Some insights into fracture propagation in weak snowpack layers

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Dry snow slab avalanches form when fracture, once initiated in a weak snowpack layer, propagates over large distances, progressively debonding a vast area of slab on its passage. Over the past decades the underlying fracture process has mostly been attributed to the growth of a volume-conserving shear crack, but in reality the fracture is most often accompanied by a rearrangement of the grains in the weak layer, causing a reduction in specific volume and a slope-perpendicular settling of the slab during the fracture process. This has important consequences both in theory and in practice. This contribution presents insights into a new theory of fracture propagation in snow based on the principles of mixed-mode anticracking at the fracture front. We find that fracture is propagated by a stable, kink-shaped wave travelling with sub-shear velocity through the snowpack. We also find that the fracture energy, despite being a crucial factor that determines whether fracture can be triggered or not, has negligible influence on the propagation of fracture after a supercritical crack has been formed. We use our model to calculate the deformation profile at the fracture front and compare the mathematical results with measured deformation profiles obtained from field experiments. The accordance between the theoretical and experimental results is very satisfying.