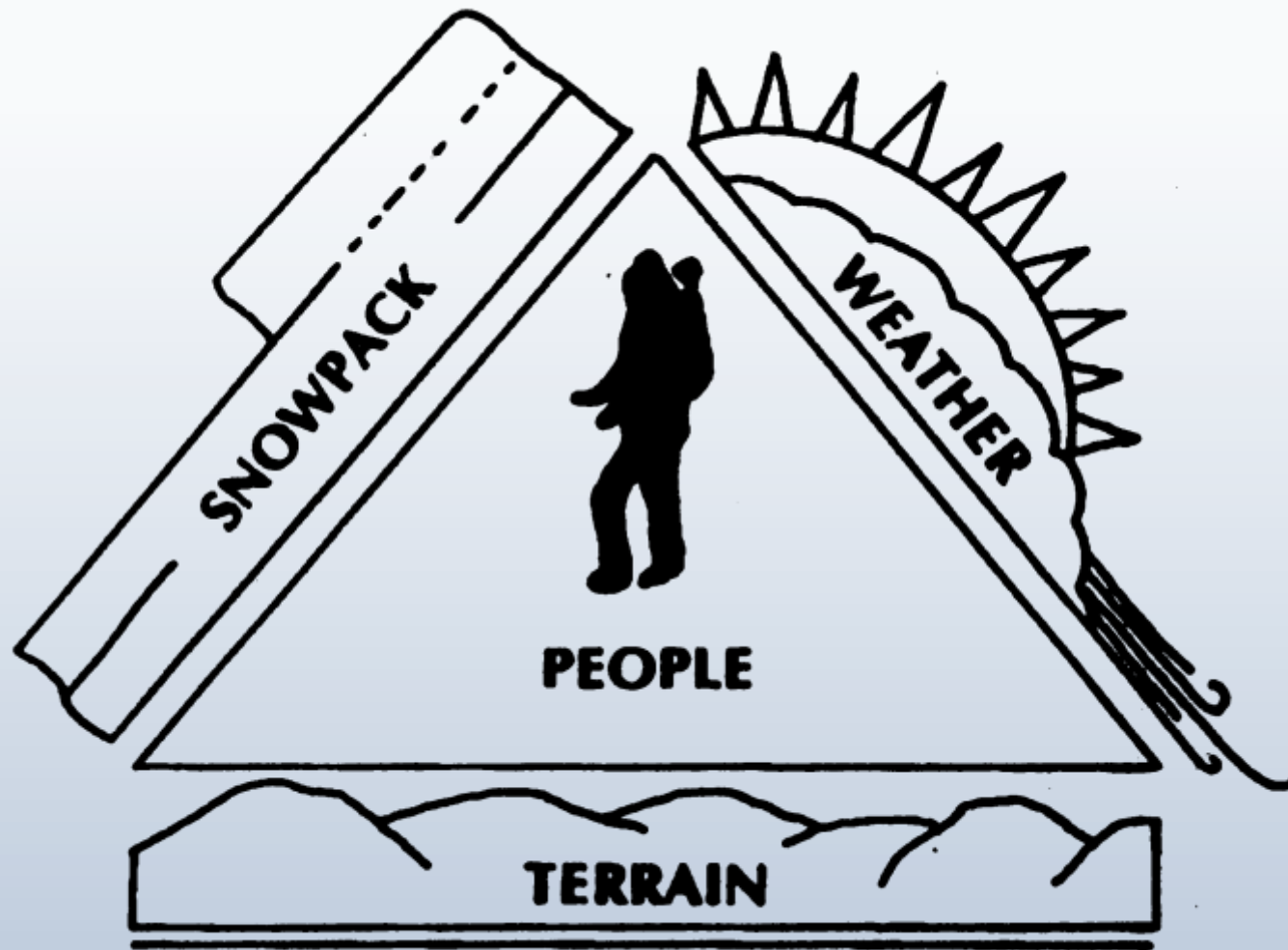
Mt Assiniboine, Canada, Spencer Gray



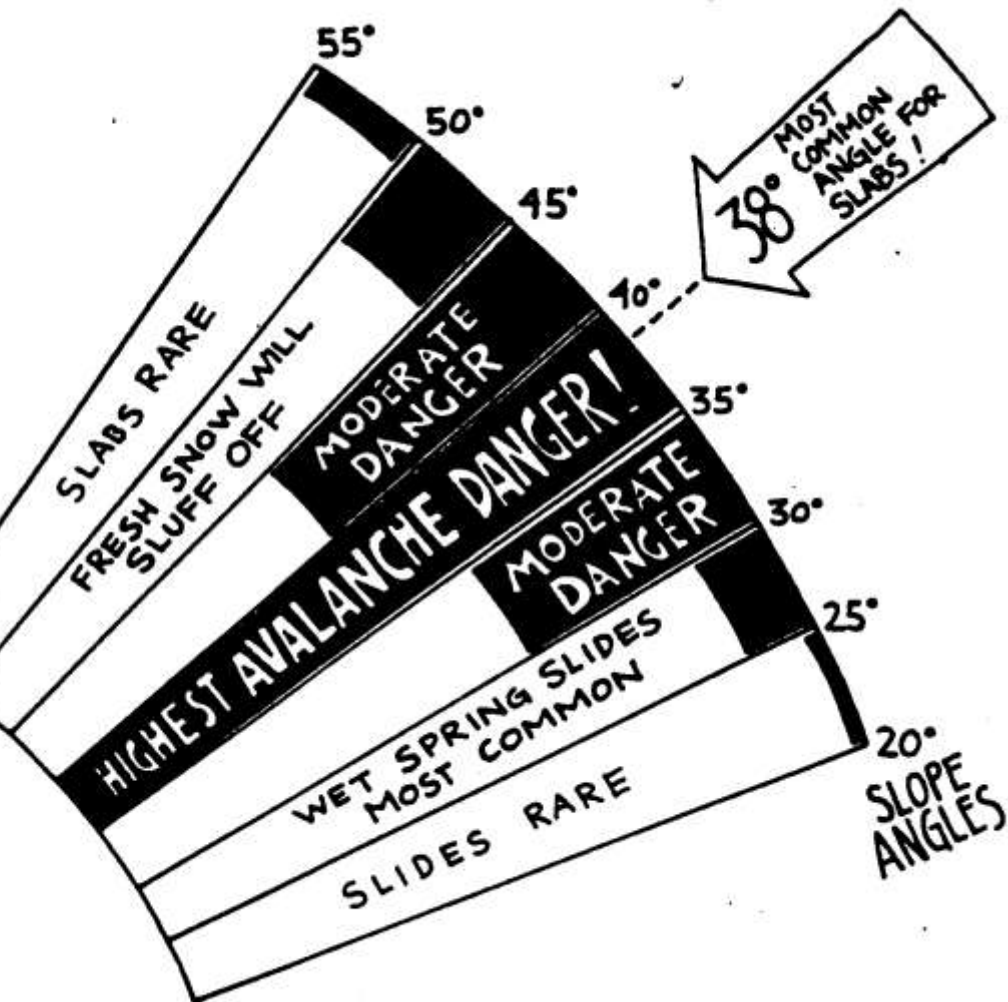




The Avalanche Triangle

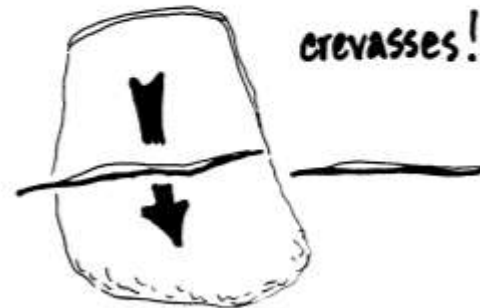


Terrain

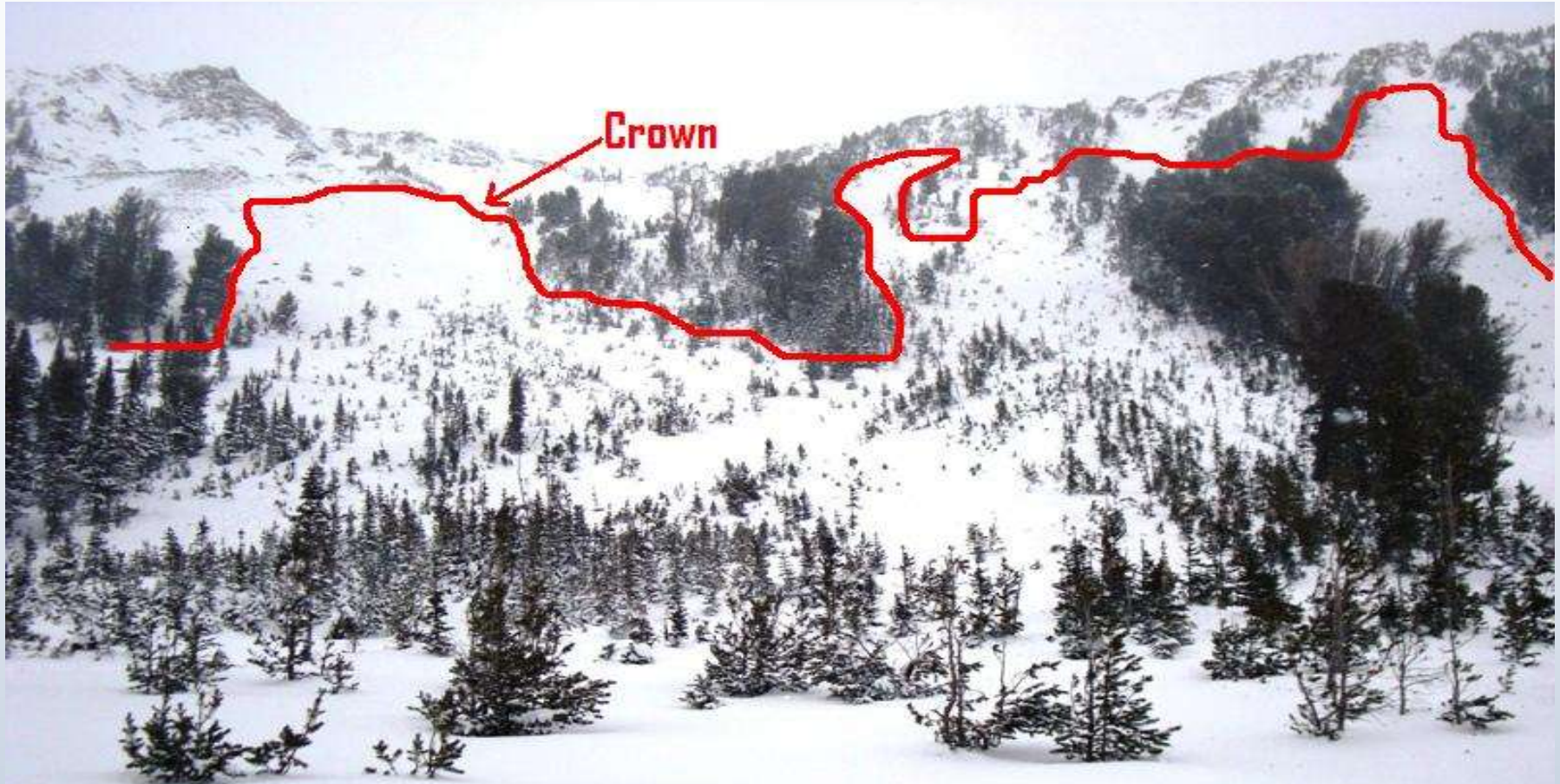


TERRAIN

TRAPS!



What is the slope connected to?



SCOTCH BONNET
December 21, 2008

Yellowstone backcountry, Montana, Gallatin
NF Avalanche Ctr

Runout?

- **Alpha angle:** you want this or smaller!
- Climatic differences:
 - Maritime: 23-25 degrees
 - Intermountain: 20-23 degrees
 - Continental: 19-22 degrees

Aspect + other clues

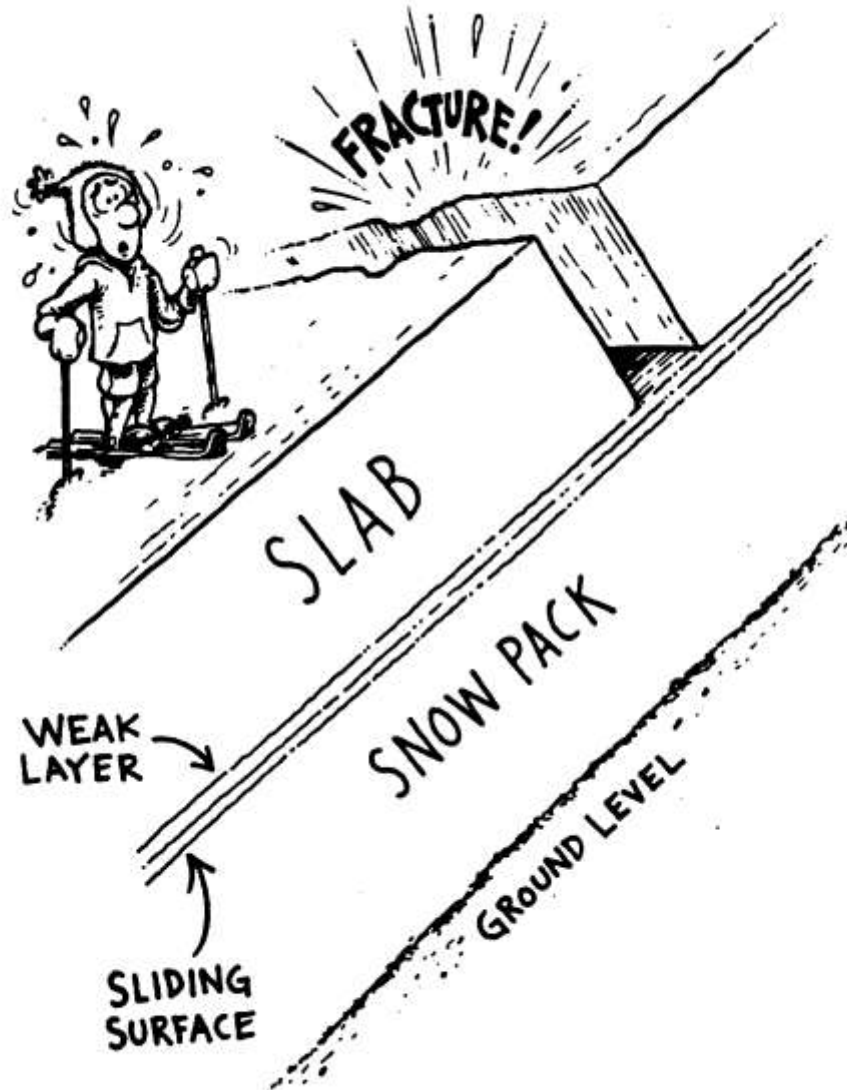
- Hemisphere and latitude *matter*
 - North vs South vs East vs West
- Vegetation clues
- Anchors
- Wind deposition





Yellowstone backcountry, Spencer Gray

Snowpack



Strong layer:

- Propagate

Weak Layer:

- Poorly bonded
- Low density

Bed Surface:

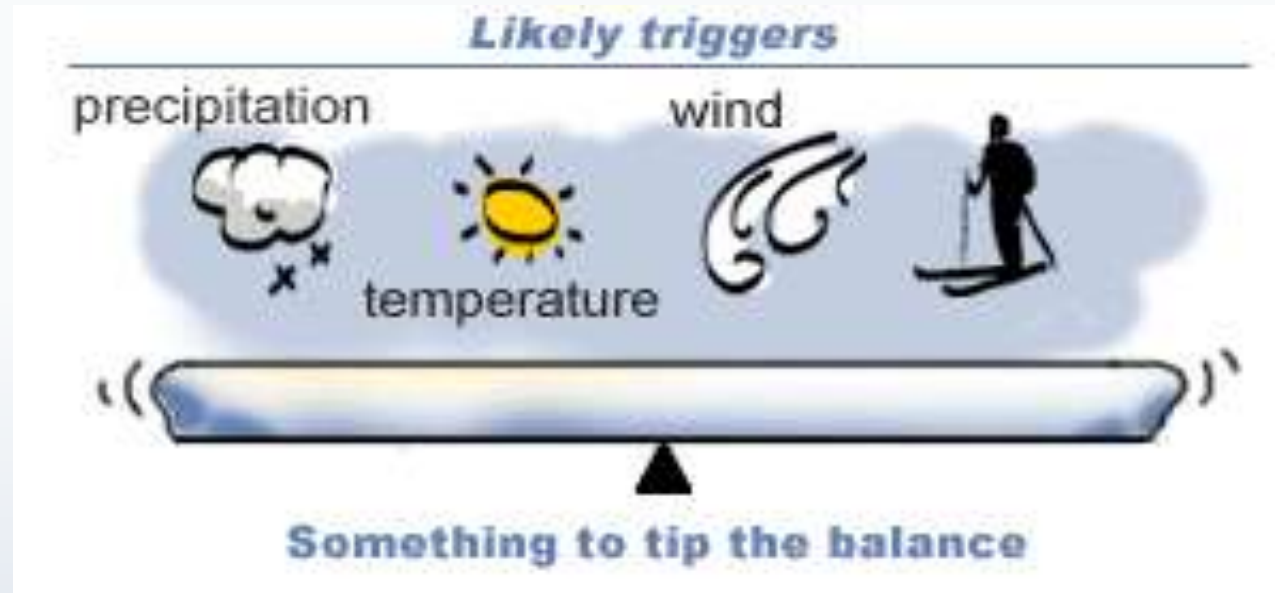
- Crust: wind, sun, rain, old
- Ground

Weak Layers

- Lots to say about different weak layers
- Important factor within snowpack:
temperature gradient
 - Becomes a **vapor gradient**
 - Critical: 1 deg. C / 10 cm
- But much less important than loading
- Example: Rockies snowpack Christmas 2008

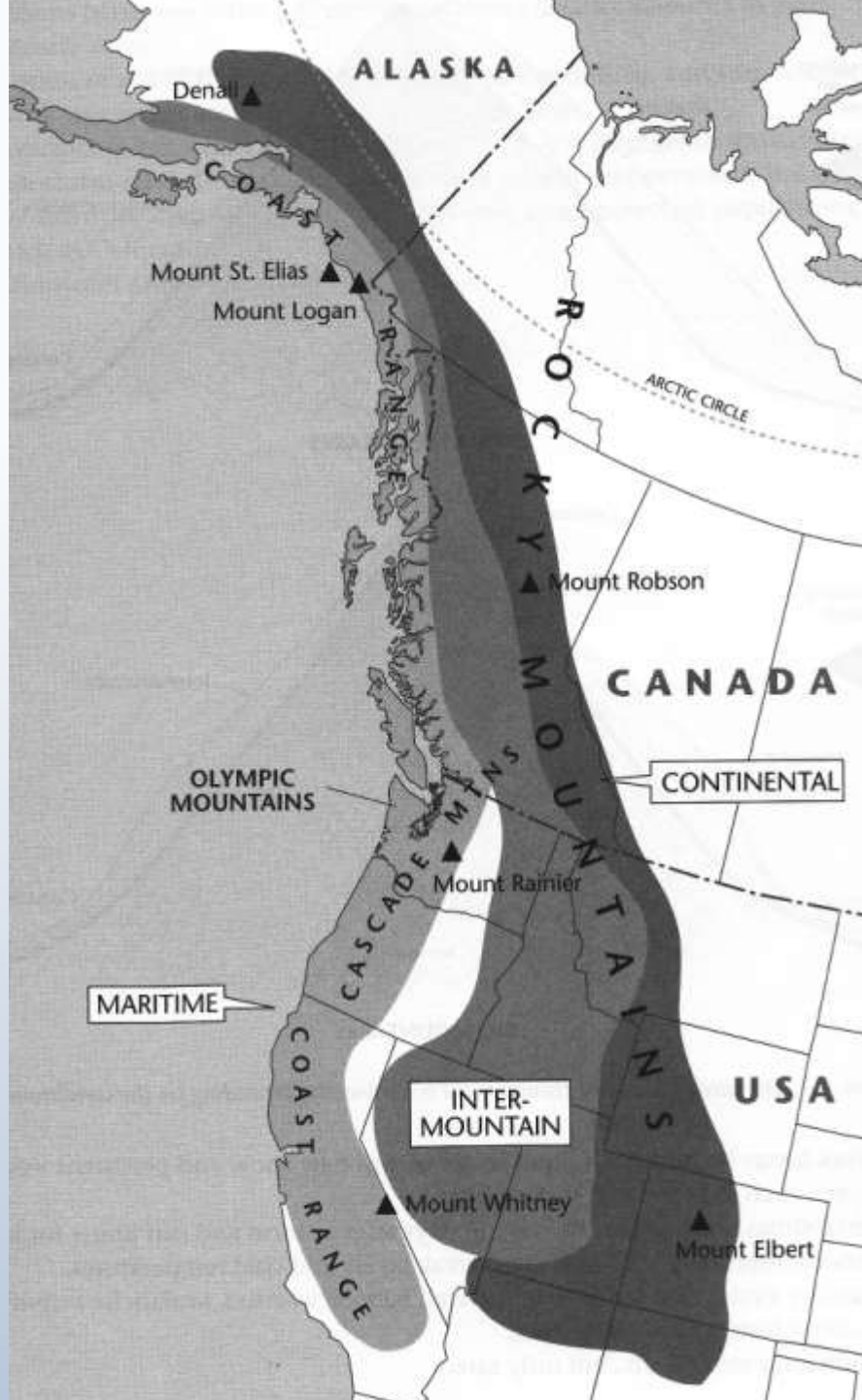


Weather



Danger:

- During or within 24hr of **storm**
- Snow: **>1in/hr**, **>12in** total
- **Wind** can move snow very rapidly
- Rain
- **Upside down storms**



From Staying Alive in Avalanche Terrain by Bruce Tremper

Human Factor

Primary Factor in **80% of Fatal Accidents**²

- Group dynamics
- Objective evaluation
- Decision making

	Red - Danger, hazard exists	Yellow - uncertain	Green - OK, no hazard exists
			
Terrain <i>Is the terrain capable of producing an avalanche?</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Snowpack <i>Is the snowpack unstable?</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Weather <i>Is the weather contributing to instability?</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Human <i>What are the alternatives and possible consequences?</i>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

²Accidents with known causes 1990-2000, Atkins (2000), International Snow Science Workshop 2000 reproduced in Tremper (2001), *Staying Alive in Avalanche Terrain*

Avalanche Report

	Low	Moderate	Considerable	High	Extreme
Natural	Very Unlikely	Unlikely	Possible	Likely	Certain
Human	Unlikely	Possible	Probable	Likely	Certain

Avalanche Advisory for Tuckerman and Huntington Ravines

Posted: 8:22 a.m., Thursday, February 12, 2009

Tuckerman and Huntington Ravines have HIGH avalanche danger. Natural and human triggered avalanches are likely on a variety of slope angles and aspects. Travel in avalanche terrain is not recommended.

The mountain gods are in the process of fully depressing the stability reset button by delivering several waves of rain to our hills. 24 hours from now this morning's current snowpack should be quite consolidated and stable as it solidifies from the surface down. However, snow returning this afternoon will present some emerging stability problems later in the day, as well as cover some of the ugliness of this brief mid-winter thaw and give the mountain a fresh look.

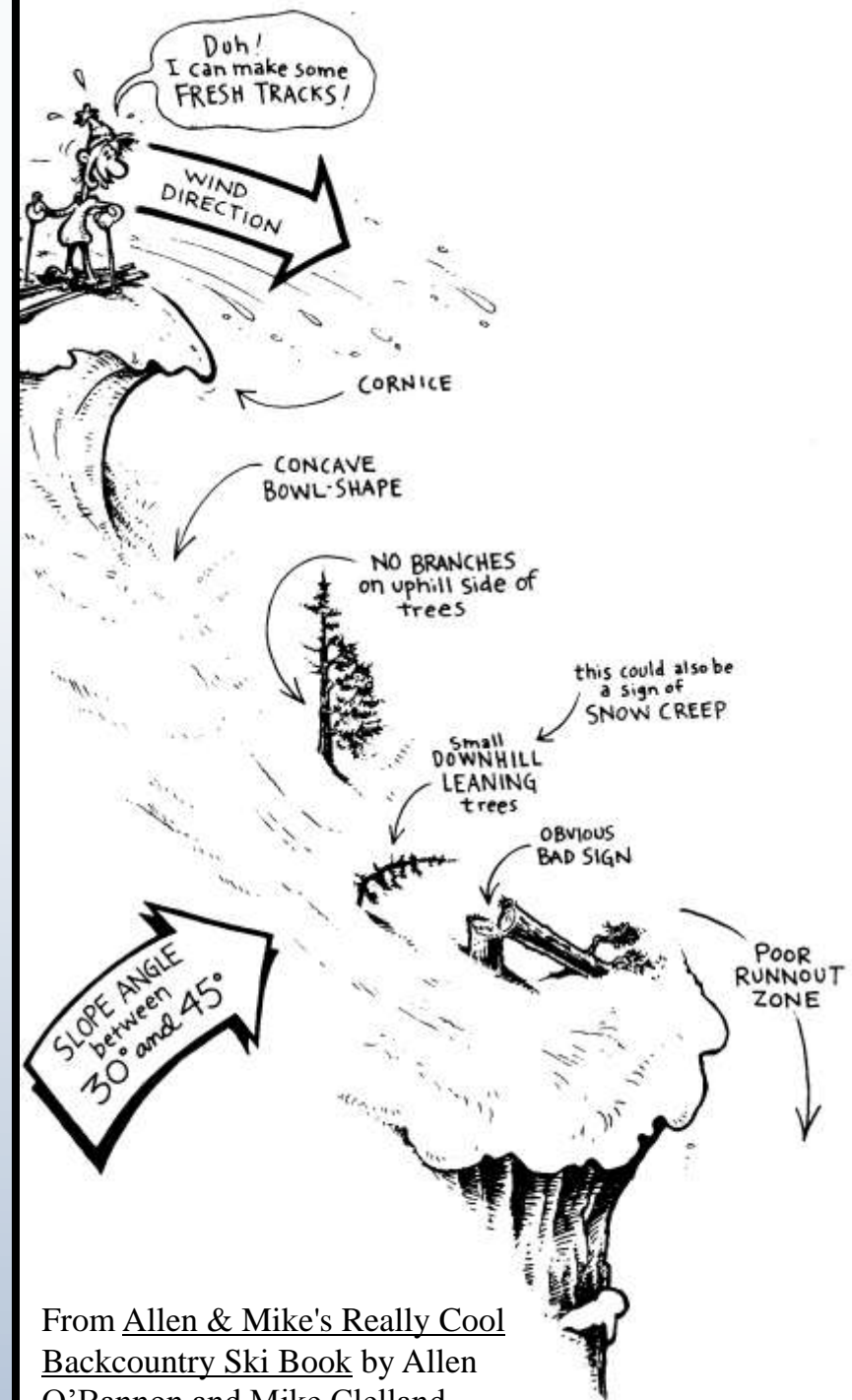
The summit has received 0.36" (0.9cm) of rain so far with more showers anticipated to be heavy at times this morning. The snowpack should be stressed with a total between 0.6" and 0.7" (1.5-1.75cm) of rain before frozen precipitation returns this afternoon. This amount of rain, and free water from the melted snow during yesterday's very warm temperatures, is sending a lot of liquid down into the snowpack. The water is adding weight, melting existing snow bonds, and looking for an impermeable layer to lubricate such as buried blue water ice. This is the first shot of rain and warm weather we have seen in a long time so we have an elevated concern about the ability for the current snowpack to handle it versus failing in the form of avalanches. The amount of rain and the intensity we expect later this morning has us all in agreement that a High rating is warranted. Peak instability will be associated with any heavy rainfall later this morning until about 1 pm when rain subsides. It is also important to give water time to drain after this period, as it will be searching for deeper weaknesses as it percolates in our cold snowpack. As water collects and runs into streams be ready for some blowouts in thinly covered locations like the Little Headwall. Natural avalanches are likely in all our forecast areas but the larger slopes in the Tuckerman Bowl are the most suspect and likely to be the first to fracture and fail. Travel into ravines just to take a look is not recommended based on the distance wet slabs can

Safe Travel Techniques

- Look up!
- Route picking (look at the map before)
- Carry Rescue Tools
- When In Questionable Areas
 - One at a time
 - Never cross above partner
 - Escape routes (**islands of safety**)
 - No straps
 - Minimize exposure time
 - Same path—think: minefield
 - Cross high
 - Belay rope
 - Gentle travel

Overall Assessment

- Avy report
- Knowledge of area
- On The Fly:**
 - Recent avies?
 - Observations
 - Whoomph**
- Snow Pits



From Allen & Mike's Really Cool Backcountry Ski Book by Allen O'Bannon and Mike Clolland



White Mountains, NH, Spencer Gray

Case study 1

- January 19, 2009:
southern Montana







The Accident Report

- On Saturday a rider was killed in a large avalanche on Crown Butte next to Daisy Pass. His snowmobile was stuck high on a northeast facing slope near 10,000 ft at the end of the day. As he worked to free his sled, it began to tumble downhill. It rolled 3-4 times before striking a rock, and the slope fractured 300 feet wide running 1000 ft vertical. Slope angles in the starting zone were 37-40 degrees and the crown had a maximum height of 10-15 ft. The victim's four partners immediately conducted a very thorough beacon search but could not detect a signal. A search continued the following day, and he was located with an avalanche dog. He was found under 3 feet of snow with his beacon accidentally turned off.

(<http://www.mtavalanche.com/data/Jan192009.shtml>)

Case study 2

- Facts:
 - Maritime climate mid-winter
 - First day: no new snow in a week; consolidated snowpack
 - Last day: 3 feet new snow
 - Knowledge of snowpack?
- Question: what to do on the last day?



Bariloche, Patagonia, Spencer Gray











Case study 3

- Facts:
 - Continental snowpack in early winter
 - 5 feet new snow in one week
 - Official avalanche danger for area: HIGH
 - Multiple reports of avalanches
 - Objective: summit
 - First blue sky day
- Question: What route should we pick?



Yellowstone backcountry, Spencer Gray









Pilot Peak, Yellowstone backcountry, Spencer Gray









Send in a report!

"Thought I'd share what we observed on an overnight ski trip the last 2 days up Pilot Cr off the Beartooth Highway.

Yesterday: Those awful winds loading slopes like crazy and breaking dead tree limbs and tops, cracks spreading from our ski tracks even in 0-5 degree meadows. Stayed off anything 30 degrees or more. Yesterday afternoon, failed to launch a 30 degree slope w/ a belay rope attached at ~8500 ft. Had not yet released this morning, but other similar slopes at just about treeline w/ bigger cornices had.

Today: at ~1pm triggered a slab on a 35 degree slope at ~9300 feet, NE exposure on the far SE spur of Pilot Peak (immediately above Pilot Cr). Took a bit of stomping, ~50ft wide crown was 2-3 ft high, heavily wind-loaded slab, broke on thick layer of heavily faceted snow. Tester safe and sound, good belay set up.

Thanks for all your great work with advisories this season. We're lucky to have this service."

--12/30/08

Some videos

- Helmet cam with AvaLung in Alaska:
<http://www.youtube.com/watch?v=6C2eWRvZgKU>
- 5th skier at Talkeetna; 1700' ride; broken scapula:
<http://www.youtube.com/watch?v=zDI51o8RXok>
- Switzerland slide:
<http://www.youtube.com/watch?v=6qVwluznFWo&feature=related>

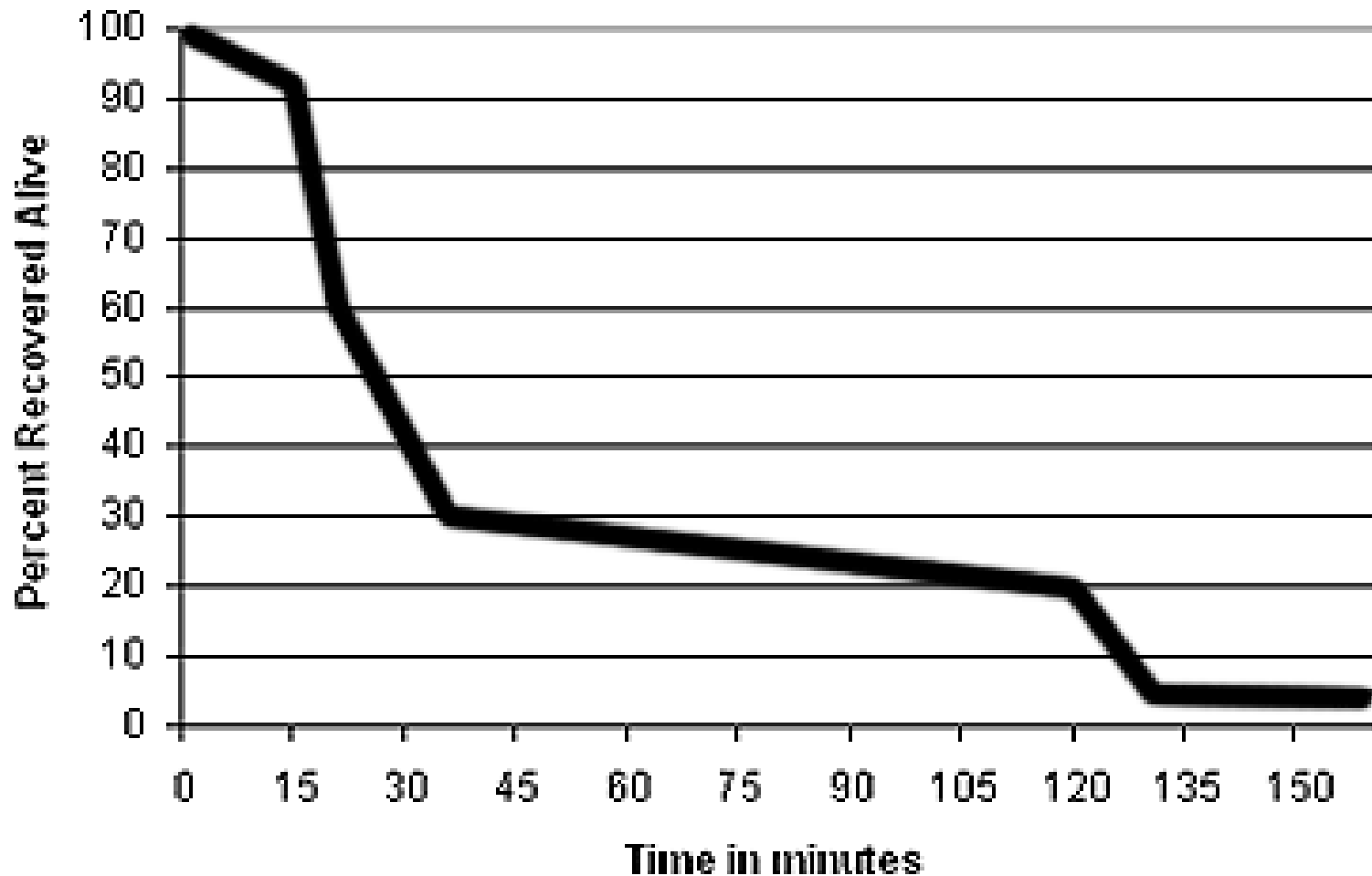
Surviving an avalanche



- Yell
- Try to ski out (~45 degrees)
- Drop ski equipment
- Swim
- Grab a tree
- Create airspace
- Thrust a hand upward
- Conserve O₂ (relax!)
- Wear a beacon!
- ~15 seconds; 4 minutes consciousness

Time is Tight

Avalanche Survival vs. Burial Time
European Data (N = 422)



Rescue Tools

- Beacons
- Probes
- Shovels



Initiating a Rescue

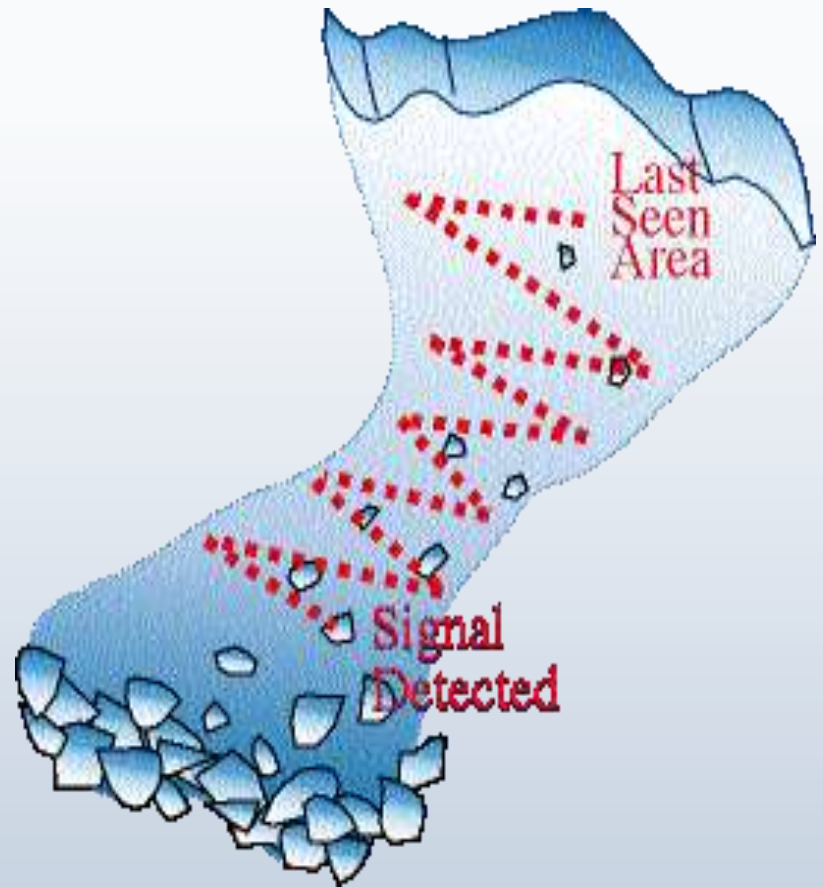
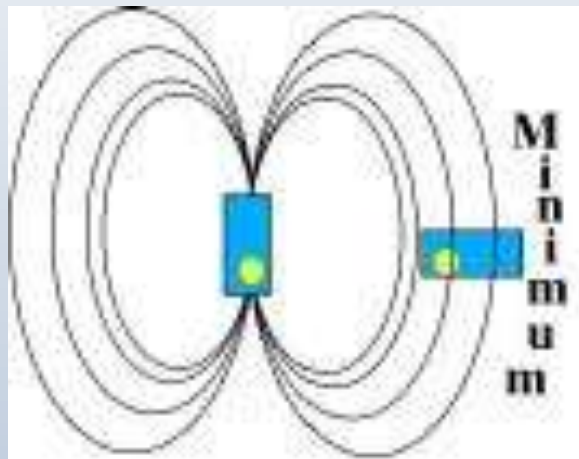
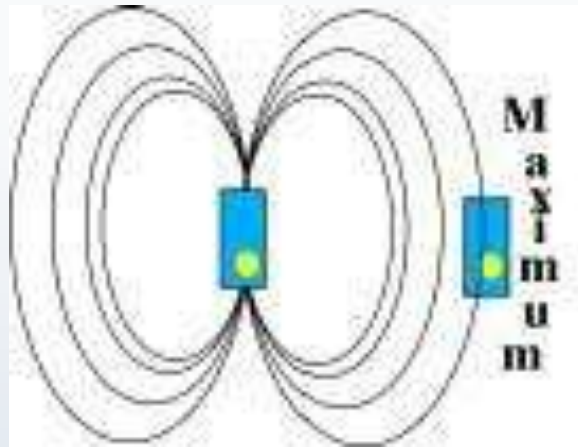
- Stop: *me, us, them*
- Look for clues
- Work downhill from point last seen
- Work quickly!





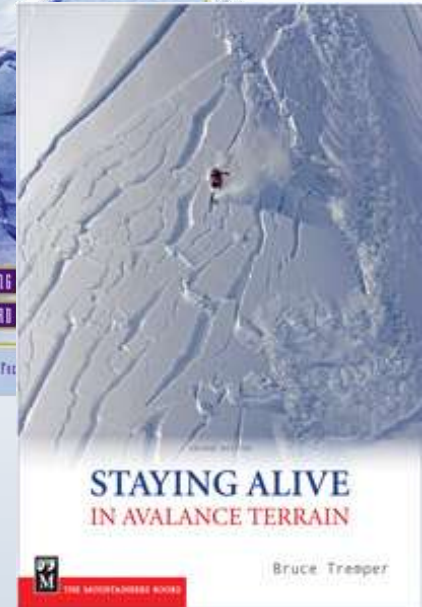
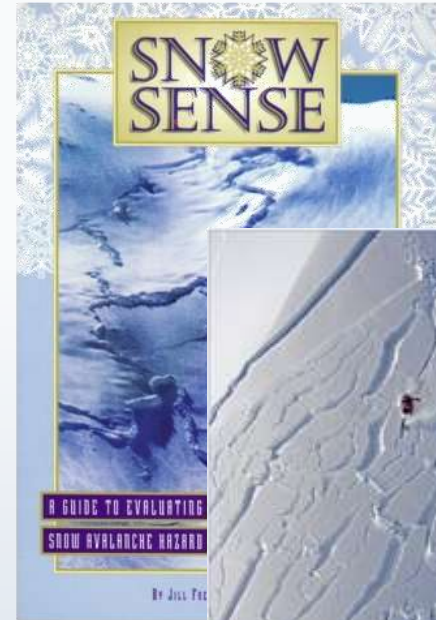
Google image search

Beacon Searches



Resources

- Classes (Avy 1)
- Books
- People
 - Rangers
 - Ski Patrollers
- Phone (in some areas)
- Online
 - www.tuckerman.org
 - www.avalanche.org
 - www.csac.org
 - www.weather.gov



Questions??



Yellowstone backcountry, Gallatin NF Avalanche Ctr