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# A new theory to evaluate the critical length for fracture propagation in snow

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The failure of a weak snow layer buried below cohesive slab layers is a necessary, but insufficient condition for the release of a dry-snow slab avalanche. The size of the crack in the weak layer must also exceed a critical length to propagate over a wide surface. In contrast to founding shear-based approaches, the recent anticrack model accounts for weak layer collapse and allows to better explain typical observations of remote triggering from flat areas. However, the latter model predicts that the critical length for crack propagation is independent of slope angle, a rather surprising and counterintuitive result. Our new mechanical model reconciles past approaches by considering for the first time the complex interplay between slab elasticity, the failure envelope of the weak layer and its structural collapse. We were able to reproduce crack propagation on flat terrain and the decrease of the critical length with slope angle observed in numerical experiments. Furthermore, we show that the anticrack model only works on flat terrain and significantly overestimates the critical crack length for steep slopes where most avalanches are triggered. This important limitation is due to strong and unfounded assumptions concerning the weak layer which is treated as a purely rigid material with a slope-independent failure criterion. The good agreement of our new model with extensive field data and its successful implementation in the snow cover model SNOWPACK opens promising prospect to improve avalanche forecasting.