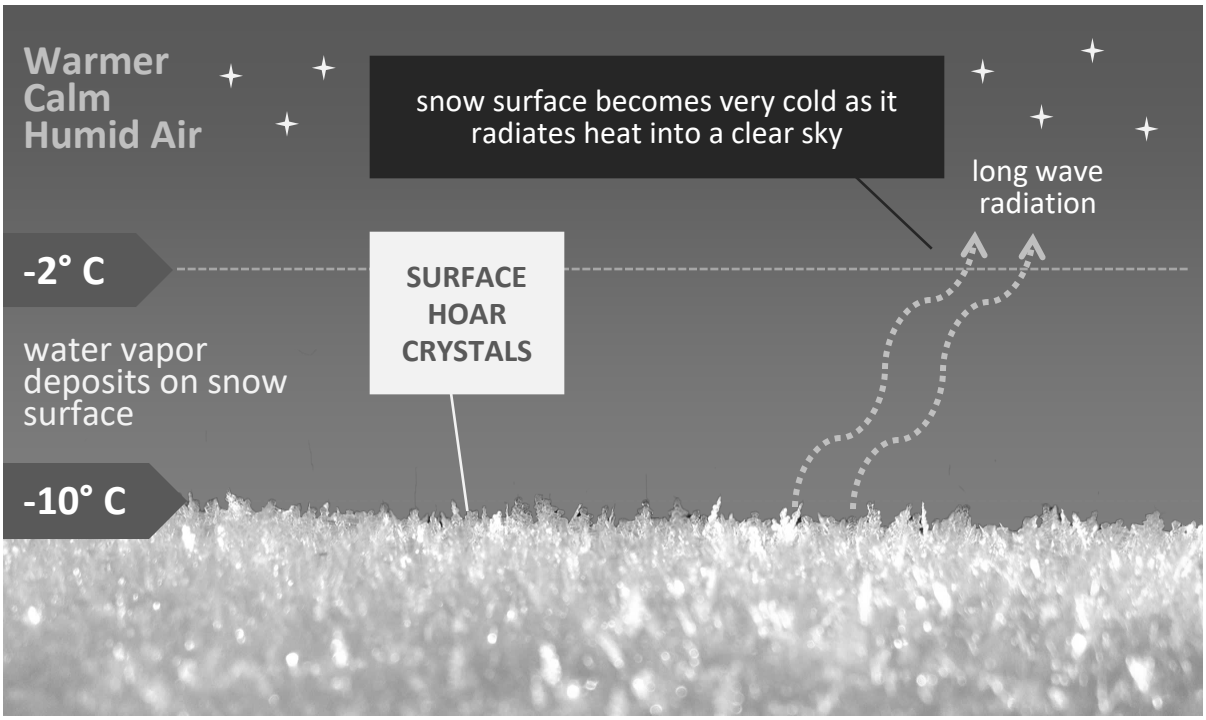
SURFACE HOAR V

Growth Conditions:

- Surface hoar forms when water vapor from moist air is deposited on a surface colder than the air. They may form on any snow surface or sub-freezing substrate.
- Surface hoar needs clear and calm conditions to form. Clear conditions allow the snow surface to reradiate longwave radiation (Infrared) to space and thus create a colder temperature at the snow/air interface than the air itself. As the air reaches 100% humidity (i.e.- cools to the frost point) water vapor deposits on the snowpack as surface hoar. All hoar crystals have hexagonal symmetry and striations. Calm conditions prohibit air turbulence, which would destroy the stratification of cooling air at the snow/air interface. It is thought that a **very light** breeze (~1-2m/s) may actually speed growth.[1]
- Ideal growth conditions can occur at the upper boundary of cloud layers where they meet the mountains. Long-lived inversion layers and large glacial valleys may lead to an elevational band of surface hoar with no surface hoar formation above or below. AKA the bathtub ring effect.
- Surface hoar can form during daylight hours in shaded areas. Sun, wind, and rain can destroy surface hoar in open areas and on sunlit aspects

[1] Hachikubo, A., T. Fukuzawa, and E. Akitaya, Formation rate of surface hoar crystals under various wind velocities, *Proceedings of 1994 International Snow Science Workshop*, Snowbird, Utah, p.137



Field Observations of Buried Surface Hoar

- Layer thinning of the surface hoar appears to be the most significant factor associated with strengthening of surface hoar over time. [2] The mechanism for layer thinning is penetration of the surface hoar into the overlying snow and underlying substrate.[3]

- Layers with larger spaces between the crystals and random crystal orientation will tend to be slower to strengthen than layers with smaller spaces between the crystals and more regular orientation (slope-normal).

- Large and/or broad surface hoar crystals may be particularly slow to strengthen and stabilize.

- The shape of the surface hoar may influence how well it bonds to the snow that comes in above it. Stacked wedges and striated wedges may form more of an "umbrella effect" than spikes. Spikes and other narrow surface hoar forms may allow new snow to penetrate between the hoar crystals and form stronger bonds to the snow below.

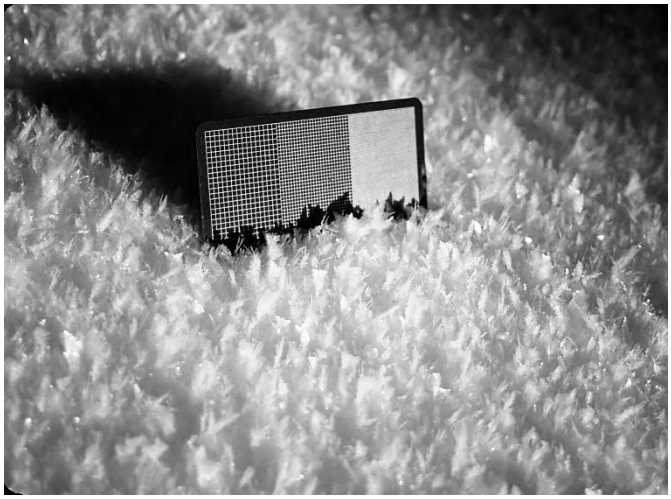
[2] Jamieson, B. and C. Johnston. 1997, Mechanisms for Strength Changes of Buried Surface Hoar Layers, *Avalanche News*, Fall 1997 volume 53, p.10

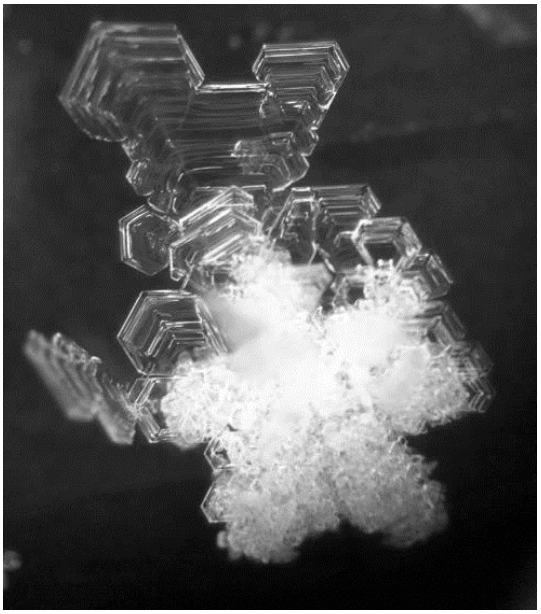
[3] Jamieson, B. and C. Johnston. 1998, Microphotography of Buried Surface Hoar Layers, *The Avalanche Review*, December 1998

- Surface hoar on crusts will likely be slower to strengthen than surface hoar that grew on softer snow. Noting the surface hardness of the snow that the surface hoar is depositing upon is important. It has strong implications on how long surface hoar will persist as a problem layer.

- Areas with greater load on the surface hoar are likely to strengthen faster than areas with less load.

- Surface Hoar may persist in the snowpack for very long periods of time. Fatal avalanches have occurred on surface hoar up to 3 months following layer burial. Surface hoar accounts for up to 34% of fatal Canadian Avalanches, 40% of fatal European avalanches, and ~50% of avalanches in the Snake River Range of Western Wyoming.





Rimed stellar crystal with surface hoar growing on top of it.
Photo: Brett Kobernick (UAFC)

Surface hoar.
Photo: Jim Conway (Glissemedia)