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Influence of weak layer heterogeneity on slab avalanche release. Application to the evaluation of avalanche release depths.

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Slab avalanches are generally caused by the collapse of a weak layer underlying a cohesive slab. The two key ingredients for the mechanical description of such slab avalanche releases are the heterogeneity of the weak layer and the redistribution of stresses via the elasticity of the slab. The finite element code Cast3M is used to build a complete full-scale mechanical model of the slab-weak layer system including inertial effects. The weak layer is modeled as a cohesive Mohr-Coulomb interface with cohesion softening which accounts for shear-induced collapse. The overlying slab is represented by an elastic layer. The system is loaded by increasing the slope angle until rupture. We first study the influence of a single weak spot in the weak layer in order to validate the model against analytical solutions. The interaction between two weak spots is also analyzed. The case of heterogeneous weak layers represented through Gaussian stochastic distributions of the cohesion with a spherical spatial covariance is then studied. Several simulations for different realizations of the heterogeneity of the weak layer are carried out and the influence of slab depth and heterogeneity correlation length on avalanche release angle distributions is examined. In particular a heterogeneity smoothing effect caused by slab elasticity and characterized by a typical length scale of the system is evidenced. Finally the model is coupled with extreme snowfall distributions belonging to the GEV class, which allows to recover with very good accuracy release depth distributions obtained from field data.