

Wind Slab Avalanches

Introduction

Wind slab avalanches are caused by a cohesive slab of wind-deposited snow overloading the bond to an underlying weak layer or interface. Wind slabs consist of snow crystals broken into small particles and packed together by the wind. These wind-deposits, often referred to as “pillows,” are usually smooth and rounded and sometimes sound hollow. The moving snow as well as the debris can include hard and soft chunks of slab. Wind slabs are created on lee (downwind) slopes and in cross-winded areas where the winds blow across the terrain. They are commonly found behind and below features that act as a natural wind-fence, such as bands or isolated stands of trees, ridges, ribs, etc.

Development

Wind slabs form when there is sufficient wind to transport falling snow or surface snow. For wind slabs to form, there must be snow falling during the wind event or there must be loose surface snow available for transport.

Time of the Season:

Wind slabs can form at any time of the year. However, in the spring there is frequently little or no loose snow available for transport, which can limit the formation of wind slabs.

Weather Patterns:

The extent of the wind slab formation depends on the speed of the wind, the duration of the wind event, and the amount of snow available for transport.

A specific condition occurs when wind slabs are formed by katabatic winds. Katabatic winds are out-flow or drainage winds that are typically light at higher elevations but a venturi effect causes the wind to accelerate as the air drains down into the narrower valleys at lower elevations. Katabatic winds are normally associated with the onset of high pressure and/or with outbreaks of arctic air. They can also occur locally on a diurnal cycle as air from cold upper elevations (especially on glaciers) descends into lower elevation areas.

Snow Climates:

Wind slabs form in all snow climates.

Spatial Distribution:

Minor wind events may form wind slabs only in the immediate lee of exposed ridge tops. As wind intensity increases, wind slabs will also form in the lee of cross-loading features well below ridge top. Major wind events will form widespread wind slabs in all open areas and occasionally even in normally wind protected areas (such as open glades below treeline).

Katabatic wind slabs have a very different distribution than other wind slabs – katabatic wind slabs form lower in the terrain at points where descending air funnels into narrower passages and at points where hanging basins break over into steeper terrain below.

Avalanche Activity Patterns

Timing and Persistence:

Wind slab avalanches often reach a peak of activity during periods of intense snowfall or wind loading. Wind slabs tend to stabilize within one or two days, but the instability may persist longer in cold temperatures. If a wind slab is deposited on a persistent weak layer, the problem may persist much longer and can eventually become a persistent slab avalanche problem. Harder wind slabs tend to persist longer than softer ones.

Size:

Wind slabs usually do not affect the entire avalanche path, and wind slab avalanches are seldom larger than size 3.

Spatial Distribution and Variability:

Wind slabs form lens shaped deposits of snow with thickness tapering off at the edges. The thicker part of the wind slab is usually deeper than the storm snow height measured in protected areas. Wind slabs frequently taper off quickly in thickness as you move down the slope, and typically cover a smaller area and involve less mass of snow than storm slabs.

Triggering:

Fresh wind slabs can often be triggered very easily by light loads. Harder wind slabs may be triggered remotely or may not be triggered until a skier or snowmobiler is in the middle of the slab, therefore involving snow from above the trigger point.

Recognition and Assessment in the Field

Avalanche Activity:

The crowns of wind slab avalanches typically show a large variation in thickness, often being thicker in the middle and thinning at the edges in a characteristic lens shape.

Snowpack Layering, Tests, and Observations:

Wind slab instabilities are often associated with shooting cracks and localized whumphing. Snow profiles dug in protected or scoured areas will not detect wind slabs. Wind slab instabilities are found near the snow surface and it is often possible to perform multiple quick shear tests to assess the thickness, bonding, and propagation potential.

Small localized wind slabs can often be managed by ski cutting, but it is not advisable to ski cut larger, thicker, or more widespread wind slabs.

Surface Conditions:

Wind slabs can vary in hardness from medium hardness snow, which still provides good riding conditions to a very hard surface that will barely hold a ski edge or leave a track mark. Wind slabs can often be recognized by the pillowed shape of the deposited snow, sometimes a dull texture to the snow surface, a cohesive feel to the snow, an upside-down feel, or sometimes a hollow drum-like feel or sound. Wind slabs are sometimes hidden under fresh loose snow.

Risk Management Strategies

Timing:

Wind slabs are most unstable when they are forming and shortly after they are first formed. Avoid travel in lee areas when wind is transporting snow and on newly formed wind slabs. Allow sufficient time for wind slabs to stabilize before traveling over them. This may require several days.

Human Factors:

Because wind slabs are often isolated or restricted to terrain features, it's easy to miss the fact they have formed if travelling in sheltered or windward terrain. Vigilance is required to observe and assess the effects of previous winds.

Especially when travelling at higher speeds, maintaining a constant impression for the character and feel of the snow beneath and around you is essential. A sudden (especially unexpected) change in hardness or penetration is cause for immediate suspicion. Stop and reassess sooner rather than later, especially when approaching steeper terrain or a convex feature.

Terrain:

Wind slabs usually form on specific aspects and elevations, so it is often possible to limit travel to wind-sheltered terrain until existing wind slabs stabilize. Wind slabs are most common in the immediate lee of ridge tops, but be aware of conditions such as katabatic winds and cross loading that produce wind slabs on terrain features well below ridge tops. Be especially wary on or near terrain breaks where steepness or convexity increases, behind stands or rows of trees that act as snow fences, and in gullies or depressions where wind deposited snow often accumulates.

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