MOUNTAIN RESCUE ASSOCIATION
Webinar Series

Late
Spring and Summer Avalanches

Strategic Decisions for Mountain Rescuers

Dale Atkins, Alpine Rescue Team

sponsored by PMI

Runnels may for easy passage, but they should be avoided as they are the chute that everything slides down.

Wet Snow Avalanches

Brian Stuebe

Which critter best represents wet snow avalanches and dry snow avalanches?

Click to find out….

Dry Snow Avalanches

Wet Snow Avalanches

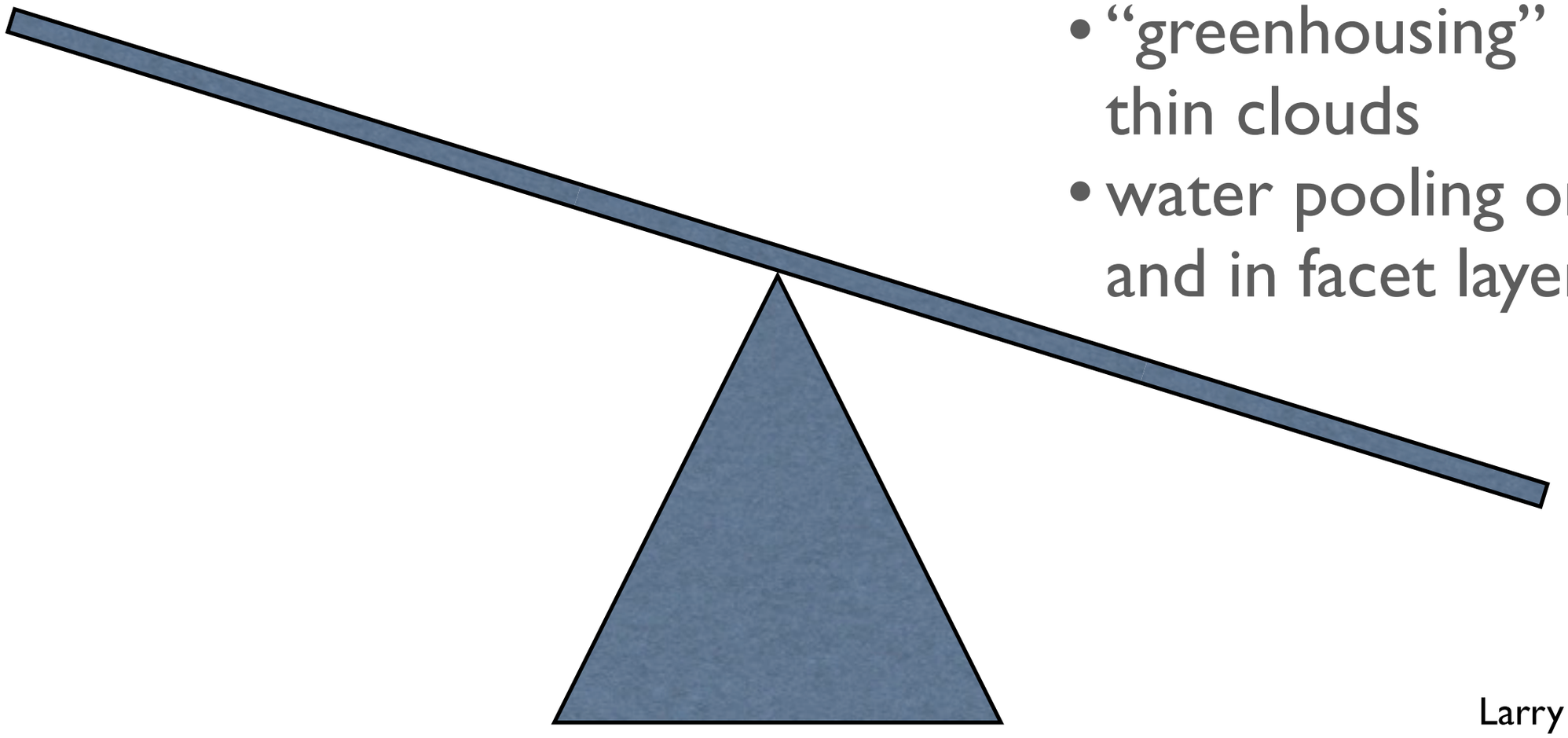
Which critter best represents wet snow avalanches and dry snow avalanches?

Click to find out….

Wet snow avalanches are like angry African honey bees. They come in swarms and keep attacking. Dry snow avalanches are like snakes. They’re solitary and generally a problem only when provoked. Wet snow instability is easier to spot, but wet snow avalanches -- once they start running -- are harder to get away from than dry snow.

Fewer Wet Avalanches

- wind
- cloud cover
- snowpack draining water



More Wet Avalanches

- 48hrs T > 32F
- several hours direct sun
- "greenhousing" under thin clouds
- water pooling on crusts and in facet layers

Larry Haywood, 2011

Here are some general conditions for less or more wet snow avalanches.

US Fatal Accidents

	Dry Snow	Wet Snow
all accidents	94%	6%

1990-2013

Wet avalanche accidents are few, however, ...

US Fatal Accidents

	Dry Snow	Wet Snow
all accidents	94%	6%

1990-2013

Wet avalanche accidents are few, however, ...

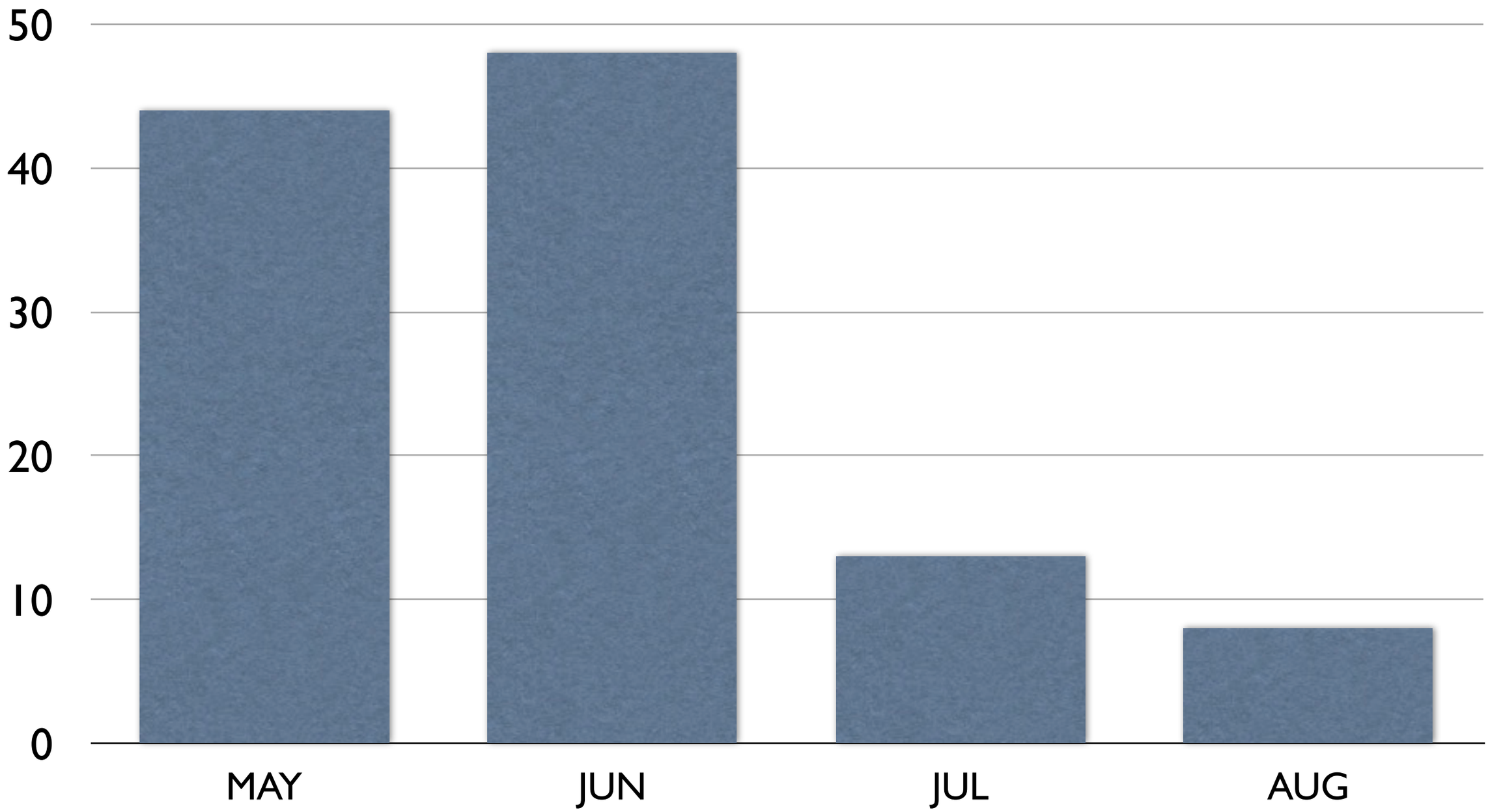
US Fatal Accidents

	Dry Snow	**Wet Snow**
all accidents	94%	6%
human trigger	95%	30%
natural trigger	5%	**70%**

1990-2013

…they are much more likely to be the result of a natural release than a dry snow avalanche.

US Avalanche Deaths: Late Spring and Summer (1950-2014)



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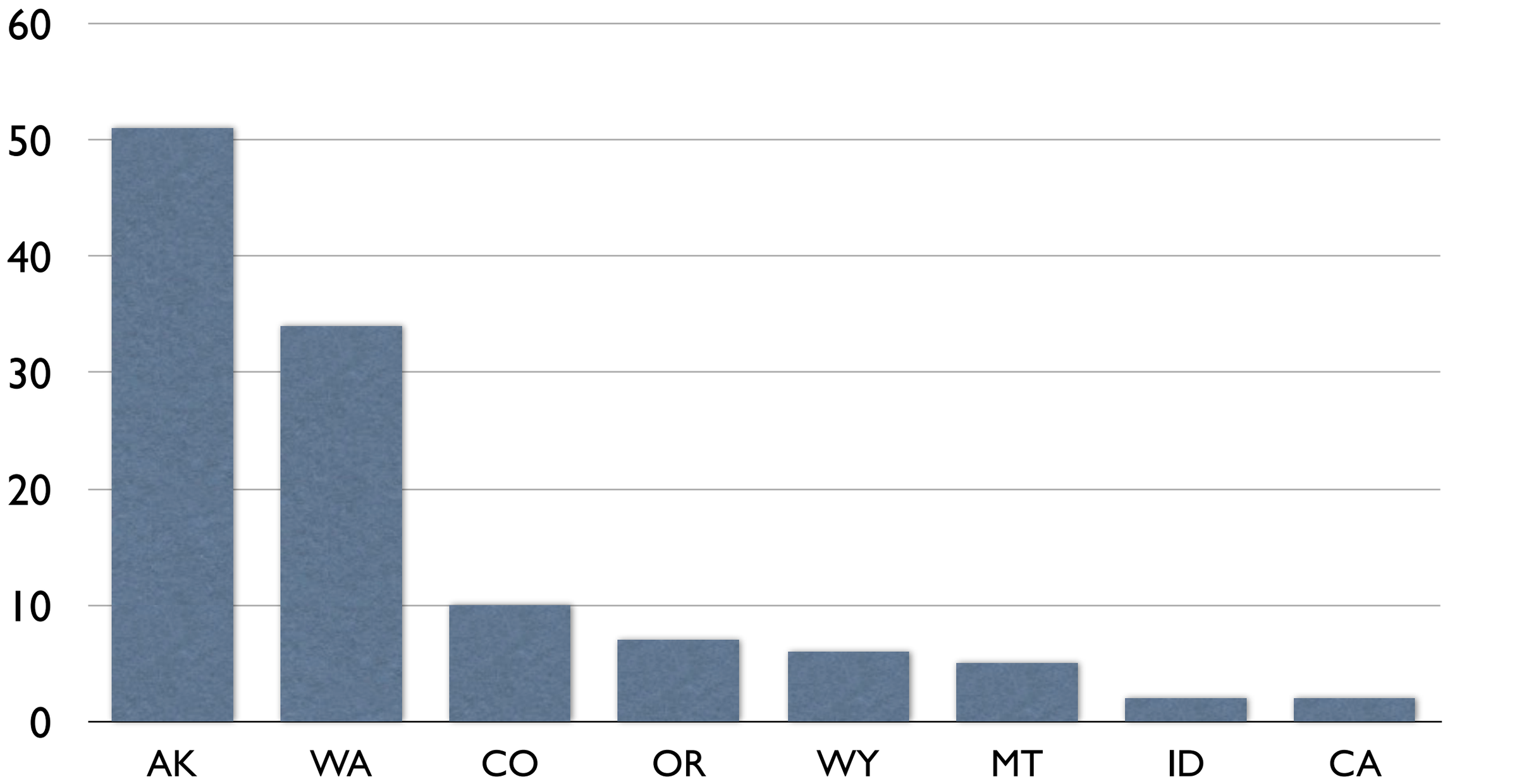
US Avalanche Deaths: Late Spring and Summer (1950-2014)



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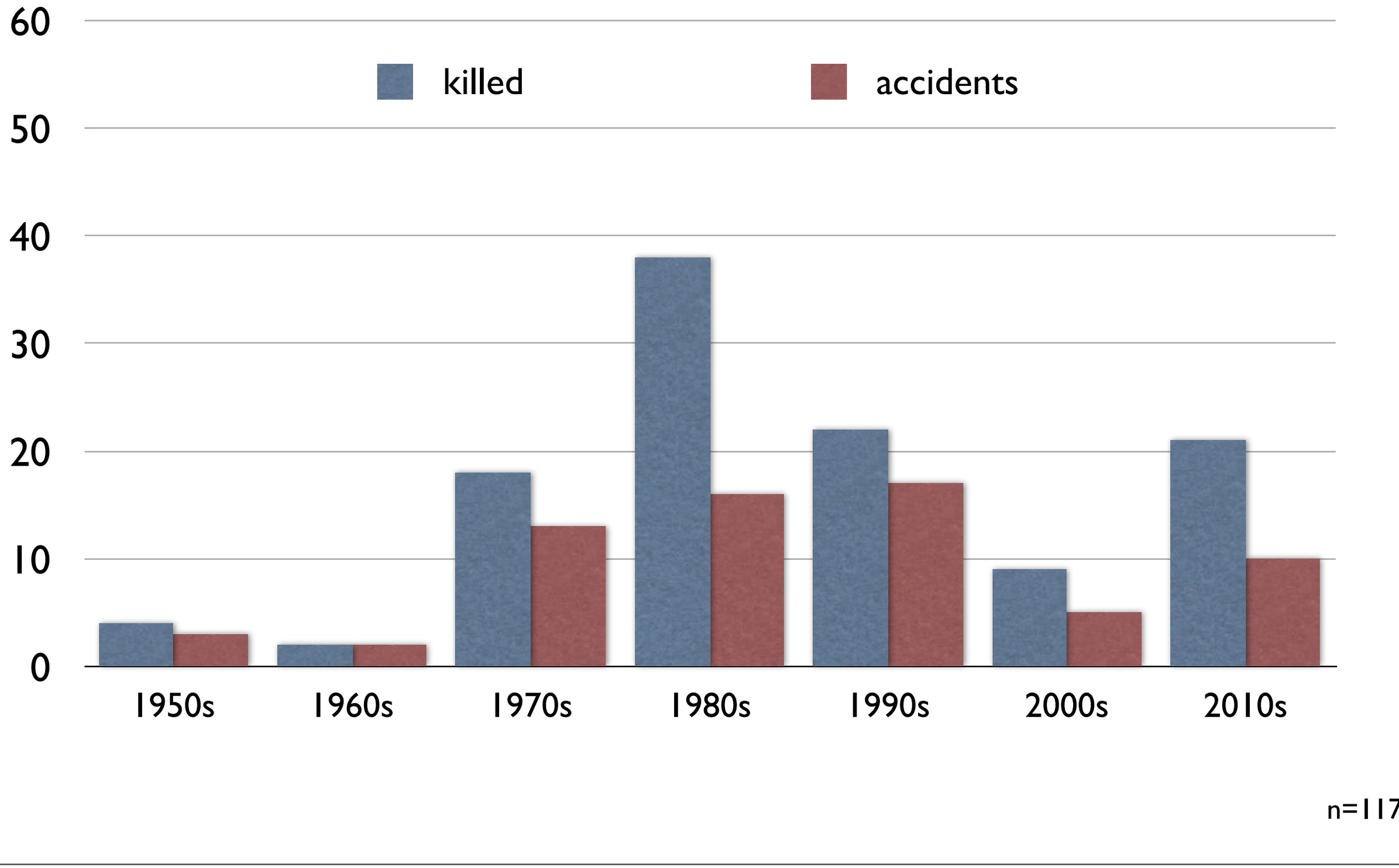

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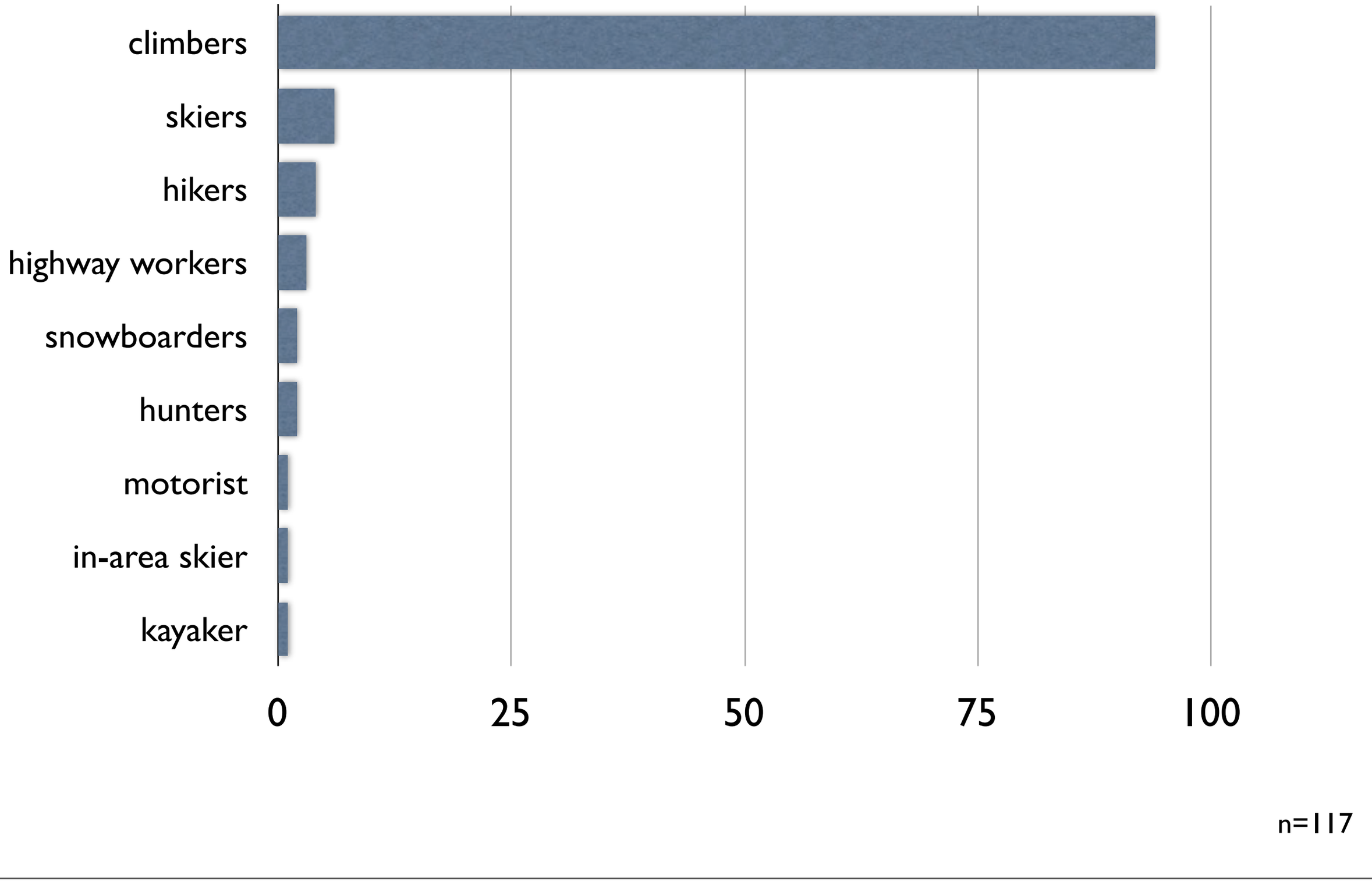
Who's Getting Into Trouble

US Avalanche Deaths: Late Spring and Summer (1950-2014)



Colorado Avalanche Deaths: Spring and Summer (1980-2013)

avalanche type	deaths (accidents)	dates
HS	8 (4)	April 9-24
SS	17 (16)	April 1-20* (*1 accident May 21)
WS	5 (4)	May 20 - July 5*
WL	1 (1)	June 22

n=31

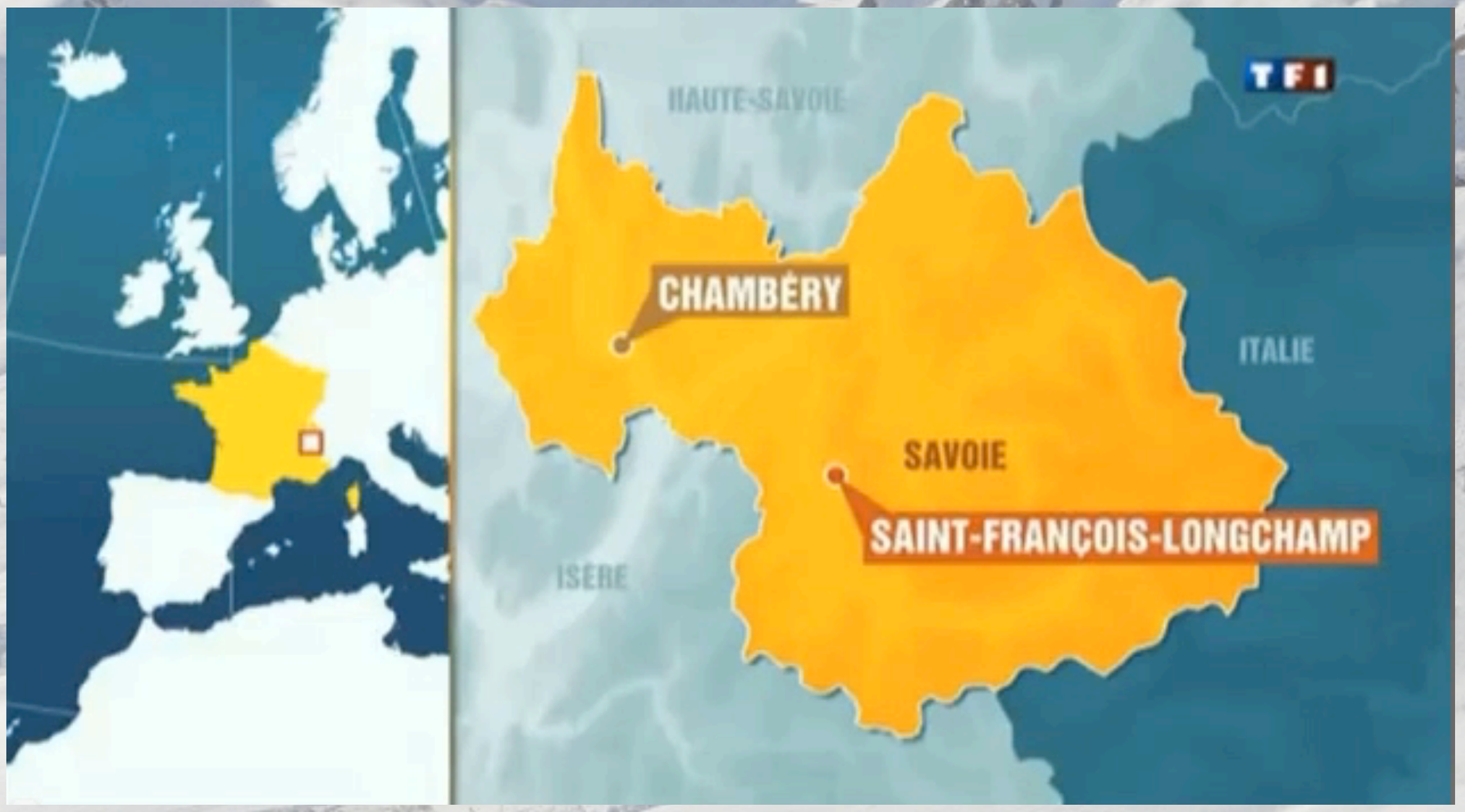
Colorado avalanche victims tend to be involved in dry snow problems until late April. Wet snow avalanches have killed in Colorado during July and August when cornices have collapsed.

This table snows fatal deaths and accidents from April through June. On March 30, 2012, a backcountry skier triggered and was killed in a very large wet slab release on Ophir Pass.

I should redo this to show deaths and accidents during the meteorological seasons of spring (March 1 to May 31) and summer (June 1 to August 31).

A wet slab avalanche at St-Francois-Longchamp (FR), 3 March 2012.

https://www.youtube.com/watch?v=F4xmerGwXmE



Video of the wet slab avalanche at St-Francois-Longchamp (FR), 3 March 2012.

Before discussing avalanches, first need to talk about “wet snow.”

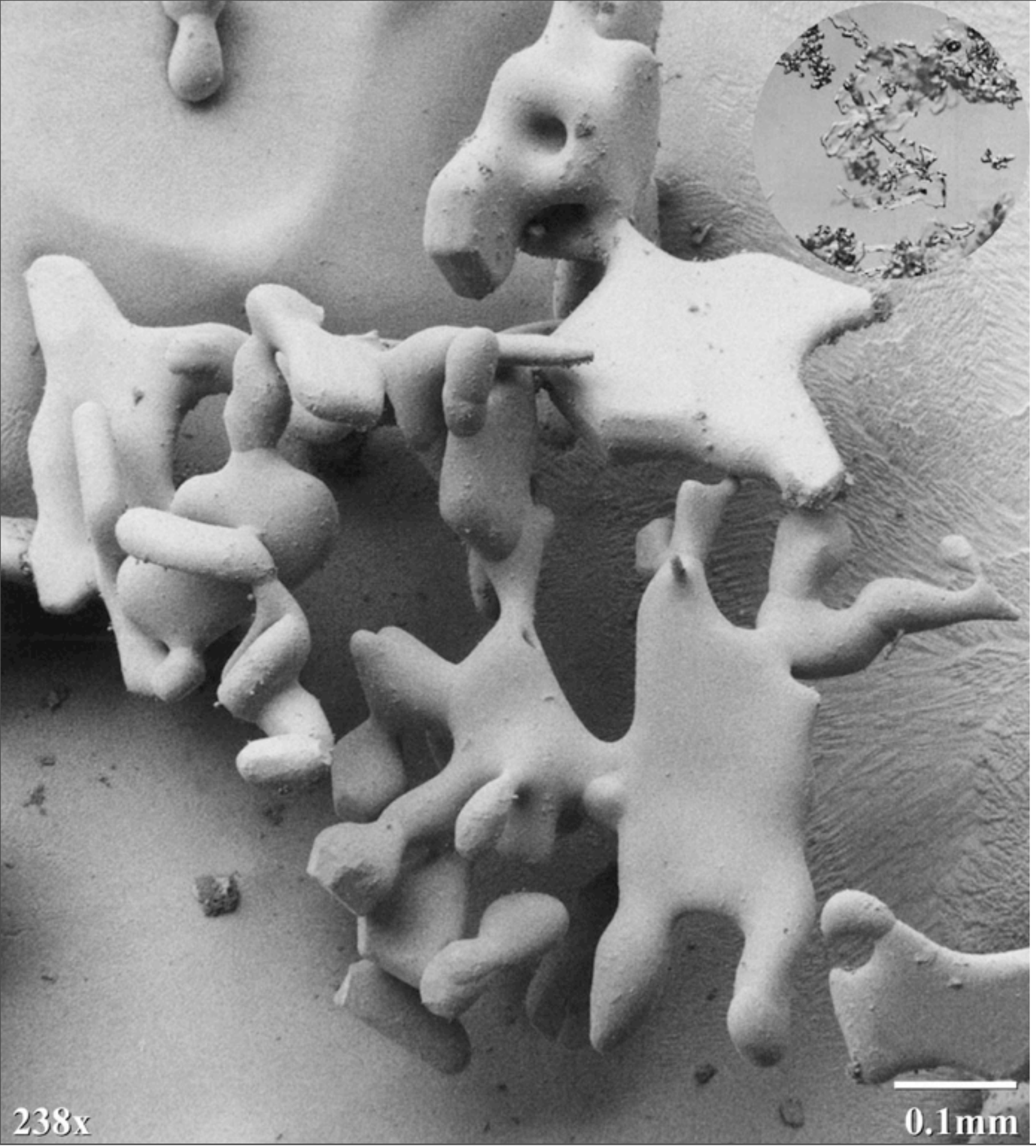
Just a quick reminder that the snow grains on the ground change over the course of the winter and when thaw conditions start.

Snow Crystals

Fresh Snow

Snow Grains

Dry Snow



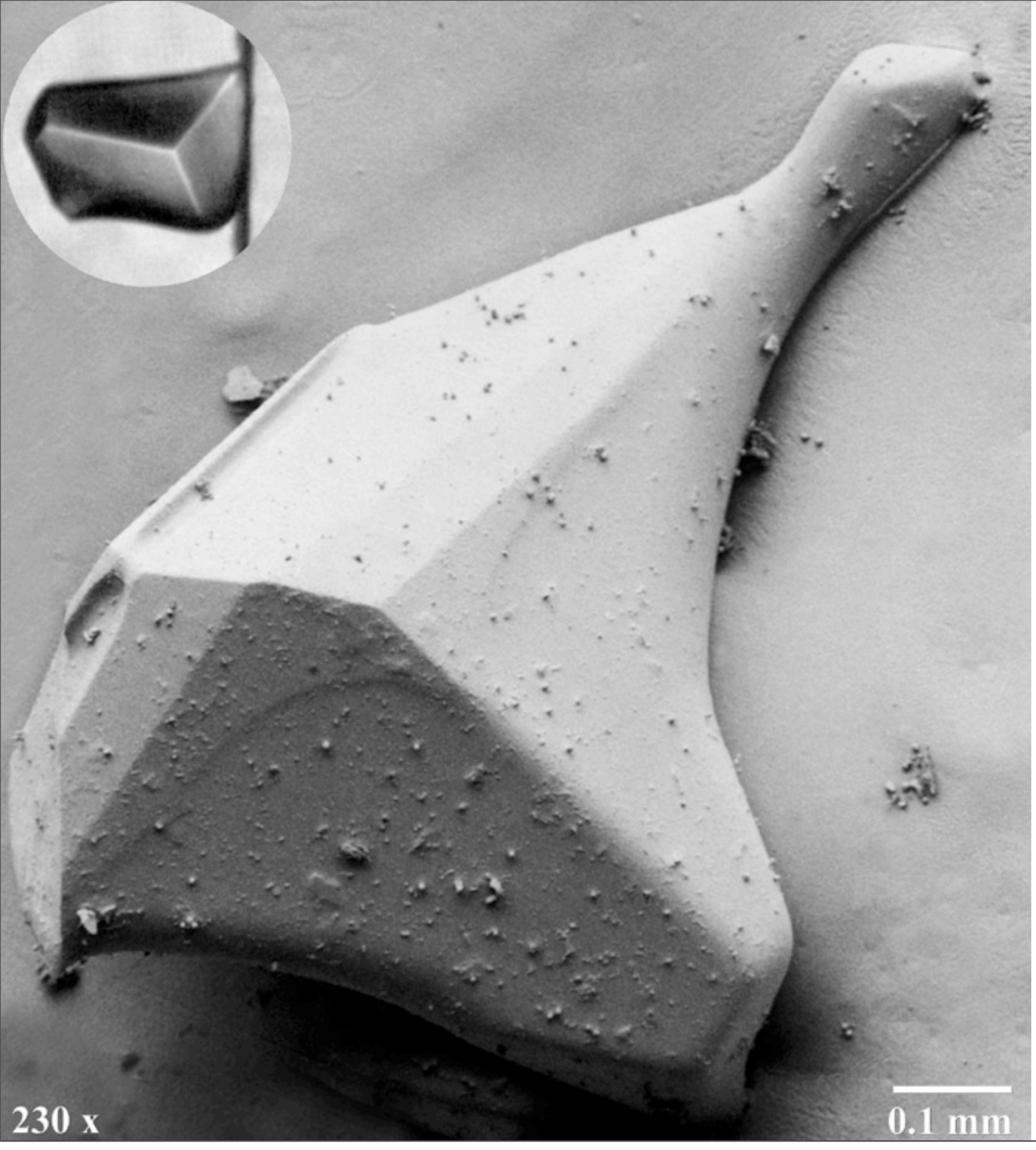
Rounding

Snow Grains

Dry Snow

STRONG

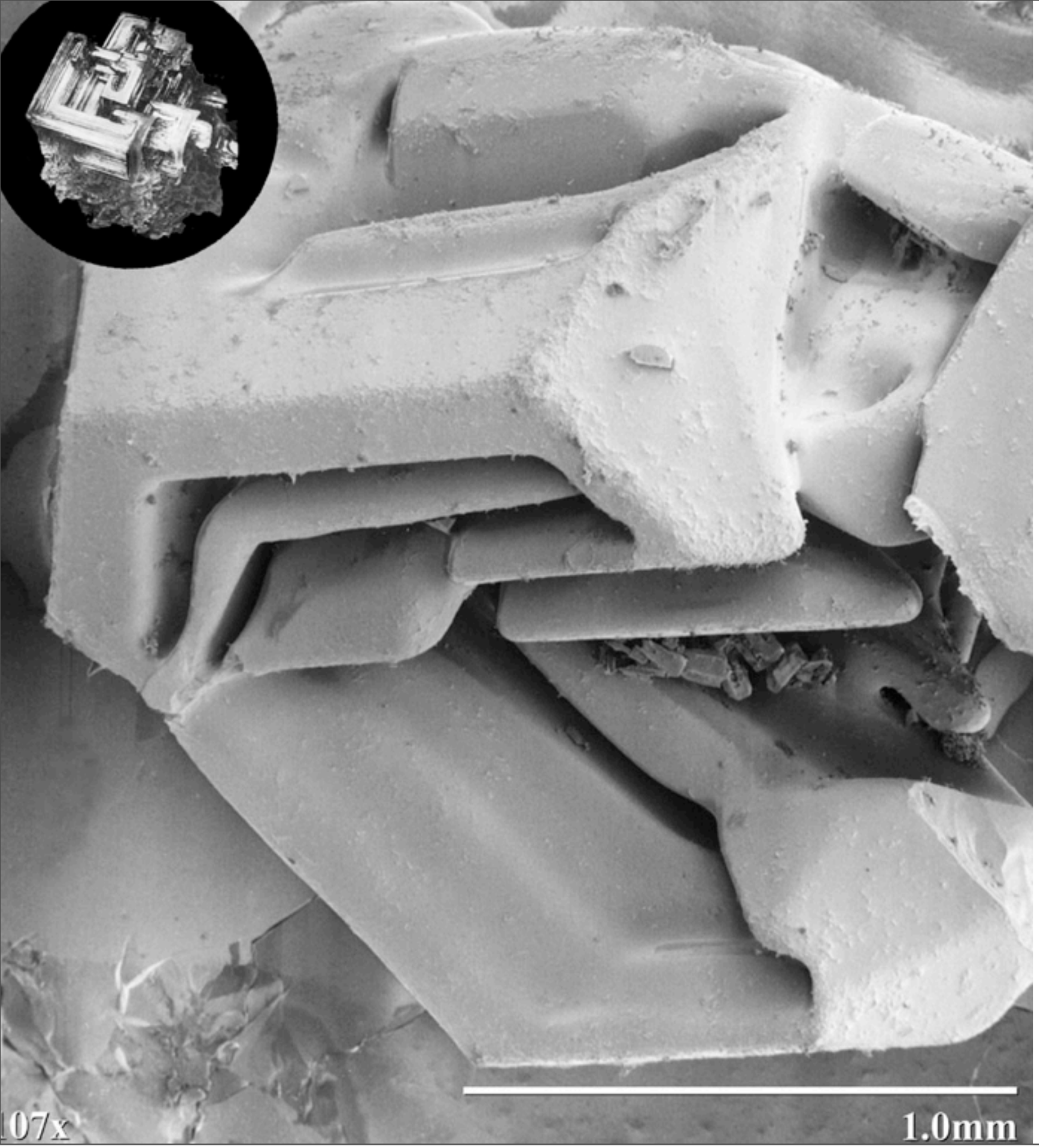
Rounding



Snow Grains

Dry Snow

Faceting



Snow Grains

Dry Snow

WEAK

Faceting

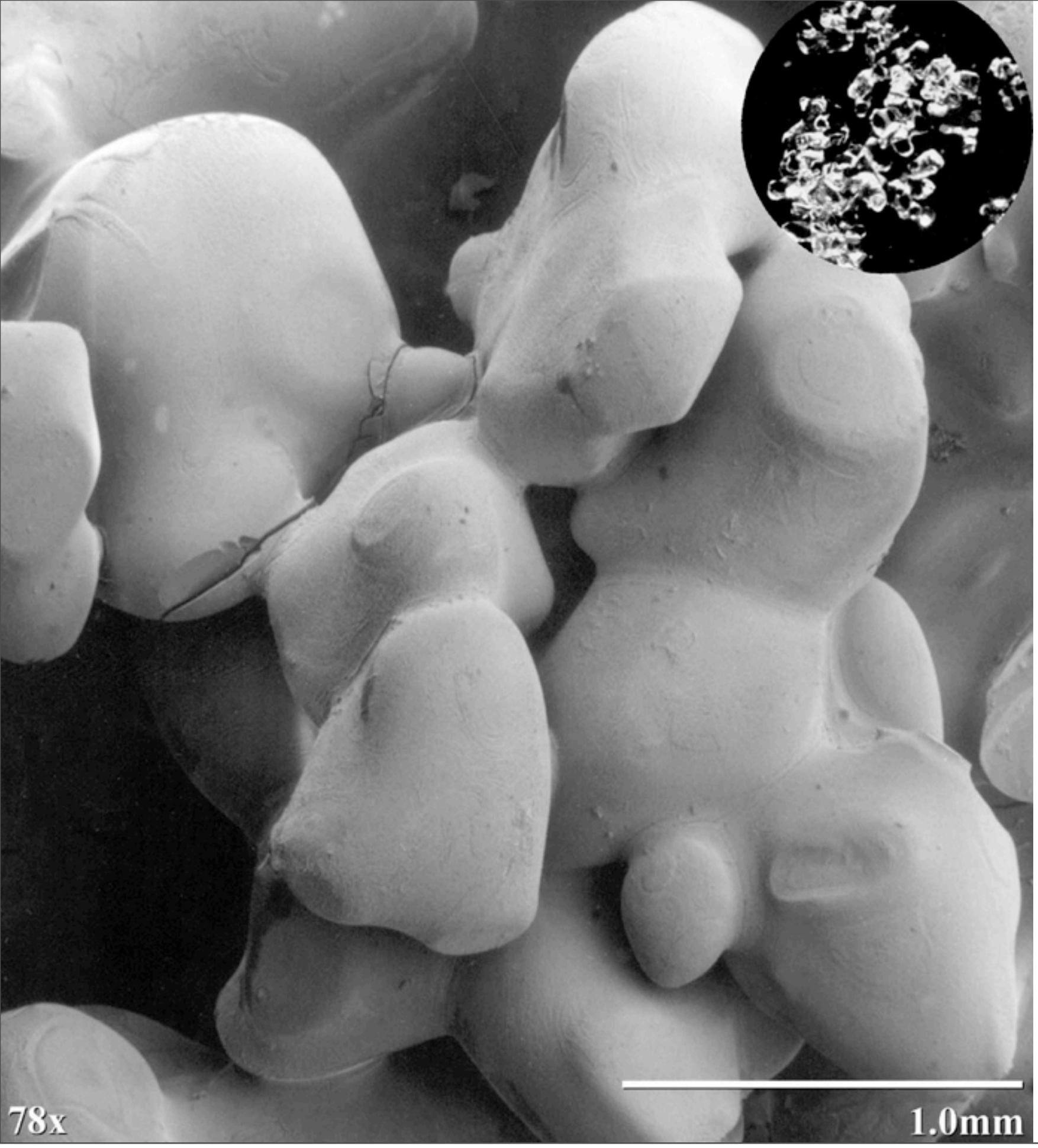
Snow Grains

Wet
(thaw)

WEAK

Melt - Freeze

These clusters of frozen water and ice grains form what skiers call “corn snow.” It forms after several cycles (days and nights) of freeze-thaw.



Snow Grains

Dry
(frozen)

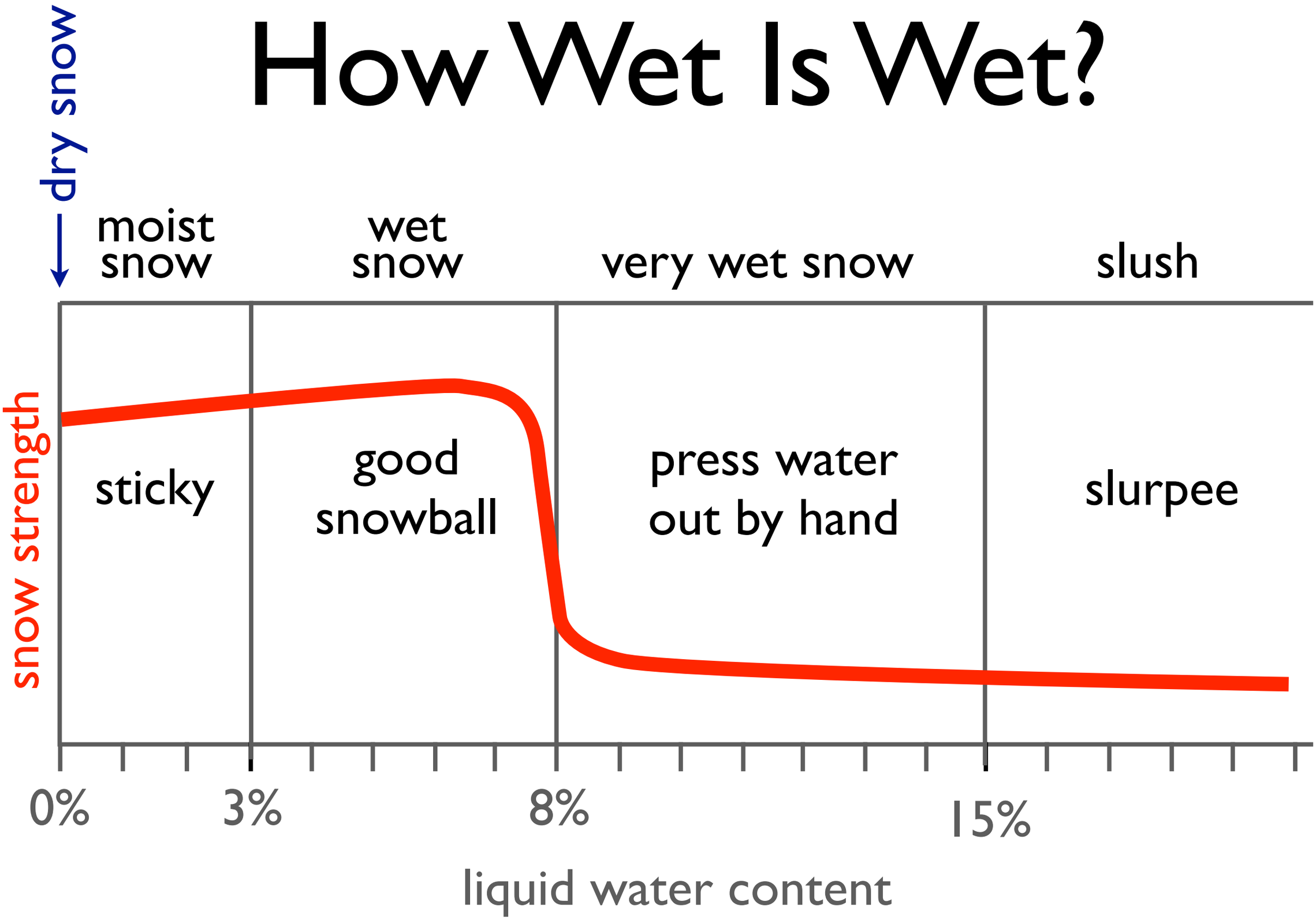
STRONG

Melt - Freeze

Wet Snow = Weak Snow

Bottom line! But how wet is weak.

How Wet Is Wet?



When the snow becomes “very wet” there is a great decrease in strength. The snow only has to undergo a slight change in liquid water content to cause a big change in strength. The transition from “wet” to “very wet” can take from minutes, to hours to days.

What factors contribute to wet snow?

Snow Stratigraphy

Temperature

Elevation

Solar radiation

Aspect

Rain

Time of Day

Different factors that contribute turning the snow wet.

Note: Rain on old snow (3-5+ days) has little affect to reducing strength and old snowpacks can take inches of rain as it tends to drain through the snowpack. However, rain on fresh/new snow results in significant instability as

How do you know it's wet?

See it

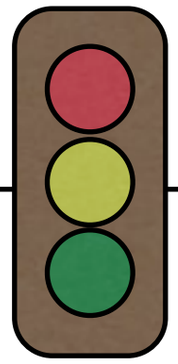
Squeeze it

Hear it

Sink in it

This slope shows drainage channels from melting. These features show the water has been draining through the snow resulting in strengthening and stabilization.

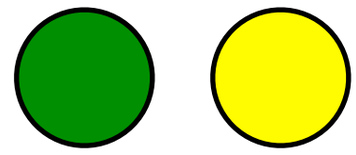
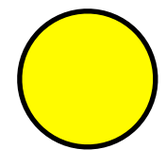
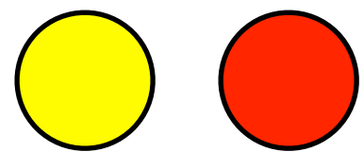
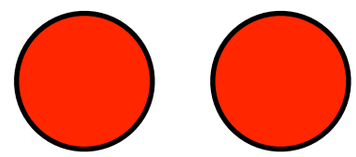
Sink In It

walking	what it means	what to do
walk on top/ supportable crust		
sink to your ankles		
sink to your calves		
sink to your knees (or deeper)		

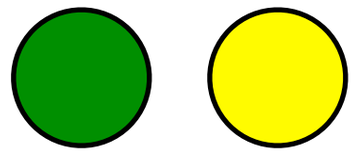
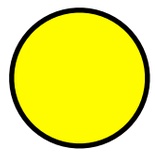
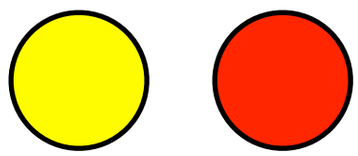
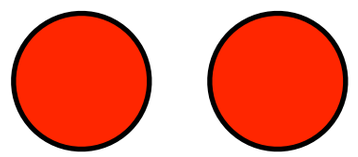
Let's use the stoplight metaphor to assess these dangers.

Collapsing snow in spring time.

Sink In It

walking	what it means	what to do
walk on top/ supportable crust		
sink to your ankles		
sink to your calves		
sink to your knees (or deeper)		

Sink In It

walking	what it means	what to do
walk on top/ supportable crust		go most everywhere
sink to your ankles		change aspects / head home
sink to your calves		get off and out from underneath steep slopes
sink to your knees (or deeper)		get off and out from underneath steep slopes

About Crusts

This shiny ice crust is called firn spiegel, or old snow mirror. It forms in later spring when the sun is high in the sky, but the snow is still cold. The surface melts but immediately refreezes.

About Crusts

Wet Snow Instability
Lionhead, West
Yellowstone, Montana
20 March 2007

This video -- sorry but can't find it online -- of a compression test on 20 March 2007 on a south aspect shows a stout melt-freeze crust about 5" thick that tops a couple of feet of very wet depth hoar. The compression test fractured on the 3rd tap with a quality 1 sheer.

Moral to this story -- don't be lulled into a false sense of security even when the crust is thick and hard.

Let’s talk about wet snow **avalanches**.

Cause of Avalanches

Dry Snow

overload
strength

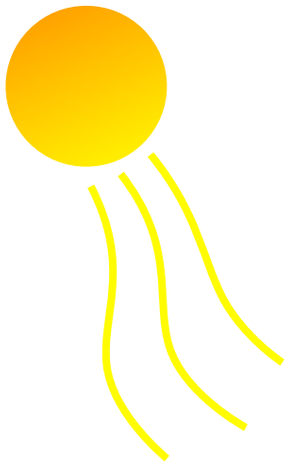
Wet Snow

reduce
strength

In dry snow the primary cause is overloading the strength of the snow, so that stress ≥ strength.

In wet snow the primary cause is a reduction in strength caused by thaw conditions.

Spring Avalanche Cycle

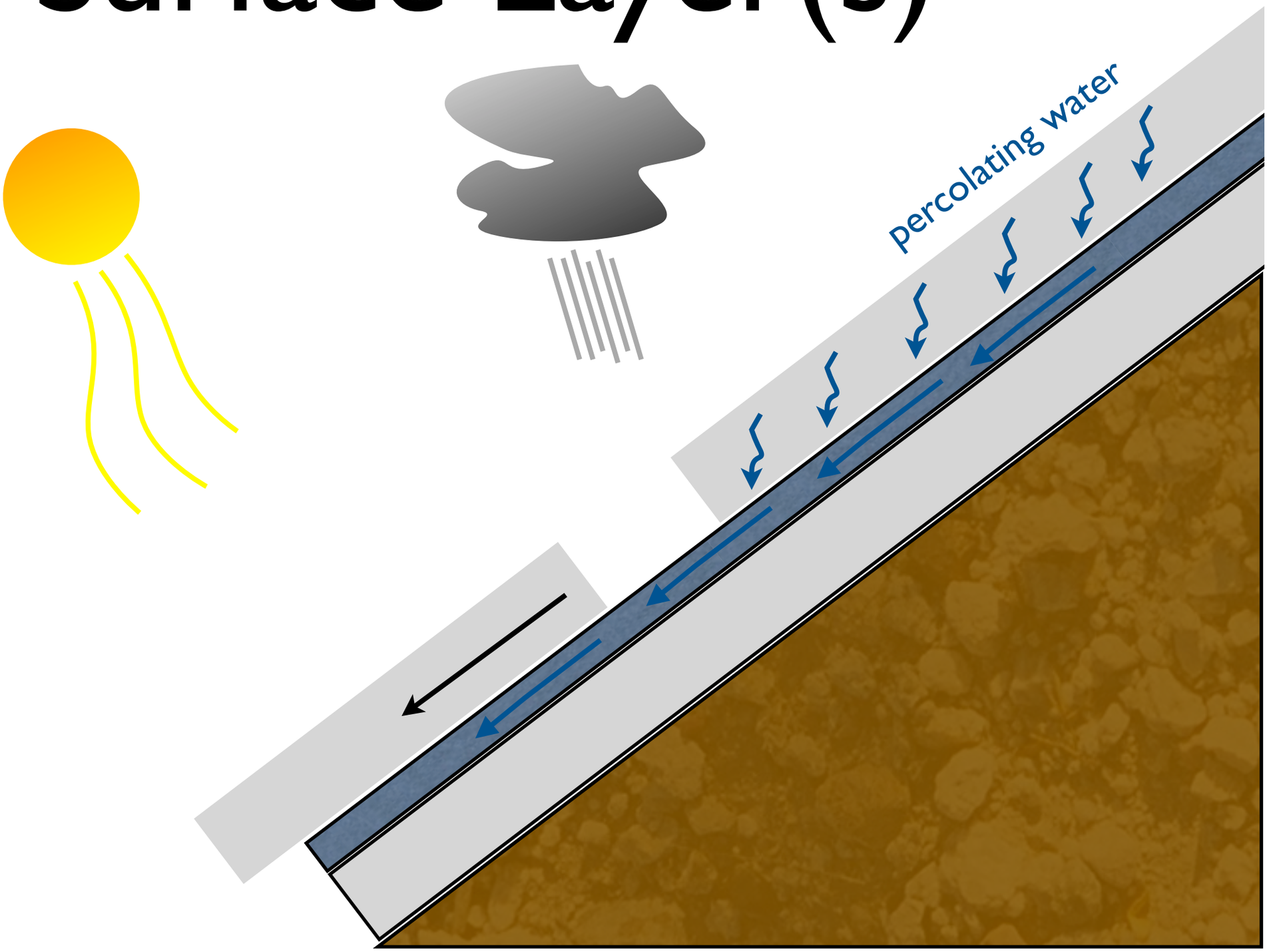


warms new surface snow

rollerballs, pinwheels, shallow-snow avalanches

Surface snow becomes wet and snow crystals/grains become more round resulting in a transitory loss of strength. This especially true of fresh, new snow. If the snow is older and becomes very wet, bonds between grains melt resulting in the loss of strength. Rollerballs, pinwheels and shallow snow avalanches only form in new or recent snow.

Surface Layer(s)

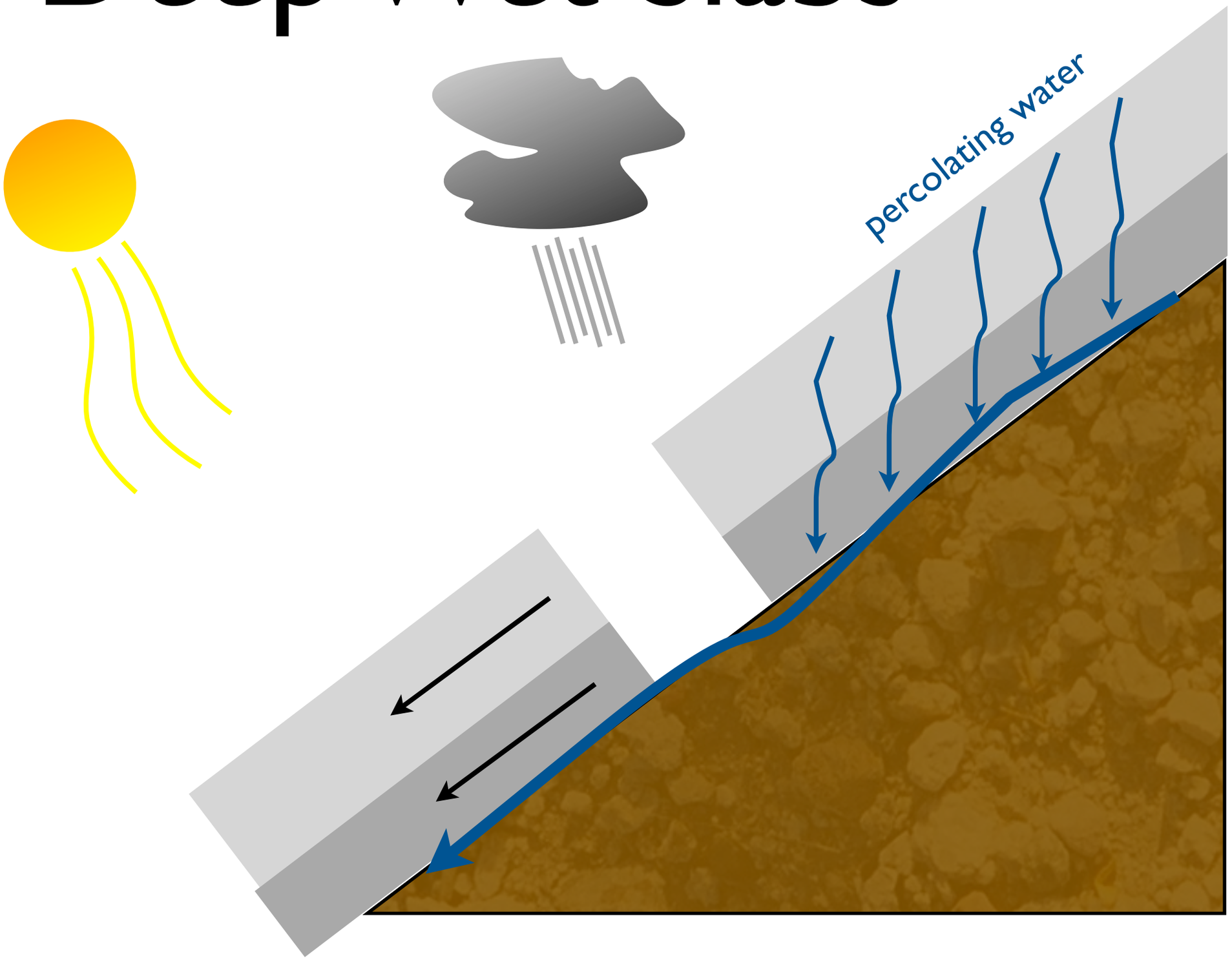


Water drains or percolates down through the snowpack until it hits a hard layer. There it melts bonds and lubricates weak layers and sliding layers.

Surface Layer(s)

Example of wet snow percolating down to potential weak layers.

Deep Wet Slabs

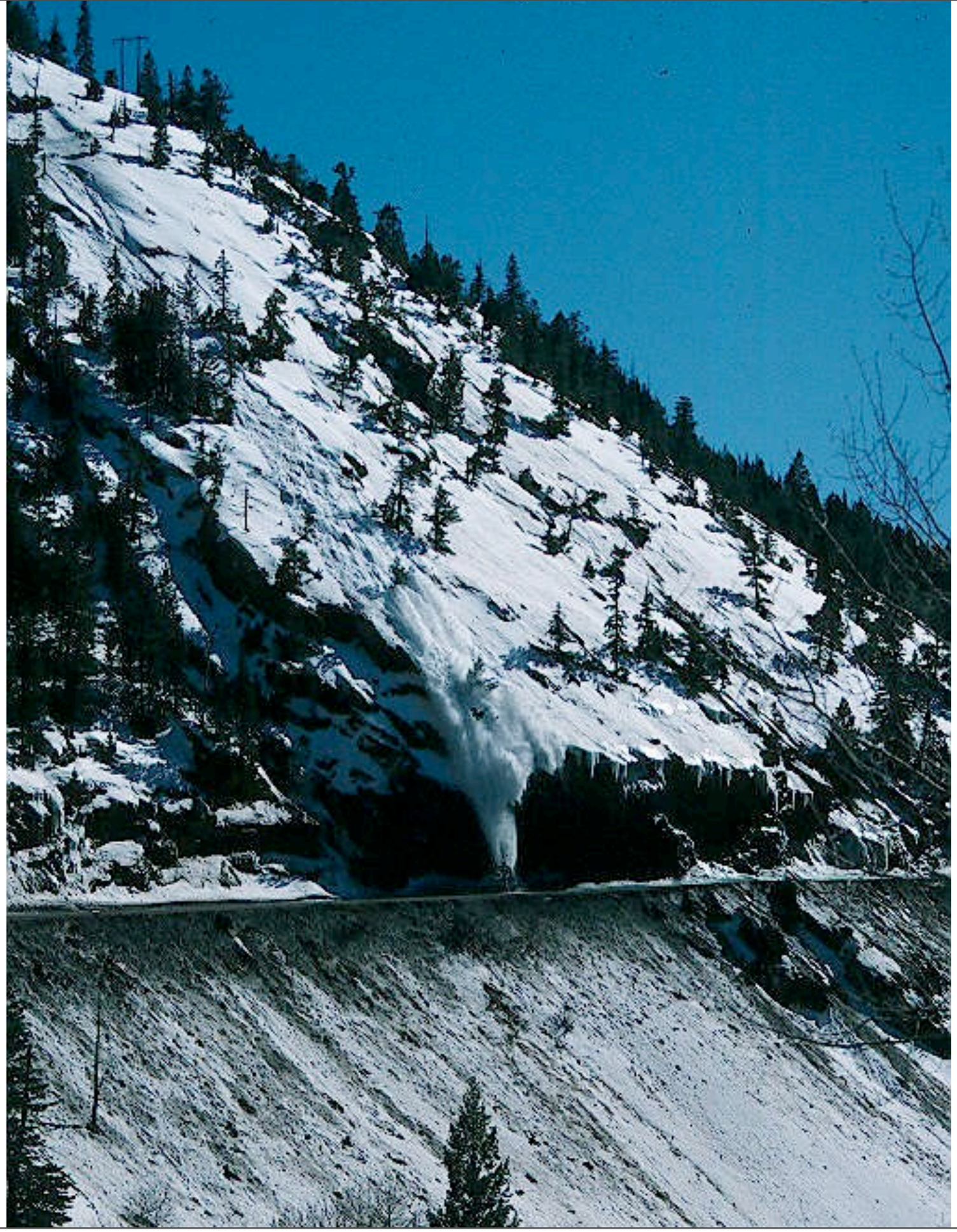


Free water drains down to the ground where it melts bonds and lubricates a sliding surface.

46

An example of numerous wet-loose snow releases. Most wet avalanches are not very impressive looking, especially when seen from across the valley. But once you get up close you will change your opinion.

Numerous wet loose releases from steep, rocky areas entrained more snow in the track resulting in a sizable wet-loose release.



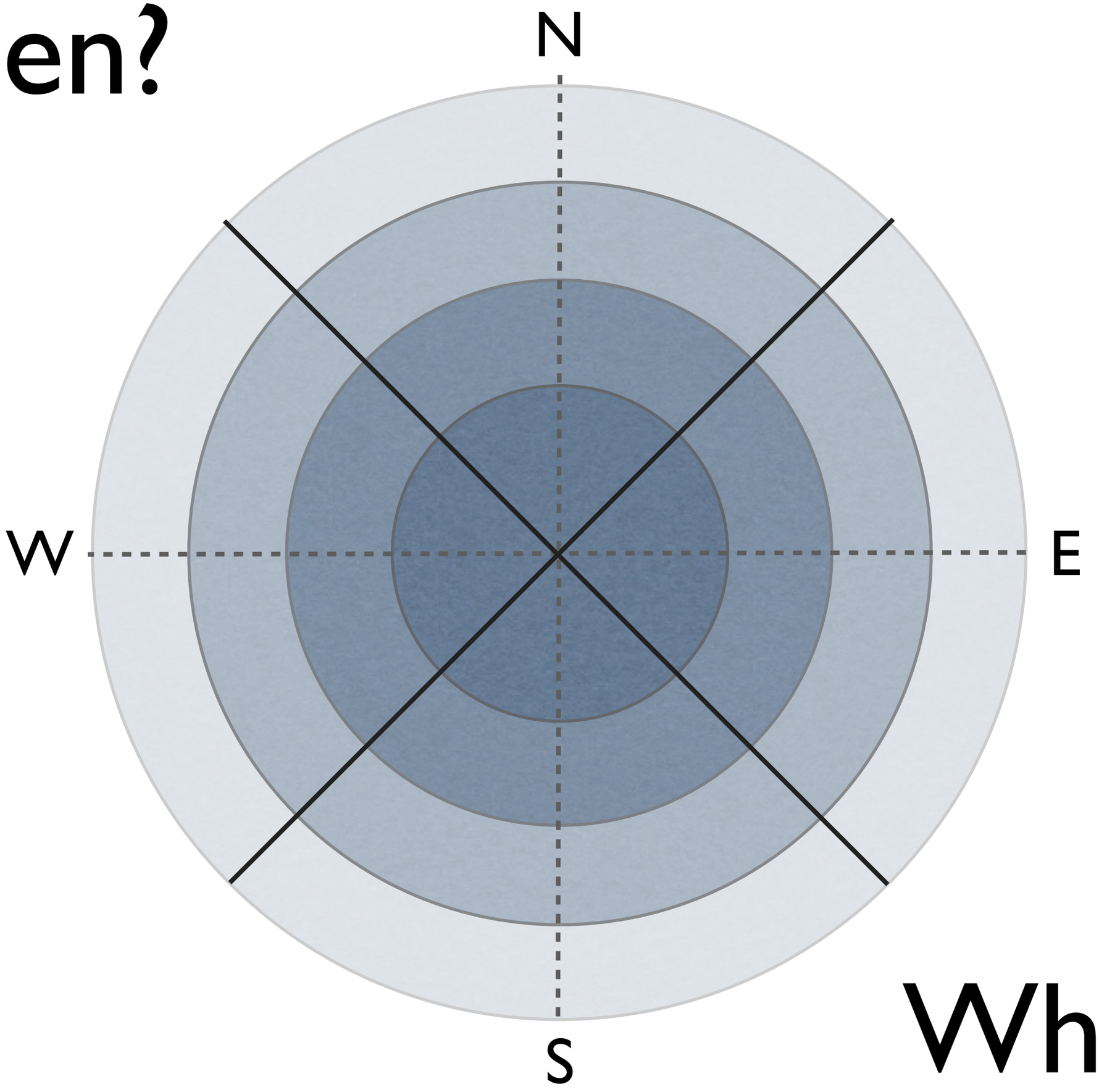
Wet-loose release from the Mother Cline path on north side of Red Mountain Pass. This is a west aspect and releases late in the afternoons or evenings.

A very large wet release triggered by a glissading climber on 20 March 2004. The slide started as a shallow, dry-snow hard slab at 13,200’. At 12,800’ it plowed into wet snow. At its widest the slide was only 100’ across.

Big wet slab release that killed a backcountry skier near Ophir Pass on 30 March 2012. This avalanche fractured 500’ across and fell 2000 vertical feet.

Example of roller balls beneath the cornice that triggered a wet loose snow avalanche that then propagated outwards as a wet slab avalanche.

When?



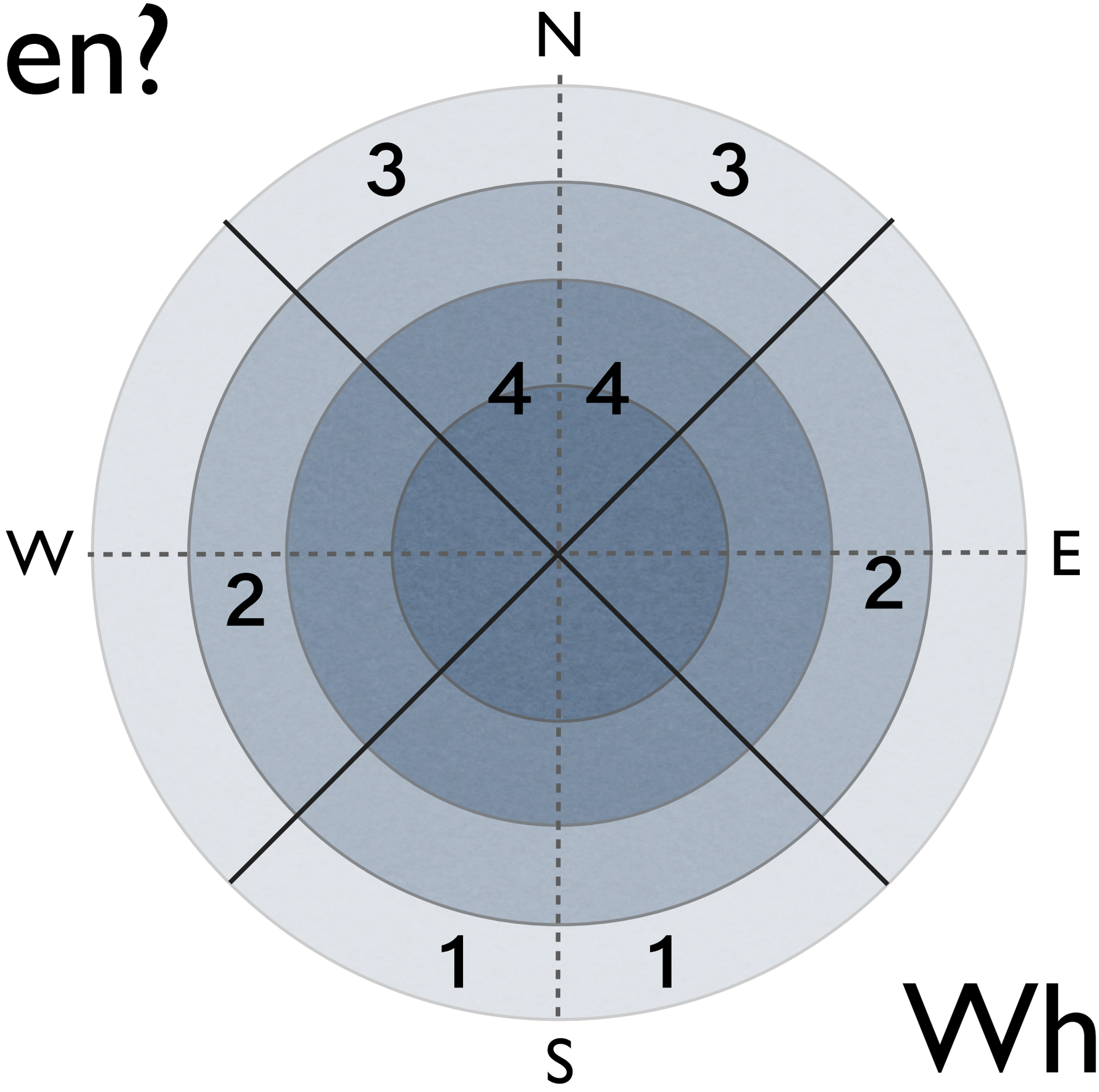
Where?

The rings represent elevation bands with the lowest elevation being the outer ring, and the center circle being the highest elevations.

Ask when – in order of occurrences – do the wet releases occur?

For example, the first wet releases will likely occur on S aspects at the lowest elevations. The last would be at the highest N aspects.

When?



Where?

Theory to Practice

Let’s see some riders trigger wet snow avalanches.

https://www.youtube.com/watch?v=WuumoGxCFFI

Know the Forecast

Front Range

Backcountry Avalanche Forecast | Forecast Discussion | Showing Archive (Back to Current Forecast) Print Share

Tue, Mar 31, 2015 at 6:03 AM
Issued by: Scott Toepfer

	Today	Tomorrow
Above Treeline	**Low (1)** Generally safe avalanche conditions. Watch for unstable snow on isolated terrain features.	**Low (1)** Generally safe avalanche conditions. Watch for unstable snow on isolated terrain features.
Near Treeline	**Moderate (2)** Heightened avalanche conditions on specific terrain features. Evaluate snow and terrain carefully.	**Moderate (2)** Heightened avalanche conditions on specific terrain features. Evaluate snow and terrain carefully.
Below Treeline	**Moderate (2)** Heightened avalanche conditions on specific terrain features. Evaluate snow and terrain carefully.	**Moderate (2)** Heightened avalanche conditions on specific terrain features. Evaluate snow and terrain carefully.

Danger Scale

—	1	2	3	4	5
No Rating	Low	Moderate	Considerable	High	Extreme

Be sure to get the forecast, it's especially important in spring as prediction is based more off weather conditions than when dealing with dry snow avalanches. Notice the danger is flipped from what is typical during mid winter conditions, when the danger is almost always greater at higher elevations.

Snow Stratigraphy: “sugar snow”

Temperature: very warm & hot

low elevations: first day avg temps stay above freezing

higher elevations: first 3 days avg temps stay above freezing

Aspect: N’erly or S’erly & rocky

Sinking In: retreat

Time of Day: mid morning to evening

Lots going on here, which highlights the many things to think about.

What can rescuers do?

As rescuers, here are some tips we should think about.

What can rescuers do?

- Know the weather and avalanche bulletin
- Dig quick pits
- Extra caution around gullies and couloirs
- Stay off wet soft snow
- Use explosives
- Stay away from cornices
- Use a guard
- Have rescuers to rescue rescuers
- Wait

Knowing the snow structure is just as important in wet snow as in dry snow.
The sides of gullies and couloirs heat up fast and can spill snow into gullies.
Wet snow is weak snow, especially if when you can squeeze water from the snow.
Explosives can be helpful, but are not always effective because wet snow attenuates the blast wave.
Always avoid cornices
When dealing with wet snow, this is the only time a guard may be able to provide sufficient warning for rescuers to escape from small exposed areas.
Wet releases are like angry African bees; it's a good idea to have rescuers for rescuers.
Sometimes the best advice is to wait -- even until well into the night -- until temperatures have cooled and the snow refreezes.

Scenario – Torreys Peak

To the rescue

Situation

- 1st Saturday in May – sunny & warm
- 1000 hrs (or 1700 hrs)
- 1 skier swept down east face

Problem

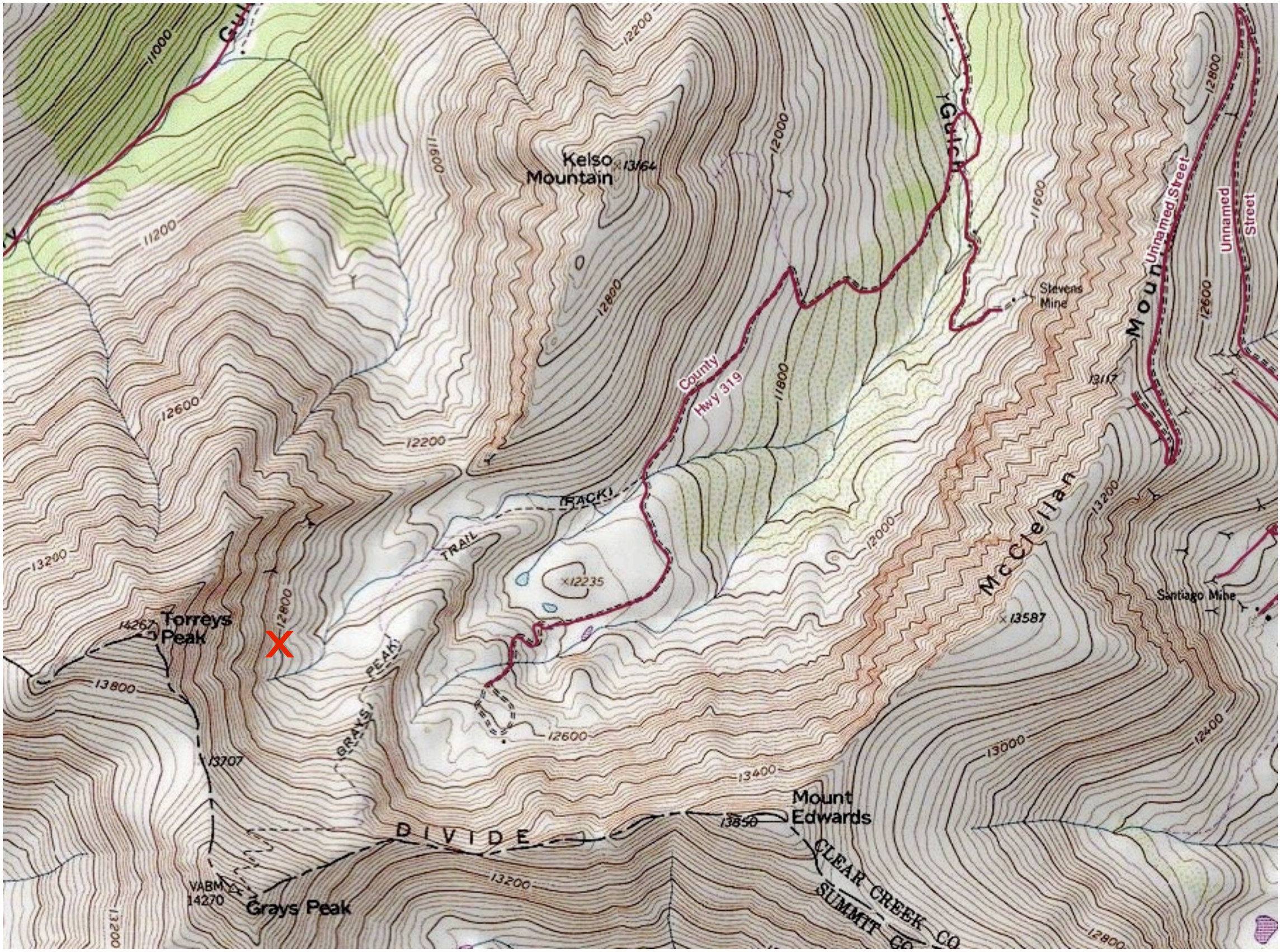
shattered helmet, significant facial trauma, heavy bleeding to face, open fx femur, responsive to verbal but 45 min later only to loud (yelling) verbal

Plan

GO / NO GO ?

Do the scenario twice, but change the time of the accident – one mid morning, the other late afternoon.

Significant facial trauma means big lacerations and swelling, also appears to have lost some teeth. He is suffering life-threatening injuries!



Scenario: Skier swept down the east face of Torreys on 1st Saturday in May. Call to 911 reports subject seriously injured, heavy bleeding to face, broken leg; initially responsive to verbal but 45 min later responsive to loud (yelling) verbal. “X” marks subject’s location.

The weather is sunny and warm; winds are light and variable. There was a light freeze overnight.

Concerns –
Saturday in May

10 am **5 pm**

If the accident happened at 10h or 17h, and given the location of the victim what are your concerns/threats about:
Snow instability?
Sun shine / shadows?
Heat?
Natural releases?
Triggers?
Other?

Concerns –
Saturday in May

10 am **5 pm**

sun

heat

natural releases

other triggers

people above

other

How might conditions be different at 17h then at 10h?

Victim’s position.

What the victim fell down. Current conditions show other recent avalanches that ran that day.

GO / NO GO ?

To the rescue

10 am **5 pm**

sun

heat

natural releases

other triggers

people above

other

What's your decision? GO or NO GO?

Much easier to say GO at 5pm than at 10am. Can still go in at 10, but would want to
- manage people near the summit so not to kick snow down,
- watch face for sometime to see if there is a rhythm to the releases and to see where the snow flows
- have rescuers to back up rescuers,
- grab patient and drag to a much less exposed area beneath cliff at looker's left of patient's position

Snow Climb

- It's May and you're planning a Saturday climb of a steep (45°), high, alpine couloir.
- Aspect = NE, though top is more E
- Wednesday and Thursday were cold and snowy, about 8-12" of snow likely fell.
- Friday dawned sunny and warm.
- Friday evening you spot a large area of debris at the bottom of the couloir.

Do you feel more confident about finding a large area of debris rather than a small pile?

Answer: Yes. Big piles mean more snow came down and less staying above. HOWEVER, did enough snow come down or is more still sitting above?

Snow Climb

- It's early Saturday morning.
- You start hiking in 0530 and reach the snowfields at sunrise.
- At 0730 you reach the debris.
- It's big!

Snow Climb

- By 0800 the sun is on the slope and the temperature is rising fast. The snow is starting to thaw.
- 500’ climbed, another 1500’ to climb.

Snow Climb

- By 1000 the snow is turning soft and very wet. You can hear water running under the snow.
- You're 300 vertical feet from the top.
- You're sinking in to mid shin.
- You're about to cross over the fracture line from yesterday's avalanche.

What are you going to do?

Snowpack Checklist

observations	red	yellow	green
rollerballs			
sinking in			
overnight freezes			
rain			

What specific clues/cues pertain to the following observations under red, yellow, and green light conditions?

Snowpack Checklist

observations	red	yellow	green
rollerballs	widespread		
sinking in	to knees		
overnight freezes	no – 3 nights		
rain	cold, dry, new snow		

Here are some examples clues/cues of red light conditions. What are they for yellow and green light conditions?

Click to see.

Snowpack Checklist

observations	red	yellow	green
rollerballs	widespread	localized or from very steep areas	
sinking in	to knees	to ankles to calves	
overnight freezes	no – 3 nights	no – 1 night	
rain	cold, dry, new snow	rain on old, dry snow	

Snowpack Checklist

observations	red	yellow	green
rollerballs	widespread	localized or from very steep areas	none
sinking in	to knees	to ankles to calves	stay on top
overnight freezes	no – 3 nights	no – 1 night	yes
rain	cold, dry, new snow	rain on old, dry snow	rain on summer snow snowpack

Decision

factor	conditions	danger
terrain	45°	
weather	sunny ➤ warm	
snowpack	very wet, sinking to mid-shin, running water	
human	strong, capable, well-equipped	

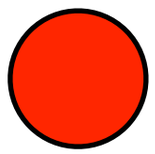
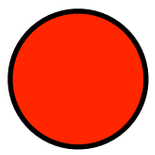
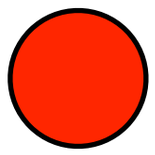
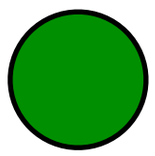
GO
or
NO GO?

But…

Have groups decided the conditions and assign a danger light (red, yellow, or green) and then ask should they go on or turn around or wait?

Next click will bring up “But…”

Decision

factor	conditions	danger
terrain	45°	
weather	sunny ➤ warm	
snowpack	very wet, sinking to mid-shin, running water	
human	strong, capable, well-equipped	

GO
or
NO GO?

But…

Here are Dale's ratings of the danger.

"But…" The problem is the group is already committed to the climb and the question becomes, can they go up faster then they can go down? If they go up, they will be slow and will encounter snow that did not avalanche. If they go down, they may encounter wetter snow; however, they will be on the old bed surface and the most unstable snow has already avalanched. If they glissade down, they have to be alert to getting entrained into a wet loose release.

Basically, at this point deciding to turn around or continue on is a decision made way too late in the climb. There is no good answer. The error is that the group waited too long to make the decision about turning around, continuing on or even waiting. Dealing with wet snow instability is about anticipating the changing snow conditions.

At 0800 when they have 1500' more to climb was the time to turn around.

This situation is similar to an accident that involved a CMC group on 6/12, 1992 that caught 6 and killed 2 on South Maroon Pk in the SE Couloir. The avalanche released right after the second climber crossed above the old fracture line. This triggered a small avalanche that swept down the couloir catching the climbers.

Questions

If you have questions, please give a shout.

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