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# Gliding avalanches: the great unknowns

**Using sensors, SLF researchers have collected data directly beneath gliding avalanches for the first time. This will allow them to better determine the timing and extent of a gliding avalanche. The aim is to formulate appropriate rules in order to provide more precise avalanche warnings.**

“We’ve gained new insights into the key processes involved in triggering a gliding avalanche,” says Amelie Fees, a scientist at the WSL Institute for Snow and Avalanche Research (SLF) in Davos. Fees has investigated what conditions are required on the ground and in the snow for a gliding avalanche (see box) to occur. This involved measuring the liquid water content and temperature of the ground over three winters. It is the first time that researchers have collected data directly beneath snow as it slides downhill on a film of water. The long-term goal is to develop appropriate rules to enable more timely warnings of gliding avalanches. This has been virtually impossible until now because, unlike other types of avalanches, the processes involved in gliding avalanches have not yet been extensively researched, making it difficult to predict when they will occur. Fees’s work is helping to change that.
The main finding is that it is helpful to continuously monitor the ground and snow on avalanche slopes using sensors, instead of relying solely on weather data. “This allows us to make more accurate predictions,” Fees explains. “The data must be resolved in terms of both time and location,” she adds.
For her research, Fees placed 44 sensors in a slope on the Seewer Berg in Davos, where this type of avalanche occurs regularly in winter. These enabled her to measure the temperature and liquid water content of the ground every 15 minutes. The results give indications as to how these two parameters are distributed and what minimum value they reach when an avalanche occurs. In other words, they provide information on how moist the ground is at given times and locations.
This helps with forecasting because gliding avalanches are released at the interface between ground and snow if water is present there. The entire snowpack then slides downhill on this film of water.
The film is created by three effects, the researcher explains:

- Warm ground: This thaws the bottom layer of the snowpack.
- Rising water: Unfrozen water in the ground penetrates into the lower layer of the snowpack.
- Water from above: Meltwater and rainwater penetrates through the snowpack to the ground.

Until now, our understanding of gliding avalanches has been largely based on observations. It has long been known that they occur mainly in early winter and in spring. This is due to the effects that Fees has demonstrated: “In early winter, the temperature of the ground is higher than that of its surroundings, and in spring the water content of the ground increases.”
Gliding avalanches pose a major challenge for the Avalanche Warning Service and local safety officers because they are often large in volume during winters when there is a lot of snow. This makes them dangerous. In addition, they can occur at any time of the day or night. Until now, no one has been able to predict exactly when this will happen. It is virtually impossible to trigger an avalanche artificially, by blasting for example. Even if there are telltale cracks in the snowpack, it can still take a day or two before the avalanche actually releases. This makes gliding avalanches unpredictable.
A lot of research is still required to develop a reliable system. “The next step for us will be to investigate how much water is needed and how large its surface area has to be to trigger an avalanche.”

What are… gliding avalanches?

In a gliding avalanche, the entire snowpack slides down a suitable substratum such as grass or slabs of rock. Such avalanches are always released naturally. This requires the snow on the ground to become moist. In winter, this happens from below, when residual heat from the summer is still stored in the ground. In spring, by contrast, the moistening takes place from above, as meltwater and rain seep through the snowpack to the ground. Often, but not always, gaps known as glide cracks form in the snow before the avalanche is triggered. These serve as an early warning signal.

What is… liquid water content (LWC)?
Snow consists of solid water. However, both frozen/solid and liquid water can occur simultaneously in a snowpack. The liquid water content (LWC) indicates the percentage of liquid water in a snowpack. Zero percent means that the snow is dry, a moist snowpack has an LWC of up to 4%, while wet snow has a value of around 20%. At 100%, the snow has completely melted and there is no more snowpack.

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Small gliding avalanche near Frauenkirch.
Stefan Margreth/SLF
Stefan Margreth/SLF

Avalanche researcher Amelie Fees records a snow profile in a glide crack, with a view to, among other things, analysing the moisture content of the near-ground snow layers.
Alec van Herwijnen / SLF
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