Induced glide-snow avalanches with low friction geotextiles

Glover J.[1], Althoff S.[2], Witek M.[1], Seupel C.[1], Braun S.[1] & Lifa I. [1]

[1] University of Applied Sciences Grisons, Institute for Construction in Alpine Regions (IBAR), Chur Switzerland [james.glover@fhgr.ch]

[2] Schoellkopf AG, Rümlang, Switzerland [althoff@schoellkopf.ch]

EGU21-15260, https://doi.org/10.5194/egusphere-egu21-15260, 2021

Glide-snow avalanche management

Gliding snow avalanches (Fig. 1 & 2) are a result of continual snow pack creep, leading to full failure and sliding. Gliding and failure occurs along the snow-ground interface on slopes between 25 – 35° (Fig. 3). The ensuing gliding-snow avalanches cause damages to infrastructure (Fig. 4) and life. The principal problem they pose is their unpredictability. Gliding snow packs have a considerable impact on the management of ski areas, transport corridors and spatial planning. With a warming climate there appear to be increasing reports of gliding snow hazards in alpine regions.

Figures 1: (Left) Gliding snow avalanche in Jenatz (GR). Following snow fall events, the steep banks regularly fail as glide-snow avalanches along the low friction grass layer. (Right) Traditional stabilisation measures using wooden tripods are placed in glide-snow affected slopes to retain the snow.

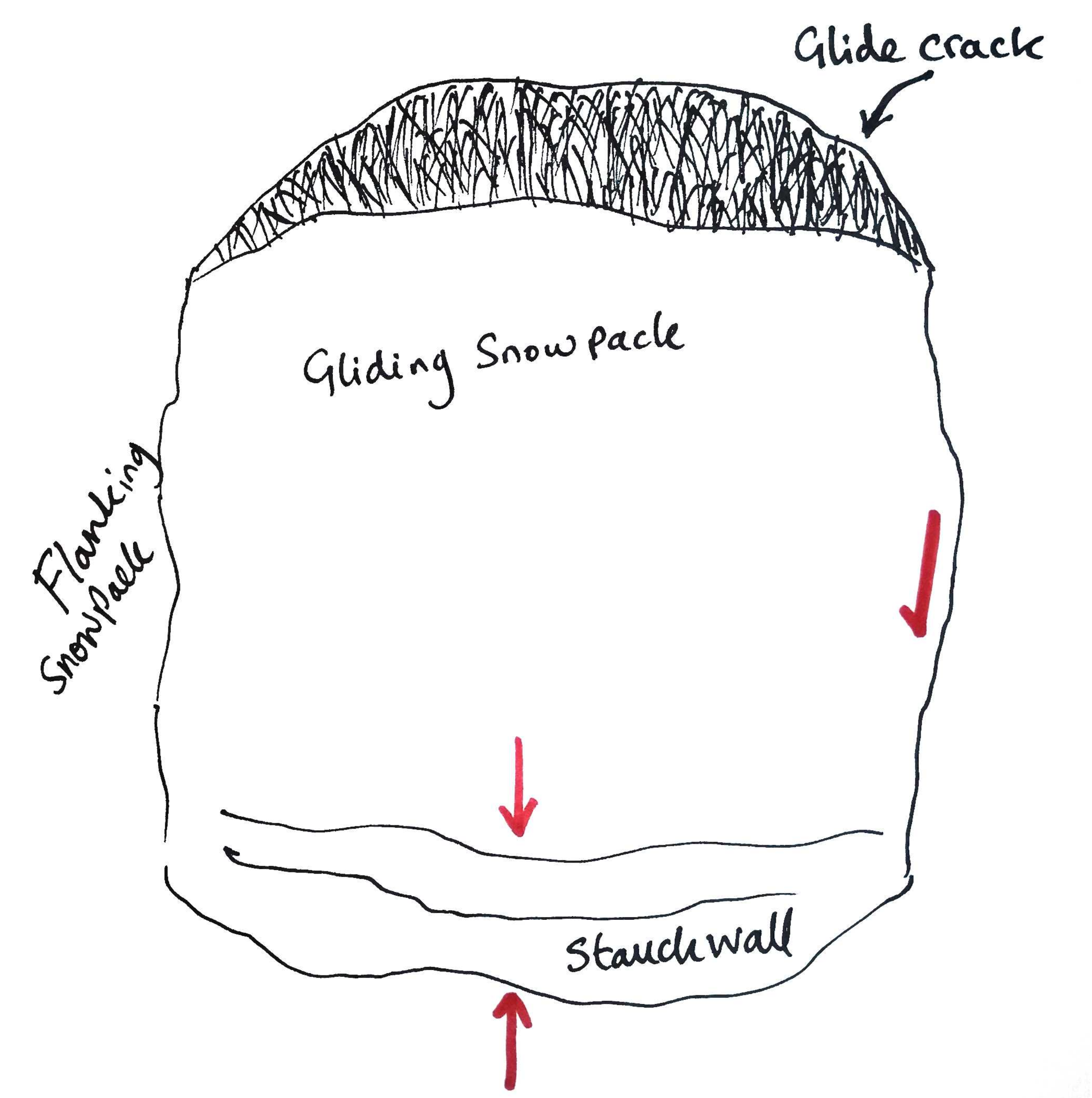

Figure 2: Sketch of a gliding snow avalanche. Once glide cracks have developed, basal sliding is also controlled by the flanking snowpack and the stauchwall.

Figure 3: Geotextiles installed on slopes between 25 and 35°.

In this proof of concept research, a series of hydrophobic low friction geotextiles were installed on slopes between 25 and 35° at 1700 m a.s.l. and observed during the winter (Fig. 3). The slopes were sun affected for half of the winter season. Initial observations show that snow accumulations quickly release and clear from the geotextiles.

See video: https://youtu.be/MPqOB67RF7k

Snow deposits from the slides do however accumulate at the base of the slope where support is given from the stauchwall and flanking snow pack that do not have geotextile material. Continuing snowfall then fills the region of the geotextiles based on the support from the surrounding stable snowpack (Fig. 4).

Induced Glide-snow Avalanches

Figures 4: (Left) Glide-snow deposits accumulate at the base of the slope being supported from snow pack without geotextile. (Middle) Large snow fall events, sliding of the snowpack also occurred despite the support from the stauchwall. (Right) Removal of the geotextiles in spring revealed a positive greening effect due to the geotextiles; opaque geotextiles lead to some damage to the natural grass regions.

Tilt-plate Experiments

Figures 5: (Left) Tilt-plate with natural snow accumulations. (Right) The geotextiles tested in the experiment series were placed on the tilt-plate and tipped to determine the slope angle at which different snow samples slipped off the tilt-plate.

Figures 6: Natural snow slide onto open road in winter.

The tilt-plate experiments identify the friction angle of geotextiles under different snow conditions. Conditions >0°C promote water accumulation and early sliding of the snow and shallow friction angles. Melt followed by freezing phases can cause the snowpack to adhere to the geotextiles. Porous geotextiles proved ineffective at snow removal.

See video: https://youtu.be/X0vj4fFa5RE

Outlook: Some of the geotextiles demonstrate appropriate snow clearing properties. However, the flanking snowpack and the stauchwall offer sufficient support to accumulate snow. Therefore, a practical application of the low friction geotextiles requires a situation without the possibility of a stauchwall, such as above a roadside retaining wall. Natural snowfall is then slid onto the road and removed during standard road clearance practice (e.g. Fig. 6). The use of geotextiles on steeper slopes may be sufficient to overcome the supporting effect of the stauchwall.

Funding: Innosuisse – Swiss Innovation Agency Nr.: 49068.1 INNO-ENG